Waters Xevo TQD

Operator's Overview and Maintenance Guide

Revision A

Waters

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Safety considerations

Some reagents and samples used with Waters instruments and devices can pose chemical, biological, and radiological hazards. You must know the potentially hazardous effects of all substances you work with. Always follow Good Laboratory Practice, and consult your organization's safety representative for guidance.

Considerations specific to the Xevo TQD

Solvent leakage hazard

The source exhaust system is designed to be robust and leak-tight. Waters recommends you perform a hazard analysis, assuming a maximum leak into the laboratory atmosphere of 10% LC eluate.

Warning: To avoid biohazardous and toxic solvent leaks, follow these guidelines:

- To confirm the integrity of the source exhaust system, renew the source O-rings at intervals not exceeding one year.
- To avoid chemical degradation of the source O-rings, which can withstand exposure only to certain solvents (see page C-2), determine whether any solvents you use that are not listed are chemically compatible with the composition of the O-rings.

Flammable solvents hazard

Warning: To prevent the ignition of accumulated solvent vapors inside the source, maintain a continuous flow of nitrogen through the source whenever using significant amounts of flammable solvents during the instrument's operation.

Never let the nitrogen supply pressure fall below 400 kPa (4 bar, 58 psi) during analyses that require flammable solvents. Connect to the LC output with a gas-fail connector to stop the LC solvent if the nitrogen supply fails.

Overload hazard

Warning: To prevent personal injury, ensure equipment placed on top of the Xevo TQD does not exceed 15kg.

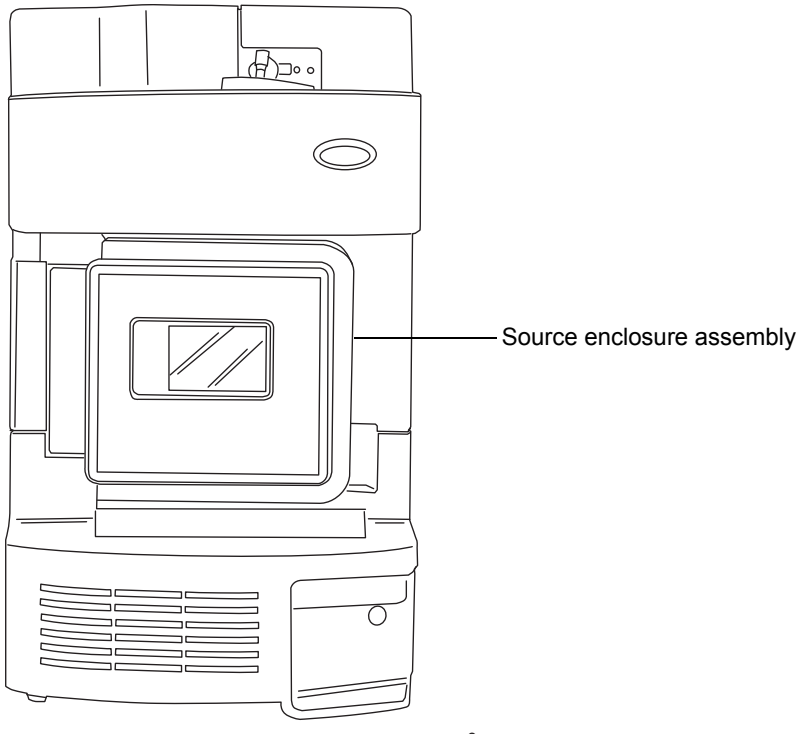
Glass-breakage hazard

Warning: To avoid injuries from broken glass, falling objects, or exposure to toxic or biohazardous substances, never place containers on top of the instrument or on its front covers.

High-temperature hazard

Warning: The source ion block, located behind the source enclosure assembly, can become hot. To avoid burn injuries, ensure the source heater is turned off and the ion block is cool before performing maintenance on these components.

Xevo TQD high temperature hazard:



Hazards associated with removing an instrument from service

Warning: To avoid personal contamination with biohazardous, toxic, or corrosive materials, wear chemical-resistant gloves during all phases of instrument decontamination.

To avoid puncture injuries, handle syringes, fused silica lines, and borosilicate tips with care.

When you remove the instrument from use to repair or dispose of it, you must decontaminate all of its vacuum areas. These are the areas in which you can expect to encounter the highest levels of contamination:

- Source interior
- Waste tubing
- Exhaust system
- Rotary pump oil (where applicable)

The need to decontaminate other vacuum areas of the instrument depends on the kinds of samples the instrument analyzed and their levels of concentration. Do not dispose of the instrument or return it to Waters for repair until the authority responsible for approving its removal from the premises specifies the extent of decontamination required and the level of residual contamination permissible. That authority must also prescribe the method of decontamination to be used and the appropriate protection for personnel undertaking the decontamination process.

You must handle items such as syringes, fused silica lines, and borosilicate tips used to carry sample into the source area in accordance with laboratory procedures for contaminated vessels and sharps. To avoid contamination by carcinogenic, toxic, or biohazardous substances, you must wear chemical-resistant gloves when handling or disposing of used oil.

Safety advisories

Consult Appendix A for a comprehensive list of warning and caution advisories.

Operating this instrument

When operating this instrument, follow standard quality-control (QC) procedures and the guidelines presented in this section.

Applicable symbols

Symbol	Definition
	Manufacturer
	Date of manufacture
	Part number
	Serial number
	Supply ratings
	Authorized representative of the European Community
	Confirms that a manufactured product complies with all applicable European Community directives
	Australia C-Tick EMC Compliant
	Confirms that a manufactured product complies with all applicable United States and Canadian safety requirements

Audience and purpose

This guide is for operators of varying levels of experience. It gives an overview of the instrument and explains how to prepare it for operation, switch between modes of operation, and maintain it.

Intended use of the Xevo TQD

Waters designed the Xevo® TQD for use as a research tool to accurately, reproducibly, and robustly quantify target compounds present at the lowest possible levels in highly complex sample matrices. It is not for use in diagnostic procedures.

When fitted with Waters APCI, APGC, APPI, ASAP, ESCi®, NanoFlow™ ESI, or TRIZAIC™ UPLC® options, or optional third-party sources (DART®, DESI, or LDTD™), the Xevo TQD does not comply with the European Union In Vitro Diagnostic Device Directive 98/79/EC.

Calibrating

To calibrate LC systems, follow acceptable calibration methods using at least five standards to generate a standard curve. The concentration range for standards must cover the entire range of quality-control samples, typical specimens, and atypical specimens.

To calibrate the Xevo TQD, consult the instrument's online Help system.

Quality control

Routinely run three QC samples that represent subnormal, normal, and above-normal levels of a compound. Ensure that QC sample results fall within an acceptable range, and evaluate precision from day to day and run to run. Data collected when QC samples are out of range are sometimes invalid. Do not report these data until you are certain that the instrument performs satisfactorily.

When analyzing samples from a complex matrix such as soil, tissue, serum/plasma, whole blood, and other sources, note that the matrix components can adversely affect LC/MS results, enhancing or suppressing ionization. To minimize these matrix effects, adopt the following measures:

- Prior to the instrumental analysis, use appropriate sample pretreatment such as protein precipitation, liquid/liquid extraction (LLE), or solid phase extraction (SPE) to remove matrix interferences.
- Whenever possible, verify method accuracy and precision using matrix-matched calibrators and QC samples.
- Use one or more internal standard compounds, preferably isotopically labeled analytes.

ISM classification

ISM Classification: ISM Group 1 Class A

This classification is assigned in accordance with IEC CISPR 11 Industrial Scientific and Medical (ISM) instrument requirements. Group 1 products apply to intentionally generated and/or used conductively coupled radio-frequency energy that is necessary for the internal functioning of the equipment. Class A products are suitable for use in commercial (that is, nonresidential) locations and can be directly connected to a low-voltage, power-supply network.

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Table of Contents

1 Specifications and Operating Modes

This chapter describes the instrument, including its controls and connections for gas and plumbing.

Contents:

Uses and compatibility

The Waters® Xevo® TQD is a tandem quadrupole, atmospheric pressure ionization (API) mass spectrometer. Designed for routine HPLC/MS/MS and UPLC®/MS/MS analyses in quantitative and qualitative applications, it can operate at fast acquisition speeds compatible with UltraPerformance LC® applications.

You can use the Xevo TQD with the following high-performance Waters ZSpray™ sources:

- Standard multimode electrospray ionization/atmospheric pressure chemical ionization/combined electrospray ionization and atmospheric pressure chemical ionization (ESI/APCI/ESCi®) source.

  Requirement: Dedicated APCI operation requires an additional probe (IonSABRE™ II).
- Optional dual-mode APPI/APCI source.
- Optional NanoFlow™ ESI source.
- Optional TRIZAIC™ UPLC source.
- Optional APGC source.
- Optional ASAP source.

For information on installing and removing the optional APGC, TRIZAIC, and ASAP sources, refer to the operator's guide supplements supplied with them.

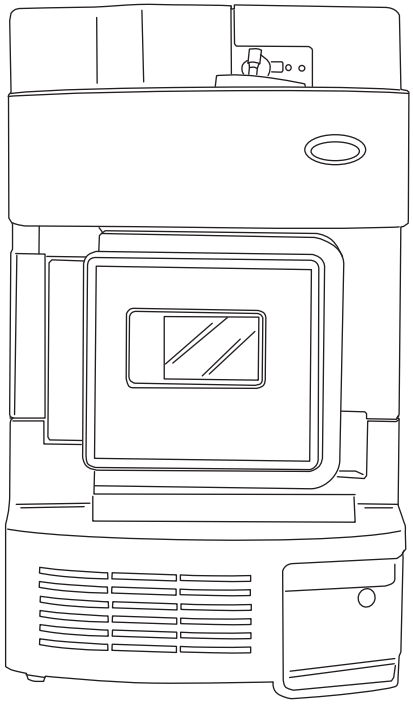
You can also use the Xevo TQD with the following optional third-party sources:

- DART®
- DESI
- LDTD™

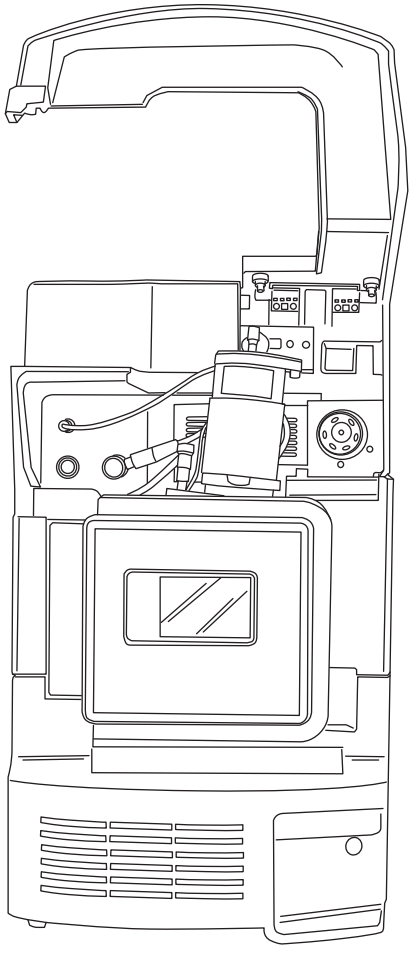
For further details, refer to the appropriate manufacturer's documentation.

For mass spectrometer specifications, see the *Waters Xevo TQD Site Preparation Guide*.

Xevo TQD:



Xevo TQD with visor up:



IntelliStart technology

IntelliStart™ technology monitors LC/MS/MS performance and reports when the instrument is ready for use.

The software automatically tunes and mass calibrates the instrument and displays performance readbacks. Integrated with MassLynx™ mass spectrometry software and ACQUITY® UPLC Console software, it enables simplified setup of the system for use in routine analytical and open access applications. (See page 1-7.)

The IntelliStart Fluidics[1] system is built into the instrument. It delivers sample directly to the MS probe from the LC column or from two integral reservoirs. The integral reservoirs can also deliver sample through direct or combined infusion so that you can optimize instrument performance at analytical flow rates. See the instrument's online Help for further details of IntelliStart.

ACQUITY H-Class and nanoACQUITY Xevo TQD UPLC/MS systems

The Waters Xevo TQD is compatible with the ACQUITY UPLC® H-Class and nanoACQUITY UPLC® systems. If you are not using either system, refer to the documentation relevant to your LC system.

The ACQUITY Xevo TQD UPLC/MS system includes an ACQUITY UPLC H-Class system and the Waters Xevo TQD fitted with the ESI/APCI/ESCi source.

The nanoACQUITY Xevo TQD UPLC/MS system includes a nanoACQUITY UPLC system and the Xevo TQD fitted with the Nanoflow source.

If you are not using your instrument as part of an ACQUITY UPLC system, refer to the documentation for your LC system.

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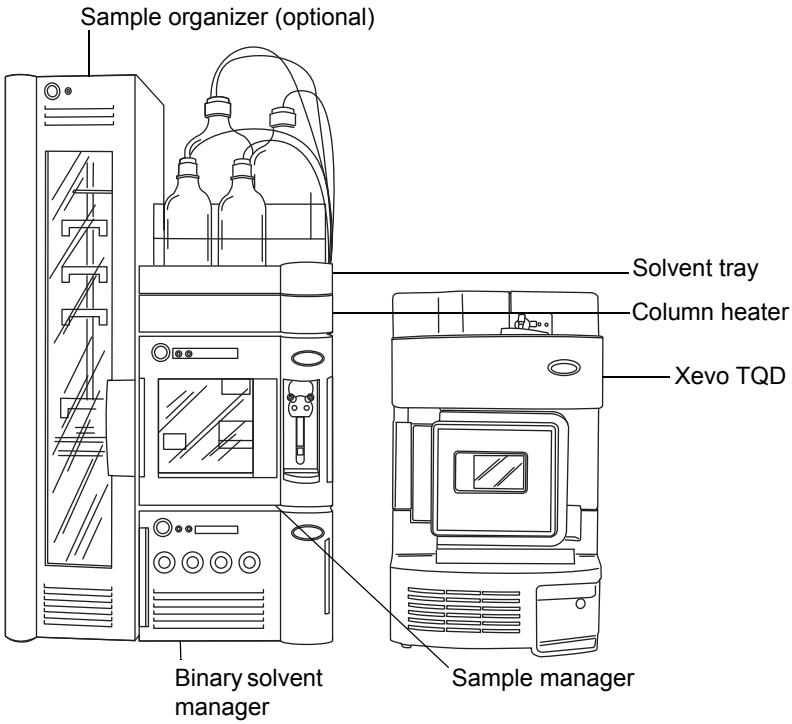
1. In Waters product documentation, the term "fluidics" denotes plumbing connections and components and the fluid pathways within and among instruments or devices. It also appears in the product name "IntelliStart™ Fluidics" where it describes a mass spectrometer's integral apparatus for delivering sample and solvent directly to the instrument's probe. Finally, the term can arise in the context of a component part name, as in "fluidics drawer".

ACQUITY UPLC H-Class system

The ACQUITY UPLC H-Class system includes a binary solvent manager, sample manager, column heater, sample organizer, detectors, and an ACQUITY UPLC column. Waters MassLynx mass spectrometry software controls the system.

For further instruction, see the *ACQUITY UPLC H-Class System Guide* or *Controlling Contamination in UPLC/MS and HPLC/MS Systems* (part number 715001307). You can find the documents on http://www.waters.com; click Services and Support > Support.

Xevo TQD with ACQUITY UPLC system:



Xevo TQD with nanoACQUITY UPLC system

Similar to the ACQUITY UPLC system, the nanoACQUITY© uses the optional NanoFlow source on the Xevo TQD. It is designed for capillary-to-nano-scale separations. Its sensitivity, resolution, and reproducibility well suit it for

biomarker discovery and proteomics applications, including protein identification and characterization.

This system is optimized for high-resolution separations at precise nanoflow rates. With closed-loop control, those rates range between 0.20 and 5.00 µL/min. With open-loop control and nanoACQUITY UPLC columns of internal diameters ranging from 75 µm to 1 mm, the flow rates can extend to 100 µL/min. The column hardware and the matched outlet tubing can withstand pressure of as much as 69,000 kPa (690 bar, 10,000 psi). The column dimensions allow optimal MS-compatible flow rates, and matched outlet tubing minimizes the effect of extra-column volume.

For further instruction, see the *nanoACQUITY UPLC System Operator's Guide* or *Controlling Contamination in LC/MS Systems* (part number 715001307). You can find these documents on http://www.waters.com; click Services and Support > Support.

Non-ACQUITY devices for use with the Xevo TQD

The following non-ACQUITY LC devices are validated for use with the Xevo TQD:

- Waters Alliance 2695 separations module
- Waters Alliance 2795 separations module
- Waters 2998 PDA detector
- Waters 2487 UV detector
- Waters 1525µ binary gradient pump + 2777 autosampler
- Spark Holland Symbiosis™ system

Software and data system

MassLynx mass spectrometry software v4.1controls the mass spectrometer. It is a high-performance application that acquires, analyzes, manages, and distributes mass spectrometry, ultraviolet (UV), evaporative light scattering, and analog data.

MassLynx software enables these major operations:

- Configuring the system.
- Creating LC and MS/MS methods that define operating parameters for a run.

- Using IntelliStart software to automatically tune and mass calibrate the mass spectrometer.
- Running samples.
- Monitoring the run.
- Acquiring data.
- Processing data.
- Reviewing data.
- Printing data.

See MassLynx v4.1 user documentation and online Help for more information on using MassLynx software.

OpenLynx™ and TargetLynx™ application managers are included as standard software.

Instrument Console software

The Instrument Console is a software application with which you configure settings, monitor performance, run diagnostic tests, and maintain the system and its modules. The Instrument Console functions independently of MassLynx software and does not recognize or control the data systems.

See the Instrument Console system online Help for details.

Ionization techniques and source probes

Electrospray ionization (ESI)

In electrospray ionization (ESI), a strong electrical charge is applied to the eluent as it emerges from a nebulizer. The droplets that compose the resultant aerosol undergo a reduction in size (solvent evaporation). As solvent continues to evaporate, the charge density increases until the droplet surfaces eject ions (ion evaporation). The ions can be singly or multiply charged.

The standard ESI probe accommodates eluent flow rates as high as 2 mL/min, making it suitable for LC applications in the range 100 µL/min to 2 mL/min.

See page 3-2 for further details.

Combined ESI and APCI (ESCi)

Combined electrospray ionization and atmospheric pressure chemical ionization (ESCi) is supplied as standard equipment on the mass spectrometer. In ESCi, the standard ESI probe is used in conjunction with a corona pin to allow alternating acquisition of ESI and APCI ionization data, facilitating high throughput and wider compound coverage.

See page 3-5 for further details.

Atmospheric pressure chemical ionization (APCI)

A dedicated high-performance APCI interface is offered as an option. APCI produces singly charged protonated or deprotonated molecules for a broad range of nonvolatile analytes.

The APCI interface consists of the ESI/APCI/ESCi enclosure fitted with a corona pin and an IonSABRE II probe.

See page 3-5 for further details.

Dual-mode APPI/APCI source

The optional, combined atmospheric pressure photoionization/atmospheric pressure chemical ionization (APPI/APCI) source comprises an IonSABRE II probe and the APPI lamp drive assembly. The APPI lamp drive assembly comprises a UV lamp and a repeller electrode. In addition, a specially shaped, dual, APPI/APCI corona pin can be used. You can operate the source in APPI,

APCI, or dual mode, which switches rapidly between APPI and APCI ionization modes.

NanoFlow source

"NanoFlow" is the name given to several techniques that use low flow rate electrospray ionization. The NanoFlow source allows electrospray ionization in the flow rate range 5 to 1000 nL/min. For a given sample concentration, the ion currents observed approximate those seen in normal flow rate electrospray. However, for similar experiments, NanoFlow's significant reduction in sample consumption accompanies significant increases in sensitivity.

The following options are available for the spraying capillary:

- Universal nebulizer sprayer (Nano-LC).

  This option is for flow injection or for coupling to nano-UPLC. It uses a pump to regulate the flow rate downward to 100 nL/min. If a syringe pump is used, a gas-tight syringe is necessary to effect correct flow rates without leakage. A volume of 250 µL is recommended.

- Borosilicate glass capillaries (nanovials).

  Metal-coated, glass capillaries allow the lowest flow rates. Usable for one sample, they must then be discarded.

- Capillary Electrophoresis (CE) or Capillary Electrochromatography (CEC) sprayer. This option uses a make-up liquid at the capillary tip that provides a stable electrospray. The make-up flow rate is less than 1 µL/min.

Atmospheric solids analysis probe (ASAP)

The ASAP facilitates rapid analysis of volatile and semivolatile compounds in solids, liquids, and polymers. It is particularly suited to analyzing low-polarity compounds.The ASAP directly replaces the electrospray or IonSABRE II probe in the instrument's source housing and has no external gas or electrical connections.

See the *Atmospheric Solids Analysis Probe Operator's Guide Supplement* for further details.

Atmospheric pressure gas chromatography (APGC)

The Waters APGC couples an Agilent GC with the Xevo TQD, making it possible to perform LC and GC analyses in the same system, without compromising performance. The APGC provides complementary information to the LCMS instrument, enabling analysis of compounds of low molecular weight and/or low-to-intermediate polarity.

See the *Atmosheric Pressure GC Operator's Guide Supplement* for further details.

TRIZAIC UPLC source

The TRIZAIC UPLC source accepts a nanoTile™ device, which combines the functions of an analytical column, trapping column, and nanospray emitter. This technology simplifies the implementation of capillary-scale chromatography and analysis of limited-volume samples.

See the *TRIZAIC UPLC System Guide* for further details.

IntelliStart Fluidics system

Functionality

The IntelliStart Fluidics system is a solvent delivery system built into the mass spectrometer. It delivers sample or solvent directly to the MS probe in one of three ways:

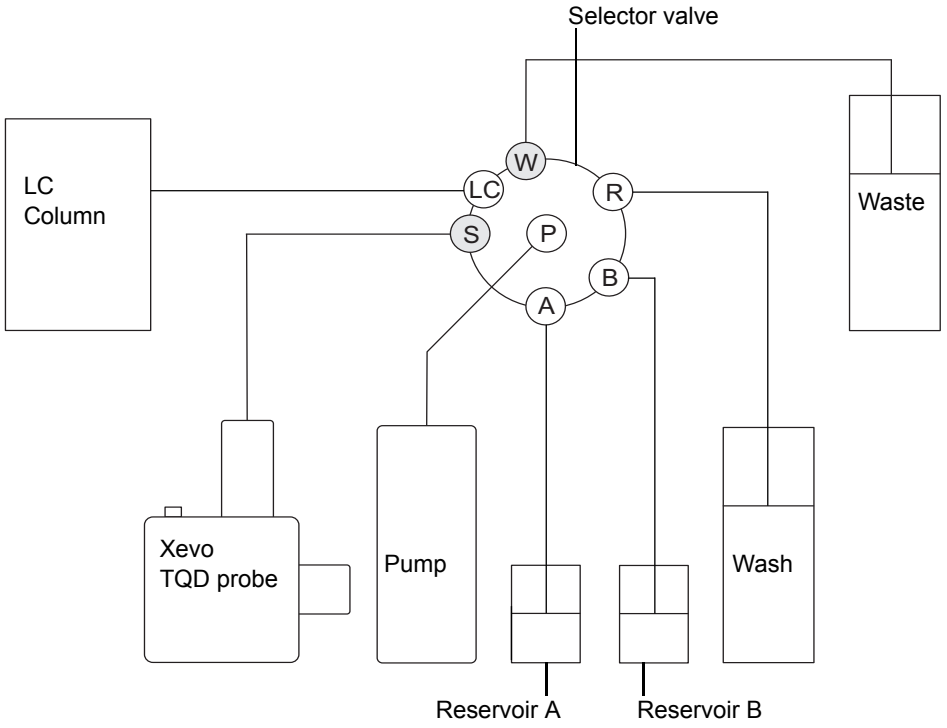
- From the LC column.
- From two integral reservoirs. Use standard reservoir bottles (15 mL) for instrument setup and calibration. Use 1.5 mL, low-volume vials (sold separately) to infuse smaller volumes (see page 2-6.)

  The reservoirs can also deliver sample through direct or combined infusion to enable optimization at analytical flow rates.
- From a wash reservoir that contains solvent for automated flushing of the instrument's solvent delivery system.

The onboard system incorporates a selector valve, an infusion pump, and two sample reservoirs mounted on the bottom, right-hand side of the instrument.

Recommendation: Use reservoir A for the calibrant solution and tuning compounds, and reservoir B for analyte/optimization solution.

IntelliStart Fluidics system:



System operation

The software automatically controls solvent and sample delivery during auto-tuning, auto-calibration, and method development. The selector valve systematically makes connections between the fluidics components to carry out the operations processed by the software.

You can set IntelliStart fluidics configuration requirements in the system console. You can edit the parameters, frequency, and extent of the automation. See the mass spectrometer's online Help for further details on IntelliStart software and operation of the solvent delivery system.

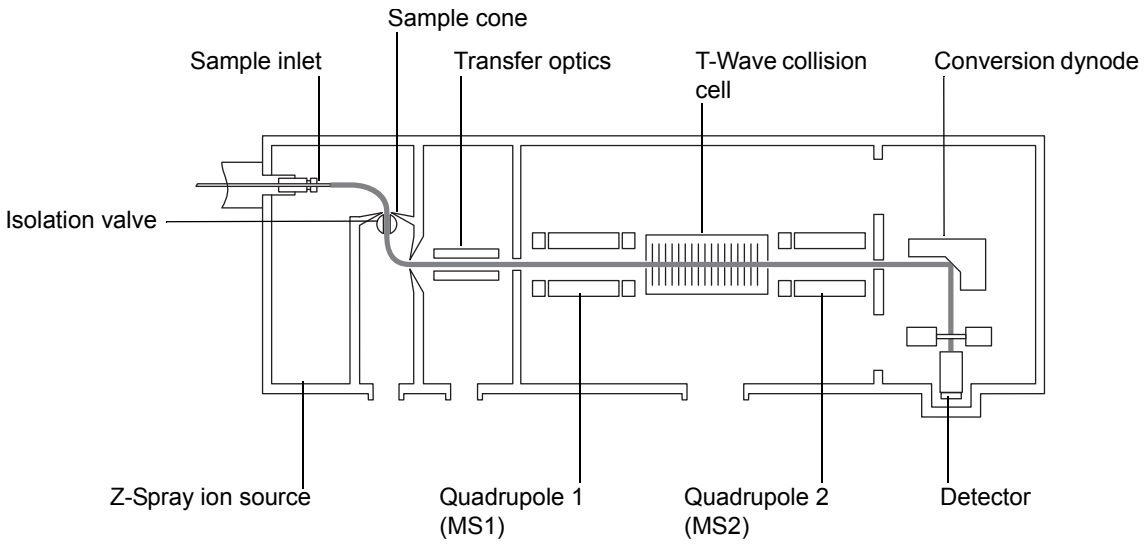
For information on plumbing the IntelliStart Fluidics system, see Appendix D.

Ion optics

The mass spectrometer's ion optics operate as follows:

1. Samples from the LC or Intellistart fluidics system are introduced at atmospheric pressure into the ionization source.
2. The ions pass through the sample cone into the vacuum system.
3. The ions pass through the transfer optics (the ion guide) to the first quadrupole, where they are filtered according to their mass-to-charge ratios.
4. The mass-separated ions pass into the T-Wave™ collision cell where they either undergo collision-induced dissociation (CID) or pass to the second quadrupole. Any fragment ions are then mass-analyzed by the second quadrupole.
5. The transmitted ions are detected by the photomultiplier detection system.
6. The signal is amplified, digitized, and sent to the MassLynx mass spectrometry software.

Ion optics overview:



MS operating modes

The following table shows the MS operating modes.

MS operating modes:

Operating mode	MS1	Collision cell	MS2
MS	Pass all masses		Resolving (scanning)
SIR	Resolving (static)	Pass all masses	

In MS mode, the instrument can acquire data at scan speeds as high as 10,000 Da/s. Use this mode for instrument tuning and calibration before MS/MS analysis. See the mass spectrometer's online Help for further information.

Use the selected ion recording (SIR) mode for quantitation when you cannot find a suitable fragment ion to perform a more specific multiple reaction monitoring (MRM) analysis (see page 1-15). In SIR and MRM modes, neither quadrupole is scanned, therefore no spectrum (intensity versus mass) is produced. The data obtained from SIR or MRM analyses derive from the chromatogram plot (specified mass intensity versus time).

MS/MS operating modes

The following table shows the MS/MS operating modes, described in more detail in the following pages.

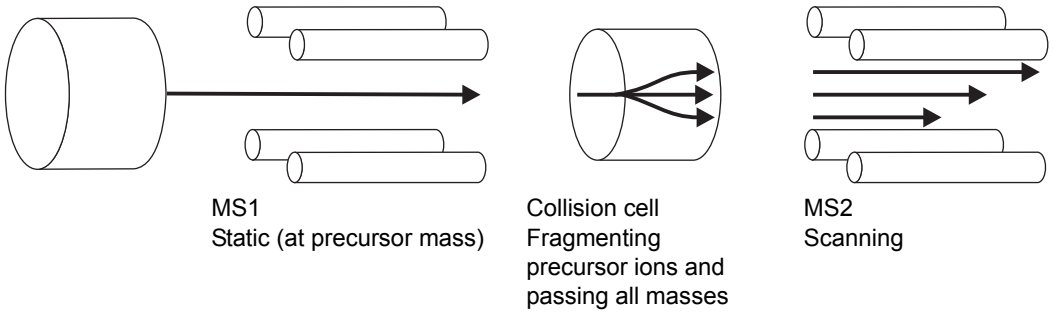
MS/MS operating modes:

Operating mode	MS1	Collision cell	MS2
Product (daughter) ion spectrum	Static (at precursor mass)	Fragment precursor ions and pass all masses	Scanning
Precursor (parent) ion spectrum	Scanning		Static (at product mass)
MRM	Static (at precursor mass)		Static (at product mass)
PICS (Product Ion Confirmation Scan)	Static (at precursor mass)		Switching between static (at product mass) and scanning
RADAR	Static (at precursor mass)		Switching between static (at product mass) and scanning
Constant neutral loss spectrum	Scanning (synchronized with MS2)		Scanning (synchronized with MS1)

Product (daughter) ion mode

Product ion mode is the most commonly used MS/MS operating mode. You can specify an ion of interest for fragmentation in the collision cell, thus yielding structural information.

Product ion mode:



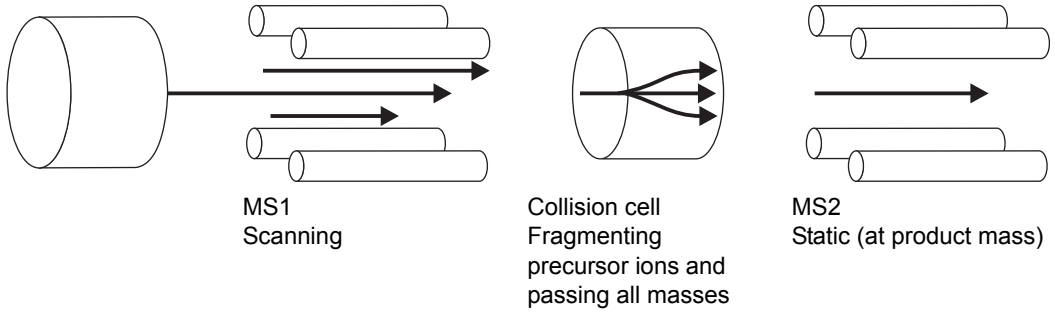
Typical applications

Product ion mode is typically used for the following applications:

- Method development for MRM screening studies:
  - Identifying product ions for use in MRM transitions.
  - Optimizing CID tuning conditions to maximize the yield of a specific product ion to be used in MRM analysis.
- Structural elucidation (for example, peptide sequencing)

Precursor (parent) ion mode

Precursor ion mode:



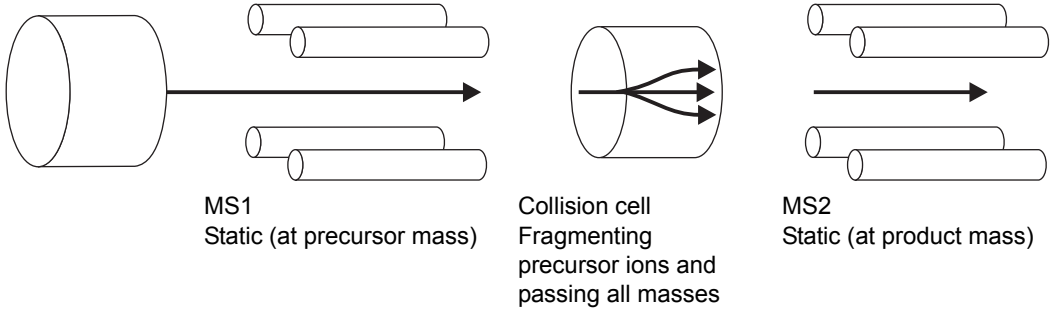
Typical application

You typically use the precursor ion mode for structural elucidation—that is, to complement or confirm product scan data—by scanning for all the precursors of a common product ion.

Multiple reaction monitoring mode

Multiple reaction monitoring (MRM) mode is the highly selective MS/MS equivalent of SIR. Because both MS1 and MS2 are static, greater dwell time on the ions of interest is possible, so the sensitivity achieved is better, compared with scanning-mode MS/MS. This mode is the most commonly used acquisition mode for quantitative analysis, allowing the compound of interest to be isolated from the chemical background noise.

Multiple reaction monitoring mode:



PICS mode

A variation on MRM, PICS allows you to collect a product ion spectrum from the top of all detected peaks in MRM mode for additional confidence in your peak assignment, activated by a single check box.

RADAR

In RADAR mode the Xevo TQD rapidly alternates between MRM and full scan MS acquisition modes. The instrument tracks target analytes with precision in MRM mode, while at the same time scanning (in MS mode) the background for all other components. This enables fast characterization of potential matrix effects, providing a platform for more robust method development

Typical application

You typically use RADAR mode during method development prior to performing MRM or PICS to quantify known analytes in complex samples:

- Drug metabolite and pharmacokinetic studies
- Environmental, for example, pesticide and herbicide analysis
- Forensic or toxicology, for example, screening for target drugs in sports

MRM analysis with no associated RADAR or PICS operation does not produce a spectrum because only one transition is monitored at a time. As in SIR mode, a chromatogram is produced.

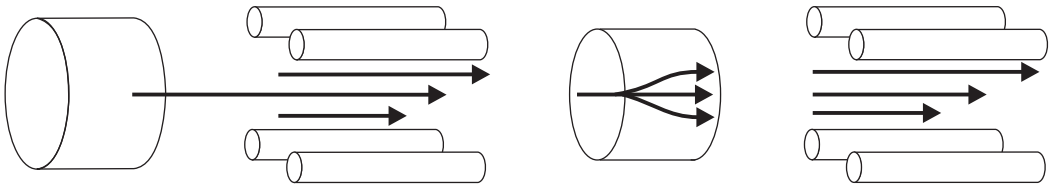
Constant neutral loss mode

Constant neutral loss mode detects the loss of a specific neutral fragment or functional group from an unspecified precursor(s).

The scans of MS1 and MS2 are synchronized. When MS1 transmits a specific precursor ion, MS2 “looks” to see whether that precursor loses a fragment of a certain mass. If it does, the loss registers at the detector.

In constant neutral loss mode, the spectrum shows the masses of all precursors that actually lost a fragment of a certain mass.

Constant neutral loss mode:



Typical application

You typically use constant neutral loss mode to screen mixtures for a specific class of compound that is characterized by a common fragmentation pathway, indicating the presence of compounds containing a common functional group.

Sample inlet

Either of two methods delivers solvent and sample to the installed probe:

- An LC system, which delivers the eluent from an LC analysis.
- IntelliStart Fluidics system, which uses onboard solutions to automate instrument optimization. You can deliver solutions by direct or combined infusion.

Leak sensors

Leak sensors in the Xevo TQD and the drip trays of the ACQUITY UPLC system continuously monitor system components for leaks. A leak sensor stops system flow when its optical sensor detects about 1.5 mL of accumulated, leaked liquid in its surrounding reservoir. At the same time, the ACQUITY UPLC Console displays an error message alerting you that a leak has developed.

See *Waters ACQUITY UPLC Leak Sensor Maintenance Instructions* for complete details.

Vacuum system

An external roughing pump and an internal split-flow turbomolecular pump combine to create the source vacuum. The turbomolecular pump evacuates the analyzer and ion transfer region.

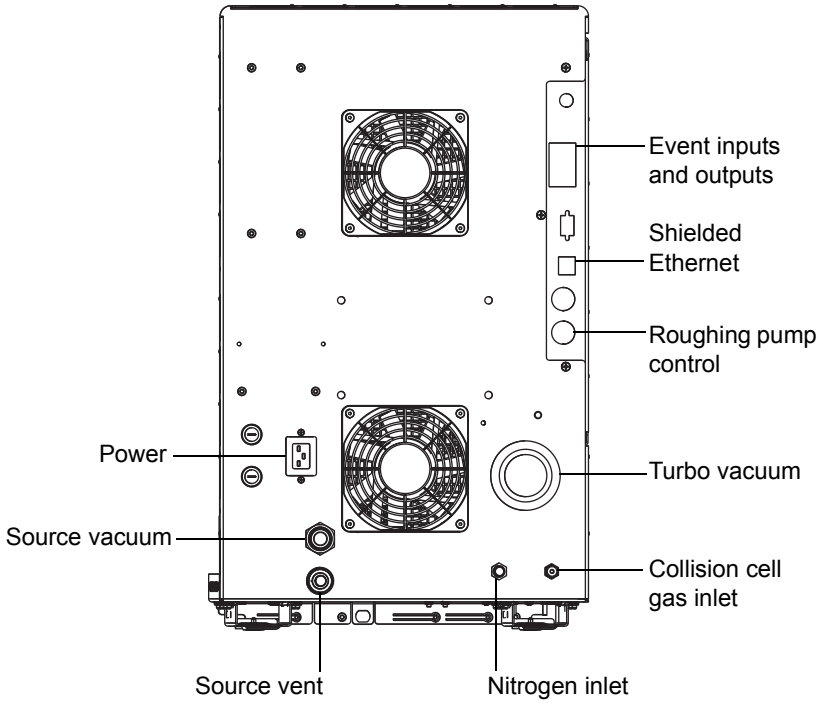
Vacuum leaks and electrical or vacuum pump failures cause vacuum loss, the damage from which is prevented by protective interlocks. The system monitors turbomolecular pump speed and continuously measures vacuum pressure with a built-in Pirani gauge. The gauge also serves as a switch, stopping operation when it senses vacuum loss.

A vacuum isolation valve isolates the source from the mass analyzer, allowing routine source maintenance without venting.

Rear panel connections

The following figure shows the rear panel locations of the connectors used to operate the instrument with external devices.

Instrument rear panel:



2 Preparing for Operation

This chapter describes how to start and shut down the instrument.

Contents:

Starting the mass spectrometer

The Waters Xevo TQD is compatible with the ACQUITY UPLC system; if you are not using an ACQUITY UPLC system, refer to the documentation relevant to the system you are using (see “Non-ACQUITY devices for use with Xevo TQD” on page 1-7).

Caution: Using incompatible solvents can cause severe damage to the instrument. For more details, refer to the following sources:

- See page C-1 for solvent information.
- Appendix C of the *ACQUITY UPLC System Operator’s Guide* for solvent compatibility with ACQUITY™ devices.

Starting the mass spectrometer entails powering-on the ACQUITY workstation, logging into the workstation, powering-on the mass spectrometer and all other ACQUITY instruments, and starting the MassLynx software.

Requirement: You must power-on and log in to the ACQUITY UPLC workstation first to ensure that it obtains the IP addresses of the system instruments.

See the mass spectrometer’s online Help for details on MassLynx and IntelliStart applications.

To start the mass spectrometer:

Warning: To avoid igniting flammable solvents, never let the nitrogen supply pressure fall below 400 kPa (4.0 bar, 58 psi).

1. On the rear panel, ensure the nitrogen supply is connected to the instrument’s nitrogen inlet connection (see the figure on page 1-21).

   Requirement: The nitrogen must be dry and oil-free, with a purity of at least 95% or, for APGC use, at least 99.999%. Regulate the supply at 600 to 690 kPa (6.0 to 6.9 bar, 90 to 100 psi).

   For more information on connections, see the figure on page 1-21.

2. Ensure that the collision gas supply is connected to the instrument’s collison cell gas inlet.

   Requirement: The collision gas is argon; it must be dry and of high purity (99.997%). Regulate the supply at 50 kPa (0.5 bar, 7 psi).

3. Power-on the ACQUITY UPLC system workstation, and log in.
4. Press the power switch on the top, right-hand side of the mass spectrometer and the switches on the top, left-hand sides of the ACQUITY instruments.

   Result: Each system instrument runs a series of startup tests.
5. Allow 3 minutes for the embedded PC to initialize and sound an alert indicating that the PC is ready.

   Tip: The power and status LEDs change as follows:

   - Each system instrument's power LED shows green.
   - During initialization, the binary solvent manager's and sample manager's status LED flashes green.
   - After the instruments successfully power-on, all power LEDs show steady green. The binary solvent manager's flow LED, the sample manager's run LED, and the mass spectrometer's Operate LED remain off.
6. Start MassLynx software and monitor the Instrument Console for messages and LED indications.
7. Click IntelliStart in the MassLynx main window's lower, left-hand corner.

   Result: The mass spectrometer's console appears. The mass spectrometer is in Standby mode.
8. Click Control > Pump to start the roughing pump.

   Tip: After a 20-second delay, during which the turbopump is starting, the roughing pump starts. IntelliStart displays "Instrument in standby", and the Operate LED remains off.
9. Wait a minimum of 2 hours for the instrument to be fully pumped down (evacuated).

   Tip: In the Instrument Console, the System Ready indicator shows green when the instrument is fully pumped down (evacuated).
10. Click Resolve  or Operate  .

    Result: When the mass spectrometer is in good operating condition, IntelliStart software displays "Ready" in the Instrument Console.

Tip: If clicking Resolve fails to put the instrument into Operate mode, IntelliStart software displays corrective actions in the Instrument Console.

Verifying the instrument's state of readiness

When the instrument is in good operating condition, the power and Operate LEDs show constant green. You can view any error messages in IntelliStart software.

Monitoring the instrument LEDs

Light-emitting diodes on the instrument indicate its operational status.

Power LED

The power LED, to the top, right-hand side of the mass spectrometer's front panel, indicates when the instrument is powered-on or powered-off.

Operate LED

The Operate LED, on the right-hand side of the power LED, indicates the operating condition.

See the instrument's online Help topic "Monitoring the detector LEDs" for details of the Operate LED indications.

Tuning and calibration information

You must tune and, if necessary, calibrate the instrument prior to use. You can perform these tasks using IntelliStart software.

For further instruction, see the mass spectrometer's online Help topic "Instrument Setup".

Running the instrument at different flow rates

The ACQUITY UPLC system runs at high flow rates. To optimize desolvation, and thus sensitivity, run the ACQUITY Xevo TQD system at appropriate gas flows and desolvation temperatures. IntelliStart software automatically sets these parameters when you enter a flow rate, according to the following table.

Flow rate versus temperature and gas flow:

Flow rate (mL/min)	Source temp (°C)	Desolvation temp (°C)	Desolvation gas flow (L/h)
0.000 to 0.020	150	200	800
0.021 to 0.100	150	300	800
0.101 to 0.500	150	500	1000
>0.500	150	600	1000

If you are using an APCI interface, IntelliStart software automatically sets the parameters according to the following table:

Flow rate versus IonSABRE II probe temperature and gas flow:

Flow rate (mL/min)	IonSABRE II probe temperature (°C)	Desolvation gas flow (L/h)
0.000 to 0.020	400	800
0.021 to 0.500	500	1000
>0.500	600	1000

Preparing the IntelliStart Fluidics system

For additional information, see page B-17 and Appendix D

Caution: To avoid accidental spillage damage to the instrument, do not store large-volume solvent reservoirs on top of the instrument.

Installing the reservoir bottles

Use standard reservoir bottles (15 mL) for instrument setup and calibration. Use the Low-volume Adaptor Kit (sold separately) to infuse smaller volumes. The low-volume vials have a volume of 1.5 mL.

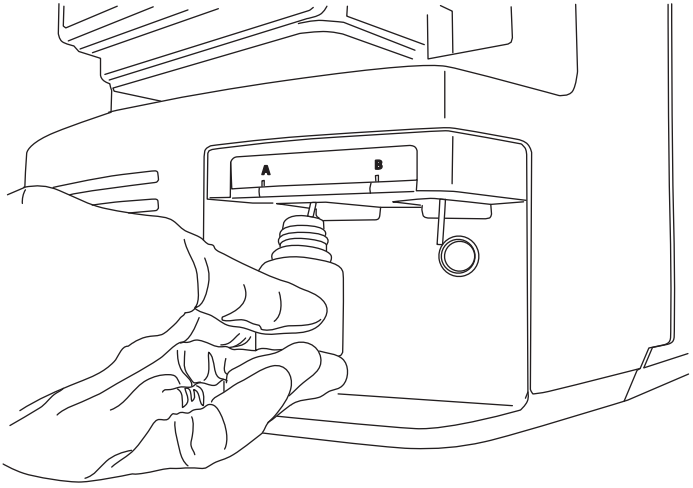
Required material

Chemical-resistant, powder-free gloves

To install the reservoir bottles:

Warning: The reservoir bottles can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Remove the reservoir bottle caps.
2. Screw the reservoir bottles onto the instrument, as shown below.



3. For each reservoir bottle, ensure that the end of the solvent delivery tube is positioned so that it is close to, but does not touch, the bottom of the bottle.

To install low-volume vials:

Warning: The reservoir bottles can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. If a standard reservoir bottle is fitted, remove it.
2. Screw the low-volume adaptor into the manifold and tighten it.
3. Screw the low-volume vial into the adaptor.
4. For each low-volume vial, ensure that the end of the solvent delivery tube is positioned so that it is close to, but does not touch, the bottom of the vial.

Purging the infusion pump

Whenever you replace a solution bottle, purge the infusion pump with the solution that you are going to use next. See the mass spectrometer's online Help for details.

Requirement: Ensure that the end of the tubing is fully submerged in the solvent in the wash reservoir.

Tip: Depending on the solutions used, the instrument's solvent delivery system can require more than one purge cycle to minimize carryover.

Rebooting the instrument

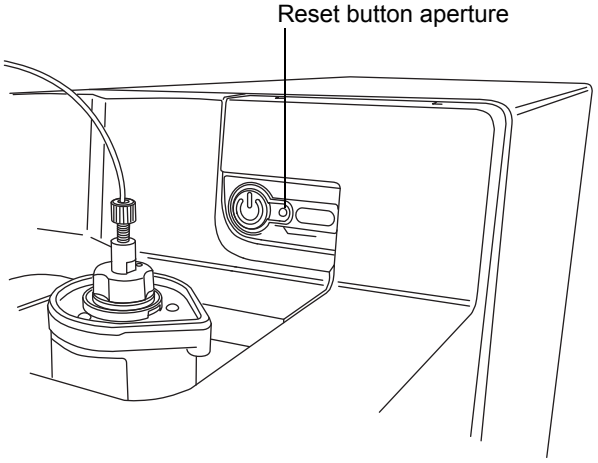
The reset button causes the mass spectrometer to reboot.

Reboot the instrument when either of these conditions applies:

- Immediately following a software upgrade.
- MassLynx software fails to initialize.

To reboot the instrument:

1. Ensure that MassLynx software is closed.
2. Insert a short length (7.5 cm) of PEEK™ tubing, or similar object, into the reset button aperture at the top, right-hand side of the instrument's front panel.



3. Remove the PEEK tubing from the reset button aperture.
4. Wait until the reboot sequence ends before starting the MassLynx software.

   Tip: An audible alert sounds when the reboot sequence is complete.

Leaving the mass spectrometer ready for operation

Leave the mass spectrometer in Operate mode except in the following cases:

- When performing routine maintenance
- When changing the source
- When leaving the mass spectrometer unused for a long period

In these instances, put the mass spectrometer in Standby mode. See the online Help for details.

Emergency shutdown of the mass spectrometer

To shut down the instrument in an emergency:

Warning: The instrument's power switch does not isolate it from the main power supply. To isolate the instrument, follow the procedure outlined below.

Caution: Data can be lost during an emergency shutdown.

1. Operate the power button on the front of the instrument.
2. Disconnect the power cable from the instrument's rear panel.

3 Changing the Mode of Operation

This chapter describes how to prepare the mass spectrometer for the following modes of operation:

- ESI (electrospray ionization)
- ESCi (combined electrospray and atmospheric pressure chemical ionization)
- APCI (atmospheric pressure chemical ionization)
- Combined Atmospheric Pressure Photoionization (APPI/APCI)
- NanoFlow

For details about other Waters and third-party source options, refer to the documentation supplied with the source.

Contents:

ESI mode

The following sections explain how to install and remove an ESI probe. For further details on running ESI applications, see page 1-9.

Installing the ESI probe

Required material

Chemical-resistant, powder-free gloves

To install the ESI probe:

Warning: The LC system connections, ESI probe, and source can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

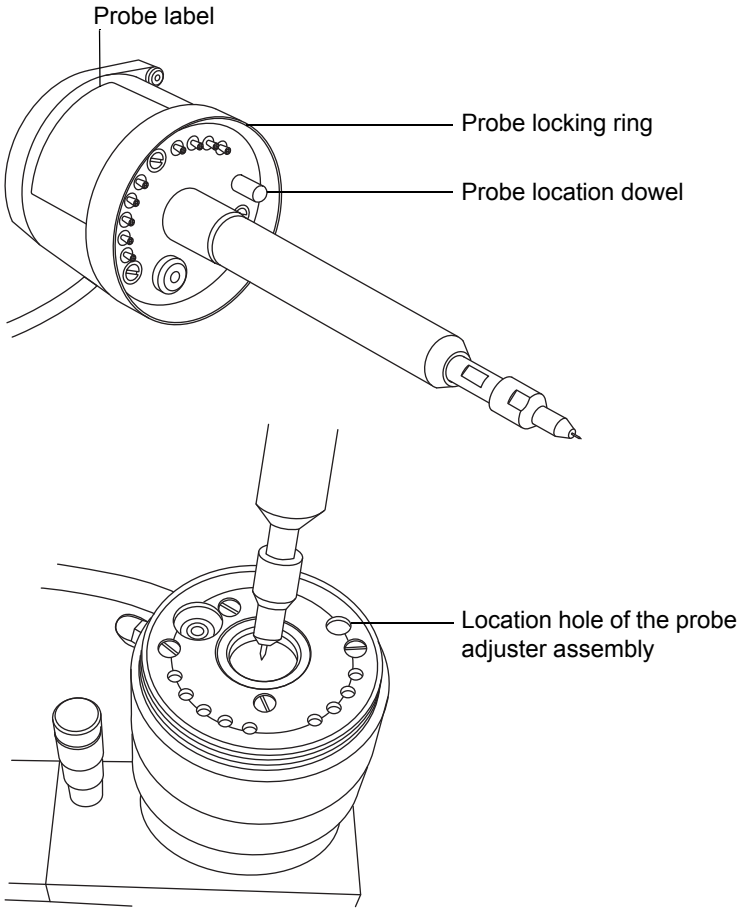
1. Prepare the instrument for working on the source (see page 4-7).

   Warning: The ESI probe tip is sharp. To avoid puncture wounds, handle it with care.

2. Remove the protective sleeve, if fitted, from the ESI probe tip.

3. With the probe label facing you, carefully slide the ESI probe into the hole in the probe adjuster assembly, ensuring that the probe location dowel aligns with the location hole of the probe adjuster assembly.



Caution: To avoid failure of the automatic pressure test, fully tighten the probe locking ring.

4. Tighten the probe locking ring to secure the probe in place.

   Tip: An automatic pressure test runs when the probe is correctly seated.

5. Connect the ESI probe's cable to the high-voltage connector.

Warning: To avoid electric shock, do not use stainless steel tubing or stainless steel finger-tight screws to connect the selector valve to the ESI probe; use the PEEK tubing and natural (beige) colored PEEK finger-tight screws supplied with the instrument.

6. Using PEEK tubing equal to 0.004-inch ID, connect port S of the selector valve to the ESI probe.

   Recommendation: To reduce peak broadening, use 0.004-inch ID tubing for sample flow rates ≤1.2 mL/min; use 0.005-inch ID tubing for sample flow rates >1.2 mL/min.

   Requirements:

   - If you are replacing the tubing between the selector valve and the probe, minimize the length to reduce peak broadening.
   - When cutting the tubing to length, cut it squarely (that is, perpendicular to its horizontal axis).

Removing the ESI probe

Required material

Chemical-resistant, powder-free gloves

To remove the ESI probe:

Warning: The LC system connections, ESI probe, and source can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).
2. Disconnect the tubing from the ESI probe.
3. Disconnect the ESI probe cable from the high-voltage connector.
4. Unscrew the probe locking ring.

Warning: The ESI probe tip is sharp. To avoid puncture wounds, handle the probe with care.

5. Carefully remove the ESI probe from the probe adjuster assembly.
6. If available, fit the protective sleeve to the ESI probe tip.

ESCi mode

To run ESCi applications, you must fit an ESI probe and corona pin to the ESI/APCI/ESCi source enclosure.

See “Installing the ESI probe” on page 3-2, “Installing the corona pin in the source” on page 4-12, and “IntelliStart Fluidics System” on page 1-11.

Optimizing the ESI probe for ESCi operation

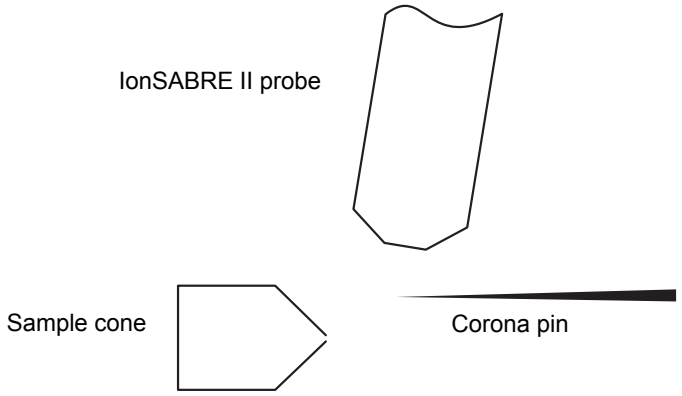
See the mass spectrometer’s online Help for details on how to optimize the ESI probe for ESCi operation.

APCI mode

APCI mode, an option for the mass spectrometer, produces singly charged protonated or deprotonated molecules for a broad range of nonvolatile analytes.

The APCI interface consists of the ESI/APCI/ESCi enclosure fitted with a corona pin and an IonSABRE II probe. Mobile phase from the LC column enters the probe, where it is pneumatically converted to an aerosol, rapidly heated, and vaporized or gasified at the probe tip.

APCI mode:



Hot gas from the IonSABRE II probe passes between the sample cone and the corona pin, which is typically operated with a discharge current of 5 µA. Mobile phase molecules rapidly react with ions generated by the corona discharge to produce stable reagent ions. Analyte molecules introduced into the mobile phase react with the reagent ions at atmospheric pressure and typically become protonated (in the positive ion mode) or deprotonated (in the negative ion mode). The sample and reagent ions then pass through the sample cone and into the mass spectrometer.

Installing the IonSABRE II probe

Required materials

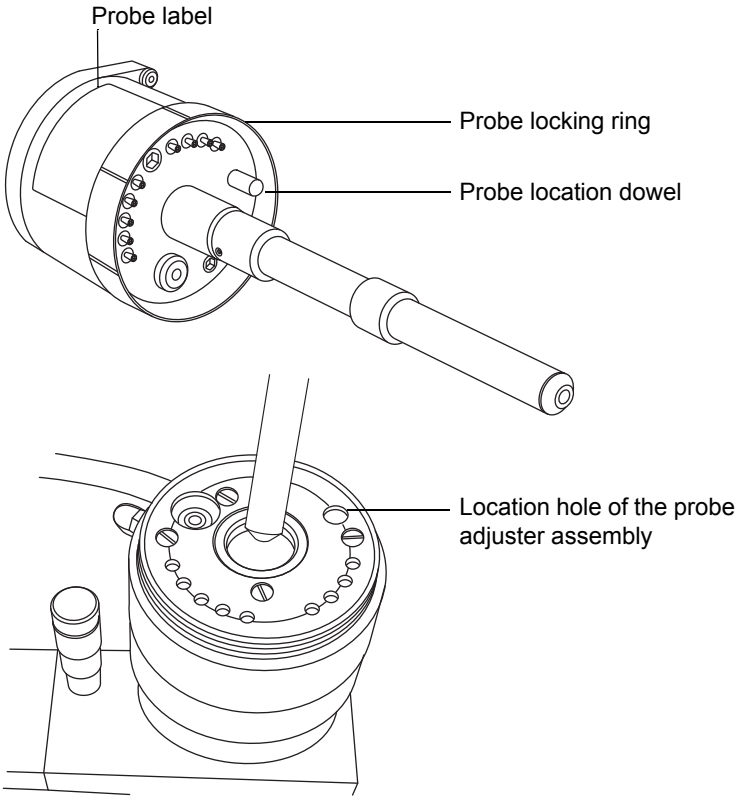
- Chemical-resistant, powder-free gloves
- Sharp knife or PEEK tubing cutter

To install the IonSABRE II probe:

Warning: The LC system connections, IonSABRE II probe, and source can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).
2. With the probe label facing toward you, carefully slide the IonSABRE II probe into the hole in the probe adjuster assembly, ensuring that the probe location dowel aligns with the probe adjuster assembly location hole.



3. Tighten the probe locking ring to secure the probe in place.

   Tip: An automatic pressure test is performed when the probe is correctly seated in position.

Warning: To avoid electric shock, do not use stainless steel tubing or stainless steel finger-tight screws to connect the selector valve to the IonSABRE II probe; use the PEEK tubing and natural (beige) colored PEEK finger-tight screws supplied with the instrument.

4. Using tubing equal to 0.004-inch ID, connect port S of the selector valve to the IonSABRE II probe.

   Recommendation: To reduce peak broadening, use 0.004-inch ID tubing for sample flow rates ≤1.2 mL/min; use 0.005-inch ID tubing for sample flow rates >1.2 mL/min.

   Requirements:

   - If you are replacing the tubing between the selector valve and the probe, minimize the length to reduce peak broadening.
   - When cutting the tubing to length, cut it squarely (that is, perpendicular to its horizontal axis).

5. Install the corona pin (see page 4-12).

Removing the IonSABRE II probe

Required material

Chemical-resistant, powder-free gloves

To remove the IonSABRE II probe:

Warning: The LC system connections, IonSABRE II probe, and source can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).
2. Remove the corona pin (see page 4-12).
3. Disconnect the selector valve tubing from the IonSABRE II probe.

4. Unscrew the probe locking ring.
5. Carefully remove the probe from the probe adjuster assembly.

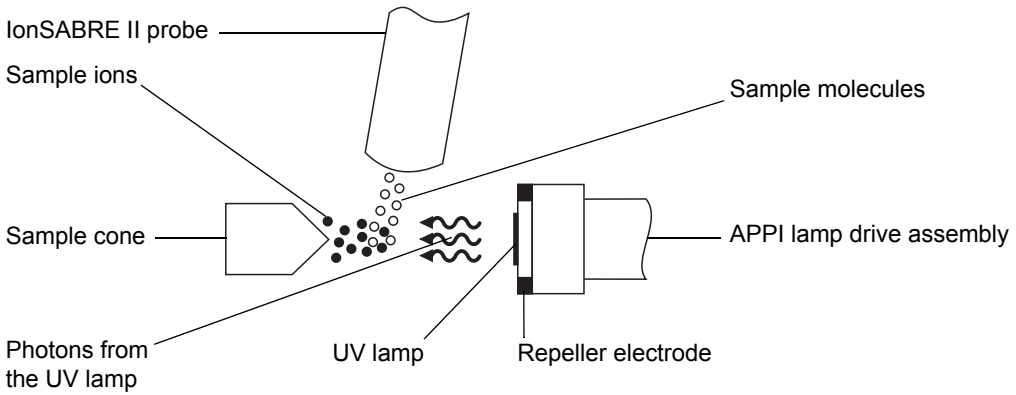
Combined APPI/APCI source

Operate this optional, replacement source enclosure in APPI, APCI, or dual APPI/APCI mode. Dual-mode APPI/APCI performs rapid switching between ionization modes.

APPI operation

In atmospheric pressure photoionization (APPI) mode, the source is fitted with an IonSABRE II probe and the APPI lamp drive assembly is advanced into the source.

APPI mode:



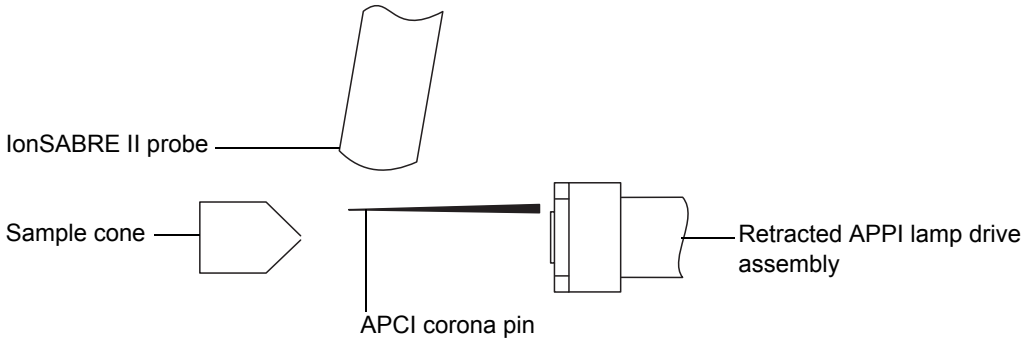
The IonSABRE II probe introduces vaporized sample into the source where photons generated by an ultraviolet (UV) lamp (mounted in the APPI lamp drive assembly) produce sample ions. Direct photoionization of a sample molecule occurs when the photon energy exceeds the ionization potential of the sample molecule.

A repeller electrode (mounted on the APPI lamp drive assembly) deflects and focuses the sample ions toward the sample cone.

APCI operation

The atmospheric pressure chemical ionization (APCI) mode produces singly charged protonated or deprotonated molecules for a large range of nonvolatile analytes. In APCI mode, the source is fitted with an APCI corona pin. Unused, the APPI lamp drive assembly is retracted from the source.

APCI mode:



The IonSABRE II probe introduces vaporized sample into the source. The sample passes between the sample cone and the corona pin, which typically operates with a discharge current of 5 µA. The corona discharge generates ions that react with the mobile phase molecules to produce stable reagent ions. Analyte molecules in the mobile phase react with the reagent ions at atmospheric pressure and become protonated (in the positive ion mode) or deprotonated (in the negative ion mode). The sample and reagent ions pass through the sample cone.

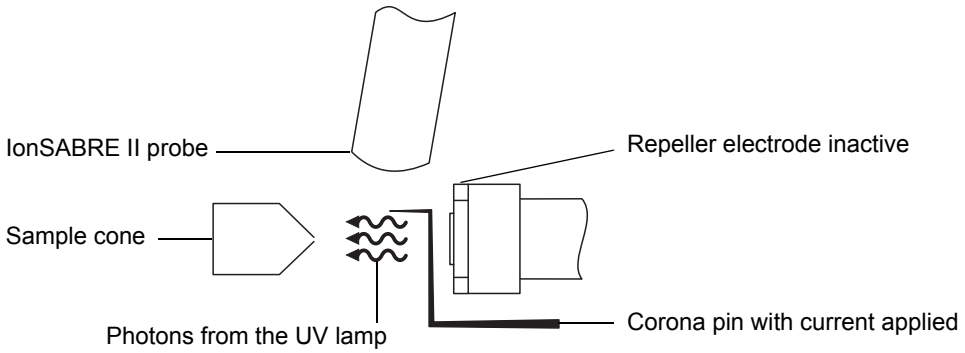
Dual-mode operation

Dual-mode operation enables rapid switching between APPI and APCI ionization modes and allows high-throughput operations (for example, for sample screening).

You replace the standard corona pin with a specially shaped APPI/APCI corona pin, so that the APPI lamp holder can be advanced into the source for dual operation.

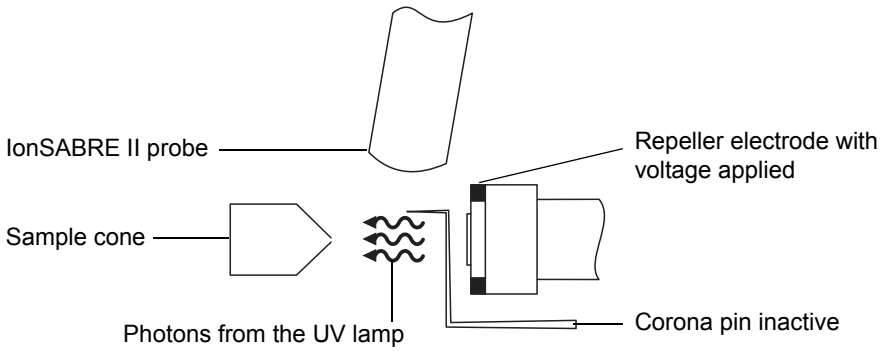
When the source is configured for dual operation in APCI mode, current is applied to the corona pin, but the repeller electrode is inactive.

Dual operation in APCI mode:



When the source is configured for dual operation in APPI mode, the corona pin is inactive, and a voltage is applied to the repeller electrode.

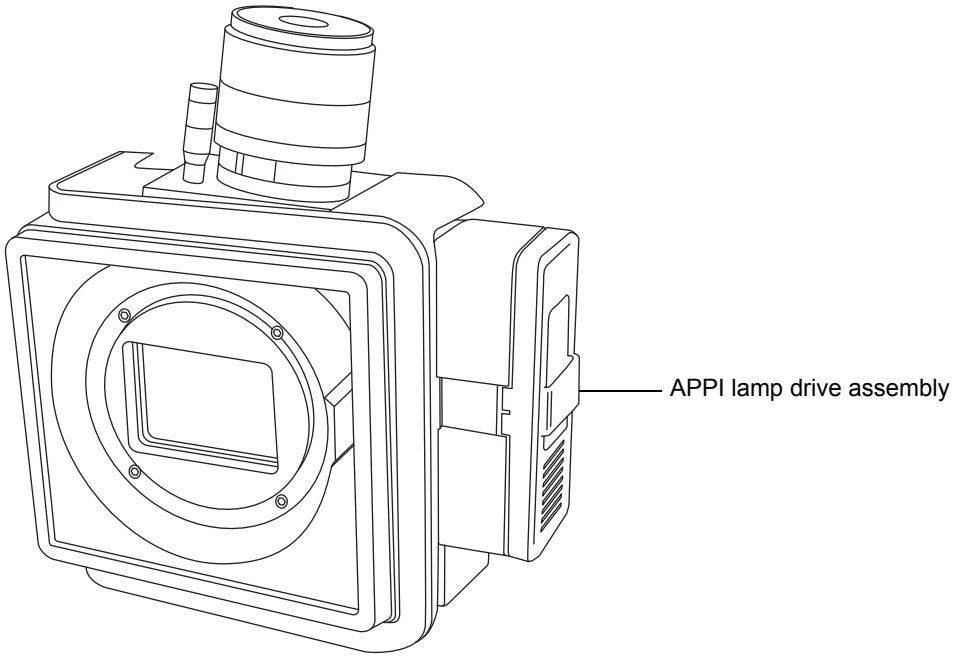
Dual operation in APPI mode:



The combined APPI/APCI source components

The combined APPI/APCI source comprises the standard IonSABRE II probe and a source enclosure with an APPI lamp drive incorporated.

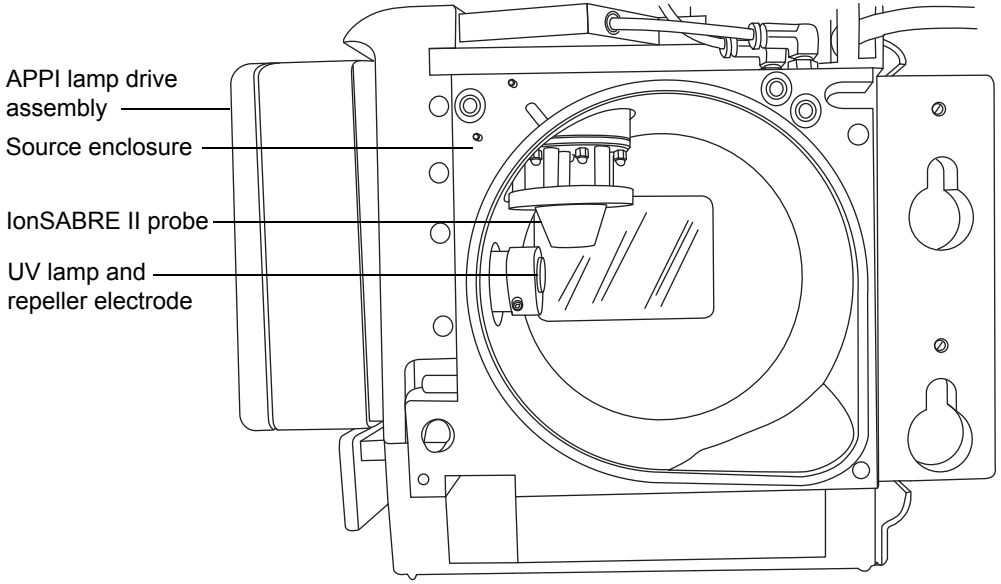
The combined APPI/APCI source enclosure:



Caution: To prevent damage to the corona pin and lamp assembly, ensure that the lamp assembly does not touch the corona pin when the source enclosure door is closed.

The UV lamp, which you ignite via a control in the MassLynx Tune window, provides a constant photon output. You vary the intensity of incident radiation upon the sample molecules by adjusting the distance between the UV lamp and probe tip.

APPI lamp drive assembly inside the source enclosure:



Installing the combined APPI/APCI source

Required material

Chemical-resistant, powder-free gloves

To install the combined APPI/APCI source:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).

Warning: The probe and source can be hot. To avoid burn injuries, take great care while working with these components.

2. Remove the probe from the currently installed source.
   - If you are removing an ESI probe, see page 3-4.
   - If you are removing an IonSABRE II probe, see page 3-8.
3. Remove the existing source enclosure (see page 4-8).
4. Install the combined APPI/APCI source enclosure (see page 4-11).
5. Install the corona pin (see page 4-12).
6. Connect the APPI drive cable to the instrument's front panel connector.
7. Connect the HT cable to the instrument's front panel connector.

Caution: To prevent damage to the corona pin and lamp assembly, ensure that the lamp assembly does not touch the corona pin when the source enclosure door is closed.

8. Install the IonSABRE II probe to the source, and ensure that it is working correctly (see page 3-6).

   Tip: An automatic pressure test runs each time you close the source enclosure and when the instrument starts.

Removing the IonSABRE II probe and APPI/APCI source enclosure

Required material

Chemical-resistant, powder-free gloves

To remove the combined APPI/APCI source:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).

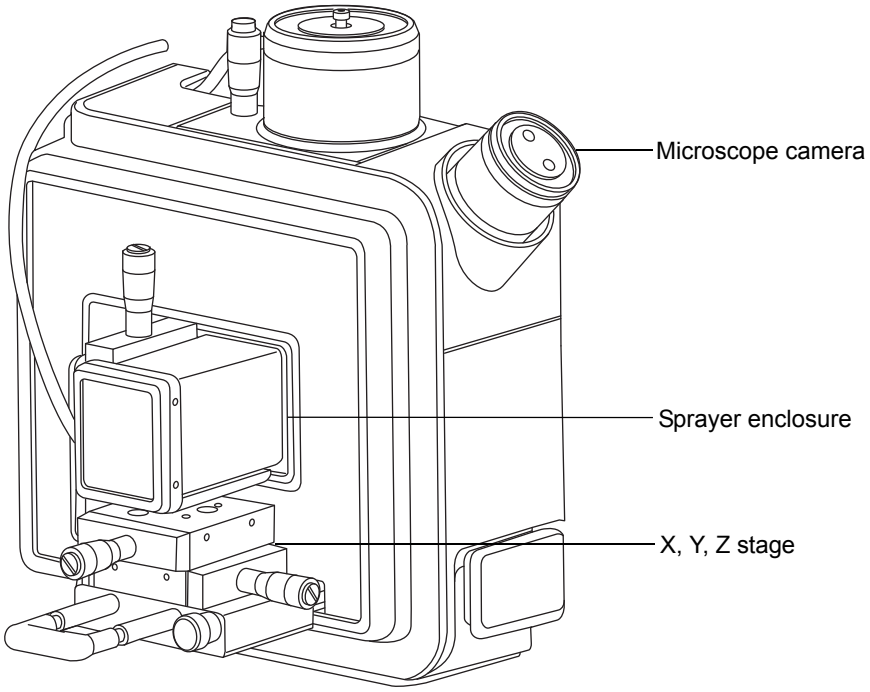
   Warning: The probe and source can be hot. To avoid burn injuries, take great care while working with these components.

2. Remove the IonSABRE II probe (see page 3-8).
3. Disconnect the HT cable from the instrument's front panel.
4. Disconnect the APPI drive cable from the instrument's front panel.
5. Remove the source enclosure (see page 4-8).
6. Remove the corona pin (see page 4-15).
7. Fit the blanking plug to the pin's mounting contact.

NanoFlow source

The NanoFlow source enclosure comprises the NanoFlow stage (for *x*-axis, *y*-axis, and *z*-axis adjustment), the sprayer-enclosure, and a microscope camera.

NanoFlow source, stage and microscope camera:



A sprayer is mounted on an X, Y, Z stage (three-axis manipulator) that slides on a pair of guide rails that allow its withdrawal from the source enclosure for maintenance and changes.

A light within the source provides illumination for the spray, which you can observe using the microscope camera mounted on the corner of the source housing.

The low flow rates involved with operating the NanoFlow source prohibit its use with the instrument's solvent delivery system.

Installing the NanoFlow source

Required material

Chemical-resistant, powder-free gloves

To install the NanoFlow source:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

Warning: The ion block, which can be hot, is exposed when you fit the NanoFlow source. To avoid burn injuries, ensure that the source heater is turned off and the block is cool before opening the source.

1. Prepare the instrument for working on the source (see page 4-7).

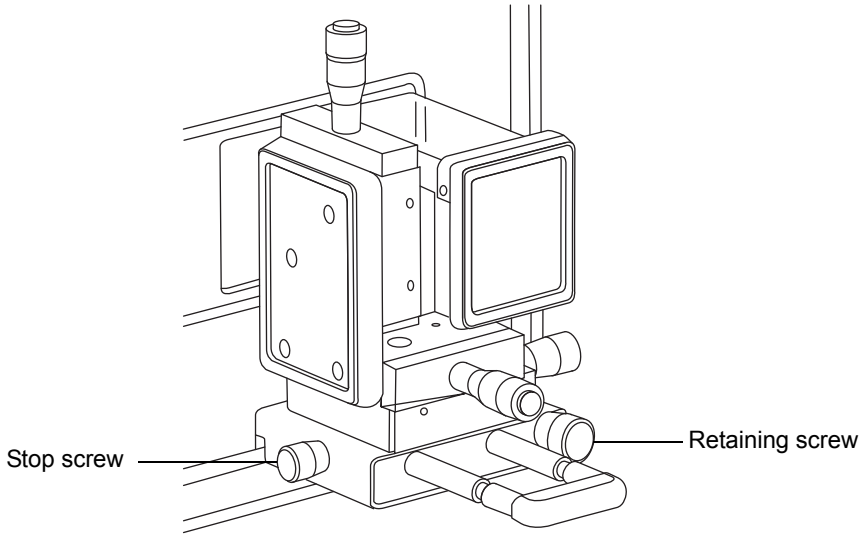
   

   Warning: The probe and source can be hot. To avoid burn injuries, take great care while working with these components.

2. Remove the probe from the currently installed source.
   - If you are removing an ESI probe, see page 3-4.
   - If you are removing an IonSABRE II probe, see page 3-8.
3. Remove the existing source enclosure (see page 4-8).

Caution: To prevent the sprayer from colliding with the cone and breaking, always retract the stage before installing the source enclosure or closing the door.

4. On the NanoFlow source, loosen the stage retaining screw, pull the stop screw, and slide the stage fully out of the enclosure.



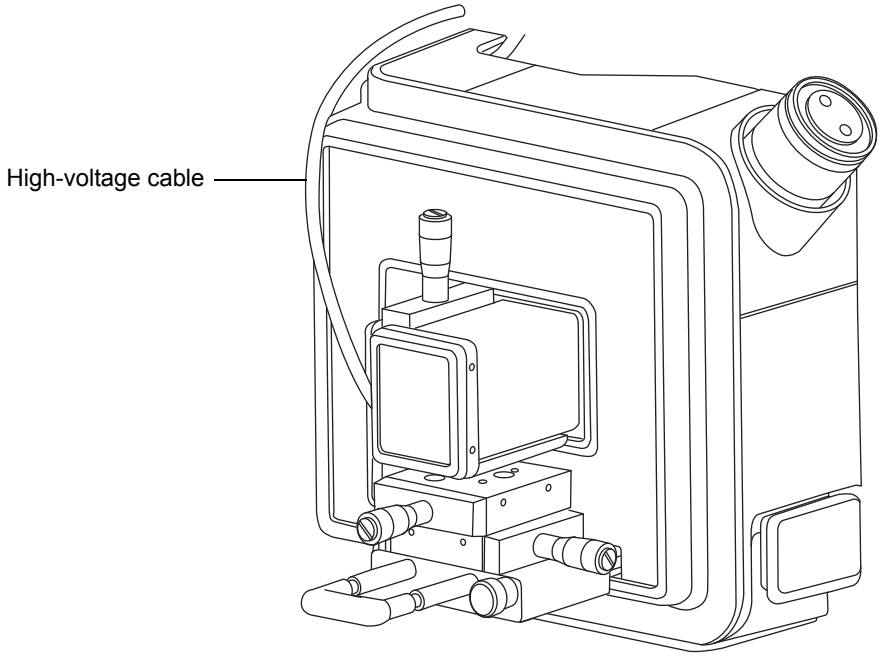
5. Using both hands, fit the NanoFlow source enclosure to the two supporting studs on the source adaptor housing.
6. Close the source enclosure door.
7. Connect a 1/16-inch PTFE tube between the mass-flow controller output (mounted beneath the stage on the front of the NanoFlow source) and your sprayer.

   Tip: For details regarding how to fit each sprayer, see the corresponding reference:

   - *Waters Universal NanoFlow Sprayer Installation and Maintenance Guide* (part number 71500110107)
   - "Fitting a borosilicate glass capillary (nanovial)" on page 3-19
   - *Capillary Electrophoresis/Capillary Electrochromatography Sprayer User's Guide* (part number 6666522)
8. Connect the probe cable to the high-voltage connector.

Caution: The NanoFlow stage contains a high-voltage interlock, so the capillary voltage (the voltage applied to the sprayer assembly) and the sampling cone voltage remain disabled until the sprayer is pushed fully forward in the source.

9. Connect the high-voltage cable to the instrument's HV connection.



10. Slide closed the instrument's source interface door.

Fitting a borosilicate glass capillary (nanovial)

Required materials

- Chemical-resistant, powder-free gloves
- Needle-nose pliers
- Borosilicate glass capillary
- Fused silica syringe needle or GELoader® tip
- Fused silica cutter

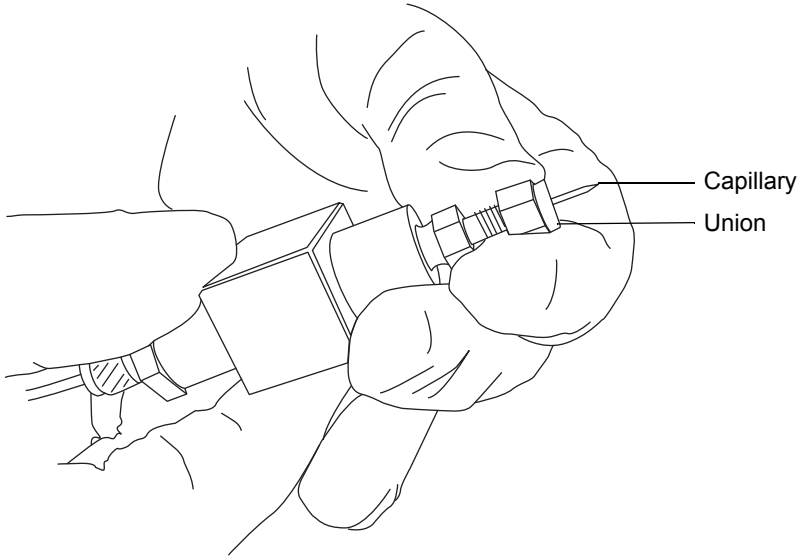
To fit a borosilicate glass capillary (nanovial):

Warning: To avoid lacerations, puncture injuries, and possible contamination with biohazardous and toxic samples, do not touch the sharp end of the capillary.

Caution: Capillaries are extremely fragile. Take great care when handling them. Always hold their blunt end, never the sharp end, which can easily be damaged.

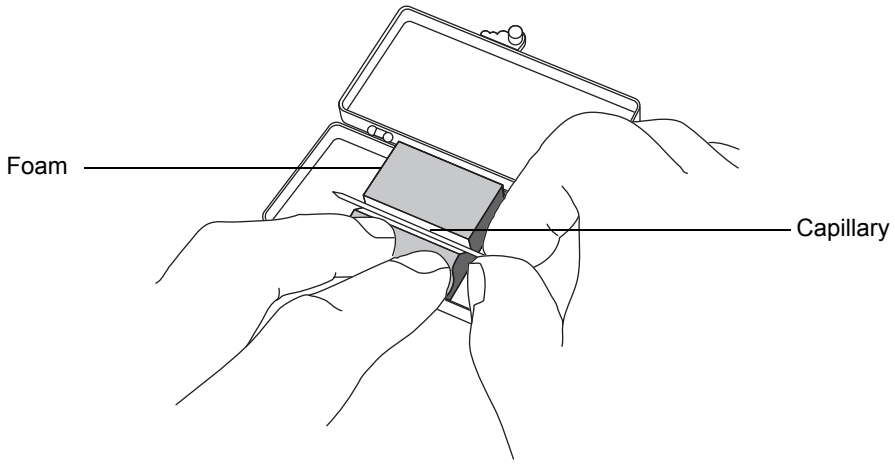
Warning: To avoid electric shock, ensure that the NanoFlow stage is fully retracted from the source before beginning this procedure.

1. Loosen the stage retaining screw.
2. Pull the stop screw to release the stage.
3. Slide the stage out of the NanoFlow source enclosure and remove the magnetic cover.
4. Unscrew the retaining screw, and lift the sprayer from the stage.
5. Unscrew the union from the end of the sprayer assembly.



6. Remove the existing capillary from the sprayer.

7. Carefully remove the new borosilicate glass capillary from its case by lifting vertically while pressing on the foam with two fingers.



8. Load sample into the capillary using a fused silica syringe needle or a GELoader tip, minimizing any bubbles between the capillary tip and the sample.

   Recommendation: When using a GELoader tip, break the glass capillary in half, scoring it with a fused silica cutter so that the GELoader can reach the capillary's tip.

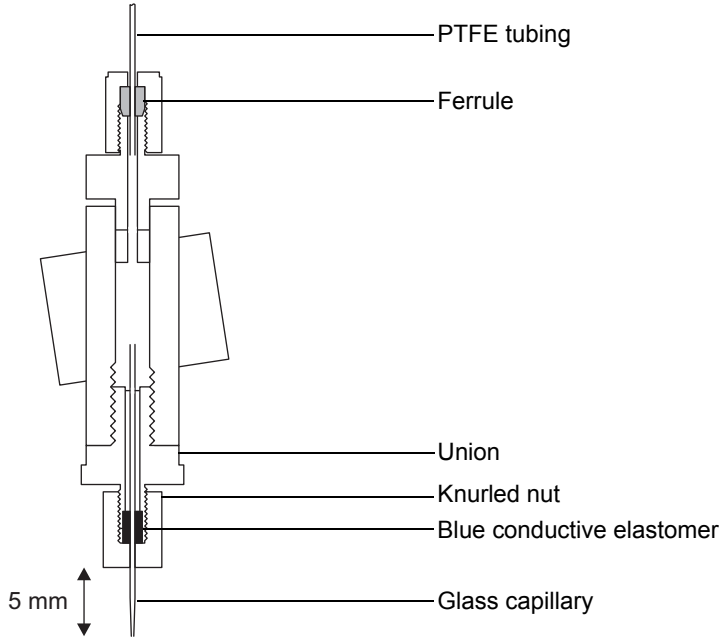
9. Thread the knurled nut and approximately 5 mm of conductive elastomer over the blunt end of the capillary

10. Fit the capillary into the holder (probe).

11. Finger-tighten the nut so that 5 mm of glass capillary protrude from its end.

    Tip: Measure the protrusion from the end of the nut to the shoulder of the glass capillary.

Sprayer assembly:



12. Screw the sprayer back into the assembly.
13. Replace the sprayer cover.
14. On the MassLynx MS Tune window, ensure that the Capillary parameter on the ES+/- Source tab is set to 0 kV.

Caution: To ensure that the capillary tip does not collide with the cone or the side of the source, adjust the sprayer tip position before you push the sprayer inside the NanoFlow source enclosure.

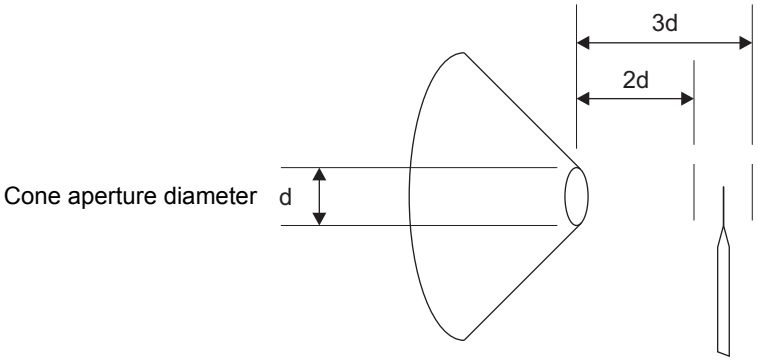
15. Carefully push the stage back into the NanoFlow source enclosure, using the stop and handle.

Positioning the borosilicate glass capillary tip

Having obtained a signal, you must adjust the tip position to maximize it. Using the three-axis manipulator, you can adjust the tip position up and down, left and right, forward and backward. As a starting point, set the tip so that it is on the center line of the sampling cone and at a distance between two

and three times the diameter of the cone aperture. Typically this distance is approximately 2 mm.

Capillary tip position:



For tuning instructions, see the MassLynx Xevo TQD online help topic, "Tuning manually for NanoFlow operation".

Restarting a stalled borosilicate glass capillary electrospray

Should the spray stop, you can restart it. To do so, in the Tune window, set Capillary to 0 kV. Then adjust the three-axis manipulator so that, viewed under magnification, the capillary tip touches the sample cone, and a small piece of the borosilicate glass capillary shears off.

If necessary, you can also apply some NanoFlow gas pressure, to force a drop of liquid from the capillary. Apply as much as 1.4 bar (20 psi). Doing so induces the drop's appearance unless the capillary is blocked.

4 Maintenance Procedures

This chapter provides the maintenance guidelines and procedures necessary to maintain the instrument's performance.

Keep to a maintenance schedule, and perform maintenance as required and described in this chapter.

Contents:

Contents:

Maintenance schedule

The following table lists periodic maintenance schedules that ensure optimum instrument performance.

The maintenance frequencies shown apply to instruments that normally receive moderate use.

Maintenance schedule:

Procedure	Frequency	For information...
Clean the instrument case.	As required.	See page 4-20.
Empty the exhaust trap bottle in the instrument exhaust line.	Check daily, empty as required.	See page 4-20.
Gas ballast the roughing pump.	ESI – weekly.	See page 4-22.
Inspect and adjust the roughing pump oil level.	Weekly.	See page 4-25.
Clean the source components.	When they are visibly fouled, the background or high-peak contaminants are unacceptably high, or sensitivity decreases to unacceptable levels.	See page 4-27.
Clean or replace the ESI probe tip.	When sensitivity decreases to unacceptable levels.	See page 4-95.
Replace the ESI probe capillary.	When sensitivity decreases to unacceptable levels or sample flow is inconsistent.	See page 4-69.

Maintenance schedule:

Procedure	Frequency	For information...
Clean the IonSABRE II probe tip. (Options using the IonSABRE II probe only.)	When sensitivity decreases to unacceptable levels or when significant chemical interference is present.	See page 4-77.
Replace the IonSABRE II probe capillary. (Options using the IonSABRE II probe only.)	When sensitivity decreases to unacceptable levels or sample flow is inconsistent.	See page 4-78.
Clean or replace the corona pin (APCI and ESCi modes).	When the corona pin is corroded or black, or the sensitivity decreases to unacceptable levels.	See page 4-84.
Replace the IonSABRE II probe heater. (Options using the IonSABRE II probe only.)	If the heater fails to heat when the instrument is pumped down (evacuated).	See page 4-85
Replace the ion block heater cartridge.	If the heater fails to heat when the instrument is pumped down (evacuated).	See page 4-87.
Replace the source assembly seals.	Annually.	See page 4-92.
Replace the instrument's air filters.	Annually.	See page 4-95.
Change the roughing pump oil.	Annually.	See page 4-97.

Maintenance schedule:

Procedure	Frequency	For information...
Replace the roughing pump's demister element.	Annually. **Tip:** Applications that contaminate the roughing pump oil reduce this period, which must be determined from experience.	See page 4-100.
Clean the APPI/APCI source UV lamp window.	When the window becomes visibly dirty or when the sensitivity decreases to unacceptable levels.	See page 4-107.
Change the APPI/APCI source UV lamp bulb.	When the bulb fails.	See page 4-106.
Replace the APPI lamp drive assembly O-rings.	Annually.	See page 4-108.

Spare parts

Replace only the parts mentioned in this document. For spare parts details, see the Waters Quality Parts Locator on the Waters Web site's Services/Support page.

Troubleshooting with Connections INSIGHT

Connections INSIGHT® is an "intelligent" device management (IDM) Web service that enables Waters to provide proactive service and support for the ACQUITY UPLC system. To use Connections INSIGHT, you must install its service agent software on your MassLynx workstation. In a client/server system, the service agent must also be installed on the computer from which you control the system. The service agent software automatically and securely captures and sends information about the support needs of your system directly to Waters.

If you encounter a performance issue when using the Instrument Console, you can manually submit a Connections INSIGHT request to Waters customer support. Alternatively, you can use Remote Desktop, a real-time collaboration option that controls the two-way connection with the ACQUITY UPLC system by enabling the Connections INSIGHT iAssist service level.

Consult these sources for more information about Connections INSIGHT and Connections INSIGHT iAssist:

- http://www.waters.com
- *Connections INSIGHT Installation Guide* (part number 715001399)
- *Connections INSIGHT User's Guide* (part number 715001400)
- Your sales representative
- Your local Waters subsidiary
- Waters Customer Support

To submit a Connections INSIGHT request:

1. Select Troubleshoot > Submit Connections INSIGHT request.
2. In the Connections INSIGHT Request dialog box, type your name, telephone number, e-mail address, and a description of the problem.
3. Click Submit, and allow approximately 5 minutes to save the service profile.

   Result: A .zip file containing your Connections INSIGHT profile is forwarded to Waters customer support for review.

   Note: Saving a service profile or plot file from the Instrument Console can require as much as 150 MB of file space.

Safety and handling

Bear in mind the following safety considerations when performing maintenance procedures:

Warning: The instrument components can be contaminated with biologically hazardous or toxic materials. Always wear chemical-resistant, powder-free gloves while handling the components.

Warning: To prevent injury, always observe Good Laboratory Practice when handling solvents, changing tubing, or operating the instrument. Know the physical and chemical properties of the solvents used (see the Material Safety Data Sheets for the solvents in use).

Warning: To avoid electric shock,

- do not remove the instrument's panels. There are no user-serviceable parts inside the instrument.
- ensure that the instrument is in Standby mode before commencing any maintenance.

Warning: The probe and source can be hot. To avoid burn injuries, take great care while working with these components.

Caution: When performing maintenance inside the source enclosure, ensure that the following criteria are met:

- Instrument is in Standby mode.
- LC flow is diverted to waste or set to Off.
- Desolvation gas is turned off.

See Appendix A for safety advisory information.

Preparing the instrument for working on the source

For safety reasons, you must follow this procedure before working on the source (for example, when changing the probe, operating the source isolation valve, and when maintaining the source).

To prepare the instrument for working on the source:

1. In the Instrument Console, click Stop Flow  to stop the LC flow or, if column flow is required, divert the LC flow to waste as follows:
   a. In the Instrument Console system tree, expand Xevo TQD, Interactive Fluidics.
   b. Click Control  .
   c. Select Waste as the flow state.
2. In the Instrument Console, click Standby  , and confirm that the Operate indicator is not illuminated.
3. Wait 3 minutes to allow the desolvation gas flow to cool the probe and source.
4. In the Instrument Console, click API  to stop the desolvation gas flow.
5. Lift the visor on the front of the instrument so that it is clear of all the source components and probe.

Removing and refitting the source enclosure

The optional combined APPI/APCI and NanoFlow sources are supplied as a complete source enclosure. To fit them, you must first remove the standard source enclosure.

Removing the source enclosure from the instrument

Required material

Chemical-resistant, powder-free gloves

To remove the source enclosure:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).

   Warning: The probe and source can be hot. To avoid burn injuries, take great care while working with these components.

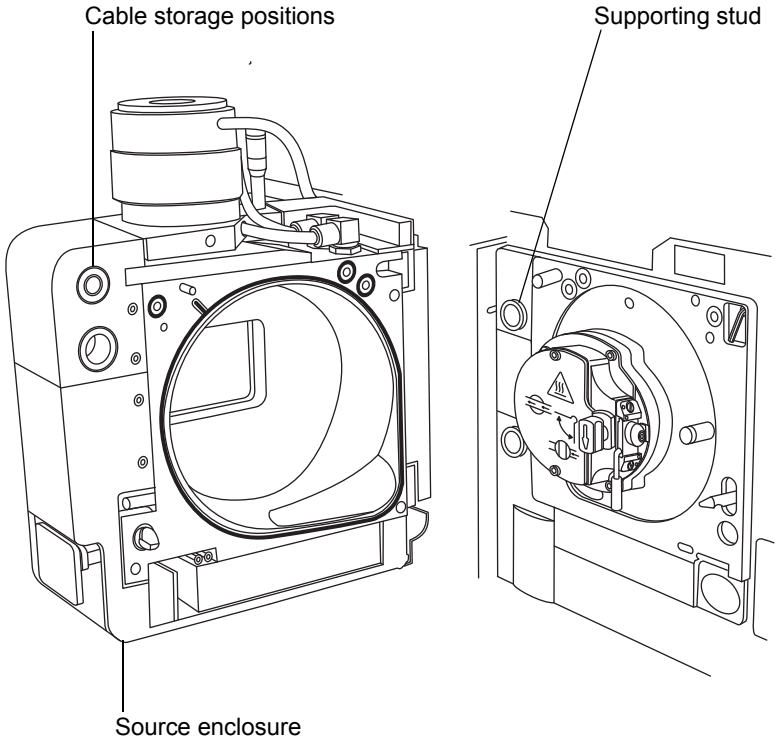
2. Remove the probe from the source.
   - If you are removing an ESI probe, see page 3-4.
   - If you are removing an IonSABRE II probe, see page 3-8.
3. Disconnect the probe adjuster and options cables from the instrument's connectors.

   Warning: The corona pin tip is sharp. To avoid puncture wounds, take great care while working with the source enclosure open if a corona pin is fitted.

4. Pull the source enclosure release (located at the bottom, right-hand side) outward, and swing open the enclosure.

5. Using both hands, grasp the source enclosure and lift it vertically off the two supporting studs on the source adaptor housing.



6. Store the cables neatly by plugging them into the cable-storage positions on the rear of the source enclosure.

Fitting the source enclosure to the instrument

Required material

Chemical-resistant, powder-free gloves

To fit the source enclosure:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid puncture wounds, take great care while fitting the source enclosure to the source if a corona pin is fitted (the pin tip is sharp).

1. Using both hands, fit the source enclosure to the two supporting studs on the source adaptor housing.

Caution: For the NanoFlow source, to prevent the sprayer from colliding with the cone and breaking, always retract the stage before closing the source enclosure door.

2. Close the source enclosure.
3. Connect the probe adjuster and options cables to the instrument's connectors.

Installing and removing the corona pin

For ESCi, APCI, and dual-mode APCI/APPI operation, you must fit a corona pin.

Installing the corona pin in the source

Required material

Chemical-resistant, powder-free gloves

To install the corona pin in the source:

Warning: The LC system connections, ESI probe, and source can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).

   Warning: The source can be hot. To avoid burn injuries, take great care while working with the source enclosure open.

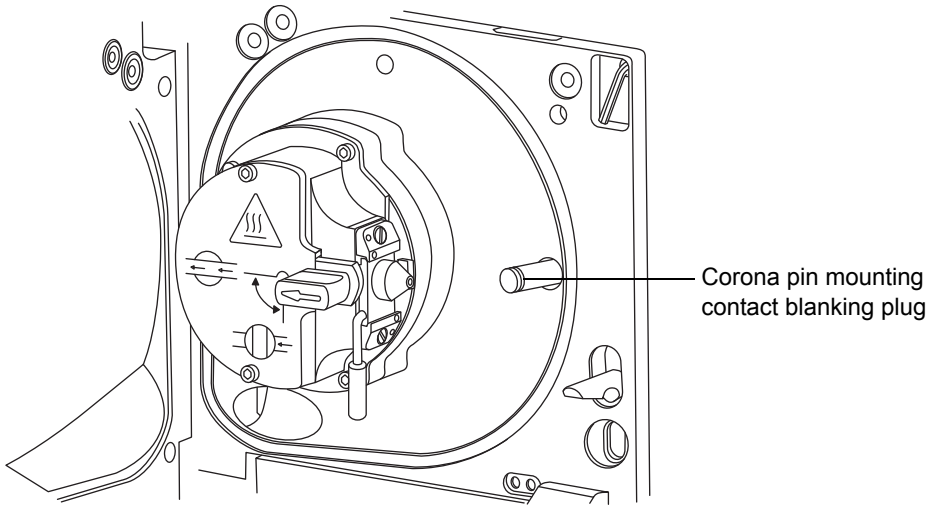
   

   Warning: The ESI probe tip is sharp. To avoid puncture wounds, take great care while working with the source enclosure open if an ESI probe is fitted.

2. Pull the source enclosure release (located at the bottom, right-hand side) outward, and swing open the enclosure.
3. Remove the blanking plug from the corona pin mounting contact.

   Tip: Store the blanking plug in a safe location.

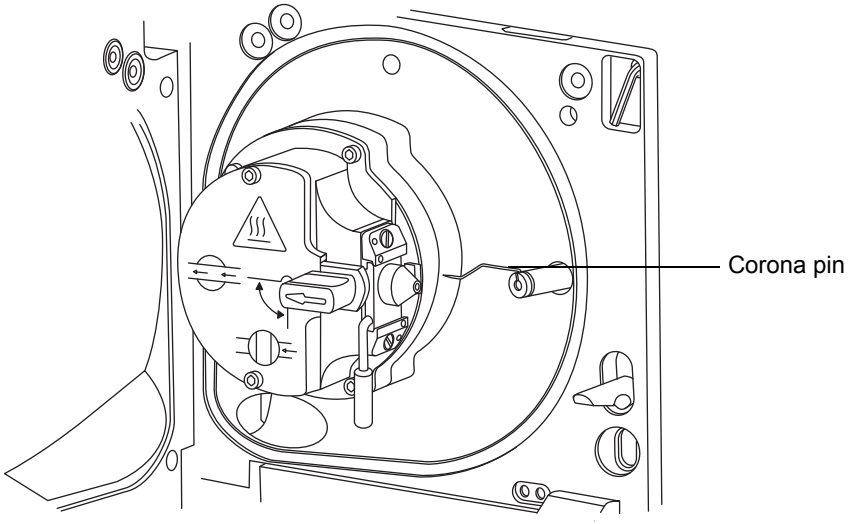
Corona pin mounting contact:



Warning: The corona pin tip is sharp. To avoid puncture wounds, handle it with care.

4. Fit the corona pin to the mounting contact, ensuring that the corona pin is securely mounted.

Corona pin:



5. Close the source enclosure.
6. Look through the source window, and use the vernier probe adjuster to position the probe tip so that it is pointing approximately midway between the tips of the sample cone and corona pin.

Removing the corona pin from the source

Required material

Chemical-resistant, powder-free gloves

To remove the corona pin from the source:

Warning: The LC system connections, ESI probe, and source can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).

   Warning: The source can be hot. To avoid burn injuries, take great care while working with the instrument's source enclosure open.

   Warning: The ESI probe tip is sharp. To avoid puncture wounds, take great care while working with the source enclosure open if an ESI probe is fitted.

2. Pull the source enclosure release (located at the bottom, right-hand side) outward, and swing open the enclosure.
3. Remove the corona pin from its mounting contact (see the figure on page 4-14).

   Tip: Store the corona pin in a safe location.
4. Fit the blanking plug to the corona pin mounting contact (see the figure on page 4-13).
5. Close the source enclosure.

Operating the source isolation valve

You must close the source isolation valve to isolate the source from the instrument vacuum system for certain maintenance procedures.

Required material

Chemical-resistant, powder-free gloves

To close the source isolation valve before starting a maintenance procedure:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is prepared for working on the source before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).

   Warning: The source can be hot. To avoid burn injuries, take great care while working with the instrument's source enclosure open.

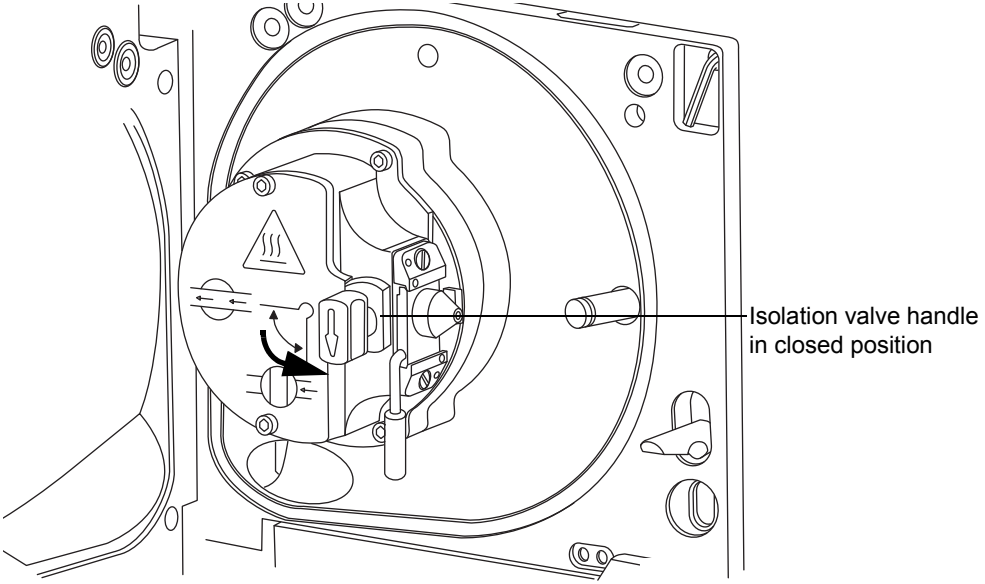
   

   Warning: To avoid puncture wounds, take great care while working with the source enclosure open if one or both of these conditions apply:

   - An ESI probe is fitted (the probe tip is sharp).
   - A corona pin is fitted (the pin tip is sharp).

2. Pull the source enclosure release (located at the bottom, right-hand side) outward, and swing open the enclosure.

3. Close the source isolation valve by moving its handle counterclockwise, to the vertical position.



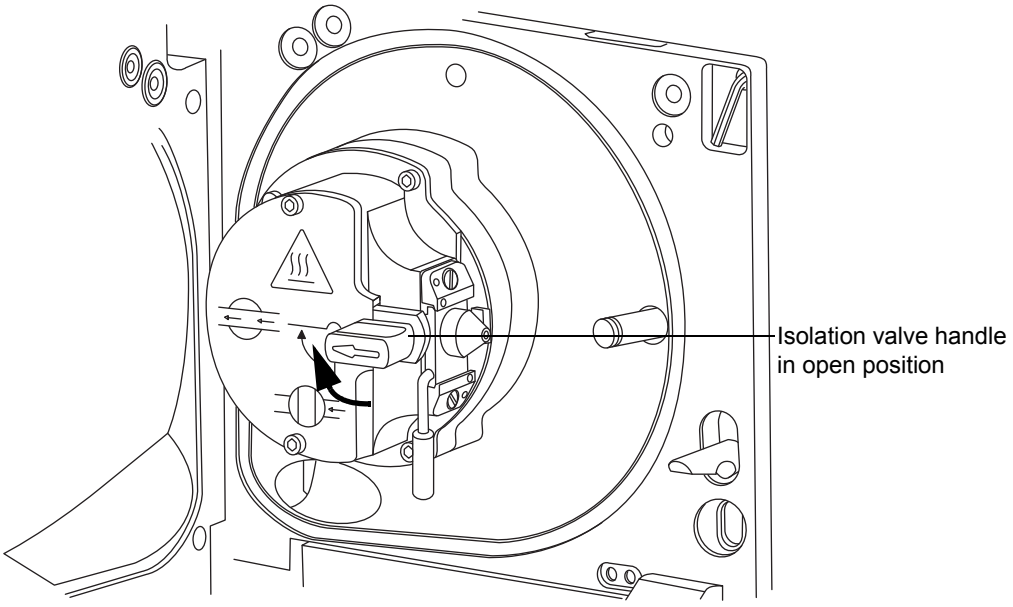
To open the source isolation valve after completing a maintenance procedure:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid puncture wounds, take great care while working with the source enclosure open if one or both of these conditions apply:

- An ESI probe is fitted (the probe tip is sharp).
- A corona pin is fitted (the pin tip is sharp).

1. Open the source isolation valve by moving its handle clockwise to the horizontal position.

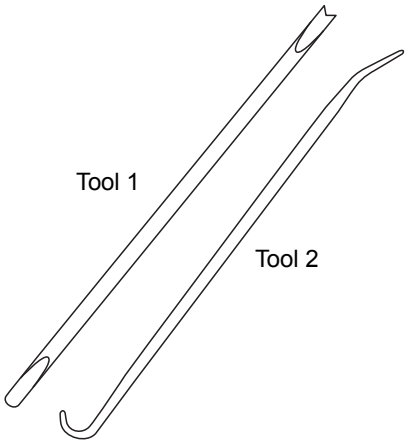


2. Close the source enclosure.

Removing O-rings and seals

When performing certain maintenance procedures, you must remove O-rings or seals from instrument components. An O-ring removal kit can be purchased separately.

O-ring removal kit:



To remove an O-ring:

Caution: When removing an O-ring or seal from a component, be careful not to scratch the component with either removal tool.

1. Use the forked end of tool 1 to impale the O-ring or seal.
2. Pull the O-ring or seal from its groove; if necessary, use tool 2 as an aid.

   Warning: The O-ring or seal can be contaminated with biohazardous and/or toxic materials. Dispose of it according to local environmental regulations.

3. Dispose of the O-ring or seal in accordance with local environmental regulations.

Cleaning the instrument case

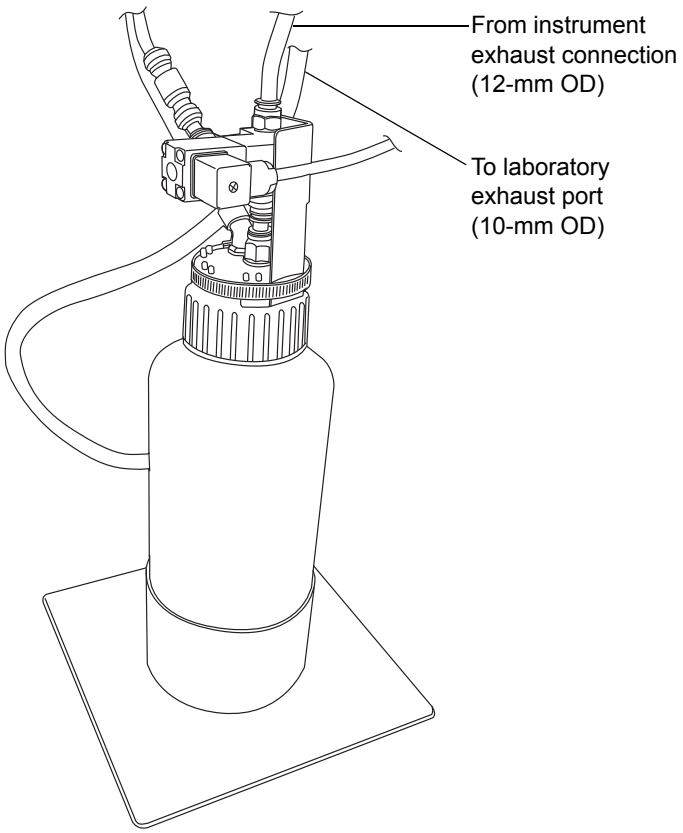
Caution: Do not use abrasives or solvents to clean the instrument's case.

Use a soft cloth, dampened with water, to clean the outside surfaces of the instrument.

Emptying the exhaust trap bottle

Inspect the exhaust trap bottle in the instrument's exhaust line daily, and empty it before it is more than 10% full.

Nitrogen exhaust trap bottle:



Required material

Chemical-resistant, powder-free gloves

To empty the nitrogen exhaust trap bottle:

1. In the Instrument Console, click Stop Flow  to stop the LC flow.
2. Pull the source enclosure release (located at the bottom, right-hand side) outward, and swing open the enclosure.

   Warning: The waste liquid in the nitrogen exhaust trap bottle comprises ACQUITY UPLC solvents and analytes, which can be biohazardous or toxic. Always wear chemical-resistant, powder-free gloves while handling the nitrogen exhaust trap bottle.

3. Unscrew and remove the nitrogen exhaust trap bottle from the cap and associated fittings.

   Warning: The waste liquid can be contaminated with biohazardous and/or toxic materials. Dispose of it according to local environmental regulations.

4. Dispose of the waste liquid in accordance with local environmental regulations.
5. Fit and fully tighten the nitrogen exhaust trap bottle to the cap.
6. Secure the nitrogen exhaust trap bottle in the upright position.
7. Close the source enclosure.

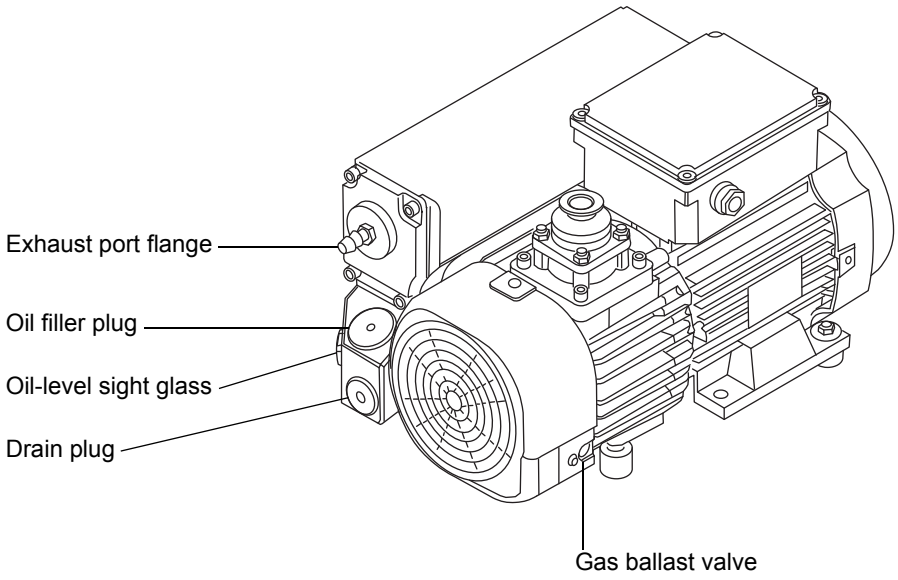
   Tip: A leak test runs automatically. If the test results in a failure, ensure that the nitrogen exhaust trap bottle is fully tightened to the cap.

8. In the Instrument Console, click Start Flow  to start the LC flow.

Gas ballasting the roughing pump

Note: This procedure is not required for an oil-free roughing pump.

Roughing pump:



Caution: Failure to routinely gas ballast the roughing pump shortens oil life and, consequently, pump life.

The roughing pump draws large quantities of solvent vapors. The vapors tend to condense in the pump oil, diminishing pumping efficiency. Gas ballasting purges condensed contaminants from the oil.

Gas ballast the roughing pump when these conditions apply:

- With ESI operation, once a week.
- When the roughing pump oil appears cloudy.
- When the vacuum pressure is higher than normal.
- When condensate forms in the roughing pump exhaust line.
- When you change the roughing pump oil.

The roughing pump can be fitted with either of the following:

- A screwdriver-operated gas ballast valve. See page 4-23.
- A handle-operated gas ballast valve. See page 4-24.

Gas ballasting a pump with a screwdriver-operated gas ballast valve

Required material

Flat-blade screwdriver

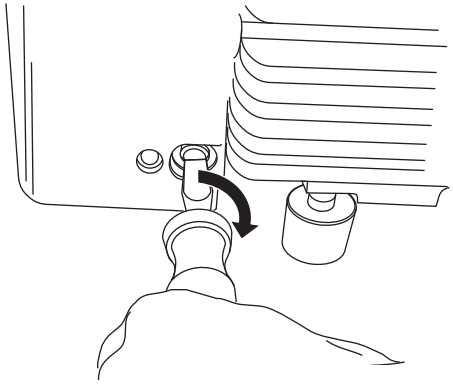
To gas ballast the roughing pump:

Warning: To avoid burn injuries, take great care while working with the roughing pump; it can be hot.

Caution: To avoid damage, follow these guidelines:

- Do not vent the instrument when the roughing pump is gas ballasting.
- Do not gas ballast the roughing pump while the instrument is in Operate mode.
- Avoid gas ballasting the roughing pump for more than 2 hours.

1. Use the flat-blade screwdriver to turn the gas ballast valve on the pump a quarter-turn to the open, ⏀, position.



2. Run the pump for 30 to 60 minutes.

   Tip: The roughing pump temperature usually increases during ballasting. To maintain an ambient temperature of <40 °C (104 °F) where the pump is located, ensure adequate ventilation.

3. Use the flat-blade screwdriver to turn the gas ballast valve to the closed, ⊖, position.

Gas ballasting a pump with a handle-operated gas ballast valve

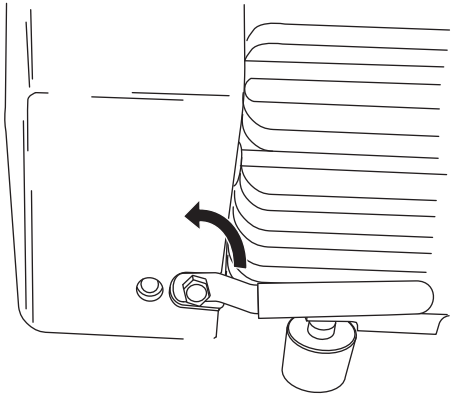
To gas ballast the roughing pump:

Warning: To avoid burn injuries, take great care while working with the roughing pump; it can be hot.

Caution: To avoid damage, follow these guidelines:

- do not vent the instrument when the roughing pump is gas ballasting.
- do not gas ballast the roughing pump while the instrument is in Operate mode.
- avoid gas ballasting the roughing pump for more than 2 hours.

1. Move the gas ballast valve handle on the pump counterclockwise from the horizontal position to the vertical position.



2. Run the pump for 30 to 60 minutes.

   Tip: It is normal for the roughing pump temperature to increase during ballasting. To maintain an ambient temperature of <40 °C (104 °F) where the pump is located, ensure there is adequate ventilation.

3. Move the gas ballast valve handle on the pump clockwise from the vertical position to the horizontal position.

Checking the roughing pump oil level

Caution: To ensure correct operation of the roughing pump, do not operate it with the oil level at less than 30% of the maximum level, as indicated in the pump's sight glass.

Note: This procedure is not required for an Edwards oil-free roughing pump.

Requirement: You must check the oil level while the roughing pump is running.

The roughing pump oil level appears in the roughing pump's oil level sight glass. Check the oil level weekly; you must maintain the oil level at or near the indicated maximum level when the pump is not operating.

Tip: The oil level in the sight glass is lower when the roughing pump is running than when it is stopped. When the pump is running, the oil level is typically at 30% to 60% of the maximum level.

Adding oil to the roughing pump

If the roughing pump's oil level is low, you must add oil to the pump.

Required materials

- Chemical-resistant, powder-free gloves
- 8-mm Allen wrench
- Container to catch used oil
- Funnel
- Anderol vacuum oil, type GS 495

To add oil to the roughing pump:

1. Vent and shut down the mass spectrometer (see the instrument's online Help for details).

   Warning: The pump oil can be contaminated with analyte accumulated during normal operation. To avoid contamination by biohazardous or toxic materials, always wear chemical-resistant, powder-free gloves when adding or replacing oil.

   Warning: To avoid burn injuries, take great care while working with the roughing pump; it can be hot.

2. Use the 8-mm Allen wrench to unscrew and remove the roughing pump's oil filler plug (see the figure on page 4-22).

   Caution: To maintain pump performance, use only Anderol vacuum oil, type GS 495.

3. Using the funnel, add Anderol vacuum oil, type GS 495, into the oil filler aperture until the oil reaches the oil level sight glass MAX level.

4. Ensure that the O-ring on the oil filler plug is clean and properly seated.

   Caution: To avoid oil leakage, when fitting the oil filler plug to the roughing pump,

   - ensure that the plug is not cross-threaded.
   - ensure that the O-ring is not pinched.
   - do not over tighten the plug.

5. Use the 8-mm Allen wrench to fit and tighten the roughing pump's oil filler plug.

   Tip: When the oil filler plug is tightened, the plug seals with an O-ring. Compression is controlled by the O-ring groove depth in the plug. Over tightening does not improve the plug seal; it only makes the plug difficult to remove later.

   Tip: After you add oil to the pump, the following situations can occur:

   - The oil level drops slightly during the first month of operation.

- The oil changes color (darkens) over time.
- After running the pump for 12 to 48 hours, it is common to see a few drops of oil near the filler plug. Excess oil around the lip of the filler plug will run down and drip off the pump once the pump reaches operating temperature.
- When the pump begins to run at normal operating temperature, spilled oil smells slightly.

Cleaning the source components

Clean the sample cone and cone gas nozzle when these conditions apply:

- The sample cone and cone gas nozzle are visibly fouled.
- You dismissed LC and sample-related causes for decreased signal intensity.

See page 4-28.

If cleaning the sample cone and cone gas nozzles fails to increase signal sensitivity, also clean the extraction cone. See page 4-37.

If cleaning the extraction cone fails to increase signal sensitivity, clean the ion block and isolation valve. See page 4-44.

If cleaning the ion block and isolation valve fails to increase signal sensitivity, also clean the ion guide assembly. See page 4-55.

Cleaning the sampling cone assembly

You can remove the sampling cone assembly (the sample cone, O-ring, and cone gas nozzle) for cleaning without venting the instrument.

Removing the sampling cone assembly from the source

Required material

Chemical-resistant, powder-free gloves

To remove the sampling cone assembly from the source

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is in Standby mode before commencing this procedure.

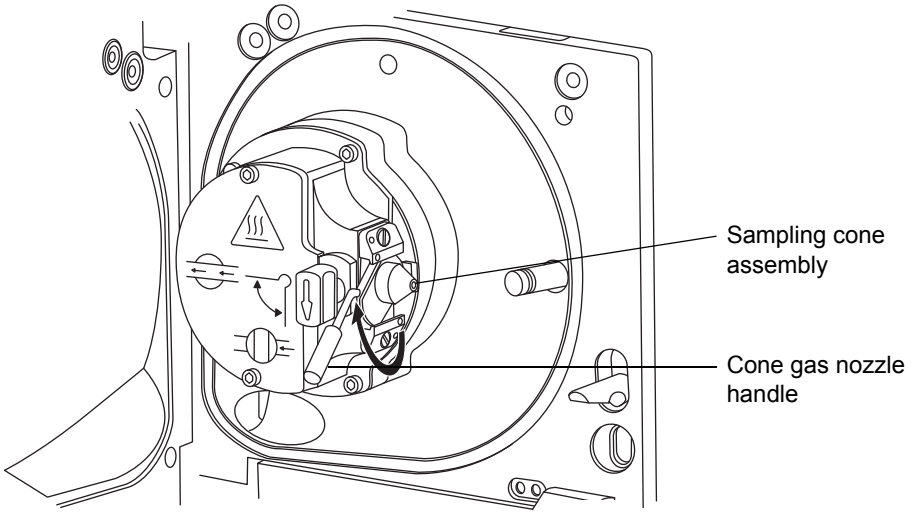
Warning: To avoid puncture wounds, take great care while working with the source enclosure open if one or both of these conditions apply:

- An ESI probe is fitted (the probe tip is sharp).
- A corona pin is fitted (the pin tip is sharp).

Warning: The source can be hot. To avoid burn injuries, take great care while working with the source enclosure open.

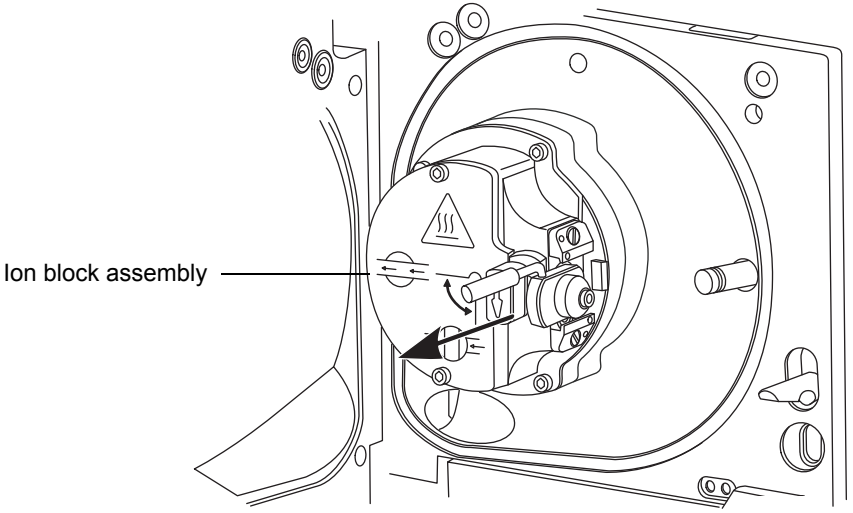
1. Close the source isolation valve (see page 4-16).

2. Grasp the cone gas nozzle handle, and use it to rotate the sampling cone assembly 90 degrees, moving the handle from the vertical to the horizontal position.



Caution: Do not open the isolation valve if the sampling cone assembly is not attached to the ion block assembly.

3. Slide the sampling cone assembly out of the ion block assembly.



Disassembling the sampling cone assembly

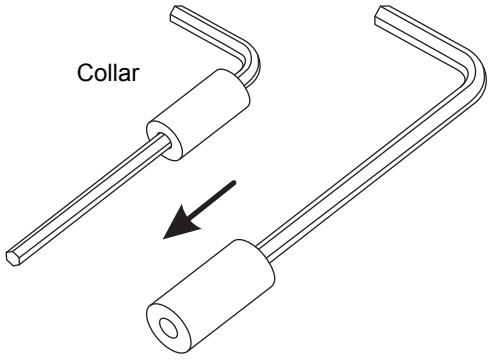
Required material

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool

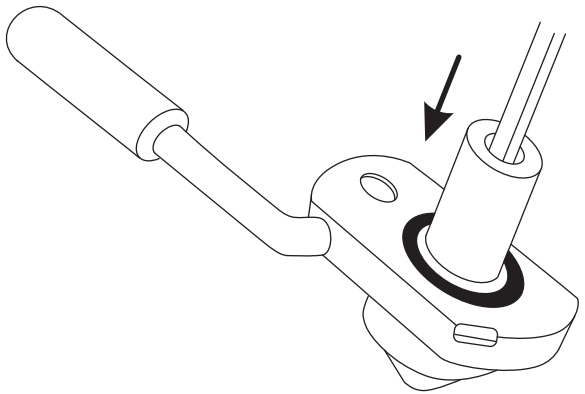
To disassemble the sampling cone assembly

Warning: The sampling cone assembly can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Slide the collar to the end of the combined 2.5-mm Allen wrench and cone extraction tool.

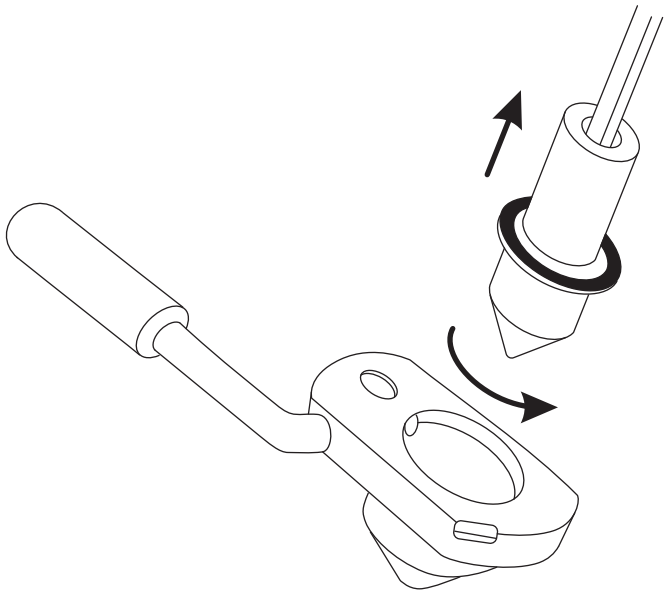


2. Insert the collar in the sample cone.

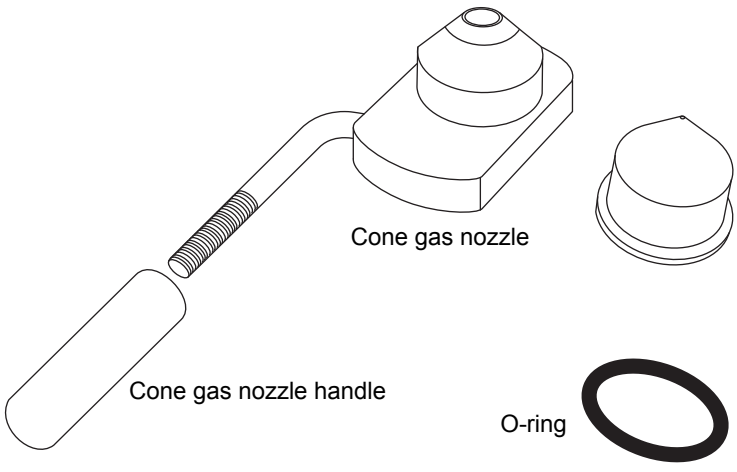


Caution: The sample cone is fragile. Never place it on its tip; always place it on its flanged base.

3. Rotate the tool and collar counter-clockwise and then lift them to remove the sample cone from the cone gas nozzle.



4. Remove the O-ring from the sample cone.



Warning: The O-ring can be contaminated with biohazardous and/or toxic materials. Dispose of it according to local environmental regulations.

5. If the O-ring shows signs of deterioration or damage, dispose of it in accordance with local environmental regulations.
6. Unscrew and remove the PEEK cone gas nozzle handle from the cone gas nozzle.

Cleaning the sample cone and cone gas nozzle

Required materials

- Chemical-resistant, powder-free gloves.
- Appropriately sized glass vessels in which to completely immerse components when cleaning. Use only glassware not previously cleaned with surfactants.
- HPLC-grade (or better) methanol.
- HPLC-grade (or better) water.
- Formic acid.
- Ultrasonic bath.
- Source of oil-free, inert gas (nitrogen or argon) for drying (air-drying optional).
- Wash bottle containing HPLC-grade (or better) 1:1 methanol/water.
- Large beaker.

To clean the sample cone and cone gas nozzle

Warning: The sample cone and cone gas nozzle can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: Formic acid is extremely corrosive and toxic. Work with extreme care, use a fume hood and suitable protective equipment.

Caution: The sample cone is fragile. Never place it on its tip; always place it on its flanged base.

1. If the sample cone contains debris, place a drop of formic acid on its aperture.
2. Immerse the sample cone, cone gas nozzle, and cone gas nozzle handle in separate glass vessels containing 1:1 methanol/water.

   Tip: If the components are obviously contaminated, use 45:45:10 methanol/water/formic acid.
3. Place the vessels in the ultrasonic bath for 30 minutes.
4. If you used formic acid in the cleaning solution, do as follows:

   a. Rinse the components by immersing them in separate glass vessels containing water and then place the vessels in the ultrasonic bath for 20 minutes.

   b. Remove any residual water from the extraction cone by immersing it in a glass vessel containing methanol and then place the vessel in the ultrasonic bath for 10 minutes.

   Caution: To avoid recontaminating the components, wear clean, chemical-resistant, powder-free gloves for the rest of this procedure.
5. Carefully remove the components from the vessels, and blow-dry them with inert, oil-free gas.

6. Inspect each component for persisting contamination. If contamination is present, do as follows:
    a. Use the wash bottle containing 1:1 methanol/water to rinse the component over the large beaker.
    b. Blow-dry the component with inert, oil-free gas.
7. Inspect each component for persisting contamination. If contamination is present, dispose of the component, and obtain a new one before reassembling the sampling cone assembly.

Assembling the sampling cone assembly

Required material

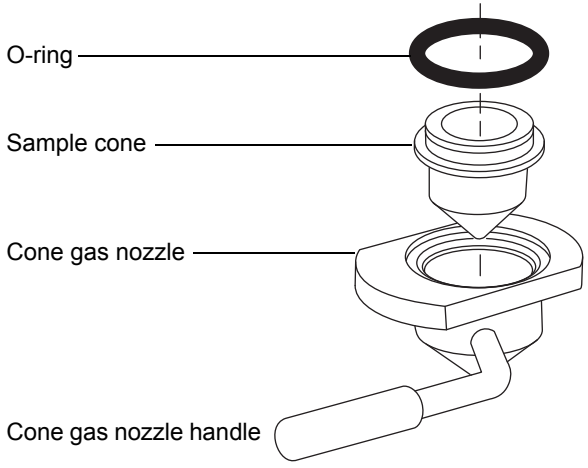
Clean, chemical-resistant, powder-free gloves

To assemble the sampling cone assembly

Caution:

- To avoid recontaminating the sampling cone assembly, wear clean chemical-resistant, powder-free gloves during this procedure.
- The sample cone is fragile. Never place it on its tip; always place it on its flanged base.

1. Fit the cone gas nozzle handle to the cone gas nozzle and turn the handle clockwise to tighten.



2. Carefully fit the sample cone into the cone gas nozzle.
3. Fit the O-ring into the groove created between the sample cone and cone gas nozzle. (Fit a new O-ring if the old one has been disposed of.)

Fitting the sampling cone assembly to the source

Required material

Chemical-resistant, powder-free gloves

To fit the sampling cone assembly to the source

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

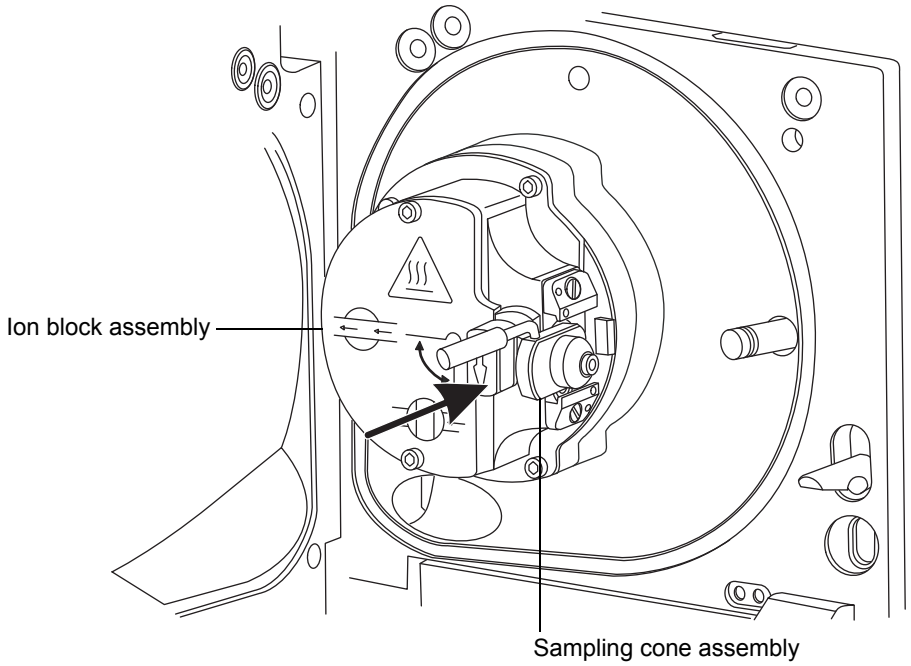
Warning: To avoid puncture wounds, take great care while working with the source enclosure open if one or both of these conditions apply:

- An ESI probe is fitted (the probe tip is sharp).
- A corona pin is fitted (the pin tip is sharp).

Caution: To avoid damage, do not open the source isolation valve before fitting the sampling cone assembly to the ion block assembly.

1. Ensure that the source isolation valve is in the closed position (see page 4-16).

2. Hold the sampling cone assembly so that the cone gas nozzle handle is oriented horizontally and at the top, and then slide the sampling cone assembly into the ion block assembly.



3. Grasp the cone gas nozzle handle and use it to rotate the sampling cone assembly 90 degrees, moving the handle downward from the horizontal to the vertical position.
4. Open the source isolation valve (see page 4-18).
5. Close the source enclosure.

Cleaning the extraction cone

Clean the ion block and extraction cone when cleaning the sample cone and cone gas nozzle fails to increase signal sensitivity. You must remove the ion block assembly from the source assembly to clean the extraction cone.

Removing the ion block assembly from the source assembly

Required materials

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool

To remove the ion block assembly

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Vent and shut down the mass spectrometer (see the mass spectrometer's online Help for details).

   Warning: The source can be hot. To avoid burn injuries, allow it to cool for at least 30 minutes before proceeding.

   Warning: To avoid puncture wounds, take great care while working with the source enclosure open, because the ESI probe tip is sharp.

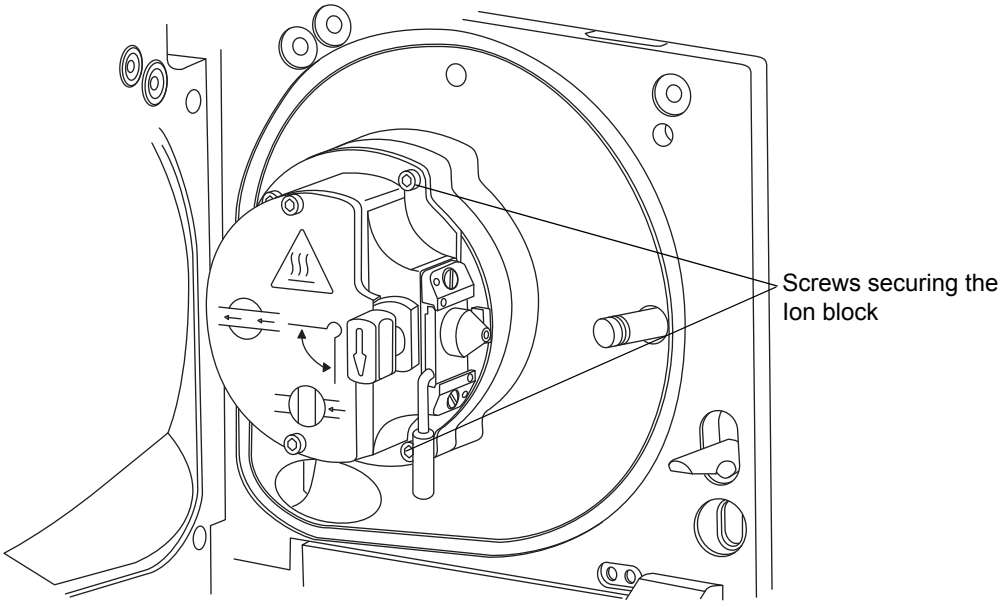
   

   Warning: To avoid puncture wounds, take great care while working with the source enclosure open if one or both of these conditions apply:

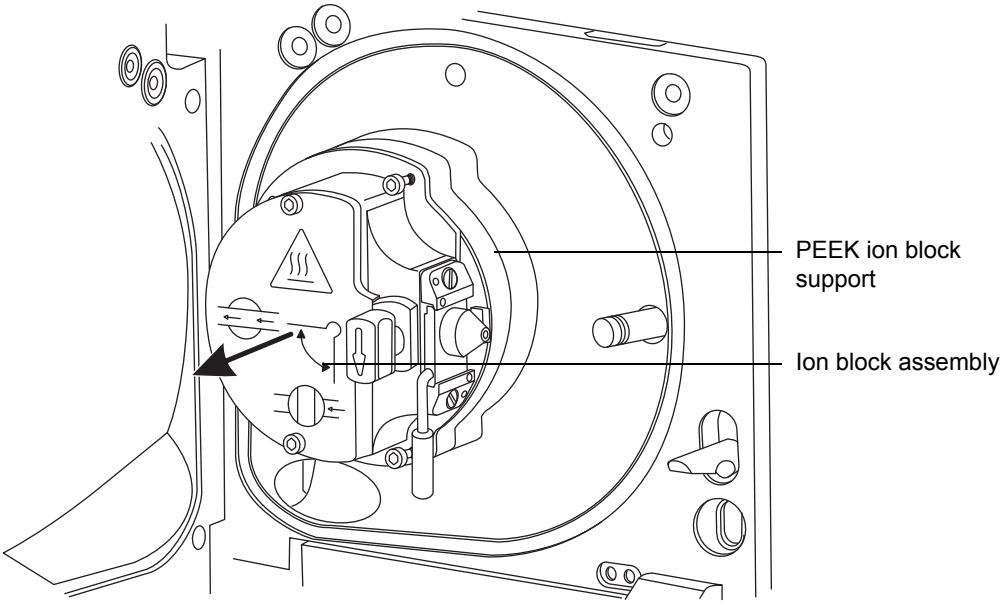
   - An ESI probe is fitted (the probe tip is sharp).
   - A corona pin is fitted (the pin tip is sharp).

2. Close the source isolation valve (see page 4-16).

3. Use the combined 2.5-mm Allen wrench and cone extraction tool to unscrew the 4 captive screws that secure the ion block assembly.



4. Remove the ion block assembly from the PEEK ion block support.



Removing the extraction cone from the ion block

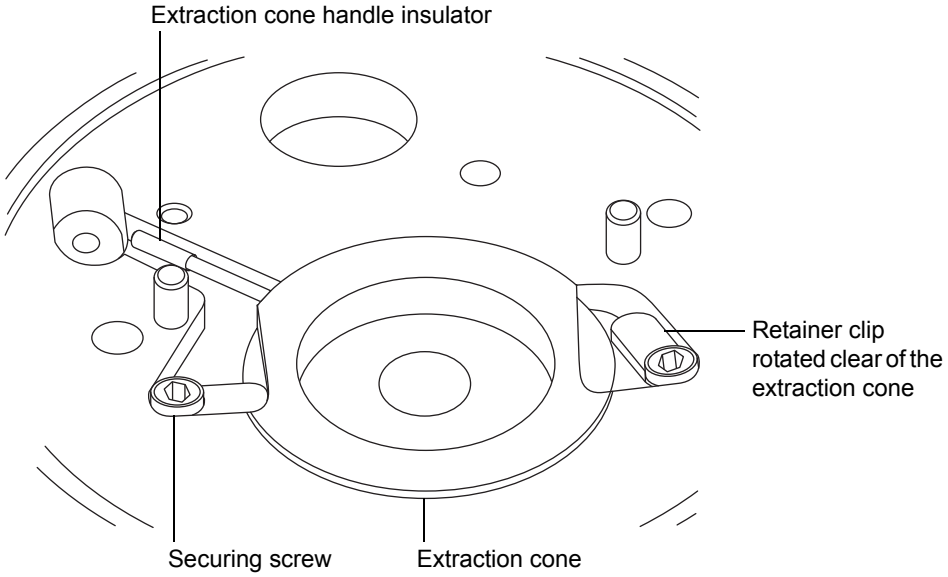
Required materials

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool

To remove the extraction cone from the ion block

Warning: The ion block components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

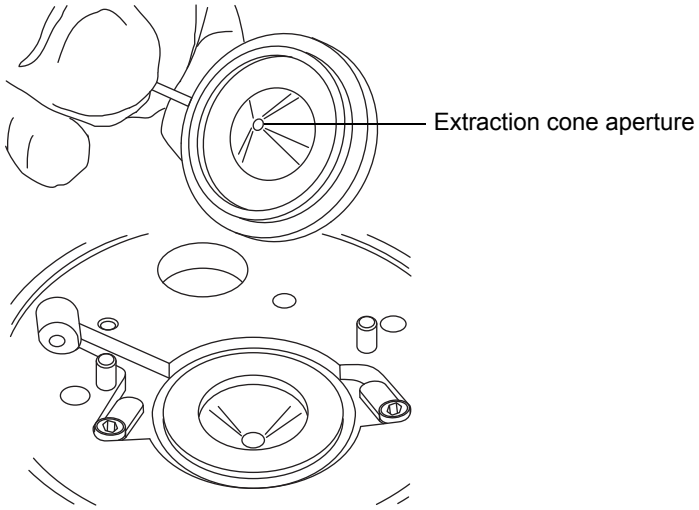
1. On the rear of the ion block, use the combined 2.5-mm Allen wrench and cone extraction tool to loosen the captive screws securing the 2 PEEK extraction cone retainer clips, and then rotate the retainer clips clear of the extraction cone.



Caution:

- Take great care not to damage the extraction cone aperture when removing the extraction cone from the ion block.
- The extraction cone is fragile. Never place it on its tip; always place it on its flanged base.

2. Remove the extraction cone from the ion block.



3. Remove the extraction cone handle insulator from the extraction cone handle.

Cleaning the extraction cone

Required materials

- Chemical-resistant, powder-free gloves.
- Appropriately sized glass vessel in which to completely immerse the extraction cone when cleaning. Use only glassware not previously cleaned with surfactants.
- HPLC-grade (or better) methanol.
- HPLC-grade (or better) water.
- Formic acid.

- Ultrasonic bath.
- Source of oil-free, inert gas (for example, nitrogen) for drying (air-drying optional).
- Wash bottle containing HPLC-grade (or better) 1:1 methanol/water.
- Large beaker.

To clean the extraction cone

Warning: The extraction cone can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: Formic acid is extremely corrosive and toxic. Work with extreme care, use a fume hood and suitable protective equipment.

Caution: The extraction cone is fragile. Never place it on its tip; always place it on its flanged base.

1. Immerse the extraction cone in the glass vessel containing 1:1 methanol/water.

   Tip: If the extraction cone is obviously contaminated, use 45:45:10 methanol/water/formic acid.

2. Place the vessel in the ultrasonic bath for 30 minutes.
3. If you used formic acid in the cleaning solution, do as follows:

   a. Rinse the extraction cone by immersing it in a glass vessel containing water and then placing the vessel in the ultrasonic bath for 20 minutes.

   b. Dry the components by immersing them in separate glass vessels containing methanol and then placing the vessels in the ultrasonic bath for 10 minutes.

Caution: To avoid recontaminating the extraction cone, wear clean, chemical-resistant, powder-free gloves for the rest of this procedure.

4. Carefully remove the extraction cone from the vessel, and blow-dry it using inert, oil-free gas.
5. Inspect the extraction cone for persisting contamination. If contamination is present, do as follows:
   a. Use the wash bottle containing 1:1 methanol/water to rinse the extraction cone over the large beaker.
   b. Blow-dry the extraction cone with inert, oil-free gas.

Warning: The extraction cone can be contaminated with biohazardous and/or toxic materials. Dispose of it according to local environmental regulations.

6. Inspect the extraction cone for persisting contamination. If contamination is present, dispose of the extraction cone, and obtain a new one.

Fitting the extraction cone to the ion block

Required materials

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool

To fit the extraction cone to the ion block

Warning: The ion block can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Fit the extraction cone handle insulator to the extraction cone handle.
2. Fit the extraction cone to the ion block.

3. Rotate the 2 PEEK extraction cone retainer clips to secure the extraction cone, then use the combined 2.5-mm Allen wrench and cone extraction tool to tighten the retainer clip securing screws.

Fitting the ion block assembly to the source assembly

Required materials

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool

To fit the ion block assembly to the source assembly

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid puncture wounds, take great care while working with the source enclosure open, because the ESI probe tip is sharp.

Warning: To avoid puncture wounds, take great care while working with the source enclosure open if one or both of these conditions apply:

- An ESI probe is fitted (the probe tip is sharp).
- A corona pin is fitted (the pin tip is sharp).

Caution: To avoid recontaminating the ion block assembly, wear clean chemical-resistant, powder-free gloves during this procedure.

1. Fit the ion block assembly to the PEEK ion block support.
2. Use the combined 2.5-mm Allen wrench and cone extraction tool to fit and then slowly tighten the 4 ion block assembly securing screws sequentially and in small increments.
3. Open the source isolation valve (see page 4-16).
4. Close the source enclosure.

Cleaning the ion block assembly

Clean the ion block assembly if cleaning the sample cone, cone gas nozzle, and extraction cone fails to increase signal sensitivity.

Disassembling the source ion block assembly

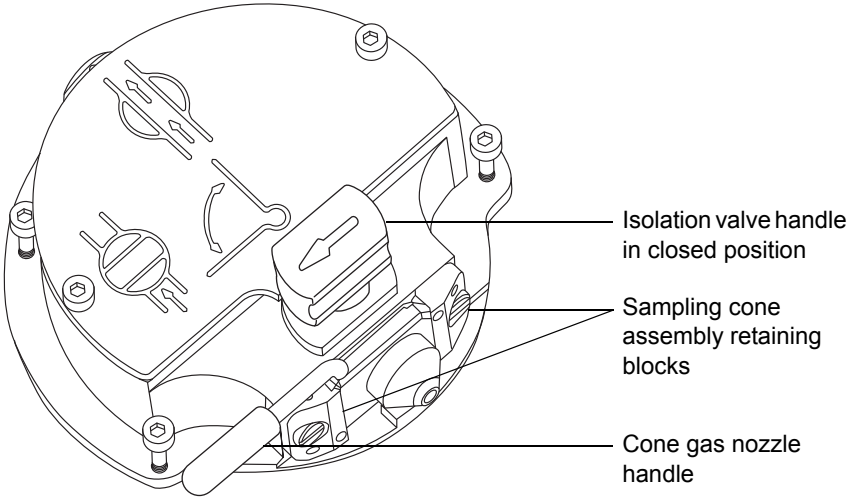
Required materials

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool
- O-ring removal kit
- Needle-nose pliers

To disassemble the ion block assembly

Warning: The ion block assembly can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves to perform this procedure.

1. Remove the ion block assembly from the source assembly (see page 4-37).
2. Ensure that the isolation valve is closed.

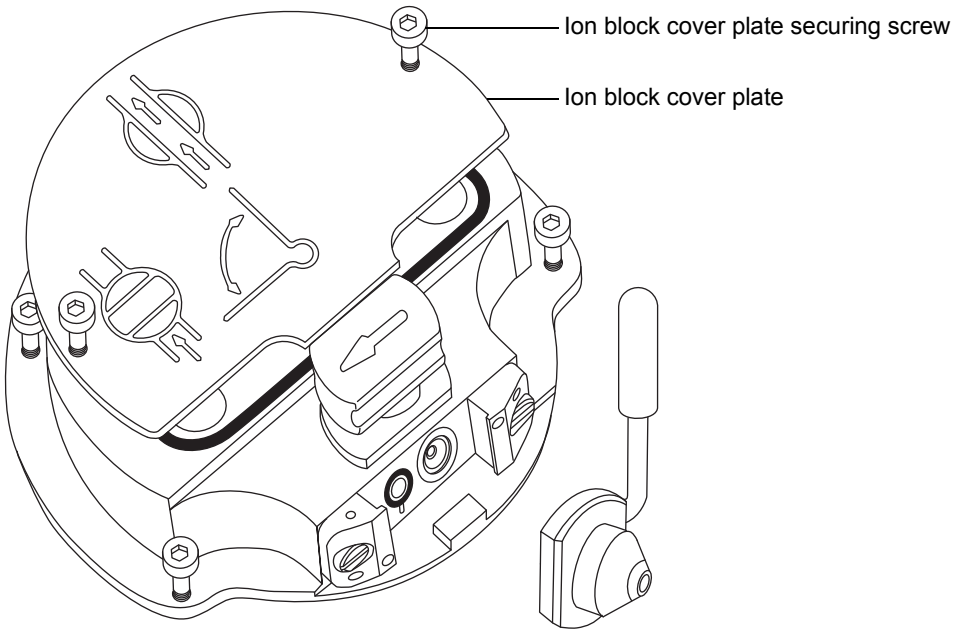


3. Grasp the cone gas nozzle handle and use it to rotate the sampling cone assembly through 90 degrees.

   Caution: To ensure correct operation of the ion block assembly after reassembly, follow these guidelines:

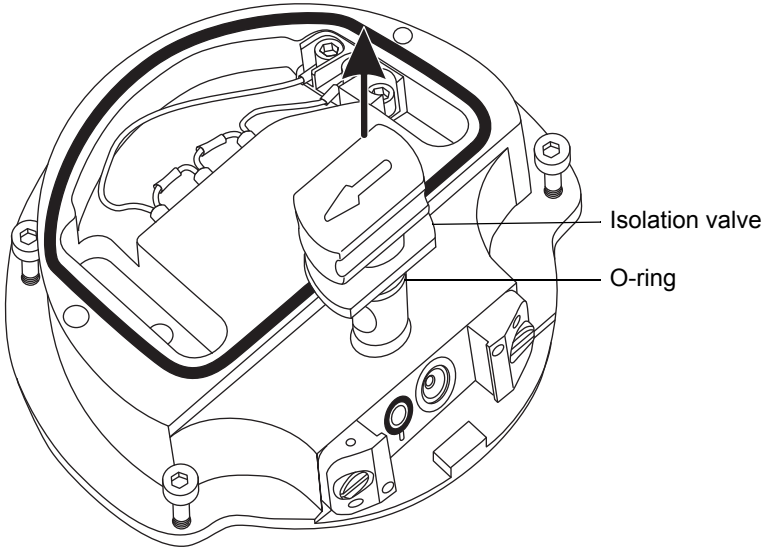
   - Do not remove the sampling cone assembly retaining blocks.
   - Do not adjust the screws securing the sampling cone assembly retaining blocks.

4. Slide the sampling cone assembly out of the ion block assembly.
5. Use the combined 2.5-mm Allen wrench and cone extraction tool to loosen the 2 ion block cover plate captive securing screws.



6. Remove the ion block cover plate.

7. Grasp the isolation valve and pull it out of the ion block.

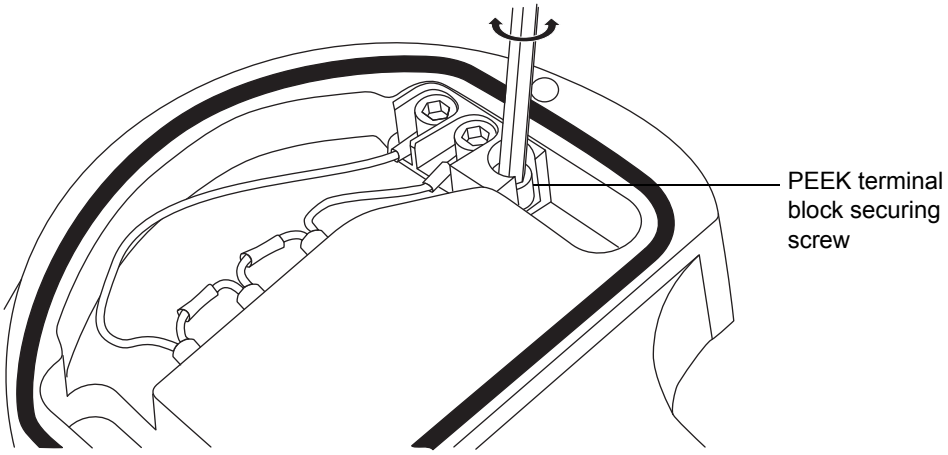


8. Use the O-ring removal kit to carefully remove the isolation valve O-ring (see page 4-19).

Warning: The isolation valve O-ring can be contaminated with biohazardous and/or toxic materials. Dispose of it according to local environmental regulations.

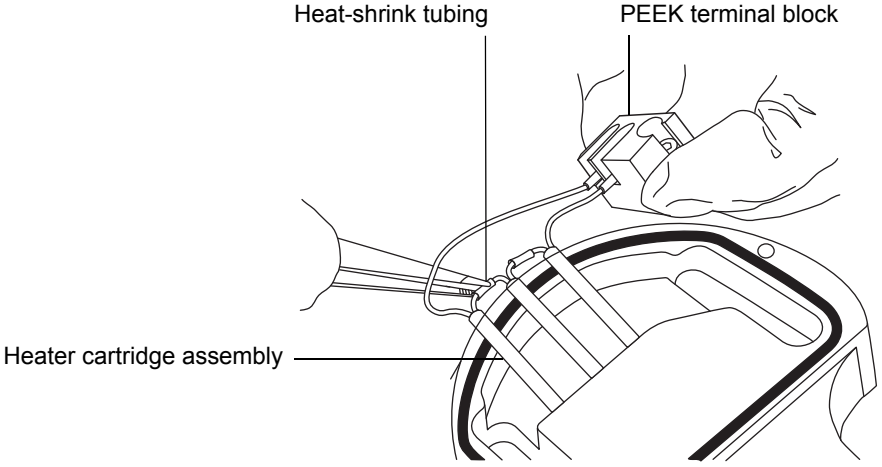
9. If the isolation valve O-ring shows signs of deterioration or damage, dispose of it in accordance with local environmental regulations.

10. Use the combined 2.5-mm Allen wrench and cone extraction tool to loosen the captive PEEK terminal block securing screw.

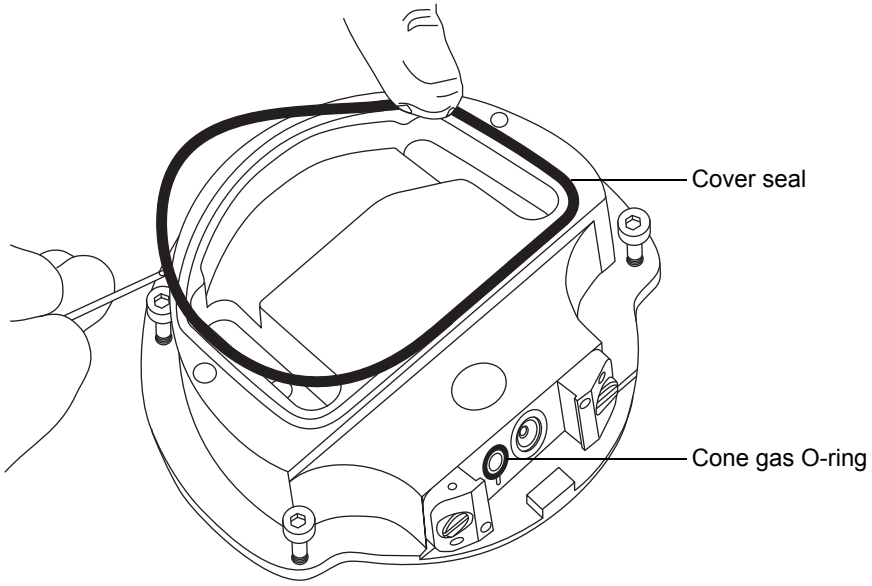


Caution: To avoid damaging the heater cartridge assembly wires, do not bend or twist them when removing the assembly from the ion block.

11. Use the needle-nose pliers to grasp the PEEK terminal block and partially lift it out of the ion block.
12. Holding the PEEK ion block gently, use the needle-nose pliers to gently grasp the heat-shrink tubing on the heater cartridge assembly, and carefully slide it and the PEEK terminal block out of the ion block.



13. Use the O-ring removal kit to carefully remove the cover seal from the ion block (see also page 4-19).

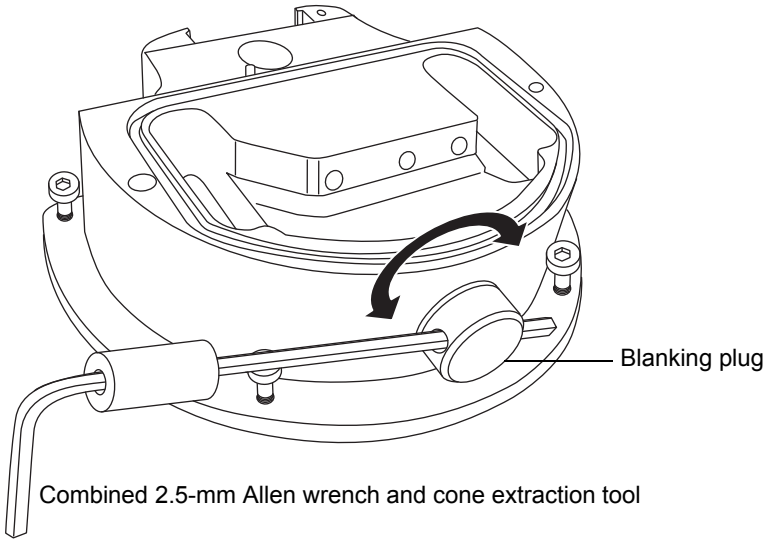


14. Use the O-ring removal kit to carefully remove the cone gas O-ring from the ion block.

Warning: The cover seal and cone gas O-ring can be contaminated with biohazardous and/or toxic materials. Dispose of them according to local environmental regulations.

15. If the cover seal or cone gas O-ring shows signs of deterioration or damage, dispose of it in accordance with local environmental regulations.

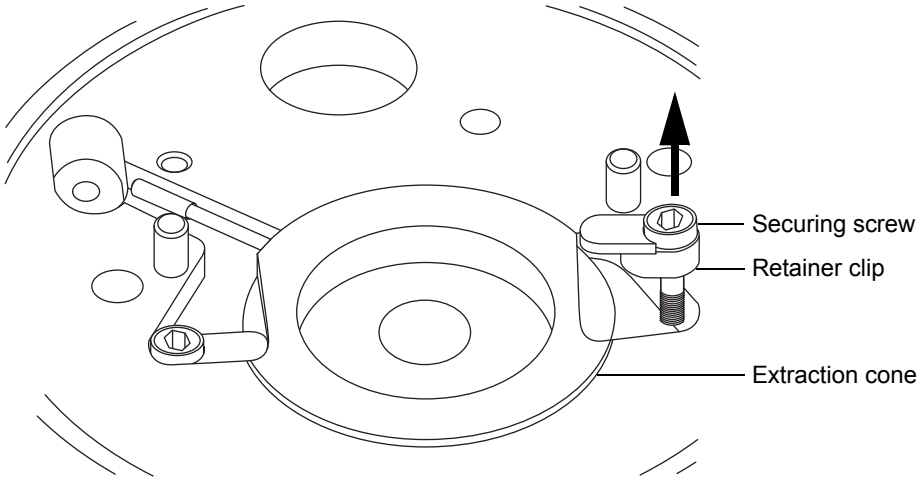
16. Insert the combined 2.5-mm Allen wrench and cone extraction tool through the hole in the ion block blanking plug, and then unscrew and remove the ion block blanking plug and associated seal.



Warning: The blanking plug seal can be contaminated with biohazardous and/or toxic materials. Dispose of it according to local environmental regulations.

17. If the blanking plug seal shows signs of deterioration or damage, dispose of it in accordance with local environmental regulations.

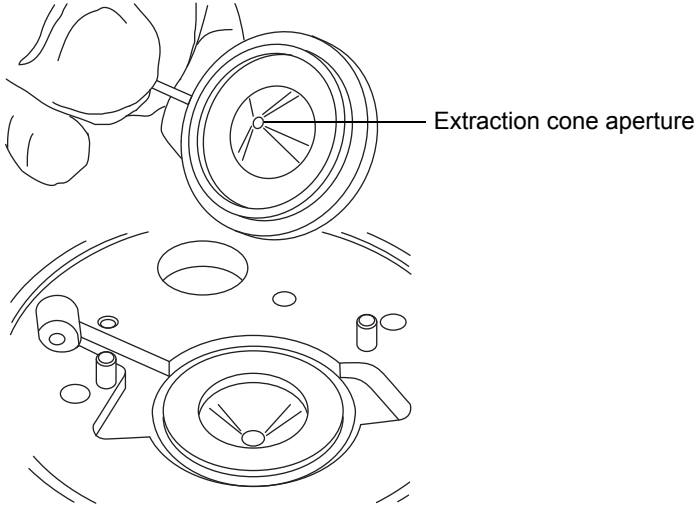
18. Use the combined 2.5-mm Allen wrench and cone extraction tool to remove the captive screws securing the 2 PEEK extraction cone retainer clips.



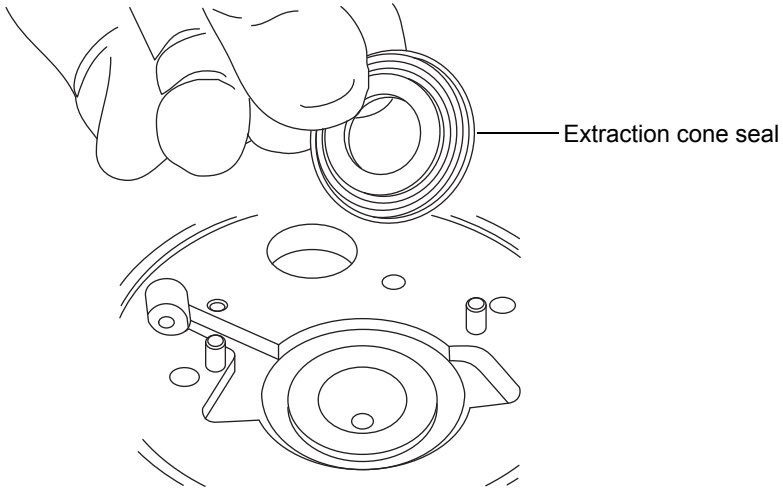
Caution:

- Take great care not to damage the extraction cone aperture when removing the extraction cone from the ion block.
- The extraction cone is fragile. Never place it on its tip; always place it on its flanged base.

19. Remove the extraction cone from the ion block.



20. Remove the extraction cone handle insulator from the extraction cone handle.
21. Remove the extraction cone seal from the ion block.



Cleaning the ion block components

Required materials

- Chemical-resistant, powder-free gloves.
- Appropriately sized glass vessels in which to completely immerse components when cleaning. Use only glassware not previously cleaned with surfactants.
- HPLC-grade (or better) methanol.
- HPLC-grade (or better) water.
- Formic acid.
- Ultrasonic bath.
- Source of oil-free, inert gas (for example, nitrogen) for drying (air-drying optional).
- Wash bottle containing HPLC-grade (or better) 1:1 methanol/water.
- Large beaker.

To clean the ion block components

Warning: The ion block components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: Formic acid is extremely corrosive and toxic. Work with extreme care, use a fume hood and suitable protective equipment.

1. Immerse the ion block and isolation valve in separate glass vessels containing 1:1 methanol/water.

   Tip: If the components are obviously contaminated, use 45:45:10 methanol/water/formic acid.

2. Place the vessels in the ultrasonic bath for 30 minutes.
3. If you used formic acid in the cleaning solution, do as follows:

   a. Rinse the components by immersing them separately in glass vessels containing water and then place the vessels in the ultrasonic bath for 20 minutes.

   b. Dry the components by immersing them in separate glass vessels containing methanol and then place the vessels in the ultrasonic bath for 10 minutes.

   Caution: To avoid recontaminating the components, wear clean, chemical-resistant, powder-free gloves for the rest of this procedure.

4. Carefully remove the components from the vessels, and blow-dry them using inert, oil-free gas.
5. Inspect each component for persisting contamination. If contamination is present, do as follows:

   a. Use the wash bottle containing 1:1 methanol/water to rinse the component over the large beaker.

   b. Blow-dry the component with inert, oil-free gas.

Warning: The components can be contaminated with biohazardous and/or toxic materials. Dispose of them according to local environmental regulations.

6. Inspect each component for persisting contamination. If contamination is present, dispose of the component and obtain a new one before reassembly.

Assembling the source ion block assembly

Required materials

- Clean, chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool
- Needle-nose pliers
- Isopropyl alcohol in small container

To assemble the ion block assembly

Caution:

- To avoid recontaminating the ion block assembly, wear clean chemical-resistant, powder-free gloves during this procedure.
- The extraction cone is fragile. Never place it on its tip; always place it on its flanged base.

1. Fit the extraction cone seal to the ion block.

   Caution: Take great care not to damage the extraction cone aperture when fitting the extraction cone to the ion block.

2. Fit the extraction cone handle insulator to the extraction cone handle.
3. Fit the extraction cone to the ion block.
4. Fit the 2 PEEK extraction cone retainer clips to the ion block.
5. Use the combined 2.5-mm Allen wrench and cone extraction tool to tighten the captive screw securing each extraction cone retainer clip to the ion block.

6. Fit the blanking plug seal to the ion block blanking plug. (Fit a new seal if the old one has been disposed of.)
7. Fit the blanking plug to the ion block and finger tighten it.
8. Insert the combined 2.5-mm Allen wrench and cone extraction tool through the hole in the blanking plug and use it to fully tighten the plug.

   Caution: To avoid damaging the heater cartridge assembly wires, do not bend or twist them when fitting the assembly to the ion block.

9. Using the needle-nose pliers to gently grasp the heat-shrink tubing on the heater cartridge assembly, slide the assembly and the PEEK terminal block into the ion block.
10. Use the combined 2.5-mm Allen wrench and cone extraction tool to tighten the captive PEEK terminal block securing screw.
11. Ensure that the grooves for the cover seal, cone gas O-ring, and isolation valve O-ring are free from dirt and debris.

    Tip: If contamination is present, use 1:1 methanol/water, applied to a lint-free cloth, to carefully clean the grooves.

12. Fit the cover seal to the ion block, ensuring that it is correctly seated. (Fit a new seal if the old one has been disposed of.)
13. Fit the cone gas O-ring to the ion block, ensuring that it is correctly seated. (Fit a new O-ring if the old one has been disposed of.)
14. If the old isolation valve O-ring has been disposed of, soak a new O-ring in isopropyl alcohol for a few minutes.

    Rationale: Doing so lubricates the O-ring and aids your fitting the O-ring to the isolation valve.

15. Fit the O-ring to the isolation valve.
16. Fit the isolation valve to the ion block assembly, so that it is in the closed position.
17. Fit the ion block cover plate to the ion block assembly, and then use the combined 2.5-mm Allen wrench and cone extraction tool to tighten the 2 ion block cover plate captive securing screws.

18. Hold the sampling cone assembly so that the cone gas nozzle handle is oriented horizontally and at the top, and then slide the sampling cone assembly into the ion block assembly.
19. Grasp the sampling cone assembly handle, and use it to rotate the sampling cone assembly through 90 degrees.
20. Fit the ion block assembly to the source assembly (see page 4-43).

Cleaning the ion guide assembly

Clean the ion guide assembly if cleaning the ion block and isolation valve fails to increase signal sensitivity.

Removing the ion block assembly and ion guide from the source assembly

Required materials

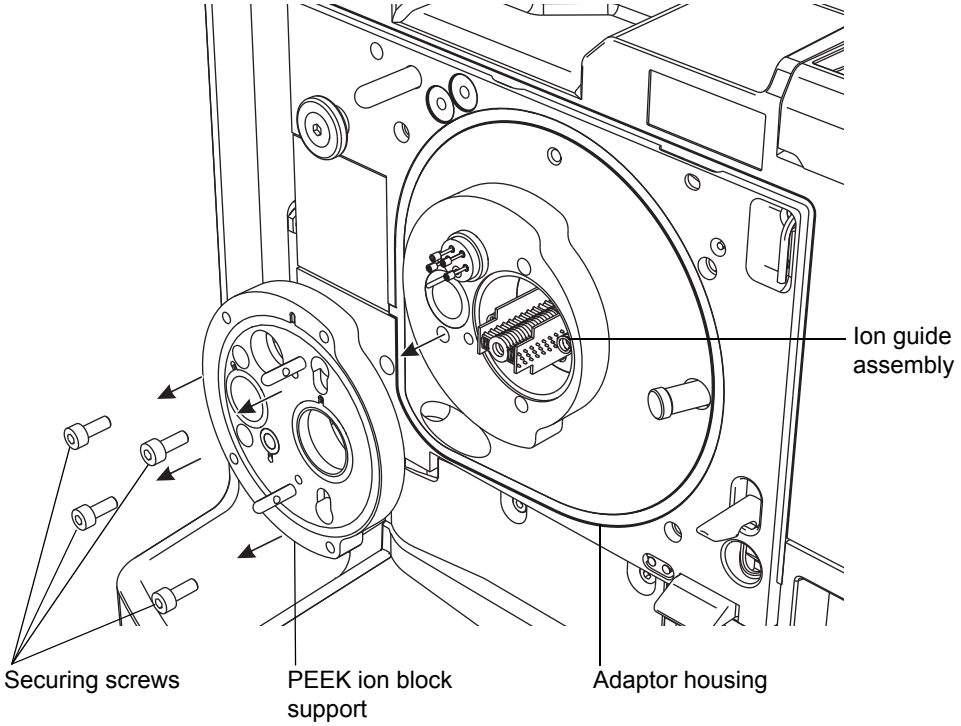
- Chemical-resistant, powder-free gloves
- 3-mm Allen wrench
- O-ring removal kit

To remove the ion block assembly and ion guide:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical resistant, powder-free gloves while performing this procedure.

1. Remove the source enclosure from the instrument (see page 4-8)
2. Remove the ion block assembly from the PEEK ion block support (see page 4-37).

3. Use the 3-mm Allen wrench to unscrew and remove the 4 screws securing the PEEK ion block support to the adaptor housing, and remove the ion block support.

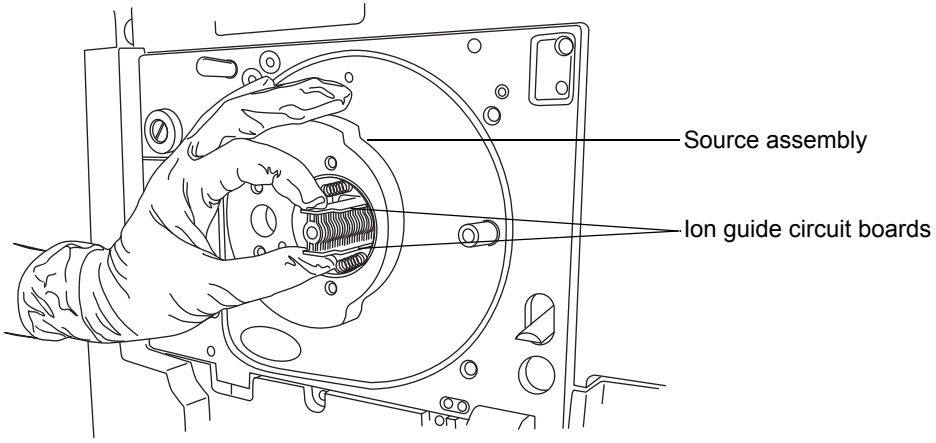


Warning: The O-rings can be contaminated with biohazardous and/or toxic materials. Dispose of them according to local environmental regulations.

4. If any of the O-rings show signs of deterioration or damage, dispose of them in accordance with local environmental regulations.

Caution: To avoid damage to the ion guide assembly when removing it from the source assembly, do not grasp the ion guide by the metal ion guide lens plates. Instead, grasp the circuit boards on the top and bottom of the device.

5. Carefully grasp the circuit boards on the top and bottom of the ion guide, and remove the guide from the adaptor housing.



Cleaning the ion guide assembly

Required materials

- Chemical-resistant, powder-free gloves.
- Glass-fiber pen.
- 500-mL measuring cylinder or appropriately sized glass vessel in which to completely immerse the ion guide when cleaning. Use only glassware not previously cleaned with surfactants.
- Length of small diameter PEEK or PTFE tubing appropriately sized for suspending the ion guide in the glass vessel when cleaning.
- HPLC-grade (or better) methanol.
- Formic acid.
- Ultrasonic bath.

- Source of oil-free, inert gas (for example, nitrogen) for drying (air-drying optional).
- HPLC-grade (or better) 1:1 methanol/water.
- Wash-bottle containing HPLC-grade (or better) 1:1 methanol/water.
- Large beaker.

To clean the ion guide assembly:

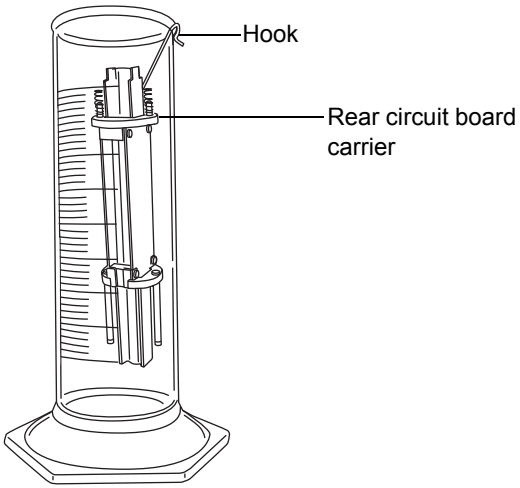
Warning: The ion guide PCB assemblies can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Caution: Use of acetone, chlorinated solvents, or acid as solvents when cleaning the ion guide assembly damages the assembly. Use only methanol and water.

1. Bend a PEEK or PTFE tube into a hook shape.
2. Insert one end of the hook into one of the holes in the ion guide's rear circuit board carrier.

Caution: To avoid vibration damage to the ion guide assembly, ensure that the bottom of the assembly is not in contact with the bottom of the glass vessel.

3. Use the hook to carefully suspend the ion guide assembly in the glass vessel so that the bottom of the assembly does not touch the bottom of the vessel.



4. Add 1:1 methanol/water to the glass vessel until the ion guide assembly is immersed completely.
5. Place the vessel in the ultrasonic bath for 30 minutes.

Caution: To avoid recontaminating the ion guide assembly, wear clean, chemical-resistant, powder-free gloves for the rest of this procedure.

6. Carefully remove the ion guide assembly from its vessel, and blow-dry it using inert, oil-free gas.
7. Inspect the ion guide assembly for persisting contamination. If contamination is present, do as follows:
   a. Use the wash bottle containing methanol to rinse the ion guide assembly over the large beaker.
   b. Blow-dry the ion guide assembly with inert, oil-free gas.

Removing the differential aperture from the ion guide

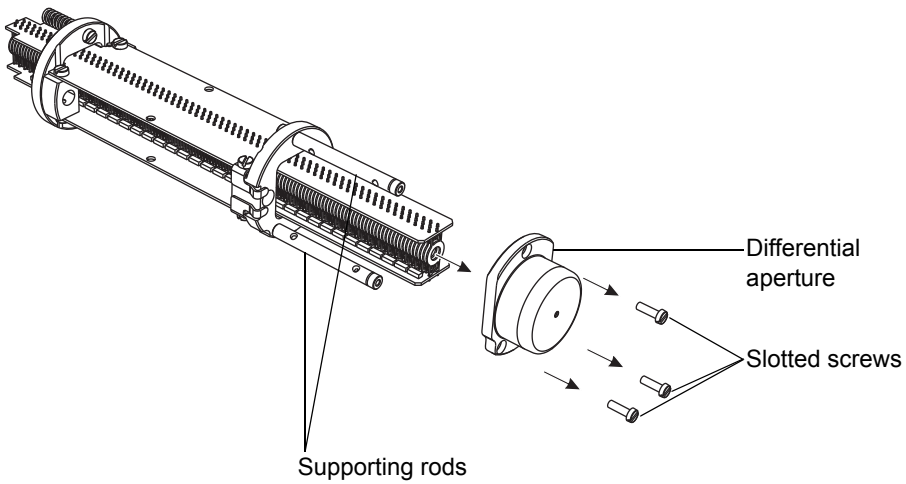
Required material

Small, flat-blade screwdriver

To remove the ion guide differential aperture:

Caution: Sensitivity may be reduced if the differential aperture is aligned incorrectly during refitting. Only remove and clean the differential aperture if cleaning the ion guide assembly fails to remove all visible contamination from the differential aperture.

1. Use the small, flat-blade screwdriver to remove the 3 slotted screws that secure the differential aperture to the 3 supporting rods.



2. Remove the differential aperture from the ion guide.

To clean the differential aperture:

Warning: The differential pumping aperture can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Use the glass-fiber pen to remove gross contamination from the differential aperture by gentle abrasion.
2. Using 1:1 methanol/water from the wash bottle, flush the differential aperture.

   Rationale: Doing so removes residual fibers displaced from the glass-fiber pen.
3. Completely immerse the differential aperture in a glass vessel containing 1:1 methanol/water.

   Tip: If the differential aperture is still contaminated after using the glass-fiber pen, use 45:45:10 methanol/water/formic acid.
4. Place the vessel in the ultrasonic bath for 30 minutes.
5. If you used formic acid in the cleaning solution, rinse the differential aperture by immersing it in a glass vessel containing water and then place the vessel in the ultrasonic bath for 20 minutes.

   Caution: To avoid recontaminating the differential aperture, wear clean, chemical-resistant, powder-free gloves for the following step.
6. Carefully remove the differential aperture from the vessel, and blow-dry it using inert, oil-free gas.

Fitting the differential aperture to the ion guide assembly

Required materials

- Clean, chemical-resistant, powder-free gloves
- Small, flat-blade screwdriver

To fit the differential aperture to the ion guide assembly:

1. Hold the differential aperture against the support rods so that the rods align with the 3 holes in the differential aperture's base.

   Caution: Sensitivity is reduced if the differential aperture is aligned incorrectly during refitting.

2. To ensure the differential aperture is correctly aligned with the ion guide assembly, look along the central axis of the ion guide from the ion entry side, and confirm that the hole at the centre of the differential aperture is concentric with the ion guide lens plates.
3. Use the small flat-blade screwdriver to fit and tighten the 3 slotted screws that secure the differential aperture to the support rods. While tightening the screws, ensure correct alignment of the differential aperture with the ion guide lens plates (see step 2).

Fitting the ion guide assembly to the source assembly

Required material

Clean, chemical-resistant, powder-free gloves

To fit the ion guide assembly to the source assembly:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Caution: To avoid recontaminating the source, wear clean, chemical-resistant, powder-free gloves during this procedure.

Caution: To avoid damage to the ion guide assembly when fitting it to the source assembly, avoid pushing on the metal ion guide lens plates. Instead, use the circuit boards on both sides of the ion guide assembly.

1. Slide a short length of the ion guide assembly's differential aperture end into the adaptor housing, with the arrows on the front circuit board carrier pointing upward.
2. Carefully slide the assembly fully into place.

Fitting the ion block support to the source

Required materials

- Chemical-resistant, powder-free gloves
- 3-mm Allen wrench
- New seals and O-rings

To fit the PEEK ion block support to the source:

Warning: The source components can be contaminated with bio-hazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Ensure that the grooves for the PEEK ion block support O-rings are free from dirt and debris.

   Tip: If contamination is present, use 1:1 methanol/water, applied to a lint-free cloth, to carefully clean the grooves.

2. Fit the O-rings (new ones if you disposed of the old) to the PEEK ion block support.

   Tip: To fit an O-ring in its groove, start fitting the O-ring at the notch in the groove, and then progressively work the ring into the groove, in either direction from the notch.

3. Fit the PEEK ion block support to the instrument's housing.
4. Use the 3-mm Allen wrench to fit and tighten the 4 screws securing the PEEK ion block support.
5. Fit the ion block assembly to the PEEK ion block support (see page 4-43).
6. Fit the source enclosure to the instrument (see page 4-11).

Replacing the ESI probe tip and gasket

Replace the ESI probe tip if a blockage occurs in the internal metal sheathing through which the stainless steel capillary passes or if the probe tip is damaged.

Removing the ESI probe tip and gasket

Required materials

- Chemical-resistant, powder-free gloves
- 7-mm wrench
- 10-mm wrench

To remove the ESI probe tip and gasket:

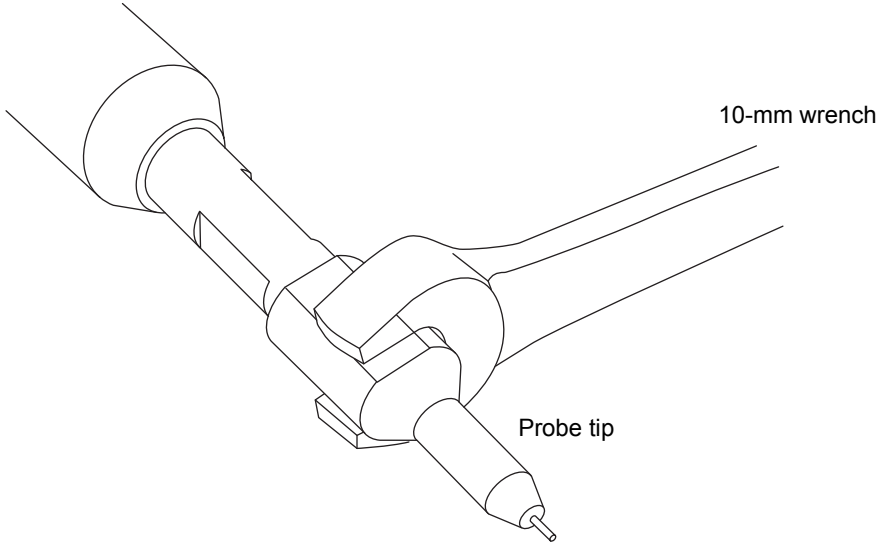
Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: The probe and source can be hot. To avoid burn injuries, take great care while performing this procedure.

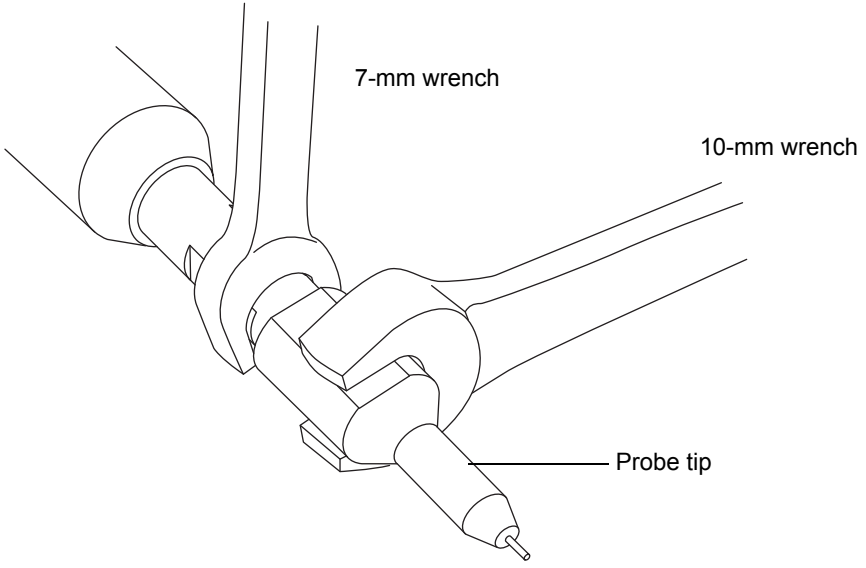
Warning: The ESI probe tip is sharp. To avoid puncture wounds, handle the probe with care.

1. Remove the ESI probe from the source (see page 3-4).

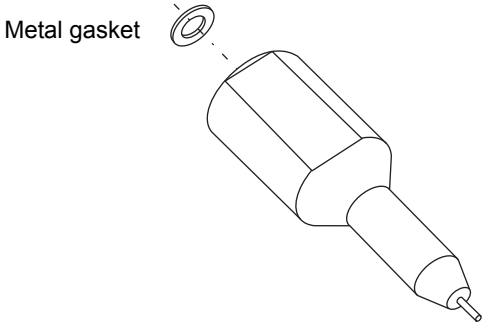
2. Use the 10-mm wrench to remove the probe tip.



Tip: If the probe tip is difficult to remove, use the 7-mm wrench in conjunction with the 10-mm wrench.



3. Remove the metal gasket from the probe tip.



Warning: The probe tip and metal gasket can be contaminated with biohazardous and/or toxic materials. Dispose of them according to local environmental regulations.

4. Dispose of the metal gasket in accordance with local environmental regulations.
5. If the probe tip is damaged, dispose of it in accordance with local environmental regulations.

Fitting the ESI probe tip and gasket

Required materials

- Chemical-resistant, powder-free gloves
- 10-mm wrench
- New metal gasket

To fit the ESI probe tip and gasket:

Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: The ESI probe tip is sharp. To avoid puncture wounds, handle the probe with care.

1. Fit the new metal gasket into the probe tip.
2. Fit the probe tip (a new one if you disposed of the old) over the capillary, and screw the tip onto the probe assembly.

   Caution: To avoid gas leakage, fully tighten the probe tip.

3. Use the 10-mm wrench to tighten the probe tip.
4. Use the nebulizer adjuster knob to adjust the capillary so that it protrudes by approximately 0.5 mm from the end of the probe.
5. Fit the ESI probe to the source (see page 3-2).

Replacing the ESI probe sample capillary

Replace the stainless steel sample capillary in the ESI probe if it becomes blocked and cannot be cleared, or if it becomes contaminated or damaged.

Removing the existing capillary

Required materials

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool
- 7-mm wrench
- 8-mm wrench
- 10-mm wrench
- Needle-nose pliers

To remove the existing capillary:

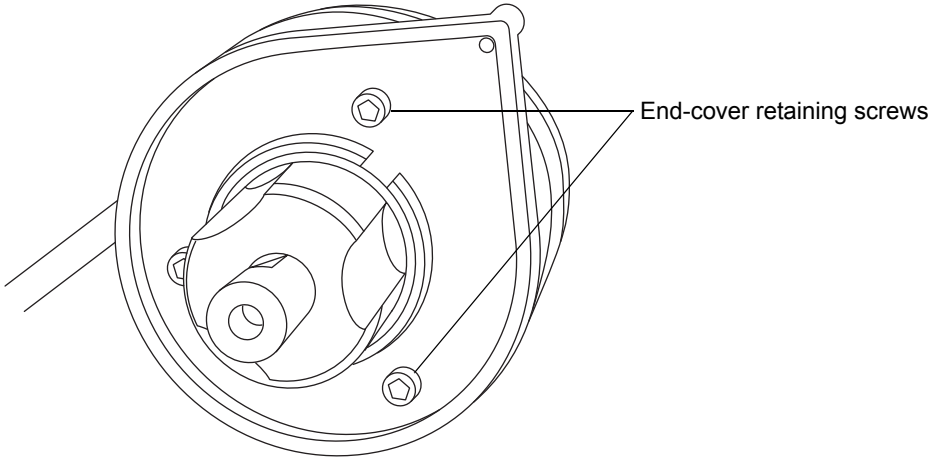
Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: The probe and source can be hot. To avoid burn injuries, take great care while performing this procedure.

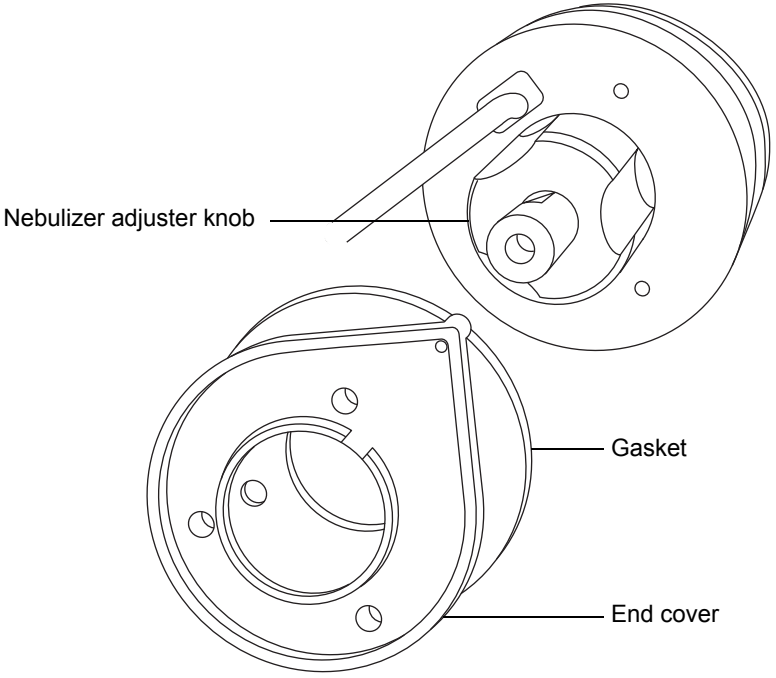
Warning: The ESI probe tip is sharp. To avoid puncture wounds, handle the probe with care.

1. Remove the probe from the source (see page 3-4).
2. Retrieve the combined 2.5-mm Allen wrench and cone extraction tool from its storage location on the source adaptor housing.

3. Use the combined 2.5-mm Allen wrench and cone extraction tool to remove the 3 screws retaining probe end-cover.

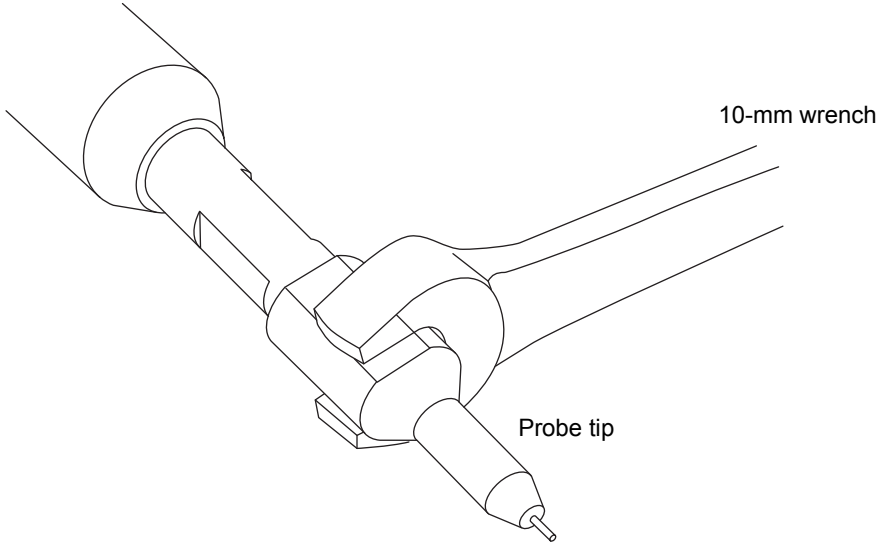


4. Remove the end cover and gasket from the probe assembly.

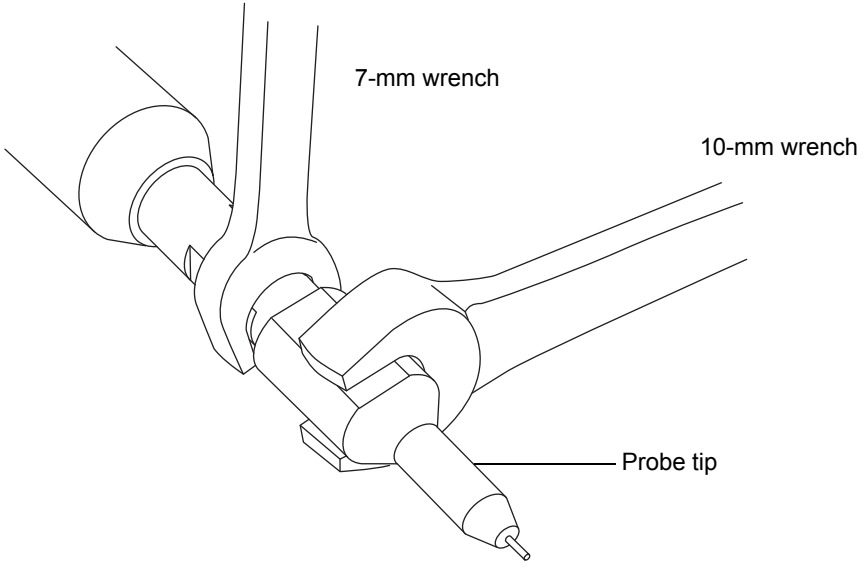


5. Unscrew and remove the nebulizer adjuster knob.

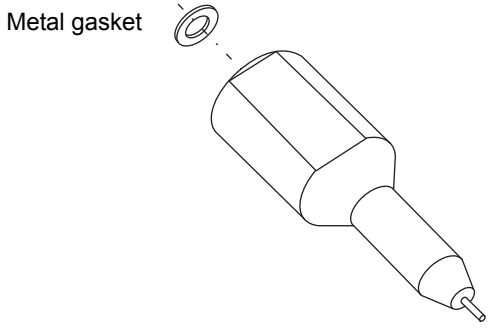
6. Use the 10-mm wrench to remove the probe tip.



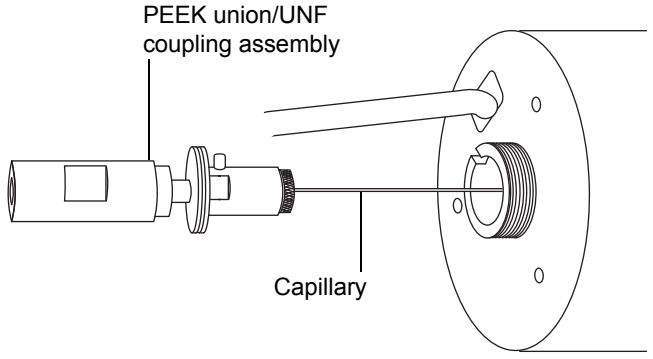
Tip: If the probe tip is difficult to remove, use the 7-mm wrench in conjunction with the 10-mm wrench.



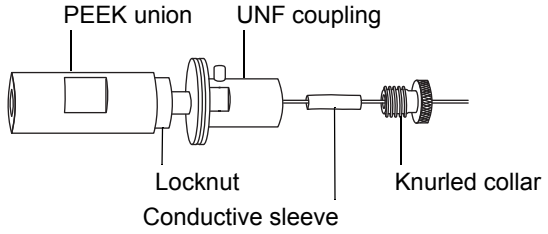
7. Remove the metal gasket from the probe tip.



8. Remove the PEEK union/UNF coupling assembly and capillary from the probe.



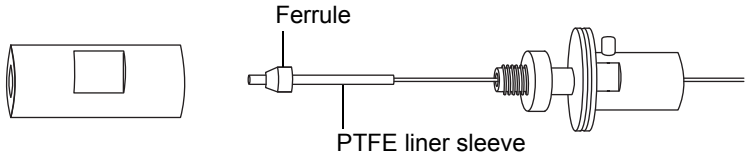
9. Unscrew and remove the knurled collar from the UNF coupling.



10. Remove the knurled collar and conductive sleeve from the capillary.
11. Use the 7-mm wrench to loosen the locknut.

    Tip: Use the 8-mm wrench to steady the UNF coupling when loosening the locknut.

12. Unscrew the finger-tight PEEK union from the UNF coupling.



13. Remove the ferrule and PTFE liner sleeve from the capillary.
14. Remove the capillary from the UNF coupling.

Warning: The capillary, PTFE liner sleeve, and ferrule can be contaminated with biohazardous and/or toxic materials. Dispose of them according to local environmental regulations.

15. Dispose of the capillary, PTFE liner sleeve, and ferrule in accordance with local environmental regulations.

Installing the new capillary

Required materials

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool
- 10-mm wrench
- Needle-nose pliers
- LC pump
- HPLC-grade (or better) 1:1 acetonitrile/water
- Ferrule
- Seal
- PTFE liner tubing
- Conductive sleeve
- Red PEEK tubing
- Sharp knife or PEEK tubing cutter
- Metal gasket for the probe tip

- Safety goggles

To install the new capillary:

Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

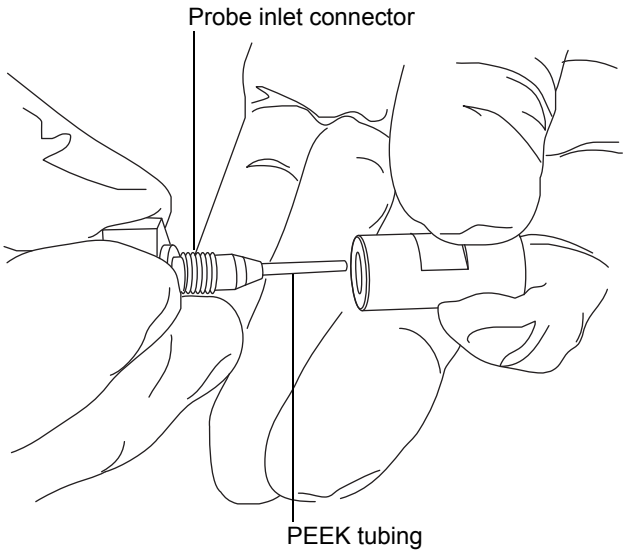
Warning: The ESI probe tip is sharp. To avoid puncture wounds, handle the probe with care.

1. Use the sharp knife or PEEK tubing cutter to cut a piece of red PEEK tubing approximately 60 cm (24 inches) long.

   Requirement: Cut the tubing squarely (that is, perpendicular to its horizontal axis).

2. Insert one end of the red PEEK tubing in the probe inlet connector, and screw the connector, finger-tight, into the PEEK union.

   Rationale: Doing so ensures a minimum dead volume when fitting the capillary.



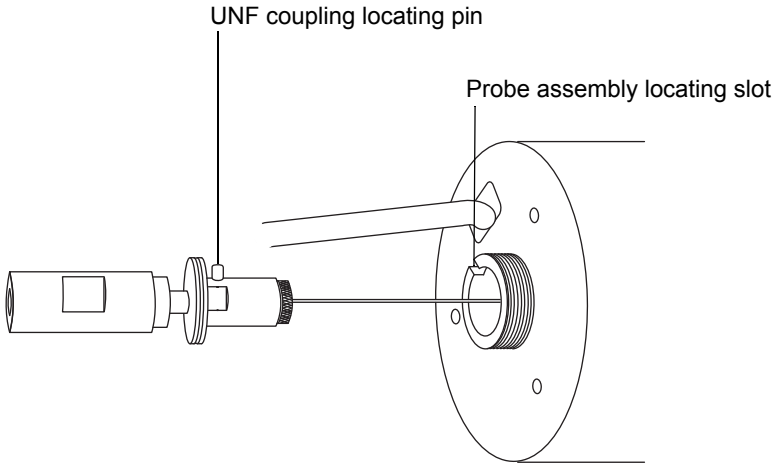
3. Fit the UNF coupling to the new capillary.

4. Use the needle-nose pliers to slide a new liner sleeve and ferrule onto the capillary.
5. Insert the capillary in the PEEK union, and ensure that it is fully seated.
6. Screw the UNF coupling into the PEEK union, finger-tight only.
7. Gently tug on the capillary, testing to ensure that it stays in place.
8. Use the 7-mm wrench to tighten the locknut against the PEEK union until the union can no longer be twisted.
9. Slide a new conductive sleeve and the knurled collar over the capillary.
10. Tighten the knurled collar to the UNF coupling.

Warning: To avoid eye injury from high-pressure liquid jet spray, wear safety goggles when performing the leak test.

11. Perform a leak test by attaching the free end of the PEEK tubing to an LC pump and pumping 50:50 acetonitrile/water through it at 1 mL/min.
    - If leakage occurs, disassemble and remake the connection, and repeat the leak test.
    - If the backpressure on the LC pump is high, replace the capillary, and repeat the leak test.
12. When no leakage occurs and the backpressure on the LC pump is normal, disconnect the PEEK tubing from the LC pump.
13. Remove the probe inlet connector and PEEK tubing from the PEEK union.
14. Carefully thread the capillary through the probe assembly.

15. Carefully push the PEEK union/UNF coupling assembly and capillary into the probe assembly so that the locating pin on the UNF coupling is fully engaged in the locating slot at the head of the probe assembly.



16. Fit the nebulizer adjuster knob to the PEEK union/UNF coupling assembly.
17. Finger-tighten the nebulizer adjuster knob onto the probe assembly.
18. Fit the gasket and end cover to the probe assembly.
19. Use the combined 2.5-mm Allen wrench and cone extraction tool to fit and tighten the 3 screws retaining the probe end-cover.
20. Return the combined 2.5-mm Allen wrench and cone extraction tool to its storage location on the source adaptor housing.
21. Fit the metal gasket to the probe tip.
22. Fit the probe tip over the capillary, and screw the tip onto the probe assembly.

Caution: To avoid gas leakage, fully tighten the probe tip.

23. Use the 10-mm wrench to tighten the probe tip.
24. Use the nebulizer adjuster knob to adjust the capillary so that it protrudes by approximately 0.5 mm from the end of the probe tip.
25. Fit the ESI probe to the source (see also page 3-2).

Cleaning the IonSABRE II probe tip

Clean the IonSABRE II probe tip when you detect buffer buildup on the probe tip or when the signal intensity weakens. See the mass spectrometer's online Help for further details.

To clean the IonSABRE II probe tip:

1. On the Instrument Console system tree, click Xevo TQ-S > Manual optimization.
2. On the Manual Optimization page, click  to stop the liquid flow.
3. Click Gas  to start the desolvation gas.
4. Set Desolvation Gas to 650 L/hr.
5. Set IonSABRE II probe Temp to 650 °C.
6. Click Operate  .
7. Wait 10 minutes.

   Rationale: The high IonSABRE II probe heater temperature removes any chemical contamination from the probe tip.
8. Click Standby  .

Replacing the IonSABRE II probe sample capillary

Replace the stainless steel sample capillary in the IonSABRE II probe if it becomes blocked and you cannot clear it, or if it becomes contaminated or damaged.

Removing the existing capillary

Required materials

- Chemical-resistant, powder-free gloves
- 7-mm wrench
- Combined 2.5-mm Allen wrench and cone extraction tool

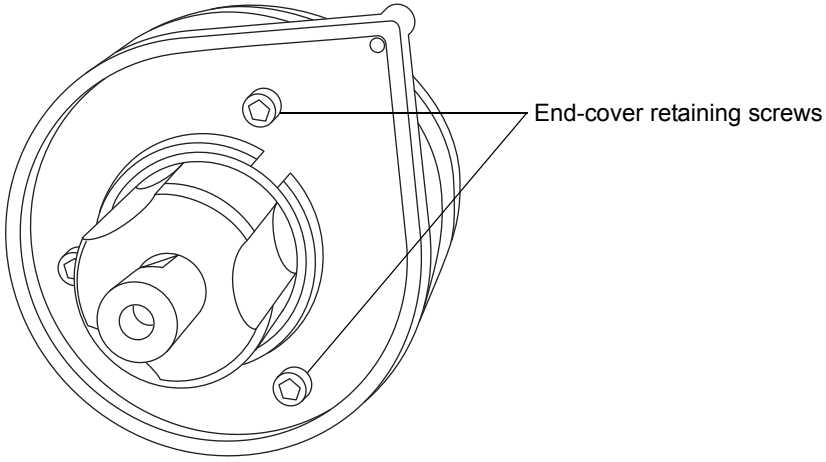
To remove the existing capillary:

Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

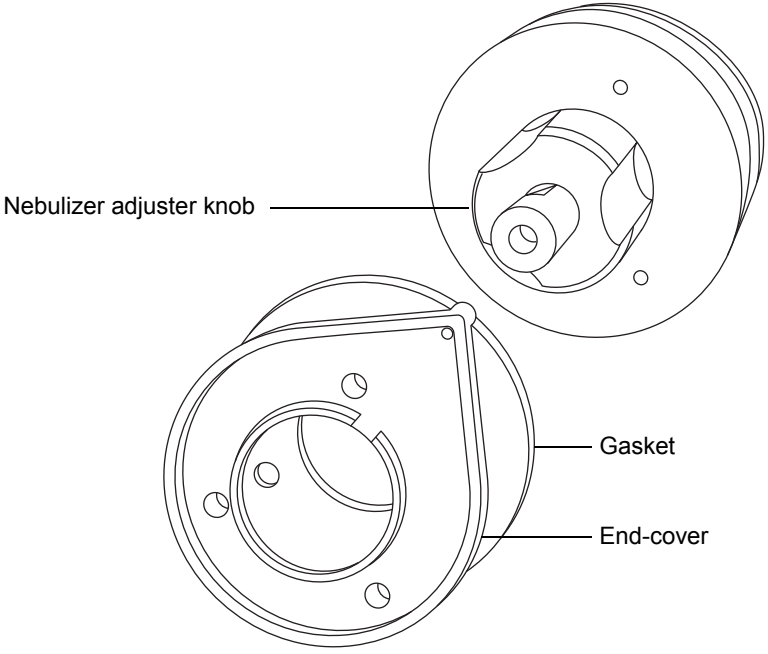
Warning: The probe and source can be hot. To avoid burn injuries, take great care while performing this procedure.

1. Remove the probe from the source (see page 3-8).
2. Retrieve the combined 2.5-mm Allen wrench and cone extraction tool from its storage location on the source adaptor housing.

3. Use the combined 2.5-mm Allen wrench and cone extraction tool to remove the 3 screws retaining the probe end-cover.

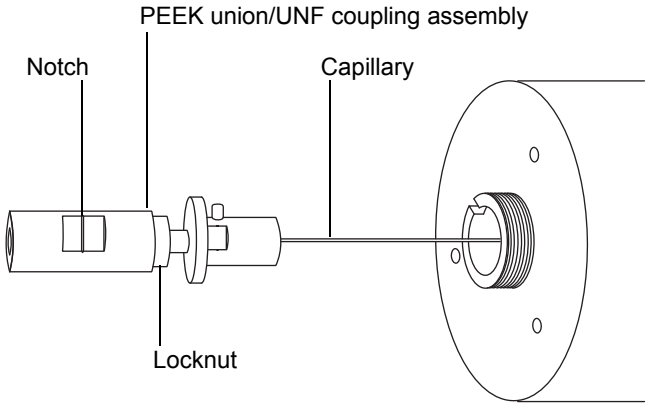


4. Remove the end cover and gasket.

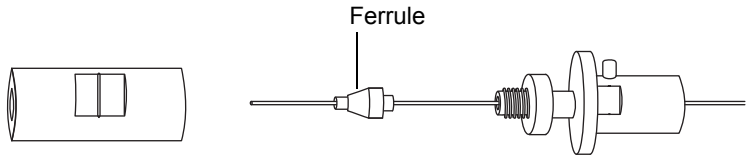


5. Unscrew and remove the nebulizer adjuster knob.
6. Remove the PEEK union/UNF coupling assembly and capillary from the probe.

Tip: The PEEK union used with the IonSABRE II probe is notched on one of its flats, a feature that distinguishes it from the PEEK union used with the ESI probe (see "Replacing the ESI probe sample capillary" on page 4-69).



7. Use the 7-mm wrench to loosen the locknut.
8. Unscrew the finger-tight PEEK union from the UNF coupling.



9. Remove the ferrule from the capillary.
10. Remove the capillary from the UNF coupling.

Warning: The capillary and ferrule can be contaminated with biohazardous and/or toxic materials. Dispose of them according to local environmental regulations.

11. Dispose of the capillary and ferrule in accordance with local environmental regulations.

Installing the new capillary

Required materials

- Chemical-resistant, powder-free gloves

- Needle-nose pliers
- 7-mm wrench
- Combined 2.5-mm Allen wrench and cone extraction tool
- Red PEEK tubing
- LC pump
- HPLC-grade (or better) 1:1 acetonitrile/water
- Capillary
- Sharp knife or PEEK tubing cutter
- Safety goggles

To install the new capillary:

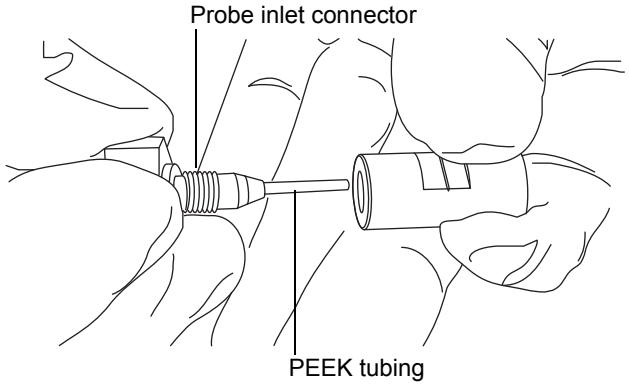
Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Use the sharp knife or PEEK tubing cutter to cut a piece of red PEEK tubing approximately 60 cm (24 inches) long.

   Requirement: Cut the tubing squarely (that is, perpendicular to its horizontal axis).

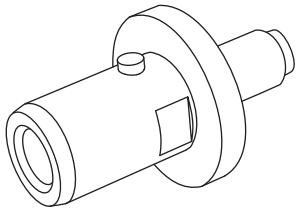
2. Insert one end of the red PEEK tubing in the probe inlet connector, and screw the connector, finger-tight, into the PEEK union.

   Rationale: Doing so ensures a minimum dead volume when fitting the capillary.



3. Fit the UNF coupling to the new capillary.

   Requirement: Use a UNF coupling with no grooves, which is appropriate for the IonSABRE II probe.

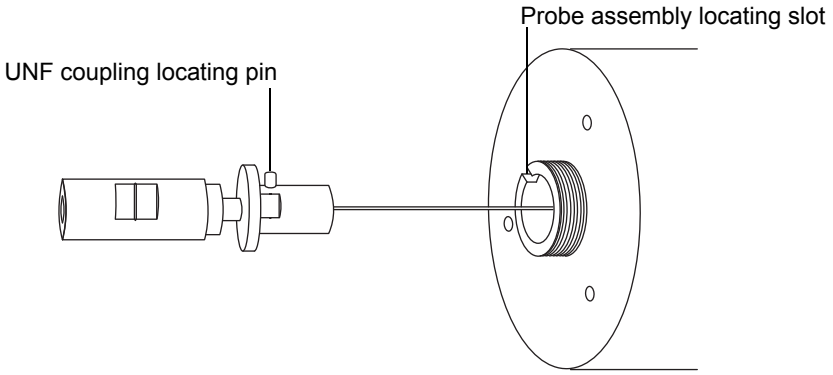


4. Use the needle-nose pliers to slide a new ferrule onto the capillary.
5. Insert the capillary in the PEEK union, and ensure that it is fully seated.
6. Screw the UNF coupling into the PEEK union, finger-tight only.
7. Gently tug on the capillary, testing to ensure that it stays in place.
8. Use the 7-mm wrench to tighten the locknut against the PEEK union.

   Warning: To avoid eye injury from high-pressure liquid jet spray, wear safety goggles when performing the leak test.

9. Perform a leak test by attaching the free end of the PEEK tubing to an LC pump and pumping 50:50 acetonitrile/water through it at 1 mL/min.
   - If leakage occurs, disassemble and remake the connection, and repeat the leak test.
   - If the backpressure on the LC pump is high, replace the capillary, and repeat the leak test.
10. When no leakage occurs and the backpressure on the LC pump is normal, disconnect the PEEK tubing from the LC pump.
11. Remove the probe inlet connector and PEEK tubing from the PEEK union.
12. Remove the probe heater (see page 4-85, step 2).
13. Fit the PEEK union/UNF coupling assembly to the nebulizer adjuster knob.
14. Carefully thread the capillary through the probe assembly.

15. Carefully push the PEEK union/UNF coupling assembly and capillary into the probe assembly so that the locating pin on the UNF coupling is fully engaged in the locating slot at the head of the probe assembly.



16. Fit the nebulizer adjuster knob to the PEEK union/UNF coupling assembly.
17. Finger-tighten the nebulizer adjuster knob onto the probe assembly.
18. Fit the probe gasket and end-cover to the probe assembly.
19. Use the combined 2.5-mm Allen wrench and cone extraction tool to fit and tighten the 3 screws retaining the probe end-cover.
20. Return the combined 2.5-mm Allen wrench and cone extraction tool in its storage location on the source adaptor housing.

Caution:

- When handling the probe heater, take great care to grip the heater so as not to damage its electrical wiring.
- Take great care not to damage the probe heater's electrical connections, capillary sleeve, or capillary when fitting the heater over the capillary sleeve.

21. Fit the probe heater (see page 4-86, step 1 through step 3).
22. Fit the probe to the instrument (see page 3-6).
23. In the Instrument Console, click API  to start the probe and desolvation gas flows.

Cleaning or replacing the corona pin

Required materials

- Chemical-resistant, powder-free gloves
- Needle-nose pliers
- HPLC-grade (or better) methanol
- Lint-free tissue
- Lapping film
- Corona pin

To clean or replace the corona pin:

Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: The probe and source can be hot. To avoid burn injuries, take great care while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is in Standby mode before commencing this procedure.

Warning: The corona pin tip is sharp. To avoid puncture wounds, handle the corona pin with care.

1. Remove the corona pin from the source (see page 4-15) and inspect the pin for damage.
2. Replace the corona pin if it is damaged; otherwise clean its tip with the lapping film and a methanol-saturated tissue.
3. Install the corona pin in the source (see page 4-12).

Replacing the IonSABRE II probe heater

Replace the IonSABRE II probe heater if it fails to heat the probe.

Removing the IonSABRE II probe heater

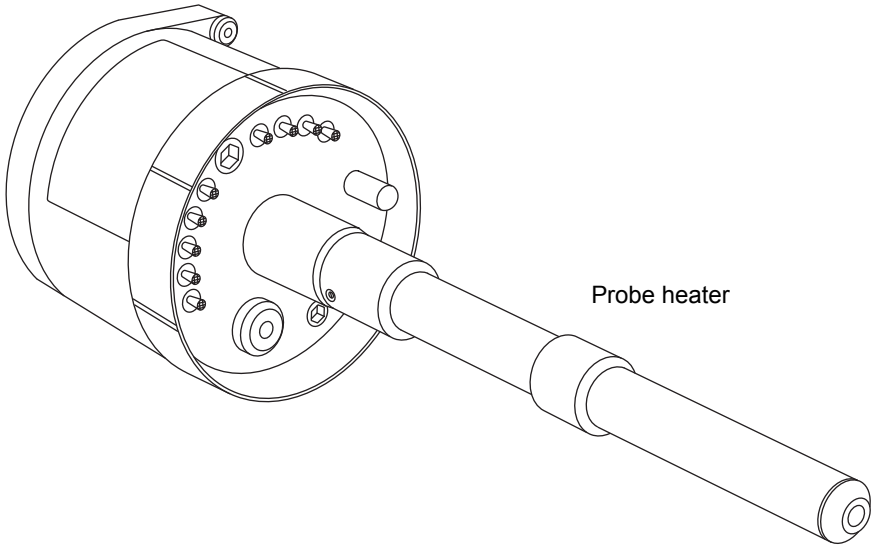
Required material

Chemical-resistant, powder-free gloves

To remove the IonSABRE II probe heater:

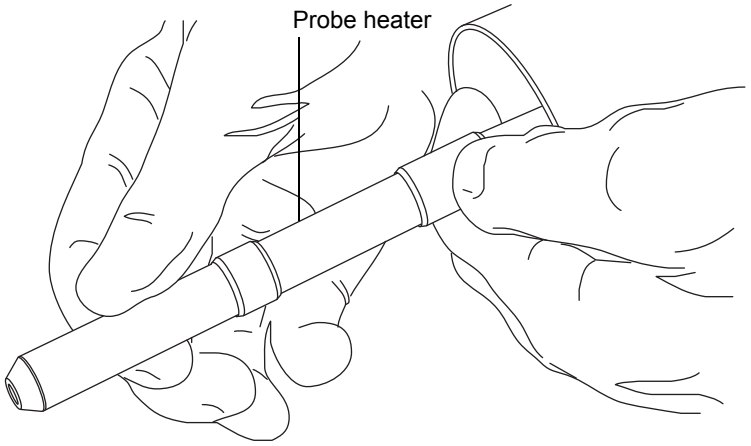
Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Remove the probe from the source (see page 3-8).



Caution: To avoid damaging the probe heater's electrical connections, do not twist the heater when removing it from the probe assembly.

2. Gripping the probe heater as shown, carefully pull it off the probe assembly.



Warning: The probe heater can be contaminated with biohazardous and/or toxic materials. Dispose of it according to local environmental regulations.

3. Dispose of the probe heater in accordance with local environmental regulations.

Fitting the new IonSABRE II probe heater

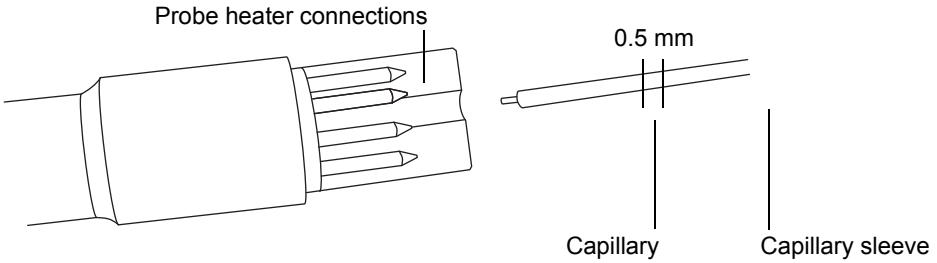
Required materials

- Chemical-resistant, powder-free gloves
- IonSABRE II probe heater

To fit the new IonSABRE II probe heater:

Caution: Take great care not to damage the probe heater's electrical connections, capillary sleeve, or capillary when fitting the heater over the capillary sleeve.

1. Use the probe adjuster knob to adjust the capillary so that it protrudes approximately 0.5 mm from the end of the probe.



2. Carefully slide the probe heater over the capillary sleeve on the probe assembly.

Caution: To avoid damaging the probe heater's electrical connections, do not twist the heater when fitting it to the probe assembly.

3. Fit the probe heater to the probe assembly, ensuring that the heater is fully seated on the probe assembly.
4. Fit the probe to the instrument (see page 3-6).
5. In the Instrument Console, click API  to start the desolvation gas.

Replacing the ion block source heater

Replace the ion block source heater if it fails to heat when the instrument is pumped down (evacuated).

Required materials

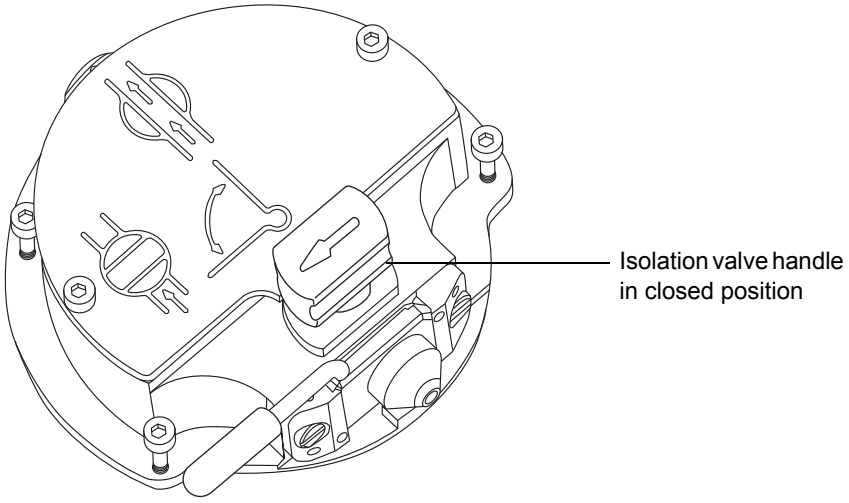
- Chemical-resistant, powder-free gloves

- Needle-nose pliers
- Combined 2.5-mm Allen wrench and cone extraction tool
- Ion block source heater

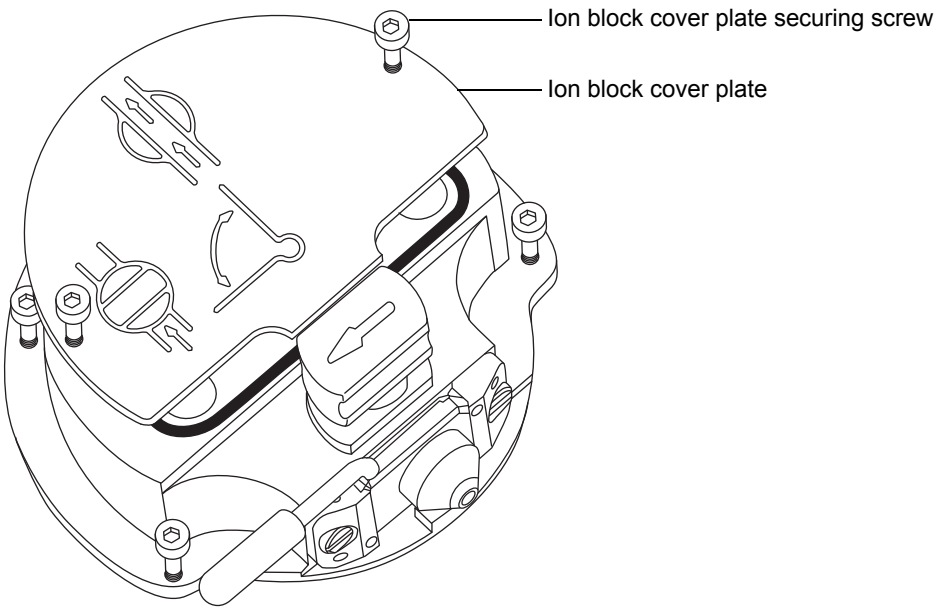
To replace the ion block source heater

Warning: The ion block assembly can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Remove the ion block assembly from the instrument (see page 4-37).
2. Ensure that the isolation valve is closed.

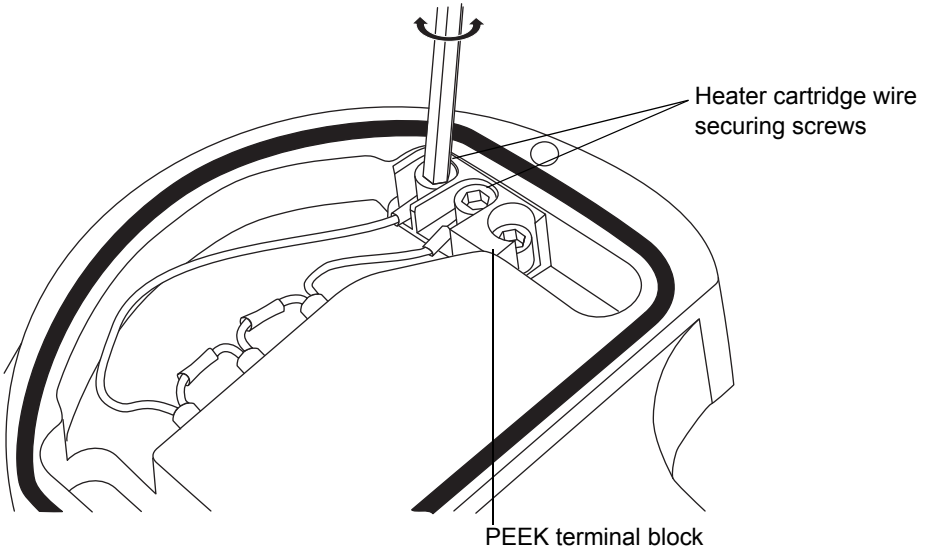


3. Use the combined 2.5-mm Allen wrench and cone extraction tool to loosen the 2 captive screws securing the ion block cover plate.

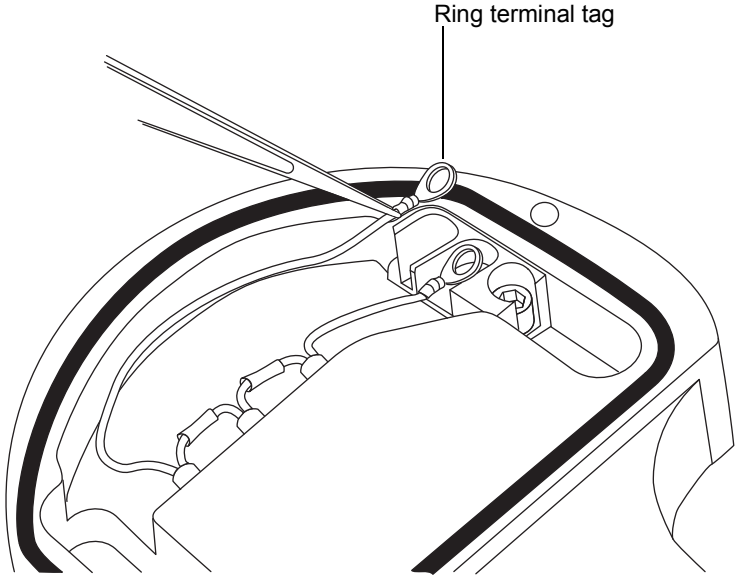


4. Remove the ion block cover plate.

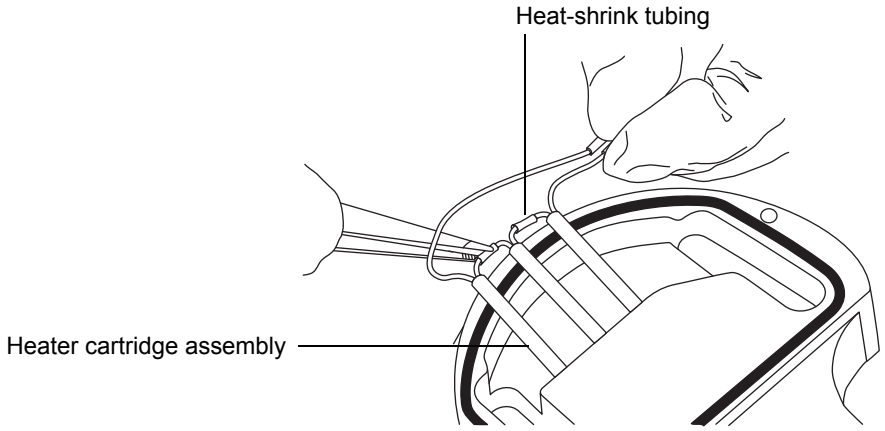
5. Use the combined 2.5-mm Allen wrench and cone extraction tool to remove the 2 screws securing the heater wires to the PEEK terminal block.



6. Use the needle-nose pliers to carefully swing the ring terminal tags out of the terminal block.



7. Use the needle-nose pliers to gently grasp the heat-shrink tubing on the heater cartridge assembly and slide the assembly out of the ion block.



8. Dispose of the heater cartridge assembly.

   Caution: To avoid damaging the heater cartridge assembly wires, do not bend or twist them when fitting the assembly to the ion block.

9. Use the needle-nose pliers to gently grasp the heat-shrink tubing on the new heater cartridge assembly and slide the assembly into the ion block.

   Caution: To avoid a short circuit to the ion block cover, ensure that the 2 heater cartridge ring tags are pushed fully down on the PEEK block terminals.

10. Use the needle-nose pliers to position the 2 heater wire ring tags fully down on the PEEK block terminals.
11. Use the combined 2.5-mm Allen wrench and cone extraction tool to fit and tighten the 2 screws securing the heater wires to the PEEK terminal block.
12. Fit the ion block cover plate to the ion block assembly, and then use the combined 2.5-mm Allen wrench and cone extraction tool to tighten the 2 captive screws securing ion block cover plate.

Fit the ion block assembly to the instrument (see page 4-55).

Replacing the source assembly seals

Warning: To avoid excessive leakage of toxic and biohazardous solvent vapor into the laboratory atmosphere, the seals listed below must be renewed, at intervals of no greater than 1 year, exactly as described in this section.

To avoid excessive leakage of solvent vapor into the laboratory atmosphere, the following seals must be renewed at intervals of no greater than 1 year:

- Probe adjuster assembly probe seal
- Probe adjuster assembly nebulization gas seal
- Source enclosure seal
- Nebulizer gas seal
- Desolvation gas seal

Removing the probe adjuster assembly probe and source enclosure seals

Required materials

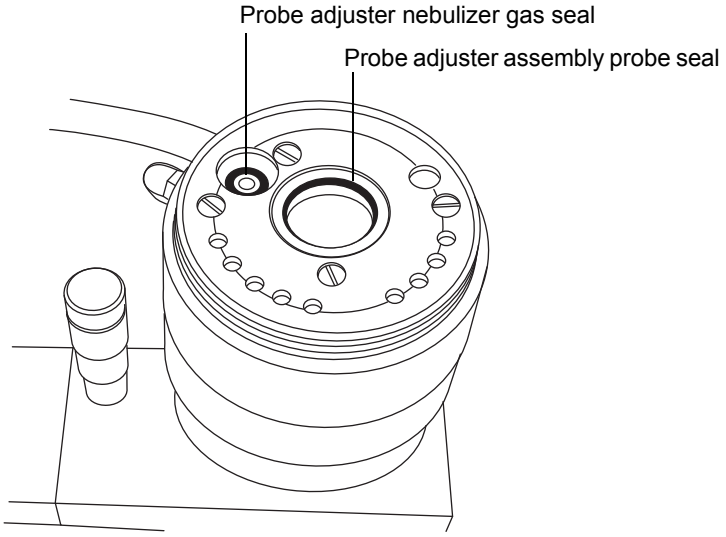
- Chemical-resistant, powder-free gloves
- O-ring removal kit

To remove the probe adjuster assembly probe and source enclosure seals:

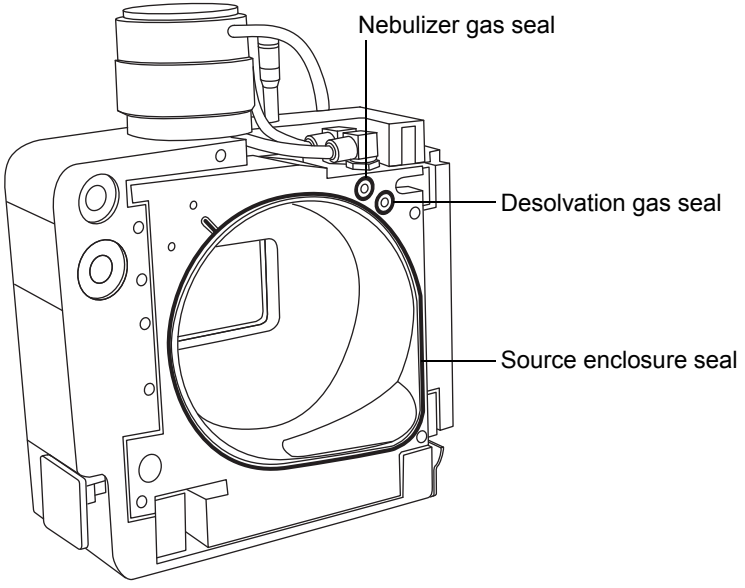
Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Remove the source enclosure from the instrument (see page 4-8).
2. Use the O-ring removal kit to carefully remove the following seals from the probe adjuster assembly (see page 4-19):
   - Probe seal

- Nebulizer gas seal



3. Use the O-ring removal kit to carefully remove the following seals from the source enclosure:
   - Source enclosure seal
   - Nebulizer gas seal
   - Desolvation gas seal



Warning: The seals can be contaminated with biohazardous and/or toxic materials. Dispose of them according to local environmental regulations.

4. Dispose of all the seals in accordance with local environmental regulations.

Fitting the new source enclosure and probe adjuster assembly seals

Required materials

- Chemical-resistant, powder-free gloves
- Wash bottle containing HPLC-grade (or better) 1:1 methanol/water
- New seals

To fit the new source enclosure and probe adjuster assembly probe seals:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Ensure that all the grooves for seals are free from dirt and debris.

   Tip: If contamination is present, use 1:1 methanol/water, applied to a lint-free cloth, to carefully clean the grooves.

   Caution: Ensure that the tails of the source enclosure seals are correctly located in the groove when fitting them to the source enclosure.

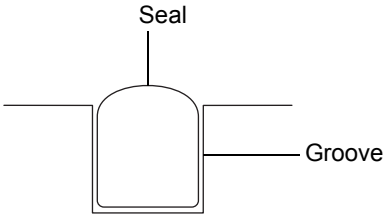
2. Fit the new source enclosure seal to the source enclosure.

   Tip: Start by feeding the seal into the groove at the bottom right-hand corner, and then working around the seal in a counterclockwise direction.

3. Fit the following new seals to the source enclosure:
   - Nebulizer gas seal

- Desolvation gas seal

Requirement: These seals have a special cross-section; fit them in the groove as shown.



4. Fit the following new seals to the probe adjuster assembly:
   - Probe seal
   - Nebulizer gas seal
5. Refit the source enclosure to the instrument (see page 4-11).

Replacing the air filter

You must replace the air filter annually.

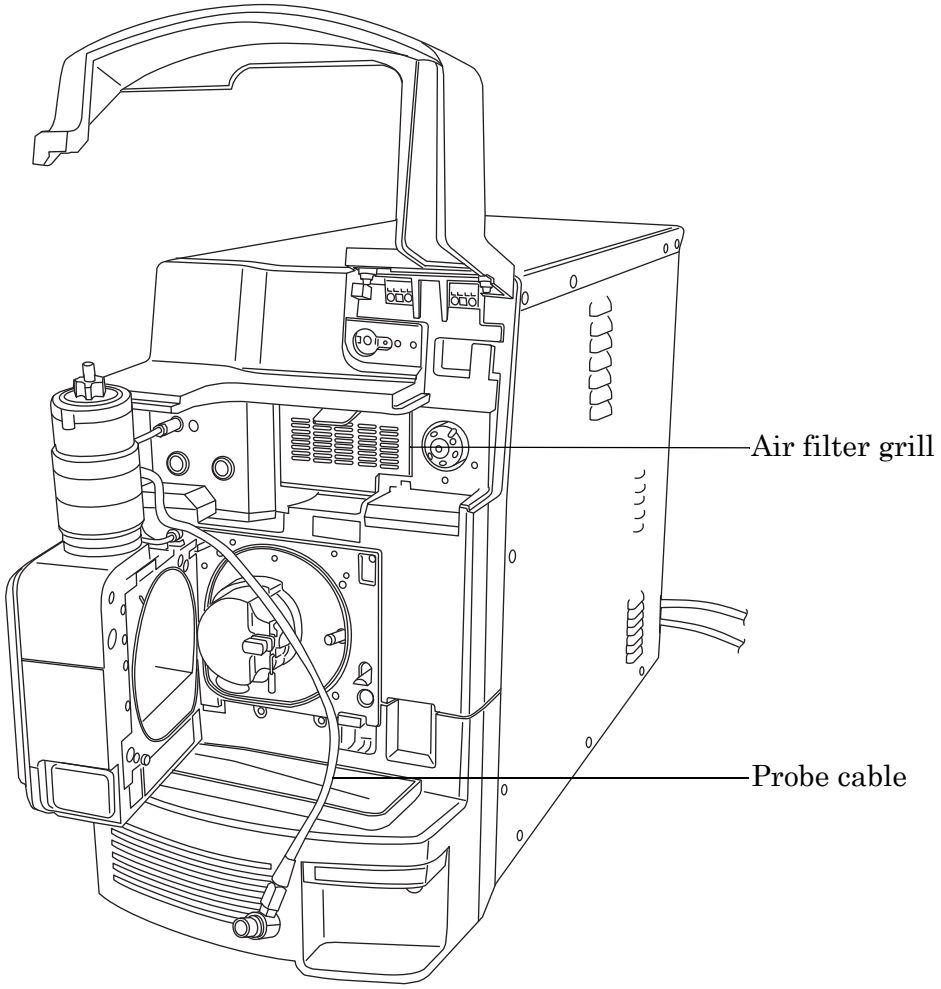
Required material

New air filter

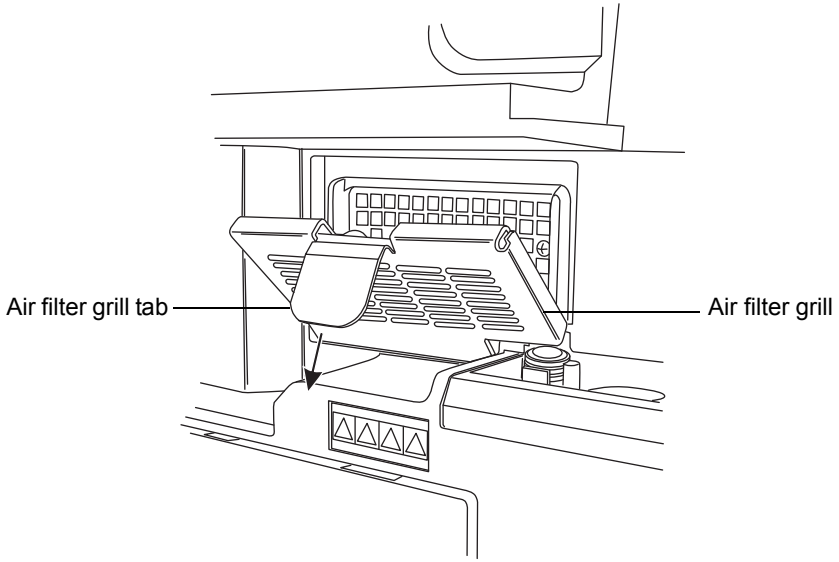
To replace the air filter:

1. Lift the instrument's visor so that the source probe is fully exposed.
2. Fully open the source enclosure.

3. Disconnect the probe cable from the high-voltage connector, and leave the cable in a position that does not obstruct the air filter grill.



4. Open the air filter grill by pulling the tab at the top of the grill toward you.



5. Remove and dispose of the old filter.
6. Place the new filter flat on the inside of the grill, with its edges beneath the metal lip.
7. Close the air filter grill.
8. Connect the probe cable to the high-voltage connector.
9. Close the source enclosure.
10. Lower the instrument's visor.

Replacing the roughing pump oil

Change the roughing pump oil annually.

Note: This procedure is not required for an Edwards oil-free roughing pump.

Required materials

- Chemical-resistant, powder-free gloves
- 8-mm Allen wrench

- Flat-blade screwdriver
- Container to catch used oil
- Funnel
- 1-L container of Anderol vacuum oil, type GS 495

To replace the roughing pump oil:

1. Gas ballast the roughing pump for 1 hour to reduce the oil viscosity (see page 4-22).

   Rationale: Gas ballasting helps to circulate and mix the oil through the pump before draining.

2. Vent and shut down the instrument (see the mass spectrometer's online Help for details).

3. Allow the roughing pump to cool.

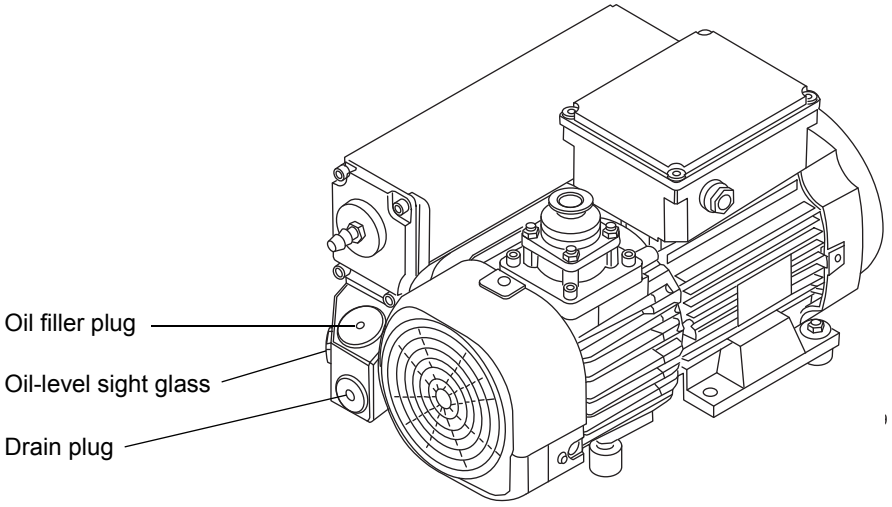
   Warning: The roughing pump oil can be irritant, or contaminated with biohazardous or toxic analyte accumulated during normal operation. Always wear chemical-resistant, powder-free gloves when adding or replacing oil.

   Warning: To avoid burn injuries, take great care while working with the roughing pump; it can be hot.

4. Place the container for used oil under the pump's drain plug.

5. Use the 8-mm Allen wrench to remove the oil filler plug.



6. Use the 8-mm Allen wrench to remove the oil drain plug.
7. Tip the pump toward the drain plug aperture and allow the oil to drain completely into the container.

Warning: The roughing pump oil can be irritant, or contaminated with biohazardous and/or toxic materials. Ensure that it is correctly disposed of according to local environmental regulations.

8. Dispose of the roughing pump oil in accordance with local environmental regulations.
9. Ensure that the O-ring on the oil drain plug is clean and properly seated.

Caution: Observe these precautions to avoid oil leakage when fitting the oil drain plug to the roughing pump:

- Ensure that the plug is not cross-threaded.
- Ensure that the O-ring is not pinched.
- Do not overtighten the plug.

10. Use the 8-mm Allen wrench to fit and tighten the roughing pump's oil drain plug.

Tip: When the oil drain plug is tightened, the plug seals with an O-ring. Compression is controlled by the O-ring groove depth in the plug. Increased torque does not improve the plug seal; it only makes the plug difficult to remove later.

Caution: To maintain pump performance, use Anderol vacuum oil, type GS 495.

11. Using the funnel, pour all the oil from the 1-L container into the oil filler aperture.
12. Wait a few minutes, and then recheck the oil level.
13. Ensure that the O-ring on the oil filler plug is clean and properly seated.

Caution: Observe these precautions to avoid oil leakage when fitting the oil filler plug to the roughing pump:

- Ensure that the plug is not cross-threaded.
- Ensure that the O-ring is not pinched.
- Do not overtighten the plug.

14. Use the 8-mm Allen wrench to refit the oil filler plug.
15. Gas ballast the roughing pump (see page 4-22).

Tip: After you add oil to the pump, the following situations can occur:

- The oil level drops slightly during the first month of operation.
- The oil changes color (darkens) over time.
- After the pump runs for 12 to 48 hours, a few drops of oil often appear near the filler plug. Excess oil around the lip of the filler plug runs down and drips off the pump once the pump reaches operating temperature.
- When the pump begins to run at normal operating temperature, spilled oil smells slightly.

Replacing the roughing pump's oil demister element

Replace the roughing pump's oil demister element annually.

Note: This procedure is not required for an Edwards oil-free roughing pump.

Required materials

- Chemical-resistant, powder-free gloves
- 6-mm Allen wrench
- 10-mm wrench

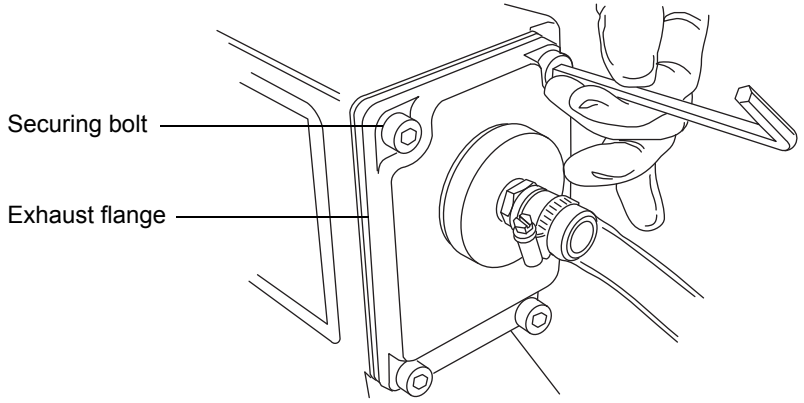
To remove the roughing pump oil demister element:

1. Vent and shut down the instrument (see the mass spectrometer's online Help for details).
2. Allow the roughing pump to cool.

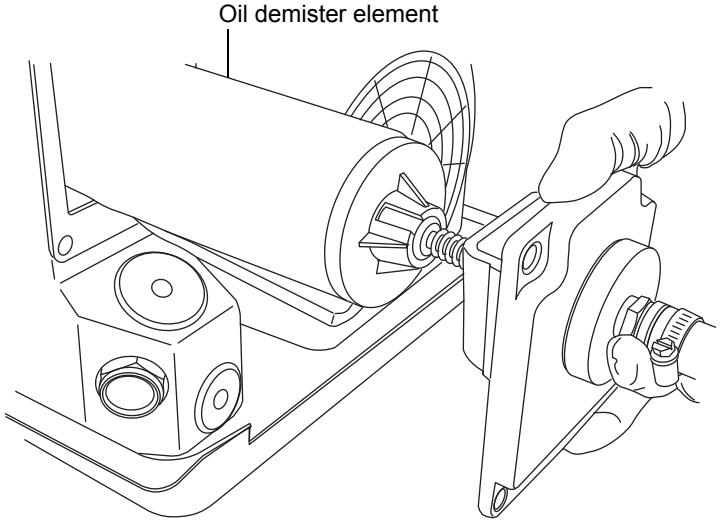
Warning: The pump oil can be irritant, or contaminated with biohazardous or toxic analyte accumulated during normal operation. Always wear chemical-resistant, powder-free gloves when replacing the oil demister element.

Warning: To avoid burn injuries, take great care while working with the roughing pump; it can be hot.

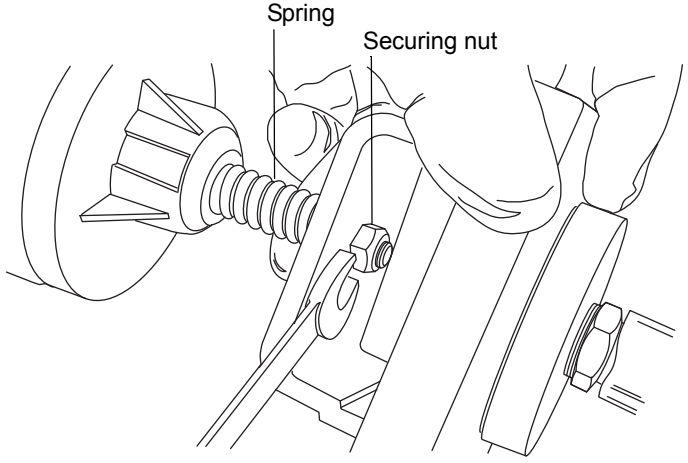
3. Use the 6-mm Allen wrench to remove the 4 bolts securing the exhaust flange to the roughing pump.



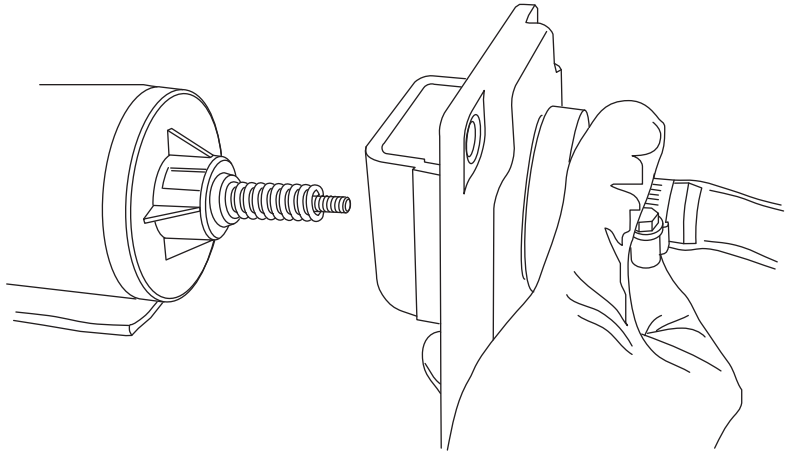
4. Carefully remove the exhaust flange and oil demister element from the roughing pump.



5. Use the 10-mm wrench to remove the nut that secures the oil demister element to the exhaust flange.



6. Holding the oil demister element slightly elevated to prevent the loss of the spring, remove the exhaust flange from the oil demister element.



7. Remove the spring from the oil demister element.

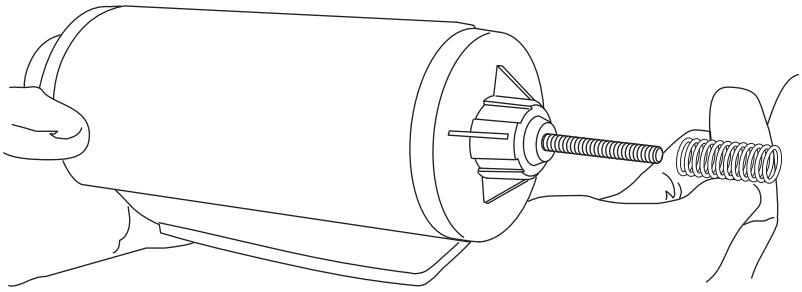
Warning: The oil demister element can be contaminated with irritant oil, or biohazardous and/or toxic materials. Ensure that it is correctly disposed of according to local environmental regulations.

8. Dispose of the oil demister element in accordance with local environmental regulations.

To fit the new oil demister element:

Warning: The pump oil can be irritant, or contaminated with biohazardous or toxic analyte accumulated during normal operation. Always wear chemical-resistant, powder-free gloves when replacing the oil demister element.

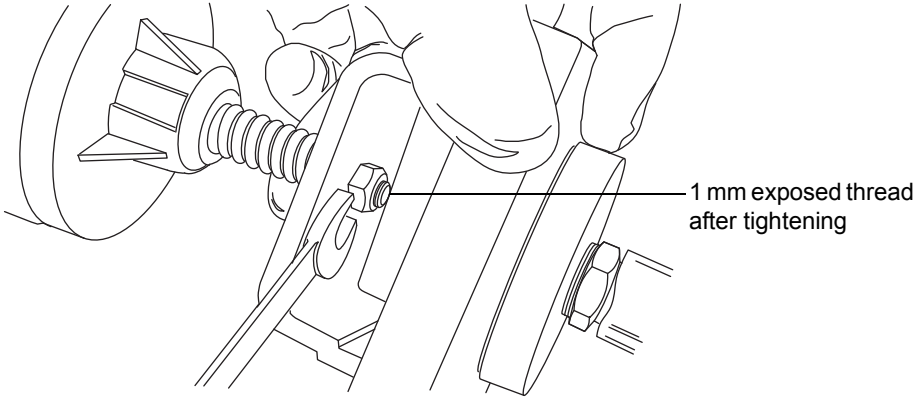
1. Fit the spring to the new oil demister element.



2. Holding the oil demister element slightly elevated to prevent the loss of the spring, fit the exhaust flange to the oil demister element.

Caution: The nut that secures the oil demister element to the exhaust flange must not be overtightened; ensure that only approximately 1 mm of thread is exposed beyond the nut when it is tightened.

3. Use the 10-mm wrench to fit and tighten the nut that secures the oil demister element to the exhaust flange.



4. Ensure that the inscription “TOP” is at the top of the oil demister element, and, using both hands, carefully fit the oil demister element and exhaust flange to the roughing pump.

Caution: The bolts securing the source exhaust flange to the roughing pump must each be sequentially and incrementally tightened until they are all fully tight.

5. Use the 6-mm Allen wrench to fit the 4 bolts securing the exhaust flange to the roughing pump.

APPI/APCI source—changing the UV lamp bulb

Required materials

- Chemical-resistant, powder-free gloves
- Combined 2.5-mm Allen wrench and cone extraction tool
- Small Phillips® (cross-head) screwdriver
- 20-cm (8-inch) length of 4-mm nylon tube

To change the UV lamp bulb:

Warning: The source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is suitably prepared before commencing this procedure.

1. Prepare the instrument for working on the source (see page 4-7).

   Warning: The probe, source, and lamp bulb can be hot. To avoid burn injuries, take great care while working with these components.

   Warning: To avoid eye injury from UV radiation, ensure that the APPI lamp is extinguished before carrying out this procedure.

2. Pull the source enclosure release (located at the bottom, right-hand side) outward, and swing open the enclosure.
3. Retrieve the combined 2.5-mm Allen wrench and cone extraction tool from its storage location on the source adaptor housing.
4. Hook the short-end of the Allen wrench through the ring on the back of the bulb extraction plug, and tug to remove it.

Caution: To avoid breaking the bulb, do not use a screwdriver to push the bulb forward in the lamp drive assembly.

5. Insert the length of 4-mm nylon tube through the back of the lamp drive assembly, and push the bulb forward.
6. Remove the bulb from the lamp drive assembly.
7. Insert the new bulb into the lamp drive assembly.

   Tip: The lamp glass is magnesium fluoride. Avoid touching it because dirt or other contaminants on the window significantly reduce UV transmission.
8. Refit the lamp bulb access plug.
9. Return the combined 2.5-mm Allen wrench and cone extraction tool to its storage location on the source adaptor housing.
10. Close the source enclosure.
11. Slide closed the instrument's source interface door.

APPI/APCI source—cleaning the lamp window

The transmission of the high-energy photons responsible for APPI relies on the cleanliness of the magnesium fluoride lamp window. Clean the window to keep the surface clear of contamination and thus avoid reduced sensitivity.

Required materials

- Chemical-resistant, powder-free gloves
- Lint-free cloth
- Methanol or isopropyl alcohol

To clean the lamp window:

1. Prepare the instrument for working on the source (see page 4-7).

Warning: The probe, source, and lamp bulb can be hot. To avoid burn injuries, take great care while working with these components.

Warning: To avoid eye injury from UV radiation, ensure that the APPI lamp is extinguished before carrying out this procedure.

2. Pull the source enclosure release (located at the bottom, right-hand side) outward, and swing open the enclosure
3. Use methanol or isopropyl alcohol, applied to the lint-free cloth, to carefully clean the lamp window.
4. Close the source enclosure.
5. Slide closed the instrument's source interface door.

APPI/APCI source—replacing the APPI lamp drive seals

Warning: To avoid leaking of biohazardous or toxic materials, ensure the integrity of the source exhaust system. The APPI lamp drive assembly O-rings listed below must be renewed at intervals not exceeding 1 year, exactly as described in this section.

The following APPI lamp drive assembly O-rings must be renewed at intervals of no greater than 1 year:

- UV lamp bulb sealing O-ring
- Mounting shaft O-rings
- UV lamp mounting flange O-ring

Tip: An automatic pressure test runs each time you close the source enclosure and when the instrument starts.

Removing the APPI lamp drive assembly seals

Required materials

- Chemical-resistant, powder-free gloves.
- Combined 2.5-mm Allen wrench and cone extraction tool.

- 3-mm Allen wrench.
- Small Phillips (cross-head) screwdriver.
- Small Pozidrive® screwdriver.
- 20-cm (8-inch) length of 4-mm nylon tube.
- O-ring removal kit.
- The mounting-shaft insertion tool.
- A suitable, clear working area on a bench.
- A soft cloth or mat to protect the source enclosure window as it is laid on its face.

To remove the APPI lamp drive assembly seals:

Warning: The probe and source components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Warning: To avoid electric shock, ensure that the instrument is in Standby mode before commencing this procedure.

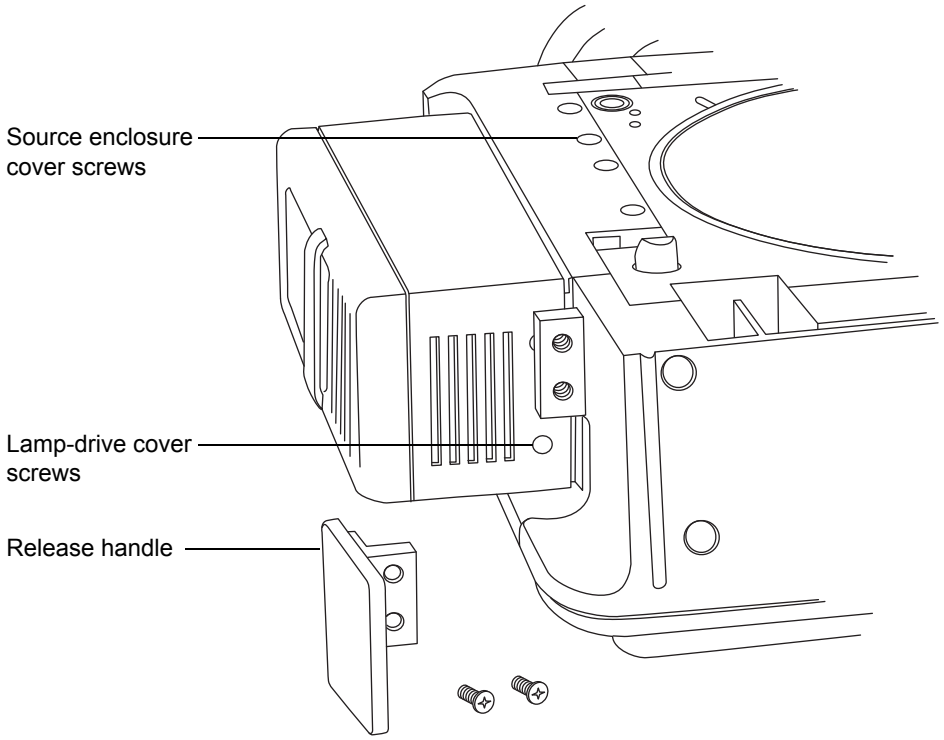
1. Remove the IonSABRE II probe and combined APPI/APCI source enclosure (see page 3-15).

Caution: The UV bulb is fragile; to avoid damaging it, handle it with care.

2. Remove the UV bulb from the lamp drive assembly, and store it in a secure place (see page 4-106).
3. Retrieve the combined 2.5-mm Allen wrench and cone extraction tool from its storage location on the source adaptor housing.
4. Use the combined 2.5-mm Allen wrench and cone extraction tool to remove the 2 lamp-drive cover screws (located above the bulb-extraction plug-aperture).

Caution: Take care to lay the source enclosure on a smooth surface. Laying it face-first on a hard object or other protrusion can smash the glass window.

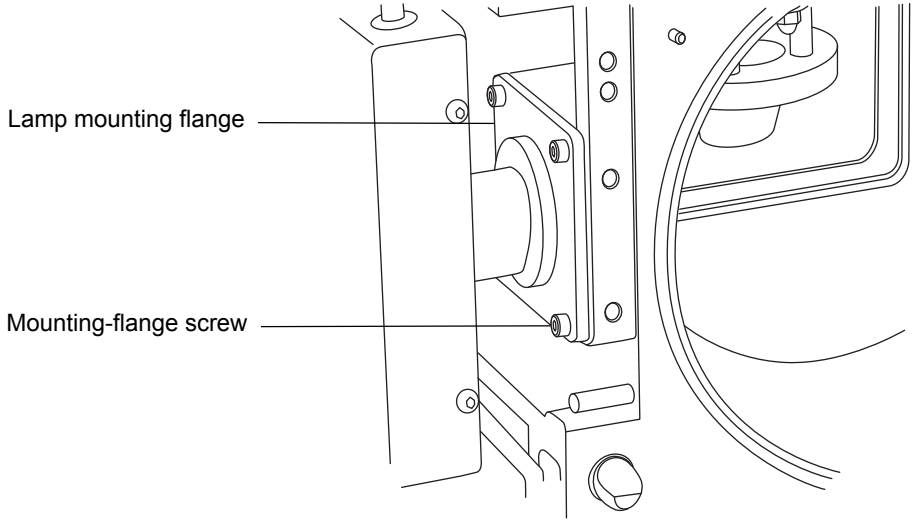
5. Clear an area, lay out the soft cloth or mat, and lay the source enclosure on its face.
6. Use the Phillips (cross-head) screwdriver to remove the 2 source enclosure, release-handle screws, and remove the handle.



7. Use the combined 2.5-mm Allen wrench and cone extraction tool to remove the remaining 2 lamp-drive cover screws, which were hidden by the release handle.
8. Slide the cover off the lamp drive.
9. Use the 3-mm Allen wrench to remove the 4 source enclosure cover screws.
10. Ease the source enclosure cover over the lamp drive assembly.

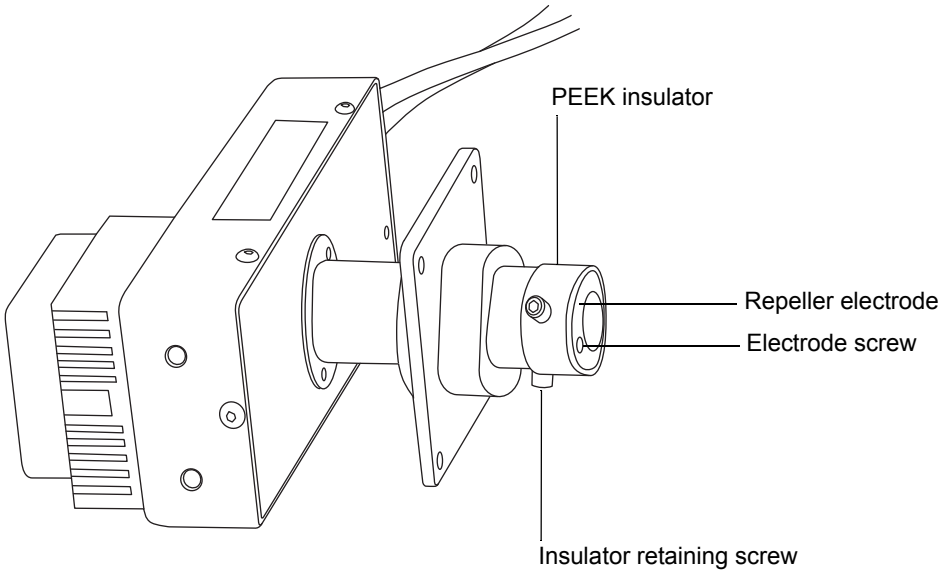
11. Use the combined 2.5-mm Allen wrench and cone extraction tool to unscrew the 4 mounting-flange screws.

    Tip: Take care not to drop the screws inside the lower cover.



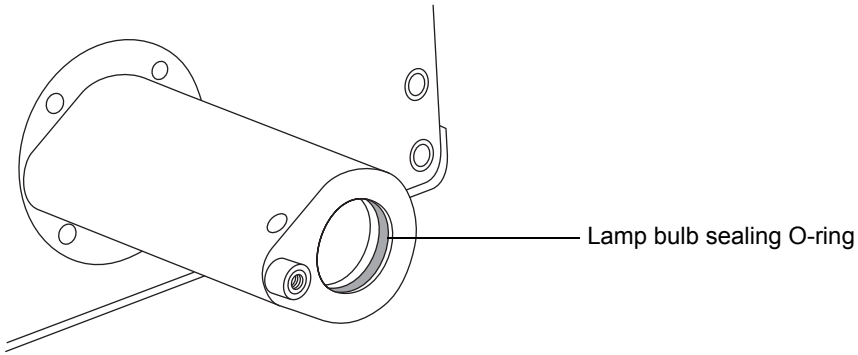
12. Slide the lamp assembly, shaft, and flange out of the APPI source enclosure.

    Tip: The cables remain attached to the shaft, which you fully withdraw and lay on the bench beside the source enclosure.

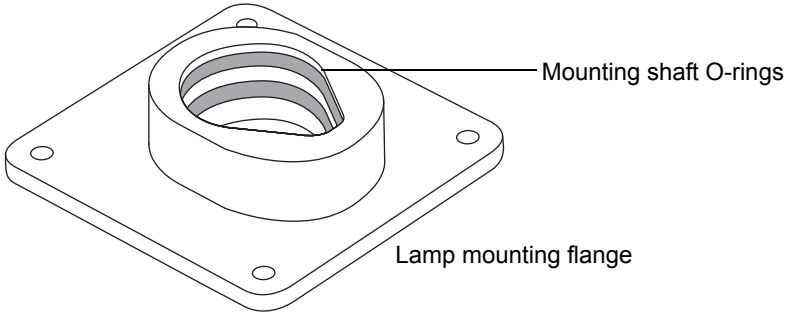


13. Using the small Phillips screwdriver, remove the electrode screw and repeller electrode.
14. Use the combined 2.5-mm Allen wrench and cone extraction tool to remove the two insulator screws.
15. Remove the PEEK insulator from the end of the mounting shaft.
16. Slide the shaft mounting flange off the shaft, and note the correct orientation, for its reassembly.

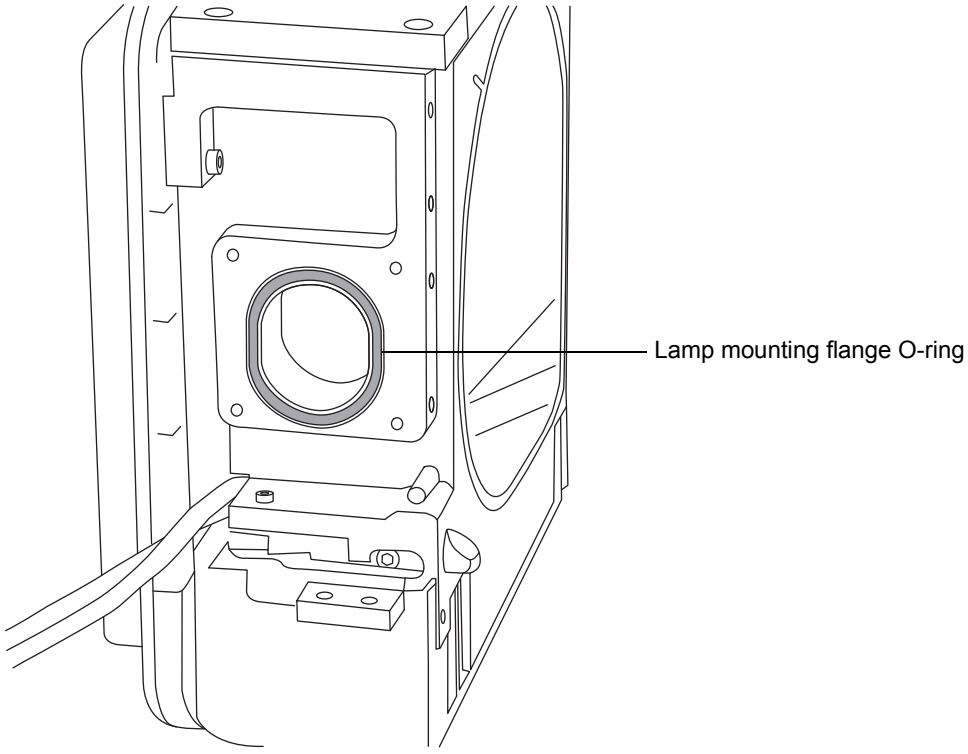
17. Use the O-ring removal kit to carefully remove the O-ring sealing the lamp bulb from inside the bulb holder (see page 4-19).



18. Use the O-ring removal kit to carefully remove the two O-rings from inside the lamp mounting flange.



19. Use the O-ring removal kit to carefully remove the shaft mounting flange O-ring from the APPI source enclosure side.



Warning: The O-rings can be contaminated with biohazardous and/or toxic materials. Ensure that they are correctly disposed of according to local environmental regulations.

20. Dispose of the O-rings in accordance with local environmental regulations.

Fitting the new APPI lamp drive assembly O-rings

Required materials

- Chemical-resistant, powder-free gloves
- 3-mm Allen wrench
- Small Phillips (cross-head) screwdriver
- Small Pozidrive screwdriver
- 1:1 methanol/water
- Lint-free cloth

To fit the new APPI lamp drive assembly O-rings:

Warning: The lamp drive assembly components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

Caution: Take care not to damage the APPI lamp drive assembly O-rings when fitting them. Small nicks, tears, dirt, and dust can compromise their performance, leading to rapid deterioration in the assembly's operation.

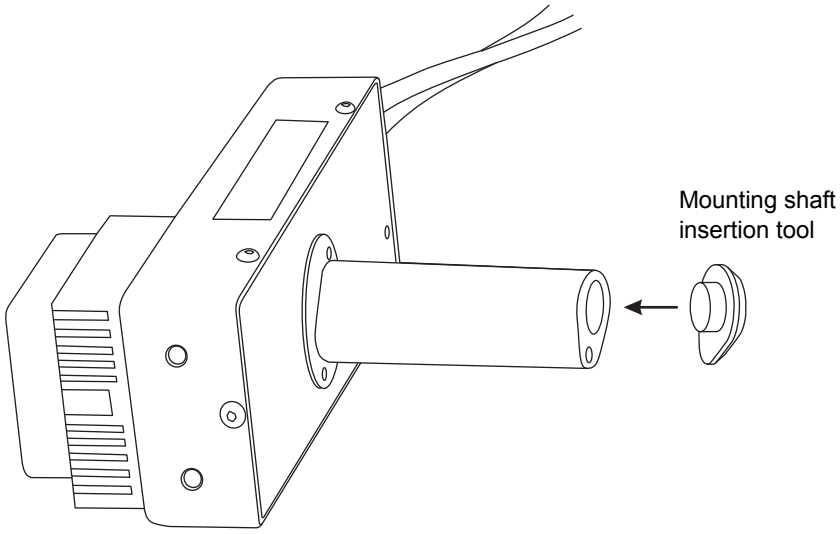
1. Ensure that all the grooves for the O-rings are free from dirt and hair.

   Tips:

   - If contamination is present, use 1:1 methanol/water, applied to the lint-free cloth, to carefully clean the grooves.
   - For the asymmetric O-ring seals, first seat the O-ring in the small radius at the bottom of the groove. Then use a suitable tool, one with a circular cross-section, to "roll" the remainder of the O-ring into the groove.

2. Fit the lamp bulb sealing O-ring in the lamp aperture.
3. Fit the two new O-rings inside the lamp mounting flange.
4. Fit the new lamp mounting flange O-ring to the APPI source enclosure side.

5. Fit the mounting shaft insertion tool to the mounting shaft.



Caution: To prevent damage to the mounting shaft O-rings, fit the mounting shaft insertion tool to the mounting shaft before fitting the shaft to the lamp mounting flange.

6. Slide the lamp mounting flange onto the shaft, taking care to align it correctly.
7. Reinsert the shaft through the side of the source enclosure, and fit the lamp mounting flange to the APPI source enclosure side.

Caution: Tighten the securing screws sequentially and by small increments until they are all fully tight. Doing so ensures that the lamp mounting flange is uniformly seated on the APPI source enclosure side plate.

8. Use the combined 2.5-mm Allen wrench and cone extraction tool to tighten the four mounting-flange securing screws.
9. Remove the mounting shaft insertion tool from the mounting shaft.
10. Fit the PEEK insulator to the end of the mounting shaft.
11. Use the combined 2.5-mm Allen wrench and cone extraction tool to fit and tighten the two insulator retaining screws.

12. Fit the repeller electrode to the PEEK insulator.
13. Use the small Phillips screwdriver to fit and tighten the repeller electrode retaining screw.
14. Insert the UV bulb into the lamp drive assembly and push it fully home.
15. Fully retract the lamp mounting shaft from the source enclosure.
16. Refit the lamp-assembly collar-cover, and secure it on its base with the 4 screws.
17. Refit the lamp assembly cover, and secure it on its base (2 screws) and above the bulb extraction aperture (2 screws).
18. Refit the source enclosure release handle, and secure it with the 2 screws.

    Refit and reconnect the source enclosure to the machine, refit the corona pin and probe. Refer to page 3-13 for instructions.

Replacing the instrument's fuses

Warning: To avoid electrical shock, disconnect the mass spectrometer from the power supply before replacing fuses.

Warning: To protect against fire, replace fuses with those of the type and rating specified below, and printed on panels adjacent to the instrument's fuse covers.

If one or both of the mass spectrometer's fuses blow, the instrument will shut down immediately. If this occurs, disconnect the power cord from the rear panel, and replace the fuses, located at the bottom left-hand-side of the instrument's rear panel, with T10AH250V, 6x32mm fuses.

A Safety Advisories

Waters instruments display hazard symbols designed to alert you to the hidden dangers of operating and maintaining the instruments. Their corresponding user guides also include the hazard symbols, with accompanying text statements describing the hazards and telling you how to avoid them. This appendix presents all the safety symbols and statements that apply to the entire line of Waters products.

Contents:

Warning symbols

Warning symbols alert you to the risk of death, injury, or seriously adverse physiological reactions associated with an instrument's use or misuse. Heed all warnings when you install, repair, and operate Waters instruments. Waters assumes no liability for the failure of those who install, repair, or operate its instruments to comply with any safety precaution.

Task-specific hazard warnings

The following warning symbols alert you to risks that can arise when you operate or maintain an instrument or instrument component. Such risks include burn injuries, electric shocks, ultraviolet radiation exposures, and others.

When the following symbols appear in a manual's narratives or procedures, their accompanying text identifies the specific risk and explains how to avoid it.


Warning: (General risk of danger. When this symbol appears on an instrument, consult the instrument's user documentation for important safety-related information before you use the instrument.)


Warning: (Risk of burn injury from contacting hot surfaces.)


Warning: (Risk of electric shock.)


Warning: (Risk of fire.)


Warning: (Risk of sharp-point puncture injury.)


Warning: (Risk of hand crush injury.)


Warning: (Risk of exposure to ultraviolet radiation.)


Warning: (Risk of contacting corrosive substances.)


Warning: (Risk of exposure to a toxic substance.)


Warning: (Risk of personal exposure to laser radiation.)

Warning: (Risk of exposure to biological agents that can pose a serious health threat.)

Warning: (Risk of tipping.)

Warning: (Risk of explosion.)

Specific warnings

The following warnings can appear in the user manuals of particular instruments and on labels affixed to them or their component parts.

Burst warning

This warning applies to Waters instruments fitted with nonmetallic tubing.

Warning: Pressurized nonmetallic, or polymer, tubing can burst. Observe these precautions when working around such tubing:

- Wear eye protection.
- Extinguish all nearby flames.
- Do not use tubing that is, or has been, stressed or kinked.
- Do not expose nonmetallic tubing to incompatible compounds like tetrahydrofuran (THF) and nitric or sulfuric acids.
- Be aware that some compounds, like methylene chloride and dimethyl sulfoxide, can cause nonmetallic tubing to swell, which significantly reduces the pressure at which the tubing can rupture.

Mass spectrometer flammable solvents warning

This warning applies to instruments operated with flammable solvents.

Warning: Where significant quantities of flammable solvents are involved, a continuous flow of nitrogen into the ion source is required to prevent possible ignition in that enclosed space.

Ensure that the nitrogen supply pressure never falls below 400 kPa (4 bar, 58 psi) during an analysis in which flammable solvents are used. Also ensure a gas-fail connection is connected to the LC system so that the LC solvent flow stops if the nitrogen supply fails.

Mass spectrometer shock hazard

This warning applies to all Waters mass spectrometers.

Warning: To avoid electric shock, do not remove the mass spectrometer's protective panels. The components they cover are not user-serviceable.

This warning applies to certain instruments when they are in Operate mode.

Warning: High voltages can be present at certain external surfaces of the mass spectrometer when the instrument is in Operate mode. To avoid nonlethal electric shock, make sure the instrument is in Standby mode before touching areas marked with this high-voltage warning symbol.

Biohazard warning

This warning applies to Waters instruments that can be used to process material that can contain biohazards: substances that contain biological agents capable of producing harmful effects in humans.

Warning: Waters instruments and software can be used to analyze or process potentially infectious human-sourced products, inactivated microorganisms, and other biological materials. To avoid infection with these agents, assume that all biological fluids are infectious, observe Good Laboratory Practice (GLP), and consult your organization's biohazard safety representative regarding their proper use and handling. Specific precautions appear in the latest edition of the US National Institutes of Health (NIH) publication, *Biosafety in Microbiological and Biomedical Laboratories* (BMBL).

Chemical hazard warning

This warning applies to Waters instruments that can process corrosive, toxic, flammable, or other types of hazardous material.

Warning: Waters instruments can be used to analyze or process potentially hazardous substances. To avoid injury with any of these materials, familiarize yourself with the materials and their hazards, observe Good Laboratory Practice (GLP), and consult your organization's safety representative regarding proper use and handling. Guidelines are provided in the latest edition of the National Research Council's publication, *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals.*

Caution symbol

The caution symbol signifies that an instrument's use or misuse can damage the instrument or compromise a sample's integrity. The following symbol and its associated statement are typical of the kind that alert you to the risk of damaging the instrument or sample.

Caution: To avoid damage, do not use abrasives or solvents to clean the instrument's case.

Warnings that apply to all Waters instruments

When operating this device, follow standard quality-control procedures and the equipment guidelines in this section.

Attention: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Important: Toute modification sur cette unité n'ayant pas été expressément approuvée par l'autorité responsable de la conformité à la réglementation peut annuler le droit de l'utilisateur à exploiter l'équipement.

Achtung: Jedwede Änderungen oder Modifikationen an dem Gerät ohne die ausdrückliche Genehmigung der für die ordnungsgemäße Funktionstüchtigkeit verantwortlichen Personen kann zum Entzug der Bedienungsbefugnis des Systems führen.

Avvertenza: qualsiasi modifica o alterazione apportata a questa unità e non espressamente autorizzata dai responsabili per la conformità fa decadere il diritto all'utilizzo dell'apparecchiatura da parte dell'utente.

Atencion: cualquier cambio o modificación efectuado en esta unidad que no haya sido expresamente aprobado por la parte responsable del cumplimiento puede anular la autorización del usuario para utilizar el equipo.

注意：未經有關法規認證部門允許對本設備進行的改變或修改,可能會使使用者喪失操作該設備的權利。

注意：未经有关法规认证部门明确允许对本设备进行的改变或改装，可能会使使用者丧失操作该设备的合法性。

주의: 규정 준수를 책임지는 당사자의 명백한 승인 없이 이 장치를 개조 또는 변경할 경우, 이 장치를 운용할 수 있는 사용자 권한의 효력을 상실할 수 있습니다.

注意：規制機関から明確な承認を受けずに本装置の変更や改造を行うと、本装置のユーザーとしての承認が無効になる可能性があります。

Warning: Use caution when working with any polymer tubing under pressure:

- Always wear eye protection when near pressurized polymer tubing.
- Extinguish all nearby flames.
- Do not use tubing that has been severely stressed or kinked.
- Do not use nonmetallic tubing with tetrahydrofuran (THF) or concentrated nitric or sulfuric acids.
- Be aware that methylene chloride and dimethyl sulfoxide cause nonmetallic tubing to swell, which greatly reduces the rupture pressure of the tubing.

Attention: Manipulez les tubes en polymère sous pression avec precaution:

- Portez systématiquement des lunettes de protection lorsque vous vous trouvez à proximité de tubes en polymère pressurisés.
- Eteignez toute flamme se trouvant à proximité de l'instrument.
- Evitez d'utiliser des tubes sévèrement déformés ou endommagés.
- Evitez d'utiliser des tubes non métalliques avec du tétrahydrofurane (THF) ou de l'acide sulfurique ou nitrique concentré.
- Sachez que le chlorure de méthylène et le diméthylesulfoxyde entraînent le gonflement des tuyaux non métalliques, ce qui réduit considérablement leur pression de rupture.

Vorsicht: Bei der Arbeit mit Polymerschläuchen unter Druck ist besondere Vorsicht angebracht:

- In der Nähe von unter Druck stehenden Polymerschläuchen stets Schutzbrille tragen.
- Alle offenen Flammen in der Nähe löschen.
- Keine Schläuche verwenden, die stark geknickt oder überbeansprucht sind.
- Nichtmetallische Schläuche nicht für Tetrahydrofuran (THF) oder konzentrierte Salpeter- oder Schwefelsäure verwenden.
- Durch Methylenchlorid und Dimethylsulfoxid können nichtmetallische Schläuche quellen; dadurch wird der Berstdruck des Schlauches erheblich reduziert.

Attenzione: fare attenzione quando si utilizzano tubi in materiale polimerico sotto pressione:

- Indossare sempre occhiali da lavoro protettivi nei pressi di tubi di polimero pressurizzati.
- Spegnere tutte le fiamme vive nell'ambiente circostante.
- Non utilizzare tubi eccessivamente logorati o piegati.
- Non utilizzare tubi non metallici con tetraidrofurano (THF) o acido solforico o nitrico concentrati.
- Tenere presente che il cloruro di metilene e il dimetilsolfossido provocano rigonfiamenti nei tubi non metallici, riducendo notevolmente la pressione di rottura dei tubi stessi.

Advertencia: se recomienda precaución cuando se trabaje con tubos de polímero sometidos a presión:

- El usuario deberá protegerse siempre los ojos cuando trabaje cerca de tubos de polímero sometidos a presión.
- Si hubiera alguna llama las proximidades.
- No se debe trabajar con tubos que se hayan doblado o sometido a altas presiones.
- Es necesario utilizar tubos de metal cuando se trabaje con tetrahidrofurano (THF) o ácidos nítrico o sulfúrico concentrados.
- Hay que tener en cuenta que el cloruro de metileno y el sulfóxido de dimetilo dilatan los tubos no metálicos, lo que reduce la presión de ruptura de los tubos.

警告：當在有壓力的情況下使用聚合物管線時，小心注意以下幾點。

- 當接近有壓力的聚合物管線時一定要戴防護眼鏡。
- 熄滅附近所有的火焰。
- 不要使用已經被壓癟或嚴重彎曲管線。
- 不要在非金屬管線中使用四氫呋喃或濃硝酸或濃硫酸。
- 要了解使用二氯甲烷及二甲基亞楓會導致非金屬管線膨脹，大大降低管線的耐壓能力。

警告：当有压力的情况下使用管线时，小心注意以下几点：

- 当接近有压力的聚合物管线时一定要戴防护眼镜。
- 熄灭附近所有的火焰。
- 不要使用已经被压瘪或严重弯曲的管线。
- 不要在非金属管线中使用四氢呋喃或浓硝酸或浓硫酸。
- 要了解使用二氯甲烷及二甲基亚枫会导致非金属管线膨胀，大大降低管线的耐压能力。

경고**:** 가압 폴리머 튜브로 작업할 경우에는 주의하십시오.

- 가압 폴리머 튜브 근처에서는 항상 보호 안경을 착용하십시오.
- 근처의 화기를 모두 끄십시오.
- 심하게 변형되거나 꼬인 튜브는 사용하지 마십시오.
- 비금속(Nonmetallic) 튜브를 테트라히드로푸란(Tetrahydrofuran: THF) 또는 농축 질산 또는 황산과 함께 사용하지 마십시오.
- 염화 메틸렌(Methylene chloride) 및 디메틸술폭시드(Dimethyl sulfoxide)는 비금속 튜브를 부풀려 튜브의 파열 압력을 크게 감소시킬 수 있으므로 유의하십시오.

警告：圧力のかかったポリマーチューブを扱うときは、注意してください。

- 加圧されたポリマーチューブの付近では、必ず保護メガネを着用してください。
- 近くにある火を消してください。
- 著しく変形した、または折れ曲がったチューブは使用しないでください。
- 非金属チューブには、テトラヒドロフラン(THF)や高濃度の硝酸または硫酸などを流さないでください。
- 塩化メチレンやジメチルスルホキシドは、非金属チューブの膨張を引き起こす場合があり、その場合、チューブは極めて低い圧力で破裂します。

Warning: The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Attention: L'utilisateur doit être informé que si le matériel est utilisé d'une façon non spécifiée par le fabricant, la protection assurée par le matériel risque d'être défectueuses.

Vorsicht: Der Benutzer wird darauf aufmerksam gemacht, dass bei unsachgemäßer Verwenddung des Gerätes die eingebauten Sicherheitseinrichtungen unter Umständen nicht ordnungsgemäß funktionieren.

Attenzione: si rende noto all'utente che l'eventuale utilizzo dell'apparecchiatura secondo modalità non previste dal produttore può compromettere la protezione offerta dall'apparecchiatura.

Advertencia: el usuario deberá saber que si el equipo se utiliza de forma distinta a la especificada por el fabricante, las medidas de protección del equipo podrían ser insuficientes.

警告：使用者必須非常清楚如果設備不是按照製造廠商指定的方式使用，那麼該設備所提供的保護將被消弱。

警告：使用者必须非常清楚如果设备不是按照制造厂商指定的方式使用，那么该设备所提供的保护将被削弱。

경고: 제조업체가 명시하지 않은 방식으로 장비를 사용할 경우 장비가 제공하는 보호 수단이 제대로 작동하지 않을 수 있다는 점을 사용자에게 반드시 인식시켜야 합니다.

警告：ユーザーは、製造元により指定されていない方法で機器を使用すると、機器が提供している保証が無効になる可能性があることに注意して下さい。

Warning: To protect against fire, replace fuses with those of the type and rating printed on panels adjacent to instrument fuse covers.

Attention: pour éviter tout risque d'incendie, remplacez toujours les fusibles par d'autres du type et de la puissance indiqués sur le panneau à proximité du couvercle de la boite à fusible de l'instrument.

Vorsicht: Zum Schutz gegen Feuer die Sicherungen nur mit Sicherungen ersetzen, deren Typ und Nennwert auf den Tafeln neben den Sicherungsabdeckungen des Geräts gedruckt sind.

Attenzione: per garantire protezione contro gli incendi, sostituire i fusibili con altri dello stesso tipo aventi le caratteristiche indicate sui pannelli adiacenti alla copertura fusibili dello strumento.

Advertencia: Para evitar incendios, sustituir los fusibles por aquellos del tipo y características impresos en los paneles adyacentes a las cubiertas de los fusibles del instrumento.

警告：為了避免火災，更換保險絲時，請使用與儀器保險絲蓋旁面板上所印刷之相同類型與規格的保險絲。

警告：为了避免火灾，应更换与仪器保险丝盖旁边面板上印刷的类型和规格相同的保险丝。

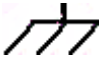
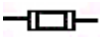
경고**:** 화재의 위험을 막으려면 기기 퓨즈 커버에 가까운 패널에 인쇄된 것과 동일한 타입 및 정격의 제품으로 퓨즈를 교체하십시오.

警告：火災予防のために、ヒューズ交換では機器ヒューズカバー脇のパネルに記載されているタイプおよび定格のヒューズをご使用ください。

Electrical and handling symbols

Electrical symbols

These electrical symbols can appear in instrument user manuals and on the instrument's front or rear panels.

	Electrical power on
	Electrical power off
	Standby
	Direct current
	Alternating current
	Protective conductor terminal
	Frame, or chassis, terminal
	Fuse
	Recycle symbol: Do not dispose in municipal waste.

Handling symbols

These handling symbols and their associated text can appear on labels affixed to the outer packaging of Waters instrument and component shipments.

	Keep upright!
	Keep dry!
	Fragile!
	Use no hooks!

B External Connections

This appendix describes the instrument's external connections.

Warning: The instrument is heavy. To avoid injury, use suitable machinery and the supplied harness to lift it.

Caution:

- Contact Waters Technical Service before moving the instrument.
- If you must transport the instrument, or remove it from service, contact Waters Technical Service for recommended cleaning, flushing, and packaging procedures.

See page 4-7.

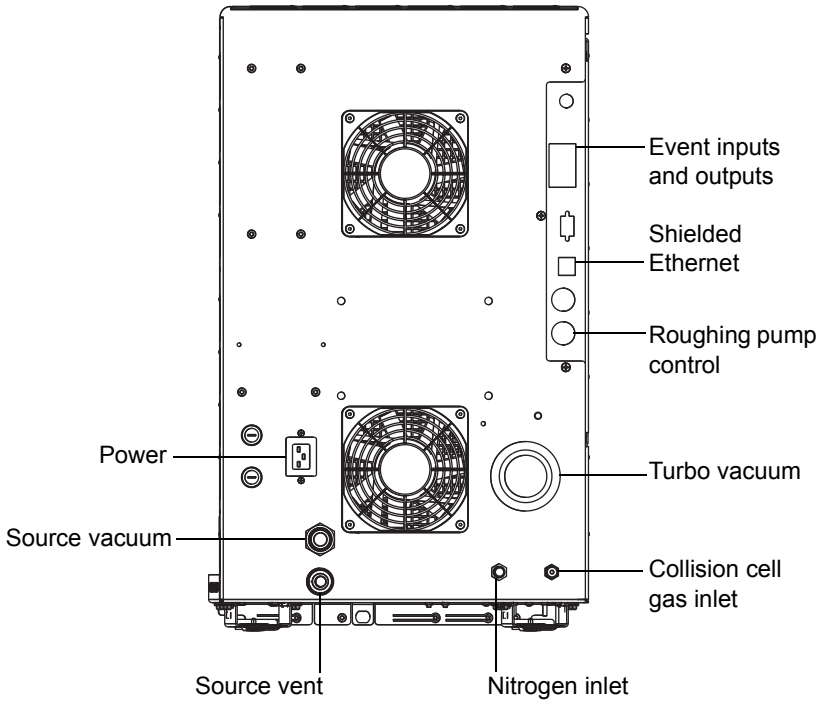
Contents:

External wiring and vacuum connections

Rear panel connections appear in the figure below.

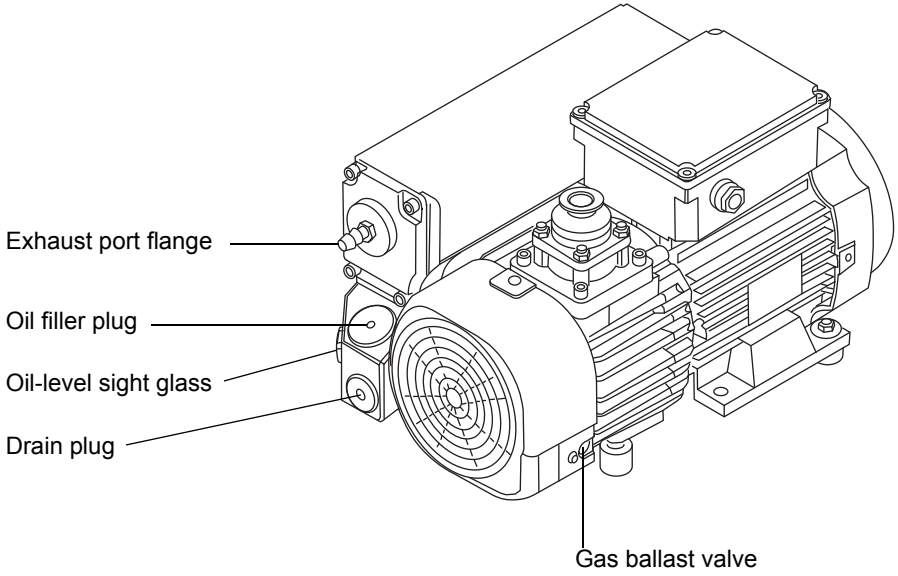
Note: Connectors and controls not identified in the following figure are for use by Waters engineers only.

Rear panel:



Connecting the oil-filled roughing pump

Note: To connect the alternative dry roughing pump, see page B-8.



Required materials:

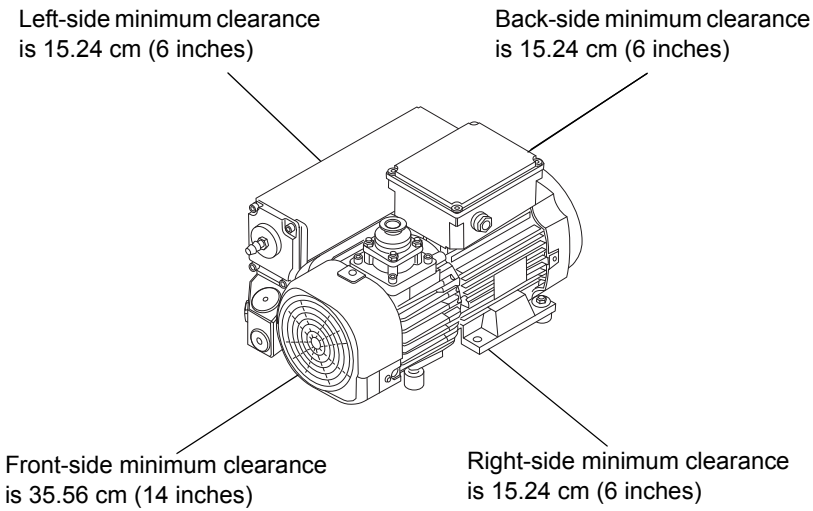
- Chemical-resistant, powder-free gloves
- 7-mm nut driver
- 8-mm Allen wrench
- Sharp knife
- NW25 tee (included in the installation kit)
- NW25 center rings (included in the installation kit)
- NW25 clamps (included in the installation kit)
- 10-mm reducer fitting (included in the installation kit)
- 10-mm ID nylon tube (included in the installation kit)
- PVC exhaust tubing (included in the Waters Rough Pump Connect Kit)
- PVC hose clamps (included in the Waters Rough Pump Connect Kit)
- 1-inch ID vacuum hose (included in the Waters Rough Pump Connect Kit)

To connect the roughing pump:

Warning: The pump and its connections can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves when performing this procedure.

Caution:

- To ensure correct operation of the roughing pump, the pump must be installed within 1 degree of horizontal.
- The area where the roughing pump is located must have an ambient temperature of 15 to 40 °C (59 to 104 °F).
- To ensure proper ventilation, the pump must be installed with the following minimum clearances:



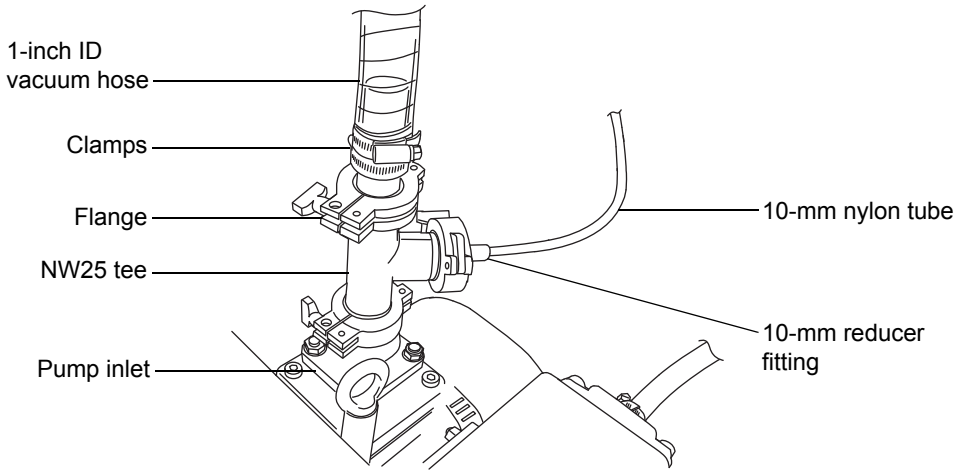
Requirement: The pump must be oriented in a way that allows easy daily access to the gas ballast valve and oil-level sight glass.

1. Place the PTFE drip tray on the floor, within 5 feet of the instrument.

   Warning: The roughing pump is heavy. To avoid injury, at least two people must lift the pump.

2. Place the pump on the PTFE drip tray.

3. Attach the NW25 tee to the inlet of the pump using the NW25 center ring, and then secure the connection with a clamp.



4. Using the NW25 center rings and clamp, and the 7-mm nut driver, attach the flanged end of a length of 1-inch ID vacuum hose to the top port on the NW25 tee, and the 10-mm reducer fitting and a length of 10-mm ID nylon tubing to the middle (perpendicular) port on the tee.
5. Using 2 hose clamps, connect the opposite end of the length of 1-inch vacuum hose in step 4 to the 1-inch OD straight vacuum port on the instrument's rear panel.
6. Connect the opposite end of the 10-mm nylon tube to the 10-mm source vent port on the instrument's rear panel.

Caution: To avoid gas leaks, use the sharp knife to cut the PVC exhaust tubing squarely (that is, perpendicular to its horizontal axis).

7. Using 1 hose clamp, connect a length of 12.7-mm clear PVC exhaust tubing to the roughing pump exhaust port NW25 nozzle fitting.

Caution: The instrument requires two separate exhaust systems: one for nitrogen, the other for the roughing pump. Vent them to atmosphere through separate exhaust lines. Oil mist can severely damage the instrument if the nitrogen exhaust line connects with the roughing pump exhaust line. Your warranty does not cover damage caused by routing exhaust lines incorrectly.

8. Route the open end of the exhaust tubing to a suitable exhaust vent.

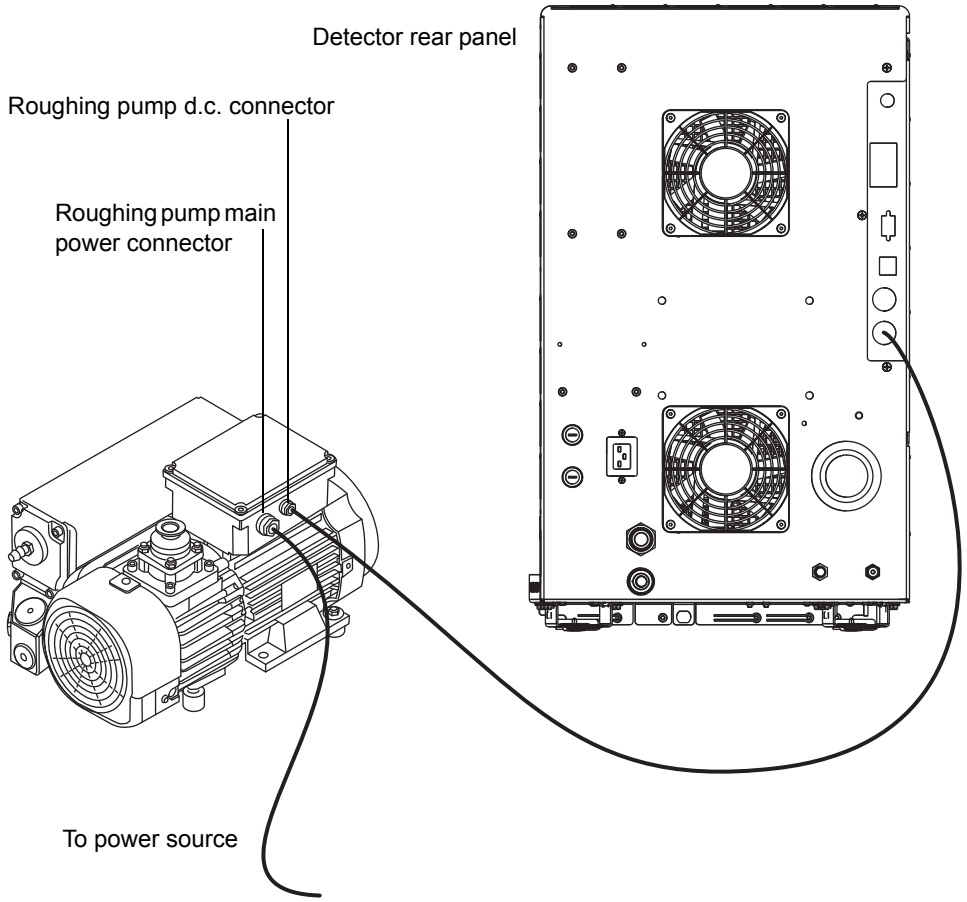
Caution: To ensure correct operation of the roughing pump, do not operate the pump with the oil level at less than 30% of the MAX level.

9. Check the oil level in the pump (see "Checking the roughing pump oil level" on page 4-25, and, if needed, "Adding oil to the roughing pump" on page 4-25).

10. Make the electrical connections to the roughing pump (see page B-7).

Making the electrical connections to the oil-filled roughing pump

Roughing pump electrical connections:



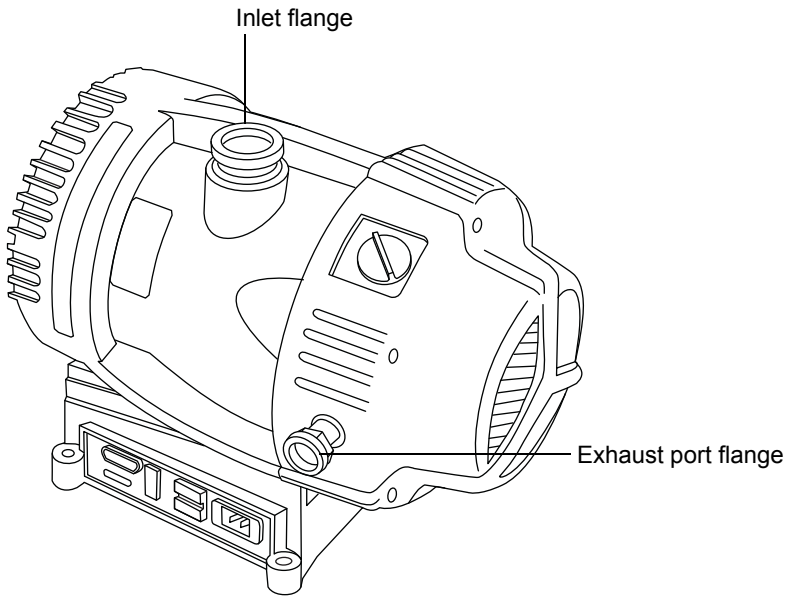
To make the electrical connections to the roughing pump:

1. Connect the relay cable from the roughing pump d.c. connector to the pump connector on the instrument's rear panel.
2. Connect the roughing pump power cord to the main power source.

Connecting the Edwards oil-free roughing pump

Warning: To avoid electric shock, power down the mass spectrometer and disconnect all power cables from the oil-free roughing pump before performing maintenance procedures on the pump. Always carry out maintenance in accordance with the operator's guide supplied with the roughing pump.

The oil-free roughing pump is an alternative to the oil-filled roughing pump. To connect the oil-filled roughing pump, see page B-3.



Required materials

- Chemical-resistant, powder-free gloves
- 7-mm nut driver
- Sharp knife
- NW25 tee (included in the installation kit)
- NW25 center rings (included in the installation kit)
- NW25 clamps (included in the installation kit)
- NW40 center rings (included in the installation kit)

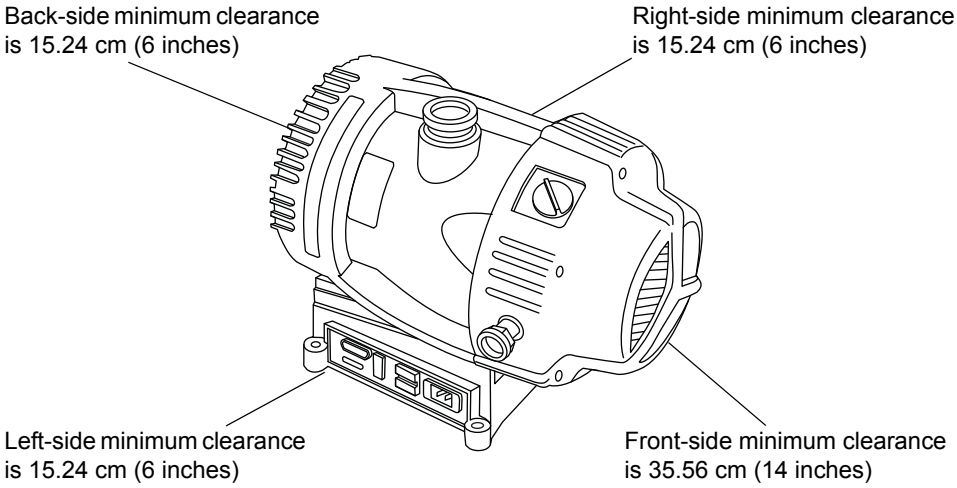
- NW40 clamps (included in the installation kit)
- NW25/NW40 adaptor (included in the installation kit)
- 10-mm reducer fitting (included in the installation kit)
- 10-mm ID nylon tube (included in installation kit)
- 12.7-mm clear PVC exhaust tubing (included in the Waters Rotary Pump Kit)
- PVC hose clamps (included in the Waters Rotary Pump Kit)
- 1-inch ID vacuum hose (included in the Waters Rotary Pump Kit)

To connect the oil-free roughing pump

Warning: The pump and its connections can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves when performing this procedure.

Caution:

- To ensure correct operation of the roughing pump, install it within 1 degree of horizontal.
- Locate the roughing pump in an area where the ambient temperature is 12 to 40 °C (54 to 104 °F).
- To ensure proper ventilation, install the pump with the following minimum clearances:



Warning: The roughing pump is heavy. To avoid injury, at least two people must lift the pump.

1. Place the pump on the floor, within 1.5 m (5 feet) of the instrument.
2. Attach the NW25/NW40 adaptor to the roughing pump inlet flange using an NW40 center ring, and then secure the connection with an NW40 clamp, using the 7-mm nut driver to install the clamp.
3. Attach the NW25 tee to the NW25/NW40 adaptor using an NW25 center ring, and then secure the connection with an NW25 clamp, using the 7-mm nut driver to install the clamp.
4. Using the NW25 center rings and clamp, and the 7-mm nut driver, attach the flanged end of a length of 1-inch ID vacuum hose to the top port on the NW25 tee, and the 10-mm reducer fitting and a length of 10-mm ID nylon tubing to the middle (perpendicular) port on the tee.
5. Using 2 hose clamps, connect the opposite end of the length of 1-inch vacuum hose in step 4 to the 1-inch OD straight vacuum port on the instrument's rear panel.
6. Connect the opposite end of the 10-mm nylon tube to the 10-mm source vent port on the instrument's rear panel.

   Caution: To avoid gas leaks, use the sharp knife to cut the PVC exhaust tubing squarely (that is, perpendicular to its horizontal axis).

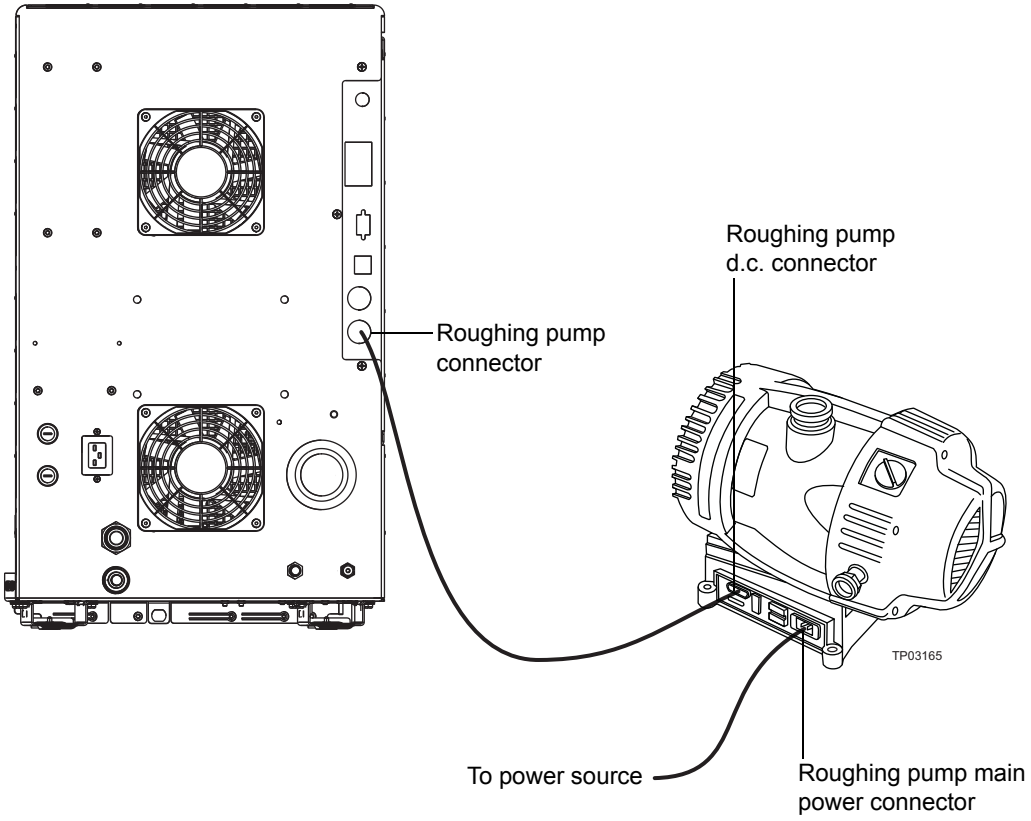
7. Using 1 hose clamp, connect a length of 12.7-mm clear PVC exhaust tubing to the roughing pump exhaust port NW25 nozzle fitting.

   Caution: The instrument requires two separate exhaust systems: one for nitrogen, the other for the roughing pump. Vent them to atmosphere through separate exhaust lines. Your warranty does not cover damage caused by routing exhaust lines incorrectly.

8. Route the open end of the exhaust tubing to a suitable exhaust vent.
9. Make the electrical connections to the roughing pump (see page B-11).

Making the electrical connections to the Edwards oil-free roughing pump

Roughing pump connections



To make the electrical connections to the oil-free roughing pump

1. Connect the relay cable from the roughing pump d.c. connector to the pump connector on the mass spectrometer's rear panel.
2. Connect the roughing pump power cord to the main power source.

Connecting to the nitrogen gas supply

Required materials

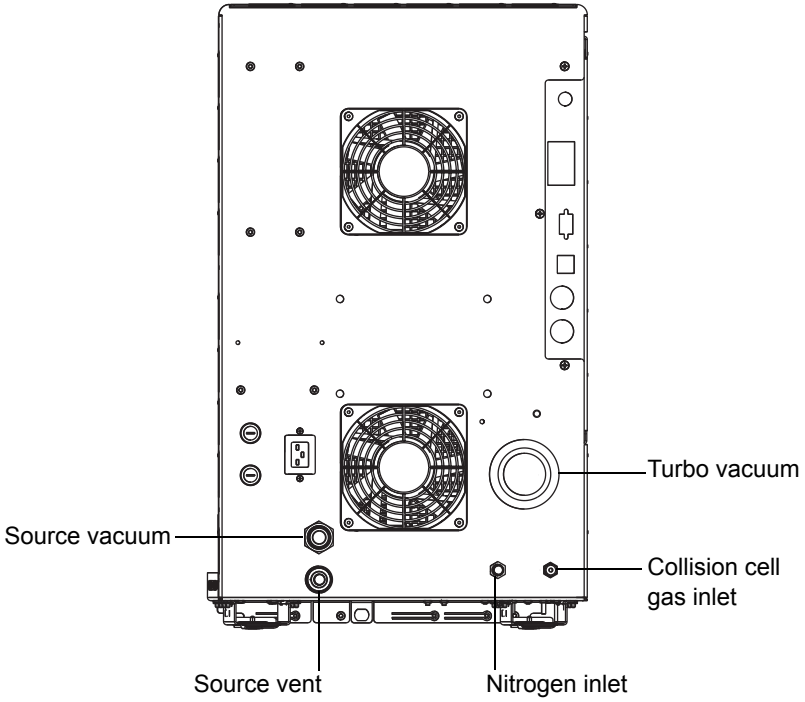
- Chemical-resistant, powder-free gloves
- Sharp knife
- Wrench
- 6-mm PTFE tubing (included in the Waters Rough Pump Connect Kit)
- Nitrogen regulator

To connect the nitrogen gas supply:

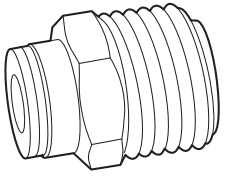
Caution: To avoid gas leaks, use the sharp knife to cut the PTFE tubing squarely (that is, perpendicular to its horizontal axis).

1. Use the sharp knife to cut a 3.8-cm to 5.0-cm (1.5-inch to 2-inch) length of 6-mm PTFE tubing.
2. Connect this piece of tubing to one end of the nitrogen supply in-line filter.
3. Connect the remaining length of the 6-mm PTFE tubing to the other end of the filter.
4. Connect the free end of the short piece of 6-mm PTFE tubing to the nitrogen inlet port on the rear of the instrument.

Gas and exhaust connections:



5. Attach the nitrogen regulator to the nitrogen supply.
6. Install the 6-mm stud into the regulator outlet.



7. Connect the free end of the long piece of 6-mm PTFE tubing to the 6-mm stud.

Connecting to the collision cell gas supply

Required materials

- Chemical-resistant, powder-free gloves
- Wrench
- 1/8-inch Swagelok® nut and ferrule
- 1/8-inch stainless steel tube (supplied with the instrument)

To connect the collision cell gas supply:

1. Use the 1/8-inch Swagelok nut and ferrule to connect the 1/8-inch stainless steel tube to the collision cell gas inlet on the rear of the instrument (see the figure on page B-13).
2. Use the wrench to tighten the 1/8-inch Swagelok nut.
3. Connect the free end of the tube to the collision gas supply.

Connecting the nitrogen exhaust line

Required materials

- Chemical-resistant, powder-free gloves
- Sharp knife
- 10-mm and 12-mm PTFE tubing (included in the Waters Rough Pump Connect Kit)
- snoop® (or equivalent) leak detector liquid

To connect the nitrogen exhaust line:

Warning:

- Biohazardous or toxic LC solvents and analytes can be carried in the nitrogen exhaust, which must be vented via the nitrogen exhaust trap bottle and laboratory exhaust system. The laboratory exhaust system must provide a minimum vacuum of 0.20 kPa (2 mbar, 0.03 psi) below atmospheric pressure (negative pressure).
- The exhaust connections can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves when performing this procedure.
- To avoid the buildup of hazardous gases, do not place the nitrogen exhaust trap bottle in an enclosed cabinet.

Caution: The instrument requires two separate exhaust systems: one for nitrogen, the other for the roughing pump. Vent them to atmosphere through separate exhaust lines. Oil mist can seriously damage the instrument if the nitrogen exhaust line connects with the roughing pump exhaust line. Your warranty does not cover damage caused by routing exhaust lines incorrectly.

1. Locate the exhaust trap bottle in an accessible area below the instrument (see the figure on page B-16).

   Caution: To avoid gas leaks, use the sharp knife to cut the PTFE tubing squarely (that is, perpendicular to its horizontal axis).

2. Cut a length of 12-mm tubing long enough to connect the instrument to the exhaust trap bottle.
3. Connect one end of the tubing to the exhaust port on the rear panel and the other end to one of two ports on the exhaust trap bottle.

   Caution: To avoid gas leaks, use the sharp knife to cut the PTFE tubing squarely (that is, perpendicular to its horizontal axis).

4. Cut a length of 10-mm tubing long enough to connect the exhaust trap bottle to the exhaust vent.

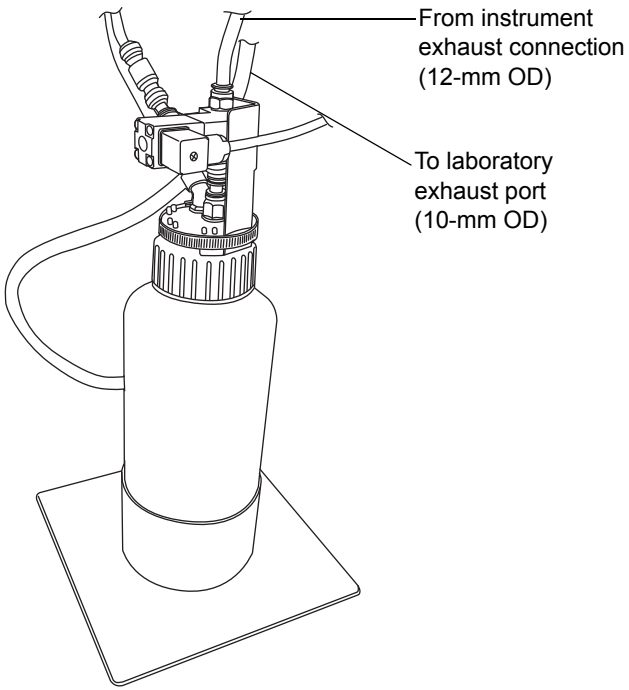
5. Insert one end of the tubing into the remaining port on the exhaust trap bottle and route the other end to the exhaust vent.

Warning: Leaks in the source exhaust system can result in the release of biohazardous or toxic materials. To confirm the integrity of the source exhaust system, perform the following leak test.

Caution: To avoid damage to the instrument, use snoop (or its equivalent) leak detector liquid only for the purpose described in the following step. Do not use it on any other part of the instrument.

6. Use snoop (or equivalent) leak detector liquid to ensure that there are no leaks at the instrument exhaust and laboratory exhaust system line connections.

Exhaust trap bottle:



Connecting the liquid waste line

Required material

Chemical-resistant, powder-free gloves

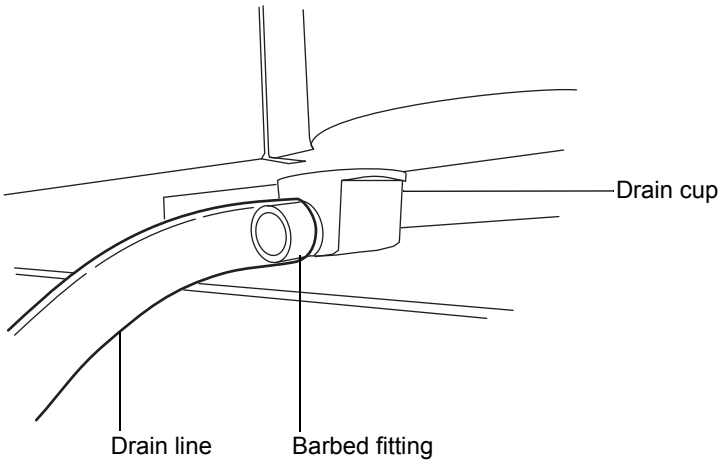
To connect the liquid waste line:

Warning: The waste line and connection can be contaminated with biologically hazardous or toxic materials. Always wear chemical-resistant, powder-free gloves while performing this procedure.

1. Place a suitable waste container below the instrument.

   Caution: To avoid distorting the drip tray or causing the drain cup to leak, restrain the drain cup when attaching or removing the waste line.

2. Slide a drain line over the barbed fitting of the drain (located at the bottom of the instrument).



Warning: To prevent leakage of biologically hazardous or toxic materials, ensure that the

- drain line does not crimp or bend. A crimp or bend can impede flow to the waste container.
- waste container is emptied before the lower end of the drain tube is covered by waste solvent.

3. Route the waste line to the waste container. If necessary, shorten the waste tube so that its end is above the surface of the waste solvent.

Positioning of drain tube:

Connecting the workstation

Before connecting the workstation to the instrument, set up the workstation according to its accompanying instructions. Locate the workstation within 5 meters (16 feet) of the instrument.

Requirement: Use shielded network cables with the instrument to ensure compliance with FCC, and other, limits.

To connect the workstation:

1. Connect the monitor to the PC.
2. Connect one end of the shielded network cable to the appropriate port on the rear panel of the instrument.
3. Connect the other end of the shielded network cable to the port labeled Instrument LAN on the workstation rear panel.

To connect the instrument to the power source:

Caution: Do not connect the instrument's power supply cord until you complete the installation procedures in the previous sections.

1. Select the correct power cord for your location.
2. Connect the female end of the power cord to the power port on the rear panel of the instrument.

Connecting Ethernet cables

Requirement: Use shielded Ethernet cables with the instrument to ensure compliance with FCC, and other, limits.

To make Ethernet connections:

1. Connect one end of one shielded Ethernet cable to the network switch, and then connect the other end to the Ethernet card on the preconfigured ACQUITY™ workstation.

   Tip: On preconfigured systems, the Ethernet card is identified as the Instrument LAN card.

2. Connect one end of the other shielded Ethernet cable to the back of the instrument, and then connect the other end to the network switch.

I/O signal connectors

Warning: To avoid electric shock, separate all electrical connections to the rear panel from hazardous voltages by double or reinforced insulation. Circuits of this type are classified as safety extra low voltage (SELV). Examples of circuits that are typically SELV include contact closure inputs and outputs for autosamplers, and UV, RI, and fluorescence detector signal outputs for LC/MS systems. The electrical connections on the rear panel of this mass spectrometer are all SELV.

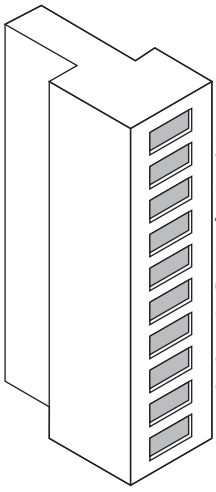
To avoid electric shock and damage to the instrument, do not apply more than

- ±30 V d.c. to the Analog (Out) connection.
- 30 V d.c. to the Stop Flow (Out), Inject Start (In), Switch 2 (Out), Switch 3 (Out), and Switch 4 (Out) connections.

The instrument's rear panel includes two removable connectors that hold the screw terminals for I/O signals. These connectors are keyed so that they can receive a signal cable inserted only one way.

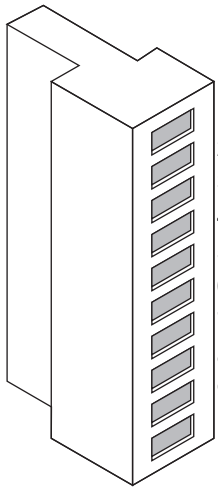
I/O signal connectors:

Connector I



1	+	Analog (Out)
2	–	Analog (Out)
3		Ground
4		Not Used
5		Not Used
6		Stop Flow (Out)
7		Stop Flow (Out)
8		Ground
9		Switch 2 (Out)
10		Switch 2 (Out)

Connector II



1	+	Inject Start (In)
2	–	Inject Start (In)
3		Ground
4	+	Event (In)
5	–	Event (In)
6	+	Switch 3 (Out)
7	–	Switch 3 (Out)
8		Ground
9	+	Switch 4 (Out)
10	–	Switch 4 (Out)

Signal connections

Instrument analog-out/event-in connections:

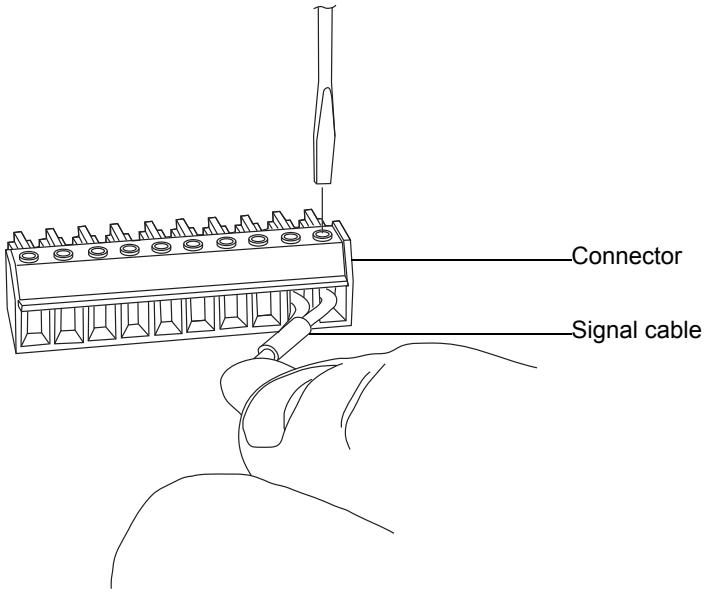
Signal connections	Description
Analog (Out)	Used for analog chart output functionality. The output voltage range is 0 to 1 V. The resolution of the voltage output is 12 bits.
Stop Flow (Out)	Used to stop the solvent flow if the nitrogen gas supply fails. Maximum 30 V, 0.5 A, 10 W.
Inject Start (In)	Signals the start of an injection. Maximum 30 V.
Event (In)	Allows an external device to start data acquisition. Maximum 30 V.
Switch 2 (Out)	Used to send time-based contact closure signals to external devices. Maximum 30 V, 0.5 A, 10 W.
Switch 3 (Out)	Used to send time-based contact closure signals to external devices. Maximum 30 V, 0.5 A, 10 W.
Switch 4 (Out)	Used to send time-based contact closure signals to external devices. Maximum 30 V, 0.5 A, 10 W.

Requirement: To meet the regulatory requirements of immunity from external electrical disturbances, install connection covers over the signal connectors.

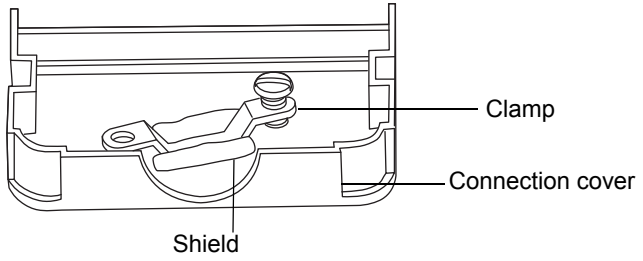
To make signal connections:

1. Reference the signal connection location from the silk-screened label for inject start or any other input/output connection you plan to use from Connector I or II on the rear panel of each instrument.

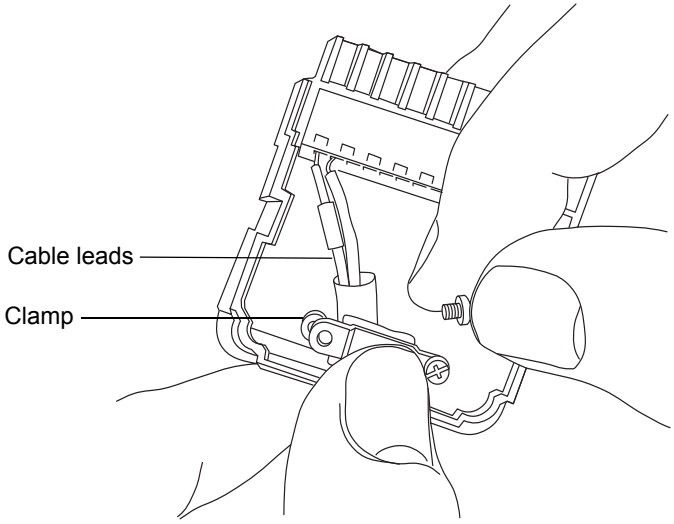
2. To make the signal connections, attach the positive and negative leads of the signal cable to the connector.



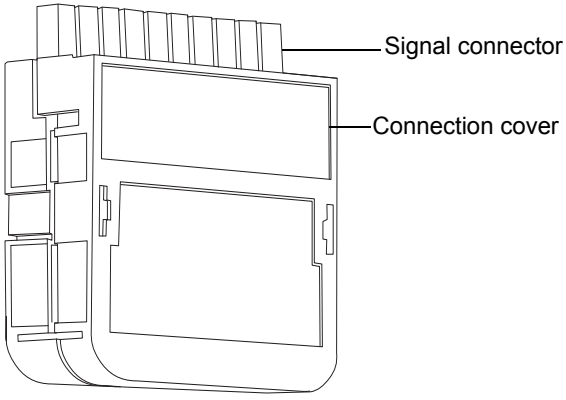
3. Slide the clamp (with the bend facing down) into the protective shield.
4. Insert the clamp and shield (with the bend facing down) into the connection cover, and loosely tighten with one self-tapping screw.



5. Insert the connector with the signal cable into the connection cover, and position the clamp over the cable leads. Tighten the clamp into place with the second self-tapping screw.



6. Place the second connection cover over the first cover, and snap it into place.



Connecting to the power supply

The instrument requires a separate, grounded power source. The ground connection in the electrical outlet must be common and connected near the system.

To connect to the power source:

Recommendation: Use a line conditioner or an uninterruptible power supply (UPS) for optimum long-term input voltage stability.

Warning: To avoid electrical shock, use the SVT-type power cord in the United States and HAR-type (or better) in Europe. For information regarding what cord to use in other countries, contact your local Waters distributor.

1. Connect the female end of the power cord to the receptacle on the rear panel of the instrument.
2. Connect the male end of the instrument power cord to the 200 to 240 V AC wall outlet prepared as described in the instrument *Site Preparation Guide*.
3. Connect the power cord from the roughing pump relay box to the 200 to 240 V AC wall outlet prepared as described in the instrument *Site Preparation Guide*.

   Tip: The system software controls electrical power to the pump.

C Materials of Construction and Compliant Solvents

Warning: To confirm the integrity of the source exhaust system, you must address any safety issues raised by the contents of this Appendix.

Contents:

Preventing contamination

For information on preventing contamination, refer to *Controlling Contamination in LC/MS Systems* (part number 715001307). Visit http://www.waters.com.

Items exposed to solvent

The items that appear in the following table can be exposed to solvent. You must evaluate the safety issues if the solvents used in your application differ from the solvents normally used with these items. See page C-3 for details about the most common ingredients used to prepare mobile phases.

Items exposed to solvent:

Item	Material
Autotune reservoirs	High-density polyethylene
Corona discharge pin mounting contact	PEEK™
Gas exhaust port	Aluminum
Gas tubes	Fluorinated ethylene propylene
Ion block	Stainless steel
Ion block support	PEEK
Isolation valve	Gold-plated aluminum/bronze
O-rings	Viton® or PTFE-encapsulated Viton
Probe adjuster bellows	PTFE/Viton
Probe adjuster assembly	Anodized aluminum, glass-filled acetal, and stainless steel
Probe shaft	PEEK
Push-in gas fittings	Nickel/brass
Solvent waste/leak management	Tygon tubing
Source enclosure	Alochromed aluminum
Source enclosure view port	Toughened plate glass
Trap bottle	Polypropylene

Items exposed to solvent:

Item	Material
Trap bottle push-in fittings	Nitrile butadiene rubber, stainless steel, polybutylene terephthalate, and polyoxymethylene

Solvents used to prepare mobile phases

These solvents are the most common ingredients used to prepare mobile phases for reverse-phase LC/MS (API):

- Water
- Methanol
- Acetonitrile
- Formic acid (<0.1%)
- Acetic acid (<0.1%)
- Trifluoroacetic acid (<0.1%)
- Ammonium acetate (<10 mM)
- Ammonium formate (<10 mM)

These solvents are not expected to cause any problems with the materials identified in the table on page C-2.

D Plumbing the IntelliStart Fluidics System

This appendix provides reference information for replacing the tubing in the IntelliStart™ Fluidics system.

Warning: To avoid electric shock, do not use stainless steel tubing or stainless steel finger-tight screws to connect the selector valve to the source probes; use the PEEK tubing and natural (beige) colored PEEK finger-tight screws specified on page D-4.

Warning: The IntelliStart Fluidics components can be contaminated with biohazardous and/or toxic materials. Always wear chemical-resistant, powder-free gloves while working on the system.

Contents:

Preventing contamination

For information on preventing contamination, refer to *Controlling Contamination in LC/MS Systems* (part number 715001307). You can find this document on http://www.waters.com; click Services and Support > Support.

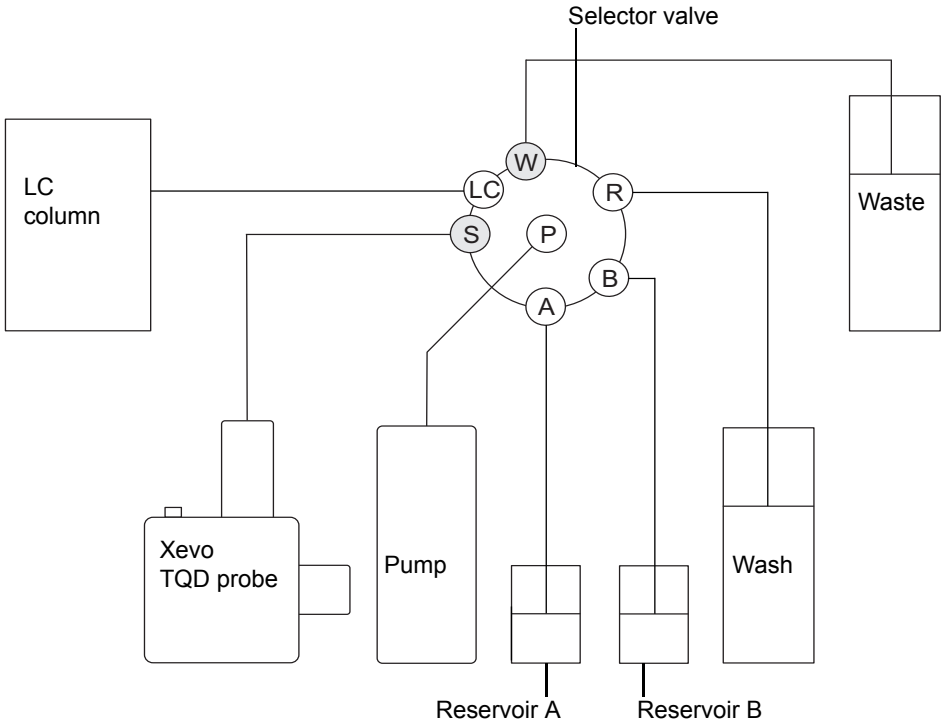
The selector valve

The selector valve is located on the right-hand side of the instrument, behind the visor. The letters etched on the front of the valve represent the components to which the associated port is connected. Etched letters with a light background indicate inputs, while letters with a dark, etched background indicate outputs. The following table outlines the component to which each port connects, and whether the port is a fluid input or output.

Selector valve connections:

Port	Component	Input/Output
P	Infusion pump	Both
A	Sample reservoir A	Input
B	Sample reservoir B	Input
R	Rinse/wash bottle	Input
W	Waste bottle	Output
LC	LC column	Input
S	Xevo TQD ion source	Output

Plumbing schematic



Requirement: Ensure that the end of the tubing is fully submerged in the solvent in the wash reservoir.

Tubing and connection specifications

Caution: When plumbing the IntelliStart Fluidics system, use only the tubes, nuts, and ferrules outlined below to ensure over-pressure protection. The use of parts not recommended here can result in leaks that the built-in leak sensor does not always detect.

When replacing the fluidics tubing and connectors, refer to the tables below for the correct specifications.

Replacement tubing specifications:

Port	ID (inches)	Color	Length (m)
R, A, and B	0.020	Orange	0.65
W	0.004	Red	0.2
S	0.004	Black	0.4
LC	0.004	Black	As required

Replacement nut and ferrule specifications:

Port	Nut code	Ferrule code
P	P245	P200
LC	F196	F192
S, W, R, A and B	F130	-

Important: The tubing for the sample reservoirs (ports A and B) is not user-serviceable. To replace the tubing, contact Waters to arrange an engineer visit.

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