ACQUITY UPLC

Binary Solvent Manager Operator's Overview and Maintenance Information

Revision A

Waters

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Overview

The Waters ACQUITY UPLC Binary Solvent Manager delivers solvent compositions for isocratic and binary gradient methods at flow rates of 0.01 to 2.0 mL per minute. Its features include in-line filters upstream of a primary check valve, the Waters® Intelligent Intake Valve (*i*^{2}*Valve*), automated priming functions, and daily system-setup routines.

Under high, system backpressure, and by means of a mixing tee, the binary solvent manager combines the outputs of two, parallel, flow-path channels, A and B. Four solvents—the chromatographic solvents—are divided into pairs, one pair for each pump channel. As such, they are designated A1 and A2 (for channel A) and B1 and B2 (for channel B). Each preselected solvent, A1 or A2, B1 or B2, passes from the degasser through a selector valve. The solvent then flows into primary and accumulator pump heads, then the vent valve, the mixing tee and, finally, the sample manager. The device has an integral six-channel solvent degasser. Two of the channels are reserved for sample manager wash solvents.

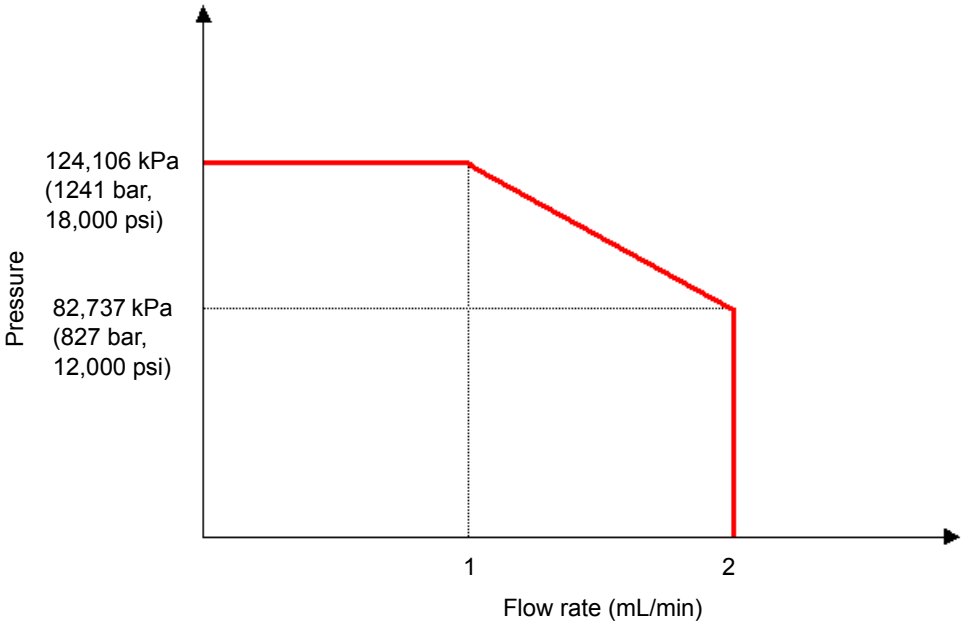
The binary solvent manager's two pump channels permit quick solvent changeovers at a flow rate of 4.0 mL per minute. Low-volume degasser channels (480 µL internal volume), automated solvent-selection valves, and an automated vent valve make the quick changeovers possible.

The pumps, whose flows are additive, can support fast or ballistic separations on short columns, with flow rates exceeding 1 mL/min at system backpressures greater than 82,737 kPa (827 bar, 12,000 psi). Their active, integral, plunger-seal-wash functions flush away particulates or precipitants from their plungers and plunger seal interfaces.

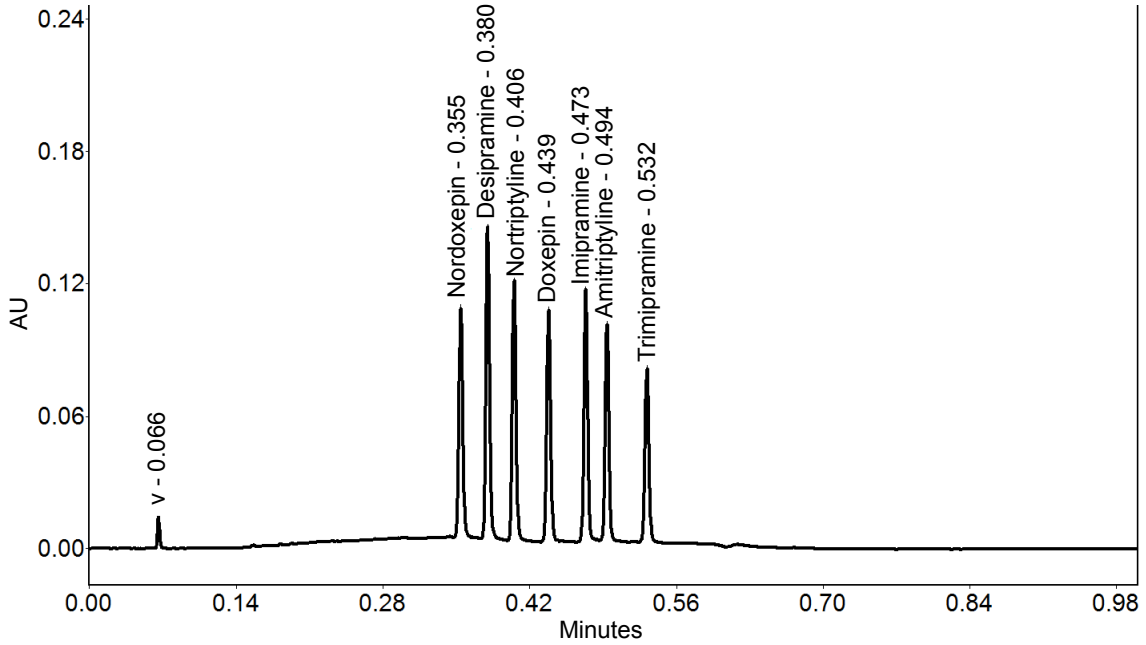
The design of the binary solvent manager (and, indeed, the system overall) is optimized for sub-2 µm particle liquid chromatography. The upper pressure limit is set at 124,106 kPa (1241 bar, 18,000 psi) per pump. A maximum flow rate of 1 mL/min is permitted at system backpressures to 124,106 kPa (1241 bar, 18,000 psi), which falls within the range of optimal linear velocity for sub-2 µm particle columns of ID 1.0 mm to 3.0 mm.

The following figure depicts the binary solvent manager's flow rate and pressure envelope.

Pressure flow envelope:



The figure below shows the chromatogram of a typical application with a separation of antidepressants. For such an analysis, you can run the system at 1.6 mL/min, with 98,595 kPa (986 bar, 14,300 psi) system backpressure, using both pumps in a proportioning mode. The example shows the capability of running extremely fast separations utilizing the very low injection cycle time and minimal system delay volume of the ACQUITY UPLC system.



These data apply to the analysis:

- System configuration:
  - ACQUITY UPLC binary solvent manager
  - ACQUITY UPLC sample manager - fixed loop, 2-µL loop installed, PLUNO mode, 3-µL needle overfill flush
  - ACQUITY UPLC column heater with active pre-heater
- Detection:
  - ACQUITY UPLC photodiode array detector, 254 nm
  - Sampling rate: 40 points/sec
  - Filter time constant: fast (0.0250 sec)

- System volume: 85 µL
- Gradient:
  - Solvent A: 10 mM ammonium bicarbonate pH 10.0
  - Solvent B: acetonitrile

Gradient:

Time	Flow (ml/min)	%A1	%B1
	1.60	75.0	25.0
0.02	1.60	75.0	25.0
0.41	1.60	20.0	80.0
0.51	1.60	20.0	80.0
0.52	1.60	75.0	25.0
1.08	1.60	75.0	25.0

- Column: ACQUITY UPLC BEH C_{18}, 1.7 µm, 2.1 × 50 mm
- Temperature: 60 °C
- Injection volume: 1.0 µL
- Recorded system pressure: 98,595 kPa (986 bar, 14,300 psi)
- Equilibration time: 32 s (5 column volumes)
- Injection-to-injection cycle time: 65 sec
- Minimum USP Rs: 3.1
- Void-volume peak: 3.96 s (0.066 min)
- Maximum peak width at inflection: <230 1 msec (0.23 s)

Flow rate accuracy

Flow rate performance of the individual pumps drives compositional accuracy in high-pressure gradient systems. The pumps precompress the solvent and then meter it at system pressure.

Note: Most HPLC qualification methods specify performing laboratory measurements of flow rate at atmospheric pressure. They thus ignore the effect of mobile-phase precompression. Yet the positive bias of the apparent flow rate increases with system backpressure, its extent varying with the

nature of the mobile phase, the partial pressure of dissolved air in the mobile phase, and the operating temperature. To verify the linearity and reproducibility of the flow rate at system pressure, Waters qualification tests measure the retention time, not volume. Such a test better suits measurements of UPLC systems at multiple flow rates. It also better suits those where the measured flow rates exceed 1 mL/min, and system backpressure can exceed 68,948 kPa (689 bar, 10,000 psi).

Delay volume and mixing characteristics

In the ACQUITY UPLC binary solvent manager, the effective delay volume begins at the point where two solvents, each delivered by one of the binary solvent manager's two pumps, combine. This mixing point comprises a subassembly of delivery tubes from each of the pumps, a small volume containing packed beads, and an in-line filter. These components provide for the proper blending of the two streams for any separation and flow rate. Appropriate mixing provides a minimized delay volume, which effects quiet, stable baselines. To further promote optimization, Waters offers optional mixing chambers of varying volumes, which are effective over the entire flow rate and pressure range of the binary solvent manager.

Intelligent intake valves

The primary intake head of each pump in the binary solvent manager is fitted with a Waters Intelligent Intake Valve. Electronically controlled and electrically actuated, the valves open and close with each pump cycle, eliminating pressure variations that can affect the detector baseline.

Connections INSIGHT® and ACQUITY UPLC Console diagnostics

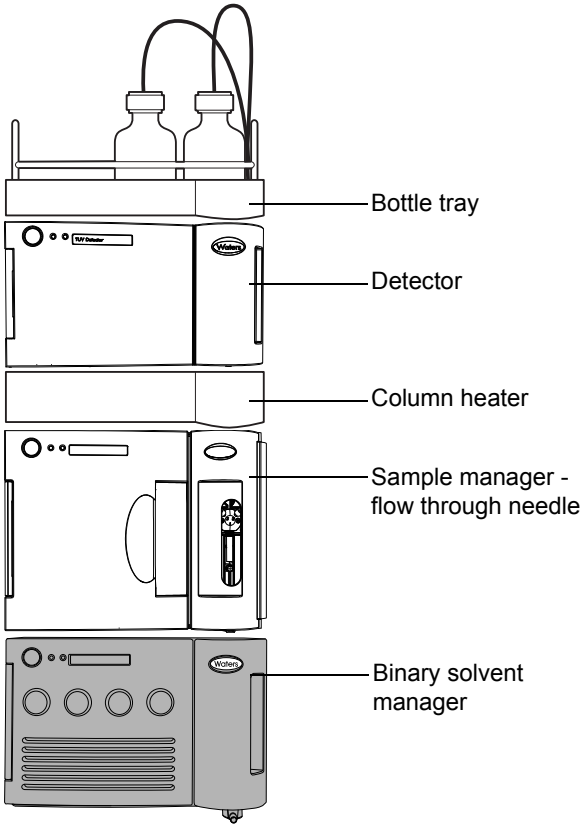
The ACQUITY UPLC Console software supports the operation of ACQUITY UPLC system modules, including the binary solvent manager. The ACQUITY Console, a graphical, real-time software interface, monitors system status, directly controls the system, troubleshoots errors, and performs automated maintenance functions. For example, via the ACQUITY Console, you can monitor the change in system backpressure as a measure of pump performance. Monitoring each pump head, you can isolate a failure, thus identifying a particular failed check valve or seal. You can then select the appropriate maintenance option for replacing the failed component.

The ACQUITY Console is also the interface for the Waters Connections INSIGHT remote service and alert capabilities. Through Connections

INSIGHT, Waters Service professionals can instantaneously respond to any alarms or errors raised by the ACQUITY UPLC system components. The software also provides the interface for particular functions, like generating a service profile, that you can send directly to the Waters Global Service and Support organization for analysis and interpretation.

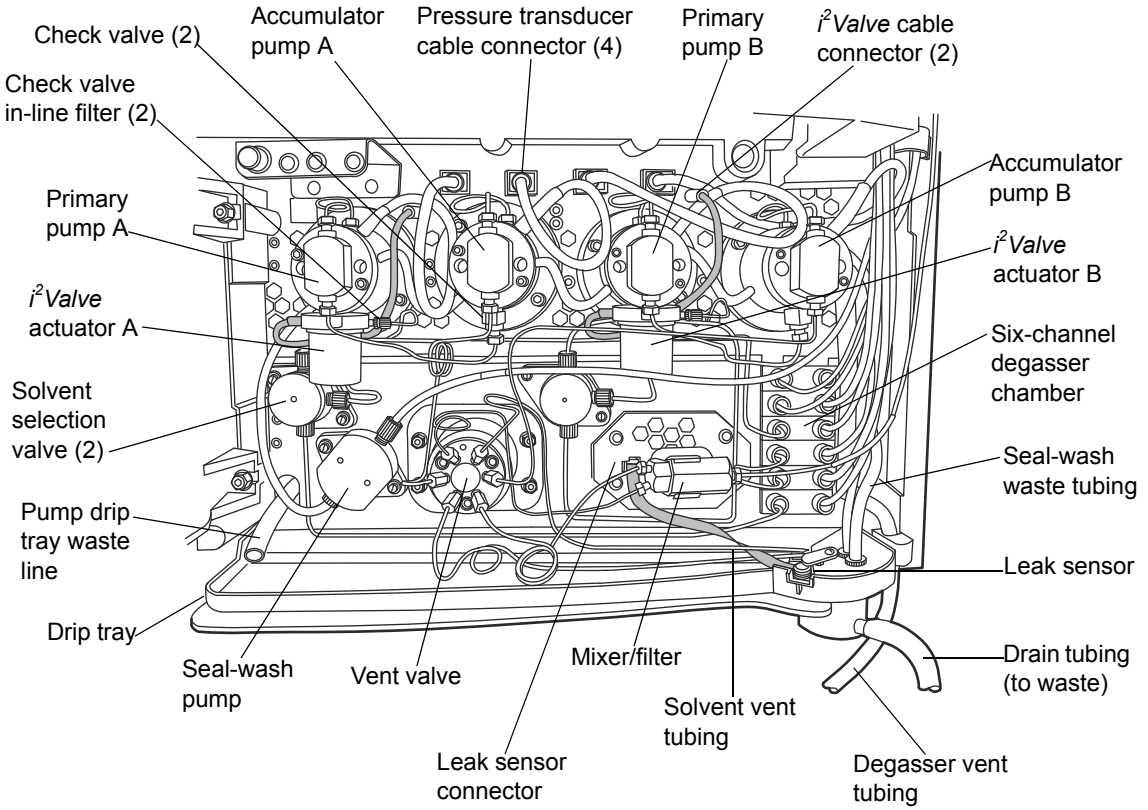
Location of binary solvent manager in an example ACQUITY UPLC system

The following diagram shows the location of the binary solvent manager in an example ACQUITY UPLC system.



Major components

The following diagram shows the binary solvent manager's major components.



Binary solvent manager's major components:

Component	Description
Accumulator pump (A and B)	Receives solvent from the primary pump and delivers it to the system.
Check valve	A dual ball check valve that allows flow in only one direction.
Check valve in-line filter	Removes particulates from the incoming solvent.
Degasser vent tubing	Vents exhaust from the degasser pump.

Binary solvent manager's major components: (Continued)

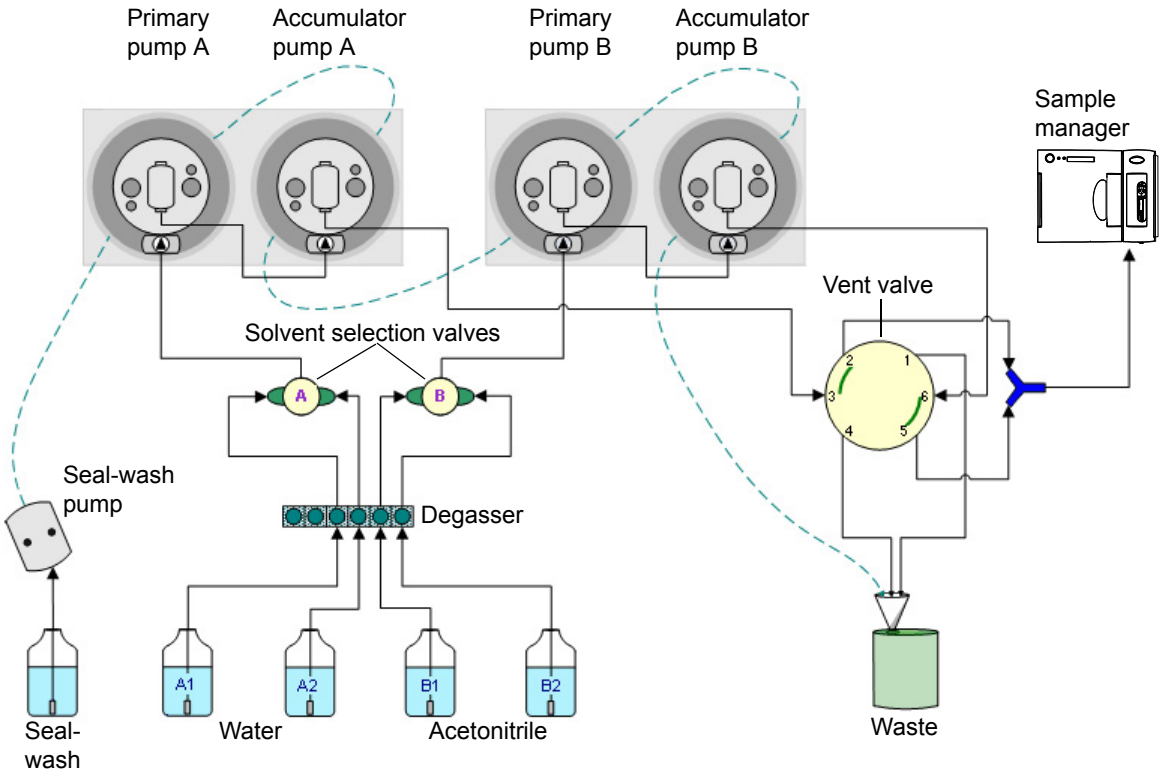
Component	Description
Drain tubing (to waste)	Routes waste from the leak management system to the waste container.
Drip tray	Manages fluid leaks.
i^2Valve	An electronically controlled ball check valve that allows flow in only one direction.
Leak sensor	Continuously monitors the binary solvent manager for leaks and stops the system flow when its optical sensor detects about 1.5 mL of accumulated, leaked liquid in its surrounding reservoir.
Mixer/filter	Mixes and filters the solvent before it reaches the sample manager. Mixer/filter sizes include 50 µL, 100 µL, and 380 µL.
6-channel degasser chamber	Removes dissolved gasses from mobile-phase solvents and exhausts them, and any condensates, through waste tubing. **Note:** Vacuum degassing can change the composition of mixed solvents.
Pressure transducer cable connectors	The electrical connections for the pressure transducers located on the front of the actuators.
Primary pump (A and B)	Draws solvent, transferring it to the accumulator pump and system as part of the serial flow design.
Pump drip tray waste line	Directs pump waste to the drip tray.
Seal-wash pump	The pump that circulates solvent, to keep the actuator's high-pressure seals and plungers free of contaminants.
Seal-wash waste tubing	Directs seal-wash waste to the drip tray.
Solvent selection valve	Allows the user to select one solvent from A1 or A2 and one solvent from B1 or B2.
Solvent vent tubing	Tubing that vents solvent to waste during priming.

Binary solvent manager's major components: (Continued)

Component	Description
Vent valve	A 3-position valve that automatically switches to the waste/vent position during priming or column switching, the block position during the binary solvent manager maintenance leak test, and the system position during normal operation (or during the system leak test).

Flow path through the solvent management system

The following diagram shows the binary solvent manager's flow.



Solvent flow sequence:

1. The solvent is stored in solvent reservoirs A1, A2, B1, and B2.
2. The in-line vacuum degasser degasses the solvent.
3. The solvent selection valve selects solvents for pump A and pump B from solvent reservoirs A1, A2, B1, and B2.
4. The solvents flow through the *i*^{2}*Valve,* a check valve, which is located on the inlet of the primary pump's actuator.
5. The primary piston fills the accumulator pump and delivers solvent to the system.
6. The accumulator pump's piston delivers solvent, under pressure, to the vent valve.
7. From the vent valve, the solvent flows to the in-line mixer, and then to the sample management system.

Preparing the binary solvent manager

For optimal performance of the ACQUITY UPLC system, you must prepare the binary solvent manager for operation.

To prepare the binary solvent manager for operation, you must prime the seal-wash system and then the binary solvent manager.

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

To maintain the efficiency of the binary solvent manager and to obtain accurate, reproducible chromatograms, use only MS-grade solvents, water, and additives. For details, see the solvent considerations document for your system.

Caution: To avoid damaging binary solvent manager components, do not use chloroform, methylene chloride, toluene, or other halogenated solvents.

Installing the waste and degasser vent tubing

Warning: To avoid personal contact with biologically hazardous or toxic materials, always wear clean, chemical-resistant, powder-free gloves when installing or removing the waste and degasser vent tubing.

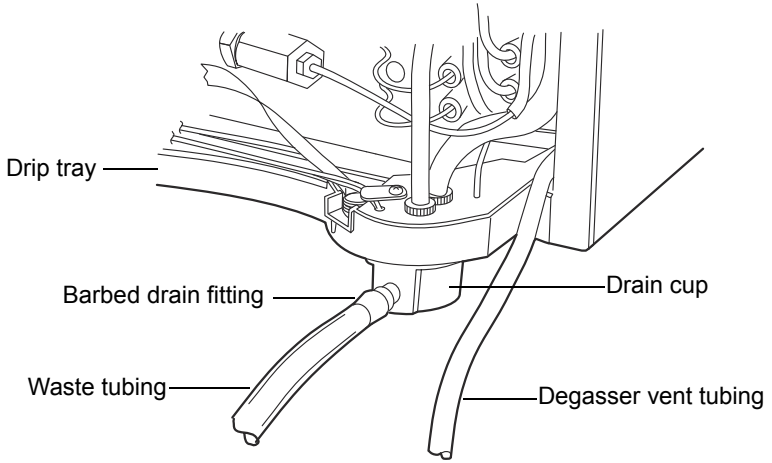
Required materials

- Degasser vent tubing
- Gloves: clean, powder-free, chemical-resistant
- Waste tubing

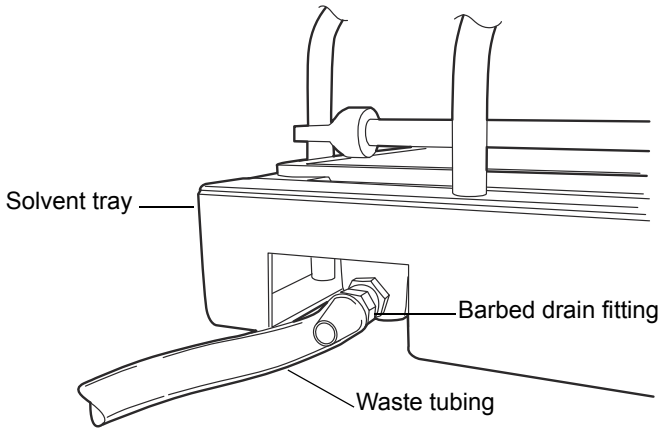
To install the waste and degasser vent tubing:

Caution: To avoid distorting the drip tray or causing the drain cup to leak, restrain the drain cup when attaching or removing the waste tubing.

1. Wet the barbed drain fitting located at the bottom of the binary solvent manager with methanol.
2. Hold the back of the drain cup, slide the waste tubing over the barbed drain fitting, and route the tubing to a suitable waste container.



3. Wet the barbed drain fitting located at the back of the solvent tray with methanol.
4. Slide the waste tubing over the barbed drain fitting, and route the tubing to a suitable waste container.



Warning: To avoid releasing solvent vapors into the room, route the degasser vent tubing to a fume hood or other suitable exhaust system, or to a suitable waste container, ensuring the tubing's discharge end is at all times elevated above the fluid level.

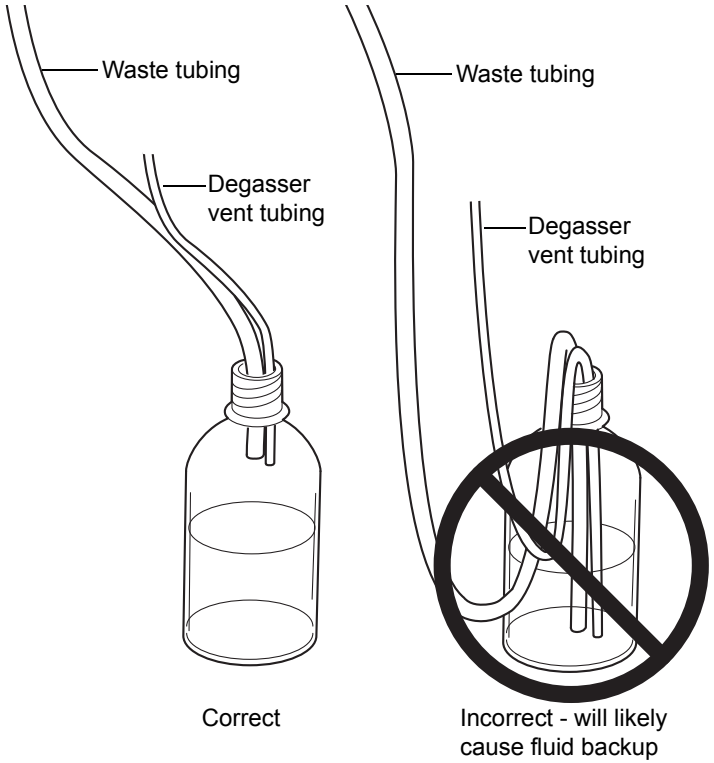
Warning: To avoid spills, empty the waste container at regular intervals.

Caution: To avoid fluid backup, you must ensure proper drainage of waste:

- Place the waste container below the system stack.
- Ensure that the waste and degasser vent tubes do not crimp or bend. A crimp or bend can impede flow to the waste container.
- Ensure the exit of the waste and degasser vent tubes is not immersed in waste solvent. If necessary, shorten each tube so that no portion of it drops below the top of the waste container (see next figure).

5. Route the degasser vent tubing to a suitable waste container.

Correct positioning of waste and degasser vent tubes:



Connecting to the solvent supply

Caution: To avoid personal contact with biologically hazardous or toxic materials, always wear clean, chemical-resistant, powder-free gloves when installing or removing the waste and degasser vent tubing.

The solvent tray located on top of the system holds up to 2 L of spilled solvent. You need a suitable waste container to collect any spill from the waste line at the rear of the tray.

To connect the solvent supply:

Warning: To avoid injuries arising from contact with spilled solvent, do not place solvent reservoirs atop the sample organizer.

Caution: To maintain adequate solvent head pressure and ensure proper solvent delivery, position the solvent reservoirs in the solvent tray at the top of the system stack.

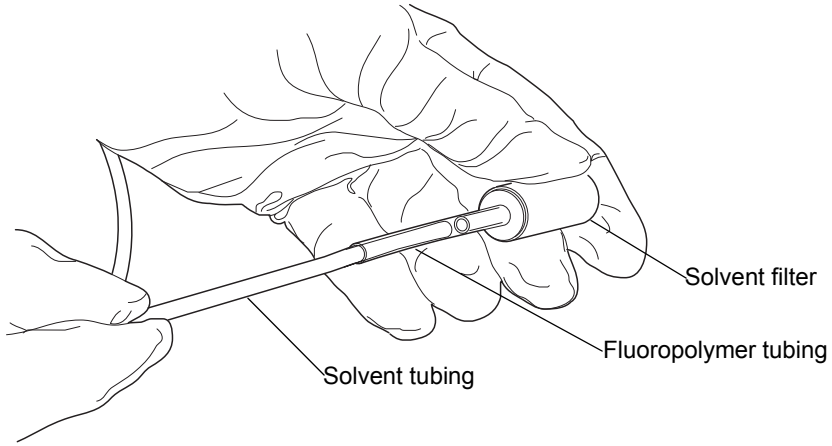
1. Choose solvent reservoirs that snugly fit the reservoir caps supplied in the startup kit.

   Requirement: Do not pressurize solvent reservoirs.

   Recommendation: Use 1-L solvent reservoirs.

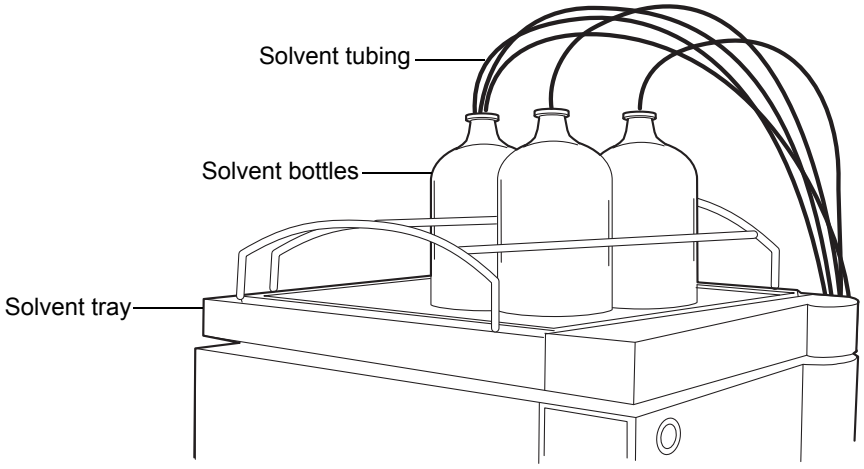
   Caution: To avoid contaminating the solvent filter with skin oils, wear clean, chemical-resistant, powder-free gloves when handling it.

2. Remove the solvent filter from the short piece of fluoropolymer tubing.



3. Insert the solvent tubing through the solvent reservoir cap.
4. Reinstall the solvent filter on the short piece of fluoropolymer tubing.

5. Insert the filtered end of the solvent tubing into the solvent bottle, in the tray atop the sample manager or (optional) detector.



6. Repeat step 2 through step 5, for the remaining solvent supply lines.

Performing a seal-wash prime

Prime the seal-wash in the binary solvent manager to lubricate the plungers, fill the tubing paths with solvent, and flush away solvent and/or any precipitated salts that have been dragged past the plunger seals from the high-pressure side of the piston chambers.

Prime the plunger seal-wash

- after using buffered mobile phase;
- when the binary solvent manager has been inactive for a few hours or longer;
- when the binary solvent manager is dry.

Caution:

- To avoid damaging the solenoid valve seats and seals of the seal-wash pump in the solvent path, do not use a nonvolatile buffer as the seal-wash solvent.
- To prevent contaminating the system, do not recycle seal-wash.

Tip: The seal-wash self-primes, but you can use a syringe to hasten the process.

Recommendations:

- Use seal-wash that contains 10% organic solvent. This concentration prevents microbial growth and ensures that the seal-wash can solubilize the mobile phase.
- Before priming the plunger seals, ensure the volume of seal-wash is adequate for priming.

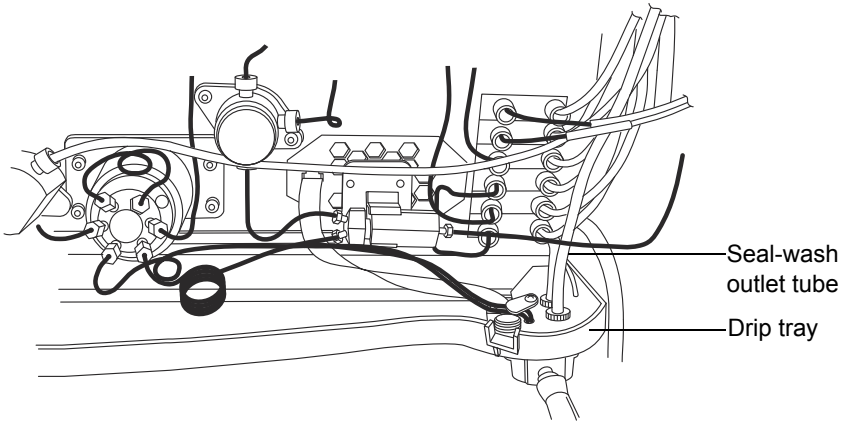
See also: *Controlling Contamination in Ultra Performance LC/MS and HPLC/MS Systems* (part number 715001307) on the ACQUITY UPLC System Bookshelf CD.

Required materials

- 30-mL syringe (startup kit)
- Gloves: clean, powder-free, chemical-resistant
- Seal-wash solution
- Tubing adapter (startup kit)

To perform a seal-wash prime:

1. Ensure the seal-wash inlet tube is in the seal-wash solvent reservoir.
2. Remove the seal-wash outlet tube from the right-hand side of the drip tray.



3. Push the syringe plunger fully into the syringe barrel.
4. Connect the tubing adapter to the syringe, and then connect the syringe assembly to the outlet tubing from the seal-wash system.

5. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.

6. Click Control > Prime seal-wash, and then click Yes to begin the seal-wash priming process.
7. Slowly withdraw on the syringe plunger, pulling seal-wash solvent through the system.
8. When the seal-wash solution begins to flow into the syringe without bubbles, disconnect the tubing and reinstall it on the fitting on the drip tray.
9. Click Control > Prime seal-wash, and then click Yes to stop the priming process.

Priming the binary solvent manager

You prime a new system or binary solvent manager to prepare it for use after changing reservoirs or after it has been idle for more than four hours. During priming, the vent valve moves to the Vent position, ensuring minimal backpressure and directing the flow to waste. The flow rate during priming is 4 mL/min for each pump primed.

Tip: If you are priming a dry binary solvent manager, using a syringe shortens the time required to complete priming.

Caution: To prevent salts from precipitating in the system, introduce an intermediate solvent, such as water, when changing from buffers to high-organic-content solvents. Be sure to consult the solvent miscibility tables in the solvent considerations document for your system.

Ensure the solvent reservoirs contain enough solvent for adequate priming and the waste container has sufficient capacity for used solvent. The priming flow rate is 4 mL/min for each pump, or 8 mL/min total. For example, priming both solvents for 5 minutes requires approximately 20 mL of each solvent.

Warning: To avoid spills, empty the waste container at regular intervals.

Priming a dry binary solvent manager

To prime a dry binary solvent manager:

1. Open the instrument's front door.
2. Locate the appropriate solvent vent tube.
3. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.
4. In the binary solvent manager information window, click Control > Prime A/B Solvents.
5. In the Prime A/B Solvents dialog box, select solvent A and/or B.
6. In the Time box, specify a duration for the priming operation, from 0.1 through 60.0 minutes.

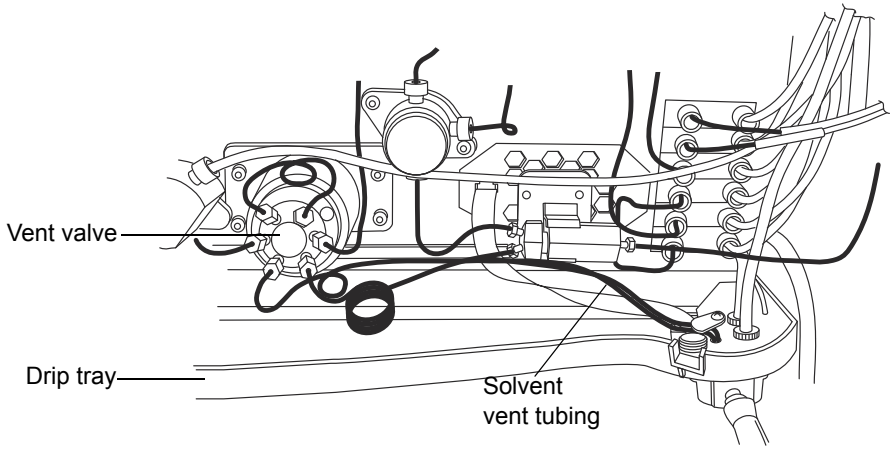
   Default: 1.0 minute

   Recommendation: Prime the binary solvent manager until a steady flow exits the vent tube (typically between 7 to 10 minutes).
7. Click Start.
8. When solvent flows out of the vent tube without bubbles, repeat step 3 through step 7, to prime the other solvents.

   Tip: Confirm that solvent reservoirs contain enough solvent for future methods.

To prime a dry binary solvent manager using a syringe:

1. Open the instrument's front door.
2. Locate the appropriate solvent vent tube.
   - If you are priming solvent A, follow the stainless steel vent tube labeled "A-VENT" from port 4 on the vent valve, and lift it from the drip tray.
   - If you are priming solvent B, follow the stainless steel vent tube labeled "B-VENT" from port 1 on the vent valve, and lift it from the drip tray.



3. Push the syringe plunger fully into the syringe barrel.
4. Connect the tubing adapter to the syringe.
5. Connect the syringe assembly to the short length of PharMed® tubing, and then connect the short length of PharMed tubing to the solvent vent tube you located in step 2.
6. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.
7. In the binary solvent manager information window, click Control > Prime A/B Solvents.
8. In the Prime A/B Solvents dialog box, select solvent A1.

9. In the Time box, specify a duration for the priming operation, from 0.1 through 60.0 minutes.

   Default: 1.0 minute

   Recommendation: Prime the binary solvent manager until a steady flow exits the vent tube (typically 3 minutes).

10. Click Start.
11. Slowly withdraw on the syringe plunger, pulling solvent through the solvent path.
12. When solvent flows out of the vent tube without bubbles, remove the syringe from the vent tube, and reconnect the vent tube to the drip tray.
13. Repeat step 2 through step 12 for solvent A2, B1, and B2.

    Tip: Ensure solvent reservoirs contain enough solvent for future methods.

Priming a wetted binary solvent manager

Refreshing the system

Use the Start up system function after the system has been idle a short period of time (a few hours to overnight) and when you plan to use the same solvents that you used during the previous run.

You can invoke the Start up system function from the control panel or by adding it as a line in a sample set.

Recommendations:

- Prime the binary solvent manager for 1 minute for each solvent when the system has been idle for four or more hours and you intent to use the solvents that are already in the system.
- Prime the binary solvent manager for four minutes for each solvent when you intend to use fresh solvents of the same composition as those already in the system.

To refresh the system:

1. In the ACQUITY UPLC Console, click Control > Start up system.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.

2. In the Start up system dialog box, review the settings and select a different option, if needed.
   - Solvent line A only (default)
   - Solvent line B only
   - Both A and B
3. Click OK.

   Result: The system primes the selected solvents, primes the sample manager with one weak-wash prime (using the wash and sample syringes), and ignites the lamp in the detector.

Washing the plungers

The plunger wash function washes the plungers with seal-wash solvent. It is designed to prevent the build-up of precipitates on the pump plungers, which can cause damage to the high-pressure seals.

The cycle starts by filling and then slowly emptying the primary and accumulator chambers with the current solvent composition while performing a high-speed and high-volume seal-wash.

Recommendation: Perform this procedure after using buffered solvents.

In addition, the plunger wash routine runs when the solvent manager is idle. The seal-wash solvent washes the plungers, moving them backward and forward, so that most of the surface is washed. The plunger wash routine continues for two minutes performing these operations:

- Starts the seal-wash pump
- Slowly empties and fills the syringes, with the vent valve set to waste, thus moving the plungers through the seal-wash flow.
- Repeats the emptying and filling of syringes for a total of two cycles.

To wash the plungers:

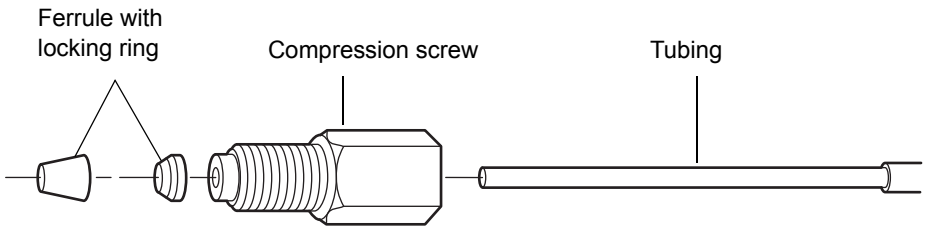
In the ACQUITY UPLC console, select the solvent manager > Maintain > Wash plungers.

Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.

Installation recommendations for fittings

Warning: To avoid personal contact with fittings contaminated with biologically hazardous or toxic materials, always wear clean, chemical-resistant, powder-free gloves when reinstalling the fittings.

The system uses gold-plated compression screws and two-piece ferrules. See the diagram below for assembly orientation.



Recommendations:

- To prevent bandspreading, ensure the tubing fully bottoms in the fitting hole before tightening the compression screw.
- For easier accessibility, use long compression screws to attach tubes to the vent valve.
- Perform the solvent manager leak test whenever you replace or loosen fittings during maintenance (see the ACQUITY UPLC online Help).
- Whenever you loosen fittings during maintenance, examine for cracks, stripped threads, and deformations.
- Do not reseat stainless steel ferrules more than six times.

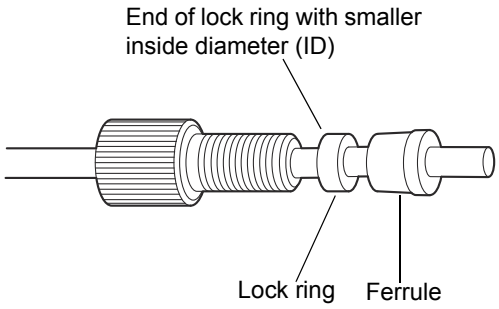
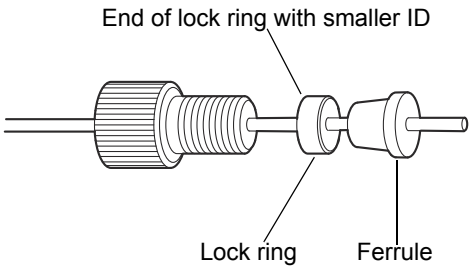
Tip: To avoid problems with the leak management system, do not use long compression screws on the injector valve.

Required material

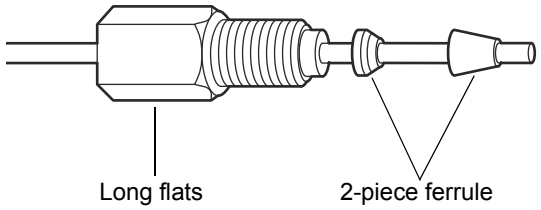
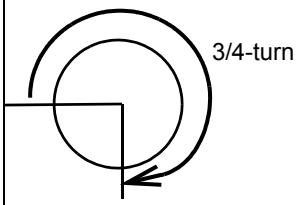
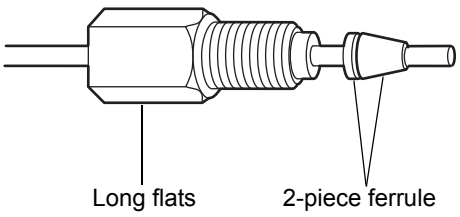
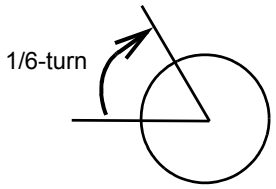
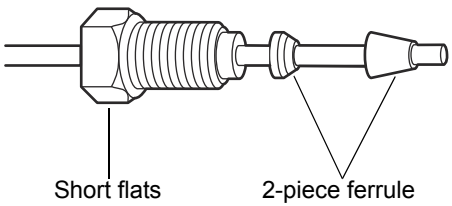
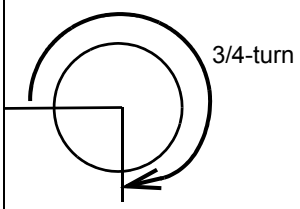
Gloves: clean, powder-free, chemical-resistant

When tightening system fittings, consult the following table.

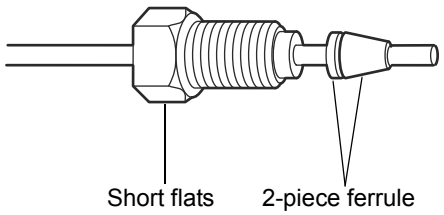
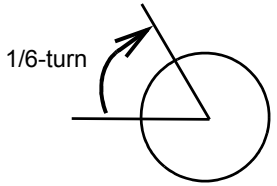
Installation recommendations for ACQUITY UPLC binary solvent manager fittings:

	Fitting	Recommended tightening
First use or reinstalled	Long 1/4-28 fitting with flangeless ferrule and stainless steel lock ring, installed on 1/8-inch outside diameter (OD) tubing 	Finger-tight
First use or reinstalled	Short 1/4-28 fitting with flangeless ferrule and stainless steel lock ring, installed on .062-inch OD tubing 	Finger-tight

Installation recommendations for ACQUITY UPLC binary solvent manager fittings: (Continued)

	Fitting	Recommended tightening
First use	Stainless steel (gold-plated) fitting with long flats and 2-piece stainless steel ferrule 	Finger-tight, plus 3/4-turn using wrench 
Reinstalled	Stainless steel (gold-plated) fitting with long flats and 2-piece stainless steel ferrule 	Finger-tight, plus up to 1/6-turn using wrench 
First use	Stainless steel (gold-plated) fitting with short flats and 2-piece stainless steel ferrule 	Finger-tight, plus 3/4-turn using wrench 

Installation recommendations for ACQUITY UPLC binary solvent manager fittings: (Continued)

	Fitting	Recommended tightening
Reinstalled	Stainless steel (gold-plated) fitting with short flats and 2-piece stainless steel ferrule 	Finger-tight, plus up to 1/6-turn using wrench 

Resolving leak sensor errors (optional)

After approximately 1.5 mL of liquid accumulate in the leak sensor reservoir, an alarm sounds, indicating that the leak sensor detected a leak.

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Warning: To avoid personal contamination from contact with biologically hazardous or toxic materials, always wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Caution: To avoid scratching or damaging the leak sensor,

- do not allow buffered solvents to accumulate and dry on it;
- submerge only the prism in a cleaning bath.

Required materials

- Cotton swabs
- Gloves: clean, powder-free, chemical-resistant
- Nonabrasive, lint-free wipes

To resolve a binary solvent manager leak sensor error:

1. View the Leak Sensors dialog box in the ACQUITY UPLC Console to confirm the leak sensor detected a leak.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.

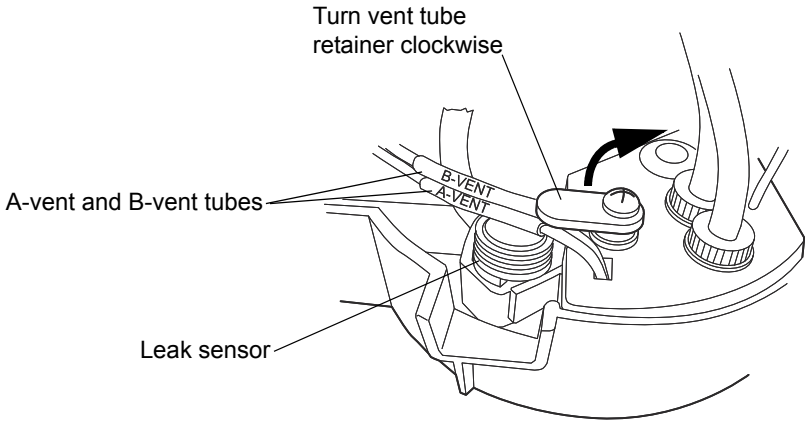
   Tip: When a leak is detected, a “Leak Detected” error message appears in the software display.

   Caution: To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to an instrument or device. To completely interrupt power, set the power switch to Off, and then unplug the power cord from the AC source. Wait 10 seconds thereafter before you disconnect an assembly.

2. Power-off the binary solvent manager.
3. Open the binary solvent manager’s door, gently pulling its right-hand edge toward you.
4. Locate the source of the leak, and make the repairs necessary to stop the leak.

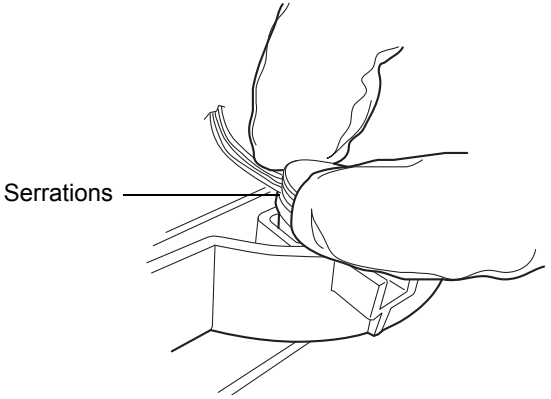
5. Turn the vent tube retainer clockwise, and then lift the A-vent and B-vent tubes from the drip tray by pulling up on them and moving them to the left-hand side of the leak sensor.



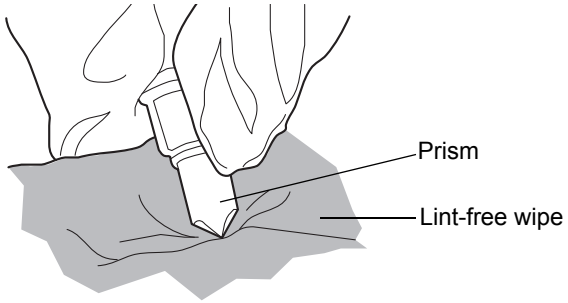
Caution: To avoid damaging the leak sensor, do not grasp it by the ribbon cable.

6. Remove the leak sensor from its reservoir by grasping the sensor by its serrations and pulling upward.

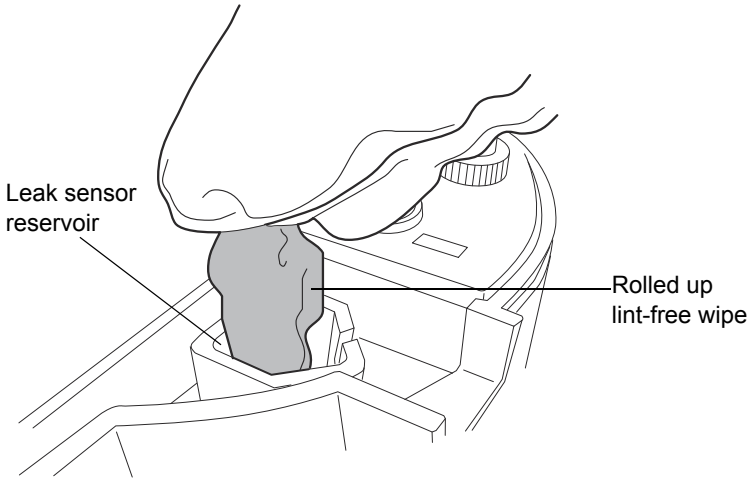
   Tip: If you cannot easily manipulate the leak sensor after removing it from its reservoir, detach the connector from the front of the instrument (see page 36).



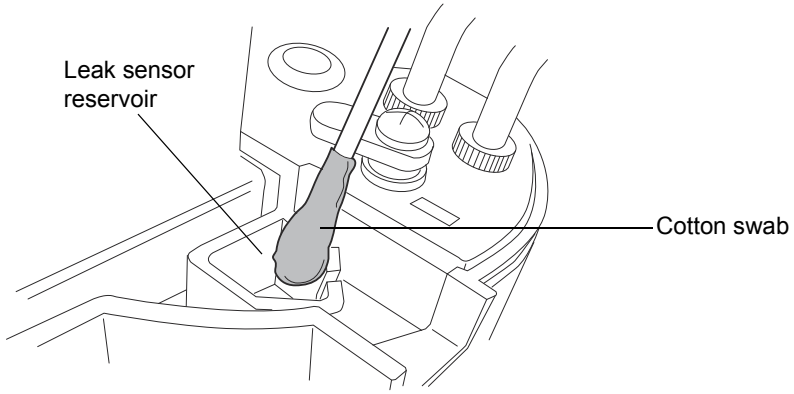
7. Use a nonabrasive, lint-free wipe to dry the leak sensor prism.



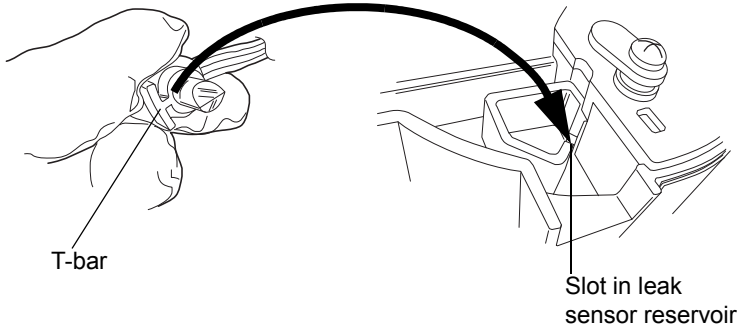
8. Roll up a nonabrasive, lint-free wipe, and use it to absorb the liquid from the leak sensor reservoir and its surrounding area.

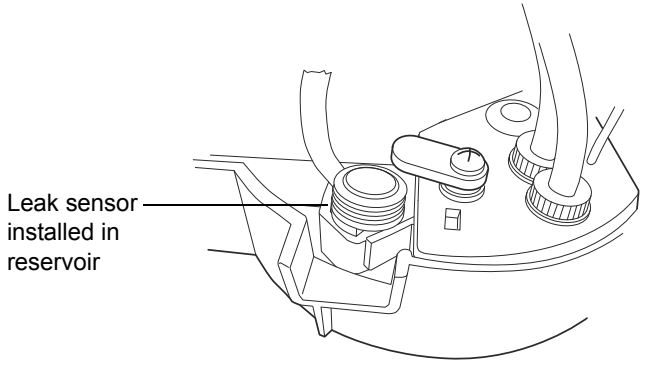


9. With a cotton swab, absorb any remaining liquid from the corners of the leak sensor reservoir and its surrounding area.

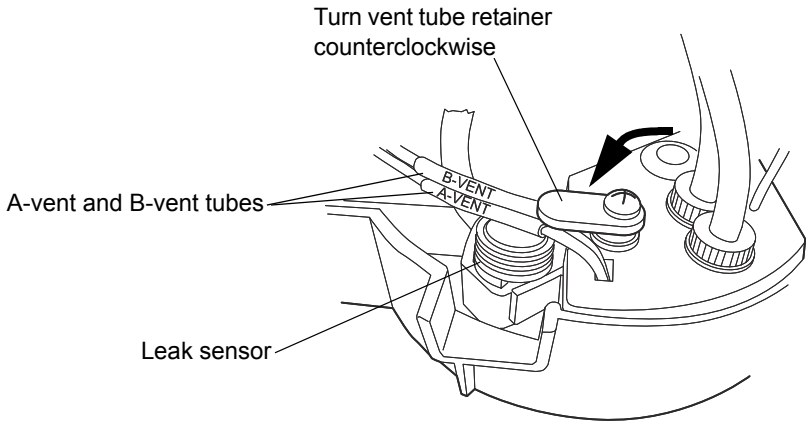


10. Align the leak sensor's T-bar with the slot in the side of the leak sensor reservoir, and slide the leak sensor into place.





11. Reinsert the A-vent and B-vent tubes into the appropriate drip tray holes.
12. Turn the vent tube retainer, which holds the A-vent and B-vent tubing in place, counterclockwise.



13. If you detached the connector from the front of the instrument, reattach it.
14. Power-on the binary solvent manager.
15. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

    Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.
16. In the binary solvent manager information window, click Control > Reset BSM, to reset the binary solvent manager.

Maintaining the binary solvent manager

Perform the procedures in this section when you discover a problem with a binary solvent manager component or during routine maintenance. For information about isolating problems in the binary solvent manager, consult the ACQUITY UPLC Console online Help.

Contacting Waters technical service

If you are located in the USA or Canada, report malfunctions or other problems to Waters Technical Service (800 252-4752). From elsewhere, phone the Waters corporate headquarters in Milford, Massachusetts (USA), or contact your local Waters subsidiary. The Waters web site includes phone numbers and e-mail addresses for Waters locations worldwide. Visit www.waters.com.

When you contact Waters, be prepared to provide this information:

- Error message (if any)
- Nature of the symptom
- Instrument serial numbers and firmware version
- Flow rate
- Operating pressure
- Solvent(s)
- Detector settings (sensitivity and wavelength)
- Type and serial number of column(s)
- Sample type and diluent
- Data software version and serial number
- ACQUITY UPLC system workstation model and operating system version

For complete information on reporting shipping damages and submitting claims, see *Waters Licenses, Warranties, and Support Services* documentation.

Locating system serial numbers

The serial number on the system's instruments and devices facilitates service and support. Serial numbers also provide a way to create single log entries for each module, so that you can review the usage history of only that instrument or device.

Be prepared to provide the serial numbers of the instruments or devices in your system when you contact Waters customer support.

To view the information for an instrument or device:

1. In the ACQUITY UPLC Console, select an instrument or device from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.

2. Click Configure > View module information.

   Result: The Module Information dialog box displays this information:

   - Serial number
   - Firmware version
   - Firmware checksum
   - Component software version

Alternatives:

- From the main window, place the pointer over the visual representation of the system instrument or device you want information for.
- Obtain the serial number from the printed labels on the rear panels of instruments and devices or inside their front doors.

Maintenance schedule

Perform the following routine maintenance on the binary solvent manager to ensure reliable operation and accurate results. When using the system throughout the day (and on nights and weekends), or when using aggressive solvents such as buffers, perform these maintenance tasks more frequently.

Recommended routine maintenance schedule:

Maintenance procedure	Frequency	For information...
Replace the leak sensor	As needed	See page 35
Replace the mixer	During scheduled routine maintenance or as needed	See page 39
Replace the *i²Valve* actuator	5 years from the date of manufacture or as needed	See page 41
Replace the *i²Valve* cartridge	During scheduled routine maintenance or as needed	See page 53
Replace the in-line filter	During scheduled routine maintenance or as needed	See page 65
Replace the accumulator check valve	During scheduled routine maintenance or as needed	See page 69
Replace solvent reservoir filters	During scheduled routine maintenance or as needed	See page 72
Clean the air filter in the door	As needed	See page 73
Replace the air filter in the door	During scheduled routine maintenance or as needed	See page 74
Replace the plunger and seals	During scheduled routine maintenance or as needed	See page 75 and page 98
Replace the vent valve cartridge	As needed	See page 114
Clean the device's exterior with a soft, lint-free cloth, or paper dampened with water	As needed	See page 118

Maintenance considerations

Safety and handling

Observe these warning and caution advisories when you perform maintenance operations on your system.

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Warning: To avoid electric shock, do not remove the device's protective panels. The components within are not user-serviceable.

Caution: To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to an instrument or device. To completely interrupt power, set the power switch to Off, and then unplug the power cord from the AC source. Wait 10 seconds thereafter before you disconnect an assembly.

Configuring maintenance warnings

Maintenance counters provide real-time usage status information that can help you determine when to schedule routine maintenance for specific components. You can set usage thresholds and maintenance warnings that alert you when a component reaches the designated threshold limit. By setting threshold limits and monitoring these usage counters regularly, you can minimize unexpected failures and unscheduled downtime during important work. For information on setting maintenance warnings, consult the ACQUITY UPLC Console online Help.

Replacing the leak sensor

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Warning: To avoid personal contamination from contact with biologically hazardous or toxic materials, always wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Required materials

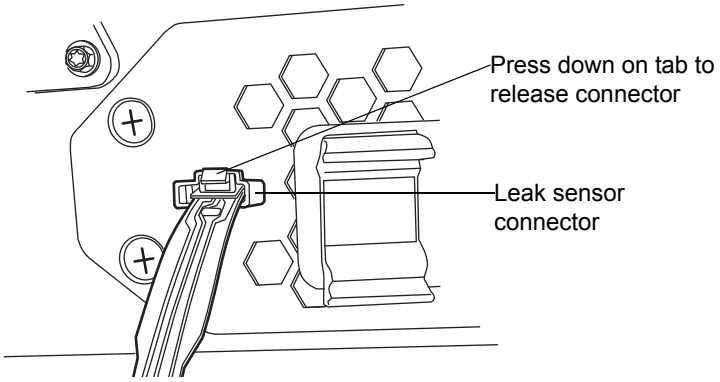
- Gloves: clean, powder-free, chemical-resistant
- Leak sensor

To replace the leak sensor:

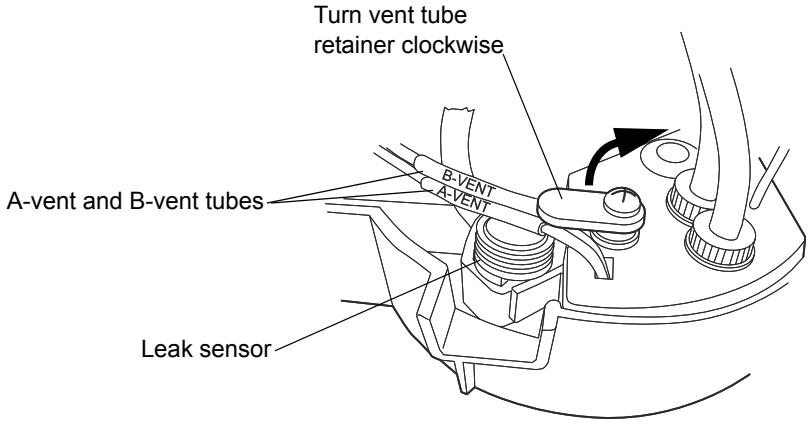
Caution: To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to an instrument or device. To completely interrupt power, set the power switch to Off, and then unplug the power cord from the AC source. Wait 10 seconds thereafter before you disconnect an assembly.

1. Power-off the binary solvent manager.
2. Open the binary solvent manager's door, gently pulling its right-hand edge toward you.

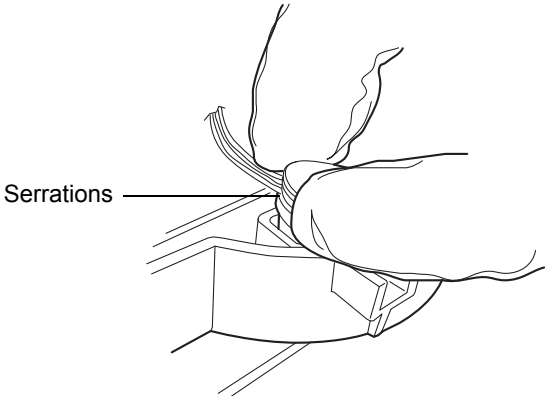
3. Press down on the tab to detach the leak sensor connector from the front of the device.



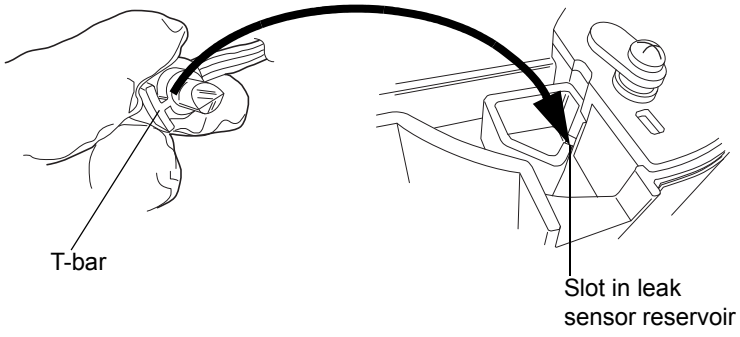
4. Turn the vent tube retainer clockwise, and then lift the A-vent and B-vent tubes from the drip tray by pulling upward on them and moving them to the left-hand side of the leak sensor.

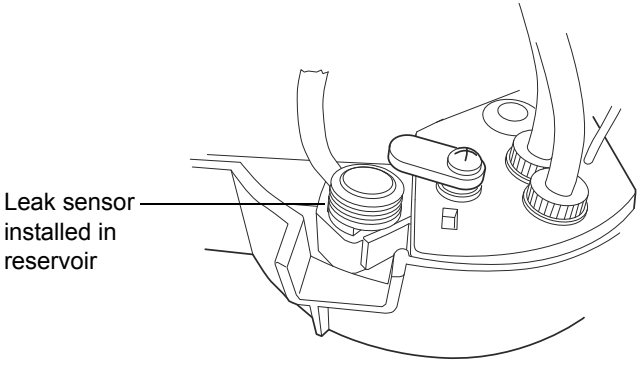


5. Remove the leak sensor from its reservoir by grasping the sensor by its serrations and pulling upward.

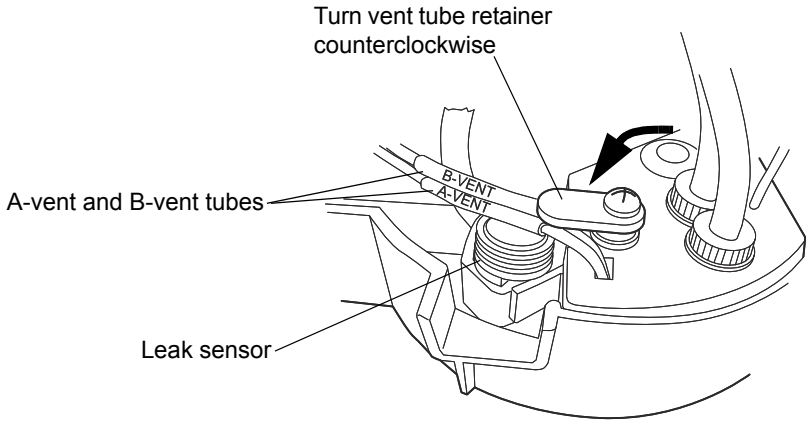


6. Unpack the new leak sensor.
7. Align the leak sensor's T-bar with the slot in the side of the leak sensor reservoir, and slide the leak sensor into place.





8. Reinsert the A-vent and B-vent tubes into the drip tray.
9. Turn the vent tube retainer, which holds the A-vent and B-vent tubing in place, counterclockwise.



10. Connect the leak sensor connector to the front of the instrument.
11. Power-on the binary solvent manager.
12. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

    Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.
13. In the binary solvent manager information window, click Control > Reset BSM, to reset the binary solvent manager.

Replacing the mixer

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Caution: To prevent contaminating system components, wear clean, chemical-resistant, powder-free gloves when replacing the mixer.

Required materials

- Gloves: clean, powder-free, chemical-resistant
- Mixer

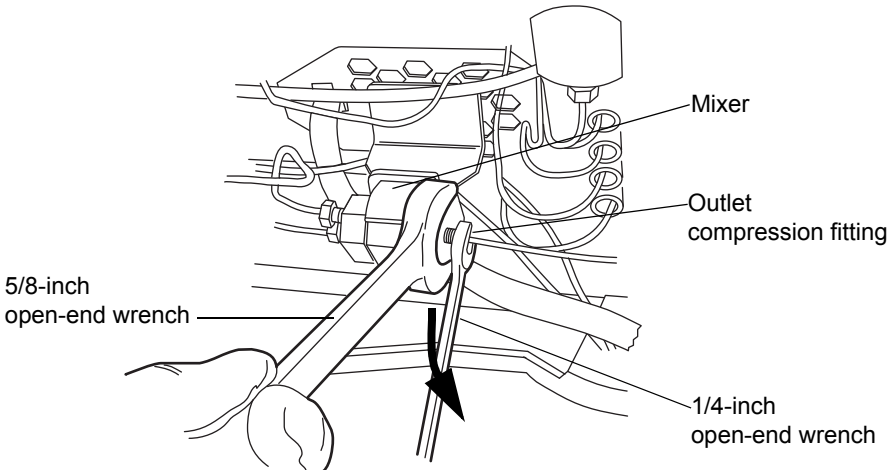
Required tools

- 1/4-inch open-end wrench
- 5/8-inch open-end wrench

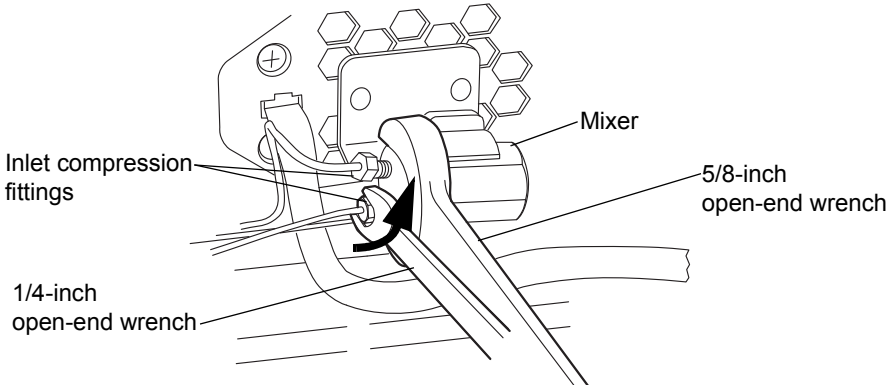
To replace the mixer:

1. Flush the binary solvent manager with nonhazardous solvent.
2. Stop the solvent flow.

3. Using the 5/8-inch open-end wrench to hold the mixer in place, disconnect the outlet compression fitting by using the 1/4-inch open-end wrench.



4. Using the 5/8-inch open-end wrench to hold the mixer, disconnect the two inlet compression fittings by using the 1/4-inch wrench.



5. Remove the old mixer from the clamp.
6. Unpack the new mixer.
7. Insert the new mixer into the clamp.
8. Reattach the compression fittings to the mixer and tighten them finger-tight plus as much as 1/6-turn, for existing fittings, or 3/4-turn for new fittings.

Replacing the *i²Valve* actuator

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Caution:

- To avoid damaging the *i²Valve* actuator, do not attempt to push or pull liquid or gas through the valve's inlet or outlet ports.
- To prevent contaminating system components, wear clean, chemical-resistant, powder-free gloves when replacing the *i²Valve* actuator.

Required materials

- Gloves: clean, powder-free, chemical-resistant
- *i²Valve* actuator
- *i²Valve* cartridge (recommended)

Required tools

- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- T8 TORX® driver

To replace the *i²Valve* actuator:

Caution: To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to an instrument or device. To completely interrupt power, set the power switch to Off, and then unplug the power cord from the AC source. Wait 10 seconds thereafter before you disconnect an assembly.

1. Flush the binary solvent manager with nonhazardous solvent.
2. Power-off the binary solvent manager.

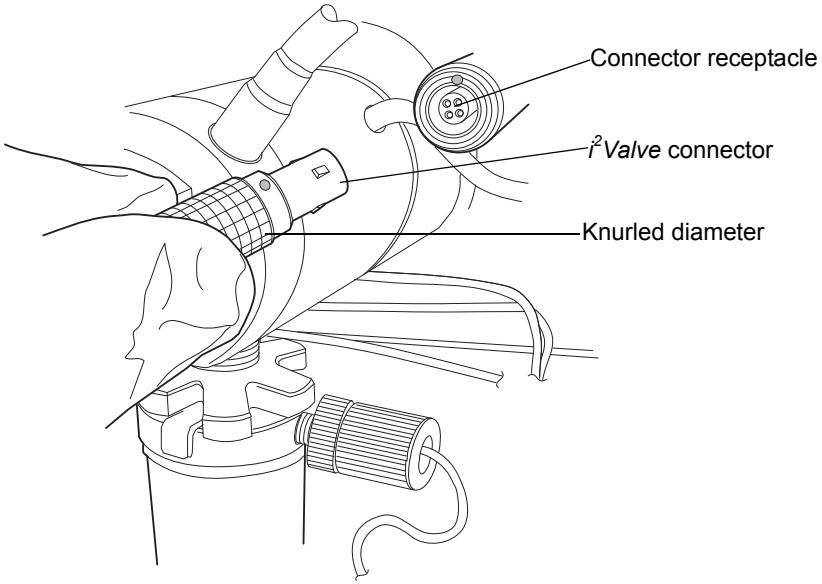
Tip: The binary solvent manager is referred to as “pump” on the warning label affixed to the *i²Valve* actuator.

Warning: To avoid injuries arising from contact with spilled solvent (siphoning), move the solvent bottles to a location below the binary solvent manager.

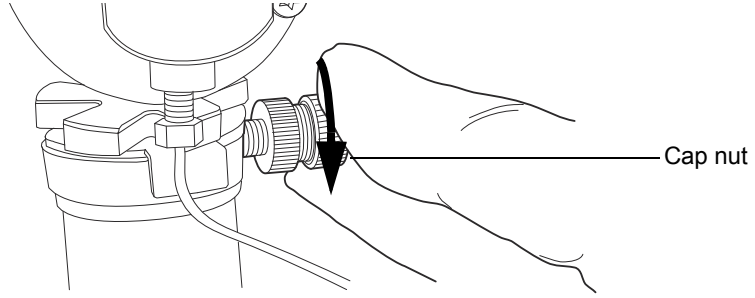
3. Move the solvent bottles to a location below the binary solvent manager.

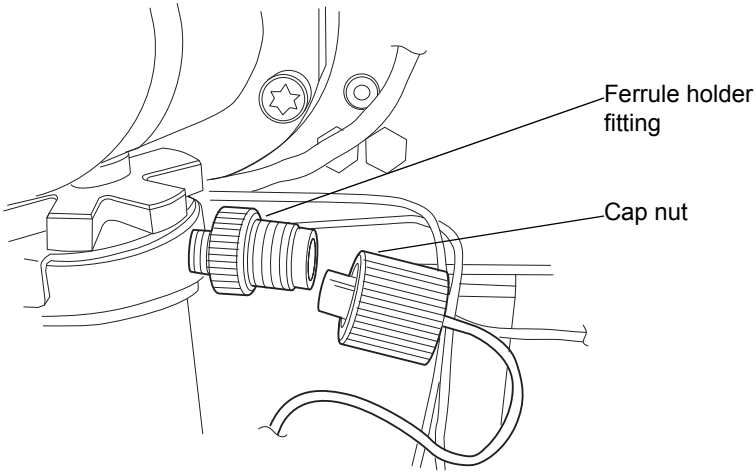
Caution: To avoid damage to the connector or cable, grasp the *i²Valve* connector by the knurled diameter.

4. Grasp the *i²Valve* connector by the knurled diameter, and pull it toward you, disconnecting it from its receptacle.

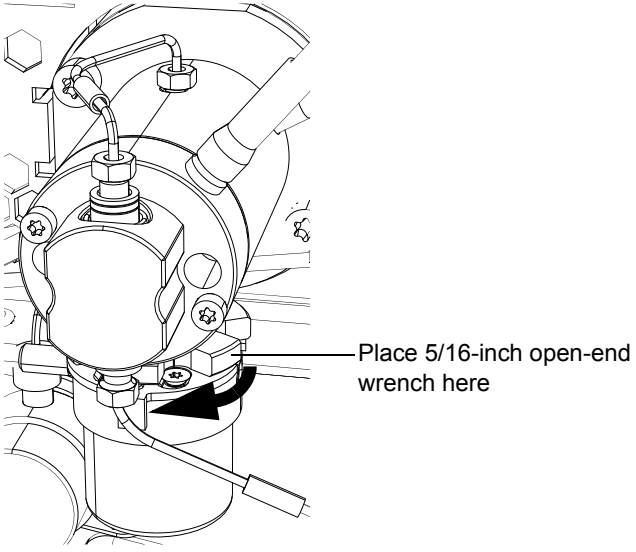


5. Loosen the cap nut on the in-line filter, so that it is removed from the threads of the ferrule holder fitting.





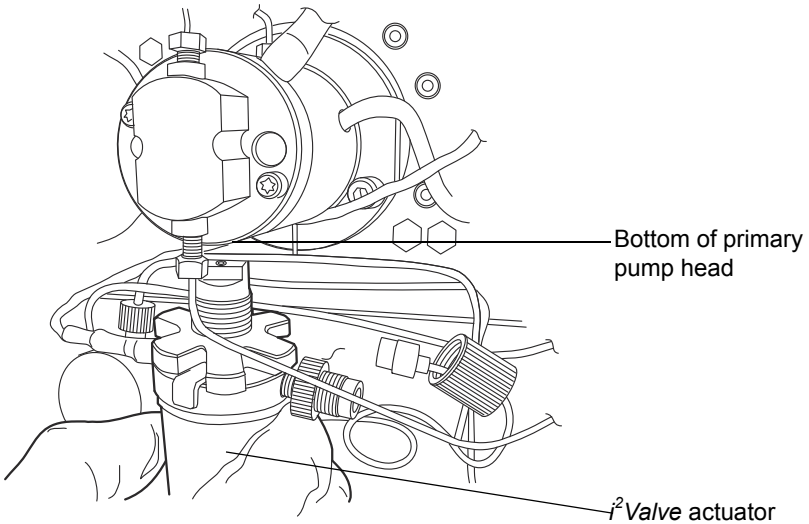
6. Use the 5/16-inch open-end wrench to loosen the shell nut, and then fully unscrew it.



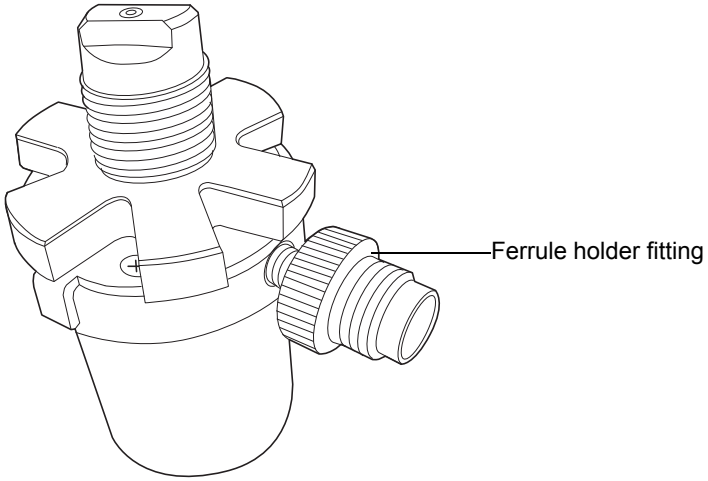
Caution:

- To avoid leaks, ensure the PEEK washer, which is normally on the top face of the *i²Valve* cartridge, does not remain in the head when you remove the valve assembly (see page 59).
- To avoid failure of the fuse on the *i²Valve* actuator's PCB board, never place the actuator assembly or electrical connector in the drip tray.

7. Remove the *i²Valve* actuator housing from the bottom of the primary pump head.



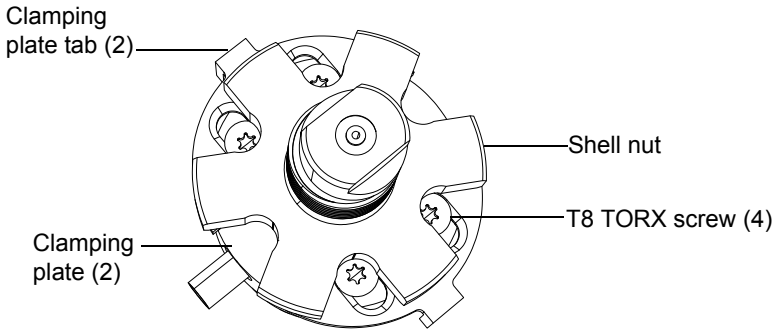
8. Remove the ferrule holder fitting from the old *i²Valve* actuator.



9. Use the T8 TORX driver to loosen 1/2-turn the 4 screws that secure the clamping plates.
10. Ensure the shell nut remains free to rotate and that the plates slide open.

Tips:

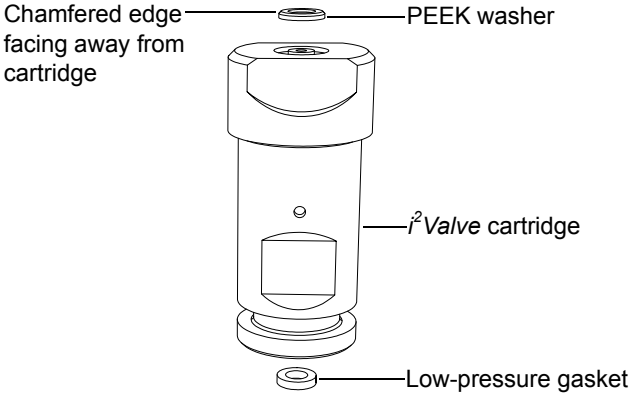
- Avoid touching the clamping plate tabs when loosening the screws.
- You can rotate the shell nut to gain access to all 4 screws.



11. When both plates are in the maximum open position, remove the cartridge from the *i*^{2}*Valve* actuator, and ensure that the low-pressure gasket is removed with the cartridge.

    Tip: If you cannot remove the cartridge from the valve actuator, rotate the cartridge 1/2-turn, and then remove it.

12. Ensure the PEEK washer is inserted into the cartridge, its chamfered edge facing away from the cartridge.



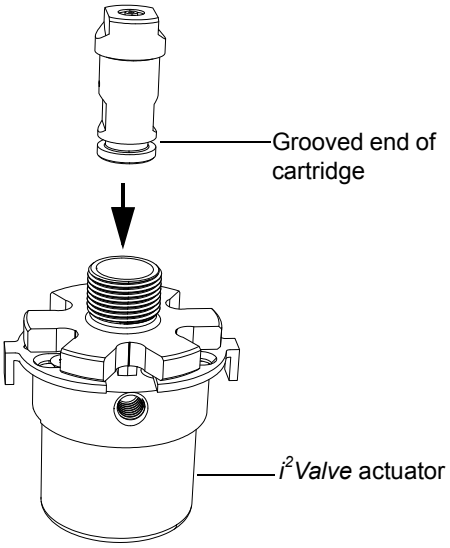
13. Ensure the plates are loose and in their maximum open position.

    Tips:

    - Avoid touching the clamping plate tabs when loosening the screws.
    - You can rotate the shell nut to gain access to all 4 screws.

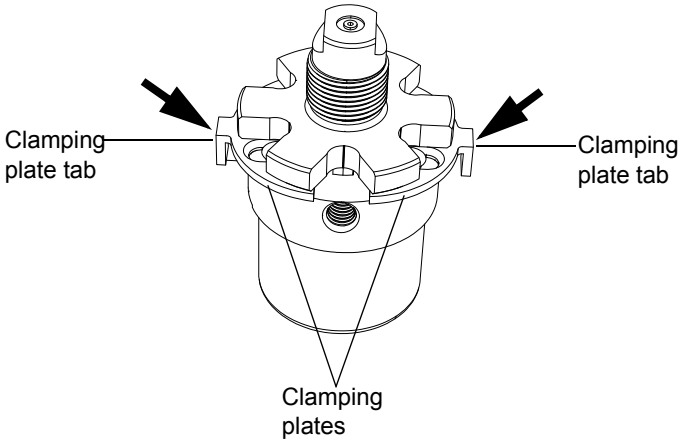
14. Insert the cartridge you removed from the old *i²Valve* actuator into the new actuator, grooved end first.

    Recommendation: Replace the cartridge whenever you replace the *i²Valve* actuator. See step 13 on page 59.

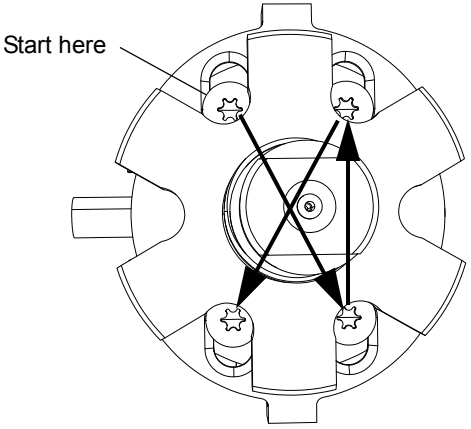


15. With one hand, squeeze the 2 clamping plate tabs on the *i²Valve* actuator, to hold the clamping plates against the cartridge.

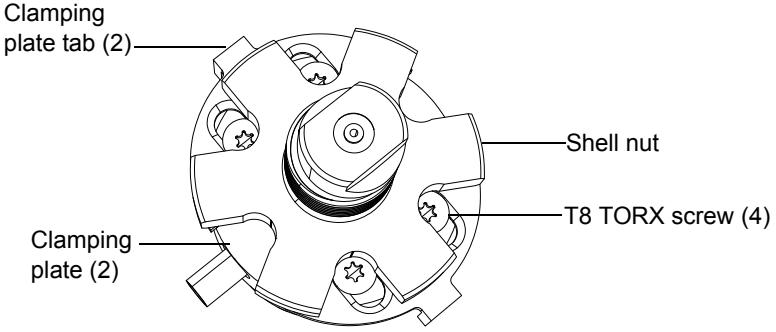
    Requirement: The clamping plates must be fully engaged in the cartridge groove.



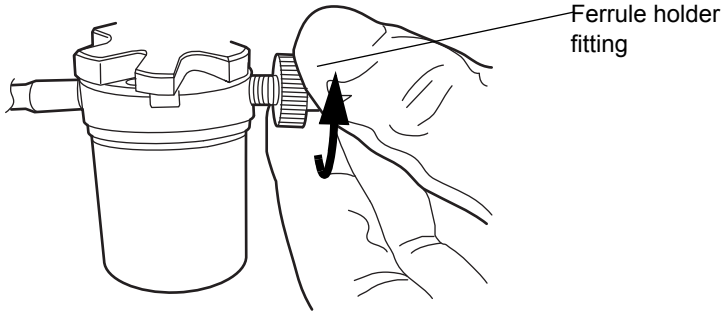
16. While squeezing the clamping plate tabs, use the T8 TORX driver to tighten the 4 screws that secure the plates, repeating the torquing pattern shown below at least 3 times and gradually increasing the torque until the screws are uniformly tight.



Tip: You can rotate the shell nut to gain access to all 4 screws.



17. Insert the ferrule holder fitting into the inlet port on the *i²Valve* assembly, and tighten it finger-tight.

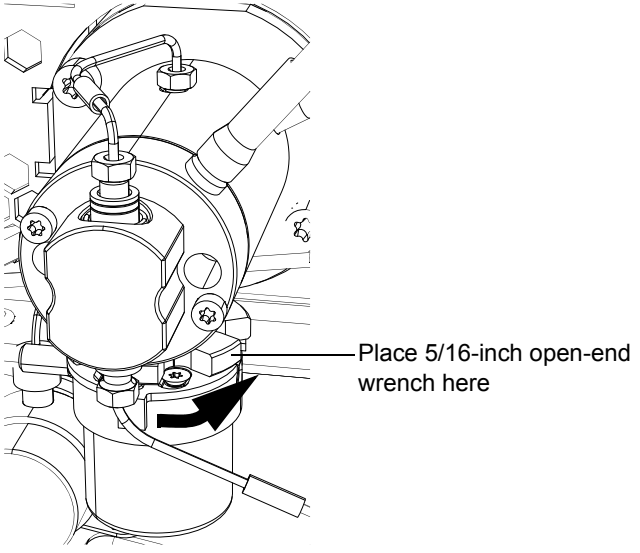


18. Orient the *i²Valve* assembly so that the cable exits from the left-hand side.

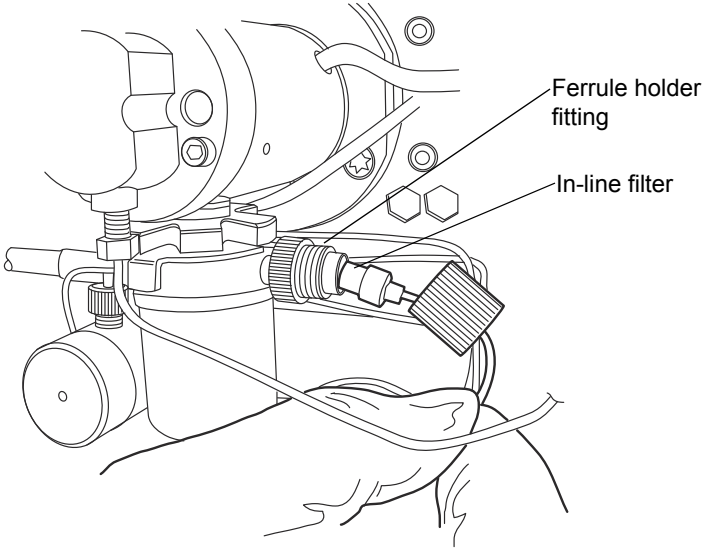
19. Insert the *i²Valve* assembly into the bottom of the primary pump head, and route the cable behind the valve actuator.

20. Finger-tighten the shell nut, rotating it approximately 5 full turns, to secure the valve.

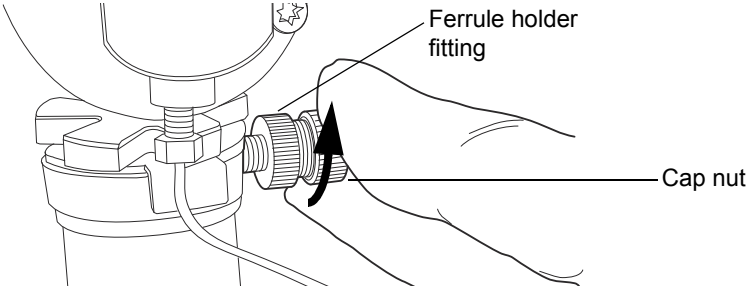
21. Use the 5/16-inch open-end wrench to tighten the nut an additional 1/8-turn.



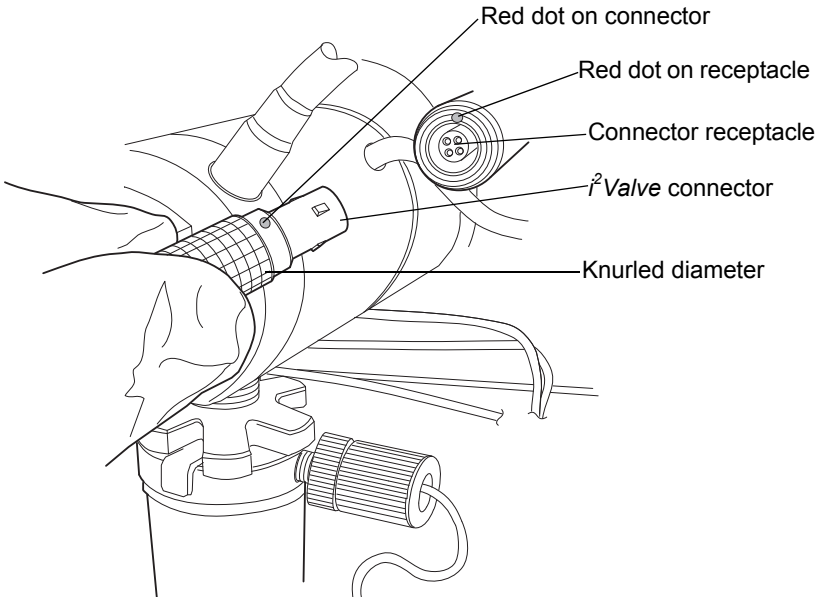
22. Reinsert the in-line filter and tube into the ferrule holder fitting.



23. Place the cap nut over the ferrule holder fitting and finger-tighten the cap nut to the extent possible.



24. Align the red dot on the *i²Valve* connector with the red dot on the receptacle, in the 12 o'clock position, and insert the connector into the receptacle.



25. Power-on the binary solvent manager.
26. Prime the binary solvent manager (see page 17).

Replacing the *i²Valve* cartridge

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Caution:

- To avoid damaging the *i²Valve* actuator, do not attempt to push or pull liquid or gas through the valve's inlet or outlet ports.
- To prevent contaminating system components, wear clean, chemical-resistant, powder-free gloves when replacing the *i²Valve* cartridge.

Required materials

- Gloves: clean, powder-free, chemical-resistant
- *i²Valve* cartridge

Required tools

- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- T8 TORX driver

To replace the *i²Valve* cartridge:

Caution: To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to an instrument or device. To completely interrupt power, set the power switch to Off, and then unplug the power cord from the AC source. Wait 10 seconds thereafter before you disconnect an assembly.

1. Flush the binary solvent manager with nonhazardous solvent.
2. Power-off the binary solvent manager.

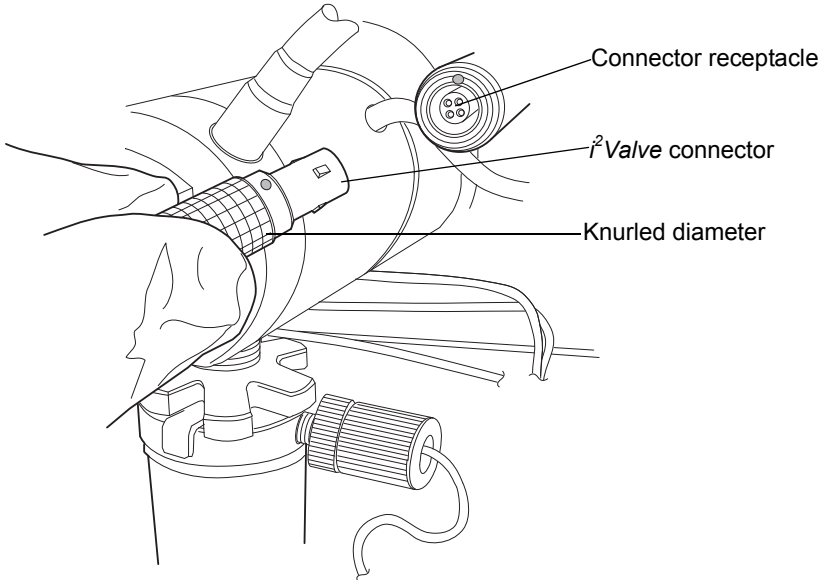
   Tip: The binary solvent manager is referred to as “pump” on the warning label affixed to the *i²Valve* actuator.

Caution: To avoid injuries arising from contact with spilled solvent (siphoning), move the solvent bottles to a location below the binary solvent manager.

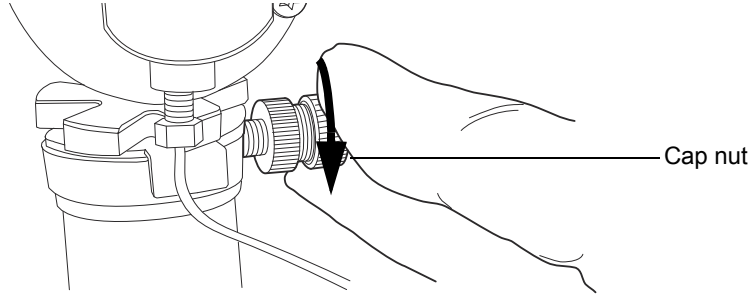
3. Move the solvent bottles to a location below the binary solvent manager.

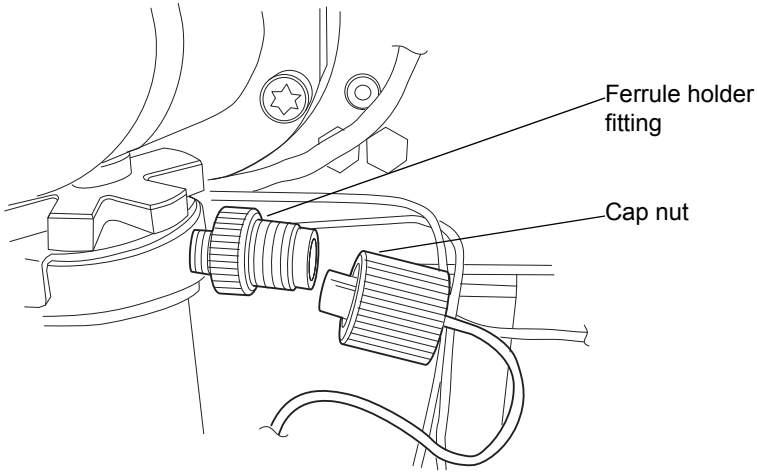
Caution: To avoid damaging the connector or cable, grasp the *i²Valve* connector by the knurled diameter.

4. Grasp the *i²Valve* connector by the knurled diameter, and pull it toward you, disconnecting it from its receptacle.

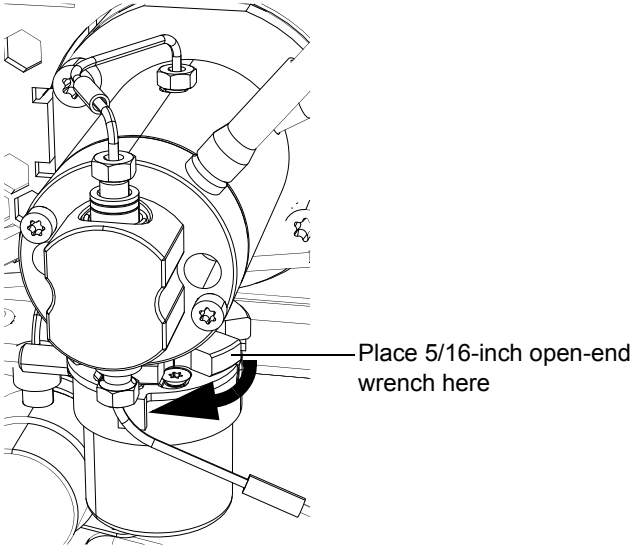


5. Loosen the cap nut on the in-line filter so that it is removed from the threads of the ferrule holder fitting.





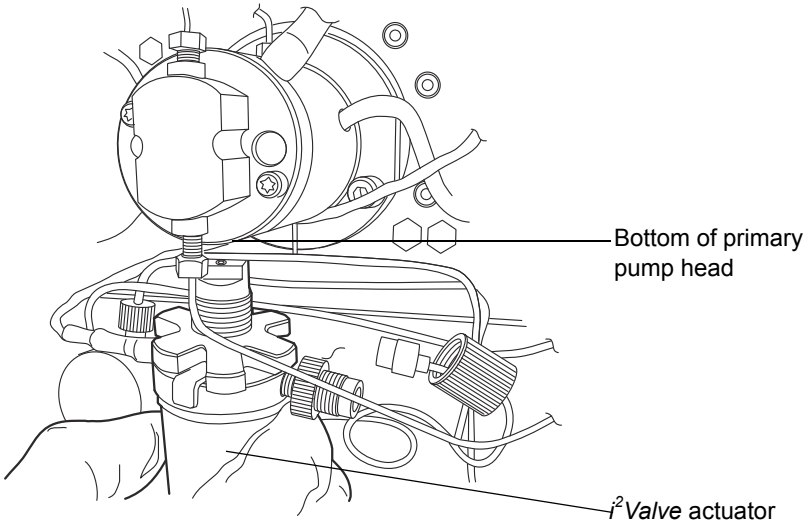
6. Use the 5/16-inch open-end wrench to loosen the shell nut, and then fully unscrew it.



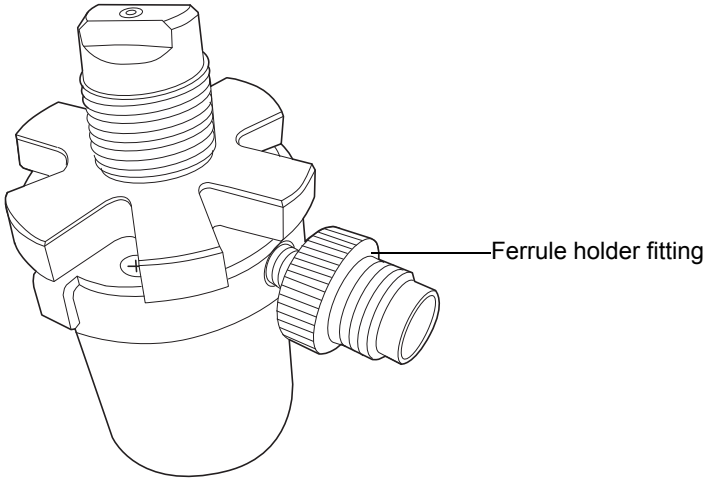
Caution:

- To avoid leaks, ensure the PEEK washer, which is normally on the top face of the *i²Valve* cartridge, does not remain in the head when you remove the valve assembly (see page 59).
- To avoid failure of the fuse on the *i²Valve* actuator's PCB board, never place the actuator assembly or electrical connector in the drip tray.

7. Remove the *i²Valve* actuator from the bottom of the primary pump head.



8. Remove the ferrule holder fitting from the old *i²Valve* actuator.



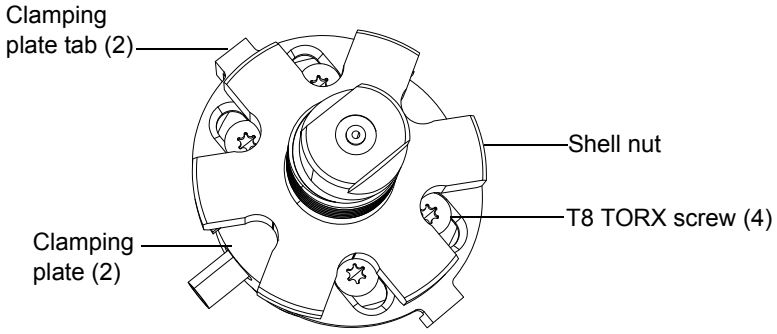
Caution: To avoid damaging the *i²Valve* actuator, do not back the screws out all the way.

9. Use the T8 TORX driver to loosen 1/2-turn the 4 screws that secure the clamping plates.

10. Ensure the shell nut remains free to rotate and that the plates slide open.

Tips:

- Avoid touching the clamping plate tabs when loosening the screws.
- You can rotate the shell nut to gain access to all 4 screws.

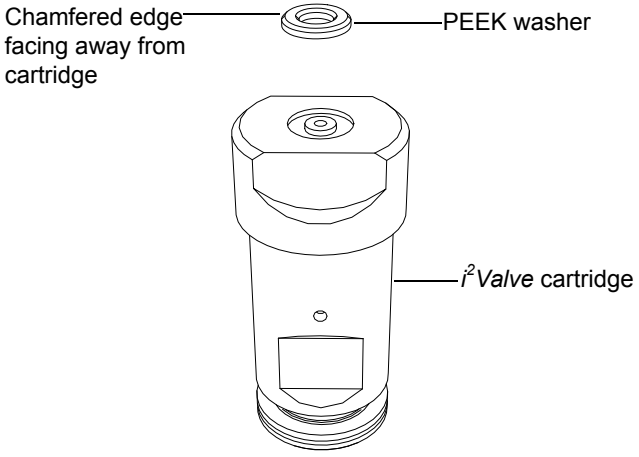


11. When both plates are in the maximum open position, remove the cartridge from the *i*^{2}*Valve* actuator.

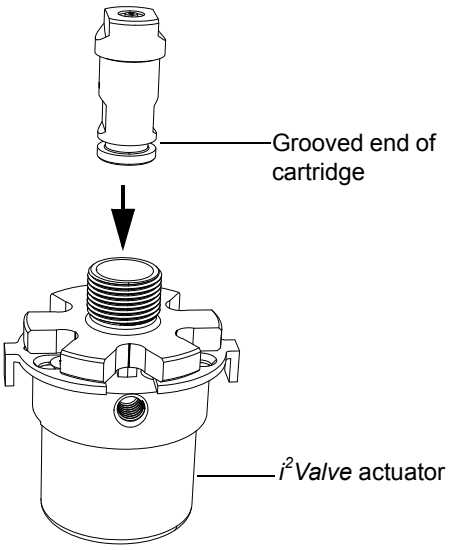
    Tip: If you cannot remove the cartridge from the valve actuator, rotate the cartridge 1/2-turn, and then remove it.

12. Unpack the new cartridge.

13. Ensure the PEEK washer is inserted into the cartridge, its chamfered edge facing away from the cartridge.

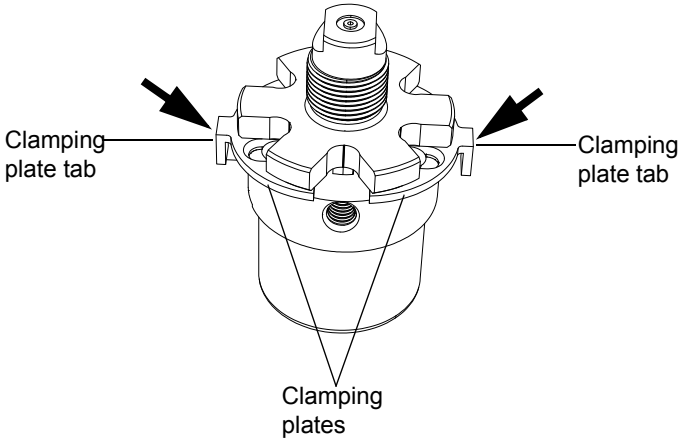


14. With the clamping plates still open, insert the cartridge into the *i²Valve* actuator, grooved end first.



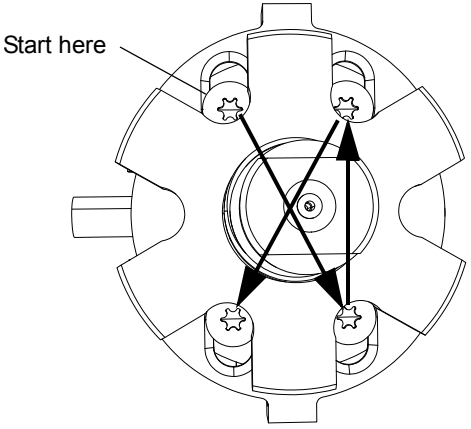
15. With one hand, squeeze the 2 clamping plate tabs on the *i²Valve* actuator, to hold the clamping plates against the cartridge.

    Requirement: The clamping plates must be fully engaged in the cartridge groove.

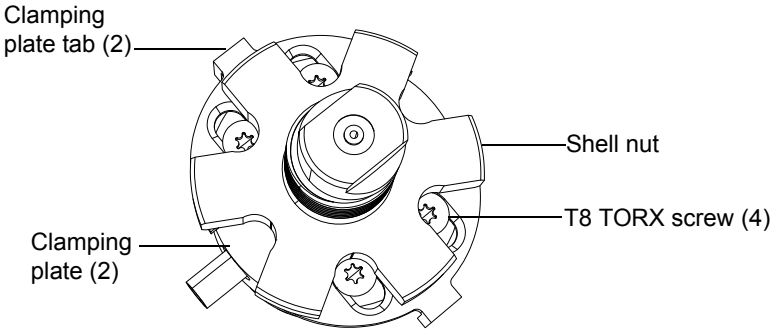


16. While squeezing the clamping plate tabs, use the T8 TORX driver to tighten the 4 screws that secure the plates, repeating the torquing

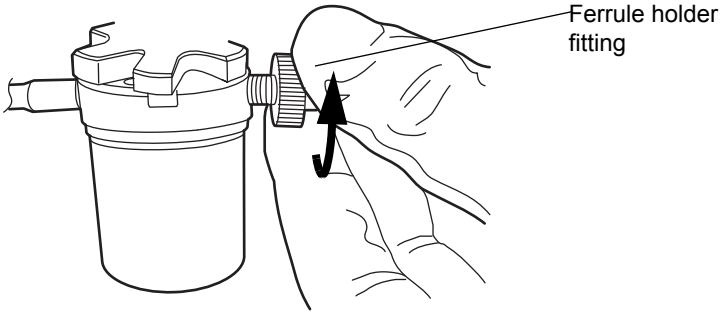
pattern shown below at least 3 times and gradually increasing the torque until the screws are uniformly tight.



Tip: You can rotate the shell nut to gain access to all 4 screws.



17. Insert the ferrule holder fitting into the inlet port on the *i²Valve* assembly, and tighten it finger-tight.

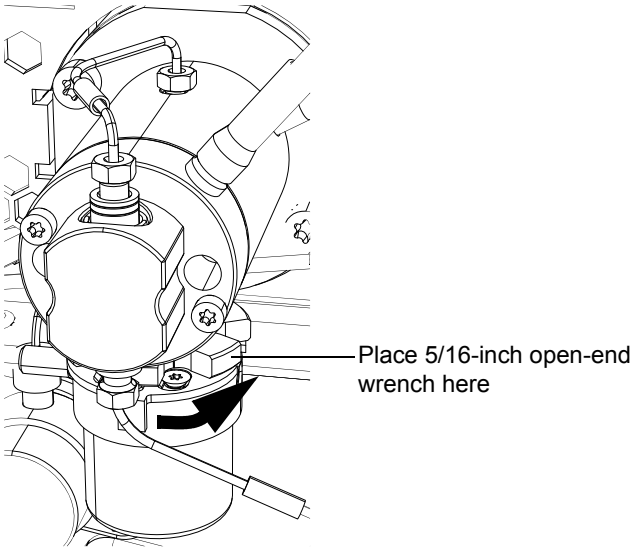


18. Orient the *i²Valve* assembly so that the cable exits from the left-hand side.

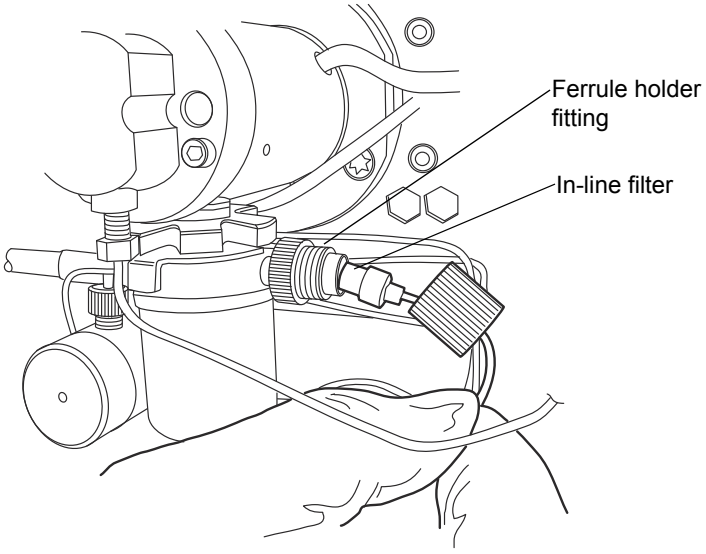
19. Insert the *i²Valve* assembly into the bottom of the primary pump head, and route the cable behind the valve actuator.

20. Finger-tighten the shell nut, rotating it approximately 5 full turns, to secure the valve.

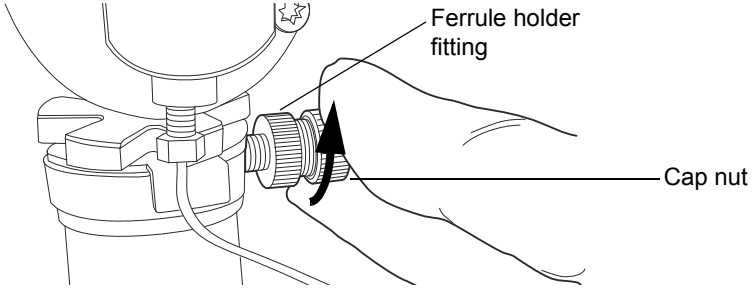
21. Use the 5/16-inch open-end wrench to tighten the nut an additional 1/8-turn.



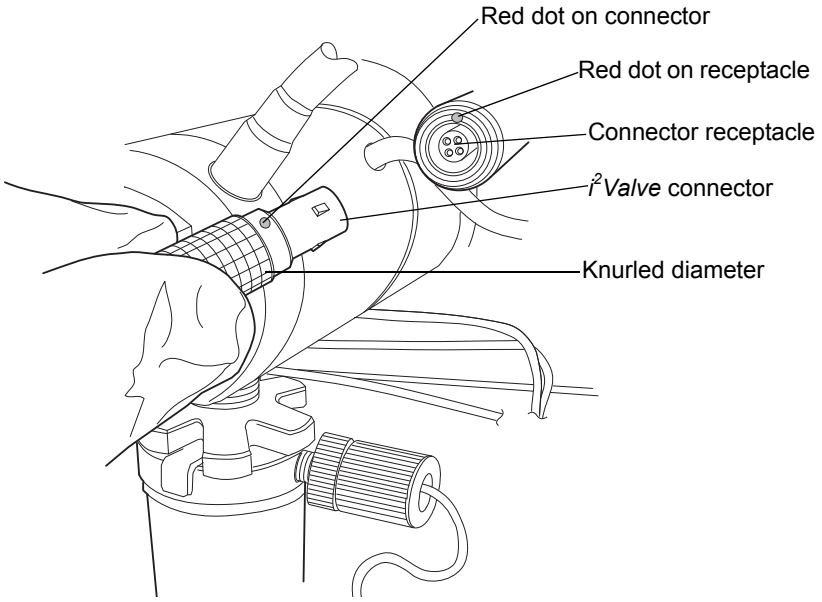
22. Reinsert the in-line filter and tube into the ferrule holder fitting.



23. Place the cap nut over the ferrule holder fitting and finger-tighten the cap nut to the extent possible.



24. Align the red dot on the *i²Valve* connector with the red dot on the receptacle, in the 12 o'clock position, and insert the connector into the receptacle.



25. Power-on the binary solvent manager.
26. Prime the binary solvent manager (see page 17).

Replacing the in-line filter cartridge on the *i²Valve* actuator

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Caution: Wear clean, chemical-resistant, powder-free gloves when handling the in-line filter cartridge. Oil from your hands can contaminate the in-line filter cartridge.

Required materials

- Gloves: clean, powder-free, chemical-resistant
- In-line filter cartridge

To replace the in-line filter:

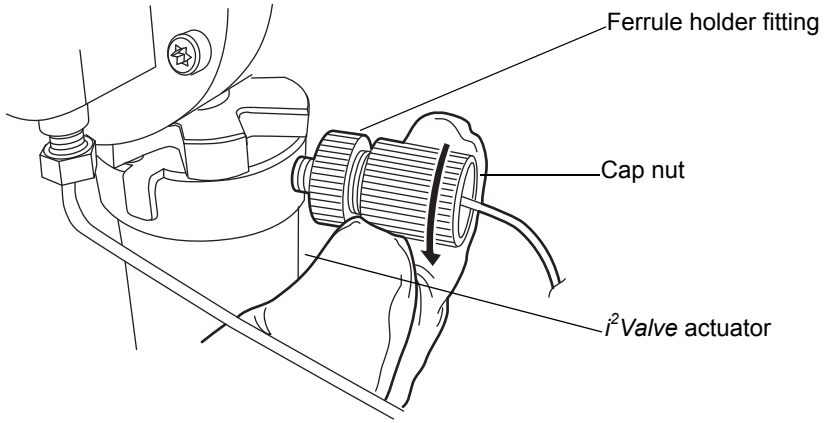
Caution: To avoid damaging the *i²Valve* actuator, do not attempt to push or pull liquid or gas through the valve's inlet or outlet ports.

1. Flush the binary solvent manager with nonhazardous solvent.
2. Power-off the binary solvent manager.

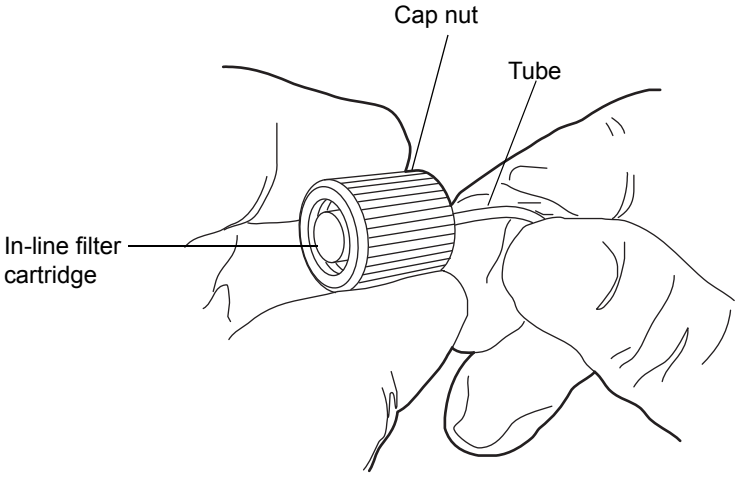
Warning: To avoid injuries arising from contact with spilled solvent (siphoning), move the solvent bottles to a location below the binary solvent manager.

3. Move the solvent bottles to a location below the binary solvent manager.

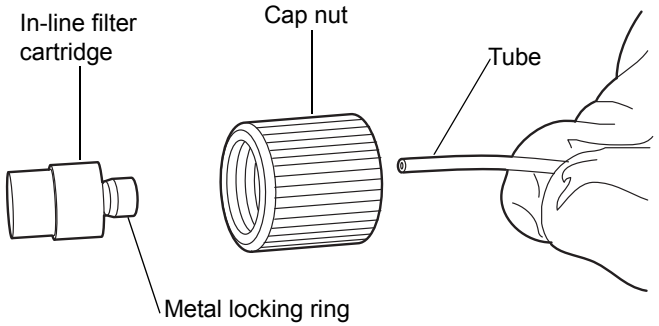
4. Unscrew the cap nut on the in-line filter assembly.



5. Pull the cap nut off the tube to remove the in-line filter cartridge.

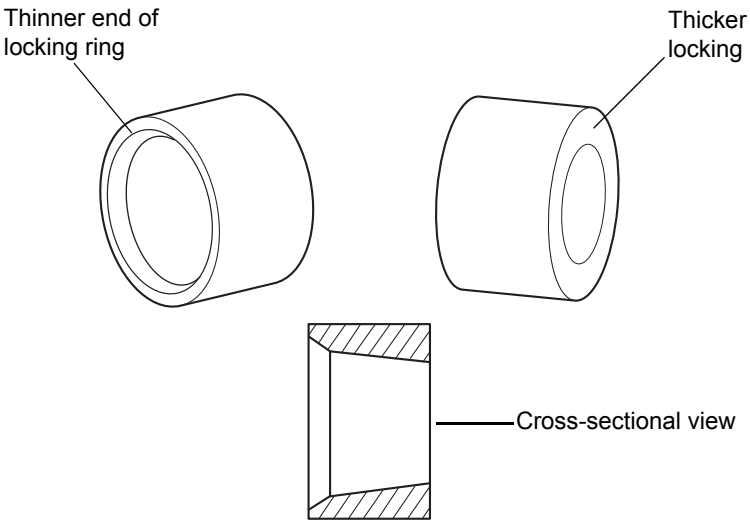


In-line filter cartridge and cap nut:



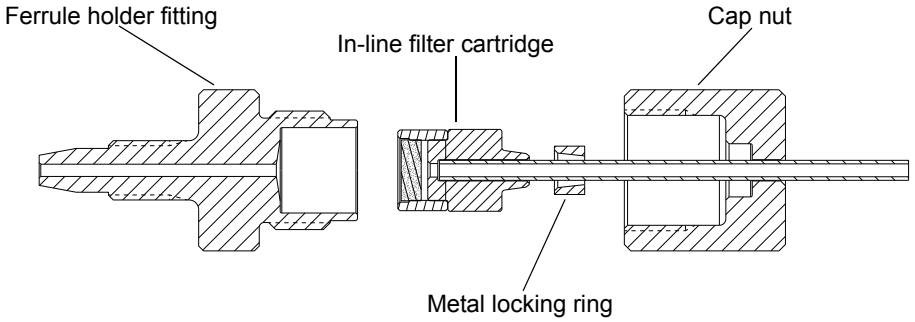
6. Put the cap nut over the end of the tube (see the figure on page 68).
7. Slide the metal locking ring onto the tube, ensuring that the thicker end of the metal locking ring is facing toward the cap nut.

Metal locking ring:

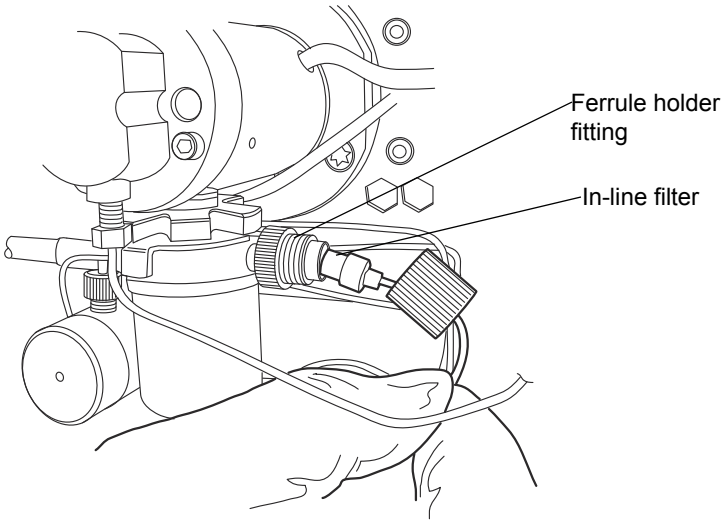


8. Slide the in-line filter cartridge onto the tube.

Exploded view of in-line filter:



9. Insert the in-line filter cartridge with tubing into the ferrule holder fitting.



10. Screw the cap nut onto the ferrule holder fitting, ensuring that the tube is bottomed out in the in-line filter cartridge. Finger-tighten it to the extent possible.
11. Return the solvent bottles to their original location.
12. Power-on the binary solvent manager.
13. Prime the binary solvent manager (see page 17).

Replacing the accumulator check valve

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Caution: To prevent contaminating system components, wear clean, chemical-resistant, powder-free gloves when replacing the check valve.

Required materials

- Accumulator check-valve assembly
- Gloves: clean, powder-free, chemical-resistant

Required tools

- 1/2-inch open-end wrench
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench

To replace the accumulator check valve:

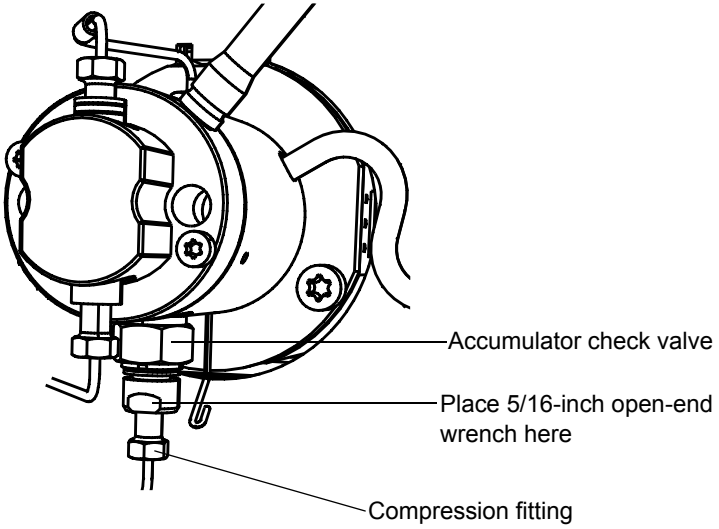
Caution: To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to an instrument or device. To completely interrupt power, set the power switch to Off, and then unplug the power cord from the AC source. Wait 10 seconds thereafter before you disconnect an assembly.

1. Flush the binary solvent manager with nonhazardous solvent.
2. Power-off the binary solvent manager.

Warning: To avoid injuries arising from contact with spilled solvent (siphoning), move the solvent bottles to a location below the binary solvent manager.

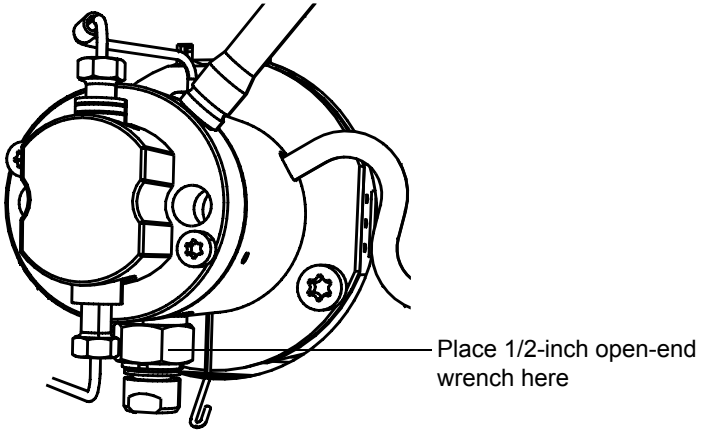
3. Move the solvent bottles to a location below the binary solvent manager.

4. Using the 5/16-inch open-end wrench to hold the check valve in place, disconnect the compression fitting by using the 1/4-inch open-end wrench.

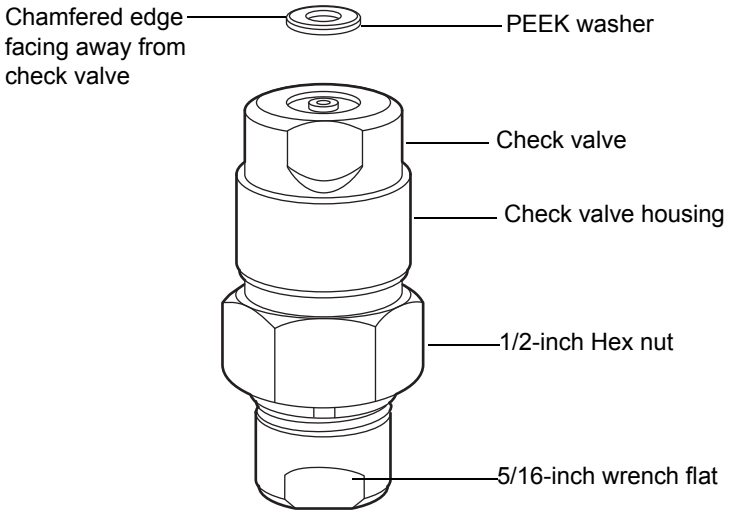


Caution: To avoid leaks, ensure the PEEK washer, which is normally on the top face of the accumulator check valve, does not remain in the head when you remove the valve assembly (see page 71).

5. Use the 1/2-inch open-end wrench to loosen the check valve, and then remove the check-valve assembly from the head.



6. Unpack the new check valve.
7. Ensure the new PEEK washer is inserted into the new check valve, its chamfered edge facing away from the check valve.



8. Insert the check-valve assembly into the head, and use the 1/2-inch wrench to tighten the check-valve nut 1/8-turn beyond finger-tight.
9. Finger-tighten the compression screw and ferrule, and then, using the 5/16-inch open-end wrench to hold the check valve in place, use the 1/4-inch wrench to tighten the compression screw up to 1/6-turn beyond finger-tight for an existing stainless steel tubing assembly, or 3/4-turn beyond finger-tight for a new stainless steel tubing assembly.
10. Return the solvent bottles to their original location.
11. Power-on the binary solvent manager.
12. Prime the binary solvent manager (see page 17).

Replacing solvent reservoir filters

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

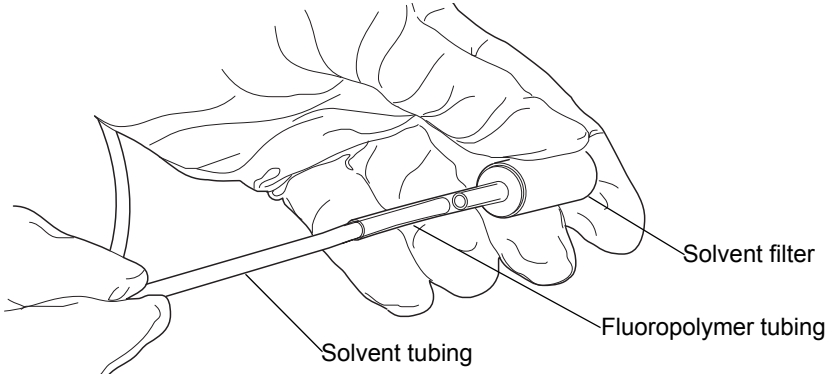
Caution: Wear clean, chemical-resistant, powder-free gloves when handling the solvent reservoir filter. Oil from your hands can contaminate the solvent reservoir filter.

Required materials

- Gloves: clean, powder-free, chemical-resistant
- New solvent filter

To replace a solvent reservoir filter:

1. Remove the filtered end of the solvent tubing from the solvent bottle.
2. Remove the old solvent filter from the short piece of fluoropolymer tubing.
3. Insert the new solvent filter into the fluoropolymer tubing, pushing until it contacts the solvent tubing.



4. Insert the filtered end of the solvent tubing into the solvent bottle.
5. Shake the filter to remove any air from it.
6. Prime the binary solvent manager (see page 17).

Cleaning the air filters in the binary solvent manager door

Required material

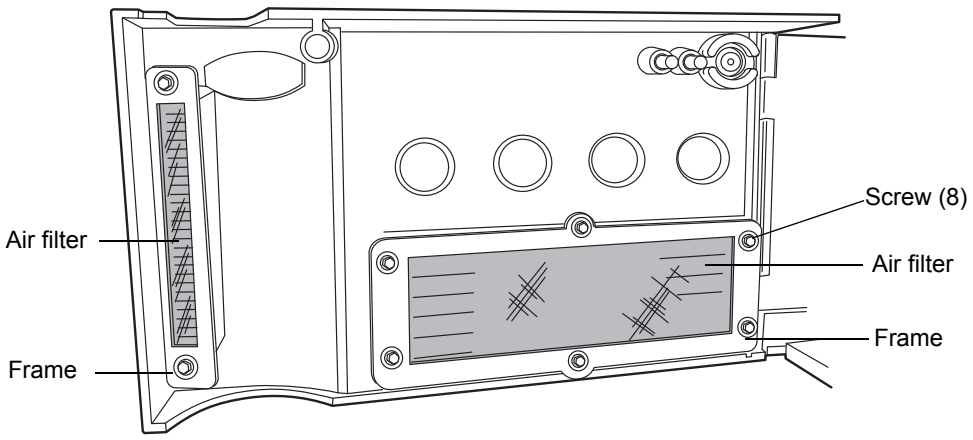
Mild detergent and water

Required tool

T10 TORX driver

To clean the air filters:

1. Using the T10 TORX driver, remove the 8 screws that secure the air filter frames and air filters to the inside of the binary solvent manager door.



2. Remove the air filters from the air filter frames.
3. Clean the air filters by using a mild detergent, and then dry the filters.
4. Align the air filters with the air filter frames.
5. Attach the air filters and frames to the inside of the binary solvent manager door, using the T10 TORX driver to secure the 8 screws.

Replacing the air filters in the binary solvent manager door

If you cannot clean the air filters by washing, replace it with a new filter.

Required material

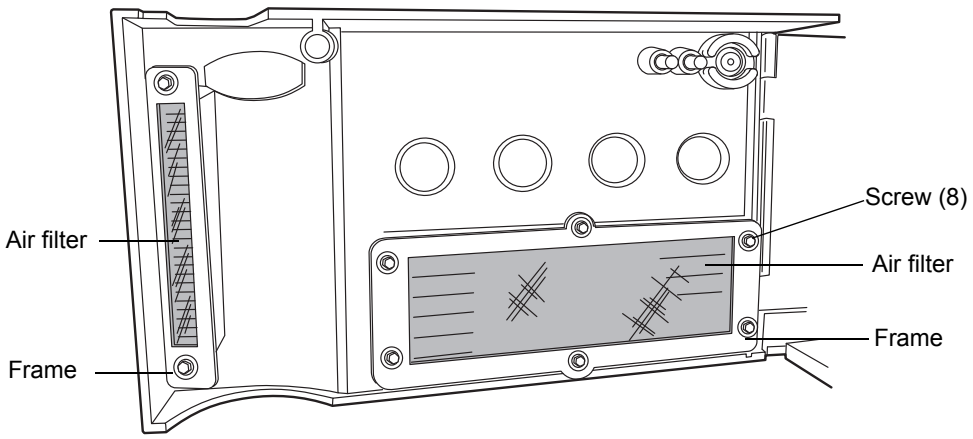
Binary solvent manager air filters

Required material

T10 TORX driver

To replace the air filters:

1. Using the T10 TORX driver, remove the 8 screws that secure the air filter frames and air filters to the inside of the binary solvent manager door.



2. Remove the old air filters from the air filter frames, and discard them.
3. Align the new air filters with the air filter frames.
4. Attach the air filters and frames to the inside of the binary solvent manager door, using the T10 TORX driver to secure the 8 screws.

Replacing the primary head plunger and seals

See the ACQUITY UPLC online Help to help determine whether you need to replace the primary plunger seals.

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Caution: To prevent contaminating system components, wear clean, chemical-resistant, powder-free gloves when removing and replacing the plunger seals.

Required materials

- Compressed air
- Gloves: clean, powder-free, chemical-resistant
- Methanol
- Plunger (recommended)
- Plunger seal and plunger seal spacer
- Fluoropolymer O-ring
- Seal-wash seal

Required tools

- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- Pliers
- Plunger removal tool (recommended)
- Seal extraction tool
- Sharp tool
- T27 TORX driver (startup kit)

To remove the primary head:

1. Flush the binary solvent manager with nonhazardous solvent.
2. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.
3. In the binary solvent manager information window, click Maintain > Heads.
4. In the Head Maintenance dialog box, select the primary head (A or B).
5. Click Move Backward, and then wait for the plunger to stop.

   Caution: To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to an instrument or device. To completely interrupt power, set the power switch to Off, and then unplug the power cord from the AC source. Wait 10 seconds thereafter before you disconnect an assembly.
6. Power-off the binary solvent manager.

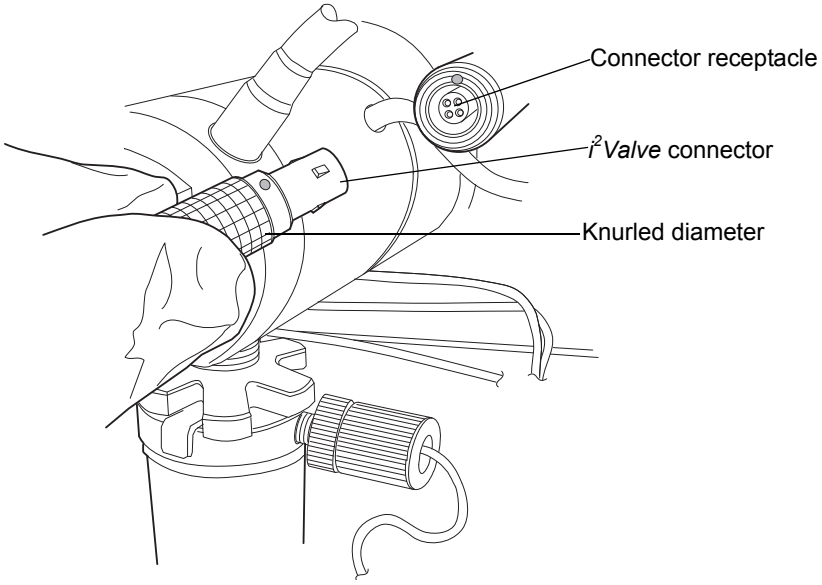
   Tip: The binary solvent manager is referred to as a pump on the warning label affixed to the *i*^{2}*Valve* actuator.

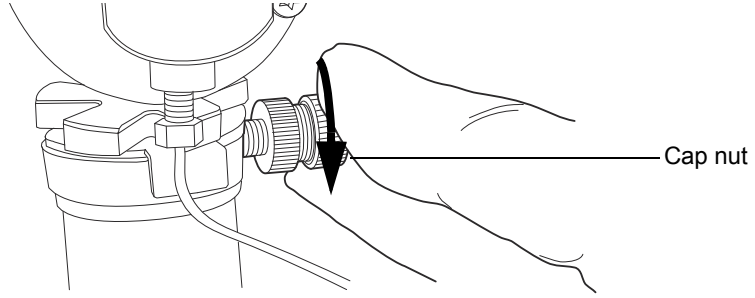
   Warning: To avoid injuries arising from contact with spilled solvent (siphoning), move the solvent bottles to a location below the binary solvent manager.
7. Move the solvent bottles to a location below the binary solvent manager.

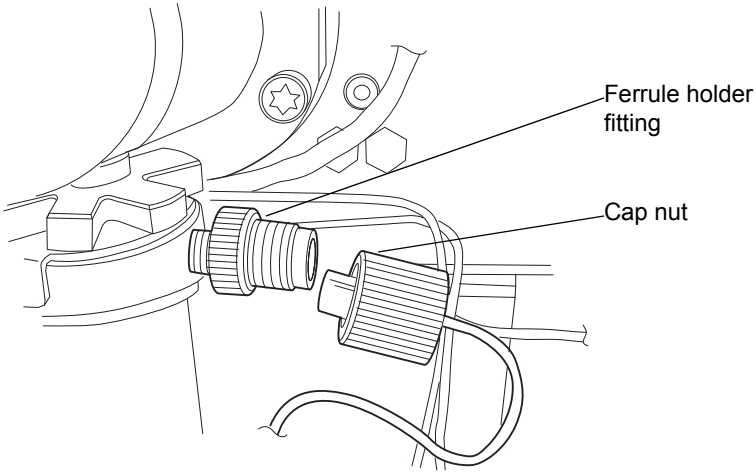
Caution: To avoid damaging the connector or cable, grasp the *i²Valve* connector by the knurled diameter.

8. Grasp the *i²Valve* connector by the knurled diameter and pull it toward you, disconnecting it from the receptacle.

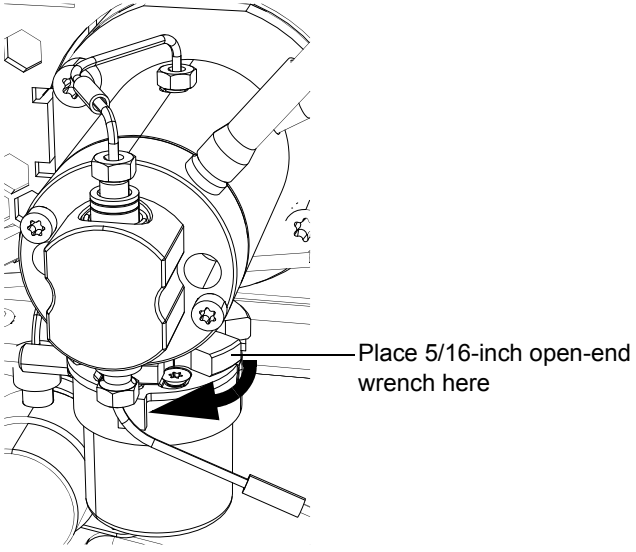


9. Loosen the cap nut on the in-line filter, removing it from the threads of the ferrule holder fitting.





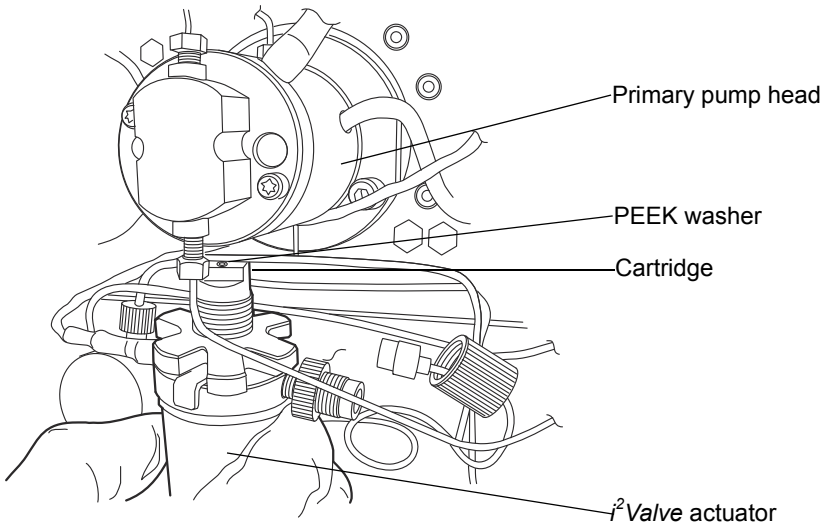
10. Using the 5/16-inch open-end wrench, loosen the shell nut, and then fully unscrew it.



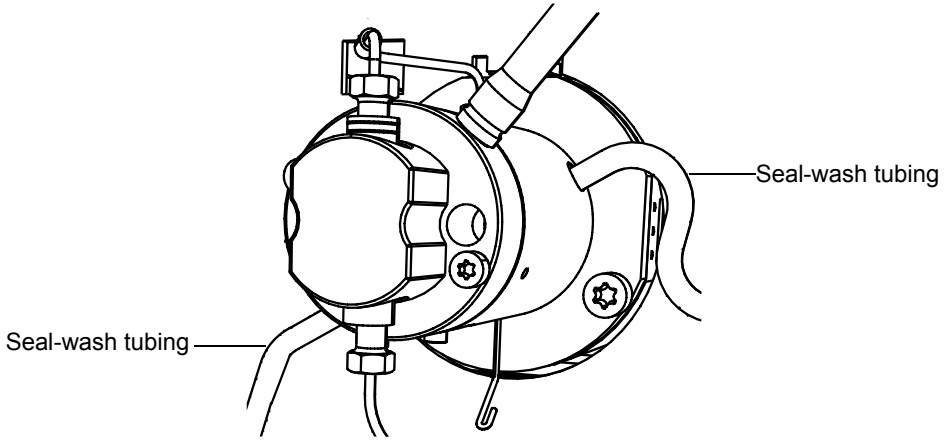
Caution:

- To avoid leaks, ensure the PEEK washer, which is normally on the top face of the *i²Valve* cartridge, does not remain in the head when you remove the valve assembly (see page 59).
- To avoid failure of the fuse on the *i²Valve* actuator's PCB board, never place the actuator assembly or electrical connector in the drip tray.

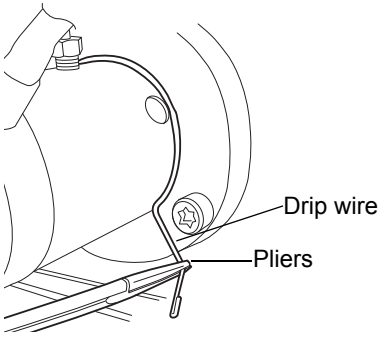
11. Remove the *i²Valve* actuator from the bottom of the primary pump head, ensuring that the PEEK washer remains in the cartridge.



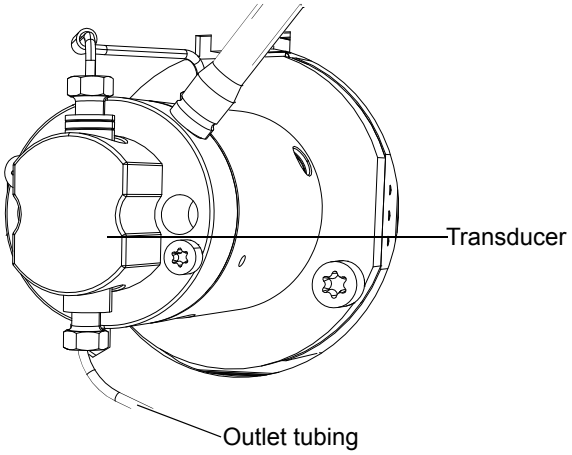
12. Remove the seal-wash tubing secured to the seal-wash housing by barbed fittings by using a tool or by pulling on the tubing as close to the head as possible.



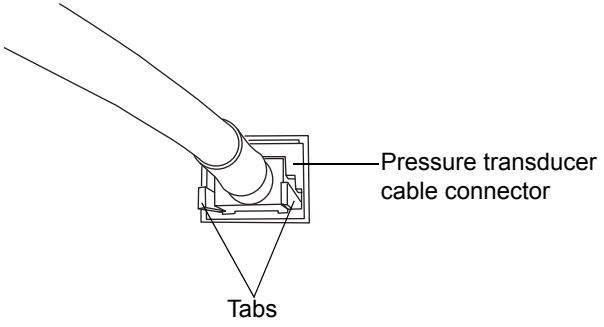
13. Using a pliers, remove the drip wire from the head assembly.



14. Using the 1/4-inch open-end wrench, disconnect the outlet tubing from the transducer.

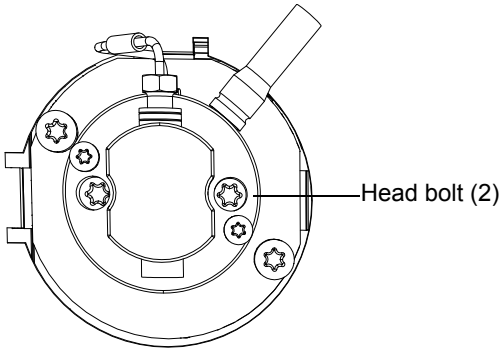


15. Disconnect the pressure transducer cable from the bulkhead by squeezing on the tabs and pulling gently.



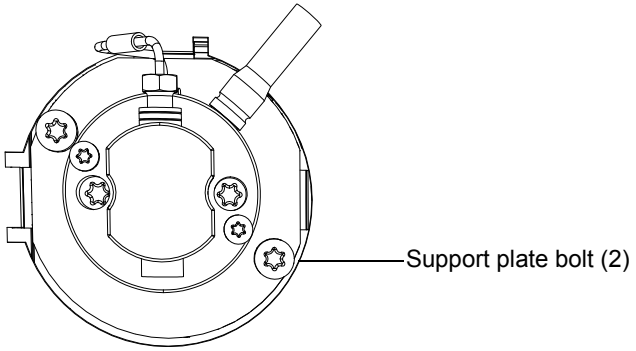
16. Using the T27 TORX driver, loosen the 2 head bolts 1/2-turn.

    Tip: The bolts are accessible from the front of the pressure transducer.

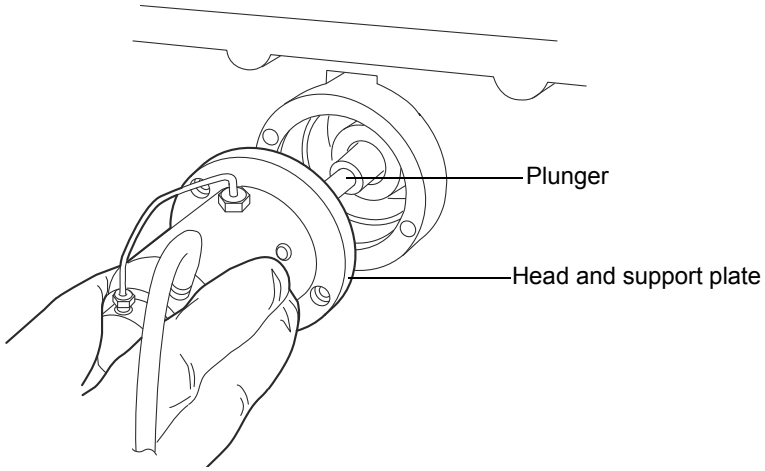


Caution: To avoid damaging the plunger, support the pump head from below as you remove it.

17. Using the T27 TORX driver, loosen and remove the 2 support plate bolts, and then gently pull the head and support plate off the actuator housing, making sure not to tilt the head during the extraction.

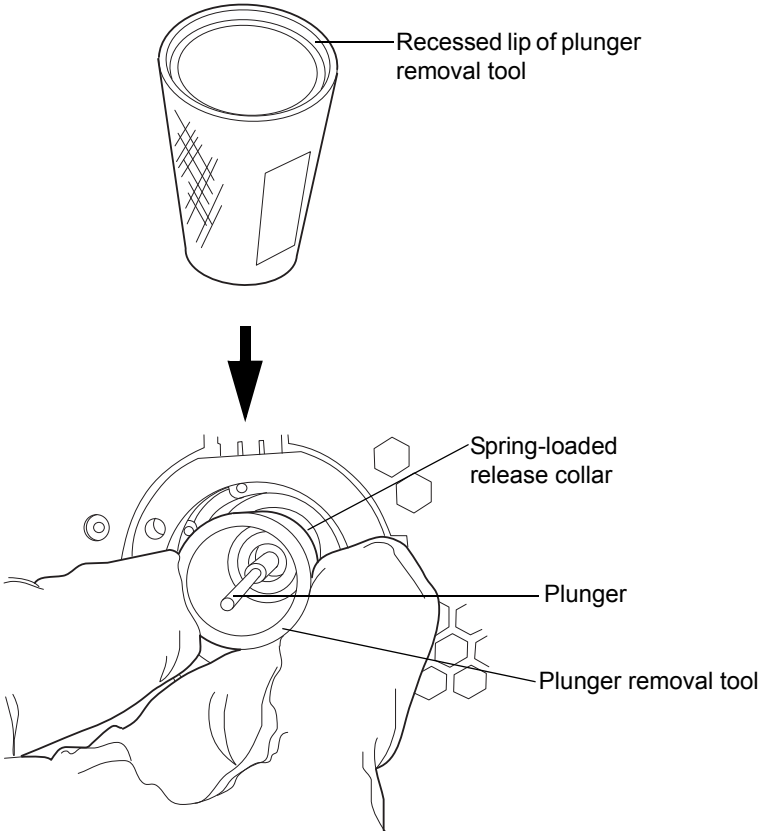


Pulling the head and support plate off the actuator housing:



Warning: To avoid hand lacerations, use care when removing the old plunger. Bending the plunger shaft can cause it to break.

18. Use the recessed side of the plunger removal tool to apply pressure to both sides of the release collar, and then remove the old plunger.

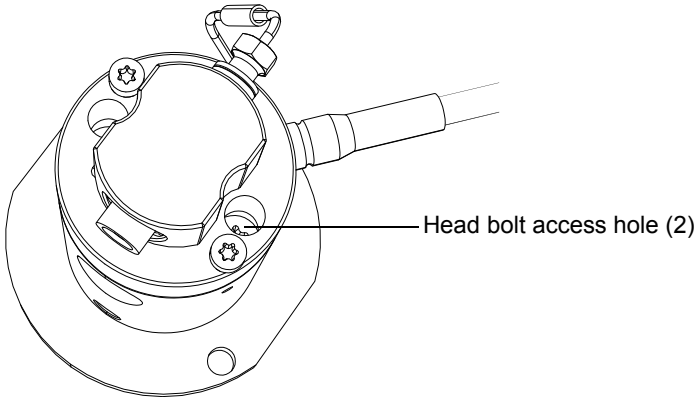


19. Remove the plunger removal tool from the release collar.

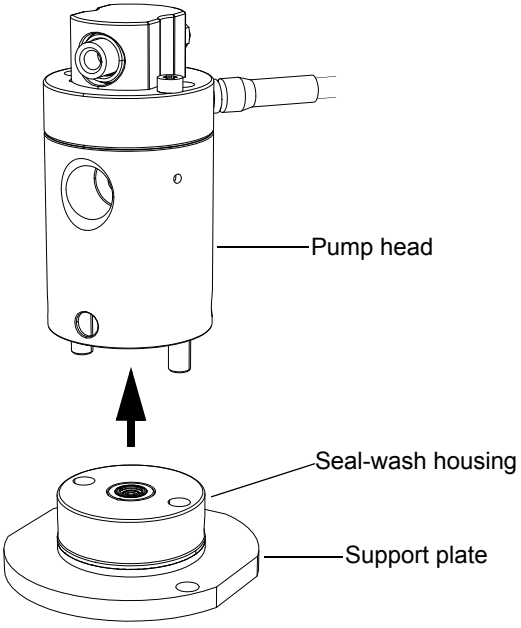
To remove the primary plunger seals:

1. Stand the head upright on a clean surface.
2. Using the T27 TORX driver, completely loosen the 2 head bolts to release the support plate from the pump head.

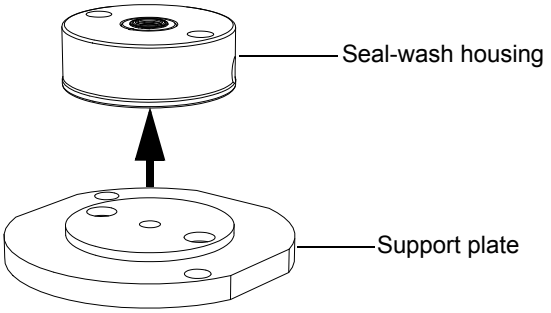
Requirement: If you remove the transducer and head bolts, be sure to reuse the head bolt washers when reassembling the pump head.



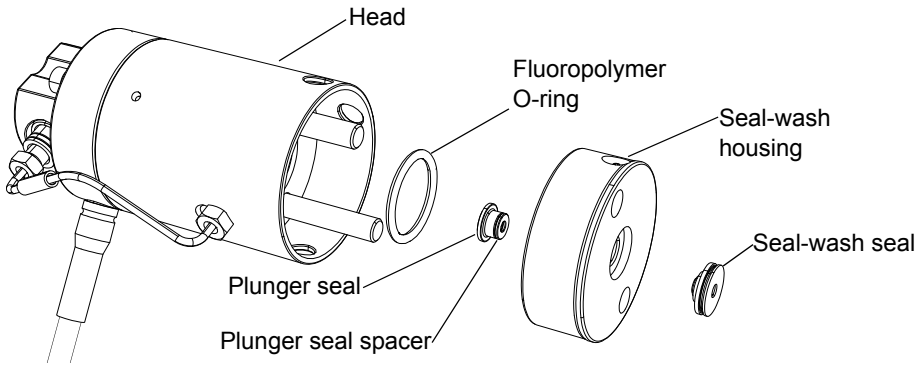
3. Lift the pump head from the support plate.



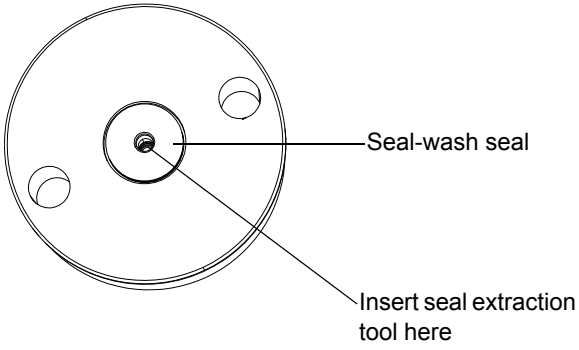
4. Lift the seal-wash housing from the support plate.



Plunger seals:

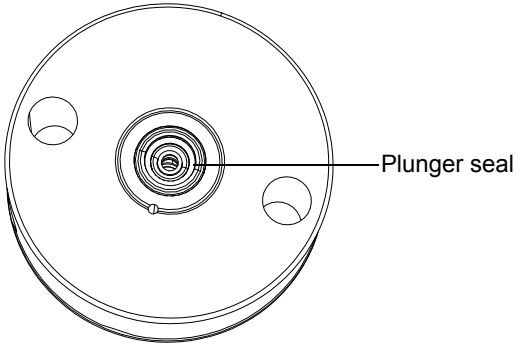


5. Using the smooth end of the seal extraction tool, pull the seal-wash seal from the seal-wash housing.



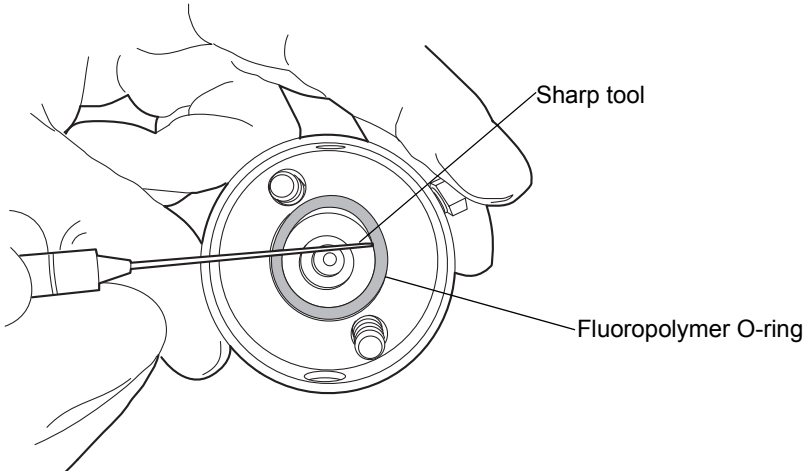
Caution: To avoid scratching any metal surfaces, use care when screwing the threaded end of the seal extraction tool into the plunger seal.

6. Taking care not to scratch any surfaces, screw the threaded end of the seal extraction tool into the plunger seal on the reverse side of the seal-wash housing and carefully withdraw the plunger seal and spacer.

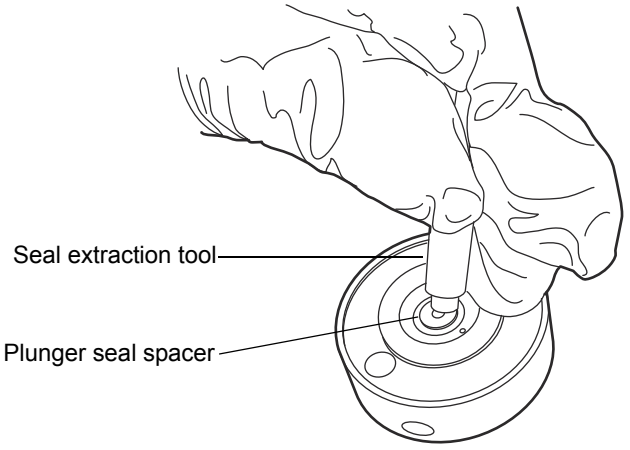


Caution: To avoid scratching any metal surfaces, use care when using a sharp tool to remove the fluoropolymer O-ring.

7. Taking care not to scratch any surfaces, use a sharp tool to remove the fluoropolymer O-ring from the pump head.

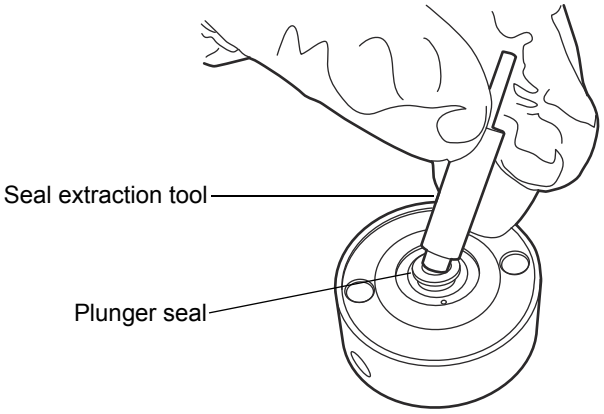


8. Inspect the seal-wash housing surface and pump head surface, ensuring both are free from scratches and particulates.
9. Lubricate the new fluoropolymer O-ring with methanol, and press the O-ring into its seat with your thumbs.
10. Lubricate the new plunger seal spacer with methanol, and use the smooth end of the seal extraction tool to place it in the seal-wash housing.

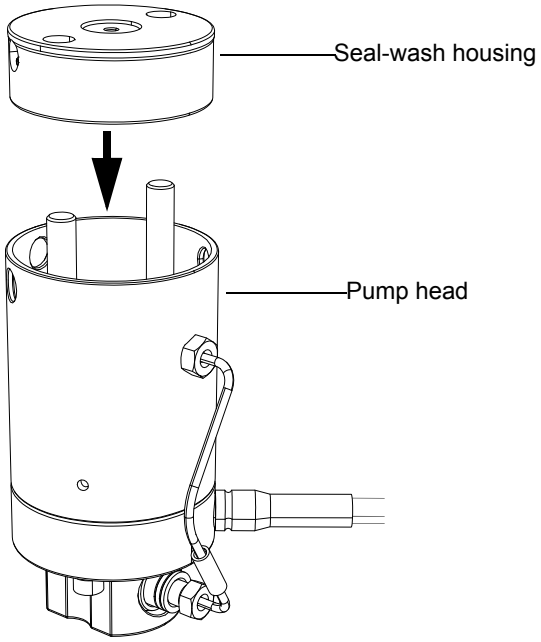


11. Spray the new plunger seal with compressed air to remove any particulates.

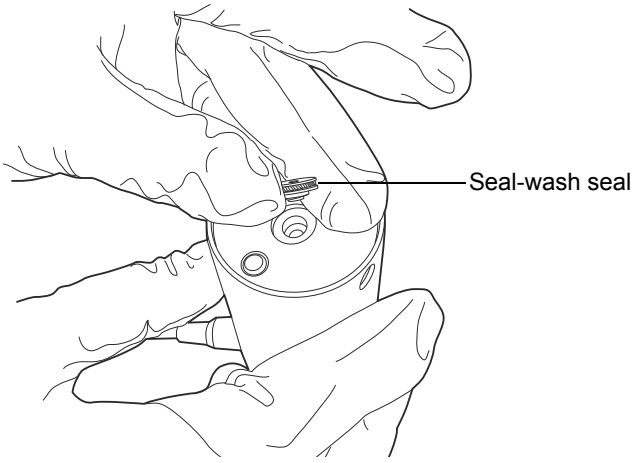
12. Lubricate the new plunger seal with methanol, and use the smooth end of the seal extraction tool to place it in the seal-wash housing, over the plunger seal spacer.



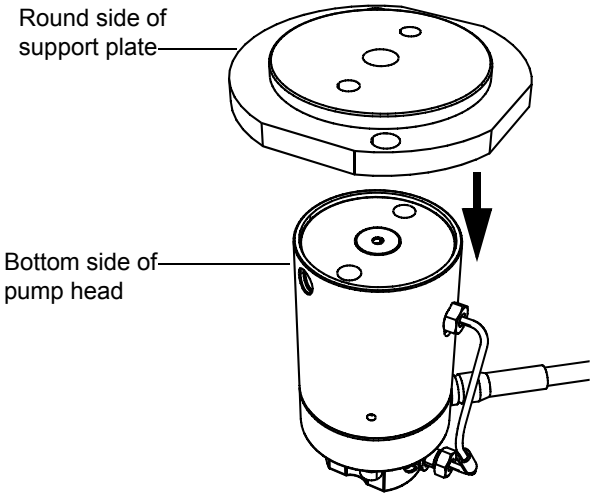
13. Orient the seal-wash housing so that the holes on its side align with the holes on the side of the pump head, and then guide it into place.



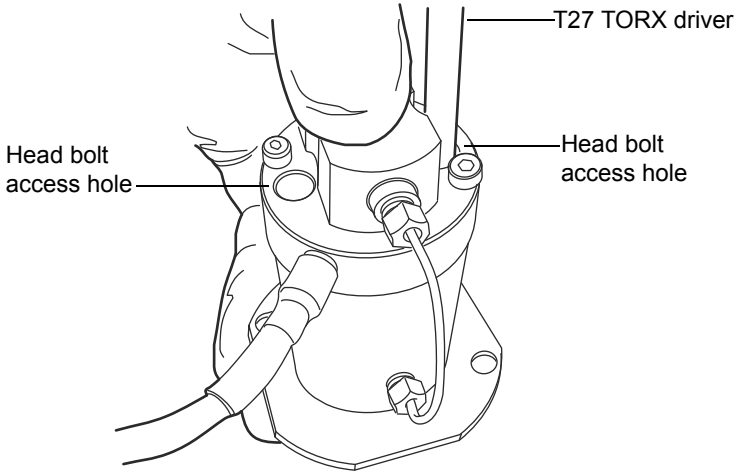
14. Spray the seal-wash seal with compressed air to remove any particulates.
15. Lubricate the new seal-wash seal with methanol, place it in the seal-wash housing, and press it into place.



16. Place the support plate on top of the pump head, ensuring the round side of the plate is oriented toward the bottom side of the head.

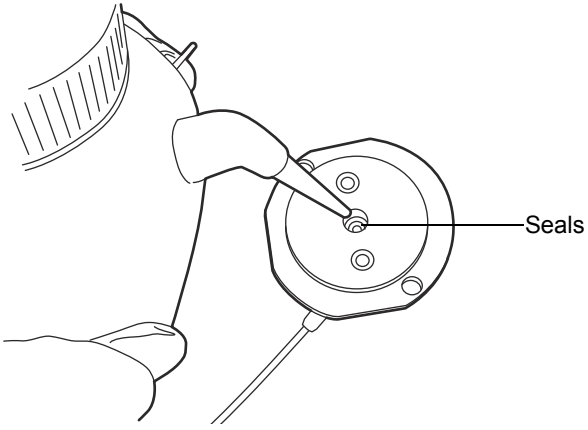


17. Holding the assembly together, use the T27 TORX driver to minimally tighten the 2 head bolts.



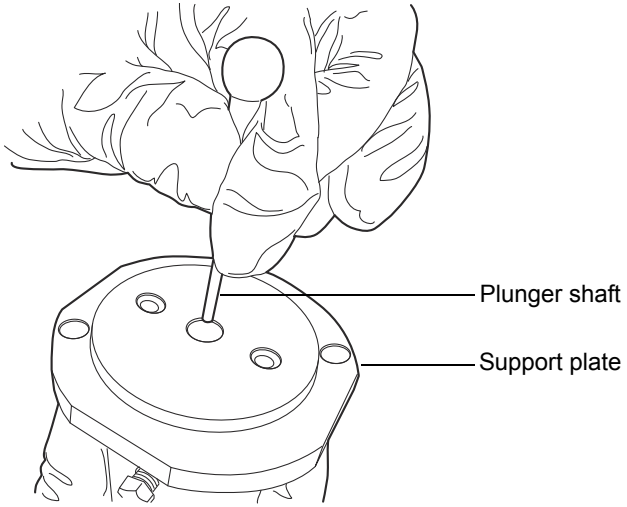
To reattach the primary head:

1. Flip the assembly over, and then lubricate the seals with methanol.



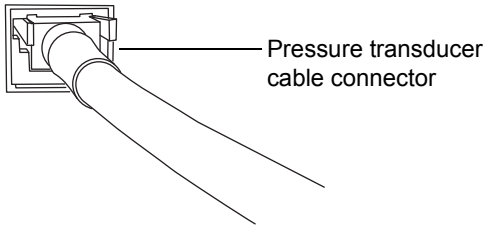
2. Carefully insert the sapphire plunger shaft into the pump head until the plunger shaft is no longer visible, ensuring the shaft does not contact the support plate.

Recommendation: Replace the plunger whenever you replace the plunger seal.



Caution: To avoid damaging the plunger, ensure that the head assembly is not tilted relative to the actuator housing when you position it on the mechanism.

3. Carefully slide the head assembly and sapphire plunger into the actuator housing, making sure not to tilt the head.
4. Connect the pressure transducer cable to the bulkhead.



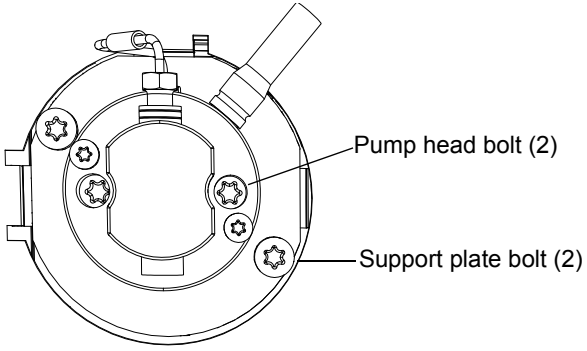
5. Power-on the binary solvent manager.
6. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.

7. In the binary solvent manager information window, click Maintain > Heads.
8. In the Head Maintenance dialog box, select the primary head (A or B).
9. Click Move Forward, and then wait for the piston to engage the plunger sphere.

Caution: To avoid damaging the plunger, alternately tighten the the support plate screws 1/4-turn so that they are uniformly torqued.

10. Hold the head assembly securely against the actuator housing, and then use the T27 TORX driver to tighten the support plate bolts securely.



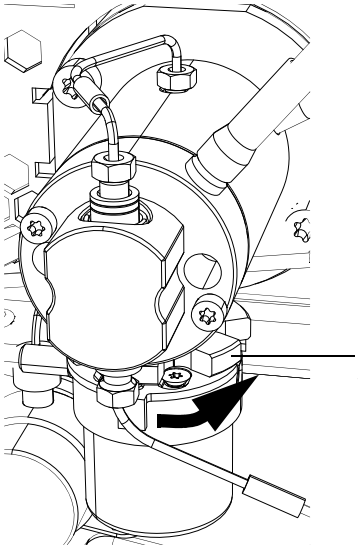
11. Use the torque driver to tighten each pump head bolt to 40 inch-pounds of torque.
12. After tightening each pump head bolt to 40 inch-pounds of torque, use the torque driver to tighten each pump head bolt to 50 inch-pounds of torque.
13. After tightening each pump head bolt to 50 inch-pounds of torque, use the torque driver to tighten each pump head bolt to 60 inch-pounds of torque.
14. After tightening each pump head bolt to 60 inch-pounds of torque, use the torque driver to tighten each pump head bolt to 70 inch-pounds of torque.

Caution: To avoid pinching the drip wire between the head assembly and support plate, be sure to install the drip wire *after* tightening the head bolts.

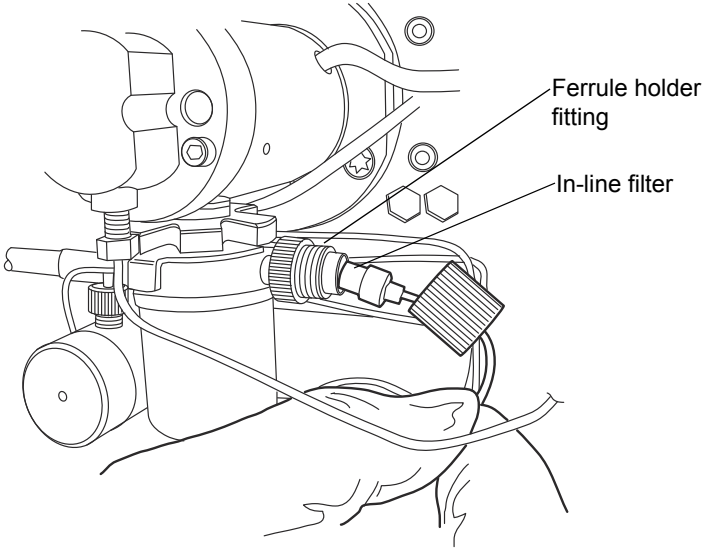
15. Reinstall the drip wire around the head assembly, ensuring that the tip is in the 6 o'clock position.
16. Reattach all fittings and seal-wash tubing.

    Tip: When reattaching the outlet tubing to the transducer, tighten the inlet-tubing fitting finger-tight plus as much as 1/6-turn, for existing fittings, or 3/4-turn for new fittings.

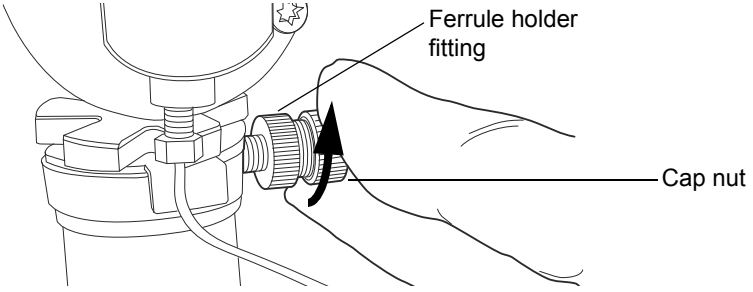
17. Orient the *i²Valve* assembly so that the cable exits from the left-hand side.
18. Insert the *i²Valve* assembly into the bottom of the primary pump head, and route the cable behind the valve actuator.
19. Finger-tighten the shell nut, rotating it approximately 5 full turns, to secure the valve.
20. Use the 5/16-inch open-end wrench to tighten the nut an additional 1/8-turn.



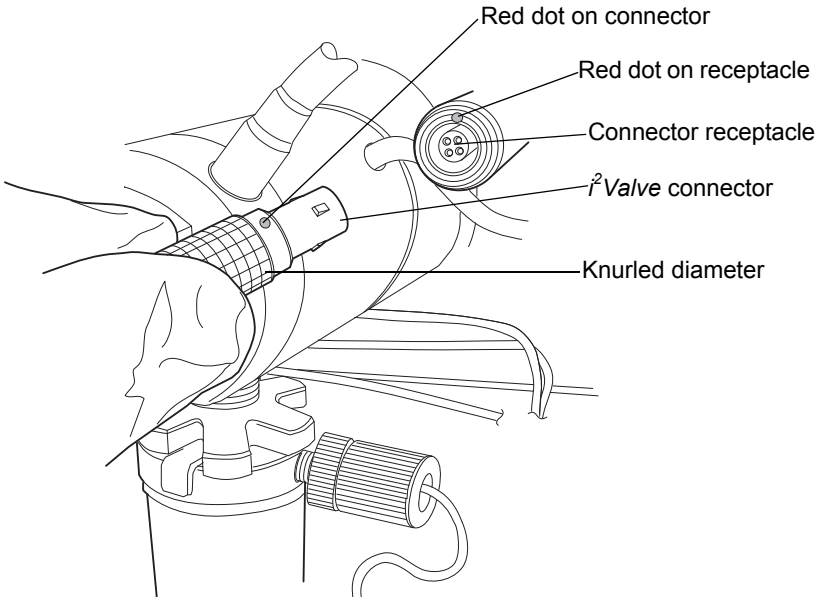
21. Reinsert the in-line filter and tube into the ferrule holder fitting.



22. Place the cap nut over the ferrule holder fitting, and finger-tighten the cap nut to the extent possible.



23. Align the red dot on the *i*^{2}*Valve* connector with the red dot on the receptacle, in the 12 o'clock position, and insert the connector into the receptacle.



24. Return the solvent bottles to their original location.
25. Prime the binary solvent manager (see page 17).
26. Perform the binary solvent manager leak test (see the ACQUITY UPLC online Help).

If the leak test results are not satisfactory, pressurize the head plunger seals to properly seat them.

To pressurize the seals:

Run the binary solvent manager at 117,211 kPa (1172 bar, 17,000 psi) for a half-hour, or run the leak test until results are satisfactory.

Replacing the accumulator head plunger and seals

See the ACQUITY UPLC Console online Help to help determine whether you need to replace the accumulator plunger seals.

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Caution: To prevent contaminating system components, wear clean, chemical-resistant, powder-free gloves when removing and replacing the plunger seals.

Required materials

- Compressed air
- Gloves: clean, powder-free, chemical-resistant
- Methanol
- Plunger (recommended)
- Plunger seal and plunger seal spacer
- Fluoropolymer O-ring
- Seal-wash seal

Required tools

- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- Pliers
- Plunger removal tool (recommended)
- Seal extraction tool
- Sharp tool
- T27 TORX driver (startup kit)

To remove the accumulator head:

1. Flush the binary solvent manager with nonhazardous solvent.
2. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.
3. In the binary solvent manager information window, click Maintain > Heads.
4. In the Head Maintenance dialog box, select the accumulator head (A or B).
5. Click Move Backward, and then wait for the plunger to stop.

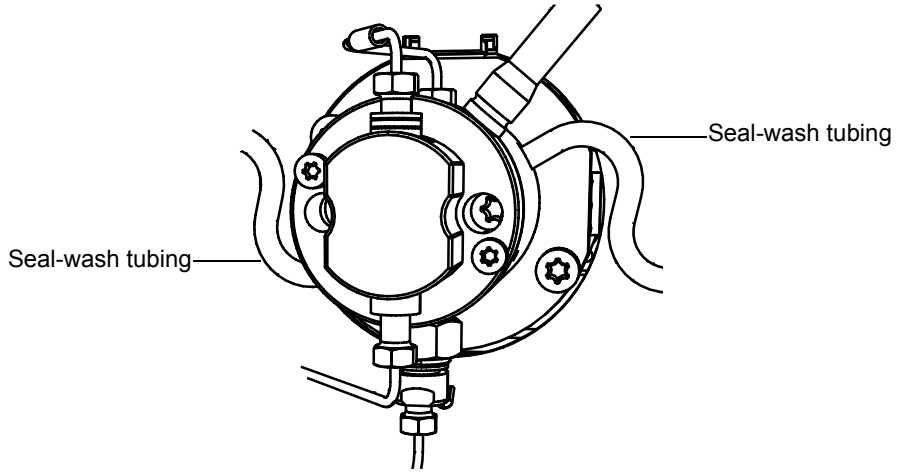
   

   Caution: To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to an instrument or device. To completely interrupt power, set the power switch to Off, and then unplug the power cord from the AC source. Wait 10 seconds thereafter before you disconnect an assembly.
6. Power-off the binary solvent manager.

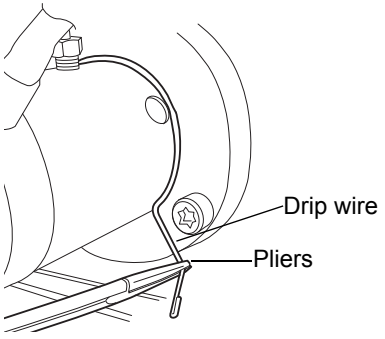
   

   Warning: To avoid injuries arising from contact with spilled solvent (siphoning), move the solvent bottles to a location below the binary solvent manager.
7. Move the solvent bottles to a location below the binary solvent manager.

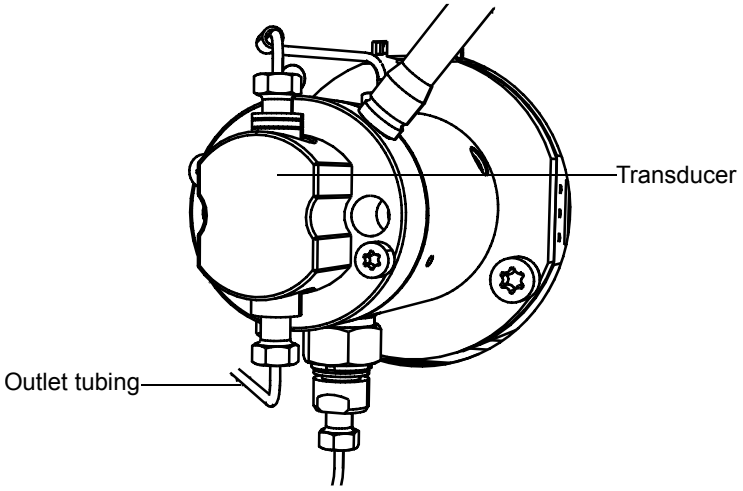
8. Remove the seal-wash tubing secured to the seal-wash housing by barbed fittings by using a tool or by pulling on the tubing as close to the head as possible.



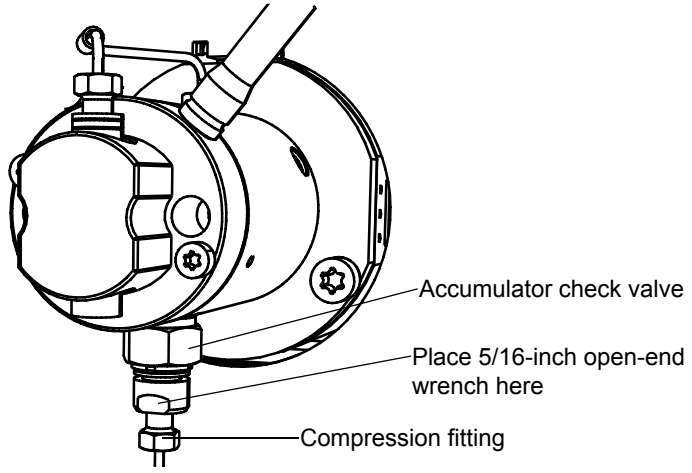
9. Using a pliers, remove the drip wire from the head assembly.



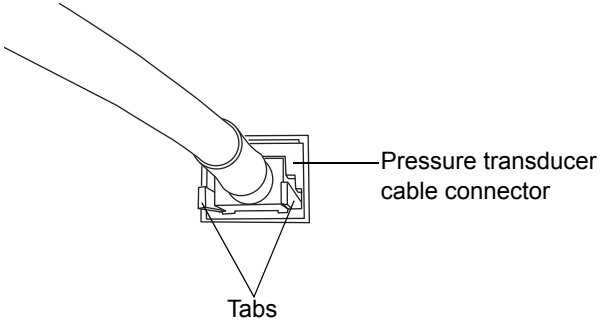
10. Using the 1/4-inch open-end wrench, disconnect the outlet tubing from the transducer.



11. Using the 5/16-inch open-end wrench to hold the check-valve cartridge in place, disconnect the tubing connection from the check valve with the 1/4-inch open-end wrench.

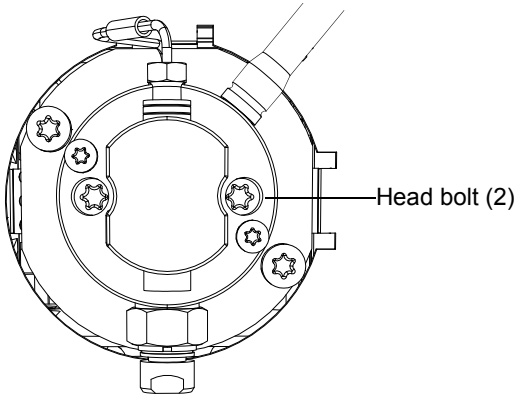


12. Disconnect the pressure transducer cable from the bulkhead by squeezing on the tabs and pulling gently.



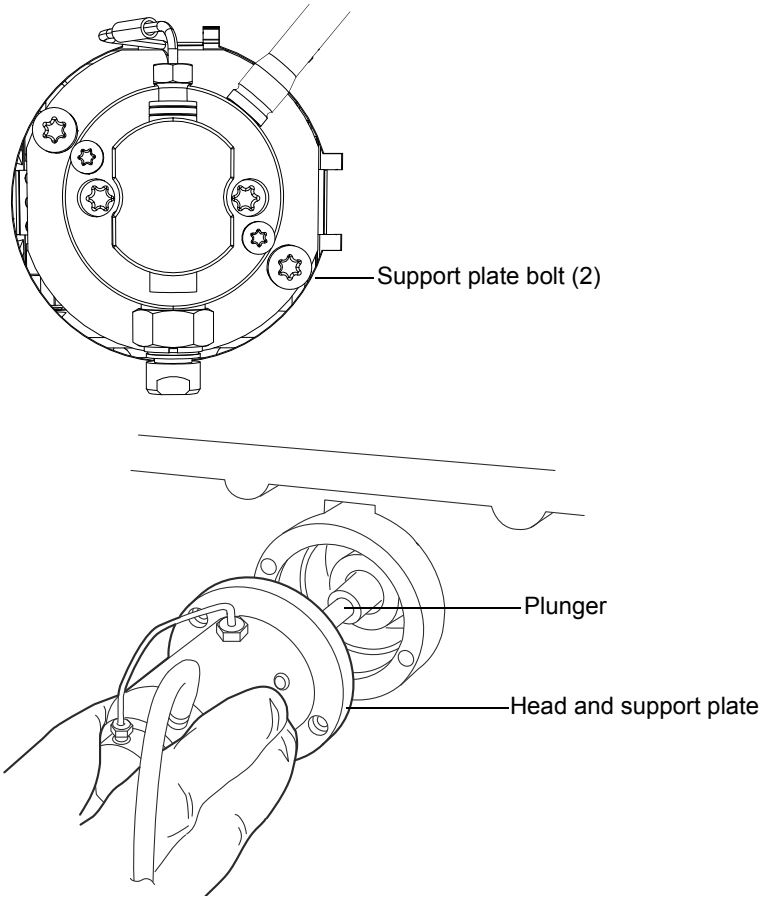
13. Using the T27 TORX driver, loosen the 2 head bolts 1/2-turn.

    Tip: The bolts are accessible from the front of the pressure transducer.



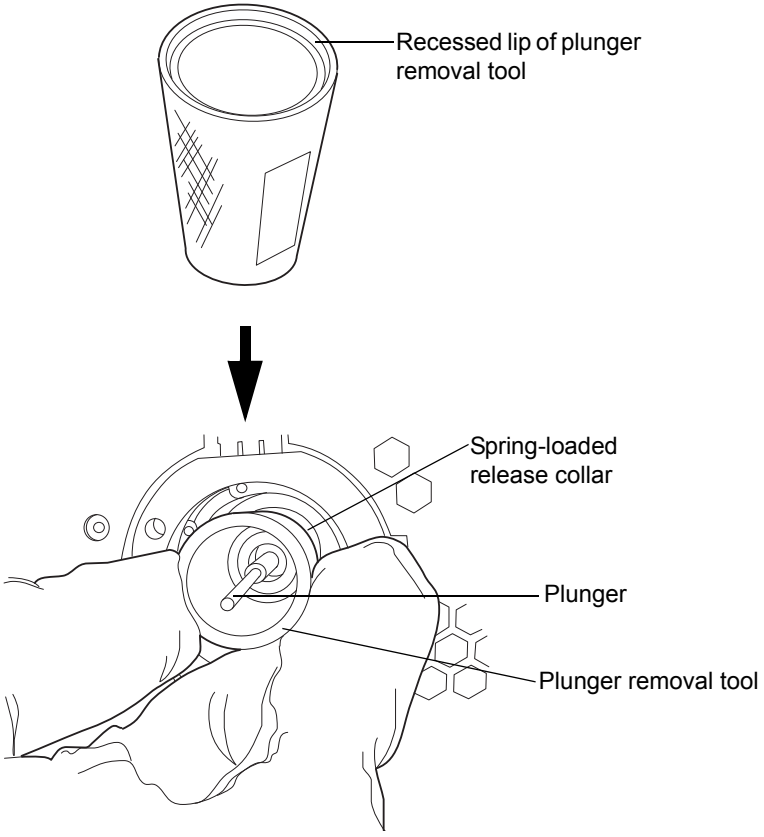
Caution: To avoid damaging the plunger, support the pump head from below as you remove it.

14. Using the T27 TORX driver, loosen and remove the 2 support plate bolts, and then gently pull the head and support plate off the actuator housing, making sure not to tilt the head during the extraction.



Warning: To avoid hand lacerations, use care when removing the old plunger. Bending the plunger shaft can cause it to break.

15. Use the recessed side of the plunger removal tool to apply pressure to both sides of the release collar, and then remove the old plunger.

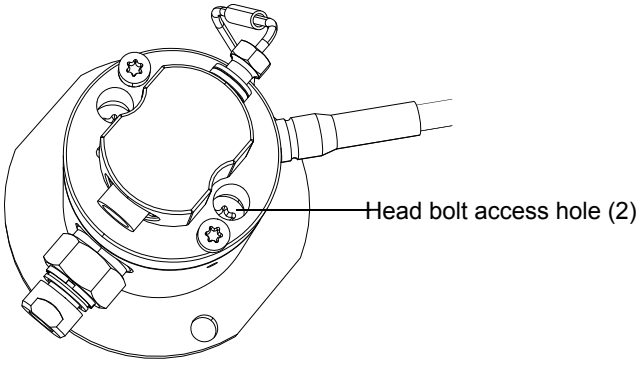


16. Remove the plunger removal tool from the release collar.

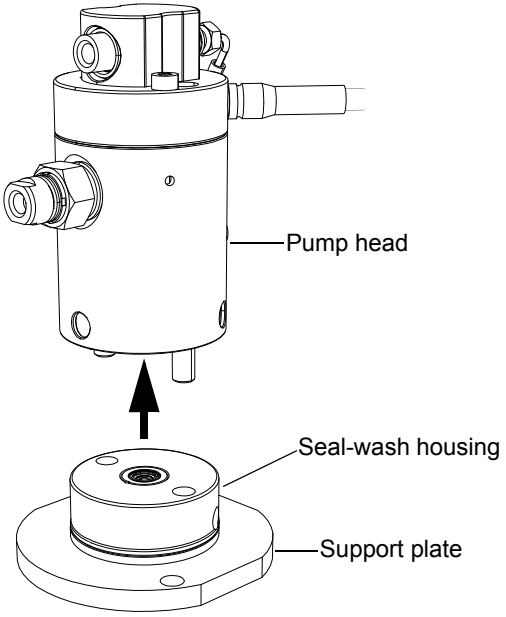
To remove the accumulator plunger seals:

1. Stand the head upright on a clean surface.
2. Using the T27 TORX driver, completely loosen the 2 head bolts to release the support plate from the pump head.

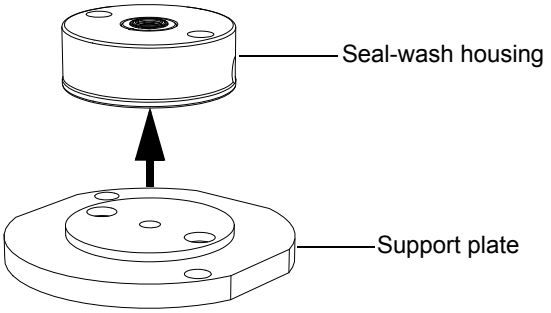
   Requirement: If you remove the transducer and head bolts, be sure to reuse the head bolt washers when reassembling the pump head.



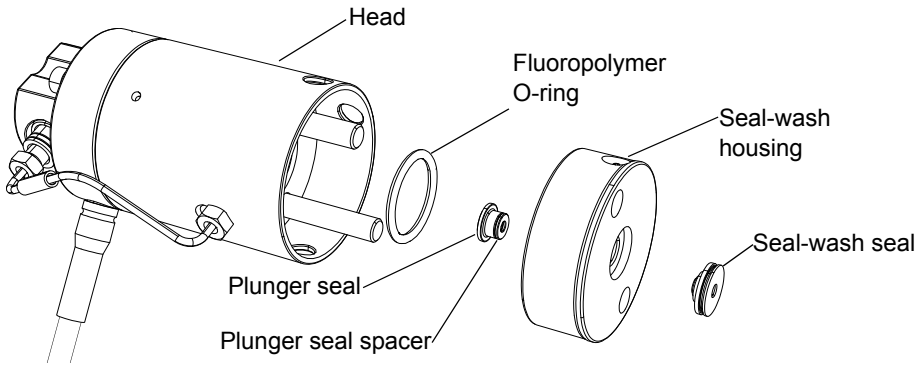
3. Lift the pump head from the support plate.



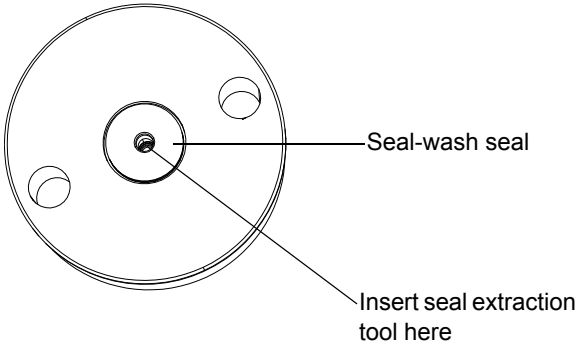
4. Lift the seal-wash housing from the support plate.



Plunger seals:

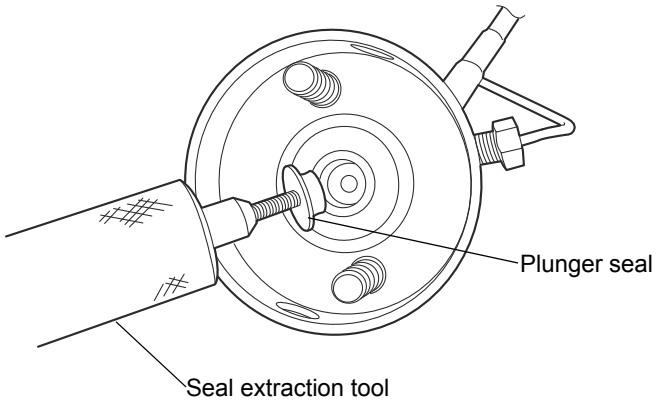


5. Using the smooth end of the seal extraction tool, remove the plunger seal spacer from the head.



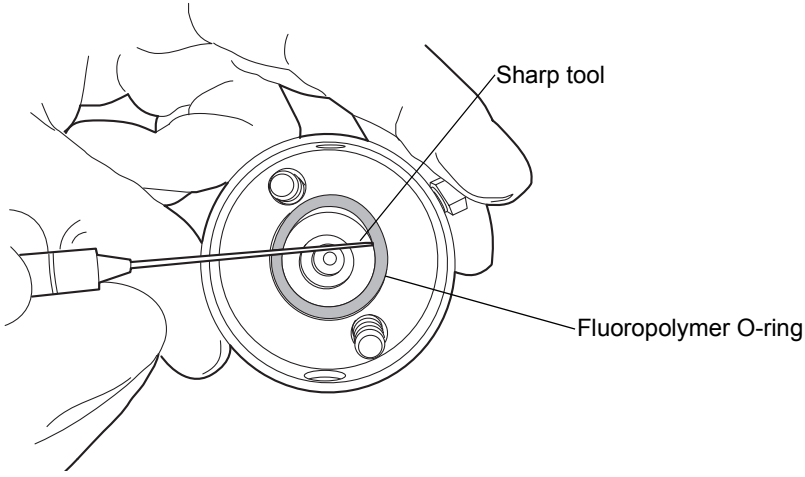
Caution: To avoid scratching any metal surfaces, use care when screwing the threaded end of the seal extraction tool into the plunger seal.

6. Taking care not to scratch any surfaces, screw the threaded end of the seal extraction tool into the plunger seal and carefully withdraw the seal from the head.

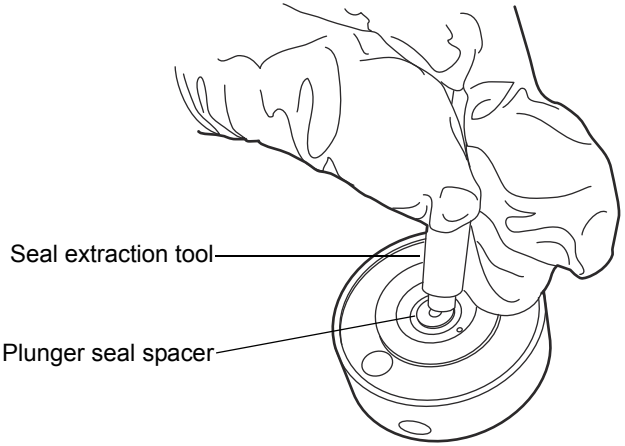


Caution: To avoid scratching any metal surfaces, use care when using a sharp tool to remove the fluoropolymer O-ring.

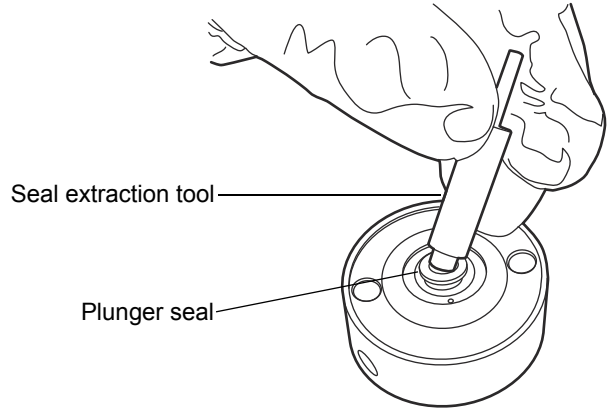
7. Use a sharp tool to remove the fluoropolymer O-ring.



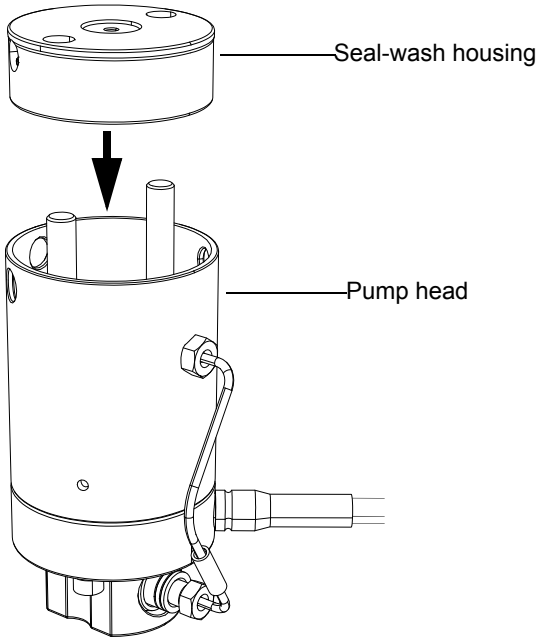
8. Lubricate the new fluoropolymer O-ring with methanol, and press the O-ring into its seat with your thumbs.
9. Lubricate the new plunger seal spacer with methanol, and use the smooth end of the seal extraction tool to place it in the seal-wash housing.



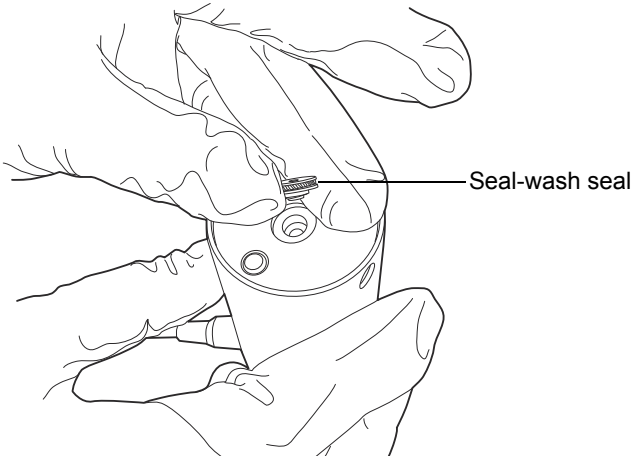
10. Spray the new plunger seal with compressed air to remove any particulates.
11. Lubricate the new plunger seal with methanol, and use the smooth end of the seal extraction tool to place it in the seal-wash housing, over the plunger seal spacer.



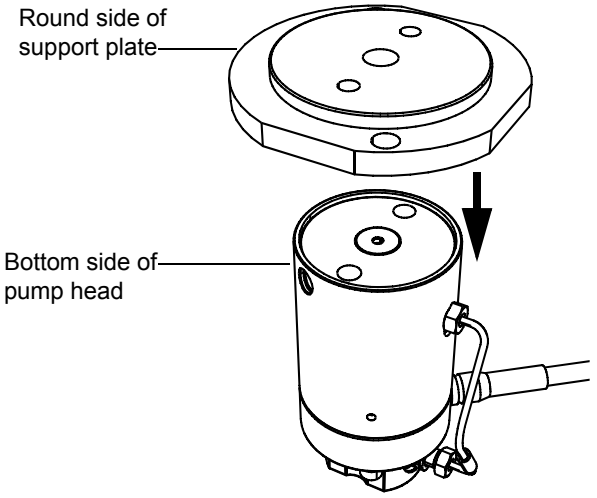
12. Orient the seal-wash housing so that the holes on its side align with the holes on the side of the pump head, and then guide it into place.



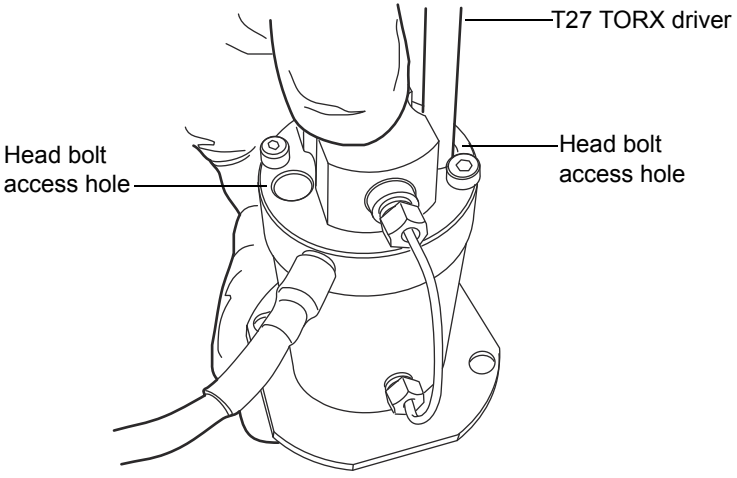
13. Spray the seal-wash seal with compressed air to remove any particulates.
14. Lubricate the new seal-wash seal with methanol, place it in the seal-wash housing, and press it into place.



15. Place the support plate on top of the pump head, ensuring the round side of the plate is oriented toward the bottom side of the head.

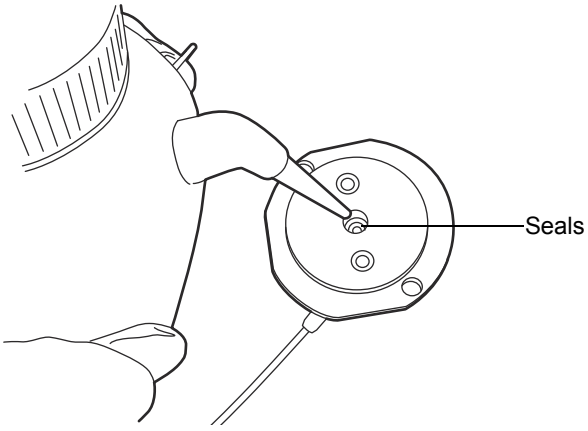


16. Holding the assembly together, use the T27 TORX driver to minimally tighten the 2 head bolts.



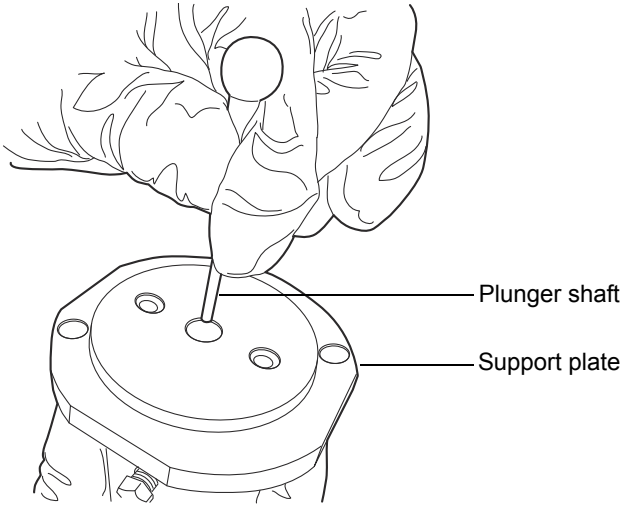
To reattach the accumulator head:

1. Flip the assembly over, and then lubricate the seals with methanol.



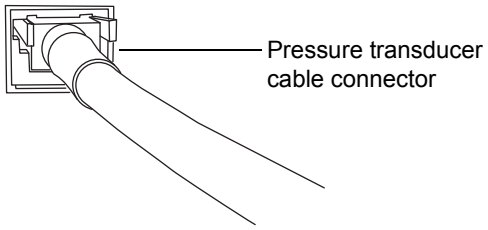
2. Carefully insert the sapphire plunger shaft into the pump head until the plunger shaft is no longer visible, ensuring the shaft does not contact the support plate.

   Recommendation: Replace the plunger whenever you replace the plunger seal.



Caution: To avoid damaging the plunger, ensure that the head assembly is not tilted relative to the actuator housing when you position it on the mechanism.

3. Carefully slide the head assembly and sapphire plunger into the actuator housing, making sure not to tilt the head.
4. Connect the pressure transducer cable to the bulkhead.

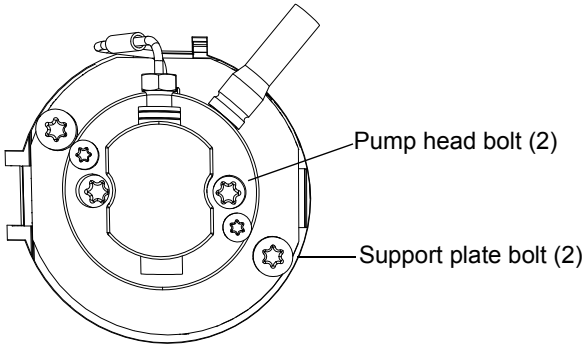


5. Power-on the binary solvent manager.
6. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.
7. In the binary solvent manager information window, click Maintain > Heads.
8. In the Head Maintenance dialog box, select the accumulator head (A or B).
9. Click Move Forward, and then wait for the piston to engage the plunger sphere.

Caution: To avoid damaging the plunger, alternately tighten the the support plate screws 1/4-turn so that they are uniformly torqued.

10. Hold the head assembly securely against the actuator housing, and then use the T27 TORX driver to tighten the support plate bolts securely.



11. Use the torque driver to tighten each pump head bolt to 40 inch-pounds of torque.
12. After tightening each pump head bolt to 40 inch-pounds of torque, use the torque driver to tighten each pump head bolt to 50 inch-pounds of torque.
13. After tightening each pump head bolt to 50 inch-pounds of torque, use the torque driver to tighten each pump head bolt to 60 inch-pounds of torque.
14. After tightening each pump head bolt to 60 inch-pounds of torque, use the torque driver to tighten each pump head bolt to 70 inch-pounds of torque.

Caution: To avoid pinching the drip wire between the head assembly and support plate, be sure to install the drip wire *after* tightening the head bolts.

15. Reinstall the drip wire around the head assembly, ensuring that the tip is in the 6 o'clock position.
16. Reattach all fittings and seal-wash tubing.

Tip: When reattaching the outlet tubing to the transducer, tighten the inlet-tubing fitting finger-tight plus as much as 1/6-turn, for existing fittings, or 3/4-turn for new fittings.

17. Return the solvent bottles to their original location.
18. Prime the binary solvent manager (see page 17).
19. Perform the binary solvent manager leak test (see the ACQUITY UPLC online Help).

If the leak test results are not satisfactory, pressurize the head plunger seals to properly seat them.

To pressurize the seals:

Run the binary solvent manager at 117,211 kPa (1172 bar, 17,000 psi) for a half-hour, or run the leak test until results are satisfactory.

Replacing the vent valve cartridge

Warning: To avoid the harmful effects of personal contact with solvents, including inhalation, observe Good Laboratory Practice when you handle them. See the Material Safety Data Sheets for the solvents you use.

Caution: To prevent contaminating system components, wear clean, chemical-resistant, powder-free gloves when replacing the vent valve cartridge.

Required materials

- Gloves: clean, powder-free, chemical-resistant
- Vent valve cartridge

Required tools

- 1/4-inch open-end wrench
- 2-mm Allen wrench (startup kit)

To replace the vent valve cartridge:

1. In the ACQUITY UPLC Console, select Binary Solvent Manager from the system tree.

   Note: If your system is controlled by UNIFI software, consult the UNIFI online Help.

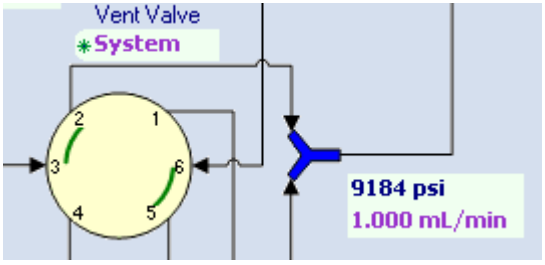
2. In the binary solvent manager information window, click Interactive Display.

3. In the binary solvent manager interactive display dialog box, click Control  .

4. Ensure the vent valve is set to Vent.

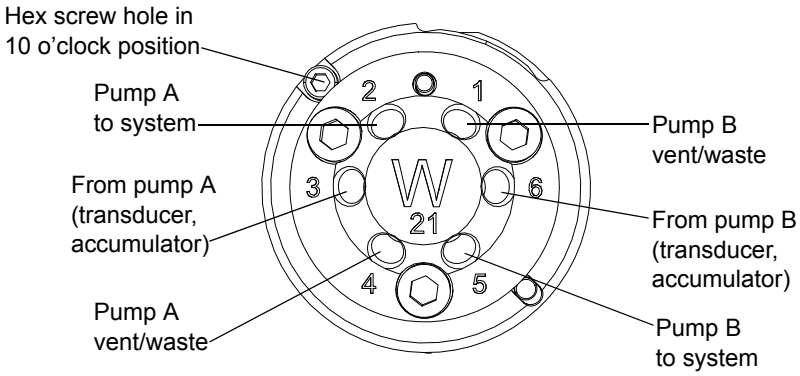
   Tip: To change the setting to Vent, click the underlined vent valve position, and select Vent.

Interactive display showing vent valve setting:



5. Use the 1/4-inch wrench to remove the fittings attached to the vent valve cartridge.

Vent valve cartridge:

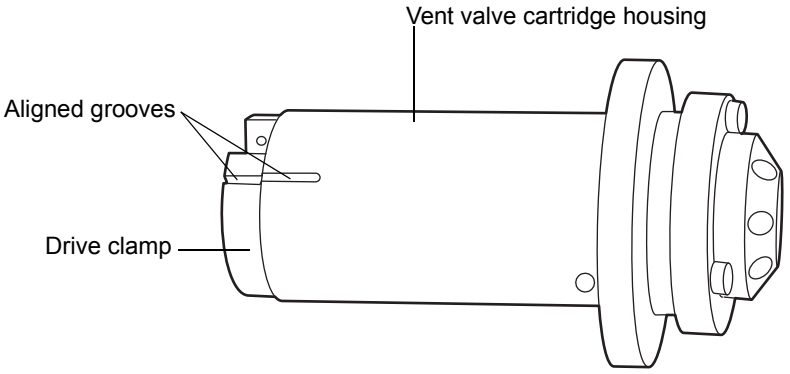


6. Use the 2-mm Allen wrench to remove the hex screw at the 10 o'clock position on the vent valve cartridge.
7. Remove the vent valve cartridge from the vent valve assembly by pulling straight forward.
8. Unpack the replacement vent valve cartridge.

Caution: To avoid scratching the drive clamp or cartridge housing, handle it with care.

9. Ensure that the groove in the cartridge housing aligns with the groove on the drive clamp.

   Tip: If the grooves fail to align, turn the drive clamp until they do.



10. Insert the new vent valve cartridge into the vent valve cartridge chamber.

    Requirements:

    - Orient the new cartridge exactly as the old one was oriented.
    - The vent valve cartridge must slide fully into the vent valve assembly. If it does not, contact Waters Technical Service.

11. Insert the 2-mm hex screw at the 10 o'clock position on the vent valve cartridge and then use the 2-mm Allen wrench to tighten the hex screw to 9 inch-pounds of torque.
12. Use the 1/4-inch wrench to reattach all fittings and tighten them up to 1/6-turn beyond finger-tight for existing fittings, or 3/4-turn beyond finger-tight for new fittings.
13. Prime the binary solvent manager (see page 17).

Cleaning the instrument's exterior

Clean surfaces of the binary solvent manager using only a clean, soft, lint-free paper or clean cloth dampened with water.

Observe these requirements when cleaning device surfaces:

- Always ensure the electrical power to the device is interrupted.
- Always use eye and hand protection during the cleaning process.
- Apply the water to a clean cloth only, and then wipe the device.
- Never spray or apply the water directly onto any device surface.