General information

Copyright notice

© 2010 – 2016 WATERS CORPORATION. PRINTED IN THE UNITED STATES OF AMERICA AND IN IRELAND. ALL RIGHTS RESERVED. THIS DOCUMENT OR PARTS THEREOF MAY NOT BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN PERMISSION OF THE PUBLISHER.

The information in this document is subject to change without notice and should not be construed as a commitment by Waters Corporation. Waters Corporation assumes no responsibility for any errors that may appear in this document. This document is believed to be complete and accurate at the time of publication. In no event shall Waters Corporation be liable for incidental or consequential damages in connection with, or arising from, its use. For the most recent revision of this document, consult the Waters Web site (waters.com).

Trademarks

ACQUITY® is a registered trademark of Waters Corporation.

ACQUITY UPLC® is a registered trademark of Waters Corporation.

THE SCIENCE OF WHAT’S POSSIBLE® is a registered trademark of Waters Corporation.

TORX® is a registered trademark of Camcar Division, Textron Inc.

Waters® is a registered trademark of Waters Corporation.

Waters Quality Parts® is a registered trademark of Waters Corporation.

All other trademarks or registered trademarks are the sole property of their respective owners.

Customer comments

Waters’ Technical Communications organization invites you to report any errors that you encounter in this document or to suggest ideas for otherwise improving it. Help us better understand what you expect from our documentation so that we can continuously improve its accuracy and usability.

We seriously consider every customer comment we receive. You can reach us at tech_comm@waters.com.
Contacting Waters

Contact Waters with enhancement requests or technical questions regarding the use, transportation, removal, or disposal of any Waters product. You can reach us via the Internet, telephone, or conventional mail.

Waters contact information

<table>
<thead>
<tr>
<th>Contacting medium</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>The Waters Web site includes contact information for Waters locations worldwide. Visit <a href="http://www.waters.com">www.waters.com</a></td>
</tr>
<tr>
<td>Telephone and fax</td>
<td>From the USA or Canada, phone 800-252-4752, or fax 508-872-1990. For other locations worldwide, phone and fax numbers appear in the Waters Web site.</td>
</tr>
<tr>
<td>Conventional mail</td>
<td>Waters Corporation Global Support Services 34 Maple Street Milford, MA 01757 USA</td>
</tr>
</tbody>
</table>

Safety considerations

Some reagents and samples used with Waters instruments and devices can pose chemical, biological, or radiological hazards (or any combination thereof). You must know the potentially hazardous effects of all substances you work with. Always follow Good Laboratory Practice (GLP), and consult your organization’s standard operating procedures as well as your local requirements for safety.

Safety hazard symbol notice

Documentation needs to be consulted in all cases where the symbol is used to find out the nature of the potential hazard and any actions which have to be taken.

Considerations specific to the QSM

Warning: To avoid electric shock, do not remove protective panels from system modules. The components within are not user-serviceable.
Warning: To avoid electrical shock, observe these precautions:

- Use SVT-type power cord in the United States and HAR-type power cord, or better, in Europe. For requirements elsewhere, contact your local Waters distributor.
- Inspect the power cord for damage, and replace it, if necessary.
- Power-off and unplug each module before performing any maintenance operation on it.
- Connect each module to a common ground.

Warning: To avoid spinal and muscular injury, do not attempt to lift a system module without assistance.

See also: For safety considerations regarding specific system modules, consult the appropriate information on the user documentation CD.

FCC radiation emissions notice

Changes or modifications not expressly approved by the party responsible for compliance, could void the user's authority to operate the equipment. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Electrical power safety notice

Do not position the instrument so that it is difficult to disconnect the power cord.

Equipment misuse notice

If equipment is used in a manner not specified by its manufacturer, protections against personal injury inherent in the equipment’s design can be rendered ineffective.

Safety advisories

Consult the "Safety advisories" appendix in this publication for a comprehensive list of warning advisories and notices.

Operating this device

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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Manufacturer" /></td>
<td>Manufacturer</td>
</tr>
<tr>
<td><img src="image" alt="Date of manufacture" /></td>
<td>Date of manufacture</td>
</tr>
<tr>
<td><img src="image" alt="Authorized representative of the European Community" /></td>
<td>Authorized representative of the European Community</td>
</tr>
<tr>
<td><img src="image" alt="Conforms to all applicable European Community Directives" /></td>
<td>Confirms that a manufactured product complies with all applicable European Community directives</td>
</tr>
<tr>
<td><img src="image" alt="Australia EMC compliant" /></td>
<td>Australia EMC compliant</td>
</tr>
<tr>
<td><img src="image" alt="Conforms to all applicable United States and Canadian safety requirements" /></td>
<td>Confirms that a manufactured product complies with all applicable United States and Canadian safety requirements</td>
</tr>
<tr>
<td><img src="image" alt="Consult instructions for use" /></td>
<td>Consult instructions for use</td>
</tr>
<tr>
<td><img src="image" alt="Alternating current" /></td>
<td>Alternating current</td>
</tr>
<tr>
<td><img src="image" alt="Electrical and electronic equipment with this symbol may contain hazardous substances and should not be disposed of as general waste. For compliance with the Waste Electrical and Electronic Equipment Directive (WEEE) 2012/19/EU, contact Waters Corporation for the correct disposal and recycling instructions." /></td>
<td>Electrical and electronic equipment with this symbol may contain hazardous substances and should not be disposed of as general waste. For compliance with the Waste Electrical and Electronic Equipment Directive (WEEE) 2012/19/EU, contact Waters Corporation for the correct disposal and recycling instructions.</td>
</tr>
<tr>
<td><img src="image" alt="Serial number" /></td>
<td>Serial number</td>
</tr>
<tr>
<td><img src="image" alt="Part number catalog number" /></td>
<td>Part number catalog number</td>
</tr>
</tbody>
</table>

**Audience and purpose**

This guide is intended for individuals who install, operate, or maintain the quaternary solvent manager (QSM). It gives an overview of the technology and operation of the QSM.
Intended use of the QSM

Waters designed the QSM for use in liquid chromatography applications. The QSM is not intended for use in diagnostic applications.

Calibrating

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

When calibrating mass spectrometers, consult the calibration section of the operator’s guide for the instrument you are calibrating. In cases where an overview and maintenance guide, not an operator’s guide, accompanies the instrument, consult the instrument’s online Help system for calibration instructions.

Quality control

Routinely run three QC samples that represent subnormal, normal, and above-normal levels of a compound. If sample trays are the same or very similar, vary the location of the QC samples in the trays. Ensure that QC sample results fall within an acceptable range, and evaluate precision from day to day and run to run. Data collected when QC samples are out of range might not be valid. Do not report these data until you are certain that the instrument performs satisfactorily.

EMC considerations

Canada spectrum management emissions notice

This class A digital product apparatus complies with Canadian ICES-001.
Cet appareil numérique de la classe A est conforme à la norme NMB-001.

ISM classification: ISM group 1 class B

This classification has been assigned in accordance with IEC CISPR 11 Industrial Scientific and Medical (ISM) instrument requirements.

Group 1 products apply to intentionally generated and/or used conductively coupled radio-frequency energy that is necessary for the internal functioning of the equipment.

Class B products are suitable for use in both commercial and residential locations and can be directly connected to a low voltage, power-supply network.
### EC authorized representative

<table>
<thead>
<tr>
<th>Address</th>
<th>Waters Corporation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stamford Avenue</td>
</tr>
<tr>
<td></td>
<td>Altrincham Road</td>
</tr>
<tr>
<td></td>
<td>Wilmslow SK9 4AX UK</td>
</tr>
<tr>
<td>Telephone</td>
<td>+44-161-946-2400</td>
</tr>
<tr>
<td>Fax</td>
<td>+44-161-946-2480</td>
</tr>
<tr>
<td>Contact</td>
<td>Quality manager</td>
</tr>
</tbody>
</table>
# Table of contents

**General information** ................................................................................................................................. ii

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copyright notice</td>
<td>ii</td>
</tr>
<tr>
<td>Trademarks</td>
<td>ii</td>
</tr>
<tr>
<td>Customer comments</td>
<td>ii</td>
</tr>
<tr>
<td>Contacting Waters</td>
<td>iii</td>
</tr>
<tr>
<td>Safety considerations</td>
<td>iii</td>
</tr>
<tr>
<td>Safety hazard symbol notice</td>
<td>iii</td>
</tr>
<tr>
<td>Considerations specific to the QSM</td>
<td>iii</td>
</tr>
<tr>
<td>FCC radiation emissions notice</td>
<td>iv</td>
</tr>
<tr>
<td>Electrical power safety notice</td>
<td>iv</td>
</tr>
<tr>
<td>Equipment misuse notice</td>
<td>iv</td>
</tr>
<tr>
<td>Safety advisories</td>
<td>iv</td>
</tr>
<tr>
<td>Operating this device</td>
<td>iv</td>
</tr>
<tr>
<td>Applicable symbols</td>
<td>v</td>
</tr>
<tr>
<td>Audience and purpose</td>
<td>vi</td>
</tr>
<tr>
<td>Intended use of the QSM</td>
<td>vi</td>
</tr>
<tr>
<td>Calibrating</td>
<td>vi</td>
</tr>
<tr>
<td>Quality control</td>
<td>vi</td>
</tr>
<tr>
<td>EMC considerations</td>
<td>vi</td>
</tr>
<tr>
<td>Canada spectrum management emissions notice</td>
<td>vi</td>
</tr>
<tr>
<td>ISM classification: ISM group 1 class B</td>
<td>vi</td>
</tr>
<tr>
<td>EC authorized representative</td>
<td>vii</td>
</tr>
</tbody>
</table>

**1 Overview** ........................................................................................................................................... 12

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Features</td>
<td>12</td>
</tr>
<tr>
<td>1.1.1 Gradient Smart Start</td>
<td>13</td>
</tr>
<tr>
<td>1.1.2 Auto•Blend Plus</td>
<td>13</td>
</tr>
<tr>
<td>1.2 Major components</td>
<td>13</td>
</tr>
<tr>
<td>1.3 Pressure flow envelope</td>
<td>17</td>
</tr>
<tr>
<td>1.4 Pressure transducer overview</td>
<td>17</td>
</tr>
<tr>
<td>1.5 Flow path through the solvent management system</td>
<td>17</td>
</tr>
</tbody>
</table>

August 8, 2016, 715005050 Rev. C
Page viii
2 Preparation and operation

2.1 Installation recommendations for fittings
2.1.1 Assembling new fittings
2.1.2 Stainless steel (gold-plated) fitting with short flats and 2-piece stainless-steel ferrule
2.1.3 Stainless steel (gold-plated) fitting with long flats and 2-piece stainless-steel ferrule
2.1.4 5/16-24 fitting with filter and stainless steel lock ring
2.1.5 Short 1/4-28 fitting with flangeless ferrule and stainless steel lock ring installed on 1/16-inch OD tubing
2.1.6 Long 1/4-28 fitting with flangeless ferrule and stainless steel lock ring installed on 1/8-inch OD tubing

2.2 Installing and routing the waste and degasser vent tubing

2.3 Electricity source
2.3.1 Connecting to a wall electricity source
2.3.2 Connecting to a cart's electricity source

2.4 Connecting signal cables
2.4.1 Input/output signal connectors

2.5 Installing the leak sensor

2.6 Priming the seal-wash system

2.7 Priming the solvent manager
2.7.1 Priming a dry solvent manager via the console
2.7.2 Priming a dry solvent manager using a syringe

2.8 Washing the plungers

2.9 Responding to a leak sensor alarm

3 Maintenance

3.1 Contacting Waters Technical Service

3.2 Viewing module information

3.3 Recommended maintenance schedule
3.3.1 Recommended maintenance schedule for the quaternary solvent manager

3.4 Spare parts

3.5 Safety and handling

3.6 Configuring maintenance warnings
3.7 Servicing the air filter in the door ................................................................................................... 46
3.8 Replacing the solvent reservoir filters ........................................................................................... 47
3.9 Replacing the leak sensor ............................................................................................................. 48
3.10 Replacing the inlet manifold ........................................................................................................ 51
3.11 Replacing the low-pressure inlet filters on the GPV outlet .......................................................... 54
3.12 Replacing the 100-µL mixer/filter ................................................................................................ 56
3.13 Installing or replacing the optional 250-µL mixer/filter................................................................. 57
3.14 Replacing the vent-valve cartridge .............................................................................................. 59
3.15 Replacing the optional solvent selection valve cartridge............................................................. 61
3.16 Replacing the accumulator check valve ...................................................................................... 63
3.17 Replacing the i2Valve actuator and cartridge .............................................................................. 66
  3.17.1 Removing the i2Valve actuator .......................................................................................... 67
  3.17.2 Removing the i2Valve cartridge from the actuator ................................................................ 71
  3.17.3 Installing the i2Valve cartridge on the actuator ................................................................ 72
  3.17.4 Installing the i2Valve actuator ............................................................................................ 76
3.18 Replacing the primary pump head's plunger and seals .............................................................. 79
  3.18.1 Moving the plunger backward ............................................................................................ 80
  3.18.2 Removing the i2Valve actuator .......................................................................................... 81
  3.18.3 Removing the primary pump head..................................................................................... 84
  3.18.4 Removing the pump head plunger .................................................................................... 87
  3.18.5 Removing the pump head seals ........................................................................................ 89
  3.18.6 Installing the new pump head seals ................................................................................... 92
  3.18.7 Installing the new pump-head plunger ............................................................................. 96
  3.18.8 Reinstalling the primary pump head .................................................................................. 98
  3.18.9 Installing the i2Valve actuator .......................................................................................... 101
3.19 Replacing the accumulator pump head's plunger and seals..................................................... 105
  3.19.1 Moving the plunger backward .......................................................................................... 106
  3.19.2 Removing the accumulator pump head .............................................................................. 106
  3.19.3 Removing the pump head plunger .................................................................................... 110
3.20 Cleaning the exterior of the equipment ..................................................................................... 125

A Safety advisories ........................................................................................................................... 126
  A.1 Warning symbols ........................................................................................................................ 126
A.1.1 Specific warnings ..............................................................................................................127
A.2 Notices ........................................................................................................................................128
A.3 Bottles Prohibited symbol ...........................................................................................................128
A.4 Required protection ....................................................................................................................129
A.5 Warnings that apply to all Waters instruments and devices .......................................................129
A.6 Warnings that address the replacing of fuses .............................................................................133
A.7 Electrical symbols .......................................................................................................................135
A.8 Handling symbols .......................................................................................................................136

B Specifications ..............................................................................................................................137
  B.1 QSM and bioQSM physical specifications ...............................................................................137
  B.2 QSM and bioQSM environmental specifications ........................................................................137
  B.3 QSM and bioQSM electrical specifications ...............................................................................137
  B.4 QSM and bioQSM input/output specifications ...........................................................................138
  B.5 QSM and bioQSM performance specifications .........................................................................139
  B.6 QSM and bioQSM wetted materials of construction .................................................................141
The quaternary solvent manager (QSM) is a high-pressure pump that can simultaneously pump four degassed solvents (A, B, C, and D) through the ACQUITY HPLC system. The pump can deliver gradients in eleven curve shapes (one linear, two step, four convex, and four concave). When the optional solvent-selection valve is installed, it is plumbed to solvent channel D, enabling solvent selections D₁ through D₆ in addition to A, B, and C (a total of nine solvents to select from).

This document explains the operation of both the QSM and the bioQSM. For information about ordering supplies for either device, visit the Waters website (www.waters.com), or consult your Waters sales representative.

1.1 Features

The solvent manager includes these features:

• Ability to blend four solvents in any combination or proportion.

• Optional solvent-selection valve, to select from up to nine solvents for blending.

• Automated solvent compressibility, to run any solvent in any combination without loss in accuracy or precision.

• A gradient proportioning valve (GPV), to dynamically blend solvents in any specified combination. The GPV produces predictable gradient segments regardless of solvent compressibility and system back pressure. Solvent selection and proportioning occur on the low-pressure (intake) side of the solvent delivery system, and solvents continue to blend under high pressure in each piston chamber.

• An integrated degasser that operates at all flow rates, including the maximum, with an independent channel for each solvent and an additional channel to accommodate the purge solvent for the sample manager.

• An automatic, programmable, seal wash. The seal wash pump prevents the buildup of precipitates on the pump plungers by washing them with seal wash solvent at programmable intervals.

• The electronically controlled Intelligent Intake Valve (I²Valve), to speed system priming and reduce startup times. The I²Valve minimizes solvent flow disturbances in the inlet lines by closely synchronizing the valve performance with pump operation.

• A vent valve that automatically switches to waste, for priming and rapid solvent changeover.
1.1.1 Gradient Smart Start

Before each sample injection, a sample manager typically performs wash sequences and then aspires the appropriate sample volume. When these tasks are completed, the solvent manager begins to deliver the gradient to the injection valve. The dwell volume of the system, which affects the amount of time required for this gradient to reach the column, can be a significant component of the overall cycle time.

The Gradient Smart Start feature adjusts when an injection is made relative to when it starts. In this way, when you transfer methods, the feature compensates for differences in dwell volume between chromatographic systems. Moreover, it automatically coordinates all pre-injection operations, minimizing delays that would increase the overall cycle time. In doing so, the feature makes it possible to begin gradient operation before or during the sample manager's pre-injection functions, resulting in significant time savings.

1.1.2 Auto•Blend Plus

Auto•Blend Plus technology uses pure solvents and concentrated stocks to blend mobile phase compositions at a specific pH. At the same time, it controls the concentration of salt or organic solvent, to optimize separations. Use the Auto•Blend Plus feature to create and store buffer systems in a solvent catalog that all users of an ACQUITY quaternary solvent manager can share. To prepare and adjust chromatographic mobile phases, you add acid, base, salt or organic solvent, and water to the solvent reservoirs. By doing so you can, for example, optimize protein separations, which are especially sensitive to a buffer's pH and salt concentration. You can also optimize reversed-phase separations that are sensitive to pH and organic-solvent composition.

See also:

- Auto•Blend Plus Technology for Ion Exchange, Size Exclusion, and Reversed-phase Chromatography
- The Auto•Blend Plus videos on the Support tab on the Waters Auto•Blend Plus page.

1.2 Major components

The following diagrams show the solvent manager's major components.
Figure 1–1: Front view, with door closed

1. On/off switch – Powers the module on and off.
2. Power LED – Indicates the power-on or power-off status of the module. This LED is green when power is on and unlit when power is off.
3. Flow LED – Indicates the flow status. A steady green flow LED indicates that there is a flow through the solvent manager.
4. Door

Figure 1–2: Front view, with door open
Pressure transducer cable connector port (2) – Connects the pressure transducers, which convert solvent pressure into electrical signals for monitoring.

Accumulator pump – Receives solvent from the primary pump and delivers it to the vent valve.

Location of the sample manager’s purge-solvent degasser – Degasses the sample manager’s purge solvent.

Note: Vacuum degassing can change the composition of mixed solvents.

Vent valve – Automatically switches to waste during priming and to a block position during the leak test.

100-µL mixer/filter – Mixes and filters the solvent before it reaches the pump outlet.

Seal wash pump – Circulates solvent, to keep the actuator’s high-pressure seals and plungers free of contaminants.

Location of degasser vent tube – Vents exhaust from the degasser pump.

Seal-wash waste fitting – Connects the tubing that directs seal-wash waste to the drip tray.

Drain fitting (to waste) – Connects the tubing that directs waste liquid to the waste container.

Solvent vent tubing – Vents solvent to waste during priming.

Location of leak sensor – The leak sensor continuously monitors the solvent manager for leaks and stops the system flow when its optical sensor detects approximately 1.5 mL of accumulated, leaked liquid in its surrounding reservoir.

Location of optional solvent selection valve – The solvent selection valve enables you to select as many as six solvents for isocratic and gradient applications. The valve is plumbed to solvent channel D, enabling solvent selections D₁ through D₆.

Leak sensor cable connector port – Connects the leak sensor, which continuously monitors the solvent manager for leaks.

Gradient proportioning valve – Blends solvents to create accurate gradients, regardless of solvent compressibility and system back pressure. The system includes two gradient proportioning valves, one for solvent channels A and B, and one for solvent channels C and D.

Low pressure inlet filters (A, B, C, and D) – Removes particulates from the incoming solvent.
16 Drip tray – Collects liquid leaks.

17 Mobile phase degasser chamber (4) – Removes dissolved gasses from mobile-phase solvents and exhausts them, along with any condensates, through waste tubing.

**Note:** Vacuum degassing can change the composition of mixed solvents.

18 Inlet manifold – Combines the solvents upstream of the pumps.

19 \( \hat{p} \)Valve – Electronically controlled ball check valve that allows flow in only one direction.

20 Primary pump – Draws solvent, transferring it to the accumulator pump and system as part of the serial flow design.

21 Check valve – A ball check valve that allows flow in only one direction.

**Figure 1–3: Rear view**

1 Signal cable connector inputs and outputs

2 RS-232 cable connector (for service only)

3 Ethernet cable connector

4 Power input
1.3 Pressure flow envelope

The QSM, a single pump with a proportioning valve, has a maximum operating pressure of 103,421 kPa (1034 bar, 15,000 psi) at flow rates to 1 mL/min. The maximum operating pressure decreases linearly to 53,779 kPa (538 bar, 7800 psi) at flow rates up to 2.2 mL/min.

1.4 Pressure transducer overview

The absolute pressure transducer (APT), which measures the pressure on the low pressure side of the degasser system, is unaffected by altitude or barometric changes.

<table>
<thead>
<tr>
<th>Item</th>
<th>Absolute pressure transducer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units displayed</td>
<td>kPa, bar, psia</td>
</tr>
<tr>
<td>Sign of displayed unit</td>
<td>Positive</td>
</tr>
<tr>
<td>Theoretical maximum vacuum</td>
<td>0.0 psia</td>
</tr>
<tr>
<td>Operating range</td>
<td>0.00 to 1.54 psia</td>
</tr>
<tr>
<td>Typical value</td>
<td>0.70 to 1.20 psia</td>
</tr>
</tbody>
</table>

1.5 Flow path through the solvent management system

The following image depicts the flow of solvent through the solvent manager.
**Solvent flow sequence:**

1. The in-line vacuum degasser degasses the solvent.
2. The gradient proportioning valve meters the solvents, prior to pressurization in the pump heads.
3. The inlet manifold blends the metered solvents.
4. The blended solvents flow through the \( i^2 \) Valve check valve and into the primary piston chamber.
5. The primary piston delivers solvent to the accumulator, the vent valve, and the in-line mixer/filter during transfer.
6. The accumulator piston delivers solvent, under pressure, to the vent valve and the in-line mixer/filter.
7. From the in-line mixer/filter, the solvent flows to the sample-management system.
2 Preparation and operation

For optimal system performance, you must prepare the solvent manager for operation.

To do so, you must prime the seal wash and then the solvent manager. Be sure to prime all four solvent lines, the seal wash tubing, and the solvent selection valve tubes (if installed).

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Requirement:** To maintain the efficiency of the solvent manager and to obtain accurate, reproducible chromatograms, use only LC/MS-grade solvents, water, and additives. For details, see the Solvent Considerations information and *Controlling Contamination in Ultra Performance LC/MS and HPLC/MS Systems* (part number 715001307).

**Notice:** To avoid damaging solvent manager components,
- do not use chloroform, methylene chloride, or toluene;
- do not use ethyl acetate, hexane, or tetrahydrofuran (THF) without the hexane/THF compatibility kit for ACQUITY UPLC systems;
- do not pressurize solvent reservoirs above 34.5 kPa (0.34 bar, 5 psi).

**Recommendation:** For optimal solvent manager performance, ensure that solvent bottles are elevated above the pump inlet and vented.

2.1 Installation recommendations for fittings

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination with biohazards or compounds that are toxic, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.
Recommendations:

- To prevent band spreading, ensure that the tubing is fully bottomed in the fitting port before tightening the compression screw.
- For easier accessibility, use compression fittings with long flats to attach tubes to the vent valve.
- Perform the solvent manager leak test whenever you replace or loosen fittings during maintenance (see the console online Help).
- Whenever you loosen fittings during maintenance, examine them for cracks, stripped threads, and deformations.
- Do not reuse stainless steel fittings more than six times.

Required tools and materials

- Chemical-resistant, powder-free gloves

2.1.1 Assembling new fittings

For metallic (SST or MP35N) fitting assemblies with ferrules not previously assembled or set to tubing, you must mark the compression screw and fitting body, and ensure that the two marks line up when you tighten them.

Requirement: Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Required tools and materials

- 1/4-inch open-end wrench – For tightening or loosening stainless steel (gold-plated) fittings with 2-piece ferrule.
- Permanent marker
- Chemical-resistant, powder-free gloves

To assemble the new fittings:

1. Insert the end of a tube into the hexagonal end of the compression screw.
2. Insert the tube into the larger end of the ferrule.
3. Insert the tube into the fitting body.
4. Rotate the compression screw, clockwise, into the fitting body until the screw is finger-tight.
5. Using a permanent marker, mark the compression screw at the 12 o’clock position.
6. Mark the fitting body at the 9 o’clock position.

7. Ensure that the tubing makes contact with the bottom of the fitting body, and use the 1/4-inch open-end wrench to rotate the compression screw clockwise 3/4-turn until the two marks line up.

2.1.2 Stainless steel (gold-plated) fitting with short flats and 2-piece stainless-steel ferrule

First use

1. Short flats

2. Compression screw

3. 2-piece stainless steel ferrule

Tighten the fitting finger-tight plus an additional 3/4-turn using a 1/4-inch open-end wrench. For detailed instructions about assembling new fittings, see Assembling new fittings.

Tip: To prevent band spreading, ensure that the tubing is fully bottomed in the fitting before tightening the compression screw.

First use tightening
Re-installed

1. Short flats
2. Compression screw
3. 2-piece stainless steel ferrule

Tighten the fitting finger-tight plus as much as an additional 1/6-turn using a 1/4-inch open-end wrench.

Re-installed tightening

2.1.3 Stainless steel (gold-plated) fitting with long flats and 2-piece stainless-steel ferrule

First use

1. Long flats
2. Compression screw
3. 2-piece stainless-steel ferrule
Tighten the fitting finger-tight plus an additional 3/4-turn using a 1/4-inch open-end wrench. For detailed instructions about assembling new fittings, see Assembling new fittings.

**Tip:** To prevent band spreading, ensure that the tubing is fully bottomed in the fitting before tightening the compression screw.

**First use tightening**

**Re-installed**

1. Long flats
2. Compression screw
3. 2-piece stainless-steel ferrule

Tighten the fitting finger-tight plus as much as an additional 1/6-turn using a 1/4-inch open-end wrench.

**Re-installed tightening**
2.1.4 5/16-24 fitting with filter and stainless steel lock ring

First use or re-installed

1. Compression screw
2. Lock ring
3. Ferrule and filter
4. End of lock ring with larger inside diameter (ID)

Tighten the fitting finger-tight.

2.1.5 Short 1/4-28 fitting with flangeless ferrule and stainless steel lock ring installed on 1/16-inch OD tubing

First use or re-installed

1. Compression screw
2. Lock ring
3. Ferrule
4. End of lock ring with larger inside diameter (ID)
Tighten the fitting finger-tight.

2.1.6 Long 1/4-28 fitting with flangeless ferrule and stainless steel lock ring installed on 1/8-inch OD tubing

First use or re-installed

1  Compression screw
2  Lock ring
3  Ferrule
4  End of lock ring with larger inside diameter (ID)

Tighten the fitting finger-tight.

2.2 Installing and routing the waste and degasser vent tubing

Notice: To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

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

Requirement: Wear clean, chemical-resistant, powder-free gloves when performing this procedure.
**Required tools and materials**

- Chemical-resistant, powder-free gloves
- Methanol
- Waste tubing

**To install and route the waste and degasser vent tubing:**

1. Wet the barbed drain fitting located at the bottom of the 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.

![Figure 2–1: Location of drain fitting and degasser vent tubing](image-url)

- Location of degasser vent tubing
- Drain cup
3. Route the pre-installed degasser vent tubing to a suitable exhaust system or vented waste container.

**Figure 2–2: Example of a suitable waste container**
2.3 Electricity source

Most modules require a separate, grounded, power source. The ground connection in the power outlet must be common and physically close to the module.

**Warning:** To avoid electric shock, do not remove protective panels from system modules. The components within are not user-serviceable.

**Notice:** To avoid damaging the electronic components of the sample manager and the column heater or column heater/cooler, always power-off the sample manager and column heater/cooler before connecting or disconnecting the interconnect cable.

### 2.3.1 Connecting to a wall electricity source

**Warning:** To avoid electrical shock, observe these precautions:

- Use SVT-type power cord in the United States and HAR-type power cord, or better, in Europe. For requirements elsewhere, contact your local Waters distributor.
- Inspect the power cord for damage, and replace it, if necessary.
- Power-off and unplug each module before performing any maintenance operation on it.
- Connect each module to a common ground.

**Recommendation:** Use a line conditioner and uninterruptible power supply (UPS) for optimum, long-term, input-voltage stability.

**To connect to a wall electricity source:**

1. Connect the female end of the power cord to the receptacle on the rear panel of the module.
2. Connect the male end of the power cord to a suitable wall outlet.

### 2.3.2 Connecting to a cart's electricity source

If your system includes the optional FlexCart or micro cart, follow this procedure to connect each module to a power source.
**Warning:** To avoid electrical shock, observe these precautions:

- Use SVT-type power cord in the United States and HAR-type power cord, or better, in Europe. For requirements elsewhere, contact your local Waters distributor.
- Inspect the power cord for damage, and replace it, if necessary.
- Power-off and unplug each module before performing any maintenance operation on it.
- Connect each module to a common ground.

**Recommendation:** Use a line conditioner and uninterruptible power supply (UPS) for optimum, long-term, input-voltage stability.

**To connect to a cart's electricity source:**

1. Connect the female end of the cart's electrical cables (included in the startup kit) to the receptacle on the rear panel of each system module.
2. Connect the hooded, male end of the cart's electrical cables to the power strips on its back.
3. Connect each power strip's cable to a wall outlet operating on its own circuit.

### 2.4 Connecting signal cables

The rear panel of the module includes a removable connector that holds the screw terminals for the I/O signal cables. The connector is keyed so that it can be inserted only one way. Refer to the cable-connection label affixed to the rear panel of the module.

**Required tools and materials**

- 9/32-inch nut driver
- Flat-blade screwdriver
- Connector
- Signal cable

**To connect the cables:**

1. Insert the connector into the connector port on the module’s rear panel.
2. Using the flat-blade screwdriver, attach the positive and negative leads of the signal cable to the connector.

Figure 2–4: Positive and negative lead connections

3. Fit the grounding cable's fork terminal on the rear-panel grounding stud, and secure the terminal using the locking nut.

Note: Use the 9/32-inch nut driver to tighten the locking nut until the terminal does not move.
2.4.1 Input/output signal connectors

Refer to the cable-connection label affixed to the rear panel of the module.

Table 2–1: Analog-out/event-in connections

<table>
<thead>
<tr>
<th>Signal connection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradient start</td>
<td>Initiates pump operation by either contact-closure input or 0-volt input (an error condition or hardware failure on another instrument or device, for example), beginning a gradient separation.</td>
</tr>
<tr>
<td>Stop flow</td>
<td>Stops the flow from the solvent manager when it receives a contact-closure input or 0-volt input.</td>
</tr>
</tbody>
</table>

2.5 Installing the leak sensor

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.
Warning: To avoid personal contamination with biohazards or compounds that are toxic, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Requirement: Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Required tools and materials
- Chemical-resistant, powder-free gloves
- Leak sensor

To install the leak sensor:

Notice: To avoid damaging electrical components and circuitry, do not disconnect an electrical assembly while electrical power is applied to a module. To completely interrupt power, set the on/off switch to the "off" position, and then disconnect the power cord from the ac source. Wait 10 seconds thereafter before disconnecting an assembly.

1. Power-off the solvent manager.
2. Open the solvent manager’s door.
3. Unpack the new leak sensor.
4. 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.

Figure 2–6: Aligning T-bar with slot
5. Attach the leak sensor connector to the port on the front of the device.

*Figure 2–7: Attaching leak sensor connector*


7. In the console, select the solvent manager, and then click **Control > Reset module**, to reset the solvent manager.

8. In the console, enable the leak sensor, to activate its leak-detection capability.

### 2.6 Priming the seal-wash system

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

Prime the seal-wash system,

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

**Notice:** To avoid damaging the seats and seals of solenoid valves in the solvent path, do not use a nonvolatile buffer as the seal wash solvent.

**Notice:** To avoid clogging system tubing, ensure that the seal-wash solvent is 100% compatible with the mobile phase conditions.

**Notice:** To avoid contaminating system components, do not recycle seal wash.
Tip: The seal-wash system is self-priming, but you can use a syringe to shorten the time required for priming.

Recommendations:

- Use seal wash that is fully soluble with all chromatographic solvents and that contains at least 10% organic solvent. This concentration prevents microbial growth and ensures that the seal wash can solubilize the mobile phase.
- Before priming the seal-wash system, 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 tools and materials

- Chemical-resistant, powder-free gloves
- 30-mL syringe (startup kit)
- Seal wash solution
- Tubing adapter (startup kit)

To prime the seal wash system:

1. Ensure the seal-wash inlet tubing is immersed in the wash solvent.
2. Remove the seal-wash outlet tubing from the seal-wash waste fitting (on the right-hand side of the drip tray).

Figure 2–8: Location of seal-wash waste fitting

![Diagram of seal wash system]

- Seal-wash waste fitting
- 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 seal-wash system’s outlet tubing.
5. In the console, select the solvent manager, and then click **Control > Prime seal wash > Yes** to begin the seal wash priming process.

6. Slowly withdraw the syringe plunger, to pull solvent through the system.

7. When the seal-wash solution begins to flow into the syringe with relatively few air bubbles, click **Control > Prime seal wash**, to stop the priming process.

8. Disconnect the tubing from the syringe assembly, and reconnect it to the fitting on the drip tray.

### 2.7 Priming the solvent manager

Priming prepares a new system or solvent manager for use and for a change in reservoirs or solvents. It also prepares a system for restarting after it has been idle for more than four hours. During priming, the vent valve moves to the vent position, ensuring minimal back pressure and directing solvent flow to waste. The flow rate during priming is 4 mL/min.

**Tip:** If you are priming a dry solvent manager, using a syringe shortens the time required for priming.

**Recommendation:** Ensure that solvents, which combine at the inlet manifold, are fully miscible.

![Notice](image)

**Notice:** 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 section of the system guide.

Ensure that the solvent reservoirs contain sufficient solvent for adequate priming and that the waste container can hold all the used solvent. For example, at 4 mL/min, priming for 5 minutes uses about 20 mL of each solvent.

![Warning](image)

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

**Requirement:** Prime all solvent lines with solvent, to ensure that the degasser functions properly.

### 2.7.1 Priming a dry solvent manager via the console

To prime a dry solvent manager via the console:

1. Open the solvent manager’s front door.
2. Locate the solvent vent tubing.
3. In the console, select the solvent manager, and then click **Control > Prime solvents**.

4. In the Prime Solvents dialog box, select solvent **A, B, C, D**, or (instead of **D**), **D₁ through D₆**.

5. In the Time box, specify the number of minutes, from 0.1 through 60.0.
   - **Default:** 2.0 minutes
   - **Recommendation:** Prime the solvent manager until a steady flow exits the vent tubing (typically four to seven minutes per solvent).

6. Click **Start**.
   - **Tip:** When solvent flows from the vent tubing continuously, the path is primed.
   - **Requirement:** Ensure that enough solvent remains in the solvent reservoirs to supply subsequent methods.

### 2.7.2 Priming a dry solvent manager using a syringe

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.
Required tools and materials

- Chemical-resistant, powder-free gloves
- 30-mL syringe (startup kit)
- Seal wash solution
- Short length of tubing
- Tubing adapter (startup kit)

To prime a dry solvent manager using a syringe:

1. Open the solvent manager’s door.
2. Locate the solvent vent tubing from the center port on the vent valve, and follow the tubing down to the drip tray.

   Figure 2–10: Solvent vent tubing and retainer

3. Turn the retainer holding the solvent vent tubing, and retract the tubing, lifting it away from the drip tray.
4. Push the syringe plunger fully into the syringe barrel.
5. Connect the tubing adapter to the syringe.
6. Connect the syringe assembly to a short length of tubing, and then connect the short length of tubing to the solvent vent tubing that you lifted from the drip tray, in step 3.
7. In the console, select the solvent manager, and then click Control > Prime solvents.
8. In the Prime Solvents dialog box, select a line for priming.
9. In the Time box, specify the number of minutes for priming, from 0.1 through 60.0.

   Recommendation: Prime the solvent manager until a steady flow exits the solvent vent tubing (typically 3 minutes).
10. Click **Start**.

11. Slowly withdraw the syringe plunger.

12. When solvent flows without bubbles from the solvent vent tubing, remove the syringe from the solvent vent tubing.

13. Reinsert the solvent vent tubing into the drip tray.

14. Turn the retainer for the solvent vent tubing, so that it holds the vent tubing in place.

   **Figure 2–11: Solvent vent tubing and retainer**

   ![Diagram](image)

   1. Solvent vent tubing  
   2. Solvent vent tubing retainer  

15. Repeat step 2 through step 14 for the remaining solvent lines, including any plumbed to the optional solvent selection valve.

   **Tip:** Ensure that the solvent reservoirs contain enough solvent for future methods.

### 2.8 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 damage 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 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:
1. In the console, select the solvent manager, and then click Maintain > Wash plungers.

### 2.9 Responding to a leak sensor alarm

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

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination with biohazards or compounds that are toxic, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Notice:** To avoid scratching or otherwise damaging the leak sensor,
- do not allow buffered solvents to accumulate and dry on it;
- do not submerge it in a cleaning bath.

**Required tools and materials**
- Chemical-resistant, powder-free gloves
- Cotton swabs
- Nonabrasive, lint-free wipes

**To respond to a leak sensor alarm:**
1. In the console’s Leak Sensors dialog box, confirm that the solvent manager's leak sensor detected a leak.
Tip: When a leak is detected, a “Leak Detected” error message appears.

**Notice:** To avoid damaging electrical components and circuitry, do not disconnect an electrical assembly while electrical power is applied to a module. To completely interrupt power, set the on/off switch to the "off" position, and then disconnect the power cord from the ac source. Wait 10 seconds thereafter before disconnecting an assembly.

2. Power-off the solvent manager.
3. Open the solvent manager’s door.
4. Locate the source of the leak, and make the repairs necessary to stop it.
   
   **Notice:** To avoid damaging the leak sensor, do not grasp it by the ribbon cable.

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

   **Figure 2–12: Leak-sensor assembly**

   ![Leak-sensor assembly]

   1. Serrations
   2. Ribbon cable
   3. Prism

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

6. Use a nonabrasive, lint-free wipe to dry the leak-sensor prism.
7. Roll up a nonabrasive, lint-free wipe, and use it to absorb the liquid from the leak-sensor reservoir and its surrounding area.
8. With a cotton swab, absorb any remaining liquid from the corners of the leak-sensor reservoir and its surrounding area.

9. 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.

10. If you detached the connector from the front of the device, reattach it.

12. In the console, select the solvent manager, and then click **Control > Reset module**, to reset the solvent manager.
3 Maintenance

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

3.1 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
- Serial number of the system module and its firmware version, if applicable
- Flow rate
- Operating pressure
- Solvent(s)
- Detector settings (sensitivity and wavelength)
- Type and serial number of column(s)
- Sample type and diluent
- Chromatography data software version and serial number
- System workstation model and operating system version

Note: For an explanation about how to report shipping damages and submit claims, see the document Waters Licenses, Warranties, and Support Services.
3.2 Viewing module information

Each system module bears a serial number that 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 a particular unit. Be prepared to provide the serial numbers of the modules in your system when you contact Waters customer support.

To view module information:

1. In the console, select a module from the system tree.
2. Click Configure > View module information.
   The Module Information dialog box displays this information:
   - Serial number
   - Firmware version
   - Firmware checksum
   - Component software version

Alternatives:
- In the main window, point to the visual representation of the system module that you want information about.
- Obtain the serial number from the printed labels on the module’s rear panel or inside the sample compartment door.

3.3 Recommended maintenance schedule

Perform the following routine maintenance on the module, 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.

3.3.1 Recommended maintenance schedule for the quaternary solvent manager

<table>
<thead>
<tr>
<th>Maintenance procedure</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean the air filter in the door</td>
<td>As necessary</td>
</tr>
<tr>
<td>Replace the air filter in the door</td>
<td>During scheduled routine maintenance or as necessary</td>
</tr>
<tr>
<td>Maintenance procedure</td>
<td>Frequency</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Replace solvent filters</td>
<td>During scheduled routine maintenance or as necessary</td>
</tr>
<tr>
<td>Replace the leak sensor</td>
<td>As necessary</td>
</tr>
<tr>
<td>Replace the inlet manifold</td>
<td>As necessary</td>
</tr>
<tr>
<td>Replace the low-pressure inlet filters on the GPV outlet</td>
<td>During scheduled routine maintenance or as necessary</td>
</tr>
<tr>
<td>Replace the 100-µL mixer/filter</td>
<td>During scheduled routine maintenance or as necessary</td>
</tr>
<tr>
<td>Replace the optional 250-µL mixer/filter</td>
<td>During scheduled routine maintenance or as necessary</td>
</tr>
<tr>
<td>Replace the vent valve cartridge</td>
<td>As necessary</td>
</tr>
<tr>
<td>Replace the cartridge of the (optional) solvent-selection valve</td>
<td>As necessary</td>
</tr>
<tr>
<td>Replace the $i^2$Valve actuator</td>
<td>Five years from the date of manufacture or as necessary</td>
</tr>
<tr>
<td>Replace the $i^2$Valve cartridge</td>
<td>During scheduled routine maintenance or as necessary</td>
</tr>
<tr>
<td>Replace the accumulator check valve</td>
<td>During scheduled routine maintenance or as necessary</td>
</tr>
<tr>
<td>Replace the pump-head seals and plungers</td>
<td>During scheduled routine maintenance or as necessary</td>
</tr>
<tr>
<td>Clean the module's exterior using a soft, lint-free cloth, or paper dampened with water</td>
<td>As necessary</td>
</tr>
</tbody>
</table>

### 3.4 Spare parts

To ensure that your system operates as designed, use only Waters Quality Parts. Visit [www.waters.com/wqp](http://www.waters.com/wqp) for information about Waters Quality Parts, including how to order them.

### 3.5 Safety and handling

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.
Warning: To avoid electric shock, do not remove protective panels from system modules. The components within are not user-serviceable.

Notice: To avoid damaging electrical components and circuitry, do not disconnect an electrical assembly while electrical power is applied to a module. To completely interrupt power, set the on/off switch to the "off" position, and then disconnect the power cord from the ac source. Wait 10 seconds thereafter before disconnecting an assembly.

3.6 Configuring maintenance warnings

Maintenance counters, if available for a particular component, provide information about real-time usage that can help you determine when to schedule routine maintenance for specific components. You can specify usage thresholds and maintenance warnings that alert you when a component reaches a specified threshold. Thus you can minimize unexpected failures and unscheduled downtime during important work. For information explaining how to specify maintenance warnings, consult the Waters console Help.

3.7 Servicing the air filter in the door

Required tools and materials

- Mild detergent and water
- Air filter (if replacing)

To service the air filter:

1. Open the solvent manager's door.
2. Slide the air filter up and out of the frame inside the door.
3. Do one of the following:
   - Clean the air filter using a mild detergent and water, and then dry the filter.
   - Discard the old air filter.
4. Slide the air filter back into the frame.

3.8 Replacing the solvent reservoir filters

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

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

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- New solvent reservoir 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 reservoir filter from the short piece of fluoropolymer tubing.
3. Insert the new solvent reservoir filter into the fluoropolymer tubing, pushing until it contacts the solvent tubing.

**Figure 3–2: Replacing the solvent reservoir filter**

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

### 3.9 Replacing the leak sensor

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination with biohazards or compounds that are toxic, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.
**Required tools and materials**

- Chemical-resistant, powder-free gloves
- Leak sensor

**To replace the leak sensor:**

Notice: To avoid damaging electrical components and circuitry, do not disconnect an electrical assembly while electrical power is applied to a module. To completely interrupt power, set the on/off switch to the "off" position, and then disconnect the power cord from the ac source. Wait 10 seconds thereafter before disconnecting an assembly.

1. Power-off the solvent manager.
2. Open the solvent manager’s door.
3. Press down on the tab, to detach the leak sensor connector from the front of the device.

**Figure 3–3: Leak sensor connector**

- Tab
- Leak sensor connector

4. Grasp the leak sensor it by its serrations and pull upward on it, to remove it from its reservoir.

**Figure 3–4: Leak sensor serrations**

- Serrations

5. Unpack the new leak sensor.
6. 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.
7. Reinsert the vent tubing into the drip tray.
8. Connect the leak sensor connector to the front of the device.

10. In the console, select the solvent manager, and then click Control > Reset module, to reset the solvent manager.
3.10 Replacing the inlet manifold

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**
- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- Inlet manifold

**To replace the inlet manifold:**
1. Power-off the solvent manager.
2. Open the solvent manager's door.
3. Disconnect the finger-tight outlet-tubing fitting from the inlet manifold outlet.

**Figure 3–7: Outlet-tubing fitting on manifold**

1. Finger-tight outlet-tubing fitting
2. Inlet manifold

4. Use the 1/4-inch open-end wrench to disconnect the inlet manifold outlet-tubing fitting on the side of the \( i^2 \)Valve and remove the tubing.
5. Use the 1/4-inch open-end wrench to disconnect the inlet-tubing fittings from the inlet manifold.

6. Remove the inlet manifold from the mounting bracket.

7. Ensuring its groove faces forward, place the new inlet manifold in the mounting bracket.
8. Reinstall the outlet-tubing fitting on the side of the \( i^2\text{Valve} \), and minimally tighten it with your fingers.

9. Reattach the inlet-tubing fittings to the inlet manifold, tighten them with your fingers, and then use the 1/4-inch open-end wrench to tighten them an additional 1/6-turn, for existing fittings, or 3/4-turn for new fittings.

**Figure 3–11: Inlet-tubing fittings on manifold**

![Inlet-tubing fittings on manifold](image)

1. Inlet-tubing fitting (4)

10. Reattach the outlet-tubing fitting to the inlet manifold, and tighten it with your fingers to the extent possible.

**Requirement:** Ensure the outlet tubing is fully engaged by raising the inlet manifold while attaching the outlet-tubing fitting.

**Figure 3–12: Reattaching outlet-tubing fitting**

![Reattaching outlet-tubing fitting](image)

1. Outlet-tubing fitting
2. Inlet manifold

11. Tighten the outlet-tubing fitting, on the side of the \( i^2\text{Valve} \) with your fingers, and then use the 1/4-inch open-end wrench to tighten the fitting an additional 1/6-turn, for existing fittings, or 3/4-turn for new fittings.
13. Prime the solvent manager (see Priming the quaternary solvent manager).

3.11 Replacing the low-pressure inlet filters on the GPV outlet

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination from contact with biologically hazardous or toxic materials, do not attempt to force or draw liquid or gas through the valve's inlet or outlet ports.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**
- Chemical-resistant, powder-free gloves
- Low-pressure inlet filters (4)
To replace the low-pressure inlet filters on the GPV outlet:

**Notice:** To avoid damaging electrical components and circuitry, do not disconnect an electrical assembly while electrical power is applied to a module. To completely interrupt power, set the on/off switch to the "off" position, and then disconnect the power cord from the ac source. Wait 10 seconds thereafter before disconnecting an assembly.

1. Power-off the solvent manager.
2. Open the solvent manager’s door.
3. Disconnect the four inlet manifold tubes from the GPV outlets.

**Figure 3–14: GPV outlets**

![GPV outlets diagram](image)

4. Remove the low-pressure inlet filters from the inlet manifold tubing.

**Tip:** If the filters are not on the ends of the inlet manifold tubing, use the tubing to retrieve them from the GPV outlets.

**Figure 3–15: Low-pressure inlet filters on inlet manifold tubing**

![Inlet manifold and low-pressure inlet filters diagram](image)
5. Place the new filters on the inlet manifold tubes.
6. Connect the inlet manifold tubes (4) to the GPV outlets and tighten the fittings with your fingers.
7. Power-on the solvent manager.
8. Prime the solvent manager (see Priming the solvent manager).

### 3.12 Replacing the 100-µL mixer/filter

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

***Required tools and materials***

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/8-inch open-end wrench
- 100-µL mixer/filter

**To replace the 100-µL mixer/filter:**

1. Flush the solvent manager with nonhazardous solvent.
2. Stop the solvent flow.
3. Open the solvent manager’s door.
4. Using the 5/8-inch open-end wrench to hold the 100-µL mixer/filter in place, disconnect the outlet compression fitting using the 1/4-inch open-end wrench.

**Figure 3–16: Location of outlet compression fitting**
5. Using the 5/8-inch open-end wrench to hold the mixer/filter, disconnect the inlet compression fittings by using the 1/4-inch wrench.

![Figure 3–17: Location of inlet compression fitting](image)

6. Remove the old 100-µL mixer/filter from the bracket.
7. Unpack the new 100-µL mixer/filter.
8. Insert the new 100-µL mixer/filter into the bracket.
9. Reattach the compression fittings to the 100-µL mixer/filter, and then tighten them with your fingers to the extent possible.
10. Using the 1/4-inch open-end wrench, tighten the fittings an additional 1/6-turn, for existing fittings, or 3/4-turn, for new fittings.

### 3.13 Installing or replacing the optional 250-µL mixer/filter

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.
Required tools and materials

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/8-inch open-end wrench
- 250-µL mixer/filter

To install or replace the 250-µL mixer/filter:

1. Flush the solvent manager with nonhazardous solvent.
2. Stop the solvent flow.
3. Open the solvent manager’s door.
4. Using the 5/8-inch open-end wrench to hold the mixer/filter in place, disconnect the outlet compression fitting by using the 1/4-inch open-end wrench.

   Figure 3–18: Location of outlet compression fitting

   ![Figure 3–18](image)

   1. Mixer/filter
   2. Outlet compression fitting

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

   Figure 3–19: Location of inlet compression fitting

   ![Figure 3–19](image)

   1. Inlet compression fitting
   2. Mixer/filter

6. Remove the old 100-µL or 250-µL mixer/filter from the bracket.
7. Unpack the new 250-µL mixer/filter.
8. Insert the mixer/filter into the bracket.
9. Reattach the compression fittings to the 250-µL mixer/filter, and then tighten them with your fingers to the extent possible.

10. Using the 1/4-inch open-end wrench, tighten the fittings an additional 1/6-turn, for existing fittings, or 3/4-turn, for new fittings.

### 3.14 Replacing the vent-valve cartridge

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 2-mm hex wrench
- Vent-valve cartridge

**To replace the vent-valve cartridge:**

1. In the console, select the solvent manager, and then click **Interactive Display > Control**.

2. Ensure that the vent valve is set to the vent position.

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

3. Open the solvent manager’s door.

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

5. Use the 2-mm hex wrench to remove the hex screw at the 10 o’clock position on the vent-valve cartridge.
Figure 3–20: Hex screw on a generic vent-valve cartridge

6. Remove the vent-valve cartridge from the vent-valve cartridge chamber by pulling the cartridge straight forward.

7. Unpack the replacement vent-valve cartridge.

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

   **Tip:** If the grooves do not align, turn the drive clamp until they do.

   **Note:** Avoid scratching the drive clamp or body.

Figure 3–21: Correct vent-valve cartridge and drive clamp groove alignment

9. 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 cartridge chamber. If it does not, report the problem to Waters Technical Service.

10. Insert the 2-mm hex screw at the 10 o’clock position on the vent-valve cartridge.
**Tip:** Use the 2-mm hex wrench to tighten it.

11. Use the 1/4-inch open-end wrench to reattach all fittings, and tighten them as much as 1/6-turn beyond finger-tight, for existing fittings, or 3/4-turn beyond finger-tight, for new fittings.

12. Prime the solvent manager (see Priming the solvent manager).

### 3.15 Replacing the optional solvent selection valve cartridge

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

#### Required tools and materials
- Chemical-resistant, powder-free gloves
- 2-mm hex wrench (startup kit)
- Solvent selection valve cartridge

#### To replace the optional solvent selection valve cartridge:

1. Open the solvent manager’s door.

2. Ensure that the solvent-selection valve is set to D₆.

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

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

4. Remove the finger-tight fittings attached to the solvent selection valve cartridge.
5. Use the 2-mm hex wrench to remove the hex screw at the 10 o’clock position on the cartridge.

Figure 3–23: Hex screw on solvent selection valve cartridge

6. Remove the cartridge from the vent valve assembly by pulling straight forward.

7. Unpack the replacement cartridge.

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

   Tip: If the grooves do not align, turn the drive clamp until they do.

   Note: Avoid scratching the drive clamp or body.
9. Insert the new cartridge into the cartridge chamber.

**Requirements:**

- Orient the new cartridge exactly as the old one was oriented.
- The cartridge must slide fully into the solvent selection valve assembly. If it does not do so, report the problem to Waters Technical Service.

10. Insert the 2-mm hex screw at the 10 o’clock position on the vent valve cartridge.

   **Tip:** Use the 2-mm hex wrench to tighten it.

11. Reattach all fittings, and finger-tighten them.

12. Return the solvent bottles to their original location.

13. Prime the solvent manager (see Priming the solvent manager).

   **Requirement:** Prime all six D lines.

### 3.16 Replacing the accumulator check valve

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.
**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**
- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- 1/2-inch open-end wrench
- Accumulator check-valve assembly

To replace the accumulator check valve:
1. Flush the solvent manager with nonhazardous solvent.
2. Power-off the solvent manager.
3. 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.

*Figure 3–25: Compression fitting on check valve*

1. Place the 5/16-inch open-end wrench here
2. Compression fitting

*Notice:* When you remove the valve assembly, ensure that the PEEK washer, which is normally on the top face of the check valve, does not remain in the head.

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

August 8, 2016, 715005050 Rev. C
5. Unpack the new check valve.

6. Ensure that the new PEEK washer is inserted into the new check valve so that its chamfered edge faces away from the check valve.

---

**Figure 3–26: Check-valve assembly on the accumulator pump head**

1. Place the 1/2-inch open-end wrench here

**Figure 3–27: Accumulator check valve**

1. Chamfered edge
2. PEEK washer
3. Check valve
4. Check-valve housing
5. Insert the check-valve assembly into the head, tighten the check-valve nut with your fingers to the extent possible, and then use the 1/2-inch wrench to tighten the nut an additional 1/8-turn.

8. Using the 5/16-inch open-end wrench to hold the check valve in place, reattach the compression fitting to the check valve.

9. Tighten the compression fitting with your fingers to the extent possible, and then use the 1/4-inch wrench to tighten the fitting as much as an additional 1/6-turn, for an existing fitting, or as much as 3/4-turn, for a new fitting.


11. Prime the solvent manager (see Priming the solvent manager).

3.17 Replacing the i²Valve actuator and cartridge

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination from contact with biologically hazardous or toxic materials, do not attempt to force or draw liquid or gas through the valve's inlet or outlet ports.

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

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

You can replace just the i²Valve actuator or cartridge.

**Recommendation:** Waters recommends replacing the i²Valve cartridge whenever you replace the actuator.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
Replacing the $i^2$Valve actuator and cartridge involves:

1. Removing the $i^2$Valve actuator.
2. Removing the $i^2$Valve cartridge.
3. Installing the new $i^2$Valve cartridge.
4. Installing the $i^2$Valve actuator.

### 3.17.1 Removing the $i^2$Valve actuator

- **Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

- **Warning:** To avoid personal contamination from contact with biologically hazardous or toxic materials, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

- **Notice:** To avoid damaging the $i^2$Valve actuator, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

- **Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

- **Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- T8 TORX driver
To remove the $i^2$Valve actuator:

**Notice:** To avoid damaging electrical components and circuitry, do not disconnect an electrical assembly while electrical power is applied to a module. To completely interrupt power, set the on/off switch to the "off" position, and then disconnect the power cord from the ac source. Wait 10 seconds thereafter before disconnecting an assembly.

1. Power-off the solvent manager.

**Tip:** The solvent manager is referred to as “pump” on the warning label affixed to the $i^2$Valve actuator.

2. Open the solvent manager’s door.

**Notice:** To avoid damaging the connector or cable, grasp the $i^2$Valve connector by its knurled surface.

3. Grasp the $i^2$Valve connector by the knurled surface, and pull it toward you, disconnecting it from its receptacle.

Figure 3–28: Removing $i^2$Valve connector from receptacle

4. Loosen the finger-tight outlet-tubing fitting on the inlet manifold outlet.
5. Use the 1/4-inch open-end wrench to disconnect the inlet manifold outlet-tubing fitting on the side of the $i^2$Valve and remove the tubing.

6. Use the 5/16-inch open-end wrench to loosen the shell nut, and then fully unscrew it.
Figure 3–31: Loosening the shell nut

1 Pump head
2 Shell nut
3 \(i^2\)Valve

Notice: To avoid damaging the \(i^2\)Valve actuator assembly when removing it,
- ensure that the PEEK washer, which is normally on the top face of the \(i^2\)Valve cartridge, does not remain in the pump head;
- never place the actuator assembly or electrical connector in the drip tray.

7. Remove the \(i^2\)Valve actuator from the bottom of the primary pump head.

Figure 3–32: Removing actuator from pump head

1 Bottom of pump head
2 \(i^2\)Valve actuator
3.17.2 Removing the $i^2$Valve cartridge from the actuator

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination from contact with biologically hazardous or toxic materials, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

**Notice:** To avoid damaging the $i^2$Valve actuator, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required materials**

- Chemical-resistant, powder-free gloves
- T8 TORX driver

**To remove the $i^2$Valve cartridge from the actuator:**

1. Using the T8 TORX driver, loosen the four screws that secure the clamping plates by 1/2-turn.

   **Figure 3–33: Top of actuator**

   ![Diagram of actuator with labels](image)

   - 1. Shell nut
   - 2. T8 TORX screw (4)
   - 3. Clamping plates (2)
   - 4. Clamping plate tab (2)

2. Ensure that 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 four screws.

3. 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.

3.17.3 Installing the $i^2$Valve cartridge on the actuator

Warning: Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

Warning: To avoid personal contamination from contact with biologically hazardous or toxic materials, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

Notice: To avoid damaging the $i^2$Valve actuator, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

Notice: To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Requirement: Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Required materials
- Chemical-resistant, powder-free gloves
- T8 TORX driver
- $i^2$Valve actuator (if replacing)
- $i^2$Valve cartridge (if replacing)

To install the $i^2$Valve cartridge on the actuator:

1. If you are replacing the $i^2$Valve actuator, use the T8 TORX driver to loosen, by 1/2-turn, the four screws that secure the clamping plates on the $i^2$Valve actuator.
2. Ensure that 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 four screws.

3. If you are replacing the $i^2$Valve cartridge, unpack the new cartridge.

   **Recommendation:** Replace the cartridge whenever you replace the $i^2$Valve actuator.

4. Ensure that the PEEK washer is inserted into the cartridge so that its chamfered edge faces away from the cartridge.

   **Figure 3–34: $i^2$Valve cartridge**

   ![Diagram of $i^2$Valve cartridge]

   1. Chamfered edge of PEEK washer
   2. PEEK washer
   3. $i^2$Valve cartridge
   4. Low pressure gasket

5. Insert the cartridge into the actuator, grooved end first.
Figure 3–35: Inserting the cartridge into the i²Valve actuator

1. Grooved end of cartridge
2. i²Valve actuator

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

Figure 3–36: i²Valve Clamping plates and tabs
7. While squeezing the clamping plate tabs, use the T8 TORX driver to tighten the four screws that secure the plates in the order shown below.

8. Repeat the torquing pattern shown below at least three times, gradually increasing the torque until the screws are uniformly tight.

**Figure 3–37: Screw torquing pattern**

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

**Figure 3–38: Top of actuator**

1. Clamping plate tab
2. Clamping plates
3. Clamping plate tab

1. Shell nut
2. T8 TORX screw (4)
3. Clamping plates (2)
4. Clamping plate tab (2)
3.17.4 Installing the $i^2$Valve actuator

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination from contact with biologically hazardous or toxic materials, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

**Notice:** To avoid damaging the $i^2$Valve actuator, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- $i^2$Valve actuator
- $i^2$Valve cartridge (recommended)

**To install the $i^2$Valve actuator:**

1. Orient the $i^2$Valve assembly so that the cable exits from the left-hand side.
2. Insert the $i^2$Valve assembly into the bottom of the primary pump head, and route the cable behind the valve actuator.
3. Tighten the shell nut using your fingers, rotating the nut approximately 5 full turns, to secure the $i^2$Valve.
4. Use the 5/16-inch open-end wrench to tighten the shell nut an additional 1/8-turn.
5. Reinstall the outlet-tubing fitting on the side of the $i^2Valve$ and minimally tighten it.

6. Reattach the outlet-tubing fitting to the inlet manifold, and tighten it with your fingers to the extent possible.

**Requirement:** Ensure that the outlet-tubing is fully engaged by raising the inlet manifold while attaching the outlet-tubing fitting.
Figure 3–41: Reattaching outlet-tubing fitting

1. Outlet-tubing fitting
2. Inlet manifold

7. Tighten the outlet-tubing fitting, on the side of the i²Valve with your fingers, and then use the 1/4-inch open-end wrench to tighten the fitting an additional 1/6-turn, for existing fittings, or 3/4-turn, for new fittings.

Figure 3–42: Inlet manifold outlet-tubing fitting

1. Inlet manifold outlet-tubing fitting
2. Inlet manifold
3. i²Valve

8. Align the white arrow on the i²Valve connector with the white arrow on the receptacle, in the 12 o’clock position, and insert the connector into the receptacle.
10. Prime the solvent manager (see Priming the solvent manager).

3.18 Replacing the primary pump head's plunger and seals

Refer to the console online Help to help determine whether the primary pump head's seals require replacing.

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- T27 TORX driver
- Pliers
• Seal removal tool
• Sharp tool, such as a dental pick
• Fluoropolymer O-ring
• Methanol
• Plunger (if replacing)
• Plunger seal and plunger-seal spacer
• Seal wash seal

Replacing the plunger and seals in the primary pump head involves these steps:

1. Flushing the solvent manager with nonhazardous solvent.
2. Moving the pump head plunger backward.
3. Removing the i^2Valve actuator.
4. Removing the pump head.
5. Removing the pump head plunger.
6. Removing the pump head seals.
7. Installing the new pump head seals.
8. Installing the new pump head plunger.
9. Reinstalling the pump head.
10. Reinstalling the i^2Valve actuator.
11. Performing the solvent-manager leak test (see the console online Help).

Tip: If the leak test results are unsatisfactory, pressurize the seals to properly seat them. To do so, run the solvent manager at 96,527 kPa (965 bar, 14,000 psi) for 30 minutes, or run the leak test until results are satisfactory.

### 3.18.1 Moving the plunger backward

**To move the plunger backward:**

1. Flush the solvent manager with nonhazardous solvent.
2. In the console, select the solvent manager, and then click **Maintain > Heads**.
3. In the Head Maintenance dialog box, select the plunger head that you want to move backward.
4. Click **Move Backward**, and then wait for the plunger to stop.
3.18.2 Removing the $i^2Valve$ actuator

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination from contact with biologically hazardous or toxic materials, do not attempt to force or draw liquid or gas through the valve's inlet or outlet ports.

**Notice:** To avoid damaging the $i^2Valve$ actuator, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**
- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- T8 TORX driver

**To remove the $i^2Valve$ actuator:**

**Notice:** To avoid damaging electrical components and circuitry, do not disconnect an electrical assembly while electrical power is applied to a module. To completely interrupt power, set the on/off switch to the "off" position, and then disconnect the power cord from the ac source. Wait 10 seconds thereafter before disconnecting an assembly.

1. Power-off the solvent manager.

   **Tip:** The solvent manager is referred to as "pump" on the warning label affixed to the $i^2Valve$ actuator.

2. Open the solvent manager’s door.

   **Notice:** To avoid damaging the connector or cable, grasp the $i^2Valve$ connector by its knurled surface.

3. Grasp the $i^2Valve$ connector by the knurled surface, and pull it toward you, disconnecting it from its receptacle.
4. Loosen the finger-tight outlet-tubing fitting on the inlet manifold outlet.

5. Use the 1/4-inch open-end wrench to disconnect the inlet manifold outlet-tubing fitting on the side of the $i^2$Valve and remove the tubing.
6. Use the 5/16-inch open-end wrench to loosen the shell nut, and then fully unscrew it.

**Notice:** To avoid damaging the \( \hat{p} \text{Valve} \) actuator assembly when removing it,

- ensure that the PEEK washer, which is normally on the top face of the \( \hat{p} \text{Valve} \) cartridge, does not remain in the pump head;
- never place the actuator assembly or electrical connector in the drip tray.

7. Remove the \( \hat{p} \text{Valve} \) actuator from the bottom of the primary pump head.
3.18.3 Removing the primary pump head

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**
- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- T27 TORX driver
- Pliers

**To remove the primary pump head:**
1. Remove the seal-wash tubing, secured to the seal-wash housing by barbed fittings, using a tool or by pulling on the tubing as close to the pump head as possible.
2. Using a pliers, remove the drip wire from the head assembly.

3. Using the 1/4-inch open-end wrench, disconnect the outlet tubing from the transducer.
4. Disconnect the pressure transducer cable from the bulkhead by squeezing on the tabs and pulling gently.

*Figure 3–52: Pressure transducer cable in connector*

![Diagram of pressure transducer cable in connector]

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

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

*Figure 3–53: Head bolts on primary pump head*

![Diagram of head bolts on primary pump head]

*Notice:* To avoid damaging the plunger, support the head from below as you remove it, and do not tilt the head when withdrawing it.

6. Using the T27 TORX driver, loosen and remove the two support-plate bolts, and then gently pull the pump head and support plate off the actuator housing, making sure not to tilt the head when withdrawing it.
Figure 3–54: Support-plate bolts on primary pump head

1. Support-plate bolts

Figure 3–55: Removing primary pump head and support plate from actuator housing

1. Support plate
2. Pump head
3. Plunger

7. Stand the pump head upright on a clean surface.

3.18.4 Removing the pump head plunger

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Recommendation:** Replace the plunger seals when you replace the plunger.
Requirement: Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Required tools and materials

- Chemical-resistant, powder-free gloves
- Plunger removal tool

To remove the pump head plunger:

**Warning:** To avoid finger or hand lacerations from sharp-edged surfaces, use care when removing head-assembly components. Bending or twisting the sapphire piston shaft can cause it to fracture or splinter.

1. 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.

Figure 3–56: Plunger removal tool on release collar

![Figure 3–56: Plunger removal tool on release collar]

1. Spring-loaded release collar
2. Plunger
3. Plunger removal tool

Figure 3–57: Recessed side of plunger removal tool

![Figure 3–57: Recessed side of plunger removal tool]

1. Recessed side of plunger removal tool
3.18.5 Removing the pump head seals

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- T27 TORX driver
- Seal removal tool
- Sharp tool

**To remove the pump head seals:**

1. Stand the pump head upright on a clean surface.
2. Using the T27 TORX driver, completely loosen the two head bolts to release the support plate from the pump head.
   
   **Figure 3–58: Location of head bolts**

   ![Figure 3–58: Location of head bolts](image)

   - 1 Head bolts
   - 2 Support plate
3. Lift the pump head from the support plate.
4. Remove the old seal-wash seal from the seal-wash housing, and discard the old seal.

5. Using the smooth end of the seal removal tool, remove the plunger-seal spacer from the pump head.
Figure 3–61: Location of plunger-seal spacer

1. Plunger-seal spacer
2. Insert seal removal tool here

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

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

Figure 3–62: Removing plunger seal

1. Plunger seal
2. Seal removal tool

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

7. Taking care not to scratch any metal surfaces, use a sharp tool to remove the O-ring.
3.18.6 Installing the new pump head seals

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- T27 TORX driver
- Seal removal tool
- Methanol
- Fluoropolymer O-ring
- Plunger seal and plunger-seal spacer
- Seal-wash seal

**To install new pump head seals:**

1. Lubricate the new O-ring with methanol, and press the O-ring into its seat with your thumbs.
Figure 3–64: Installing O-ring

1. O-ring

2. Lubricate the new plunger seal with methanol, and use the smooth end of the seal removal tool to place it in the pump head.

Figure 3–65: Placing plunger seal in pump head

1. Plunger seal
2. Seal removal tool
3. Seal removal tool
4. Plunger seal
3. Center the new plunger-seal spacer over the plunger seal so that the cross-side faces upward.

   **Figure 3–66: Correct installation of plunger-seal spacer**

   1. Plunger-seal spacer

4. 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.

   **Figure 3–67: Installing seal-wash housing in pump head**

   1. Seal-wash housing
   2. Holes
   3. Pump head

5. Install the new seal-wash seal in the seal-wash housing.
Figure 3–68: Installing seal-wash seal in seal-wash housing

1. Seal-wash seal
2. Seal-wash housing

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

Figure 3–69: Placing support plate on pump head
7. Holding the assembly together, use the T27 TORX driver to minimally tighten the two head bolts.

**Figure 3–70: Securing support plate to pump head**

- Round side of support plate
- Bottom side of pump head

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

### 3.18.7 Installing the new pump-head plunger

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Recommendation:** Replace the plunger seals when you replace the plunger.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- Lint-free cloth
- Plunger removal tool
- Replacement plunger
To install the new pump head plunger:

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

   Figure 3–71: Pump head seals

   1 Pump-head seals

2. Carefully insert the plunger shaft into the pump head until the shaft is no longer visible.

   Requirement: Ensure that the shaft does not make contact with the support plate.

   1 Plunger shaft
   2 Support plate
3.18.8 Reinstalling the primary pump head

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Required tools and materials

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- T27 TORX driver

To reinstall the primary pump head:

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

1. Carefully slide the head assembly and plunger into the actuator housing, making sure not to tilt the head.

*Figure 3–72: Installing primary pump head, support plate, and plunger on actuator housing*
1. Support plate
2. Pump head
3. Plunger

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

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

*Figure 3–73: Support-plate bolts on primary pump head*

![Support-plate bolts](image)

3. Alternately tighten the head bolts so that they are uniformly torqued.

*Figure 3–74: Head bolts on primary pump head*

![Head bolts](image)

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

4. Reinstall the drip wire around the pump head assembly, ensuring that the tip is in the 6 o'clock position.
5. Connect the pressure transducer cable to the bulkhead.

**Figure 3–76: Pressure transducer cable in connector**

6. Reattach the outlet-tubing fitting to the transducer, tighten it with your fingers to the extent possible, and then use the 1/4-inch open-end wrench to tighten the fitting an additional 1/6-turn, for existing fittings, or 3/4-turn, for new fittings.
7. Reinstall the seal-wash tubing on the barbed fittings on the seal wash housing.

Figure 3–78: Location of seal-wash tubing

1. Seal-wash tubing
2. Seal-wash tubing

3.18.9 Installing the \( i^2V \) alve actuator

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Warning:** To avoid personal contamination from contact with biologically hazardous or toxic materials, do not attempt to force or draw liquid or gas through the valve's inlet or outlet ports.

**Notice:** To avoid damaging the \( i^2V \) alve actuator, do not attempt to force or draw liquid or gas through the valve’s inlet or outlet ports.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.
Requirement: Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Required tools and materials
- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- \(i^2\text{Valve}\) actuator
- \(i^2\text{Valve}\) cartridge (recommended)

To install the \(i^2\text{Valve}\) actuator:

1. Orient the \(i^2\text{Valve}\) assembly so that the cable exits from the left-hand side.
2. Insert the \(i^2\text{Valve}\) assembly into the bottom of the primary pump head, and route the cable behind the valve actuator.
3. Tighten the shell nut using your fingers, rotating the nut approximately 5 full turns, to secure the \(i^2\text{Valve}\).
4. Use the 5/16-inch open-end wrench to tighten the shell nut an additional 1/8-turn.

Figure 3–79: Tightening the shell nut

5. Reinstall the outlet-tubing fitting on the side of the \(i^2\text{Valve}\) and minimally tighten it.
6. Reattach the outlet-tubing fitting to the inlet manifold, and tighten it with your fingers to the extent possible.

**Requirement:** Ensure that the outlet-tubing is fully engaged by raising the inlet manifold while attaching the outlet-tubing fitting.

7. Tighten the outlet-tubing fitting, on the side of the \( \hat{p} \text{Valve} \) with your fingers, and then use the 1/4-inch open-end wrench to tighten the fitting an additional 1/6-turn, for existing fittings, or 3/4-turn, for new fittings.
8. Align the white arrow on the $i^2$Valve connector with the white arrow on the receptacle, in the 12 o’clock position, and insert the connector into the receptacle.


10. Prime the solvent manager (see Priming the solvent manager).
3.19 Replacing the accumulator pump head’s plunger and seals

Refer to the console online Help to help determine whether the accumulator pump head’s seals require replacing.

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- T27 TORX driver
- Pliers
- Seal removal tool
- Sharp tool, such as a dental pick
- Fluoropolymer O-ring
- Methanol
- Plunger (if replacing)
- Plunger seal and plunger-seal spacer
- Seal-wash seal

Replacing the plunger and seals in the accumulator pump head involves these steps:

1. Flushing the solvent manager with nonhazardous solvent.
2. Moving the pump head plunger backward.
3. Removing the pump head.
4. Removing the pump head plunger.
5. Removing the pump head seals.
6. Installing the new pump head seals.
7. Installing the new pump head plunger.
8. Reinstalling the pump head.
9. Performing the solvent-manager leak test (see the console online Help).

   **Tip:** If the leak test results are unsatisfactory, pressurize the seals, to properly seat them.
   To do so, run the solvent manager at 96,527 kPa (965 bar, 14,000 psi) for 30 min, or run the leak test until results are satisfactory.

### 3.19.1 Moving the plunger backward

**To move the plunger backward:**
1. Flush the solvent manager with nonhazardous solvent.
2. In the console, select the solvent manager, and then click **Maintain > Heads**.
3. In the Head Maintenance dialog box, select the plunger head that you want to move backward.
4. Click **Move Backward**, and then wait for the plunger to stop.

### 3.19.2 Removing the accumulator pump head

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**
- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- T27 TORX driver
- Pliers
To remove the accumulator pump head:

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

   Figure 3–84: Location of seal-wash tubing

   ![Diagram of seal-wash tubing]

   1. Seal-wash tubing
   2. Seal-wash tubing

2. Using the pliers, remove the drip wire from the head assembly.

   Figure 3–85: Removing drip wire

   ![Diagram of drip wire and pliers]

   1. Drip wire
   2. Pliers

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

5. Disconnect the pressure transducer cable from the bulkhead by squeezing the tabs and pulling gently.
Figure 3–88: Pressure transducer cable in connector

1. Connector
2. Tabs

6. 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.

Figure 3–89: Head bolts on accumulator pump head

1. Head bolts

Notice: To avoid damaging the plunger, support the head from below as you remove it, and do not tilt the head when withdrawing it.

7. Using the T27 TORX driver, loosen and remove the 2 support-plate bolts, and then gently withdraw the pump head and support plate from the actuator housing, making sure not to tilt the head during the extraction.
8. Stand the pump head upright on a clean surface.

### 3.19.3 Removing the pump head plunger

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.
**Recommendation:** Replace the plunger seals when you replace the plunger.

** Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**
- Chemical-resistant, powder-free gloves
- Plunger removal tool

**To remove the pump head plunger:**

> **Warning:** To avoid finger or hand lacerations from sharp-edged surfaces, use care when removing head-assembly components. Bending or twisting the sapphire piston shaft can cause it to fracture or splinter.

1. 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.

**Figure 3–92: Plunger removal tool on release collar**

![Diagram of plunger removal tool and release collar](image)

1. Spring-loaded release collar
2. Plunger
3. Plunger removal tool

**Figure 3–93: Recessed side of plunger removal tool**

![Diagram of recessed side of plunger removal tool](image)
3.19.3.1 Removing the pump head seals

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- T27 TORX driver
- Seal removal tool
- Sharp tool

**To remove the pump head seals:**

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

**Figure 3–94: Location of head bolts**

- Head bolts
- Support plate
3. Lift the pump head from the support plate.
4. Remove the old seal-wash seal from the seal-wash housing, and discard the old seal.

5. Using the smooth end of the seal removal tool, remove the plunger-seal spacer from the pump head.
Notice: To avoid scratching any metal surfaces, use care when screwing the threaded end of the seal removal tool into the plunger seal.

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

Figure 3–98: Removing plunger seal

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

7. Taking care not to scratch any metal surfaces, use a sharp tool to remove the O-ring.
3.19.3.2 Installing the new pump head seals

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- T27 TORX driver
- Seal removal tool
- Methanol
- Fluoropolymer O-ring
- Plunger seal and plunger-seal spacer
- Seal-wash seal

**To install new pump head seals:**

1. Lubricate the new O-ring with methanol, and press the O-ring into its seat with your thumbs.
Figure 3–100: Installing O-ring

1. O-ring

2. Lubricate the new plunger seal with methanol, and use the smooth end of the seal removal tool to place it in the pump head.

Figure 3–101: Placing plunger seal in pump head

1. Plunger seal
2. Seal removal tool
3. Seal removal tool
4. Plunger seal
3. Center the new plunger-seal spacer over the plunger seal so that the cross-side faces upward.

   **Figure 3–102: Correct installation of plunger-seal spacer**

   1 Plunger-seal spacer

4. 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.

   **Figure 3–103: Installing seal-wash housing in pump head**

   1 Seal-wash housing
   2 Holes
   3 Pump head

5. Install the new seal-wash seal in the seal-wash housing.
6. Place the support plate on top of the pump head, ensuring that the round side of the plate is oriented toward the bottom side of the pump head.

Figure 3–105: Placing support plate on pump head
7. Holding the assembly together, use the T27 TORX driver to minimally tighten the two head bolts.

Figure 3–106: Securing support plate to pump head

1. Round side of support plate
2. Bottom side of pump head

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

3.19.3.3 Installing the new pump-head plunger

Warning: Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

Notice: To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Recommendation: Replace the plunger seals when you replace the plunger.

Requirement: Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

Required tools and materials
- Chemical-resistant, powder-free gloves
- Lint-free cloth
- Plunger removal tool
- Replacement plunger
To install the new pump head plunger:

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

   Figure 3–107: Pump head seals

   1 Pump-head seals

2. Carefully insert the plunger shaft into the pump head until the shaft is no longer visible.

   Requirement: Ensure that the shaft does not make contact with the support plate.

   1 Plunger shaft
   2 Support plate
3.19.3.4 Reinstalling the accumulator pump head

**Warning:** Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials. Consult the Material Safety Data Sheets regarding the solvents you use. Additionally, consult the safety representative for your organization regarding its protocols for handling such materials.

**Notice:** To avoid contaminating system components, wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**Required tools and materials**

- Chemical-resistant, powder-free gloves
- 1/4-inch open-end wrench
- 5/16-inch open-end wrench
- T27 TORX driver

**To reinstall the accumulator pump head:**

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

1. Carefully slide the head assembly and plunger into the actuator housing, making sure not to tilt the head.

**Figure 3–108:** Installing accumulator pump head, support plate, and plunger on actuator housing
1. Support plate
2. Pump head
3. Plunger

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

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

*Figure 3–109: Support-plate bolts on accumulator pump head*

3. Alternately tighten the head bolts so that they are uniformly torqued.

*Figure 3–110: Head bolts on accumulator pump head*

4. Reinstall the drip wire around the pump head assembly, ensuring that the tip is in the 6 o’clock position.

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

August 8, 2016, 715005050 Rev. C
Page 122
5. Connect the pressure transducer cable to the bulkhead.

**Figure 3–112: Pressure transducer cable in connector**

6. Using the 5/16-inch open-end wrench to hold the check-valve cartridge in place, reconnect the tubing connection to the check valve with the 1/4-inch open-end wrench.
7. Reattach the outlet-tubing fitting to the transducer, tighten it with your fingers to the extent possible, and then use the 1/4-inch open-end wrench to tighten the fitting an additional 1/6-turn, for existing fittings, or 3/4-turn, for new fittings.

8. Reinstall the seal-wash tubing on the barbed fittings on the seal wash housing.
3.20 Cleaning the exterior of the equipment

**Warning:** To avoid electric shock,
- ensure that the electrical power to the equipment is interrupted;
- when cleaning the surface of the equipment, apply water to a cloth, and then wipe the instrument or device. Do not spray or otherwise apply water directly onto any equipment surface.

**Warning:** To avoid personal injury, use eye and hand protection during the cleaning process.

**Requirement:** Use eye protection when performing this procedure.

**Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

**To clean the exterior of the equipment:**
Clean surfaces of the equipment using only a clean, soft, lint-free paper or clean cloth dampened with water.
Waters instruments and devices display hazard symbols that alert you to the hidden dangers associated with a product’s operation and maintenance. The symbols also appear in product manuals where they accompany statements describing the hazards and advising how to avoid them. This appendix presents the safety symbols and statements that apply to all of Waters’ product offerings.

### A.1 Warning symbols

Warning symbols alert you to the risk of death, injury, or seriously adverse physiological reactions associated with the misuse of an instrument of device. Heed all warnings when you install, repair, or operate any Waters instrument or device. Waters accepts no liability in cases of injury or property damage resulting from the failure of individuals to comply with any safety precaution when installing, repairing, or operating any of its instruments or devices.

The following symbols warn of risks that can arise when you operate or maintain a Waters instrument or device or component of an instrument or device. When one of these symbols appear in a manual’s narrative sections or procedures, an accompanying statement identifies the applicable risk and explains how to avoid it.

* **Warning:** (General risk of danger. When this symbol appears on an instrument, consult the instrument’s user documentation for important safety-related information before you use the instrument.)

* **Warning:** (Risk of burn injury from contacting hot surfaces.)

* **Warning:** (Risk of electric shock.)

* **Warning:** (Risk of fire.)

* **Warning:** (Risk of sharp-point puncture injury.)

* **Warning:** (Risk of hand crush injury.)
Warning: (Risk of injury caused by moving machinery.)

Warning: (Risk of exposure to ultraviolet radiation.)

Warning: (Risk of contacting corrosive substances.)

Warning: (Risk of exposure to a toxic substance.)

Warning: (Risk of personal exposure to laser radiation.)

Warning: (Risk of exposure to biological agents that can pose a serious health threat.)

Warning: (Risk of tipping.)

Warning: (Risk of explosion.)

A.1.1 Specific warnings

A.1.1.1 Burst warning

This warning applies to Waters instruments and devices fitted with nonmetallic tubing.

Warning: To avoid injury from bursting, nonmetallic tubing, heed these precautions when working in the vicinity of such tubing when it is pressurized:

- Wear eye protection.
- Extinguish all nearby flames.
- Do not use tubing that is, or has been, stressed or kinked.
- Do not expose nonmetallic tubing to compounds with which it is chemically incompatible: tetrahydrofuran, nitric acid, and sulfuric acid, for example.
- Be aware that some compounds, like methylene chloride and dimethyl sulfoxide, can cause nonmetallic tubing to swell, significantly reducing the pressure at which the tubing can rupture.
A.1.1.2 Biohazard warning

The following warning applies to Waters instruments and devices that can process material containing biohazards, which are substances that contain biological agents capable of producing harmful effects in humans.

**Warning:** To avoid infection with potentially infectious, human-sourced products, inactivated microorganisms, and other biological materials, assume that all biological fluids that you handle are infectious.

Specific precautions appear in the latest edition of the US National Institutes of Health (NIH) publication, *Biosafety in Microbiological and Biomedical Laboratories* (BMBL). Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials, and consult the biohazard safety representative for your organization regarding the proper use and handling of infectious substances.

A.1.1.3 Biohazard and chemical hazard warning

This warning applies to Waters instruments and devices that can process biohazards, corrosive materials, or toxic materials.

**Warning:** To avoid personal contamination with biohazards, toxic materials, or corrosive materials, you must understand the hazards associated with their handling.

Guidelines prescribing the proper use and handling of such materials appear in the latest edition of the National Research Council's publication, *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards*.

Observe Good Laboratory Practice (GLP) at all times, particularly when working with hazardous materials, and consult the safety representative for your organization regarding its protocols for handling such materials.

A.2 Notices

Notice advisories appear where an instrument or device can be subject to use or misuse that can damage it or compromise a sample’s integrity. The exclamation point symbol and its associated statement alert you to such risk.

**Notice:** To avoid damaging the instrument’s case, do not clean it with abrasives or solvents.

A.3 Bottles Prohibited symbol

The Bottles Prohibited symbol alerts you to the risk of equipment damage caused by solvent spills.
**Prohibited:** To avoid equipment damage caused by spilled solvent, do not place reservoir bottles directly atop an instrument or device or on its front ledge. Instead, place the bottles in the bottle tray, which serves as secondary containment in the event of spills.

### A.4 Required protection

The Use Eye Protection and Wear Protective Gloves symbols alert you to the requirement for personal protective equipment. Select appropriate protective equipment according to your organization’s standard operating procedures.

- **Requirement:** Use eye protection when performing this procedure.
- **Requirement:** Wear clean, chemical-resistant, powder-free gloves when performing this procedure.

### A.5 Warnings that apply to all Waters instruments and devices

When operating this device, follow standard quality-control procedures and the equipment guidelines in this section.

- **Warning:** Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

- **Avertissement:** Toute modification sur cette unité n’ayant pas été expressément approuvée par l’autorité responsable de la conformité à la réglementation peut annuler le droit de l’utilisateur à exploiter l’équipement.

- **Warnung:** Jedwede Änderungen oder Modifikationen an dem Gerät ohne die ausdrückliche Genehmigung der für die ordnungsgemäße Funktionstüchtigkeit verantwortlichen Personen kann zum Entzug der Bedienungsbefugnis des Systems führen.

- **Avvertenza:** qualsiasi modifica o alterazione apportata a questa unità e non espressamente autorizzata dai responsabili per la conformità fa decadere il diritto all'utilizzo dell'apparecchiatura da parte dell'utente.

- **Advertencia:** cualquier cambio o modificación efectuado en esta unidad que no haya sido expresamente aprobado por la parte responsable del cumplimiento puede anular la autorización del usuario para utilizar el equipo.
Warning: Use caution when working with any polymer tubing under pressure:

- Always wear eye protection when near pressurized polymer tubing.
- Extinguish all nearby flames.
- Do not use tubing that has been severely stressed or kinked.
- Do not use nonmetallic tubing with tetrahydrofuran (THF) or concentrated nitric or sulfuric acids.
- Be aware that methylene chloride and dimethyl sulfoxide cause nonmetallic tubing to swell, which greatly reduces the rupture pressure of the tubing.

Avertissement: Manipulez les tubes en polymère sous pression avec précaution:

- Portez systématiquement des lunettes de protection lorsque vous vous trouvez à proximité de tubes en polymère pressurisés.
- Éteignez toute flamme se trouvant à proximité de l’instrument.
- Évitez d’utiliser des tubes sévèrement déformés ou endommagés.
- Évitez d’utiliser des tubes non métalliques avec du tétrahydrofurane (THF) ou de l’acide sulfurique ou nitrique concentré.
- Sachez que le chlorure de méthylène et le diméthylesulfoxide entraînent le gonflement des tuyaux non métalliques, ce qui réduit considérablement leur pression de rupture.
Warnung: Bei der Arbeit mit Polymerschläuchen unter Druck ist besondere Vorsicht angebracht:

- In der Nähe von unter Druck stehenden Polymerschläuchen stets Schutzbrille tragen.
- Alle offenen Flammen in der Nähe löschen.
- Keine Schläuche verwenden, die stark geknickt oder überbeansprucht sind.
- Nichtmetallische Schläuche nicht für Tetrahydrofuran (THF) oder konzentrierte Salmeter- oder Schwefelsäure verwenden.
- Durch Methylchlorid und Dimethylsulfoxid können nichtmetallische Schläuche quellen; dadurch wird der Berstdruck des Schlauches erheblich reduziert.

Avvertenza: fare attenzione quando si utilizzano tubi in materiale polimerico sotto pressione:

- Indossare sempre occhiali da lavoro protettivi nei pressi di tubi di polimero pressurizzati.
- Spegnere tutte le fiamme vive nell'ambiente circostante.
- Non utilizzare tubi eccessivamente logorati o piegati.
- Non utilizzare tubi non metallici con tetraidrofurano (THF) o acido solforico o nitrico concentrati.
- Tenere presente che il cloruro di metilene e il dimetilsolfossido provocano rigonfiamenti nei tubi non metallici, riducendo notevolmente la pressione di rottura dei tubi stessi.

Advertencia: se recomienda precaución cuando se trabaje con tubos de polímero sometidos a presión:

- El usuario deberá protegerse siempre los ojos cuando trabaje cerca de tubos de polímero sometidos a presión.
- Si hubiera alguna llama las proximidades.
- No se debe trabajar con tubos que se hayan doblado o sometido a altas presiones.
- Es necesario utilizar tubos de metal cuando se trabaje con tetrahidrofurano (THF) o ácidos nitrico o sulfúrico concentrados.
- Hay que tener en cuenta que el cloruro de metileno y el sulfóxido de dimetilo dilatan los tubos no metálicos, lo que reduce la presión de ruptura de los tubos.
警告：當在有壓力的情況下使用聚合物管線時，小心注意以下幾點。

- 當接近有壓力的聚合物管線時一定要戴防護眼鏡。
- 熄滅附近所有的火焰。
- 不要使用已經被壓瘪或嚴重彎曲管線。
- 不要在非金屬管線中使用四氫呋喃或濃硝酸或濃硫酸。
- 要了解使用二氯甲烷及二甲基亞楓會導致非金屬管線膨脹，大大降低管線的耐壓能力。

警告：当有压力的情况下使用管线时，小心注意以下几点：

- 当接近有压力的聚合物管线时一定要戴防护眼镜。
- 熄灭附近所有的火焰。
- 不要使用已经被压瘪或严重弯曲的管线。
- 不要在非金属管线中使用四氢呋喃或浓硝酸或浓硫酸。
- 要了解使用二氯甲烷及二甲基亚砜会导致非金属管线膨胀，大大降低管线的耐压能力。

경고: 가압 폴리머 튜브로 작업할 경우에는 주의하십시오.

- 가압 폴리머 튜브 근처에서는 항상 보호 안경을 착용하십시오.
- 근처의 화기를 모두 끄십시오.
- 심하게 변형되거나 꼬인 튜브는 사용하지 마십시오.
- 비금속(Nonmetallic) 튜브를 테트라히드로푸란(Tetrahydrofuran: THF) 또는 농축 질산 또는 황산과 함께 사용하지 마십시오.
- 염화 메틸렌(Methylene chloride) 및 디메틸스ル포시드(Dimethyl sulfoxide)는 비금속 튜브를 부풀려 튜브의 파열 압력을 크게 감소시킬 수 있으므로 유의하십시오.

警告：压力のかかったポリマーチューブを扱うときは、注意してください。

- 加圧されたポリマーチューブの付近では、必ず保護メガネを着用してください。
- 近くにある火を消してください。
- 著しく变形した、または折れ曲がったチューブは使用しないでください。
- 非金属チューブには、テトラヒドロフラン(THF)や高濃度の硝酸または硫酸などを流さないでください。
- 塩化メチレンやジメチルスルホキシドは、非金属チューブの膨張を引き起こす場合があり、その場合、チューブは極めて低い圧力で破裂します。

This warning applies to Waters instruments fitted with nonmetallic tubing. This warning applies to instruments operated with flammable solvents.
**Warning:** The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

**Avertissement :** L'utilisateur doit être informé que si le matériel est utilisé d'une façon non spécifiée par le fabricant, la protection assurée par le matériel risque d’être défectueuse.

**Warnung:** Der Benutzer wird darauf aufmerksam gemacht, dass bei unsachgemäßer Verwendung des Gerätes die eingebauten Sicherheitseinrichtungen unter Umständen nicht ordnungsgemäß funktionieren.

**Avvertenza:** si rende noto all'utente che l'eventuale utilizzo dell'apparecchiatura secondo modalità non previste dal produttore può compromettere la protezione offerta dall'apparecchiatura.

**Advertencia:** el usuario deberá saber que si el equipo se utiliza de forma distinta a la especificada por el fabricante, las medidas de protección del equipo podrían ser insuficientes.

**警告：** 使用者必须非常清楚如果設備不是按照製造廠商指定的方式使用，那麼該設備所提供的保護將被削弱。

**警告：** 使用者必须非常清楚如果设备不是按照制造厂商指定的方式使用，那么该设备所提供的保护将被削弱。

**경고:** 제조업체가 명시하지 않은 방식으로 장비를 사용할 경우 장비가 제공하는 보호 수단이 제대로 작동하지 않을 수 있다는 점을 사용자에게 반드시 인식시켜야 합니다。

**警告:** 用户是，製造元により指定されていない方法で機器を使用すると，機器が提供している保証が無効になる可能性があることに注意して下さい。

### A.6 Warnings that address the replacing of fuses

The following warnings pertain to instruments and devices equipped with user-replaceable fuses. Information describing fuse types and ratings sometimes, but not always, appears on the instrument or device.

**Finding fuse types and ratings when that information appears on the instrument or device:**

**Warning:** To protect against fire, replace fuses with those of the type and rating printed on panels adjacent to instrument fuse covers.
Avertissement : pour éviter tout risque d'incendie, remplacez toujours les fusibles par d'autres du type et de la puissance indiqués sur le panneau à proximité du couvercle de la boîte à fusible de l'instrument.

Warning: Zum Schutz gegen Feuer die Sicherungen nur mit Sicherungen ersetzen, deren Typ und Nennwert auf den Tafeln neben den Sicherungsabdeckungen des Geräts gedruckt sind.

Avvertenza: per garantire protezione contro gli incendi, sostituire i fusibili con altri dello stesso tipo aventi le caratteristiche indicate sui pannelli adiacenti alla copertura fusibili dello strumento.

Advertencia: Para evitar incendios, sustituir los fusibles por aquellos del tipo y características impresos en los paneles adyacentes a las cubiertas de los fusibles del instrumento.

警告：为了避免火灾，应更换与仪器保险丝盖旁边面板上印刷的类型和规格相同的保险丝。

警告：为了避免火灾，应更换与仪器保险丝盖旁边面板上印刷的类型和规格相同的保险丝。

경고: 화재의 위험을 막으려면 기기 퓨즈 커버에 가까운 패널에 인쇄된 것과 동일한 타입 및 정격의 제품으로 퓨즈를 교체하십시오.

警告：为了避免火灾，更换与仪器保险丝盖旁边面板上印刷的类型和规格相同的保险丝。

Finding fuse types and ratings when that information does not appear on the instrument or device:

Warning: To protect against fire, replace fuses with those of the type and rating indicated in the "Replacing fuses" section of the Maintenance Procedures chapter.

Avertissement : pour éviter tout risque d'incendie, remplacez toujours les fusibles par d'autres du type et de la puissance indiqués dans la rubrique "Remplacement des fusibles" du chapitre traitant des procédures de maintenance.


Avvertenza: per garantire protezione contro gli incendi, sostituire i fusibili con altri dello stesso tipo aventi le caratteristiche indicate nel paragrafo "Sostituzione dei fusibili" del capitolo "Procedure di manutenzione".

Advertencia: Para evitar incendios, sustituir los fusibles por aquellos del tipo y características indicados en la sección "Sustituir fusibles".

警告：为了避免火灾，应更换与仪器保险丝盖旁边面板上印刷的类型和规格相同的保险丝。
A.7 Electrical symbols

The following electrical symbols and their associated statements can appear in instrument manuals and on an instrument’s front or rear panels.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>┬</td>
<td>Electrical power on</td>
</tr>
<tr>
<td>◐</td>
<td>Electrical power off</td>
</tr>
<tr>
<td>◐</td>
<td>Standby</td>
</tr>
<tr>
<td>┐</td>
<td>Direct current</td>
</tr>
<tr>
<td>┐</td>
<td>Alternating current</td>
</tr>
<tr>
<td>3</td>
<td>Alternating current (3 phase)</td>
</tr>
<tr>
<td>┐</td>
<td>Safety ground</td>
</tr>
<tr>
<td>┬</td>
<td>Frame, or chassis, terminal</td>
</tr>
<tr>
<td>┐</td>
<td>Fuse</td>
</tr>
<tr>
<td>┐</td>
<td>Functional ground</td>
</tr>
<tr>
<td>◐</td>
<td>Input</td>
</tr>
<tr>
<td>◐</td>
<td>Output</td>
</tr>
</tbody>
</table>
A.8 Handling symbols

The following handling symbols and their associated statements can appear on labels affixed to the packaging in which instruments, devices, and component parts are shipped.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Keep upright!</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Keep dry!</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Fragile!</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Use no hooks!</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Upper limit of temperature</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Lower limit of temperature</td>
</tr>
<tr>
<td><img src="image" alt="Symbol" /></td>
<td>Temperature limitation</td>
</tr>
</tbody>
</table>
The reproducibility of the specifications presented in this document depends on the conditions in individual laboratories. Contact the Waters Technical Service organization for additional information about specifications.

### B.1 QSM and bioQSM physical specifications

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (with feet)</td>
<td>23.8 cm (9.4 in) with 2.2 cm (0.875 in) feet</td>
</tr>
<tr>
<td>Width</td>
<td>34.3 cm (13.5 in)</td>
</tr>
<tr>
<td>Depth</td>
<td>66.1 cm (26.0 in)</td>
</tr>
<tr>
<td>Weight</td>
<td>27.5 kg (60.5 lb)</td>
</tr>
</tbody>
</table>

### B.2 QSM and bioQSM environmental specifications

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustic noise</td>
<td>&lt;65 dBA, system</td>
</tr>
<tr>
<td>Ambient operating temperature</td>
<td>4 to 40 °C</td>
</tr>
<tr>
<td>Ambient operating humidity</td>
<td>20 to 80%, noncondensing</td>
</tr>
<tr>
<td>Transportation and storage temperature</td>
<td>-30 to 60 °C</td>
</tr>
<tr>
<td>Transportation and storage humidity</td>
<td>20 to 80%, noncondensing</td>
</tr>
</tbody>
</table>

### B.3 QSM and bioQSM electrical specifications

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection class *</td>
<td>Class I</td>
</tr>
<tr>
<td>Attribute</td>
<td>Specification</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Overvoltage category&lt;sup&gt;b&lt;/sup&gt;</td>
<td>II</td>
</tr>
<tr>
<td>Pollution degree&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2</td>
</tr>
<tr>
<td>Moisture protection&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Normal (IPXO)</td>
</tr>
<tr>
<td>Line voltages, nominal</td>
<td>Grounded AC</td>
</tr>
<tr>
<td>Voltage range</td>
<td>100 to 240 Vac</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 to 60 Hz</td>
</tr>
<tr>
<td>Maximum power draw</td>
<td>360 VA</td>
</tr>
</tbody>
</table>

a. **Protection Class I** – The insulating scheme used in the instrument to protect from electrical shock. Class I identifies a single level of insulation between live parts (wires) and exposed conductive parts (metal panels), in which the exposed conductive parts are connected to a grounding system. In turn, this grounding system is connected to the third pin (ground pin) on the electrical power cord plug.

b. **Overvoltage Category II** – Pertains to instruments that receive their electrical power from a local level such as an electrical wall outlet.

c. **Pollution Degree 2** – A measure of pollution on electrical circuits that can produce a reduction of dielectric strength or surface resistivity. Degree 2 refers only to normally nonconductive pollution. Occasionally, however, expect a temporary conductivity caused by condensation.

d. **Moisture Protection** – Normal (IPXO) – IPXO means that no Ingress Protection against any type of dripping or sprayed water exists. The “X” is a placeholder that identifies protection against dust, if applicable.

## B.4 QSM and bioQSM input/output specifications

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradient start</td>
<td>Maximum input voltage: 30 Vdc  &lt;br&gt;Logic high: 3.0 Vdc  &lt;br&gt;Logic low: 1.9 Vdc  &lt;br&gt;Minimum pulse width: 100 ms</td>
</tr>
<tr>
<td>Stop flow</td>
<td>Maximum input voltage: 30 Vdc  &lt;br&gt;Logic high: 3.0 Vdc  &lt;br&gt;Logic low: 1.9 Vdc  &lt;br&gt;Minimum pulse width: 100 ms</td>
</tr>
</tbody>
</table>
### B.5 QSM and bioQSM performance specifications

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of solvents</td>
<td>One to four (A, B, C, and D), in any combination. Optional 6-position solvent selection valve enables solvent selections D1 through D6 on line D, in addition to A, B, and C (a total of nine solvents to select from).</td>
</tr>
<tr>
<td>Solvent degassing</td>
<td>Integrated vacuum degassing, four chambers. One additional chamber for the sample manager purge solvent.</td>
</tr>
<tr>
<td>Gradient formation</td>
<td>Low-pressure mixing, quaternary gradient</td>
</tr>
<tr>
<td>Gradient profiles</td>
<td>11 gradient curves, including linear, step (2), concave (4), and convex (4)</td>
</tr>
<tr>
<td>Primary check valve</td>
<td>Intelligent Intake Valve ($i^2$Valve), standard Passive check valve, optional</td>
</tr>
<tr>
<td>Flow accuracy</td>
<td>±1.0% of set flow at 0.500 to 2.000mL/min using 100% solvent A (with $i^2$Valve). Back pressure 4137 to 6895 kPa (41 to 69 bar, 600 to 1000 psi), with degassed water.</td>
</tr>
<tr>
<td>Flow precision</td>
<td>0.075% RSD or ±0.020 min SD, whichever is greater, based on six replicates ($i^2$Valve). Test conditions:</td>
</tr>
<tr>
<td></td>
<td>• Mobile phase: 60:40 water/methanol mixed via Auto•Blend Plus technology</td>
</tr>
<tr>
<td></td>
<td>• Flow rate: 0.5 mL/min</td>
</tr>
<tr>
<td></td>
<td>• Sample mix: alkylphenone mix (5.0 µL injection volume)</td>
</tr>
<tr>
<td></td>
<td>• Column: ACQUITY UPLC BEH C$_{18}$, 1.7 µm, 2.1 × 50 mm</td>
</tr>
<tr>
<td></td>
<td>• Column temperature: 35 °C ±0.3 °C</td>
</tr>
<tr>
<td></td>
<td>• Detector: UV, 254 nm wavelength</td>
</tr>
<tr>
<td>Composition ripple</td>
<td>&lt;1.0 mAU (&lt;0.1 mAU with optional 250-µL mixer), with $i^2$Valve Test conditions:</td>
</tr>
<tr>
<td>(baseline noise)</td>
<td>• Mobile phase: A: water + 0.1%, trifluoroacetic acid; B: acetonitrile + 0.1% trifluoroacetic acid</td>
</tr>
<tr>
<td></td>
<td>• Flow rate: 0.5 mL/min</td>
</tr>
<tr>
<td></td>
<td>• Gradient conditions: 1.0 to 33% B in 10 min; time average window, 10 s. Noise range 4.00 to 6.00 min</td>
</tr>
<tr>
<td></td>
<td>• Column: ACQUITY UPLC BEH C$_{18}$, 1.7 µm, 2.1 × 50 mm</td>
</tr>
<tr>
<td></td>
<td>• Detector: ACQUITY TUV, 214 nm wavelength, 10 Hz sampling rate</td>
</tr>
<tr>
<td>Attribute</td>
<td>Specification</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Composition accuracy       | ±0.5% absolute (full scale) from 5 to 90% from 0.5 to 2.0 mL/min, with \( i^2 \) Valve  
  Test conditions:  
  • Mobile phase: degassed 90:10 acetonitrile/water; 90:10 acetonitrile/water with caffeine at 12 mg/L concentration  
  • Back pressure: 13,790 kPa (138 bar, 2000 psi)  
  • Gradient conditions: Step gradient method  
  • Detector: UV, 273 nm wavelength |
| Composition precision      | <0.15% RSD or ±0.04 min SD, whichever is greater, based on six replicate injections, with \( i^2 \) Valve  
  Test conditions:  
  • Mobile phase: 60:40 water/methanol mixed via Auto•Blend Plus technology  
  • Flow rate: 0.5 mL/min  
  • Sample mix: alkylphenone mix (5.0 µL injection volume)  
  • Column: ACQUITY UPLC BEH C\textsubscript{18}, 1.7 µm, 2.1 × 50 mm  
  • Column temperature: 35 °C ±0.3 °C  
  • Detector: UV, 254 nm wavelength |
| Compressibility compensation | Automatic and continuous                                                                                                                     |
| Priming                    | Wet priming can run at flow rates up to 4 mL/min                                                                                           |
| Pump seal wash             | Equipped with a wash system, to flush the rear of the high pressure seal and the plunger.  
  QSM: The default interval between seal wash pump activations is 5.0 min.  
  bioQSM: The default interval between seal wash pump activations is 0.1 min (6 s). |
| Flow ramping               | Range: 0.01 to 30.00 min to reach 2.0 mL/min  
  Default: 0.45 min, to reach 2.0 mL/min at 4.44 mL/min                                                                                  |
| Vent valve                 | Used for priming the pump and automated leak testing. When the column manager switches columns, the vent valve switches to the vent position, to reduce system pressure. |
| Solvent lines              | Set of factory-installed inlet tubing assemblies. Each assembly includes a 10-µm reservoir filter.                                          |
| Composition range          | 0.0 to 100.0% settable in 0.1% increments.                                                                                                   |
### B.6 QSM and bioQSM wetted materials of construction

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>QSM</td>
<td>316L stainless steel, DLC, fluoroelastomer, fluoropolymer, Nitronic 60, PEEK, PEEK blend, PPS, ruby, sapphire, titanium alloy, UHMWPE blend, zirconia</td>
</tr>
<tr>
<td>bioQSM</td>
<td>DLC, fluoroelastomer, fluoropolymer, Nitronic 60, PEEK, PEEK blend, PPS, ruby, sapphire, titanium, UHMWPE blend, zirconia</td>
</tr>
</tbody>
</table>