

ACQUITY Arc

System Guide

General information

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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.

Power cord replacement hazard



Warning: To avoid electric shock, use SVT-type power cords in the United States and HAR-type (or better) cords in Europe. The power cords must be replaced only with ones of adequate rating. For information regarding which cord to use in other countries, contact your local Waters distributor.

Hand crush hazard



Warning: To avoid hazards associated with the reciprocating or rotating parts in the source, keep hands clear of the regions marked with yellow and gray labels.

High-voltage hazard



Warning: To avoid electric shock, observe these precautions:

- Do not remove the mass spectrometer's protective panels. The components they cover are not user-serviceable.
- When the instrument is in Operate mode, avoid touching the areas marked with the high voltage warning symbol. To touch external areas marked with the symbol, first put the instrument in Standby mode.

Bottle placement prohibition



Warning: To avoid injury from electrical shock or fire, and damage to the equipment, follow these guidelines:

- Do not expose the workstation or ancillary equipment to dripping or splashing liquids.
- Do not place objects filled with liquid, such as solvent bottles, on top of the workstation or ancillary equipment.

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 the system

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

Applicable symbols

The following symbols can be present on the device, system, or packaging.

Symbol	Definition
	Manufacturer
	Date of manufacture
	Authorized representative of the European Community

Symbol	Definition
	Confirms that a manufactured product complies with all applicable European Community directives
	Australia EMC compliant
	Confirms that a manufactured product complies with all applicable United States and Canadian safety requirements
	Consult instructions for use
	Alternating current
	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.
	Serial number
	Part number, catalog number

Audience and purpose

This guide is intended for personnel who operate and maintain the ACQUITY Arc system.

Intended use of the ACQUITY Arc system

Waters designed the ACQUITY Arc system to perform liquid chromatography separations in these environments:

- Pharmaceutical development and discovery
- Quality assurance and quality control
- Chemical materials
- Environmental
- Food safety

The system 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.

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 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



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1 ACQUITY Arc system

The ACQUITY Arc system, which provides true plug-and-play method compatibility for HPLC and UHPLC separations, can replicate established assays developed on older HPLC platforms. Using Arc Multi-flow-path technology, the system accepts methods from any HPLC platform, emulating the dwell volume and mixing behavior of the original. The system can also improve productivity by pairing with UHPLC column technology without requiring manual adjustment. Lastly, the ACQUITY Arc system accepts UPLC methods that have undergone adjustment for larger particle sizes.

1.1 Features of the ACQUITY Arc system

The ACQUITY Arc system performs validated assays using quaternary-based LC technology that adjusts for the differences between HPLC and UPLC separations.

These are among the system's features and capabilities:

- Pump and sample manager design enhancements that minimize dispersion and reduce cycle time
- Plug-and-play method compatibility with HPLC or UHPLC
- Direct programming of gradients, in units of pH and ionic strength, using Auto•Blend Plus technology to vary composition, eliminating the need to manually prepare mobile phases
- Automatic management of gradient start time and pre-injection steps, in parallel, minimizing cycle time and maximizing sample throughput
- Automatic counteraction of differences in system dwell volume without the need to alter gradient-table inputs
- Continuous needle cleansing during the run, minimizing carryover
- Column heater and column heater/cooler options that ensure method repeatability from lab to lab
- Optional column-selection valve that provides fast column changes
- Optical detection options that maximize HPLC and UHPLC performance
- Extend the dynamic range of sample analysis with mass spectrometer options

1.1.1 Flow-through-needle injector

The sample manager's flow-through-needle mechanism aspirates a sample and holds it in the sample needle, prepared to inject the sample onto the column. The needle serves as part of the injection flow path when the sample is pushed onto the column.

The flow-through-needle mechanism facilitates the transfer of LC methods, improves injection accuracy and decreases cycle time for small-volume injections, and does not require learning new injection modes. Mobile-phase gradients pass through the needle during injection, ensuring complete sample recovery.

1.1.2 Wash solvent

The sample manager needle wash system is used to minimize sample carryover. It uses a single wash solvent and this solvent does not enter the flow path of the system.



Notice:

- Do not leave buffers stored in the system.
- Flush all flow paths, including the needle wash, with plenty of non-buffered solvent before shutting down the system.
- For extended shutdown periods (longer than 24 hours), use 10% to 20% methanol in water.
- When using a buffered wash solvent, prime it for a minimum of 30 sec.
- Use of buffers can cause salt build-up on the needle and wash port, which can require periodic cleaning.

Restriction: Avoid buffered wash solvents.

1.1.3 Purge solvent

The primary function of the purge solvent is to move sample along the injection pathway. The purge solvent also primes the sample syringe and injection pathway. The solvent's injection onto the column occurs only during auto-dilution, when it is used as the dilution solvent.

Notes:

- Purge solvent must be miscible with the needle wash solvent.
- Waters recommends a purge solvent of 90/10 Water/Methanol whenever possible.

1.1.4 Software features

1.1.4.1 Quantum Synchronization

Introducing a low-pressure sample into the high-pressure fluid stream during injection causes a pressure pulse that can affect chromatographic results. The Quantum Synchronization feature reduces the effect of this pressure pulse. The sample manager and solvent manager communicate to automatically coordinate the injection sequence, enabling the solvent manager to provide additional pressure at the exact moment the sample manager switches its injector valve to the inject position, to introduce the low-pressure sample.

1.1.4.2 Gradient Smart Start

Before each sample injection, a sample manager typically performs wash sequences and then aspirates 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.

1.1.4.3 Wash Plungers

Precipitated material that remains on the solvent manager's pump plungers can damage the high-pressure seals. The Wash Plungers function washes the seals and plungers with seal wash solvent, to remove any precipitate. You can use the Wash Plungers function as needed, or run the function as part of the No-Flow Shutdown feature.

Tip: The Wash Plungers function is not available when the module is operating.

1.1.4.4 No-Flow Shutdown

The No-Flow Shutdown feature runs the Wash Plungers function after the solvent manager remains idle for a specified time interval. This feature prevents deposition of precipitated material on the pump plungers and plunger seals while the system is idle.

1.1.4.5 Automatic Prime

When you enable the solvent manager's Automatic Prime function, the system primes the lines of the optional solvent selection valve when a new line is selected. You can specify the flow rate and duration of the prime for the new solvent line.

Example: If a first injection uses line D1 and a second injection uses line D2, the solvent manager primes line D2 between the first and second injections.

1.1.4.6 Flow Ramping

Using the Flow Ramping function, you specify the rate at which the solvent manager increases or decreases flow.

Tip: The default value is set to support rigid, HPLC and UPLC column particles. For pressure sensitive columns (such as gel columns), the flow ramping should be adjusted.

1.1.4.7 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.

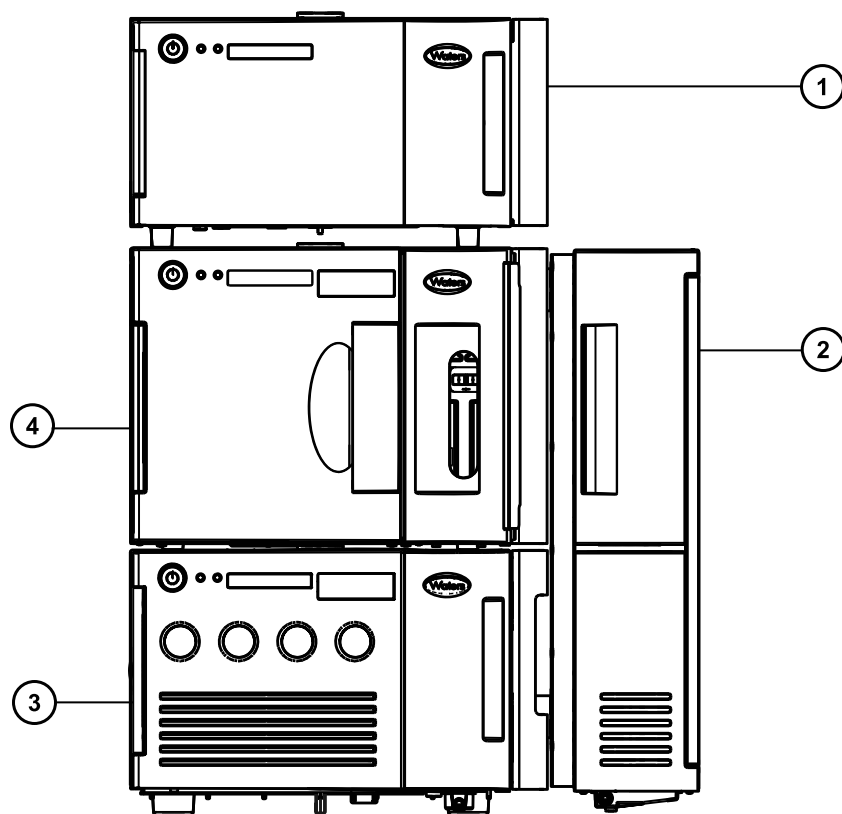
See also:

- *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.

1.1.5 System components

The following illustration depicts an ACQUITY Arc system stack that includes the three core modules and a detector.

Figure 1–1: Instrument modules



- ① Detector
- ② Column module
- ③ Quaternary Solvent Manager-R (QSM-R)
- ④ Sample Manager FTN-R (SM FTN-R)

The ACQUITY Arc system includes these core modules:

- Quaternary solvent manager
- Sample manager-flow through needle
- Column module (30-cm Column Heater, 30-cm Column Heater/Cooler, or 30-cm Column Heater-Active)

In addition to the three core modules, the system comprises one or more detectors (ultra violet/visible, photodiode array, evaporative light scattering, fluorescence, refractive index, or mass spectrometer), and optionally, a sample organizer or Waters Fraction Manager-Analytical.

1.1.5.1 Quaternary solvent manager-R

The quaternary solvent manager-R (QSM-R) is a low-pressure mixing, high-pressure pump. It provides steady (pulse-free) solvent flow at analytical flow rates to 5 mL/min at 65,500 kPa (655 bar, 9500 psi). The quaternary solvent manager can pump four degassed solvents simultaneously using a gradient proportioning valve (GPV) to dynamically create a specified composition.

1.1.5.2 Sample manager flow through needle-R

The sample manager flow through needle-R (SM FTN-R) uses a direct-injection mechanism to inject samples drawn from plates and vials onto a chromatographic column. Optional extension loops, installed between the sample needle and the injection valve, can increase the injection volume beyond that of the sample needle. The sample manager flow through needle can also dilute samples using the auto-dilution option.

Note: The 50 µL extension loop is included in the standard configuration.

1.1.5.3 30-cm column heater and 30-cm column heater/cooler

The 30-cm Column Heater (30-cm CH) and 30-cm Column Heater/Cooler (30-cm CHC) are the standard column heating and column heating/cooling modules that manage and maintain column temperature for ACQUITY Arc systems. Except for the 30-cm CHC module's cooling capability and the additional components required to support this capability, the modules are identical.

The 30-cm CH module can control compartment temperatures from 5 °C above the ambient temperature to 65 °C. Compartment temperature set points range from 20 to 65 °C. The 30-cm CHC module can control compartment temperatures as high as 65 °C. It is capable of heating from 5 °C above the ambient temperature to 65 °C, whichever temperature is higher, and of cooling to 15 °C below the ambient temperature or 4 °C, whichever temperature is higher.

The base configuration of both modules includes a passive preheater that helps achieve the column's set-point temperature within the column compartment. Both modules support the column-selection valve option that provides automated column switching to method conditions. The 30-cm CH and 30-cm CHC column compartment accommodates LC columns with dimensions up to 7.8-mm internal diameter (ID), and 30-cm long.

Restriction: If your system configuration includes multiple column compartments, you can operate the system using only one column compartment at a time.

Restriction: You cannot use the 30-cm CH or 30-cm CHC module in conjunction with the optional 30-cm column heater with active preheater module (CH-30A).

Restriction: You cannot use the 30-cm CH or 30-cm CHC module's passive preheater in concert with the optional column-selection valve.

1.1.5.4 30-cm column heater-active (optional)

A standard, active preheater (APH) assembly heats the incoming solvent before it enters the column, optimizing thermal performance and minimizing dispersion. The CH-30A module can

control compartment temperatures from 5 °C above the ambient temperature to 90 °C. The set points for column temperatures range from 20 to 90 °C. The column compartment accommodates LC columns of dimensions as large as 4.6-mm ID and 30-cm long.

Restriction: If your system configuration includes multiple column compartments, you can operate the system using only one column compartment at a time.

1.1.5.5 Waters Fraction Manager - Analytical (optional)

The Waters Fraction Manager (WFM-A) is an analytical fraction collector for LC systems. It minimizes fraction loss and carryover to better manage low volume peaks, and allows for efficient collection of small amounts of material for further assays. Providing high purity and recovery, the WFM-A is designed to confidently minimize sample loss and reduce carryover of complex mixtures and sample.

1.1.5.6 Sample organizer (optional)

The sample organizer stores multiple microtiter or vial plates and transfers them to and from the sample manager, automating processing and increasing throughput. The sample organizer's storage shelf compartment can hold a selection of ANSI/SBS plates, which you load into the organizer through a large, swing-open front door. Heaters and coolers thermally condition the shelf compartment and, together with the sample manager's heater/cooler, maintain the temperature at a set point that you determine. The sample organizer is controlled via the sample manager's console.

Note: The sample organizer is compatible only with sample managers fitted with a rotary tray (the sample manager-flow through needle, for example).

Requirement: The sample organizer must be installed and configured by a Waters service engineer.

1.1.5.7 Detection

The optical detectors compatible with your system detect and quantify concentrations of sample analyte. The system accommodates these detectors:

- 2998 PDA
- 2489 UV/Vis
- 2414 RI
- 2475 FLR
- 2424 ELS

See also: For information about the supported optical detectors, refer to the detector's overview and maintenance guide that is included on the system documentation media.

Note: Although the same model number is utilized, each of these HPLC optical detectors have specific part numbers to order with the ACQUITY Arc system. Specific chassis alterations and

leak management features were made specifically to utilize these detectors on the ACQUITY Arc system. When ordering, ensure that the detector is specific to, and compatible with, your LC system.

Requirement: To avoid exceeding the pressure limitations of the system, the 2414 RI and 2475 FLR detectors must be positioned last in the fluidic path.

1.1.5.7.1 ACQUITY QDa

The ACQUITY QDa mass detector characterizes LC-separated analytes, determining their mass by means of a photomultiplier detection system and chromatography data software. The instrument acquires data in one of these operating modes:

- Scanning, where the instrument scans mass-to-charge (m/z) ratios to produce a mass spectrum.
- Selected ion recording (SIR), where the instrument records the signal intensity at a static m/z ratio.

1.1.5.8 Column technology

The ACQUITY Arc system can accommodate any HPLC or UHPLC column in which the particle size is 2.5 μm or greater. It is particularly well-suited to column sizes of 3.0 mm ID or greater.

1.1.5.8.1 eCord technology

eCord technology provides the history of a column's performance throughout its lifetime. The eCord fob interacts with the system software, recording information for as many as 50 sample queues run on the column. In regulated environments, the eCord fob provides documentation of the column used in the validation method.

In addition to the variable column usage data, the eCord fob also stores fixed column manufacturing data, including the following:

- Unique column identification
- Certificate of analysis
- QC test data

When you attach the eCord fob to the receptacle on the column compartment, the chip automatically records and stores system information. No further action is required.

Restriction: The 30-cm CH and 30-cm CHC modules do not contain eCord fob functionality. Although eCord fobs can be used with these modules, manufacturing and usage data go unrecorded.

Restriction: The CORTECS 4.6-mm column does not include eCord functionality.

1.1.5.9 For additional information

On the system documentation media, you can find additional information about the supported system modules.

2 Performance optimization

Follow the advice and guidelines in this chapter to help ensure optimum performance from your system.

2.1 General guidelines

The ACQUITY Arc system provides the ability to replicate established HPLC methods by emulating a system's dwell volume and mixing behavior. In the instrument method editor, you can select between Path 1 (HPLC emulation path) and Path 2 (UHPLC path).

You can maximize separation performance by using columns of 3.0-mm ID or larger that are packed with particles sized 2.5 μm or larger.

Follow these general recommendations when performing a UHPLC analysis:

- Use high-quality solvents, buffers, and additives (HPLC or MS-grade).
- Use high-quality water (HPLC or MS-grade).
- Always use solvent filters on tubing in solvent bottles.
- Filter buffers with a 0.45- μm filter membrane.
- Keep concentrated stock solutions to use when preparing working solutions, and refrigerate it when not using it, to maximize shelf life.
- Do not add fresh buffer to old (a practice known as "topping off"); doing so can promote microbial growth.
- Do not block the degasser's vent line. Trim the tubing, if necessary.
- Do not submerge the waste or degasser-vent lines in liquid (refer to the solvent manager's overview and maintenance guide for details about how to route the system tubing).
- Keep all solvent lines primed.
- Flush buffers from the system when they are not in use, taking care to avoid using solvents that can precipitate or otherwise react.
- Do not store the system in 100% acetonitrile. Doing so can cause certain components to fail.
- Use 10%-20% organic solvent in water as a storage solvent if you expect the system to remain idle longer than 24 hours.
- Keep the seal-wash line primed.

- Monitor the level in the waste vessel to ensure that it can accommodate all of the expected waste.
- Do not use the Load Ahead or Loop Offline options when troubleshooting carryover problems.

2.2 Carryover

You observe carryover in chromatographic systems when a previously injected analyte appears as a peak in the chromatogram of subsequent samples. Carryover tends to occur when a small amount of analyte remains in the system after a sample is injected. You can measure carryover by observing analyte peaks that appear when you run a blank sample immediately after an analytical sample.

Waters specifies carryover on the ACQUITY Arc system at less than 0.002%.

A common cause of carryover is inadequate washing of the system. Choosing an appropriate wash solvent can minimize carryover for a particular analysis. The wash solvent must be strong enough to dissolve any remaining sample, and the wash duration must be long enough to remove the residue from the system.

Method conditions also affect carryover. Too short a hold-time at the final conditions of a gradient, especially if the gradient is steep, can fail to remove all analytes from the system. It is important to completely flush the system and re-equilibrate the column before proceeding to a subsequent analysis. Use caution when choosing the load-ahead and loop-offline options. Initiating these options before the highly organic part of the gradient reaches the needle can leave sample residue in the system, and whatever time savings you gain can be lost in terms of inadequate system cleaning.

The hydrophobicity and solubility of samples as well as cleanliness during sample preparation are additional factors to consider when trying to minimize carryover, as is contamination from sample preparation tools.

2.3 Reproducibility

The precision (area reproducibility) when using the SM FTN-R is less than 0.25% RSD for injection volumes from 5 to 1000 μL .

2.4 Cycle time (between injections)

The sample manager's Load Ahead option can help decrease cycle time. It causes the sample manager to aspirate the next sample while a current sample is running.

You can reduce cycle time by setting an appropriate draw rate for the syringe that allows maximum throughput and performance.

The Loop Offline option reduces the effect of delay volume on cycle time by taking the needle and extension loop offline before the gradient reaches the injection valve and after the sample transfers to the column.

Requirement: Take the loop offline before the first gradient change reaches the injection valve or after the gradient returns to the initial conditions. To do so, use solvent at the initial gradient composition. The volume of solvent must be at least five times that of the combined needle and extension loop. Also, if you intend to take the needle and optional extension loop offline after the end of the gradient, before doing so, ensure that they are completely filled with solvent of the initial gradient composition.

2.5 Preventing leaks

Preventing leaks during an analysis ensures adequate flow pressure in the system and the integrity of the sample.

Leaks can occur at any tubing connection, gasket, or seal but are most common at tubing connections. Low pressure leaks (on the intake side of the solvent manager's pump) cause solvent loss and air introduction during the intake cycle. Leaks at high pressure fittings (downstream of the check valves) can leak solvent but do not introduce air.

To prevent leaks, follow Waters' recommendations for the proper tightening of system fittings. Note that different techniques apply to re-tightening fittings versus installing them for the first time.

2.5.1 Installation recommendations for fittings

Two types of fittings are used within the system: PEEK (polymer-based) fittings and SST (stainless steel) fittings. When connecting tubing, heed the following recommendations for installing and tightening 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 biologically hazardous materials, 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 long compression screws to attach tubes to the injector and 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 for cracks, stripped threads, and deformations.
- Do not reuse stainless steel fittings more than six times.

2.5.1.1 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

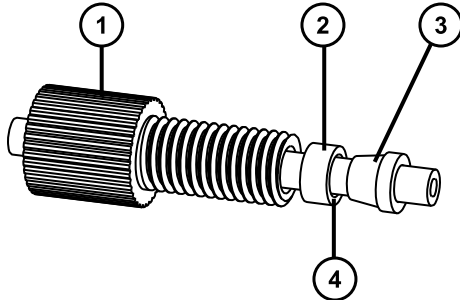
- 1/4-inch open-end wrench – For tightening or loosening stainless steel (gold-plated) fittings with 2-piece ferrule.
- Permanent marker
- Chemical-resistant, powder-free gloves

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.

2.5.1.2 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

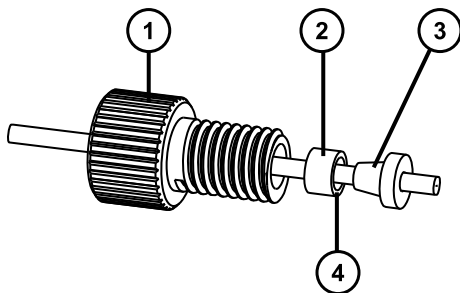


- ① Compression screw
- ② Lock ring
- ③ Ferrule
- ④ End of lock ring with larger inside diameter (ID)

Tighten the fitting finger-tight.

2.5.1.3 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

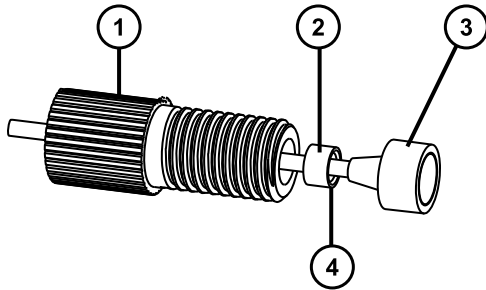


- ① Compression screw
- ② Lock ring
- ③ Ferrule
- ④ End of lock ring with larger inside diameter (ID)

Tighten the fitting finger-tight.

2.5.1.4 5/16-24 fitting with filter and stainless steel lock ring

First use or re-installed

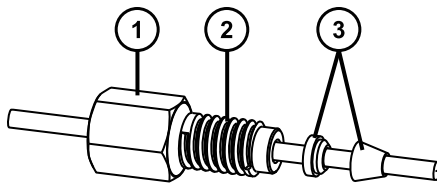


- ① Compression screw
- ② Lock ring
- ③ Ferrule and filter
- ④ End of lock ring with larger inside diameter (ID)

Tighten the fitting finger-tight.

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

First use

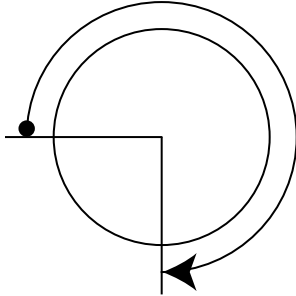


- ① Long flats
- ② Compression screw
- ③ 2-piece stainless steel ferrule

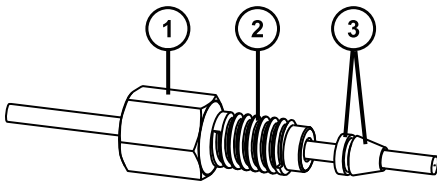
Tighten the fitting finger-tight plus an additional 3/4-turn using a 1/4-inch open-end wrench. For detailed instructions about assembling new fittings, see [Assembling new fittings](#).

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

First use tightening



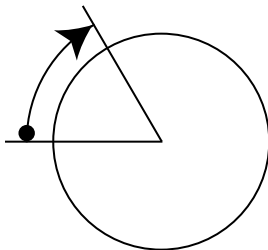
Reinstalled



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

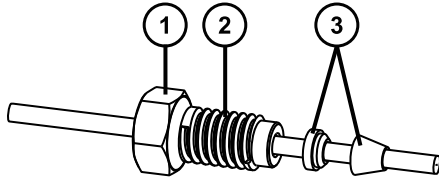
Tighten the fitting finger-tight plus as much as an additional 1/6-turn using a 1/4-inch open-end wrench.

Reinstalled tightening



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

First use

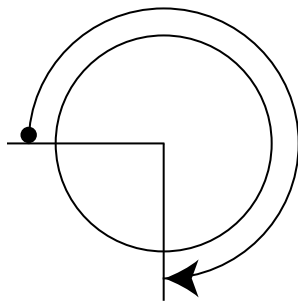


- ① Short flats
- ② Compression screw
- ③ 2-piece stainless steel ferrule

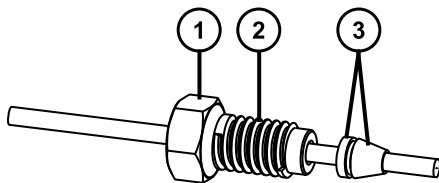
Tighten the fitting finger-tight plus an additional 3/4-turn using a 1/4-inch open-end wrench. For detailed instructions about assembling new fittings, see [Assembling new fittings](#).

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

First use tightening



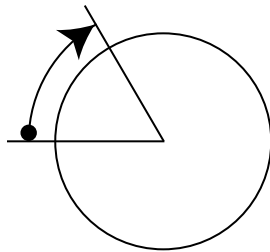
Re-installed



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

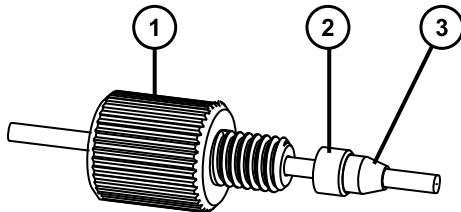
Tighten the fitting finger-tight plus as much as an additional 1/6-turn using a 1/4-inch open-end wrench.

Re-installed tightening



2.5.1.7 PEEK fitting with PEEK ferrule and stainless steel lock ring

First use or re-installed

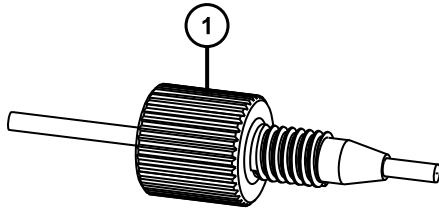


- ① Compression screw
- ② Lock ring
- ③ Ferrule

Tighten the fitting finger-tight.

2.5.1.8 One-piece PEEK fitting

Figure 2–1: First use or reinstalled



① Compression screw

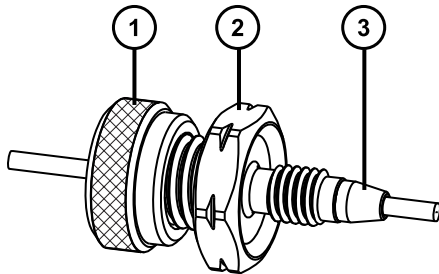
Tighten the fitting finger-tight.

2.5.1.9 Dual-threaded fitting with locking cap nut

Required tools and materials

- 1/2-inch open-end wrench

Figure 2–2: First use or reinstalled



① Locking cap nut

② Gold-plated, locking compression screw

③ Back-locking or standard PEEK ferrule

To tighten the fitting:

1. Loosen the cap nut from the compression screw.
2. Slide the compression screw together with the ferrule into the inlet of the column (or in-line filter).
3. Finger-tighten the compression screw into the inlet of the column (or in-line filter).

Important: To prevent band spreading, ensure that the tubing bottoms in its fitting before you tighten the compression screw.

4. Engage the column (or in-line filter), and tighten the column (or in-line filter) onto the compression screw.
5. Tighten the cap nut onto the compression screw.

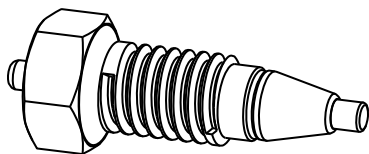
Tip: If you are operating the system at, or close to, its maximum system operating pressure limit, finger-tighten the cap nut onto the compression screw, and then use the 1/2-inch open-end wrench to tighten the compression screw an additional 1/8- to 1/6-turn.

Tip: When reinstalling the fitting,

- examine the captive ferrule for damage and replace it if necessary;
- always loosen the locking cap nut before reconnecting the fitting.

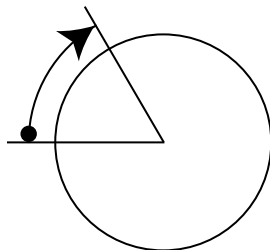
2.5.1.10 High-pressure pin plug

First use or reinstalled



Tighten the pin plug finger-tight, plus up to 1/6-turn using a wrench.

First use or reinstalled tightening



2.6 Developing methods

See also: For information about method development and validation, consult the *Auto•Blend Plus Technology for Ion Exchange, Size Exclusion, and Reversed-phase Chromatography* documentation.

2.7 Measuring dwell volume

When transferring a gradient LC method, you must calculate the dwell volume of the two systems. The dwell volume is the system volume between the point where the gradient is formed and the column inlet. The dwell volume varies from system to system but is typically between 0.1 and 2.0 mL.

You can measure dwell volume using the midpoint of a 0–100% gradient. To do so, run a gradient between two identical solvents, A and B, spiking the B solvent with a marker. Perform the measurement after configuring the system without the column for the method being transferred, replacing the column with a low-volume restrictor, to ensure proper pump function.

See also: “*Measuring system volume for methods transfer*” in the console online Help.

2.8 Transferring methods

Transferring an LC method from one system to another can sometimes be necessary. For such transfers, the object is to maintain or enhance a separation’s performance by reducing run time, improving resolution, or both. Arc Multi-flow path technology offers plug-and-play method compatibility with HPLC and UHPLC methods. In addition, still or circulated-air column modules are available, to emulate the heating behavior of an original system.

2.9 Matching sample diluents

When you use the sample manager’s auto-dilution option, the purge solvent serves as the sample diluent. Ensure that your sample solution is soluble and miscible in your chosen purge solvent.

3 System preparation

Before proceeding, ensure that all of the procedures that explain how to prepare the system modules for operation were performed as specified in the modules' overview and maintenance guides.

3.1 Powering-on the system

To power-on the system, you must power-on the system workstation, system modules, and the chromatography software. When powered-on, each module beeps three times and performs a series of startup tests. After all modules complete their startup tests, you open the system software and prime the system.

Tip: When you power-on a new system for the first time, if it has leak sensors, they default to disabled status. Subsequently, they retain their last specified setting. To enable or disable leak sensors, see the console online Help.

To power on the system:

1. Power-on the system's workstation.

Result: The following start-up tests run: CPU board, memory (RAM and ROM), external communication system (Ethernet), and clock. If the start-up tests indicate a malfunction, consult the console online Help.

Important: If the system includes a sample organizer, power-on the device by toggling the power switch on the top, left-hand side of the door, before powering-on the sample manager.

Important: If the system includes a 30-cm column heater/cooler power-on the device by toggling the power switch on the rear, right-hand side of the unit, before powering-on the sample manager.

2. Power-on the sample manager and then the solvent manager, by pressing the power switch on the top, left-hand side of each device's door.

Note: The system's communications occur at an internal Ethernet switch in the sample manager. This module must be powered-on for any other system modules to communicate with the data system.

3. After power LEDs on the solvent manager and sample manager glow steady green, power-on each detector by pressing the power switch on the detector's top, left-hand side.

Tip: Power-on detectors only when the flow cell is wetted, to prevent initialization errors.

See also: [Monitoring module LEDs](#)

4. Launch the chromatography data system software, and open the system.

Requirement: If this is the first time you are using this system, you must define a new system. For instructions, see the online Help.

5. Open the control panels and console.

See also: [Monitoring from control panels](#) and [Opening the console](#)

Important: If the system includes a sample organizer, initiate communication with the sample manager from the sample manager's console.

6. Prime the system.

See also: [Priming the system](#)

3.2 Monitoring module LEDs

The LEDs on each module indicate its operational status. Note that the significance of an LED's color differs from one module to another.

Note: The 30-cm column heater and column heater/cooler and the 30-cm column heater-active modules are not equipped with LEDs.

3.2.1 Power LED

The power LED indicates the power-on or power-off status. Two LEDs appear on each device or instrument, typically located on the left-hand side of the front panel or door. The one on the left is the power LED, which glows green when power is applied to the device and unlit when power is not applied.

Note: To provide adequate ventilation, the sample manager's fans run continuously, even when the power switch is in the "off" position. These fans switch off only when you disconnect the power cable from the ac wall outlet or rear panel.

3.3 Monitoring from control panels

You can monitor the sample manager, solvent manager, column module, detector, and fraction manager from control panels, which you access via the chromatography data system.

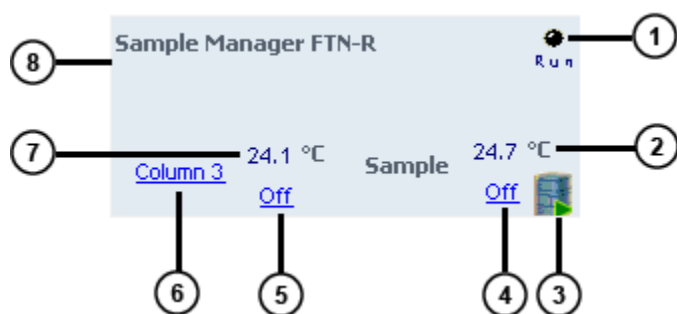
- When Empower software controls the system, the control panels appear at the bottom of the Run Samples window.
- When MassLynx software controls the system, the control panels appear on the **Additional Status** tab of the Inlet Editor window.
- When UNIFI software controls the system, the control panels appear in the right-hand utility pane of the main window whenever a system is selected for the System Console or data analysis activities.

You can update a parameter set point directly from a control panel, providing sample analysis is not running. When the parameter value is underscored and appears in blue, sample analysis is not running, and you can click the parameter value and specify a new value in the dialog box that appears.

3.3.1 SM FTN-R control panel

The control panel of the SM FTN-R displays the current temperatures of the sample compartment heater/cooler and column heater/cooler or heater, their set points, and the selected column.

Figure 3–1: SM FTN-R control panel



- ① Run LED – Mirrors the run status LED on the sample manager's front panel, unless communications are interrupted.
- ② Current sample heater/cooler temperature – Displays the current temperature of the sample heater, if installed.
- ③ Launch console icon – When clicked, launches the console software.
- ④ Sample heater/cooler temperature set point – Displays the temperature set point for the sample heater/cooler.
- ⑤ Column compartment temperature set point – Displays the temperature set point for the column compartment, if installed.
- ⑥ Selected column – Displays the currently selected column position.

⑦ Column compartment temperature – Displays the current temperature in the column compartment.

⑧ Status – Displays the status of the current operation.

You can access these additional functions by right-clicking anywhere in the SM FTN-R control panel.

Table 3–1: Additional functions in the SM FTN-R control panel

Control panel function	Description
Prime	Displays the Prime dialog box.
Wash needle	Displays the Wash Needle dialog box.
Launch console	Launches the console software.
Reset module	Resets the SM FTN-R following an error condition.
Help	Launches the console online Help.

3.3.2 QSM-R control panel

The control panel of the Quaternary Solvent Manager-R (QSM-R) displays system pressure, total flow rate, and solvent composition.

Figure 3–2: QSM-R control panel



① Flow LED – Mirrors the flow status LED on the solvent manager's front panel, unless communications are interrupted.

② Stop flow – When clicked, immediately stops all flow from the solvent manager.

- ③ Δ pressure value – The difference between the maximum system back pressure and minimum system back pressure over the last minute.
- ④ Solvent composition – Displays the percentage of solvent to be drawn from solvent lines A through D. Composition values range from 0.0 to 100.0%.
- ⑤ Valve position – Displays the solvent-manager path currently in use.
- ⑥ Flow rate – Displays the flow rate of solvent through all lines of the solvent manager.
- ⑦ System pressure – Displays system pressure in kPa, bar, or psi. You can specify pressure units in the console software.
- ⑧ Status – Displays the status of the current operation.

You can access these additional functions by right-clicking anywhere in the QSM-R control panel.

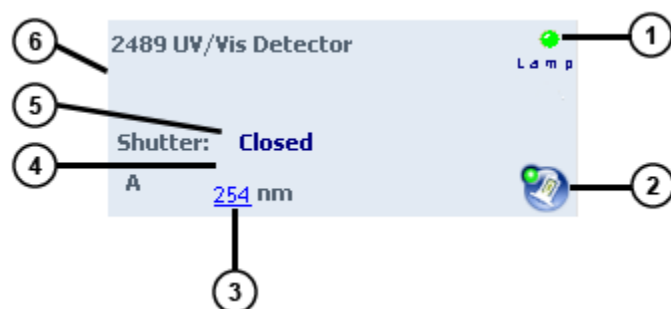
Table 3–2: Additional functions in the QSM-R control panel

Control panel function	Description
Start-up system	Brings the system to operational conditions after an extended idle period or when switching to different solvents. See: Console online Help.
Prime solvents	Displays the Prime Solvents dialog box.
Prime seal wash	Starts or stops priming the seal wash.
Wash plungers	Initiates the plunger wash sequence.
Launch console	Launches the console software.
Reset module	Resets the QSM-R following an error condition.
Help	Displays the console online Help.

3.3.3 2489 UV-Vis control panel

The 2489 UV/Visible detector's control panel displays absorbance units and wavelength values. When the detector is running in dual mode, the values for both wavelength A and B appear.

Figure 3–3: 2489 UV/Vis Detector (single mode) control panel



- ① Lamp LED – Mirrors the lamp status LED on the front panel of the detector, unless communications with the detector are interrupted.
- ② Lamp ignition – When clicked, ignites or extinguishes the lamp. If the icon is green, the lamp is ignited. If the icon is red, the lamp is extinguished.
- ③ Value of wavelength A – Displays the value of wavelength A, in nm. If the detector is in dual wavelength mode, the value of wavelength B also appears.
- ④ AU – Displays the absorbance units of wavelength A. If the detector is in dual wavelength mode, the absorbance units of wavelength B also appears.
- ⑤ Shutter position – Displays the current position of the detector shutter.
- ⑥ Status – Displays the status of the current operation.

You can access these additional functions by right-clicking anywhere in the detector control panel.

Table 3–3: Additional functions in the 2489 UV-Vis detector control panel

Control panel function	Description
Autozero	Resets the absorbance value to 0.
Launch Console	Launches the console software.
Reset module	Resets the detector after an error condition.
Help	Displays console online Help.

3.3.4 2998 PDA control panel

The 2998 Photodiode Array detector's control panel displays the detector status.

Figure 3–4: 2998 PDA detector control panel



- ① Lamp LED – Mirrors the lamp status LED on the front panel of the detector, unless communications with the detector are interrupted.
- ② Lamp icon – When clicked, ignites or extinguishes the lamp. If the icon is green, the lamp is ignited. If the icon is red, the lamp is extinguished.
- ③ Shutter position – Displays the current position of the detector shutter: open, closed, erbium, or UV-blocking.
- ④ Status – Displays the status of the current operation.

You can access these additional functions by right-clicking anywhere in the detector control panel.

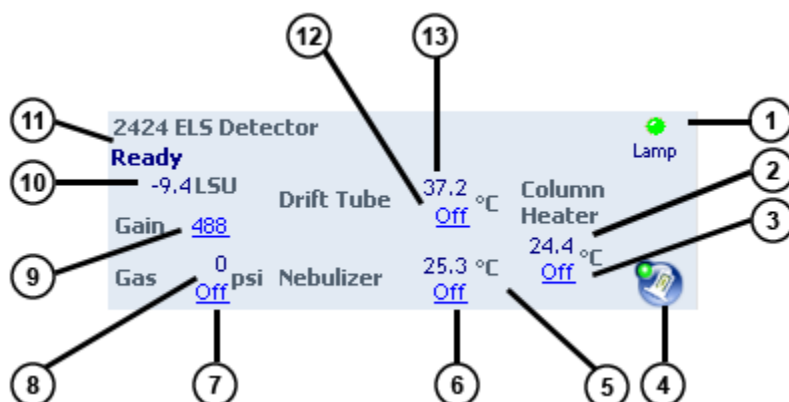
Table 3–4: Additional functions in the 2998 PDA detector control panel

Control panel function	Description
Autozero	Resets the detector offsets.
Launch Console	Launches the console software.
Reset module	Resets the detector after an error condition.
Help	Displays console online Help.

3.3.5 2424 ELS control panel

The 2424 Evaporative Light Scattering detector's control panel displays light scattering units, photomultiplier tube gain factor, gas pressure, nebulizer temperature, and drift tube temperature.

Figure 3–5: 2424 ELS detector control panel



- ① Lamp LED – Mirrors the lamp status LED on the front panel of the detector, unless communications with the detector are lost.
- ② Current column heater temperature – Displays the current column heater temperature.
- ③ Column heater set point – Displays the column heater set point.
- ④ Lamp icon – When clicked, ignites or extinguishes the lamp. If the icon is green, the lamp is ignited. If the icon is red, the lamp is extinguished.
- ⑤ Current nebulizer temperature – Displays the current nebulizer temperature.
- ⑥ Nebulizer temperature set point – Displays the set point for the nebulizer temperature.
- ⑦ Nebulizer gas pressure set point – Displays the set point for the nebulizer gas pressure, in kPa, bars, or psi. You specify pressure units in the console software.
- ⑧ Current nebulizer gas pressure – Displays the current nebulizer gas pressure.
- ⑨ Photomultiplier tube gain factor – Displays the current photomultiplier-tube gain factor.
- ⑩ Current sample energy – Displays the sample signal, in light scattering units.
- ⑪ Status – Displays the status of the current operation.
- ⑫ Drift tube temperature set point – Displays the set point for the drift tube temperature.
- ⑬ Current drift tube temperature – Displays the current drift tube temperature.

You can access these additional functions by right-clicking anywhere in the detector control panel:

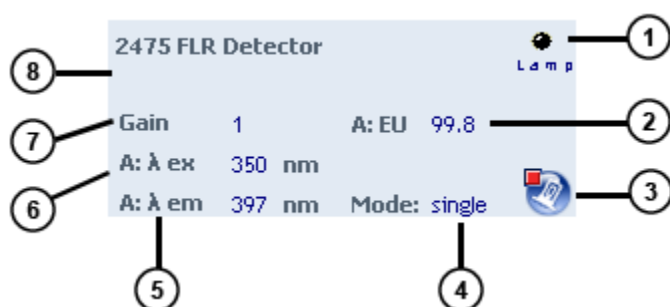
Table 3–5: Additional functions in the 2424 ELS detector control panel

Control panel function	Description
Autozero	Resets the detector offsets.
Launch Console	Launches the console software.
Reset module	Resets the detector after an error condition.
Help	Displays the console online Help.

3.3.6 2475 FLR control panel

The 2475 Multi λ Fluorescence detector's control panel displays emission or energy units, the excitation and emission wavelengths, and the photomultiplier tube gain factor.

Figure 3–6: 2475 FLR detector control panel



- ① Lamp LED – Mirrors the lamp status LED on the front panel of the detector, unless communications with the detector are lost.
- ② Emission units or energy units – Displays the emission units or energy units.
- ③ Lamp icon – When clicked, ignites or extinguishes the lamp. If the icon is green, the lamp is ignited. If the icon is red, the lamp is extinguished.
- ④ Operating mode – Displays the current operating mode of the detector: single channel, multichannel, spectrum scanning, or 3D.
- ⑤ Em λ – Displays the emission wavelength.
- ⑥ Ex λ – Displays the excitation wavelength.
- ⑦ Photomultiplier tube gain factor – Displays the current photomultiplier-tube gain factor.
- ⑧ Status – Displays the status of the current operation.

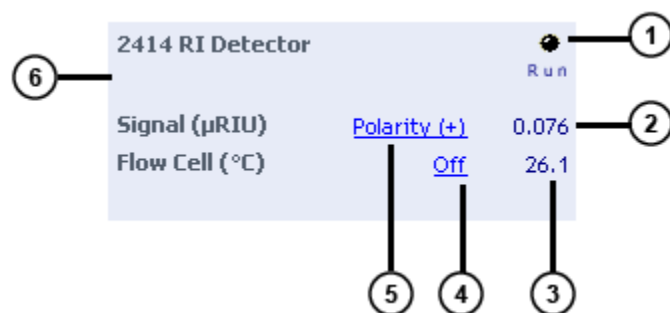
You can access these additional functions by right-clicking anywhere in the detector control panel:

Table 3–6: Additional functions in the 2475 FLR detector control panel

Control panel function	Description
Autozero	Resets the detector offsets.
Launch Console	Launches the console software.
Reset module	Resets the detector after an error condition.
Help	Displays the console online Help.

3.3.7 2414 RI control panel

The 2414 Refractive Index detector's control panel displays signal measurement, peak polarity, and the temperatures of the flow cell and external column manager.



- ① Run status LED – Mirrors the run status LED on the front panel of the detector, unless communications with the detector are interrupted.
- ② Signal measurement – Displays the signal, in µRIU.
- ③ Current flow cell temperature – Displays the current flow cell temperature.
- ④ Flow cell temperature set point – Displays the set point for the flow cell temperature.
- ⑤ Peak polarity – Displays the polarity of the output signal. If the polarity is negative, the chromatogram is inverted.
- ⑥ Status – Displays the status of the current operation.

You can access these additional functions by right-clicking anywhere in the detector control panel.

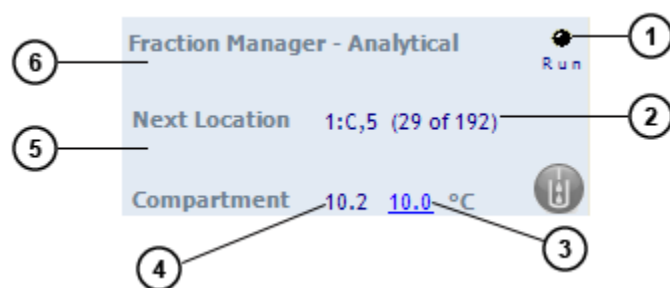
Table 3–7: Additional functions in the 2414 RI detector control panel

Control panel function	Description
Autozero	Resets the detector's offsets.
Launch Console	Launches the console software.
Reset module	Resets the detector after an error condition.
Help	Displays the console online Help.

3.3.8 Waters Fraction Manager - Analytical (WFMA) control panel

If Empower software controls the system, the fraction manager's control panel appears at the bottom of the Run Samples window. If MassLynx software controls the system, the fraction manager's control panel appears at the bottom of the Inlet Editor window.

Figure 3–7: Fraction manager control panel



- ① Run LED
- ② Location/next location
- ③ Set fraction compartment temperature
- ④ Current fraction compartment temperature
- ⑤ Collections
- ⑥ Status

The fraction manager control panel displays the fraction manager status, number of collections performed, set and current fraction compartment temperatures, and dispensing needle location. You cannot edit fraction manager parameters while the system is running.

The following tables list the items in the fraction manager control panel.

Table 3–8: Modifiable fraction manager control panel items

Control panel item	Description
Set fraction compartment temperature	Displays the set fraction compartment temperature.

Table 3–9: Nonmodifiable fraction manager control panel items

Control panel item	Description
Status	Displays the status of the current operation (appears only if the fraction manager is running) Status can be: • Running: No Collections • Running: Collections Complete • Collecting (number of minutes fraction manager has been collecting) • Waiting to Collect (number of minutes until the next collection)
Run LED	Displays status of the run state (Initializing, Idle/Ready, Running) on the front panel of the fraction manager
Location/next location	Displays the current or next dispensing location
Collections	Real-time counter of the number of collections performed during an injection (appears only if the fraction manager is running)
Current fraction compartment temperature	Displays the current fraction compartment temperature

You can access additional functions by right-clicking anywhere in the fraction manager control panel.

Table 3–10: Additional functions in the fraction manager control panel

Control panel function	Description
Prime syringe	Primes the syringe for the number of cycles specified
Rinse needle	Rinses the needle for the number of cycles specified
Manual collection	Opens the Manual Collection window
Reset bed	Invokes a function to reset both plates, plate 1, or plate 2
Launch console	Launches the console
Reset FMA	Resets the fraction manager after an error condition
Help	Displays the online Help for the console software

3.4 Opening the console

You can perform the following tasks in the console:

- Monitor system performance
- Specify settings for certain module parameters
- Run diagnostic tests
- View an interactive diagram of the module components

See also: The console online Help for additional information on how to perform these tasks.

3.4.1 To open the console from Empower software

1. From the Empower navigation bar, select **Run Samples** and then **Control Panel**.

Result: A control panel for each device in the system appears.

2. In the sample manager control panel, click **Display console** .

Alternative: Right-click the control panel for any module, and select **Launch Console** from the menu that appears.

3.4.2 To open the console from MassLynx software

1. From the MassLynx window, click **Inlet Method**.
2. Click the **Additional Status** tab.

Result: A control panel for each device in the system appears.

3. In the sample manager control panel, click **Display console** .

Alternative: Right-click the control panel for any module, and select **Launch Console** from the menu that appears.

3.5 Priming the system

Requirement: You must prime the system after starting up the system, as well as after changing the mobile phase, after changing the sample needle, and after the system has been idle for four hours or more.

Recommendation: If you are introducing new solvents, prime them at 10 mL/min for 7 minutes. Alternatively, prime the solvents at 10 mL/min for 3 minutes. Ensure that sufficient quantities of solvent are available for priming.

Tip: In the console, you can select the Startup System feature to prime all solvents and to specify the solvent composition, flow rate, column and sample temperatures, and needle characterization. For details, see the console online Help.

4 System maintenance

Perform the maintenance activities described in this chapter to ensure an optimally operating system.

4.1 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*.

4.1.1 Locating system serial numbers

The serial number on the system's modules 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 module. Be prepared to provide the serial numbers of the modules that comprise the system when you report a problem to Waters Technical Support.

To locate system serial numbers:

1. In the console, select a module from the system tree.
2. Click **Configure > View module information**.

Result: The Module Information dialog box displays this information:

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

Alternatives:

- In the main window, move the pointer over the icon of the system module for which you want to view the information.
- Obtain the serial number from the printed labels affixed to the rear panels of the system modules or inside their front doors.

4.2 Maintenance procedures and frequency

Consult the individual module's overview and maintenance guide on the documentation CD for routine maintenance procedures and frequency.

4.3 Spare parts

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

4.4 Troubleshooting with Connections INSIGHT

Connections INSIGHT is an intelligent device management (IDM) Web service that enables Waters to provide proactive service and support for a system. To use Connections INSIGHT, you must install its service agent software on the same PC as the chromatography data software. In a client/server system, you must also install the service agent on the computer that controls the system. The service agent software automatically and securely captures and sends information about the support needs of a system directly to Waters.

If you encounter a performance problem when using the console software, manually submit a Connections INSIGHT request to Waters Technical Service. Alternatively, use **Remote Desktop**, a real-time collaboration option that controls the two-way connection with the system by enabling the Connections INSIGHT iAssist service level.

These sources, available on the Waters' website, provide more information about Connections INSIGHT and Connections INSIGHT iAssist:

- *Connections INSIGHT Quick Start Guide* (715003037)
- *Connections INSIGHT User's Guide* (715003036)

4.4.1 Submitting a Connections INSIGHT request

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

Result: A ZIP file containing your Connections INSIGHT profile is forwarded to Waters Technical Service for review.

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

4.5 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.

5 External connections

See also: For information explaining how to connect chromatographic tubing, see [Installation recommendations for fittings](#).

Note: A Waters Technical Service representative unpacks and installs the system components.



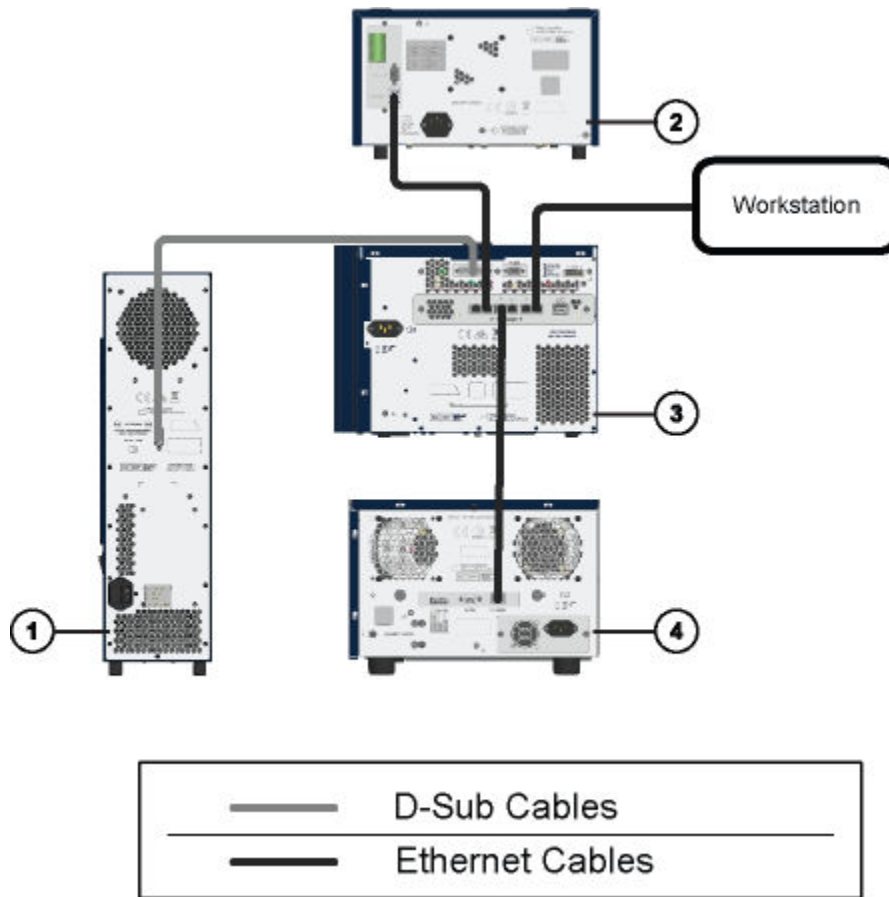
Warning: To avoid spinal and muscular injury, do not attempt to lift a system module without assistance.

If you must transport a system component, or remove it from service, request recommended cleaning, flushing, and packaging procedures from Waters Technical Service.

5.1 External wiring and plumbing connections

5.1.1 External wiring connections

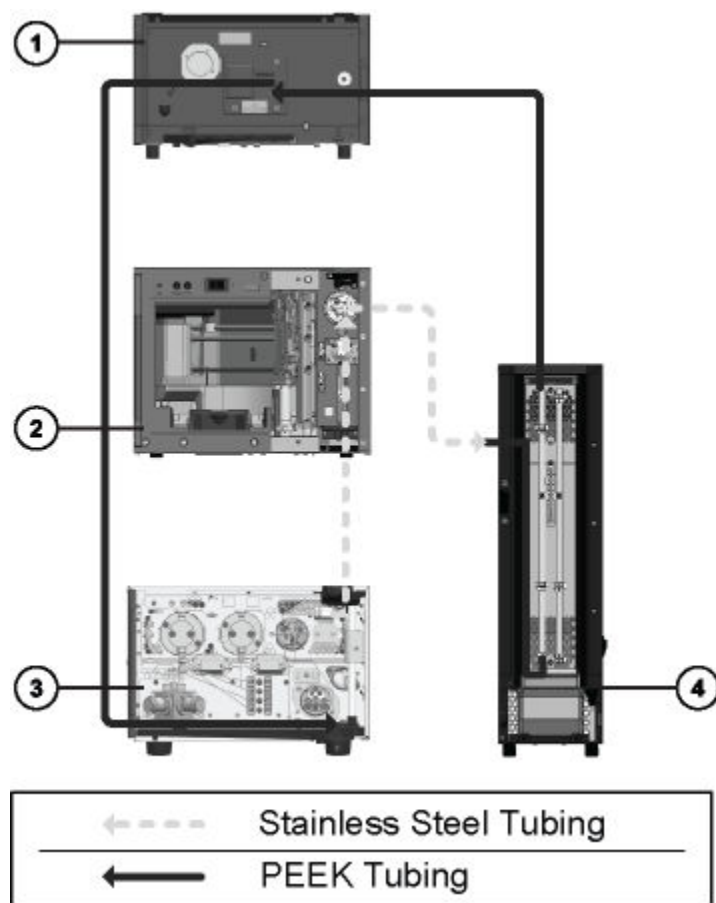
Figure 5–1: System rear-panel wiring connections



- ① Column module (30-cm CHC shown)
- ② Detector
- ③ SM FTN-R
- ④ QSM-R

5.1.2 Plumbing connections

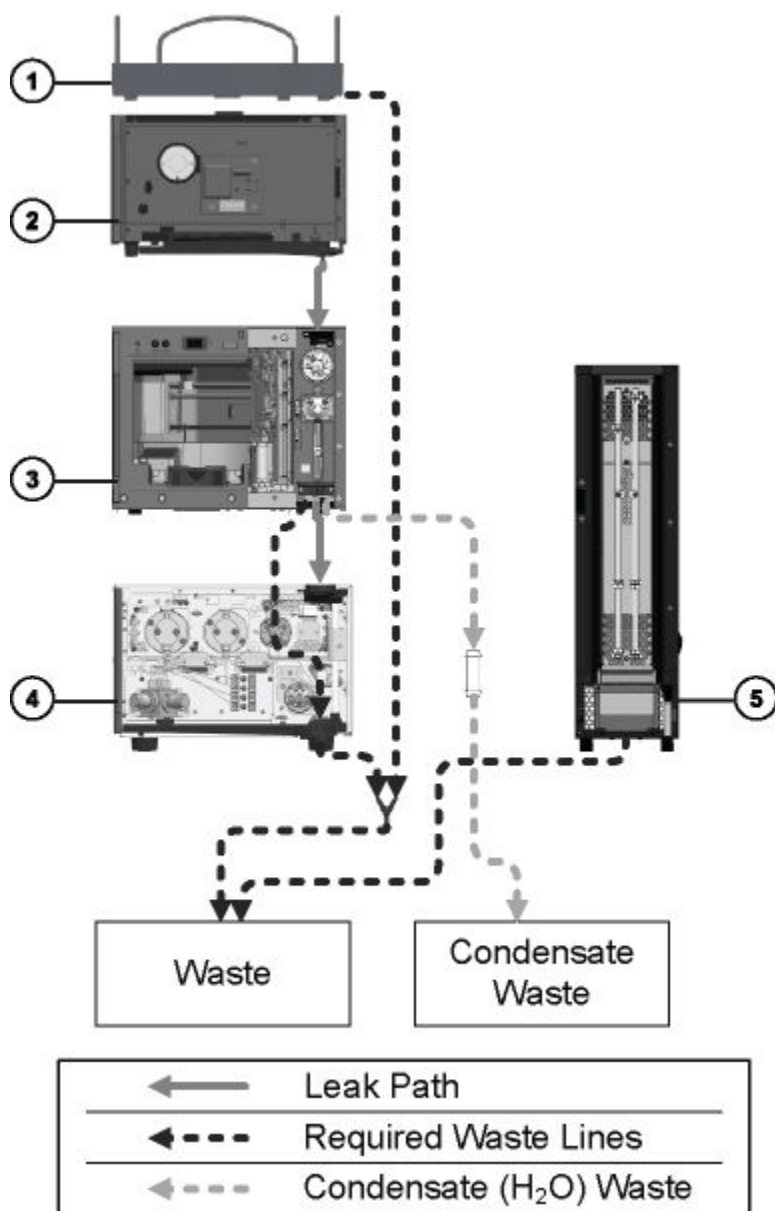
Figure 5–2: System plumbing connections



- ① Detector
- ② SM FTN-R
- ③ QSM-R
- ④ Column module (30-cm CHC shown)

5.1.3 Waste-tubing connections

Figure 5–3: System waste-tubing connections



- ① Solvent tray
- ② Detector
- ③ SM FTN-R
- ④ QSM-R
- ⑤ Column module (30-cm CHC shown)

5.1.4 Connecting to a wall electricity source



Warning: To avoid electric shock, observe these precautions:

- Use SVT-type power cords in the United States and HAR-type power cords, or better, in Europe. For requirements elsewhere, contact your local Waters distributor.
- Inspect the power cords for damage, and replace them 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. Contact Waters to ensure the correct selection and size.

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 grounded wall outlet.

5.1.5 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.

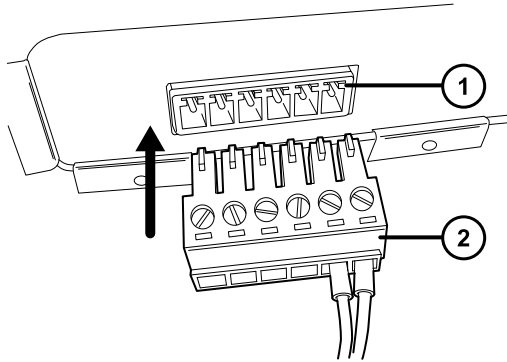
Required tools and materials

- 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.

Figure 5-4: Inserting connector into connector port

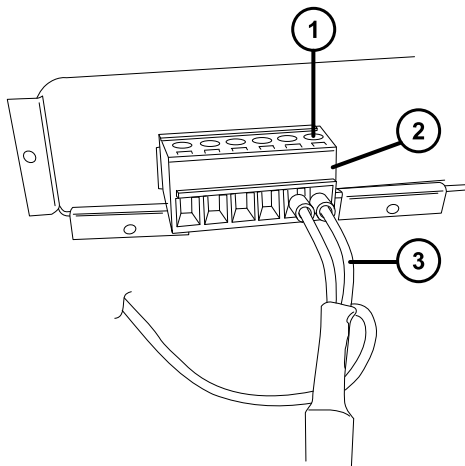


① Connector port

② Connector

2. Using the flat-blade screwdriver, attach the positive and negative leads of the signal cable to the connector.

Figure 5-5: Positive and negative lead connections



① Screw

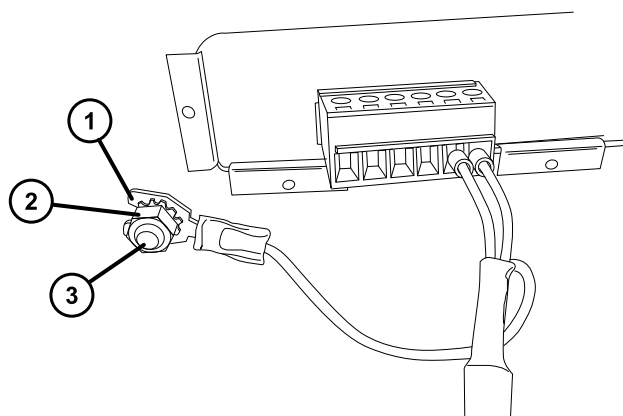
② Connector

③ Signal cable

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.

Figure 5–6: Grounding cable fork terminal on grounding stud



- ① Fork terminal
- ② Locking nut
- ③ Grounding stud

5.2 Ethernet connections

The sample manager incorporates an internal Ethernet switch that accommodates the PC (workstation) and as many as six system modules. Connect the shielded Ethernet cables from each module to the electronic connections on the rear panel of the sample manager. The sample manager is connected internally to the Ethernet switch.

Alternative: Some column modules connect to the sample manager using an interconnect (D-sub) cable assembly.

A Safety advisories

Waters products display safety symbols that identify hazards associated with the product's operation and maintenance. The symbols also appear in product manuals with statements that describe the hazards and advise how to avoid them. This appendix presents all safety symbols and statements that apply to Waters' product offerings. The symbols and statements can apply to a specific product, or apply to other products within the same system.

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 or 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 appears 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.)



Warning: (Risk of high-pressure gas release.)

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.



A.2 Notices

Notice advisories appear where an instrument, device, or component 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 case of the instrument or device, 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.



警告： 未經有關法規認證部門允許對本設備進行的改變或修改,可能會使使用者喪失操作該設備的權利。



警告： 未经有关法规认证部门明确允许对本设备进行的改变或改装,可能会使使用者丧失操作该设备的合法性。



경고: 규정 준수를 책임지는 당사자의 명백한 승인 없이 이 장치를 개조 또는 변경할 경우, 이 장치를 운용할 수 있는 사용자 권한의 효력을 상실할 수 있습니다.



警告: 規制機関から明確な承認を受けずに本装置の変更や改造を行うと、本装置のユーザーとしての承認が無効になる可能性があります。



Warning: Use caution when working with any polymer tubing under pressure:

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



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.
- Eteignez toute flamme se trouvant à proximité de l'instrument.
- Evitez d'utiliser des tubes sévèrement déformés ou endommagés.
- Evitez d'utiliser des tubes non métalliques avec du tétrahydrofurane (THF) ou de l'acide sulfurique ou nitrique concentré.
- Sachez que le chlorure de méthylène et le diméthylesulfoxyde entraînent le gonflement des tuyaux non métalliques, ce qui réduit considérablement leur pression de rupture.



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 Salpeter- oder Schwefelsäure verwenden.
- Durch Methylenchlorid 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.
- Spegnerle tutte le fiamme vive nell'ambiente circostante.
- Non utilizzare tubi eccessivamente logorati o piegati.
- Non utilizzare tubi non metallici con tetraidrofurano (THF) o acido solforico o nitrico concentrati.
- Tenere presente che il cloruro di metilene e il dimetilsolfossido provocano rigonfiamenti nei tubi non metallici, riducendo notevolmente la pressione di rottura dei tubi stessi.



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

- El usuario deberá protegerse siempre los ojos cuando trabaje cerca de tubos de polímero sometidos a presión.
- Si hubiera alguna llama las proximidades.
- No se debe trabajar con tubos que se hayan doblado o sometido a altas presiones.
- Es necesario utilizar tubos de metal cuando se trabaje con tetrahidrofurano (THF) o ácidos nítrico o sulfúrico concentrados.
- Hay que tener en cuenta que el cloruro de metileno y el sulfóxido de dimetilo dilatan los tubos no metálicos, lo que reduce la presión de ruptura de los tubos.



警告：當在有壓力的情況下使用聚合物管線時，小心注意以下幾點。

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



警告：当有压力的情况下使用管线时，小心注意以下几点：

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



경고: 가압 폴리머 튜브로 작업할 경우에는 주의하십시오.

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



警告: 圧力のかかったポリマーチューブを扱うときは、注意してください。

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



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： 使用者必須非常清楚如果設備不是按照製造廠商指定的方式使用，那麼該設備所提供的保護將被消弱。



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



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



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

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.



Warnung: 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： 為了避免火災，更換保險絲時，請使用與儀器保險絲蓋旁面板上所印刷之相同類型與規格的保險絲。



警告： 為了避免火災，應更換與儀器保險絲蓋旁邊面板上印刷的類型和規格相同的保險絲。



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



警告: 火災予防のために、ヒューズ交換では機器ヒューズカバー脇のパネルに記載されているタイプおよび定格のヒューズをご使用ください。

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.



Warnung: Zum Schutz gegen Feuer die Sicherungen nur mit Sicherungen ersetzen, deren Typ und Nennwert im Abschnitt "Sicherungen ersetzen" des Kapitels "Wartungsverfahren" angegeben sind.



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: 為了避免火災・更換保險絲時・應使用「維護步驟」章節中「更換保險絲」所指定之相同類型與規格的保險絲。



警告: 为了避免火灾, 应更换“维护步骤”一章的“更换保险丝”一节中介绍的相同类型和规格的保险丝。



경고: 화재의 위험을 막으려면 유지관리 절차 단원의 “퓨즈 교체” 절에 설명된 것과 동일한 타입 및 정격의 제품으로 퓨즈를 교체하십시오.



警告: 火災予防のために、ヒューズ交換ではメンテナンス項目の「ヒューズの交換」に記載されているタイプおよび定格のヒューズをご使用ください。

A.7 Electrical symbols

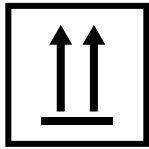
The following electrical symbols and their associated statements can appear in instrument manuals and on an instrument's front or rear panels.

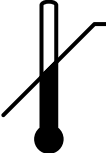
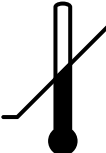
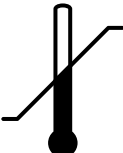
Symbol	Description
	Electrical power on

Symbol	Description
	Electrical power off
	Standby
	Direct current
	Alternating current
	Alternating current (3 phase)
	Safety ground
	Frame, or chassis, terminal
	Fuse
	Functional ground
	Input
	Output

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.

Symbol	Description
	Keep upright!
	Keep dry!
	Fragile!

Symbol	Description
	Use no hooks!
	Upper limit of temperature
	Lower limit of temperature
	Temperature limitation

B Solvent considerations

This information applies to the ACQUITY Arc system modules.



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.

B.1 Preventing contamination

For information explaining how to prevent contamination, refer to *Controlling Contamination in Ultra Performance LC/MS and HPLC/MS Systems* (part number 715001307) , available on the Waters Web site. Visit www.waters.com.

B.1.1 Clean solvents

Clean solvents ensure reproducible results and permit you to operate with minimal instrument maintenance.

Dirty solvents can cause baseline noise and drift, and they can clog solvent reservoir filters, inlet filters, and capillary lines.

B.1.2 Solvent quality

Use MS-grade solvents for the best possible results; the minimum requirement is HPLC-grade. Filter solvents through an appropriate membrane filter.

Recommendation: Heed the recommendations of the filter's manufacturer or vendor to ensure that the filter is appropriate for the solvents used.

B.1.3 Solvent preparation

Proper solvent preparation, primarily filtration, can prevent many pumping problems.

Recommendation: Store mobile phases in borosilicate glass reservoirs type 1, class A² or type 3.3³. Use high-quality, brown-tinted glassware to inhibit microbial growth. Use aluminum foil or Waters caps to cover the reservoirs.

B.1.4 Water

Use water only from a high-quality water purification system. If the water system does not deliver filtered water, filter the water through a 0.2- μ m membrane filter.

! **Notice:** Using 100% water can cause microbial growth. Waters recommends changing 100% water solutions daily. Adding a small amount of an organic solvent (~10%) prevents microbial growth.

B.1.4.1 Using buffers

Adjust the pH of aqueous buffers. Filter them, to remove insoluble material, and then blend them with appropriate organic modifiers. After you use a buffer, flush it from the pump by wet priming using at least five system volumes of HPLC-grade distilled or deionized water. When using a buffer, choose good quality reagents, filtering them through a 0.2- μ m membrane filter.

For shutdowns of more than a day's duration, flush the pump with a 20% methanol/water solution, to prevent microbial growth.

! **Notice:** Some buffers can be incompatible with mass spectrometers. Consult the documentation that accompanies your instrument for compatible buffers.

See also: For an explanation about how to prevent contamination, refer to *Controlling Contamination in LC/MS Systems Best Practices* (part number 715001307) on the Waters Web site. Visit www.waters.com.

B.2 Common solvent properties

The following table lists the properties for some common chromatographic solvents.

Table B–1: Properties of common solvents

Solvent	Vapor pressure mm Hg (Torr)	Boiling point (°C)	Flash point (°C)
Acetone	184.5 at 20 °C	56.29	-20
Acetonitrile	88.8 at 25 °C	81.6	6
<i>n</i> -butyl acetate	7.8 at 20 °C	126.11	22
<i>n</i> -butyl alcohol	4.4 at 20 °C	117.5	37
<i>n</i> -butyl chloride	80.1 at 20 °C	78.44	-9
Chlorobenzene	8.8 at 20 °C	131.69	28
Chloroform	158.4 at 20 °C	61.15	
Cyclohexane	77.5 at 20 °C	80.72	-20
Cyclopentane	400 at 20 °C	49.26	-7

Table B–1: Properties of common solvents (continued)

Solvent	Vapor pressure mm Hg (Torr)	Boiling point (°C)	Flash point (°C)
o-Dichlorobenzene	1.2 at 20 °C	180.48	66
Dichloromethane	350 at 20 °C	39.75	
Dimethyl acetamide	1.3 at 25 °C	166.1	70
<i>N, N</i> -Dimethylformamide	2.7 at 20 °C	153.0	58
Dimethyl sulfoxide	0.6 at 25 °C	189.0	88
1, 4-Dioxane	29 at 20 °C	101.32	12
Ethyl acetate	73 at 20 °C	77.11	-4
Ethyl alcohol	43.9 at 20 °C	78.32	15
Ethyl ether	442 at 20 °C	34.55	-45
Ethylene dichloride	83.35 at 20 °C	83.48	13
Heptane	35.5 at 20 °C	98.43	-4
Hexane	124 at 20 °C	68.7	-22
Iso-octane	41 at 20 °C	99.24	-12
Isobutyl alcohol	8.8 at 20 °C	107.7	28
Isopropyl alcohol	32.4 at 20 °C	82.26	12
Isopropyl myristate	<1 at 20 °C	182.6	164
Methanol	97 at 20 °C	64.7	11
Methyl <i>t</i> -butyl ether	240 at 20 °C	55.2	-28
Methyl ethyl ketone	74 at 20 °C	79.64	-9
Methyl isobutyl ketone	16 at 20 °C	117.4	18
<i>N</i> -Methylpyrrolidone	0.33 at 25 °C	202.0	86
Pentane	420 at 20 °C	36.07	-49
<i>n</i> -Propyl alcohol	15 at 20 °C	97.2	23
Propylene carbonate		241.7	135
Pyridine	18 at 25 °C	115.25	20
Tetrahydrofuran	142 at 20 °C	66.0	-14
Toluene	28.5 at 20 °C	110.62	4
1,2,4-Trichlorobenzene	1 at 20 °C	213.5	106
Triethylamine	57 at 25 °C	89.5	-9
Trifluoroacetic acid	97.5 at 20 °C	71.8	-3
Water	17.54 at 20 °C	100.0	

Table B–1: Properties of common solvents (continued)

Solvent	Vapor pressure mm Hg (Torr)	Boiling point (°C)	Flash point (°C)
o-xylene	6 at 20 °C	144.41	17

B.2.1 Solvent miscibility

Before you change solvents, refer to the table below to determine solvent miscibility. Be aware of these effects:

- Changes involving two miscible solvents can be made directly. Changes involving two solvents that are not totally miscible (for example, from chloroform to water) require an intermediate solvent like n-propanol.
- Temperature affects solvent miscibility. If you are running a high-temperature application, consider the effect of the higher temperature on solvent solubility.
- Buffers dissolved in water can precipitate when mixed with organic solvents.
- When you switch from a strong buffer to an organic solvent, thoroughly flush the system with distilled water before you add the organic solvent.

Note: λ cutoff is the wavelength at which the absorbance of the solvent equals 1 AU.

Table B–2: Solvent miscibility

Polarity index	Solvent	Viscosity cP, 20 °C (at 1 atm)	Boiling point °C (at 1 atm)	Miscibility number (M)	λ cutoff (nm)
0.0	N-hexane	0.313	68.7	29	—
1.8	Triethylamine	0.38	89.5	26	—
4.2	Tetrahydrofuran (THF)	0.55	66.0	17	220
4.3	1-propanol	2.30	97.2	15	210
4.3	2-propanol	2.35	117.7	15	—
5.2	Ethanol	1.20	78.3	14	210
5.4	Acetone	0.32	56.3	15, 17	330
5.5	Benzyl alcohol	5.80	205.5	13	—
5.7	Methoxyethanol	1.72	124.6	13	—
6.2	Acetonitrile	0.37	81.6	11, 17	190
6.2	Acetic acid	1.26	117.9	14	—
6.4	Dimaethylformamide	0.90	153.0	12	—

Table B–2: Solvent miscibility (continued)

Polarity index	Solvent	Viscosity cP, 20 °C (at 1 atm)	Boiling point °C (at 1 atm)	Miscibility number (M)	λ cutoff (nm)
6.5	Dimethylsulfoxide	2.24	189.0	9	—
6.6	Methanol	0.60	64.7	12	210
9.0	Water	1.00	100.0	—	—

B.2.1.1 Using miscibility numbers (M-numbers)

Use miscibility numbers (M-numbers) to predict the miscibility of a liquid with a standard solvent.

To predict the miscibility of two liquids, subtract the smaller M-number value from the larger M-number value.

- If the difference between two M-numbers is 15 or less, the two liquids are miscible, in all proportions, at 15 °C.
- A difference of 16 indicates a critical solution temperature from 25 to 75 °C, with 50 °C as the optimal temperature.
- If the difference is 17 or greater, the liquids are immiscible, or their critical solution temperature is above 75 °C.

Some solvents prove immiscible with solvents at both ends of the lipophilicity scale. These solvents receive a dual M-number:

- The first number, always lower than 16, indicates the degree of miscibility with highly lipophilic solvents.
- The second number applies to the opposite end of the scale. A large difference between these two numbers indicates a limited range of miscibility.

For example, some fluorocarbons are immiscible with all the standard solvents and have M-numbers of 0 and 32. Two liquids with dual M-numbers are usually miscible with each other.

A liquid is classified in the M-number system by testing for miscibility with a sequence of standard solvents. A correction term of 15 units is then either added or subtracted from the cutoff point for miscibility.

B.2.2 Solvent stabilizers

Certain solvents degrade, or become unstable, over time. Highly unstable solvents represent a potential explosion hazard. Solvent stabilizers are added to slow or stop solvent degradation.

Do not leave solvents containing stabilizers, like THF with butylated hydroxytoluene (BHT), to dry in the system's flow path. A dry flow path, including the detector flow cell, becomes contaminated

with residual stabilizer, and a substantial cleaning effort is needed to restore the flow path to its initial condition.

B.2.3 Solvent viscosity

Generally, viscosity is not a consideration when you use a single solvent or under low pressure. In gradient chromatography, however, the viscosity changes that occur as the solvents are mixed in varying proportion can effect pressure changes during the run.

If you do not know the extent to which pressure changes affect the analysis, monitor the pressure during the run.

B.2.4 Wavelength selection

The tables in this section provide UV cutoff values for these items:

- Common solvents
- Common mixed mobile phases

B.2.4.1 UV cutoffs for common solvents

The table below shows the UV cutoff (the wavelength at which the absorbance of the solvent equals 1 AU) for some common chromatographic solvents. Operating at a wavelength near or below the cutoff increases baseline noise because of solvent absorbance.

Table B–3: UV cutoff wavelengths for common chromatographic solvents

Solvent	UV cutoff (nm)
Acetone	330
Acetonitrile	190
Diethyl amine	275
Ethanol	210
Isopropanol	205
Isopropyl ether	220
Methanol	205
n-Propanol	210
Tetrahydrofuran (THF)	230

B.2.4.2 Mixed mobile phases

The following table provides approximate wavelength cutoffs for some other solvents, buffers, detergents, and mobile phases. The solvent concentrations represented are those most commonly used. If you want to use a different concentration, you can determine approximate absorbance using Beer's law, because absorbance is proportional to concentration.

Note: λ cutoff is the wavelength at which the absorbance of the solvent equals 1 AU.

Table B-4: Wavelength cutoffs for different mobile phases

Mobile phase	UV cutoff (nm)
Acetic acid, 1%	230
Ammonium acetate, 10 mM	205
Ammonium bicarbonate, 10 mM	190
Polyoxyethylene (35) lauryl ether (BRIJ 35), 0.1%	190
3-[(3-cholamidopropyl)-dimethylammonio]-1-propanesulfonate) (CHAPS) 0.1%	215
Diammonium phosphate, 50 mM	205
(Ethylenedinitrilo) tetraacetic acid disodium salt (disodium EDTA), 1 mM	190
4-(2-hydroxyethyl)-1-piperazineet hanesulfonic acid (HEPES), 10 mM, pH 7.6	225
Hydrochloric acid, 0.1%	190
Morpholinoethanesulfonic acid (MES), 10 mM, pH 6.0	215
Potassium phosphate, monobasic, 10 mM	190
Potassium phosphate, dibasic, 10 mM	190
Sodium acetate, 10 mM	205
Sodium chloride, 1 M	207
Sodium citrate, 10 mM	225
Sodium dodecyl sulfate	190
Sodium formate, 10 mM	200
Triethylamine, 1%	235
Trifluoroacetic acid, 0.1%	190
TRIS HCl, 20 mM, pH 7.0	202
TRIS HCl, 20 mM, pH 8.0	212
Triton X-100, 0.1%	240
Waters PIC Reagent A, 1 vial/liter	200
Waters PIC Reagent B-6, 1 vial/liter	225
Waters PIC Reagent B-6, low UV, 1 vial/liter	190
Waters PIC Reagent D-4, 1 vial/liter	190

B.2.4.3 Mobile phase absorbance

This section lists the absorbances at several wavelengths for frequently used mobile phases. Choose the mobile phase carefully to reduce baseline noise.

The best mobile phase for your application is one that is transparent at the chosen detection wavelengths. With such a mobile phase, ensure that any absorbance is caused only by the sample. Absorbance by the mobile phase also reduces the linear dynamic range of the detector by the amount of absorbance the Autozero function cancels. Wavelength, pH, and concentration of the mobile phase affects its absorbance. Examples of several mobile phases are given in the table below, where the absorbances are based on a 10-mm path length.

Table B–5: Mobile phase absorbance measured against air or water

	Absorbance (AU) at specified wavelength (nm)									
	200	205	210	215	220	230	240	250	260	280
Solvents										
Acetonitrile	0.05	0.03	0.02	0.01	0.01	<0.01	—	—	—	—
Methanol (not degassed)	2.06	1.00	0.53	0.37	0.24	0.11	0.05	0.02	<0.01	—
Methanol (degassed)	1.91	0.76	0.35	0.21	0.15	0.06	0.02	<0.01	—	—
Isopropanol	1.80	0.68	0.34	0.24	0.19	0.08	0.04	0.03	0.02	0.02
Unstablized tetrahydrofuran (THF, fresh)	2.44	2.57	2.31	1.80	1.54	0.94	0.42	0.21	0.09	0.05
Unstablized tetrahydrofuran (THF, old)	>2.5	>2.5	>2.5	>2.5	>2.5	>2.5	>2.5	>2.5	2.5	1.45
Acids and bases										
Acetic acid, 1%	2.61	2.63	2.61	2.43	2.17	0.87	0.14	0.01	<0.01	—
Hydrochloric acid, 0.1%	0.11	0.02	<0.01	—	—	—	—	—	—	—
Phosphoric acid, 0.1%	<0.01	—	—	—	—	—	—	—	—	—
Trifluoroacetic acid	1.20	0.78	0.54	0.34	0.22	0.06	<0.02	<0.01	—	—
Diammonium phosphate, 50 mM	1.85	0.67	0.15	0.02	<0.01	—	—	—	—	—
Triethylamine, 1%	2.33	2.42	2.50	2.45	2.37	1.96	0.50	0.12	0.04	<0.01

Table B–5: Mobile phase absorbance measured against air or water (continued)

	Absorbance (AU) at specified wavelength (nm)									
	200	205	210	215	220	230	240	250	260	280
Buffers and salts										
Ammonium acetate, 10 mM	1.88	0.94	0.53	0.29	0.15	0.02	<0.01	—	—	—
Ammonium bicarbonate, 10 mM	0.41	0.10	0.01	<0.01	—	—	—	—	—	—
Ethylenedinitrilotetraacetic acid disodium salt (disodium EDTA), 1 mM	0.11	0.07	0.06	0.04	0.03	0.03	0.02	0.02	0.02	0.02
4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid (HEPES), 10 mM, pH 7.6	2.45	2.50	2.37	2.08	1.50	0.29	0.03	<0.01	—	—
Morpholinoethanesulfonic acid (MES), 10 mM, pH 6.0	2.42	2.38	1.89	0.90	0.45	0.06	<0.01	—	—	—
Potassium phosphate, monobasic (KH ₂ PO ₄), 10 mM	0.03	<0.01	—	—	—	—	—	—	—	—
Potassium phosphate, dibasic, (K ₂ HPO ₄), 10 mM	0.53	0.16	0.05	0.01	<0.01	—	—	—	—	—
Sodium acetate, 10 mM	1.85	0.96	0.52	0.30	0.15	0.03	<0.01	—	—	—
Sodium chloride, 1 M	2.00	1.67	0.40	0.10	<0.01	—	—	—	—	—
Sodium citrate, 10 mM	2.48	2.84	2.31	2.02	1.49	0.54	0.12	0.03	0.02	0.01
Sodium formate, 10 mM	1.00	0.73	0.53	0.33	0.20	0.03	<0.01	—	—	—
Sodium phosphate, 100 mM, pH 6.8	1.99	0.75	0.19	0.06	0.02	0.01	0.01	0.01	0.01	<0.01
Tris HCl, 20 mM, pH 7.0	1.40	0.77	0.28	0.10	0.04	<0.01	—	—	—	—
Tris HCl, 20 mM, pH 8.0	1.80	1.90	1.11	0.43	0.13	<0.01	—	—	—	—
Waters PIC reagents										
PIC A, 1 vial/L	0.67	0.29	0.13	0.05	0.03	0.02	0.02	0.02	0.02	<0.01
PIC B6, 1 vial/L	2.46	2.50	2.42	2.25	1.83	0.63	0.07	<0.01	—	—
PIC B6, low UV, 1 vial/L	0.01	<0.01	—	—	—	—	—	—	—	—

Table B–5: Mobile phase absorbance measured against air or water (continued)

	Absorbance (AU) at specified wavelength (nm)									
	200	205	210	215	220	230	240	250	260	280
PIC D4, 1 vial/L	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01
BRI J 35, 1%	0.06	0.03	0.02	0.02	0.02	0.01	<0.01	—	—	—
3-[(3-cholamidopropyl)-dimethylammonio]-1-propanesulfonate) (CHAPS), 0.1%	2.40	2.32	1.48	0.80	0.40	0.08	0.04	0.02	0.02	0.01
Sodiumdodecyl sulfate (SDS), 0.1%	0.02	0.01	<0.01	—	—	—	—	—	—	—
4-octylphenol polyethoxylate (Triton X-100), 0.1%	2.48	2.50	2.43	2.42	2.37	2.37	0.50	0.25	0.67	1.42
Polyoxyethylene sorbitan monolaurate (Tween 20), 0.1%	0.21	0.14	0.11	0.10	0.09	0.06	0.05	0.04	0.04	0.03

C Specifications

C.1 System specifications

See also: For individual module physical, environmental, and input/out specifications consult the module's overview and maintenance guide.

Item	Specification
Dwell volume (total system)	Path 1 = 1190 μ L Path 2 = 760 μ L
Operating flow rate range	0.001 to 5.000 mL/min, in 0.001 mL increments
Maximum operating pressure	65,500 kPa (655 bar, 9500 psi)
pH range	2 to 12
Unattended operation	For leak sensors and safe leak handling: 96-hour display of diagnostic data, via the console
Cycle time	<30 seconds, injection-to-injection

C.1.1 Instrument control specifications

Attribute	Specification
Informatics compatibility	Empower Chromatography Data System, MassLynx Mass Spectrometry Software
Communications	Ethernet or D-Sub interconnect cable
Event input/output	Contact closure and/or TTL input/output
Connections INSIGHT	Provides real-time monitoring and automatic notification of instrument performance and diagnostic information

C.1.2 Environmental specifications

Attribute	Specification
Acoustic noise, system	<65 dBA
Operating temperature range	4 to 40 °C
Operating temperature stability	$\Delta T \leq \pm 2$ °C/hr
Operating humidity range	20% to 80%, non-condensing
Shipping and storage temperature range	-30 °C to 60 °C
Shipping and storage humidity range	20% to 85%, non-condensing
Elevation	≤ 2000 m

C.1.3 Electrical specifications

Note: The total system power is a function of the modules and instruments that comprise it. Refer to the module or instrument operator's guide for further information.

Attribute	Specification
Power requirements	100 to 240 VAC
Line frequency	50–60 Hz
Power consumption	QSM-R: 200 VA SM FTN-R: 400 VA 30-cm CHC: 240 VA 30-cm CH: 50 W CH-30A: 50 W WFMA: 400 VA Sample Organizer: 540 VA

C.1.4 Physical specifications

This table provides the physical specifications for a system that includes the Quaternary Solvent Manager-R, Sample Manager FTN-R, 30-cm Column Heater, and Mounting Bracket.

Attribute	Specification
Width	55.9 cm (22.0 in.)
Height	57.1 cm (22.5 in.)
Depth	62.8 cm (24.7 in.)

Attribute	Specification
Weight	62.1 kg (137.0 lbs) ^a

a. Actual system weight will vary depending upon the solvent and number of solvent bottles in the solvent tray.

C.2 Performance specifications

The following tables list the performance specifications for the system modules.

C.2.1 QSM-R performance specifications

Item	Specification
Pressure flow envelope	0.5 to 5.0 mL/min = 65,500 kPa (655 bar, 9500 psi)
Minimum operating pressure	Back pressure = 6895 kPa (69 bar, 1000 psig)
Flow rate range	Programmable and executable range of 0.001 to 5.000 mL/min, in 0.001 mL/min increments
Contribution of pump to system delay volume (mixing point to the outlet of filter/mixer)	Combined system and pump delay volume when configured for the lowest volume. • Path 1 = 1100 µL • Path 2 = 700 µL
Flow accuracy	±1.0% of set flow at 0.5, 3.0, and 5.0 mL/min Test method details: • Solvent: HPLC-grade water, degassed • Solvent manager: back pressure 8618 kPa (86 bar, 1250 psi) ±20% • Measurement technique: gravimetric or volumetric

Item	Specification
Flow precision	0.075% RSD or ± 0.02 min SD, whichever is greater Test conditions: • Measurement: based on six replicates • Mobile phase: 60:40 water/methanol pre-mixed • Flow rate: 1.5 mL/min • Sample mix: alkylphenone mix (24.0 μL injection volume) • Column: CORTECS C₁₈, 2.7 μm, 4.6 $\times$ 50 mm • Column temperature: 35 °C • Detector: HPLC, 254 nm wavelength
Composition accuracy	$\pm 0.5\%$ absolute (full scale) from 5 to 95% from 0.5 to 5.0 mL/min Test conditions: • Mobile phase: methanol; methanol with 5.0 mg/mL caffeine step gradient • Flow rate: 0.5 to 5.0 mL/min • Gradient: step gradient • Solvent manager: back pressure 8618 kPa (86 bar, 1250 psi) $\pm 20\%$ • Detector: UV, 273 nm wavelength
Composition precision	0.15% RSD or ± 0.04 min SD, whichever is greater Test conditions: • Measurement: based on six replicates • Mobile phase: Dial-a-mix 60:40 water/methanol via Auto•Blend Plus technology • Sample: alkylphenone mix • Flow rate: 0.5 mL/min • Sample manager: injection volume = 24.0 μL • Column: CORTECS C₁₈, 2.7 μm, 4.6 $\times$ 50 mm • Column temperature: 35 °C • Detector: TUV, 254 nm wavelength

Item	Specification
Composition ripple (baseline noise)	<0.5 mAU average peak-to-peak with 760 µL mixer Test conditions: • Solvent A: 0.1% trifluoroacetic acid in water • Solvent B: 0.1% acetonitrile in water • Flow rate: 1.5 mL/min • Gradient conditions: 1.0 to 33% solvent B in 10 min, time average window 10 sec, noise range is 2 to 4 min • Column: CORTECS C₁₈, 2.7 µm, 4.6 × 50 mm • Column temperature: 35 °C ±0.1 °C • Detector: HPLC class detector, UV at 214 nm
Noise (instrument generated)	<58 dBA

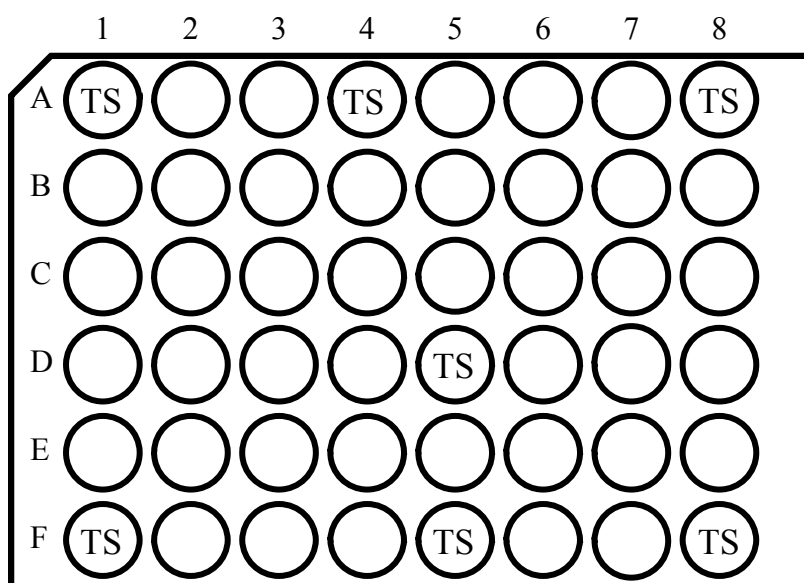
C.2.2 SM FTN-R performance specifications

Item	Description
Injection volume range	0.1 to 50 µL as standard. 0.1 to 1000 µL with optional needles and holding loops.
Accuracy (aspiration)	±0.2 µL, measured by fluid weight removed from vial, with 10 µL injections averaged over 20 injections using standard 100-µL syringe, 100% water
Sample capacity	Any two of the following: • 48-position, 2.0-mL vial holder (total capacity of 96 vials) • 96-well plate • 384-well plate • 48-position, 0.65-mL micro-centrifuge tube plate • 24-position, 1.50-mL micro-centrifuge plate
Flow rate range	0 to 5 mL/min
Operating pressure	0 to 65,500 kPa (655 bar, 9500 psig)
Audible noise	<60 db
Residual sample volume	3 µL, Total Recovery vials, with a minimum specified needle depth

Item	Description
Sample-compartment programmable range	4 to 40 °C (0.1 °C increments)
Sample compartment controllable temperature: heating mode	Capable of maintaining a temperature differential up to 25 °C above ambient. The tolerance range for the temperature maintained within the sample compartment at the compartment's temperature sensor site and sample location is -4 °C to +2 °C. Measure at the sample compartment temperature sensor and the sample locations shown in the diagram that follows this table when validating specifications. The sample compartment must be at thermal equilibrium for one hour before taking measurements.
Sample compartment controllable temperature: cooling mode	Capable of maintaining a temperature differential up to 19 °C below ambient. The tolerance range for the temperature maintained within the sample compartment at the compartment's temperature sensor site and sample location is -2 °C to +4 °C. Measure at the sample compartment temperature sensor and the sample locations shown in the diagram that follows this table when validating specifications. The sample compartment must be at thermal equilibrium for one hour before taking measurements.
Temperature accuracy (accuracy of the sample compartment's temperature sensor, as compared with an ASTM qualified external probe)	±0.5 °C. Measure at the sample compartment temperature sensor. Compartment should be at thermal equilibrium for one hour before taking measurements.
Temperature stability (variation of temperature over time, measured at the compartment temperature sensor)	±1.0 °C. Measure at the sample compartment temperature sensor. Compartment should be at thermal equilibrium for one hour before taking measurements. Stability should be recorded over a duration of 30 minutes.

Item	Description
Sample carryover - UV	<0.002% caffeine (UV) Test conditions: • Wash solvent: water/acetonitrile, 90/10 • Pre-injection wash: 0 seconds • Post-injection wash: 6 seconds • Column: CORTECS C₁₈, 2.7 µm, 4.6 × 50 mm • Sample: caffeine, at 0.8 ug/mL (standard) and 4.0 mg/mL (challenge) in water/acetonitrile, 90/10, compared to blanks of water/acetonitrile, 90/10 • Mobile phase: water/acetonitrile, 90/10 • Flow rate: 1.4 mL/min • Injection volume: 5 µL • Column temperature: 40 °C • Detection: UV at 273 nm • Run time: 2 min • Data system: Empower 3, or higher • Basis of calculation: Any peak in the blanks after the challenge sample are compared to the known (0.002%) standard. Carryover peak areas below the standard area are within specification.

Figure C–1: Recommended temperature sensor locations



C.2.3 30-cm CH and 30-cm CHC performance specifications

The following table lists the performance specifications for the 30-cm CH and 30-cm CHC module operating with the passive preheater.

Item	Specification
Settable temperature range	30-cm CH: 20.0 to 65.0 °C, in 0.1 °C increments 30-cm CHC: 4.0 to 65.0 °C, in 0.1 °C increments
Controllable temperature range	30-cm CH: (Ambient +5 °C) to 65.0 °C 30-cm CHC: (Ambient –15 °C) to 65.0 °C
Temperature accuracy	±0.5 °C at sensor Test qualification: The temperature measured by a NIST-traceable probe located next to the measurement sensor must fall within this specification.
Solvent conditioning	Passive preheating
Leak control	Compartment drip tray installs under valve, if applicable. 30-cm CHC has additional condensate drain. Single exit drain manages leaks to waste.
Door open to heater cutoff delay	1-minute maximum

C.2.4 CH-30A performance specifications

Item	Specification
Settable temperature range	20.0 to 90.0 °C, in 0.1 °C increments
Controllable temperature range	(Ambient + 5.0 °C) to 90.0 °C
Temperature accuracy ^a	±0.5 °C at sensor Test qualification: The temperature measured by a NIST-traceable probe located next to the measurement sensor must fall within this specification.
Temperature stability ^a	±0.3 °C at sensor
Solvent conditioning	Active preheating
Leak control	Compartment drip tray with leak sensor installed under compartment; single exit drain manages leaks to waste

Item	Specification
Door open to heater cutoff delay	1-minute maximum
Column tracking	eCord technology column information management tracks and archives column usage history

a. Operating with active preheating via the APH assembly

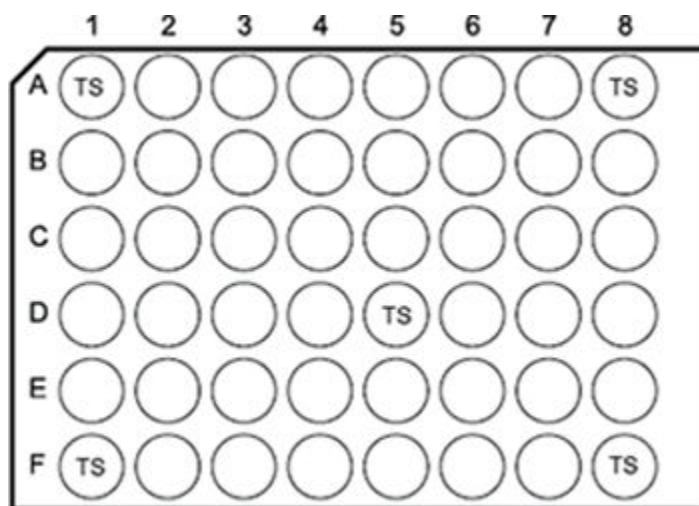
C.2.5 Waters Fraction Manager - Analytical performance specifications

Item	Specification
Maximum operating pressure at detector outlet	6895 kPa (69 bar, 1000 psig)
Audible noise	<65 db
pH operating range	2 to 12
Collection modes	Time-based, threshold start and end, slope start and end, threshold or slope, and upper- and lower-slope threshold.
Fraction collection volume range	25 to 10,000 μ L
Fraction collection volume accuracy	± 10 μ L for fractions <200 μ L, $\pm 5\%$ for fractions >200 μ L Conditions: • Post-collection flush disabled • Fraction windows at least two seconds apart • Fractions collected into adjacent vessels
Typical move time	0.2 to 0.5 seconds, depending on plate type and collection scheme
Maximum total collections	192 collections with two 96-well plates (fraction volume dependent)
Fraction time windows allowable per run	50
Number of fraction plates	2

Item	Specification
Collection vessel compatibility	• ANSI 96-well plates • 2 mL 48-position vial holders • 4 mL 24-position vial holders • Waters 15 × 10 mL vial holders • 0.65 mL Eppendorf tube holders • 1.5 mL Eppendorf tube holders
Collection pattern	• Horizontal continuous • Horizontal discontinuous • Vertical continuous • Vertical discontinuous
Fraction compartment programmable range	4 to 40 °C (0.1 °C increments)
Temperature accuracy (accuracy of the fraction compartment temperature sensor as compared to an ASTM-qualified external probe)	±0.5 °C at the sensor
Temperature stability (variation of temperature at the sensor at equilibrium and at a constant set point measured over a set period of time)	±1 °C at the sensor
Fraction temperature distribution (after equilibration)	±2 °C with tray rotation enabled
Fraction carryover with rinse	<0.1% Conditions: • Sample solution: 4 mg/mL caffeine in 90:10 water/ acetonitrile solution • Injection size: 2 µL • Analyte mass: 8 µg • Subsequent fractions contain <8 ng of caffeine contamination

Item	Specification
Fraction compartment temperature range	4.0 to 40.0 °C with a tolerance range between -2 and +4 °C - At a set point of 4 °C with ambient temperature <23 °C and humidity <80%, maintains a fraction temperature of 2 to 8 °C. - At ambient temperatures >23 °C or humidity >80%, the fraction manager can maintain an average fraction temperature of 18 °C below ambient, with a tolerance range between -2 and +4 °C. The diagram below indicates recommended temperature sensor locations for accurate measurement of the fraction compartment's interior temperature.

Figure C–2: Recommended temperature sensor locations



TS Temperature sensor

C.2.6 Sample organizer performance specifications

Item	Specification
Sample plate compatibility	Consult the sample manager's overview and maintenance guide or system consumables catalog for a list of approved plates, vials, sealing caps, and sample covers for use with your sample manager and sample organizer.

Item	Specification
Sample plate capacity	Maximum of 19 plates, as high as 15.5 mm Maximum of 9 plates, as high as 40.0 mm Maximum of 6 plates, as high as 53.0 mm
Minimum sample plate height	13 mm
Maximum sample plate height (includes vials, caps, and cap mats)	53 mm
Sample compartment temperature range	Between 4 and 40 °C, in increments of 0.1 °C, with a tolerance range of between -2 and +4 °C • At a setpoint of 4 °C with ambient temperature <23 °C and humidity <80%, maintains a sample temperature of 2 to 8 °C. • At ambient temperatures >23 °C and/or humidity >80%, the sample manager and sample organizer can maintain an average sample temperature of 18 °C below ambient, ±3.0 °C.
Temperature accuracy	No more than ±1.0 °C in temperature between a traceable external temperature measurement device and an instrument temperature measurement device.
Temperature stability	±1.0 °C (at the sensor, with the sample compartment door closed)
Pneumatic system operating pressure range	414 to 758 kPa (4 to 8 bar, 60 to 110 psi)
Optional external pneumatic source pressure range	517 to 689 kPa (5 to 7 bar, 75 to 100 psi)