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Overview

You can submit samples for analysis on the ACQUITY UPLC system by loading microtiter plates or vials onto the rotary sample tray of the Sample Manager-Flow Through Needle (SM-FTN). Using a flow-through-needle mechanism, in which the needle is part of the high-pressure sample flow path, the Sample Manager injects the samples it draws from the plates and vials onto a chromatographic column. Optional extension loops (installed between the sample needle and the injection valve) increase the volume of your injections beyond that of the sample needle. Using the SM-FTN, you also can dilute injected samples (auto-dilution).

Location of SM-FTN in the ACQUITY UPLC system

The following diagram shows the location of the SM-FTN in the ACQUITY UPLC system.
Tips:

- Use care when stacking or moving the SM-FTN. Ensure the drip tray does not collide with any surface.
- Use care when installing and removing reusable fittings.

See also: Column Compartments Operator's Overview and Maintenance Information on the ACQUITY UPLC System Documentation CD to avoid potential leaks or carryover.

Flow path through the sample management system

The following diagram shows how the SM-FTN functions as part of the ACQUITY UPLC system.
SM-FTN major components

The following diagrams show the SM-FTN’s major components.

Front view with doors closed:
Front view, with doors open:

- Chamber temperature sensor
- Plate selector switch
- Access panel
- Location of column heater leak sensor
- Injection valve
- Sample syringe valve
- Location of back pressure regulator
- Sample syringe
- Sample tray
- Location of sample manager leak sensor
Sample compartment components visible with access panel removed:

**SM-FTN components:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access panel</td>
<td>Removable panel (requires a TORX® driver) that allows access to sample compartment components such as the seal assembly and needle carriage.</td>
</tr>
<tr>
<td>Compartment lighting</td>
<td>LED that illuminates the sample compartment. The compartment light automatically turns on when the SM-FTN’s sample compartment door is opened and turns off when the door is closed. The light can also be turned off via the console to accommodate light-sensitive samples.</td>
</tr>
<tr>
<td>Injection/wash port</td>
<td>An assembly that houses the injection port, needle seal, needle wash mechanism, and force sensor.</td>
</tr>
</tbody>
</table>
Functional systems

RΘ positioning mechanism

The RΘ (R-theta) positioning mechanism’s two axes control the orientation of the sample plates within the sample compartment and the relative position of the sample needle carriage. The theta-rotary axis is a belt-driven shaft that rotates a pair of sample plates 360° from a reference point. The R-linear axis is the axis along which the sample needle carriage is oriented. The carriage runs from the rear-left corner to the front-right corner of the sample compartment.
Injection system

The injection flow path includes the assemblies required to aspirate a sample and deliver it to the column. The process involves the needle, optional extension loop, sample syringe and syringe valve, injection valve, and injection/wash port.

Flow path diagram:

Injection mechanics

During an injection:

1. The needle is positioned and driven down by the R-carriage.
2. A PEEK support sleeve prevents buckling and helps ensure proper alignment with the seat.
3. The needle is driven into the seat to a specified force to form the first high-pressure seal.

4. The second high-pressure seal on the seat is formed during assembly when the seat is locked into place between the support sleeve and overflow cup via a compression nut.

5. The entire injection port assembly rests on a spring and is guided in an aluminum housing.

6. The needle presses against the seat, compressing the spring, which creates the required load between the needle and the seat.

Cross-view of injection needle and seal:

The following figures show a standard ACQUITY UPLC system cycle time and load-ahead cycle time.
Standard ACQUITY UPLC system cycle time definition:

Wash system

The wash system cleans the outside of the sample needle while it is inside the injection/wash port.

You can choose two external needle washes, pre-injection or post-injection. Neither wash sequence allows wash solvent to enter the sample stream.

**Pre-injection (insertion) wash**

The pre-injection wash washes the needle at a location above the seal position used for injection. The solvent begins to flow before the needle is lowered to this wash position.

Choose to perform this wash if you are concerned about material on the outside of the sample needle damaging the seal or affecting the contact between the seal and the needle.

**Post-injection (OD needle) wash**

Performed by default, this wash washes the exterior of the sample needle after an injection is made and the needle remains in the seal position.
Two priming modes are available:

- Wash solvent prime, where the wash solvent flows through the wash system to prime each component.
- Purge solvent prime, where the degassed purge solvent flows through the sample syringe.

The purge solvent used for priming is also the solvent used to move sample through the injection flow path. During auto-dilution, the purge solvent is the dilution solvent.

**Thermal system**

The thermal system maintains the set temperature in the sample compartment.

**Tips:**

- You do not need to defrost the sample compartment.
- The SM-FTN’s fans stop circulating air whenever the sample compartment door is open.
- The sample tray rotates slowly when the system is idle, to help maintain a uniform temperature across the plates.

**Preparing for operation**

**Note:** The system is shipped with a 15-μL needle. If you are not using the default ACQUITY UPLC system configuration, which uses this needle, see page 43.

Before you prepare the SM-FTN for operation, prepare the solvent manager.

**Tip:** For instructions on preparing the solvent manager, see _ACQUITY UPLC Quaternary Solvent Manager Operator’s Overview and Maintenance Information_ or _ACQUITY UPLC Binary Solvent Manager Operator’s Overview and Maintenance Information_.

Preparation of the SM-FTN involves these steps:

- Installing the leak sensor
- Installing the waste tubing
- Calibrating the rotary sample tray
- Priming the SM-FTN
Installing the leak sensor

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

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

**Required materials**

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

**To install the leak sensor:**

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

1. Power-off the SM-FTN.
2. Open the fluidics compartment door.
3. Carefully unpack the new leak sensor.
4. Align the leak sensor’s T-bar with the slot in the side of the leak sensor reservoir, and slide the leak sensor into place.

5. Plug the leak sensor connector into the front of the instrument.

6. Power-on the SM-FTN.

7. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.

8. In the SM-FTN information window, click Control > Reset SM, to reset the SM-FTN.
Installing the waste tubing

**Caution:** To prevent contamination to system components, wear clean, chemical-resistant, powder-free gloves when installing or removing the waste tubing.

**Required material**

Gloves: clean, powder-free, chemical-resistant

**To install the waste tubing:**

1. Locate the pre-installed, corrugated tubing running from the process waste port (found on the lower drip tray of the sample manager), and
route it through the pass-through on the upper drip tray of the solvent manager.

2. Slide the adapter onto the end of the corrugated Teflon® tubing.

3. Connect the adapter to the front boss fitting on the lower drip tray of the solvent manager.

Tip: For instructions on routing the solvent manager waste and vent lines, see the Quaternary Solvent Manager Operator’s Overview and Maintenance Information or ACQUITY UPLC Binary Solvent Manager Operator’s Overview and Maintenance Information.
Calibrating the needle’s z axis

You must calibrate the needle’s z axis before you use the FTN for the first time and whenever you replace the sample needle. Failing to calibrate the needle can damage it. The calibration procedure is the same for all needles.

To calibrate the needle’s z axis

1. Open the sample manager door.
2. Remove the plates from the trays.
3. In the console, select Sample Manager > Control > Reset SM.
   **Result:** The mechanism moves to the home position, with the needle above the wash station.
4. Click Maintain > Calibrate needle Z axis.
5. Click Start, and then click OK in the confirmation window.
   **Tip:** To easily and efficiently achieve the correct needle setting, slide a business card under the needle.
6. Select 1.0 mm for displacement per keystroke.
7. Use the +Z button (Page Down key) to drive the needle down to within 1 millimeter of the tray surface.
8. Switch the displacement increment to 0.1 millimeter, and lower the needle until it is almost touching the surface of the business card.
9. Click Save > Yes, and then click Close.
10. Remove the card.
11. Specify the sample needle and syringe volumes, if they changed.
12. Characterize the needle seal (see the ACQUITY UPLC online Help).

Priming the SM-FTN

The priming process fills the wash system with wash solvent or the injection pathway with purge solvent. You prime the system to accomplish these tasks:

- Prepare a new SM-FTN for operation
- Prepare a SM-FTN for operation after it has been idle for an extended period
• Change the purge solvent
• Remove bubbles from the lines

Ensure that the purge and wash solvents are correctly composed and that they are high in quality and miscible with any other solvents used in your system. Use filters in all solvent reservoirs, and ensure the volumes of solvents are sufficient for priming.

To prime the sample syringe:

1. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.

   **SM-FTN information window:**

   ![ACQUITY UPLC Console](image)

   2. Click Control > Prime.

   **Alternative:** Right-click in the SM-FTN control panel, in the data application, and then click Prime.

3. In the Prime dialog box, click the boxes on the left-hand side, to place a check mark next to the priming function you want to perform.

4. Specify a duration, in seconds, for priming the wash solvent and the number of cycles for priming the purge solvent, and then click OK.
Priming parameter values:

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash solvent</td>
<td>1 to 600 seconds</td>
<td>15 seconds</td>
</tr>
<tr>
<td>Purge solvent</td>
<td>1 to 50 cycles</td>
<td>5 cycles</td>
</tr>
</tbody>
</table>

Recommendation: Specify 5 to 7 primes when you are changing solvents.
Each priming cycle takes approximately 0.5 minutes. When the system status is “Idle,” priming is finished.

Using the SM-FTN

Before running samples,

- Examine the injection valve, sample syringe, and all fittings for leaks. Tighten fittings as needed.
- Ensure both the sample compartment door and the fluidics compartment door are closed.

Interface requirements

Ventilation

Allow at least 15.2 cm clearance at the rear and at least 1.3 cm clearance on the right-hand side of the SM-FTN for ventilation.

Drainage system

- Allow clearance for fluid lines to pass along the right-hand side of the instrument (twelve 0.125-inch OD tubes or four 1/6-inch OD tubes, for example).
- Ensure that the SM-FTN can accept drainage from the column heater and provide a path to waste.
Installation recommendations for fittings

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

**Caution:** When installing or removing a column, be sure that you turn the column itself and not the fitting (compression screw and ferrule). If the fitting turns, the collet could become stuck and cause the active pre-heater tubing to turn with the fitting, potentially damaging the active pre-heater assembly.

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

![Diagram of tubing, compression screw, and ferrule with locking ring](image)

**Recommendations:**
- To prevent band spreading, ensure the tubing bottoms in its fitting hole before you tighten the compression screw.
- For easier accessibility, use long compression screws to attach tubes to the injector and vent valve.
- Perform the sample syringe leak test whenever you replace or loosen fittings during maintenance (see the ACQUITY UPLC online Help).
- Whenever you loosen fittings during maintenance, examine them for cracks, stripped threads, and deformations.
- Do not reuse stainless steel fittings more than six times.

**Required material**

Gloves: clean, powder-free, chemical-resistant
When tightening system fittings, consult the following table.

**Installation recommendations for ACQUITY UPLC fittings:**

<table>
<thead>
<tr>
<th>Fitting</th>
<th>Recommended tightening</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4-28 flangeless with ferrule</td>
<td>Finger-tight</td>
</tr>
<tr>
<td>First use or re-installed</td>
<td></td>
</tr>
<tr>
<td>1/4-28 flangeless with 2-piece ferrule</td>
<td>Finger-tight</td>
</tr>
<tr>
<td>First use or re-installed</td>
<td></td>
</tr>
<tr>
<td>10-32 one-piece PEEK</td>
<td>Finger-tight</td>
</tr>
<tr>
<td>First use or re-installed</td>
<td></td>
</tr>
<tr>
<td>Stainless steel (gold-plated) with 2-piece stainless steel ferrule</td>
<td>Finger-tight, plus 3/4-turn using wrench</td>
</tr>
<tr>
<td>First use</td>
<td></td>
</tr>
<tr>
<td>Stainless steel (gold-plated) with 2-piece stainless steel ferrule (re-installed)</td>
<td>Finger-tight, plus up to 1/6-turn using wrench</td>
</tr>
<tr>
<td>Re-installed</td>
<td></td>
</tr>
</tbody>
</table>
Selecting purge and wash solvents

Purge solvent

The primary function of the purge solvent is to move sample along the injection pathway. The solvent comes into contact with the sample (as the dilution solvent) only when you choose the auto-dilution option. You also use purge solvent to prime the syringe.

See also: page 15

Wash solvent

You can use wash solvent in an optional procedure that cleans the exterior of the needle before or after an injection. By default, the system washes the exterior of the needle after an injection. You can also prime the wash system with wash solvent to ascertain proper flow through the waste tubing and to confirm that the wash system is operating properly.

See also: page 9

General guidelines

For best performance, follow these guidelines when selecting purge and wash solvents. Otherwise, you can increase the risk of carryover. The guidelines do not prohibit all other solvent combinations, however, which you can run with lower performance expectations or by manipulating default injection parameters.

Use purge and wash solvents based on the sample and mobile phase chemistries of your application. When you perform auto-dilutions, ensure purge solvent and sample solutions/buffers are miscible and soluble.

For buffered aqueous, reversed-phase chromatographic conditions and MS applications, it is best to use a wash solvent of 100% methanol or acetonitrile or a mixture of methanol or acetonitrile with 0% to 20% water. Use a purge solvent with low organic content (~5% to 10%), to minimize dissolved gas while still preventing microbial growth.

See the Solvent Considerations appendix in the ACQUITY UPLC System Guide for further information about solvents.
Caution: To avoid damaging the solenoid valve seats and seals in the solvent path, do not use a nonvolatile buffer as the purge or wash solvent.

For best performance if you use the auto-dilution option, the purge solvent must be similar or identical to your isocratic or initial gradient solvent conditions, excluding buffers. Do not use salt buffers in purge or wash solvents.

Wash solvent effects:

<table>
<thead>
<tr>
<th>Property</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic species</td>
<td>As a general principle, purge and wash solvents must include the same organic species, which is not always practicable. You can, however, use a 100% organic wash solvent.</td>
</tr>
<tr>
<td>Solvent composition</td>
<td>The purge solvent, if used for auto-dilution, must reflect as closely as possible the same composition as the initial gradient mobile phase.</td>
</tr>
<tr>
<td>pH</td>
<td>Adjust the pH of the purge and wash solvents for best peak shape and carryover performance.</td>
</tr>
<tr>
<td>Concentration of wash solvent</td>
<td>Wash solvent must be no stronger than the concentration needed to reduce carryover to an acceptable level.</td>
</tr>
<tr>
<td>Solubility of sample</td>
<td>The sample must be soluble in the purge solvent if you are performing auto-dilution.</td>
</tr>
<tr>
<td>Sample diluent</td>
<td>The purge solvent (diluent) will contact the sample, so match the sample matrix as closely as possible. To offset adverse effects on peak shape caused by the matrix’s composition, adjust the purge solvent composition.</td>
</tr>
<tr>
<td>Cycle times</td>
<td>Higher viscosity wash solvents lengthen wash cycles.</td>
</tr>
</tbody>
</table>
Washing the SM-FTN needle

To wash the SM-FTN needle (OD needle wash):

1. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.
2. In the SM-FTN information window, click Control > Wash Needle.
   Alternative: Right-click the SM-FTN control panel in the data application, and then click Wash Needle.
3. In the Needle Wash box, specify the wash duration, in seconds.
   Tips:
   - The range is 0 through 99 seconds; the default is 6 seconds.
   - The flow rate of the wash solvent is 20 mL/min +/- 20%.
4. Click OK.
   Result: The needle wash begins. When it ends, the status returns to idle.

To stop a needle wash routine before it finishes:

In the SM-FTN information window, click Control > Reset SM.
Alternative: Right-click the SM-FTN control panel in the data application, and then click Reset SM.

Loading sample plates

The SM-FTN is compatible with the ANSI standard well-plates, vial-trays, vials, and cap-mats/seals that are approved for use with the ACQUITY UPLC system. The SM-FTN holds two ANSI/SBS plates that you load through the sample compartment door.

Requirement: The plates you use must meet ANSI/SBS standards.

Tip: Vial positions V1 through V4, located on the right-hand and left-hand sides of the sample tray, accommodate 4-mL vials. Contact Waters for inserts that allow you to use 2-mL vials in these positions.
Observing vial and plate recommendations

Waters recommends that you observe these usage guidelines for sample vials and plates in the SM-FTN:

• **Vials**
  – Use only Waters-certified vials.
  – Ensure that vial holders conform to ANSI/SBS standards.

• **Plates**
  – Use only 1860024XX-series plates and cap mats in the SM-FTN.
  – When selecting a new plate supplier, especially for 384-well plates, measure the plate size to ensure compatibility with Waters’ specifications for the SM-FTN.
  – To avoid warping plates, do not centrifuge them.
  – Be aware that plates containing samples with high concentrations of organic solvent can give inconsistent results at room temperature.

• **Covers**
  – Use foil covers on vial plates whenever possible.
  – Use pre-slit cap-mats/seals and vial caps. Use of non-pre-slit cap mats and vial caps can cause clogging in the wash lines.
  – To prevent sample spillage or needle damage, use only Waters-approved covers on the sample vials.

For more information about plates and vials, see *Using Plates and Vials with ACQUITY UPLC Systems*, part number 715002434.

![Warning](image)

**Warning:** To avoid eye injury, wear safety glasses when loading sample plates.

**Required material**

Safety glasses

**To load a sample plate:**

1. Open the sample compartment door.
2. Press the plate selector switch on the top, center of the door frame to select plate position 1 or 2.
**Exception:** If the SM-FTN is accessing the sample tray when you select a new plate position, the selector switch does not operate and the instrument beeps once. The selector switch operates again after the SM-FTN no longer accesses the sample tray.

**Tip:** Press the plate selector switch twice to toggle between loading a sample plate and loading positions that accept 4-mL vials.

3. Pull the sample tray out.

4. Load the plate onto the tray so that well position A,1 is at the rear, left-hand corner, and the forward edge of the plate is behind the spring inside the front of the carrier.
Tip: “A” represents the row number, “1” represents the vial position.

Sample plate vial positions:
5. Slide the tray in until it clicks into place.

![Sample tray handle]

**Caution:** To avoid damaging the sample needle, the sample plates must be positioned correctly and the sample tray must be fully engaged.

6. Close the sample compartment door.

**Sample chamber considerations**

**Warning:** To avoid puncture wounds, keep hands or loose clothing clear of the needle assembly mechanism while it is moving. Note that the SM-FTN beeps three times whenever the sample compartment door is open, and the needle assembly mechanism is about to move.

**Choosing needles and extension loops**

**Sample needles**

Waters offers multiple needle sizes, so you can choose the best option for your injection volume and sample viscosity. The needles, made from metal, provide greater strength and more robust operation than some other traditional materials. Waters recommends metal needles for samples known to be
attracted to hydrophobic polymers and also when you use hexane and tetrahydrofuran.

**Tip:** Using a smaller needle increases cycle times.

**The following metal sample needles are available for the SM-FTN:**

<table>
<thead>
<tr>
<th>Needle size</th>
<th>Recommended maximum injection volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-µL (24-inch L × 0.007-inch ID) – Default</td>
<td>10 µL</td>
</tr>
<tr>
<td>30-µL (24-inch L × 0.010-inch ID)</td>
<td>25 µL</td>
</tr>
</tbody>
</table>

**Extension loops**

Extension loops, which increase the volume of sample that can be drawn and held for injection, are an optional part of the injection system. You install them between the needle and the injection valve port.

**The following extension loops are available to use in the SM-FTN:**

<table>
<thead>
<tr>
<th>Loop size</th>
<th>Recommended maximum injection volume for a needle of any size</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 µL</td>
<td>50 µL</td>
</tr>
<tr>
<td>100 µL</td>
<td>100 µL</td>
</tr>
<tr>
<td>250 µL</td>
<td>250 µL</td>
</tr>
</tbody>
</table>

**Recommendation:** Use a sample syringe with a volume of at least two times that of your sample. When using the 50-µL extension loop, you can use the default (100-µL) sample syringe. Larger extension loops require a larger sample syringe. See page 69 for more information about replacing the sample syringe.

**Required materials**

- Extension loop kit
- 1/4-inch open-end wrench
- Gloves: clean, powder-free, chemical-resistant
To install an extension loop:

1. Power-off the SM-FTN.
2. Open the fluidics compartment door.
3. Remove the sample needle from port 4 of the injection valve.

4. Screw the extension loop fitting into port 4 of the injection valve, and then use the 1/4-inch open-end wrench to tighten the fitting 3/4-turn past finger-tight.

5. Screw the sample needle fitting into the extension loop union, and then use the 1/4-inch open-end wrench to tighten the fitting 3/4-turn past finger-tight.

Requirement: During system operation, ensure solvent does not leak from the connection between the sample needle fitting and the extension.
loop. The waste management system cannot collect leaks from this connection.

6. Close the fluidics compartment door.
7. Power-on the SM-FTN.
8. Modify the extension loop volume configuration according to the instructions in page 29.

**Modifying needle and extension loop configuration parameters**

To configure the system for a needle or extension loop size that differs from the one currently fitted:

1. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.
2. Select Configure > Volumes.
3. In the Volume Configuration dialog box, select the appropriate needle or extension loop size from the list, and then click OK.

**Choosing the sample syringe**

The following sample syringe sizes are available to use in the SM-FTN:

- 50 μL
- 100 μL – Default
- 250 μL
- 500 μL

Choose a syringe size that allows you to draw your desired total sample volume into the sample needle (and optional extension loop). Waters recommends using a sample syringe volume that is at least two times your sample volume.
Modifying sample syringe configuration parameters

To configure the system for a syringe size that differs from the one currently fitted:

1. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.
2. Select Configure > Volumes.
3. In the Volume Configuration dialog box, select the appropriate sample syringe size from the list, and then click OK.

Choosing the sample syringe draw rate

The ideal syringe draw rate depends on sample volume, sample viscosity, and desired cycle time. The default syringe draw rates depend on the needle size:

- 15 µL needle: 30 µL/min
- 30 µL needle: 120 µL/min

You can also specify the draw rate (in µL/min), if desired.

Maximum syringe draw rates:

<table>
<thead>
<tr>
<th>Solvent Type</th>
<th>15-µL needle (0.007-inch ID)</th>
<th>30-µL needle (0.010-inch ID)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50:50 methanol/water</td>
<td>30 µL/min</td>
<td>120 µL/min</td>
</tr>
<tr>
<td>100% water</td>
<td>55 µL/min</td>
<td>230 µL/min</td>
</tr>
<tr>
<td>100% acetonitrile</td>
<td>150 µL/min</td>
<td>640 µL/min</td>
</tr>
<tr>
<td>100% dimethyl sulfoxide (DMSO)</td>
<td>25 µL/min</td>
<td>100 µL/min</td>
</tr>
</tbody>
</table>
Choosing the needle height setting

The default setting for needle penetration depth prevents you from reaching the bottom of the vial.

⚠️ **Caution:** To avoid damaging the needle, follow the guidelines in this section, and use the appropriate needle-height setting for your sample plates or vials.

You can change the default needle placement (needle height) setting in the software in two places: the Dilution tab of the Sample Manager instrument method editor and the Advanced Settings dialog box. Set consistent values in both places.

To aspirate more sample from the vial, decrease the value so that the needle tip is closer to the bottom of the vial.

**Tips:**
- The default needle-height setting for 48-vial plates with a 2-mL vial is "automatic", which is set at 4.0 mm.
- The default needle-height setting for all other plates is 2.0 mm.
Recovering maximum sample from vials

The current ANSI plate (48 vials) definition for the 2-mL Maximum Recovery Vials can leave some sample in the vial. If you want to recover the maximum amount of sample, change the needle placement setting.

**Tip:** To modify needle placement for vials, click Instrument Method Editor > ACQ-FTN > General tab > Advanced, and change the “Needle Placement (from bottom)” value.

<table>
<thead>
<tr>
<th>Vial type</th>
<th>Minimum needle placement (mm)</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waters Supplied Total Recovery Vial</td>
<td>0.7</td>
<td>Screw Cap 12 × 32 mm Clear Total Rec pre-slit PTFE/Silicone Septa</td>
<td>186000385C</td>
</tr>
<tr>
<td>Waters Supplied Max. Recovery Vial</td>
<td>2.1</td>
<td>Screw Cap 12 × 32 mm Clear Max Rec pre-slit PTFE/Silicone Septa</td>
<td>186000327C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Screw Cap 12 × 32 mm Amber Max Rec pre-slit PTFE/Silicone Septa</td>
<td>186003886C</td>
</tr>
<tr>
<td>Waters Supplied Flat Bottom Vial</td>
<td>0.1</td>
<td>Screw Cap 12 × 32 mm Clear with pre-slit PTFE/Silicone Septa</td>
<td>186000307C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Screw Cap 12 × 32 mm Amber pre-slit PTFE/Silicone Septa</td>
<td>186000847C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Screw Cap 12 × 32 mm 750 µL PP pre-slit PTFE/Silicone Septa</td>
<td>186002636</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Screw Cap 12 × 32 mm 300 µL PP pre-slit PTFE/Silicone Septa</td>
<td>186002639</td>
</tr>
</tbody>
</table>

**See also:** Waters Sample Vials and Accessories brochure on www.waters.com.
Revising a plate type

The ANSI-48Tube0.65mLHolder plate type is defined in Empower software so that the needle does not use sample near the bottom of the vial, greatly increasing the residual volume. The plate type contains 0.65 mL tubes.

To create a new plate type and correct the depth value:

1. In Empower software, open the Configure System window.
2. From the Empower Configuration tree, select Plate Types.
3. Select the plate type “ANSI-48Tube0.65mLHolder”.
4. From the menu, select File > Properties.
5. Under Plate Type, type a suitable name for the plate.
6. Change the Depth parameter to 28.5.
7. Click OK.

Result: A copy of the plate definition is created with a new name and revised needle depth.

Air gaps

If air gaps are required for your chromatography, you can specify an air-gap volume in the instrument method editor. The default air-gap volume is 0 μL.

To specify an air-gap volume:

1. In the instrument method editor, click the ACQ-FTN tab and then the General tab.
2. Click Advanced.
3. In the Advanced Settings dialog box, mark the box for the air-gap option.
4. Specify volumes for your pre-aspirate and post-aspirate air gaps, and then click OK.
Load-ahead and loop offline options

Load ahead

The load-ahead option instructs the sample manager to aspirate the next sample in a sample list while a current sample is running, thus reducing the overhead time (time in addition to the chromatographic analysis time) of an injection cycle. In many applications, the Load Ahead option reduces cycle time without degrading chromatographic performance.

Restriction: The first injection of a sample set, and injection sets with different methods, cannot utilize load-ahead mode.

Requirement: You must take the needle and optional extension loop off-line when you use the load-ahead option.

The following figures show a standard ACQUITY UPLC system cycle time and load-ahead cycle time.

Standard ACQUITY UPLC system cycle time definition:
ACQUITY UPLC system load-ahead cycle time definition:

Load-ahead mode after the first injection

Tip: The time buffer delay is a “wait time” that compensates for variations in the time it takes to load a sample.

If the wash time and the sample prep time are equal to or greater than the chromatographic run time then load ahead does not improve the cycle time.

Loop offline

The loop-offline option can reduce the delay volume by taking the needle and extension loop offline before the gradient reaches the injection valve and after the sample transfers to the injection port. However, dwell volume is significant only in systems that use extension loops larger than 50 µL.

Take the loop offline:

• Before the first gradient change reaches the injection valve
• After the gradient returns to the initial conditions

Determining the correct time to take the loop offline

At the point the loop is eliminated from the flow path, it contains the mobile phase composition. Solutes that deposit in the extension loop due to poor solubility are not transferred to the column until the gradient composition dissolves the sample and flushes it onto the column. At that point, the solute’s
high retention factor (k') causes it to elute from the column in one column volume. Choosing the correct time to take the extension loop offline ensures that all of the peaks are flushed out of the loop.

If you are taking the loop offline before the first gradient change, flush the needle and extension loop with at least five loop volumes of solvent at the initial gradient composition to completely flush the sample onto the column. In this case, use the following formula to calculate the loop offline time:

\[
\text{Loop offline time (min)} = \frac{\text{Nominal needle and extension loop volume (µL)}}{\text{Flow rate (µL/min)}} \times 5
\]

Example: For a system flowing at 100 µL per minute, with a 50 µl loop installed, the loop offline time should be at least 2.5 minutes.

\[
\text{Loop offline time (min)} = \frac{50 (µL)}{100 (µL/min)} \times 5
\]

\[
\text{Loop offline time (min)} = .5 \text{ min} \times 5
\]

\[
\text{Loop offline time (min)} = 2.5 \text{ min}
\]

If you are taking the needle and optional extension loop offline after the end of the gradient, ensure they are completely filled with solvent of the initial gradient composition before taking them offline.

In addition, observe these considerations when determining the correct loop offline time:

- If the wash solvent volume has been significantly increased, the washing process may not be complete when the loop switches back. If this is the case, extend the loop offline time.
- The loop offline time must not occur if the contents of the needle and optional extension loop are of a higher concentration than the initial gradient conditions.
To choose the load-ahead and loop-offline options:

1. In the instrument method editor, click the ACQ-FTN tab and then the General tab.
2. Mark the boxes for the load-ahead and loop-offline options.
3. Specify a time interval for the loop-offline option.

**Tip:** In the SM-FTN, a programmed gradient typically flows through all parts of the instrument that contact the sample. If you initiate the loop-offline option before the gradient reaches its final conditions, the highly organic portion of your gradient does not pass through the needle. As a result, the gradient can fail to remove all sample from the needle – resulting in low sample recovery and an increased risk of carryover.

Reducing carryover

In a chromatographic system, any substance that creates unwanted peaks or excessive background noise is contamination. Carryover, a specific type of contamination, occurs when sample material remaining in the system after an injection appears as peaks in subsequent injections, compromising quantification. To optimize system performance, carryover must be minimized and held to an acceptable level (often, below the limits of detection).

Carryover can result from incorrectly installed tubing, fittings, or other hardware or by selecting ineffective wash solvents. Take these actions to reduce carryover:

- Restrict extension loop usage to one system. Due to part tolerances, fittings that have already been mated to one part may become a source of carryover when used with a different part.
- Ensure all tubing connections are properly set. Tubing must seat properly (that is, without gaps) in its fittings before you tighten them. Poorly seated connections create unnecessary space-reservoirs that retain sample, increasing carryover.
- Inspect the needle guide for sample residue or debris, which can cause carryover. If necessary, clean or replace the guide.
- Avoid plate or vial sealing systems that use sticky substances, which can cause carryover.
• If you suspect sample interaction with the needle material, increase the strength of your wash solvent or the wash time. If carryover persists, replace the needle with one of a different material composition, such as the Bio (MP35N) needle, which may reduce sample interaction.

• Follow the guidelines in page 20 when selecting wash solvents.

**Auto additions**

If you use Empower 3 to control the SM-FTN, use the Auto additions function to make an injection that is composed of sample from up to ten vials, one of which is the sample vial. You can specify a delay time to allow the sample to mix once the sample from all vials is in the sample loop.

**Requirement:** The total volume of an Auto additions injection must be less than the sample loop volume.

**See also:** Empower 3 online Help for additional information about using the Auto additions function.

**Auto dilution**

Choose the auto-dilution option to dilute dissolved samples (containing no solids) with a solvent the sample syringe delivers. You can specify an interval, to allow time for sample mixing.

**To choose the dilution option:**

1. In the instrument method editor, click the ACQ-FTN tab and then the Dilution tab.
2. Mark the box to Enable dilution.
3. Specify a needle height, purge solvent volume, and a post dilution delay interval.

**Diagnostic tests**

You can select these diagnostic tests from the SM-FTN's Maintain menu:

• Needle seal readiness test, which verifies that, when the needle is in the “seal” position and the injection valve is in the “inject” position, no unacceptable drop in solvent pressure occurs.

• Sample syringe leak test, which verifies the sample path is free of leaks.
The Maintain menu also lists these functions:

- Characterizing the needle seal, which determines the seal location.
- Calibrating the needle’s Z-axis, which calibrates the vertical position of the needle.
- Disabling motors, which you do before manually moving the sample tray and R-carriage.
- Parking the sample needle and injection valve, which you do before storing the system, or replacing a needle or valve.
- Replacing the needle, seal, and sample syringe.

See also:

- *Quaternary Solvent Manager Operator’s Overview and Maintenance Information or ACQUITY UPLC Binary Solvent Manager Operator’s Overview and Maintenance Information* document for information on the solvent manager’s leak test.
- ACQUITY Console online Help for additional information about running diagnostic tests.

**Resolving leak sensor errors**

The SM-FTN is the only ACQUITY UPLC instrument fitted with two leak sensors, bottom and top: called the SM-FTN leak sensor and the column heater leak sensor, respectively.

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

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

⚠️ **Caution:** To avoid scratching or damaging the leak sensor
- do not allow buffered solvents to accumulate and dry on it.
- do not submerge it in a cleaning bath.
Required materials

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

To resolve a leak sensor error:

1. In the ACQUITY UPLC Console’s Leak Sensors dialog box, determine which of the SM-FTN’s 2 leak sensors detected a leak.

2. If the message reads “Leak Detected”, locate the source of the leak, and make the repairs necessary to stop it. If you need additional information, see the Column Compartments Operator’s Overview and Maintenance Information document.

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

3. Remove the leak sensor from its reservoir, grasping it by its serrations, and pull upward on it.

Tip: If you cannot easily manipulate the leak sensor after removing it from its reservoir, detach the connector from the front of the device (see page 46).
4. Use a nonabrasive, lint-free wipe to dry the leak sensor prism.

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

6. With a cotton swab, absorb any remaining liquid from the corners of the leak sensor reservoir and its surrounding area.
7. Align the leak sensor’s T-bar with the slot in the side of the leak sensor reservoir, and slide the leak sensor into place.

8. If you detached the connector from the front of the instrument, reattach it.

9. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.

10. In the SM-FTN information window, click Control > Reset SM, to reset the SM-FTN.
Maintaining the SM-FTN

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). Otherwise, 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 malfunction
• Instrument serial numbers (see page 43)
• Flow rate
• Operating pressure
• Solvent(s)
• Detector settings (sensitivity and wavelength)
• Type and serial number of column(s)
• Sample type
• Data application version and serial number
• ACQUITY UPLC system workstation model and operating system version

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

Locating system serial numbers

Each system instrument or device bears a serial number that facilitates service and support. Serial numbers also provide a way to create single log entries for each instrument so that you can review the usage history of a particular unit.

Be prepared to provide the serial numbers of the instruments in your system when you contact Waters customer support.
To view instrument information:

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

2. Click Configure > View module information.

The Module Information dialog box displays this information:

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

Alternatives:

- From the main window, hover the pointer over the visual representation of the system instrument or device you want information about.
- Obtain the serial number from the printed labels on the device’s rear panel or inside the sample compartment door.

Maintenance schedule

Waters recommends that you perform the following routine maintenance on the SM-FTN to ensure reliable operation and accurate results. When using the system throughout the day (and on nights and weekends), or when using aggressive solvents such as buffers, perform these maintenance tasks more frequently.

Recommended routine maintenance schedule:

<table>
<thead>
<tr>
<th>Maintenance procedure</th>
<th>Frequency</th>
<th>For information...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace the leak sensor</td>
<td>As needed</td>
<td>See page 46.</td>
</tr>
<tr>
<td>Replace the seal</td>
<td>During scheduled routine maintenance or as needed</td>
<td>See page 48.</td>
</tr>
<tr>
<td>Replace the sample needle and needle guide</td>
<td>During scheduled routine maintenance or as needed</td>
<td>See page 61.</td>
</tr>
</tbody>
</table>
Recommended routine maintenance schedule: (Continued)

<table>
<thead>
<tr>
<th>Maintenance procedure</th>
<th>Frequency</th>
<th>For information...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace the sample syringe</td>
<td>During scheduled routine maintenance or as needed</td>
<td>See page 69.</td>
</tr>
<tr>
<td>Clean the injection port</td>
<td>Weekly or monthly, according to system usage</td>
<td>See page 72.</td>
</tr>
<tr>
<td>Replace the injection valve cartridge</td>
<td>During scheduled routine maintenance or as needed</td>
<td>See page 75.</td>
</tr>
<tr>
<td>Clean the instrument with a soft, lint-free cloth, or paper dampened with water</td>
<td>As needed</td>
<td>See page 77.</td>
</tr>
</tbody>
</table>

Maintenance considerations

Safety and handling

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

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

⚠️ **Warning:** To avoid electric shock, do not remove the instrument’s protective panels. The components within are not user-serviceable.

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

Proper operating procedures

To ensure your system runs efficiently, follow the procedures on page 10.
Configuring maintenance warnings

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

Replacing the leak sensor

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

Required materials

- Gloves: clean, powder-free, chemical-resistant
- New leak sensor

To replace the leak sensor:

1. Open the fluidics compartment door.
2. Press down on the tab to detach the leak sensor connector from the front of the instrument.
3. Remove the leak sensor from its reservoir, grasping it by its serrations, and pull upward on it.

4. Carefully unpack the new leak sensor.

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

6. Plug the leak sensor connector into the front of the SM-FTN.
7. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.

8. In the SM-FTN information window, click Control > Reset SM, to reset the SM-FTN.

Replacing the seal

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

**Required materials**

- 5/16-inch open-end wrench
- 1/4-inch open-end wrench
- 1/2-inch open-end wrench
- T10 TORX driver
- T20 TORX driver
- Gloves: clean, powder-free, chemical-resistant
- Seal kit

**To replace the seal:**

1. In the ACQUITY UPLC Console, select Sample Manager-FTN from the system tree.

2. Click Maintain > Replace > Seal.
   
   **Result:** Doing so moves the needle carriage towards the back of the sample compartment.

3. Open the sample compartment and the fluidics compartment doors.
4. Using the T20 TORX driver, loosen the two captive screws that secure the access panel, and then remove the panel.

5. Using the 1/4-inch open-end wrench, unscrew the seal port tube’s fitting from port 1 of the injection valve.

   **Tip:** The seal port tube’s fitting is located in the 1 o’clock position.
6. Using the T10 TORX driver, remove the screw that secures the seal assembly to the sample compartment floor, lift the assembly upward, and remove it and the seal port tube from the sample compartment.

7. Unscrew the finger-tight wash tube fitting from the finger-tight wash fitting.

8. Unscrew the finger-tight wash fitting from the seal assembly.

9. Slide the support sleeve out of the metal housing, and guide the seal port tube through the slots.
**Requirement:** Hold the assembly in a vertical position when disassembling it. Doing so helps ensure that the metal spring stays in place and in the proper position.

10. Straighten the seal port tube.

11. Place the seal port’s metal housing in its original location on the sample compartment floor.

**Result:** Doing so helps ensure that the metal spring stays in place and in the proper position.

**Note:** The metal spring can fall out of the spring cup if the seal port metal housing is not placed in its original location on the sample compartment floor.

12. Place the 1/2-inch open-end wrench on the PEEK support sleeve to hold it in place.
13. Place the 5/16-inch open-end wrench on the stainless steel locking nut.

14. Loosen the locking nut, and unscrew it from the support sleeve.
15. Remove the seal from the seal port, and discard the seal.
Caution: To prevent contamination to system components, wear clean, chemical-resistant, powder-free gloves and work on a clean surface when replacing the seal.

16. Insert the new seal into the seal port. The seal is keyed, ensuring that it will only install one way, as shown below.
17. Finger-tighten the locking nut into the support sleeve.

18. Place the 1/2-inch open-end wrench on the support sleeve to hold it in place.

**Caution:** To avoid damaging the seal port tube, do not excessively twist the tube.

19. Place the 5/16-inch open-end wrench on the locking nut and tighten 1/4-turn beyond finger tight.
20. Bend the line 90 degrees in line with the threaded hole in the support sleeve.

**Note:** To avoid interfering with the motion of the metal spring in the metal housing, the bend in the seal port tube must not extend beyond the step in the locking nut.

21. Slide the seal port tube into the slot on the side of the metal housing.

**Requirement:** Ensure the three prongs on the locking nut are seated inside the metal spring.
22. Slide the support sleeve into the metal housing, ensuring the fitting hole on the support sleeve aligns with the slot on the metal housing.
**Caution:** To avoid damaging the support sleeve, be careful not to cross-thread the wash fitting.

23. Screw the wash fitting finger-tight into the support sleeve.

24. Screw the wash tube fitting into the wash fitting, and tighten it finger-tight plus 1/4-turn.

25. Adjust the amount of tubing in the sample compartment by sliding it in and out of the foam.

   **Tip:** The wash tube is secured to the wall and should not interfere with the sample tray operation or vertical motion of the wash port.

26. Place the seal assembly in its original location on the sample compartment floor and align the screw hole with the hole in the floor, ensuring the injection port wash drain is in the needle wash basin.

   **Tip:** There are unused holes in the sample compartment floor.
27. Using the T10 TORX driver, tighten the screw that secures the seal assembly to the sample compartment floor.

28. Ensure all cables are routed so they do not interfere with the operation of the needle carriage home sensor.

Using gentle radius bends, route the seal port tube to the right, following straight up the right side edge of the sample compartment. The seal port tube must be routed in the middle of the wash fitting and the load cell cable. Ensure the cable exits the injection port assembly without any tight bends in front of the load cell cable.

Caution: To avoid errors in operation, ensure that the load cell cable is routed behind the seal port tube and the wash tube.

29. Using gentle radius bends, route the seal port tube behind the needle tube and to the right.
30. Screw the seal port’s fitting into port 1 of the injection valve, and then use the 1/4-inch open-end wrench to tighten the fitting 1/4-turn past finger-tight.

31. Reinstall the access panel using the T20 TORX driver to tighten the two screws that secure the panel to the front of the unit.

**Requirement:** Ensure that the seal port tube is routed under the gap on the side of the access panel.

32. Close the sample compartment and fluidics compartment doors.

33. Characterize the needle seal (see the ACQUITY UPLC online Help).

34. Perform the needle seal readiness test (see the ACQUITY UPLC online Help).
Replacing the sample needle and needle guide

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

**Required materials**
- T6 TORX driver
- T10 TORX driver
- T20 TORX driver
- Gloves: clean, powder-free, chemical-resistant
- Needle assembly kit

**To replace the sample needle and needle guide:**

1. In the ACQUITY UPLC Console, select Sample Manager-FTN from the system tree.
2. Click Maintain > Replace > Needle.
   **Result:** Doing so invokes a wizard that moves the sample needle assembly to an accessible position.
3. Open the sample compartment and fluidics compartment doors.
4. Using a T20 TORX driver, loosen the two captive screws that secure the access panel, and then remove the panel.

5. Remove the sample plate if a plate is loaded.

6. Unscrew the needle assembly’s fitting from injector port 4.
7. Inside the sample compartment, open the needle-tubing guide cover, located on the roof of the compartment, by rotating it clockwise.

8. Push the needle latch back, to release the needle mounting cylinder from its mounting cavity and the needle tubing from its notches.
9. Lift the needle tip out of the needle guide at the bottom of the needle mechanism.

![Diagram of needle and needle guide]

**Warning:** To avoid puncture wounds, or damage to the end of the needle, do not touch or press the end of the sample needle.

10. Using a T10 TORX driver, loosen the screw on the needle-tubing clamp and remove the tubing.

![Diagram of needle-tubing clamp]

Remove needle assembly from this clamp

Clamp screw
11. Using the T6 TORX driver, loosen the needle guide set screw, and then remove the needle guide.

![Diagram of Needle Guide and Set Screw](image)

12. Install the new needle guide, and tighten the set screw.

13. Holding the new needle assembly with both hands to control its position within the sample compartment, secure the mounting sleeve in the opening of the tubing clamp, with the fitting oriented toward the valve.

⚠️ **Caution:** To avoid letting go of the needle assembly and possibly damaging the tip of the needle, do not tighten the clamp screw during this step of the procedure.

**ACQUITY UPLC sample needle assembly:**

![Diagram of Needle Assembly](image)
14. From inside the sample compartment, take hold of the needle assembly tubing as it enters the compartment from above.

15. Ensure the needle tubing is routed to the left side of the needle carriage's rails and is secured in the guide channel on the roof of the compartment.

16. Remove the protective cap from the needle tip.

17. Insert the needle mounting cylinder into the mounting cavity.
18. Route the tubing through the two notches below the Z-flag.
19. Push the needle latch forward to secure the needle assembly.

**Caution:** To avoid damaging the instrument, do not place the loose loop of tubing above the Z-flag.

20. Using a T10 TORX driver, tighten the screw on the needle-tubing clamp.
21. Insert the needle’s tip into the needle guide at the bottom of the needle mechanism.

22. Ensure that the needle tubing is fully inserted into port 4, on the injection valve, and then thread the fitting into the port, tightening the fitting securely.

23. Reinstall the access panel, using the T20 TORX driver to tighten the two screws that secure it to the front of the unit.

**Requirement:** Ensure that the seal port tube is routed under the gap on the side of the access panel.

24. Close the sample compartment and fluidics compartment doors.

25. Calibrate the needle’s Z axis (see the ACQUITY UPLC online Help).
26. Characterize the needle seal (see the ACQUITY UPLC online Help).

27. Perform the needle seal readiness test (see the ACQUITY UPLC online Help).

**Replacing the sample syringe**

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

**Recommendation:** Perform the sample syringe leak test whenever you replace the sample syringe (see the ACQUITY UPLC online Help).

Air bubbles in the sample syringe adversely affect system pressure, baseline, volume, and peak area.

⚠️ **Caution:** To avoid breaking the sample syringe, do not attempt to remove air bubbles from the syringe by tapping on it.

Replace the sample syringe when any of these conditions arise:

- The syringe plunger tip becomes worn or discolored
- You want to change to the other syringe size
- The syringe leaks or causes air bubbles
- The syringe fails the leak test

**Required materials**

- Degassed, weak wash solvent
- Gloves: clean, powder-free, chemical-resistant
- Replacement sample syringe
Warning: To avoid a pinch injury or puncture wound, ensure that no injection is in progress or pending before you remove the sample syringe.

**To replace the sample syringe:**

1. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.

2. Click Maintain > Replace > Sample syringe > OK.

   **Result:** Doing so invokes a wizard that moves the syringe to the “down” position.

3. Open the fluidics compartment door.

4. Remove the knurled screw that holds the sample syringe to the syringe mounting bracket.

**Sample syringe assembly components:**

5. Unscrew the sample syringe, counterclockwise, until it separates from the sample syringe valve.
Caution: To avoid breaking the syringe, do not grasp it by its glass barrel. Always grasp the syringe by its knurled collar.

6. Depress the syringe barrel to clear the top mounting bracket, and remove the syringe.

7. Carefully unpack the replacement sample syringe.

8. Partially fill the new syringe (by hand) with weak wash solvent (to help remove air bubbles).

   Requirement: Make sure all air bubbles are removed.

9. Retract the syringe plunger so that the plunger end slides over the threaded post on the syringe guide mounting bracket.

10. Screw the new sample syringe partially into the sample syringe valve.

11. Finger-tighten the sample syringe.

12. Install and finger-tighten the knurled screw that holds the sample syringe plunger to the mounting bracket.

13. Run the Prime Sample Syringe Only option until no air bubbles remain in the sample syringe.

14. Close the fluidics compartment door.
Cleaning the injection port

The surfaces of the injection port can become coated with salt or buffer buildup, especially for systems used in biopharmaceutical applications. The buildup can interfere with the motion of the injection port. To ensure consistent injection performance, clean the injection port weekly or monthly, as necessary. The frequency of cleaning varies according to system usage and solvent composition.

Required materials

- T20 TORX driver
- Spray bottle
- Gloves: clean, powder-free, chemical-resistant
- Nonabrasive, lint-free wipes
- HPLC-grade water

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

⚠️ Warning: To avoid eye injury, wear safety glasses when cleaning the injection port.

To clean the injection port:

1. Stop the solvent flow.
2. Open the sample compartment and fluidics compartment doors.
3. Remove the sample plate.
4. In the ACQUITY UPLC Console, select Sample Manager-FTN from the system tree.
5. Click Maintain > Replace > Seal.
   
   **Result:** Doing so moves the needle carriage towards the back of the sample compartment, improving access to the injection port.
6. Open the SM-FTN’s door.
7. Using the T20 TORX driver, loosen the two captive screws that secure the access panel, and then remove the panel.

![Access panel and Captive screw (2)](image)

8. Dampen a nonabrasive, lint-free wipe with HPLC-grade water and use it to clean the areas of the injection port shaded in the image below.

![Injection port](image)

9. In the ACQUITY UPLC console, click Maintain > Change Needle.
10. The needle carriage moves to the front of the sample compartment, improving access to the needle.

11. Place a nonabrasive, lint-free wipe underneath the needle carriage.

12. Spray the needle and needle guide with HPLC-grade water to wash off any deposits.

13. Allow the water and deposits to drip off the needle, and then carefully remove the wipe from beneath the needle.

14. Reinstall the access panel using the T20 TORX driver to tighten the two screws that secure the panel to the front of the unit.
**Requirement:** Ensure that the seal port tube is routed through the gap in the insulation on the side of the access panel.

15. Close the sample compartment and fluidics compartment doors.
16. Reset the SM-FTN.

**Replacing the injection valve cartridge**

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

**Requirement:** When you replace the injection valve, you must also replace the sample loop.

**Required materials**

- 2-mm Allen wrench
- Gloves: clean, powder-free, chemical-resistant
- Injection valve cartridge
To replace the injection valve cartridge:

1. In the ACQUITY UPLC Console, select Sample Manager FTN from the system tree.

2. In the SM-FTN information window, click Maintain > Park needle and inject valve > Yes.

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

3. Power-off the SM-FTN.

4. Open the fluidics compartment door.

5. Remove the fittings attached to the injection valve cartridge.

6. Use the 2-mm Allen wrench to remove the screw at the 10 o’clock position on the injection valve cartridge.

7. Remove the injection valve cartridge from the injection valve assembly.

8. Carefully unpack the replacement injection valve cartridge.

9. Ensure that the groove in the cartridge housing and the groove on the drive clamp align.
Tip: If they do not align, turn the drive clamp until the grooves line up.

10. Insert the new injection valve cartridge into the injection valve assembly.

Note: If the injection valve cartridge does not slide fully into the injection valve assembly, contact your Waters service representative.

11. Insert the 2-mm Allen screw at the 10 o’clock position on the injection valve cartridge, and tighten it.

12. Reattach all fittings, ensuring the tubes bottom in their fitting holes.

13. Close the fluidics compartment door.

14. Power-on the SM-FTN.

Cleaning the instrument’s exterior

Clean surfaces of the SM-FTN using only a soft, lint-free paper or cloth dampened with water.

Observe these requirements when cleaning device surfaces:

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