Waters 2707 Autosampler

Operator's Guide

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Safety considerations

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

When you develop methods, follow the "Protocol for the Adoption of Analytical Methods in the Clinical Chemistry Laboratory," *American Journal of Medical Technology*, 44, 1, pages 30–37 (1978). This protocol addresses good operating procedures and the techniques necessary to validate system and method performance.

Decontamination information

For an explanation about how to decontaminate Waters liquid chromatography/mass spectrometry (LC/MS) products, see the Waters publication *Controlling Contamination in LC/MS Systems* (part number 715001307).

Safety advisories

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

Operating this instrument

When operating this instrument, follow standard quality control procedures and the guidelines in this section.

Intended use

Waters designed the 2707 Autosampler as a sample handler with a reliable, precise fluid path versatile enough for use in varied methods and applications. The optional heating/cooling module accommodates a wide range of samples, from heat labile biological samples to viscous polymer samples.

Quality control

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

Table of Contents

1 Understanding Operating Principles

Contents

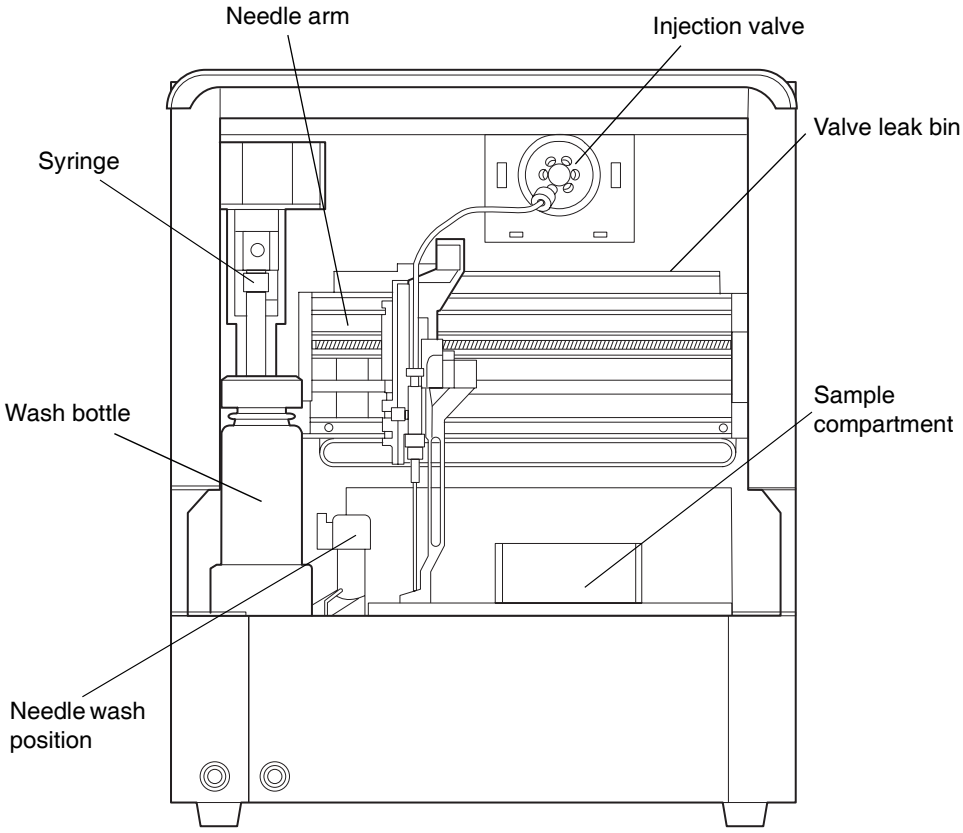
Describing the autosampler

The Waters 2707 Autosampler is a comprehensive, high-throughput instrument that offers the following features:

- Service-friendly design that requires little bench space
- High-resolution syringe control for high-precision injections
- Interchangeable fixed-volume sample loops
- Variable-volume partial-loop injection capability
- Optional sample cooling for consistent results (see the "Identifying options" section on page 1-5)
- Pressure-assisted sample aspiration injection capability (see the "Defining pressure-assisted sample aspiration" section on page 1-6)

Listing component parts

The autosampler's sampling compartment includes the following parts:



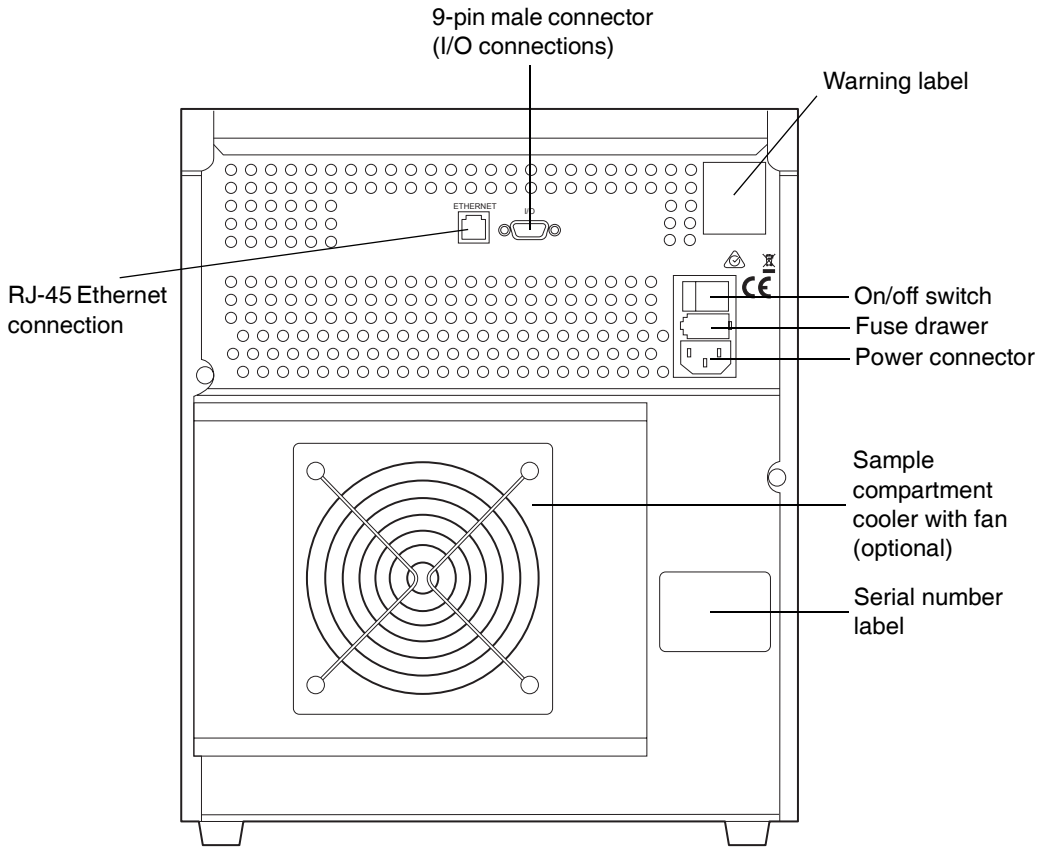
These parts are fitted as standard equipment:

- 100-µL sample loop
- 15-µL injection needle
- 500-µL syringe
- 1000-µL buffer tubing

The instrument uses standard high or low well plates or vial trays. The sampling compartment can house two well plates in any combination.

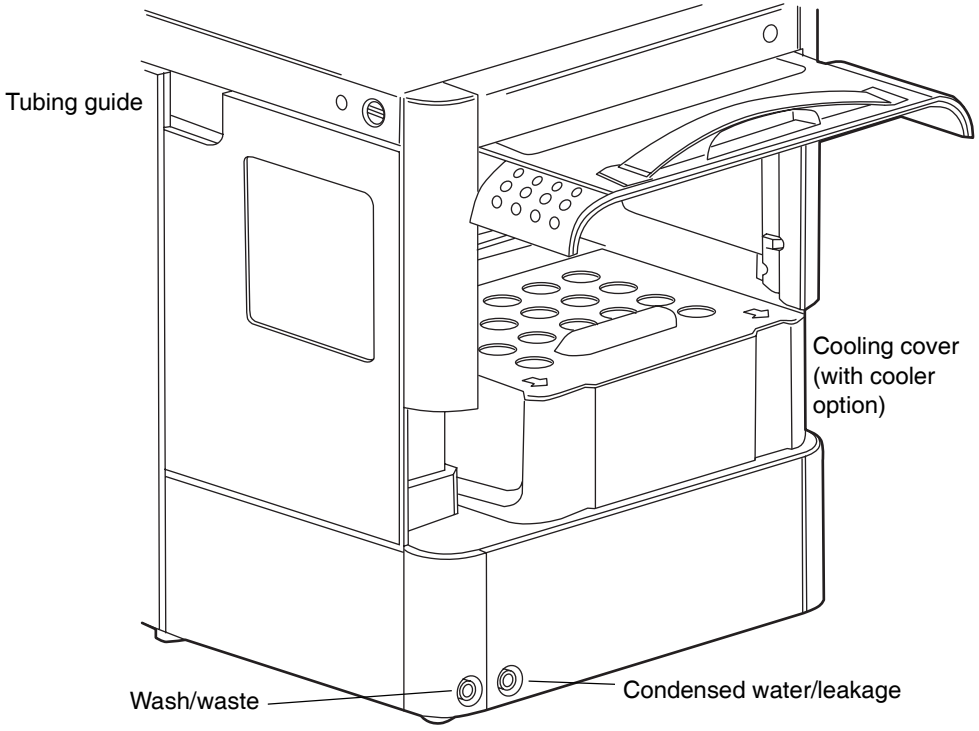
> **Exception:** The sampling compartment cannot accommodate 384 short on the left and 96 tall on the right (see the "Using well plates and vial trays" section on page 1-24).

These items appear on the instrument's rear panel:



Identifying options

With the factory-installed sample cooling option, the instrument has a cooling fan at its back (see the preceding figure) and a cooling cover in its sampling compartment (see the following figure). It also includes the following parts:



These are the user-installable options:

- Biocompatible sample flow path and valve – Inert sample needle (Silco® steel) and biocompatible valve (PEEK®)
- Prep kit for large-volume sampling – 2500 µL syringe, prep valve, 10000-µL sample loop, large sample volume (LSV) needle, and sample tray for 10-mL vials
- Air needles – Six types, each for a different type of well/vial plate, for pressurizing sample vials of varied heights during aspiration

Exploring injection principles

The autosampler has three injection modes:

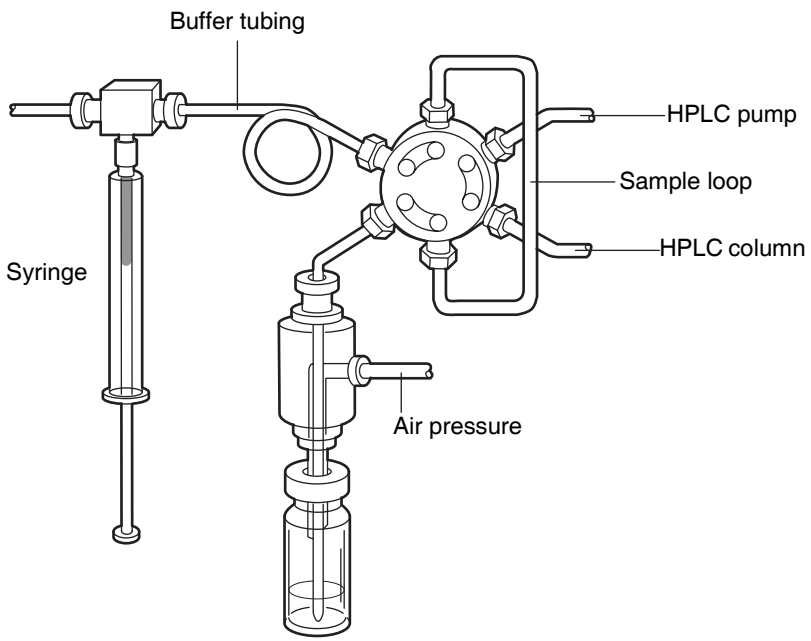
- Full loop– For maximum injection volume precision
- Partial loop needle overfill – For maximum flexibility
- Partial loop – For zero sample loss

Defining pressure-assisted sample aspiration

For all injection modes, the instrument method can enable loop injection with pressure-assisted sample aspiration. This option pairs an on-board compressor with intelligent valve switching and highly accurate syringe control, resulting in these benefits:

- Helps aspirate viscous samples
- Reduces the risk of bubbles in the sample line
- Prevents unwanted sample movement in the needle

Pressurizing vial



The syringe aspirates the sample from a vial into the sample loop. Buffer tubing between the syringe and the injection valve prevents syringe contamination. Wash solvent serves to:

- Remove sample from the buffer tubing and sample needle
- Rinse the buffer tubing and sample needle

Understanding syringe and buffer tubing

The instrument has two syringe sizes:

- 500 µL (standard)
- 2500 µL (included in the prep kit)

With standard 1000-µL buffer tubing and the standard 100-µL sample loop, injection volume ranges are as follows:

- Full loop – 100 µL
- Partial loop needle overfill – 0 to 50 µL
- Partial loop – 0 to 27 µL

Maximum injection volumes are calculated as follows:

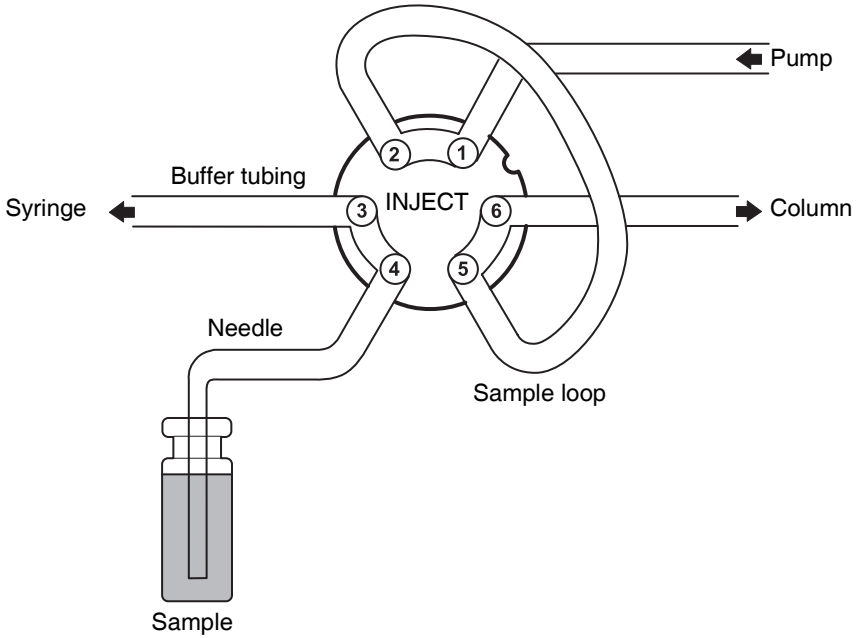
- Full loop – Loop volume
- Partial loop needle overfill – Half the loop volume
- Partial loop – (Loop volume - [3 × needle volume])/2

Full loop injections

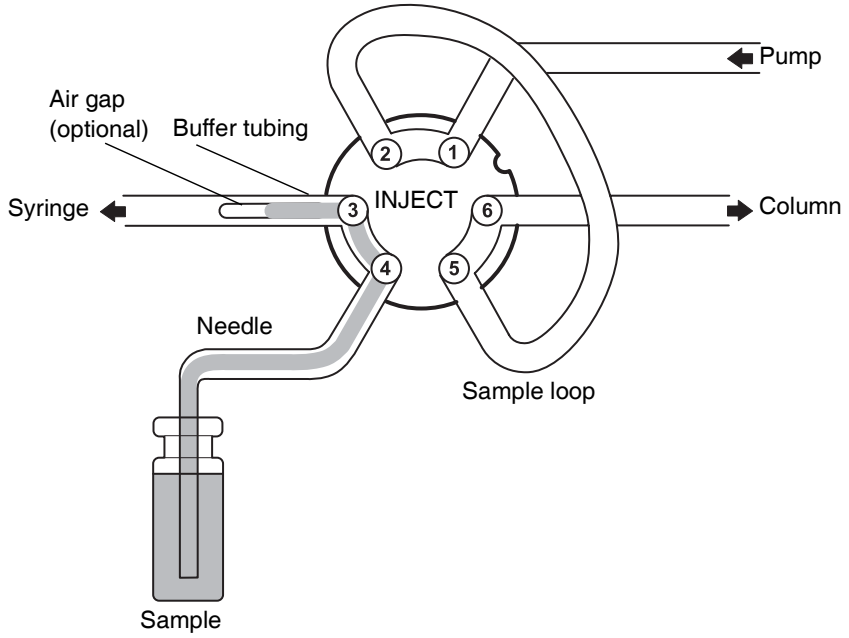
In the standard configuration, full loop injections yield maximum possible reproducibility < 0.3% RSD but not necessarily maximum accuracy, because loop volume is typically specified with an accuracy of ± 10%. Typical sample usage is 330 µL (3 × loop overfill + 30 µL flush volume for the needle). The minimum flush volume of 30 µL is recommended; you can program smaller flush volumes, but they decrease performance.

This is the full loop injection sequence:

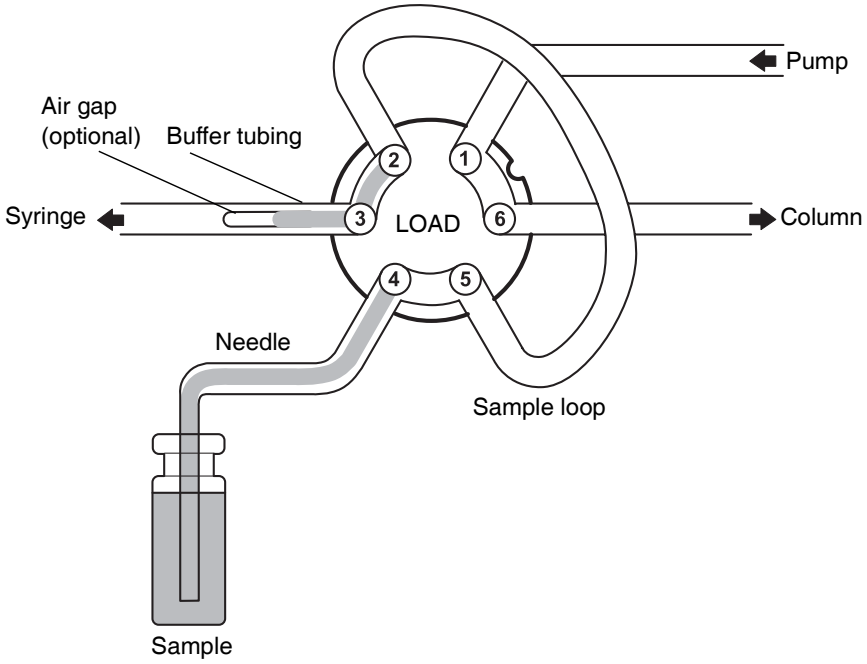
1. The injection valve moves to the Inject position, and the sample needle and air needle enter the well or vial. When the instrument method enables sample pressurization, the air needle applies headspace pressure to prevent air or vapor bubbles from forming during sample aspiration.



2. The syringe dispenser aspirates the flush volume (30 µL default) from the sample well or vial to fill the sample line with sample and remove wash solvent.



3. The injection valve switches to the Load position, placing a sample plug at the sample loop inlet.

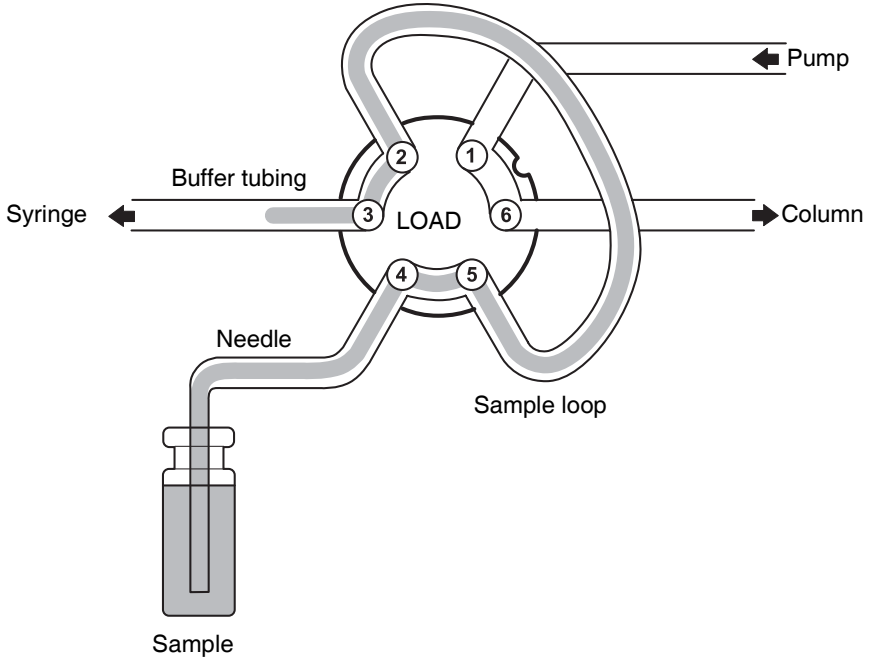


4. The sample loop fills quantitatively by transporting a multiple of loop volumes through the loop, as follows:

   3 × loop volume for loops ≤ 100 µL

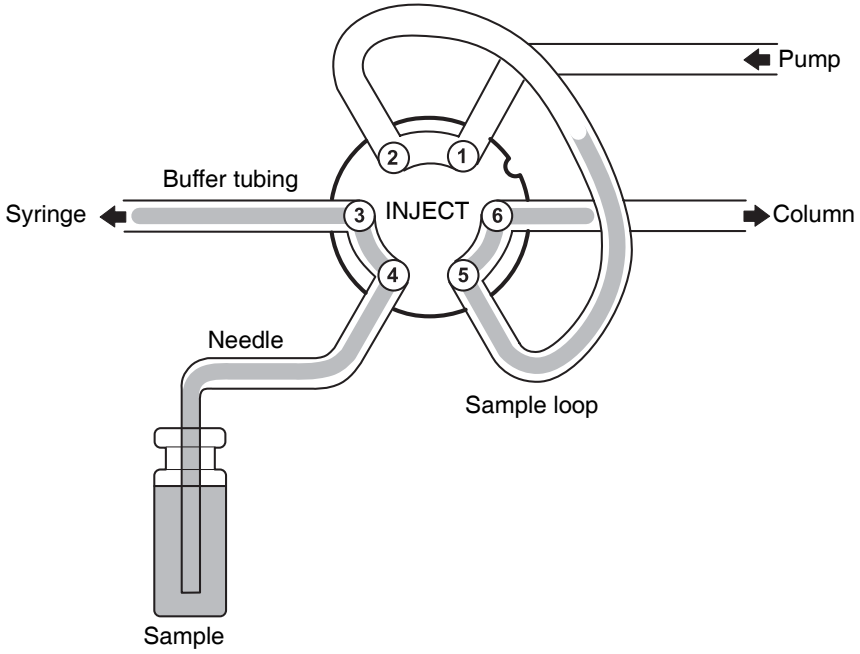
   2 × loop volume for loops 100 to 500 µL

   1.5 × loop volume for loops > 500 µL



5. The injection valve switches to the Inject position, and the sample loop becomes part of the flow path for the high performance liquid

chromatography (HPLC) mobile phase. Sample enters the column, and analysis starts.

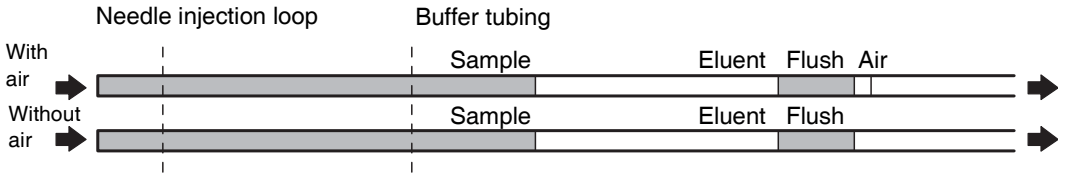


After each injection, a wash routine of programmable volume occurs.

Air segment with full loop injections

A 5-µL air segment that is at the front of the flush volume but not injected can minimize sample dilution caused by dispersion during aspiration.

With a standard needle, recommended flush volumes are 30 µL for injections that incorporate air segments and 35 µL for injections that do not. To enhance performance with highly viscous samples, larger flush volumes and reduced syringe speeds may be needed.

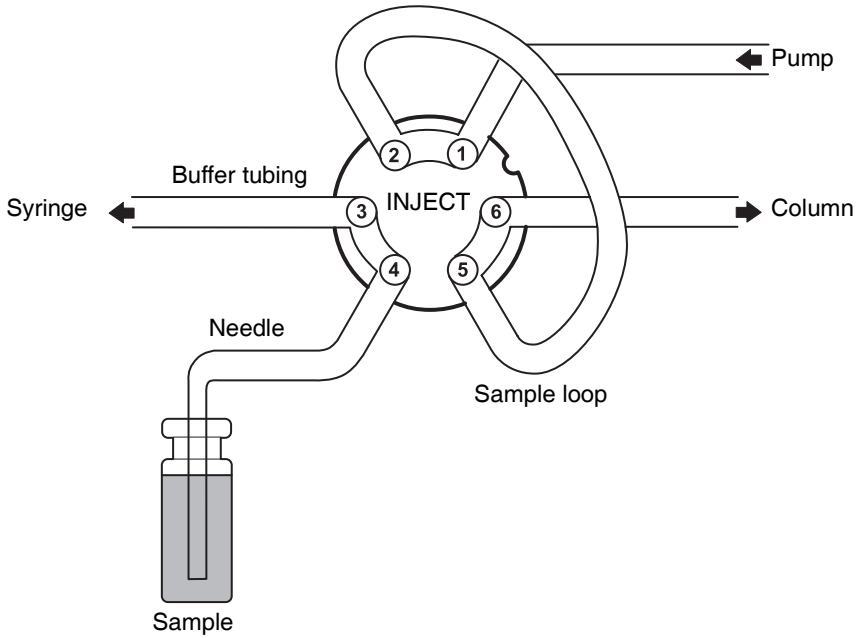


Partial loop needle overfill injections

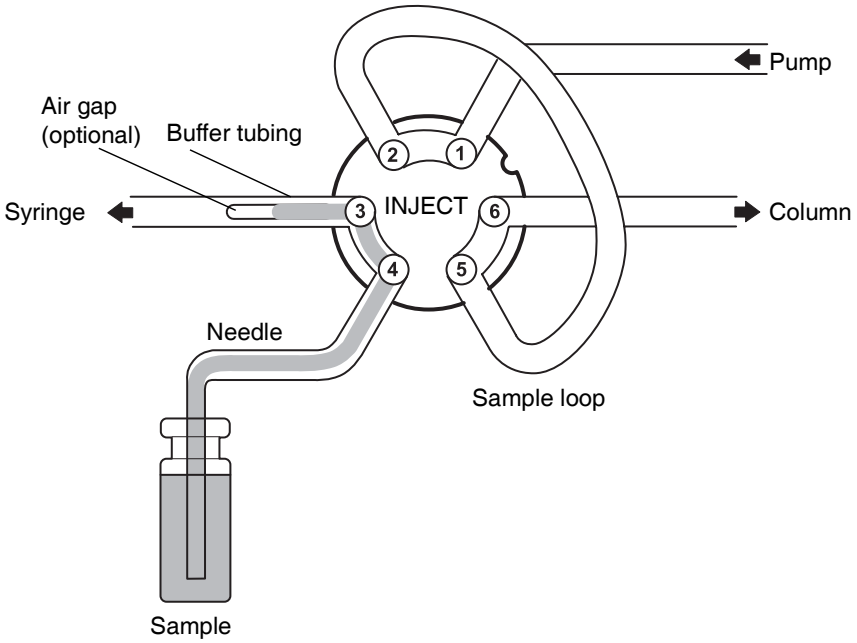
In the standard configuration, partial loop needle overfill injections yield maximum accuracy and reproducibility better than 0.5% RSD for injection volumes > 10 µL. The minimum flush volume of 30 µL is recommended.

This is the partial loop needle overfill injection sequence:

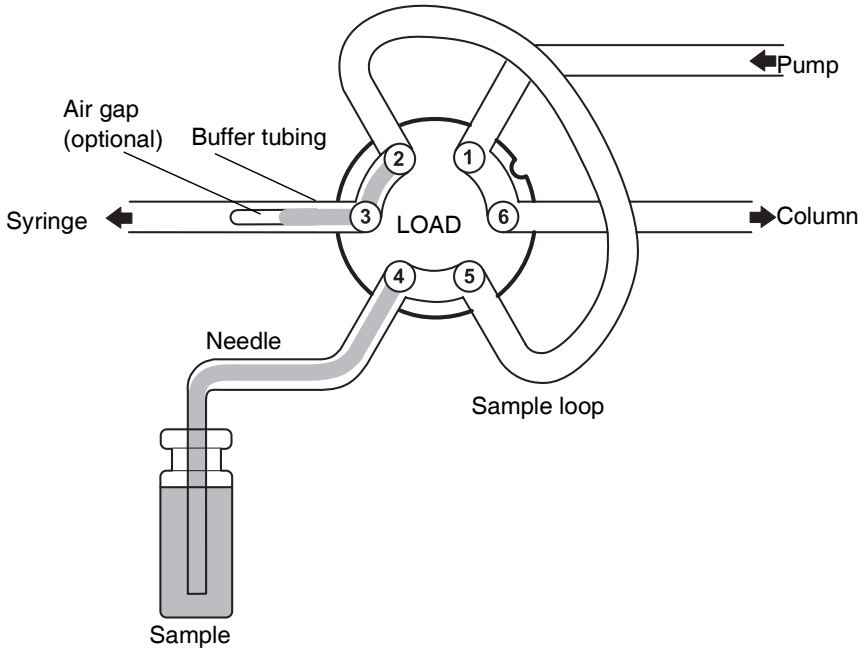
1. The injection valve moves to the Inject position, and the sample needle and air needle enter the vial or well. When the instrument method enables sample pressurization, the air needle applies headspace pressure to prevent air or vapor bubbles from forming during sample aspiration.



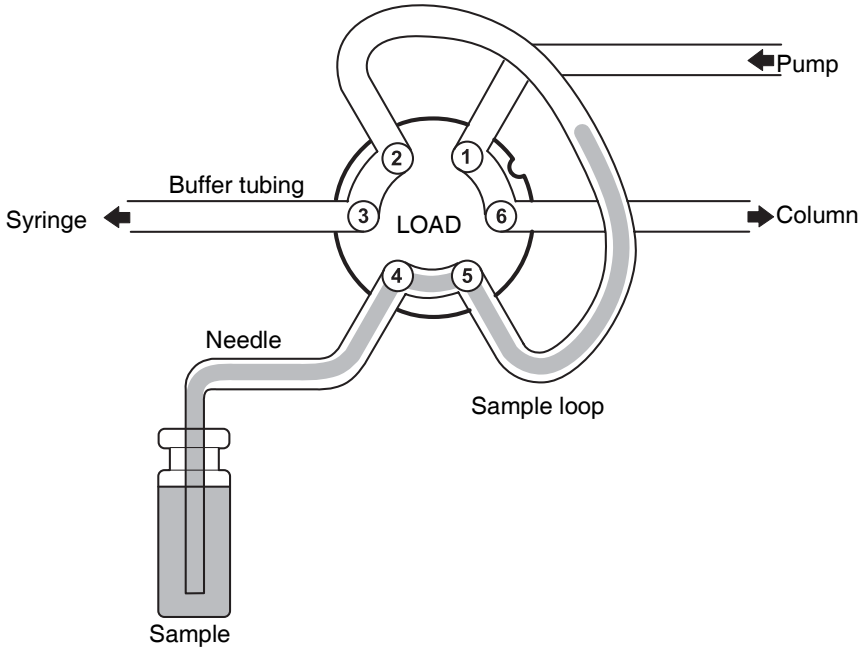
2. The syringe dispenser aspirates the flush volume (30 µL default) from the sample vial to fill the sample line with sample and remove wash solvent.



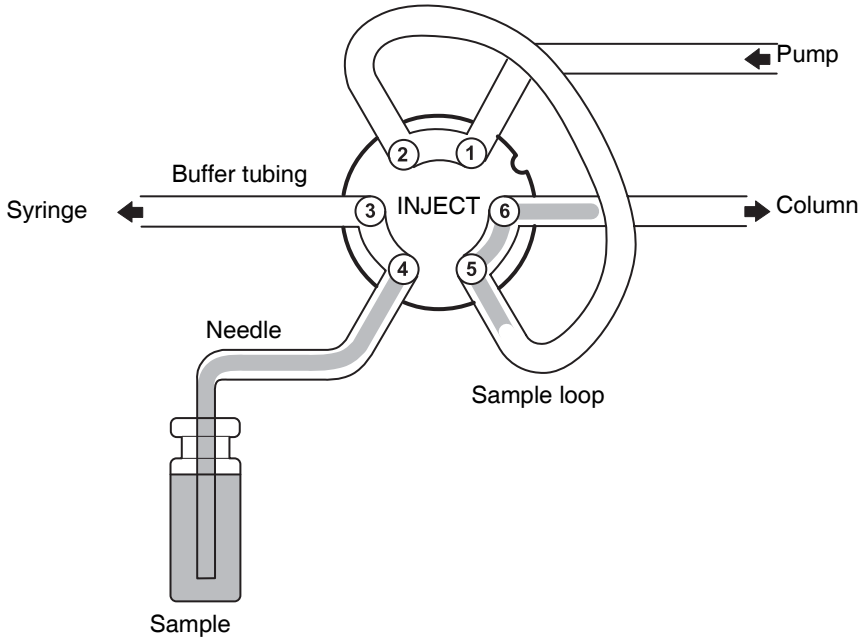
3. The injection valve switches to the Load position, placing a plug of sample at the beginning of the sample loop.



4. The programmed injection volume is aspirated into the sample loop.



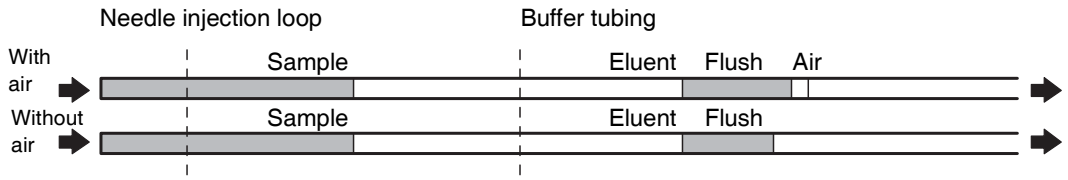
5. The injection valve switches to the Inject position, and the sample loop becomes part of the flow path for the HPLC mobile phase. Sample enters the column, and analysis starts.



Air segment with partial loop needle overfill injections

An air segment that is at the front of the flush volume, but not injected, can minimize sample dilution caused by dispersion during aspiration.

With a standard needle, recommended flush volumes are 30 µL for injections that incorporate air segments and 35 µL for injections that do not. To enhance performance with highly viscous samples, larger flush volumes and reduced syringe speeds may be needed.



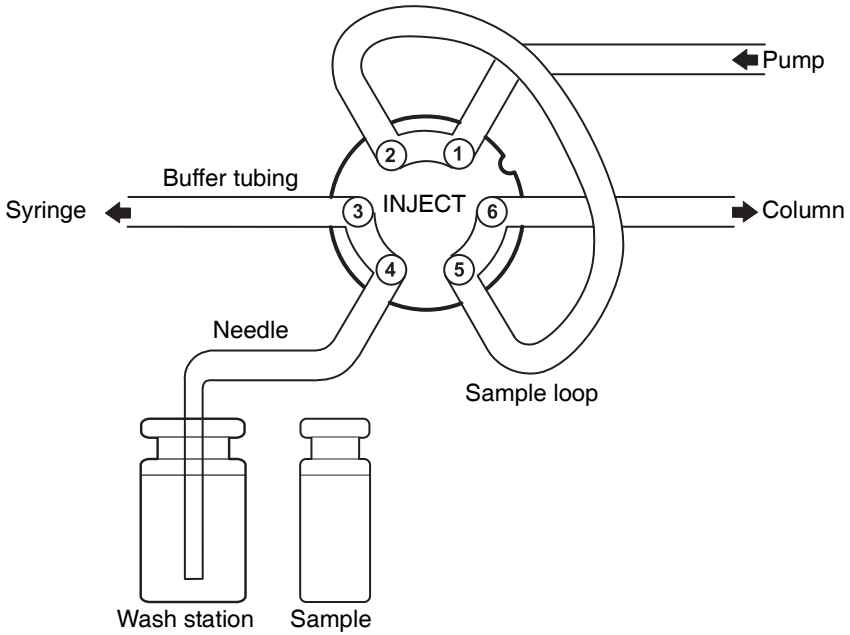
Partial loop injections

Partial loop injections yield no sample loss and, like partial loop needle overfill injections, maximum accuracy. However, their reproducibility specification is slightly lower. In the standard configuration, peak area RSD is < 1% for injection volumes > 10 µL.

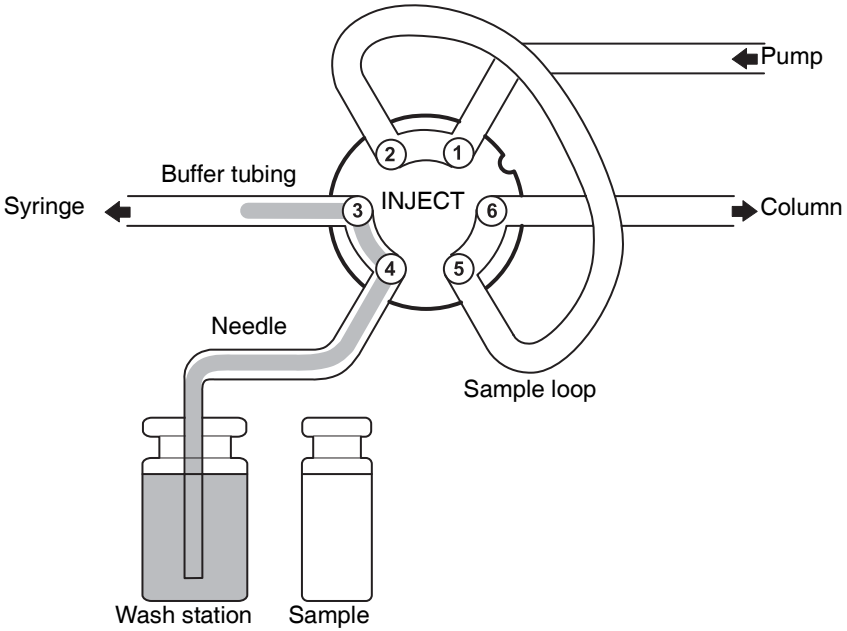
> **Recommendation:** Because wash solvent injects with the sample in partial loop mode, consider the effect on the chromatography. In general for reverse phase chromatography, match the wash solvent mixture to the initial gradient conditions.

This is the partial loop injection sequence:

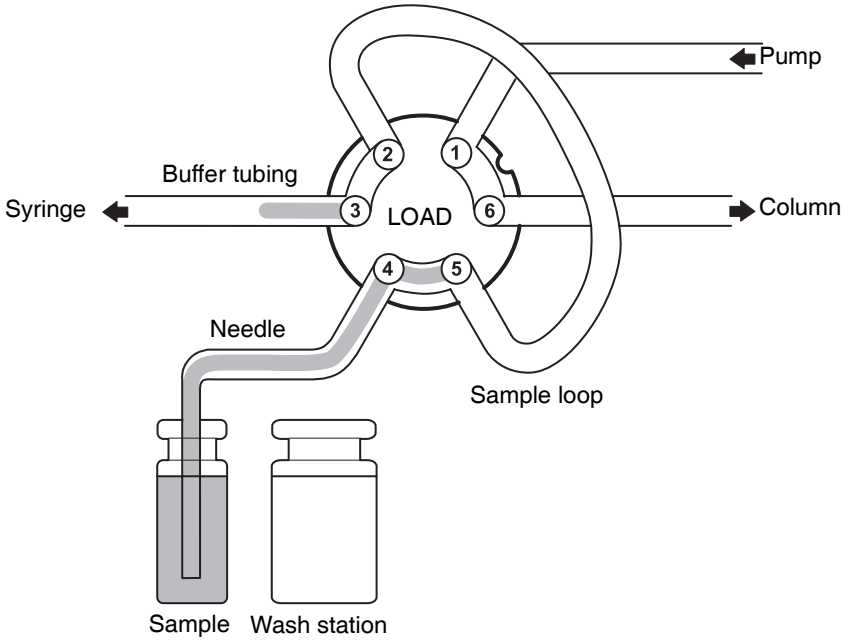
1. The injection valve moves to the Inject position, and the sample needle moves to the Transport position.



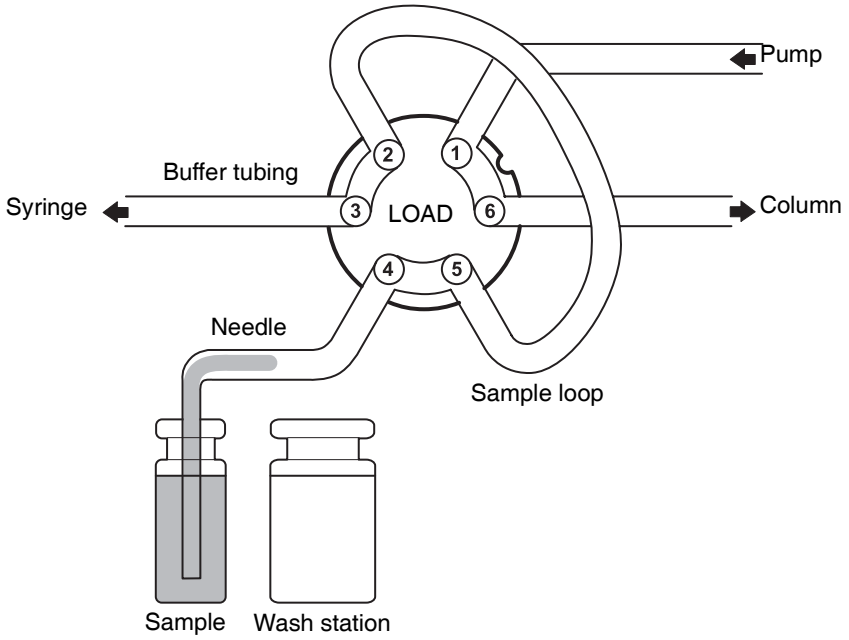
2. The syringe dispenser aspirates a plug of wash solvent from the wash station, filling the sample line with transport liquid.



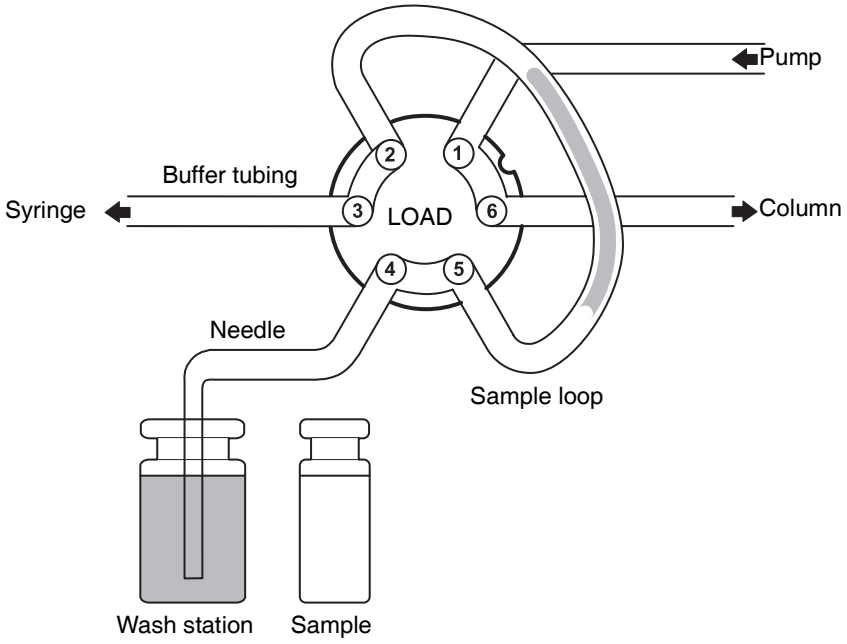
3. The needle moves from the wash station to the sample vial. The injection valve switches to the Load position.



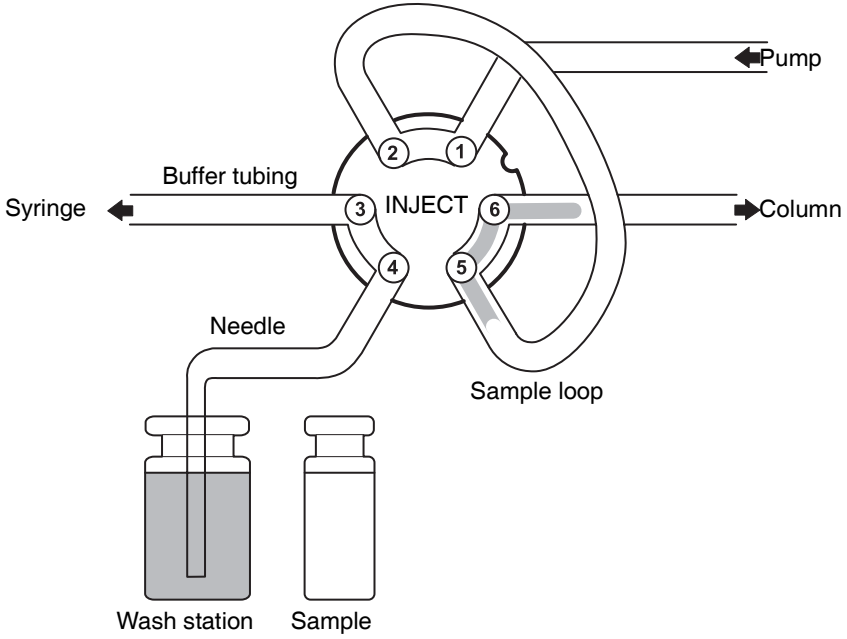
4. The programmed injection volume of sample is aspirated from the sample vial.



5. The sample needle moves back to the wash station, and a second plug of wash solvent is aspirated. The sample enters the loop.



6. The injection valve switches to the Inject position, and the sample loop becomes part of the flow path for the HPLC mobile phase. Sample enters the column, and analysis starts.



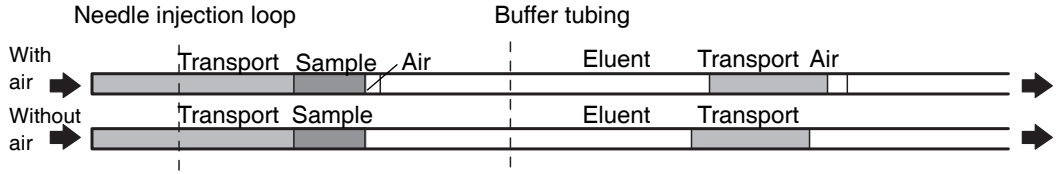
After each injection, a wash routine of programmable volume occurs.

Air segment with partial loop injections

When an air segment has been programmed, it appears at the front of the first plug of transport liquid and at the front of every sample plug.

The following conditions apply to this injection mode:

- The air segment at the front of the sample plug injects into the HPLC system
- No headspace pressure can be applied on vials or wells to avoid sample errors arising from air expansion during exchange from the sample vial/well to the transport position



Using well plates and vial trays

The instrument accommodates the following well plates and vial holders:

- 96 well tall and deep microtiter (1 or 2 mL)
- 96 well short microtiter (300 µL)
- 384 well short or tall (100 or 250 µL)
- 48 position 2-mL vial holder trays
- 12 position 10-mL vial holder trays (must be used with the prep kit)

  Tip: Data-system references to trays 1 and 2 correspond to the left and right trays, respectively, in the autosampler.

American National Standards Institute (ANSI)-compliant plates are preferred, but the needle and tray mechanism adjusts to accommodate non-ANSI-compliant plates.

Caution: Do not use hard plastic storage capmats or vial septa. The instrument's needle is of narrow diameter (0.031”) and cannot penetrate firm materials.

Use the following materials as covers:

- For samples in vials – Caps with PTFE or preslit PTFE/silicone septa
- For samples in low-volume inserts – PTFE/silicone caps or cap mats
- For samples in plates – Polypropylene or PTFE/silicone cap mats; heat-sealed microtiter plate film

Caution: To avoid contamination from the adhesive, do not use adhesive-backed microtiter film.

2 Preparing the Autosampler

Contents

Preparing for installation

Requirement: To install the autosampler, you must know, in general, how to set up and operate laboratory instruments and computer-controlled devices, as well as how to handle solvents properly.

Tip: Before installing the instrument, ensure that:

- It is not situated under a heating or cooling vent
- All required components are present
- No shipping containers or unpacked items are damaged

If you discover any damage or discrepancy when inspecting carton contents, immediately contact the shipping agent and your local Waters representative.

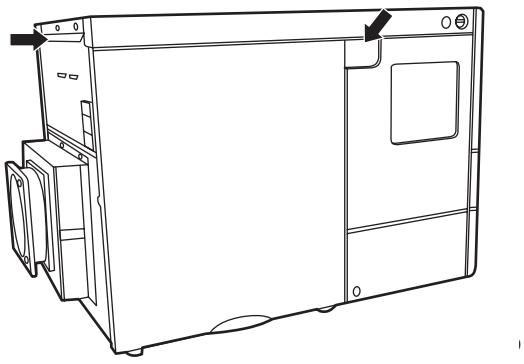
If you are in the USA or Canada, report damage and discrepancies to Waters Technical Service (800-252-4752). From other areas, contact your local Waters subsidiary or Waters corporate headquarters in Milford, MA, USA, or visit http://www.waters.com.

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

Setting up the instrument

To set up the autosampler

1. Using both hands as shown in the accompanying figure, lift the instrument from its packaging.



2. With both hands under the instrument, lift the instrument to its operating location, keeping it upright.

3. Place the instrument in its operating position.

   Requirement: Arrange the instrument's power cord such that its access to the power source is unobstructed.

   
   Caution: Extreme environmental conditions can impede instrument performance, so choose an indoor operating location that lacks direct heat or sunlight exposure, as well as excessive dust and shocks.

   
   Caution: Blocked ventilation holes can affect the instrument's performance and cooling capabilities, so make sure the ventilation holes at the back of the instrument are unobstructed.

   
   Caution: When objects are placed to only one side of the instrument, allow 5 cm from the instrument. When objects are placed on both sides, allow 10 cm.

4. Allow the instrument to equilibrate to ambient temperature for at least 1 hour.

Plumbing the instrument


Warning: Using solvents that are incompatible with each other can injure you or severely damage the instrument.

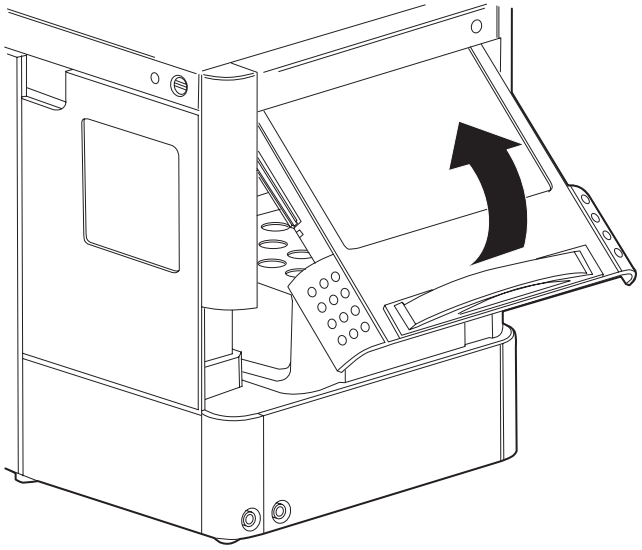
Plumbing the instrument involves connecting the solvent lines to the pump and column and filling the wash bottle. To access the instrument's components, open the instrument's door.

Tip: The plate and needle drive mechanisms are designed to move more slowly when the instrument's front cover is removed or the door is open.

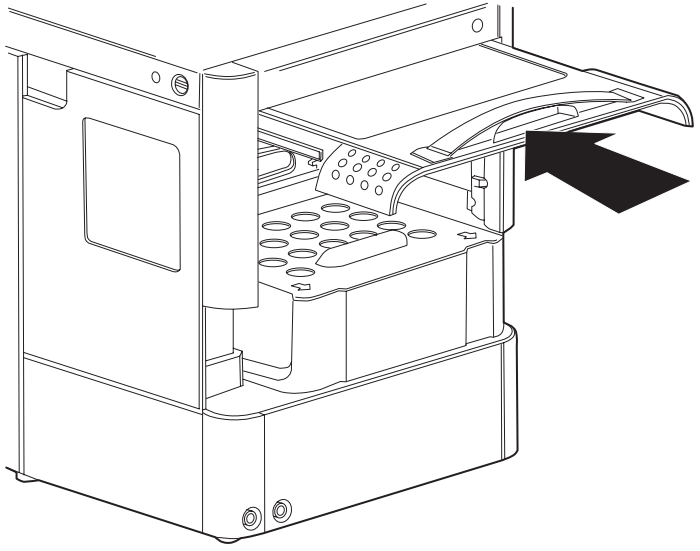

Caution: During normal operation, keep the instrument's front cover intact and the door closed.

To open the instrument door

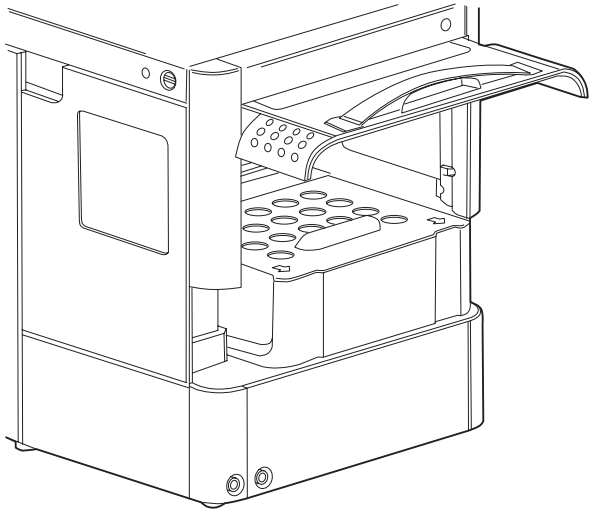
1. Grasp the door handle.



2. Gently pull the handle toward you, and push it upward until it is horizontal.



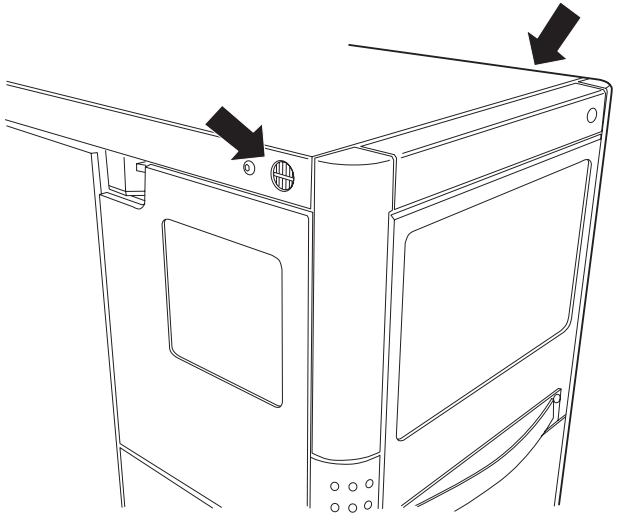
3. Slide the door into the cabinet.



Tip: To access components more easily, remove the instrument's cover.

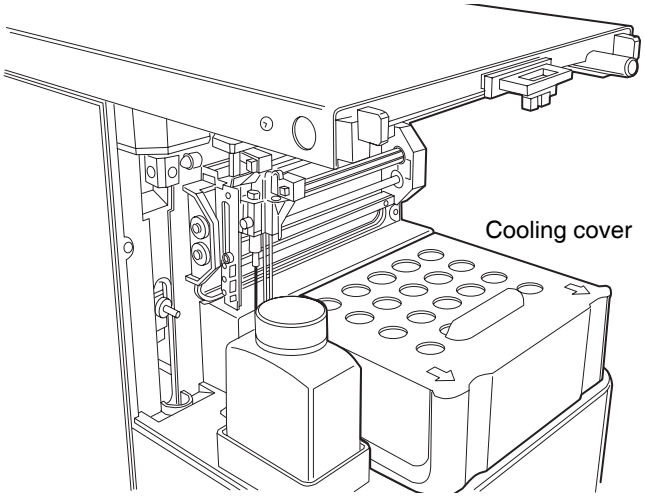
To remove the instrument's cover

1. Simultaneously press the two black buttons on either side of the top of the instrument.

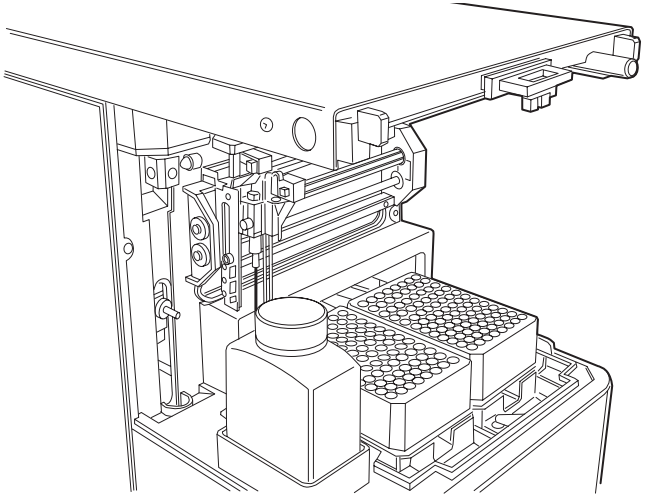


2. Gently pull the cover toward you.

When the cooling option is installed, a cooling cover overlays the well plates.



To remove the cooling cover, slide the cooling cover outward by pulling it gently toward you.



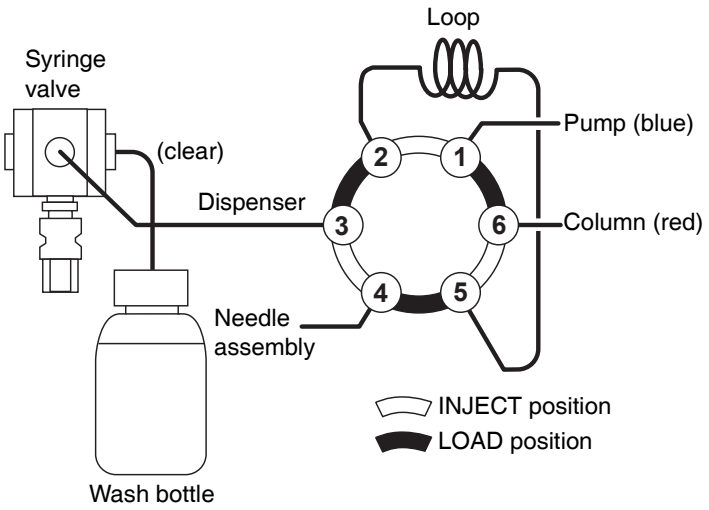
Identifying instrument tubing

Caution: To avoid extreme environmental conditions, which can impede instrument performance, choose an indoor operating location away from direct heat, sunlight exposure, excessive dust, and shocks.

When all components are installed, the following fluid-line connections are made:

- Clear – Plastic tubing for wash solvent.
- Blue – High-pressure steel tubing, 0.03-inch (0.75-mm) ID; connects the instrument to the pump.
- Red – High-pressure steel tubing, 0.009-inch (0.25-mm) ID; connects the instrument to the column.
- Drain – Two 0.25-inch clear lines; attach to the drip trays on the instrument's bottom. One drains solvent and sample spills; the other drains water from the cooler as well as sample spills and mobile phase leaks.

Fluid-line connections



Recommendation: If air bubbles appear in the syringe or injection precision is poor, ensure that the fittings on the syringe valve, needle

assembly, and ports 3 and 4 of the injector valve are finger tight. Do not overtighten these fittings with a tool.

Tip: The tubing is attached to the injection valve at the factory.

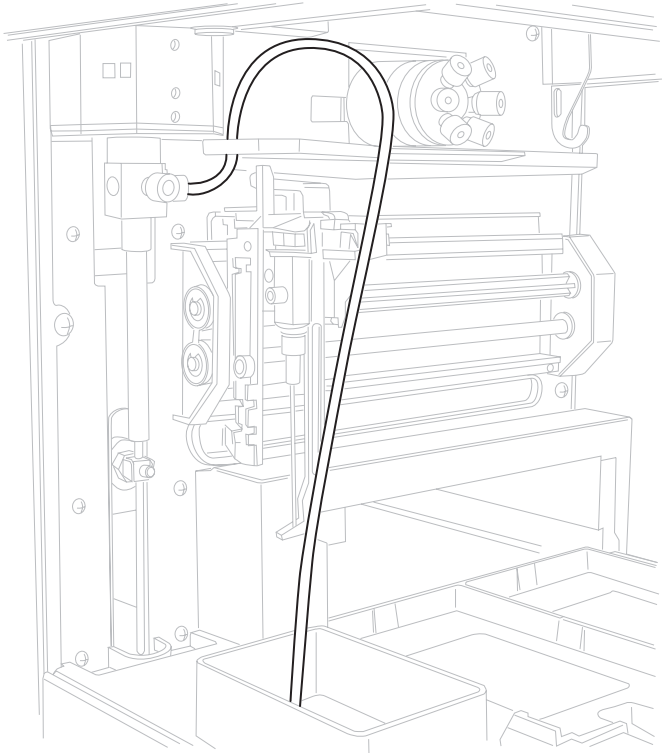
Requirement: Correctly connect these items:

- HPLC pump (blue) to port 1 of the injection valve
- HPLC column (red) to port 6 of the injection valve

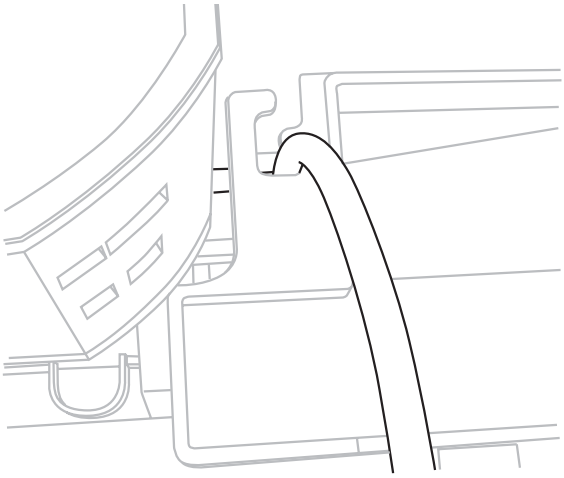
Routing and connecting the tubing

To prevent tubing from obstructing the needle unit's horizontal movement, use the tubing guide in the leakage drain.

Wash solvent tubing guide



Top view of tubing guide



Tip: For Waters connections, the startup kit includes stainless steel and PEEK plastic fittings.

To connect the tubing

1. Connect the pump inlet line (blue) to the pump.

   Tip: Route the tubing through one of the square cut-outs on either side of the instrument.

2. Place the red line in a waste container.

3. Set the mobile phase pump to deliver 1 mL/min of 100% methanol or acetonitrile for 10 minutes.

   Recommendation: Before connecting the column, flush the system according to the following procedure.

4. Route the red line through one of the square cut-outs on either side of the instrument, and then connect it to the column.

   Tip: When a Waters 1500 series pump and column heater are used, both the red and blue lines are likely to exit the instrument through the left-hand cut-out.

5. Set pump flow, and check for leaks.

   Recommendation: Allow the system to stabilize for 5 minutes.

Working with waste tubing

To dispose of general waste liquids

1. Connect the tee end of each drain tubing to the right- and left-hand drain hose connectors.

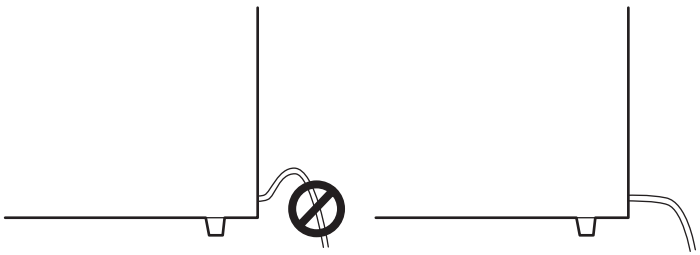
   Tip: Point the center tee port upward.

2. Place the other ends of the drain tubings in a waste container on the floor.

   Tip: General waste tubing removes all liquid dispensed to the wash position, as well as uninjected sample liquid and condensate from the cooler.

   Tip: To keep the flow path clear, ensure that the drain or waste tubes are untwisted.

Caution: To avoid hindering waste drainage, route the waste tubing downward, toward the waste container, with no rise in elevation.



Accommodating the wash solvent and syringe rinse

Caution: To avoid blockages, which can severely damage the instrument, do not use crystalline or buffer solutions as wash solvents.

To fill the wash solvent tubing

1. Fill a clean wash solvent bottle with wash solvent, and degas it.

   Recommendation: Use only water or organic wash solvents, preferably distilled water and methanol (80%/20%) or mobile phase.

   Recommendation: To improve the wash solvent degassing, use a Waters inline degasser.

2. Place the wash solvent bottle to the left of the instrument.

   Tip: The approved wash solvent bottle is made of glass.

3. Place the end of the wash solvent tubing in the filled wash solvent bottle.

   Recommendations:

   - To achieve the necessary length, replace the wash solvent line with tubing from the Waters inline degasser. Attach the tubing to the front of the syringe valve, and route it out one of the square cutouts on the instrument's side.
   - To avoid flow problems, use tubing with low gas permeability and an internal diameter sufficient to minimize flow impedance, such as the tubing supplied with the Waters inline degasser.

4. From either the Control menu in the 2707 Console or as a right-click command from the 2707 Control panel in Run Samples of Empower, select Wash/Prime Needle to fill the tubes with liquid.

   Tip: To remove all air from the syringe and achieve maximal operation, perform an extra wash.

   Tip: If bubbles form in the syringe on the intake stroke of the wash cycle, the wash solvent can be insufficiently degassed or, in the case of an external degasser, the inlet tubing diameter can be too small.

Making Ethernet connections

1. Connect one end of one Ethernet cable to the network switch, and then connect the other end to the Ethernet card on the computer.

   Recommendation: Use only the shielded Ethernet cables in the startup kit.

2. Connect one end of one Ethernet cable to the instrument's rear panel, and then connect the other end to the network switch.

   Recommendation: For workstations with only one Ethernet instrument, connect an Ethernet cable to the PC's network interface card (NIC).

   Requirement: Older, nonautosensing NICs require shielded cross-over cables, which are not supplied in the startup kit.

Controlling I/O connections

Caution: Connect this instrument only to other instruments that meet relevant safety standards.

The instrument has one I/O connector, which supports TTL inputs (active low) and contact closure output.

Defining TTL inputs

TTL inputs allow other devices to control the instrument. Following are options for the instrument's two TTL inputs, which you define via the instrument method (click Instrument Method Editor > W2707 > Events > Inputs):

- Hold Inject (default) – When this input is active before the start of an analysis, the instrument performs all programmed preinjection sample handling (sample loop) but waits to inject the sample until the input becomes inactive. If the input becomes active during an analysis, it has no effect until the next analysis is started.
- Stop Inject – Aborts the run immediately.

Explaining contact closure output

Requirement: Route an Inject Start I/O cable to any non-Ethernet or non-Waters device that requires an injection trigger signal. Waters IEEE detectors, such as the 2487 UV/Vis and 2996 PDA, require this I/O cable connection.

Tip: Some Waters Ethernet instruments, like the 2489 UV absorbance and 2998 PDA detectors, start remotely through the Ethernet and require no Inject Start I/O connections.

I/O connector—Contact closure output and TTL inputs

Pin number	Description	Cable color
1	Inject Start	White
2	Inject Start	Green
3	Input 1	Red
4	Input 2	Black

I/O connector—Contact closure output and TTL inputs

Pin number	Description	Cable color
5	*Not used*	None
6	*Not used*	Gray
7	*Not used*	None
8	Ground	Orange
9	Ground	Brown

The Inject Start switch generates an injection marker output when the injection valve switches from the Load to Inject position. Status duration of the injection marker is 1.0 second.

Tip: Contact closure capacity: V_{max} = 28 Vdc/Vac, I_{max} = 0.25 A

Connecting to the electricity source

The instrument requires a grounded electricity source. The ground connection in the electrical outlet must be common and connected near the system.

Requirement: Arrange the instrument's power cord such that its access to the power source is unobstructed

Warning: To avoid electrical shock, confirm that the line voltage conforms to that required by the instrument and insert power cords in correct voltage sources.

To connect to the electricity source

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

1. Confirm that fuses and the voltage range on the rear of the instrument match the target power outlet.
2. Connect the female end of the power cord to the receptacle on the rear panel of the instrument.
3. Connect the male end of the power cord to a suitable wall outlet.
4. Power-on the instrument.

Installing the prep kit

Installing the optional prep kit involves removing and replacing the following accessories:

- Injector valve with sample loop

  Tip: The 10 mL prep loop is large.
- Syringe (2500 µL instead of 500 µL)
- Buffer tube (2000 µL instead of 1000 µL)
- Needle assembly (60 µL instead of 15 µL)
- Air needle (for 10-mL vials)
- Vial trays (for 10-mL vials)

  Requirement: To install the prep kit, from the 2707 Console Configure menu select the Prep mode check box on the Volumes tab. Then select the Use Prep Mode check box.

  Tip: For procedures on removing and replacing prep kit accessories, see Chapter 3.

Installing the biocompatibility kit

Installing the optional biocompatibility kit involves removing and replacing the following accessories:

- Injector valve with sample loop (PEEK instead of stainless steel)
- Needle assembly (silica-coated stainless steel version instead of stainless steel)
- Inlet (pump) and outlet (column) tubing with plastic fittings (not included in the startup kit)

Caution: To avoid damaging the manifold, avoid using metal fittings in the biocompatible injector valve.

3 Maintaining the Autosampler

Contents

Outlining maintenance basics

Tip: Most maintenance procedures require removal of the instrument's front bezel. For the removal procedure, see Chapter 2.

Warning: Because panel removal exposes potentially dangerous voltages, disconnect the instrument from all power sources before removing protective panels.

Contacting Waters Technical Service

If you are 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. Our Web site includes phone numbers and e-mail addresses for Waters locations worldwide. Go to www.waters.com, and click About Waters > Worldwide Offices.

When you phone Waters Technical Service, be prepared to provide the following information:

- Error message (if any)
- Nature of the symptom
- Serial number
- Flow rate
- Operating pressure
- Solvent(s)
- Settings (sensitivity and wavelength)
- Type(s) and serial number(s) of column(s)
- Sample type
- Empower or MassLynx software version and serial number

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

Heeding maintenance considerations

Safety and handling

Observe these warning and caution advisories when performing instrument maintenance.

Warning: Always observe good laboratory practices when handling solvents, changing tubing, or operating the instrument. Know the physical and chemical properties of the solvents you use, and consult their Material Safety Data Sheets.

Caution:

- To avoid damaging electrical parts, never disconnect an electrical assembly while power is applied to the instrument. To completely interrupt power to the instrument, set the power switch to Off, and then unplug the power cord from the AC outlet. After power is interrupted, wait 10 seconds before disconnecting an assembly.
- To prevent circuit damage due to static charges, touch no integrated circuit chips or other system instruments that require no manual adjustment.

Warning: It is unnecessary to remove the instrument's top and side panels to complete any instrument maintenance procedures. Doing so exposes potentially dangerous voltages.

Proper operating procedures

To ensure your instrument runs efficiently, follow the operating procedures and guidelines in Chapter 2.

Spare parts

Waters recommends that you replace only the parts mentioned in this document. For spare parts details, see the Waters Quality Parts Locator on the Waters web site's Services/Support page.

Recommendations

- To prolong column life, reduce pressure fluctuations, and decrease baseline noise, filter and degas solvents.
- To avoid malfunctions resulting from the following conditions, flush buffered mobile phase from the instrument before shutting it down:
  - Plugged solvent lines and flow cell
  - Damaged instrument components
  - Microbial growth

Cleaning the autosampler

In general, the instrument needs little maintenance.

Recommendation: Clean exterior parts with a damp cloth and nonaggressive cleaning liquid.

Recommendation: Periodically clean these components:

- Valve leak bin– Clean this bin with a damp cloth and nonaggressive cleaning liquid.
- Sample tray – Wipe with a damp cloth and nonaggressive cleaning liquid.
- Drain tubing – Regularly flush with solvent to prevent clogging and ensure disposal of liquids and condensate.

Removing or replacing the injection valve rotor seal

The plastic rotor seal of the instrument's injection valve requires periodic cleaning and replacing.

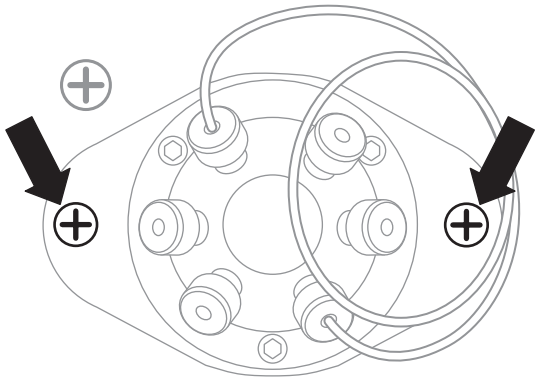
> **Tip:** While injection frequency and solvent cleanliness determine the seal's cleaning and replacement intervals, most seals require annual replacement.

To remove or replace the injection valve rotor seal

1. Disconnect all tubing from the valve.

   Exception: Keep the sample loop intact.

2. Using a #2 Phillips® screwdriver, remove the two screws on either side of the valve body.



   Tip: The two removed screws secure the plastic valve flange to the instrument's chassis. Do not remove the screw that is diagonal to the valve on the sheet metal.

3. Using a 2.5-mm hex key wrench, remove the three screws from the stator part of the valve.

   Recommendation: Loosen each screw a half-turn each in rotation until all screws disengage.

4. Gently open the valve, and remove the rotor seal.
5. Clean and/or replace the seal.
6. Place the stator back on the rotor, and fasten the screws.

Recommendation: Tighten each screw a half-turn each in rotation until all screws are tight.

7. With port 1 pointing upward, hold the valve for mounting.
8. Place the valve in its slot, and fasten it.
9. Reconnect all tubing to the valve.
10. Perform a needle wash by right-clicking in the Run Sample control panel or via the Console Control menu.

Installing a sample loop

The instrument is fitted with a 100-µL sample loop as standard equipment. You can install a different sample loop provided you select the proper combination of syringe and tubing.

Connect the loop between ports 2 and 5 of the injection valve. When installing a loop of nonstandard volume, from the Configure menu of the 2707 Console click Volumes... and adapt settings.

Tip: Calculate maximum injection volumes using the following equations:

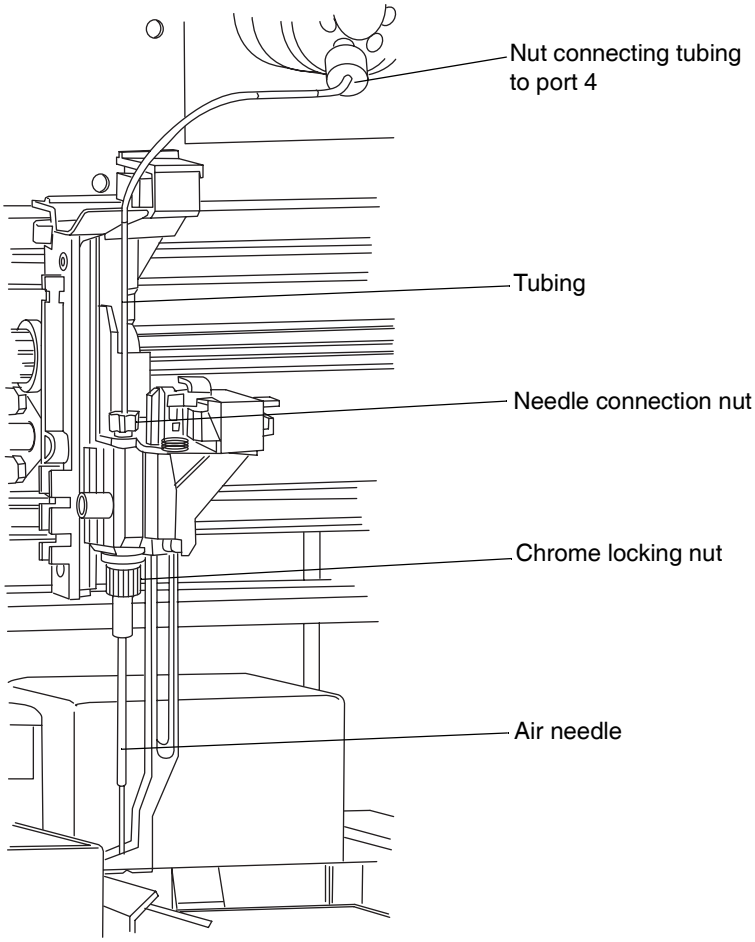
- Full loop – Injection volume = loop volume
- Partial loop needle overfill – Maximum injection volume = 50% of loop volume
- Partial loop – Maximum injection volume = (loop volume - [3 × needle volume])/2

Replacing the sample needle

To replace the sample needle

1. From the Maintain menu in the 2707 Console, click Replace and the needle.

   Result: The needle moves to the exchange position.
2. Follow the instructions in the Replace Needle warning box, and then click OK.
3. Loosen the needle connection nut.



4. Loosen the nut that connects the tubing to port 4 of the injection valve.
5. Pull the sample needle out of its fitting by the tubing.
6. Install a new needle assembly.

   Recommendation: Make sure the air seal encircles the needle.
7. Using the needle connection nut, tighten the needle assembly.
8. Connect the other end of the needle connection tubing to port 4 of the injection valve.

   Recommendation: To avoid blocking the tubing, finger tighten only.
9. In the new Replace Needle window, click Reset.

Result: The sample needle returns to the home position.

10. Clean the new needle by clicking “Wash needle” from the Control menu of the 2707 Console.
11. If needed, use the Adjust Needle Position function to finetune the x-y injection position. See the following “Adjusting needle position” section.

Caution: To prevent the needle from touching the bottoms of vials when using trays with 12 or 48 vials, make sure the needle height setting is > 2 mm.

Adjusting needle position

The air needle comprises the outer shell of the needle assembly. Its tip extends downward, but not as low as the tip of the sample needle. The air needle supports the needle wash process and mechanically supports the sample needle. When you enable the pressurize vial feature, it delivers pressurized air.

The instrument’s needle and tray mechanism is preadjusted at the factory to work with any of the supported well plates or vial holders. When using plates or holders whose dimensions do not comply with ANSI dimensions or other geometrical offsets, use the Adjust Needle function.

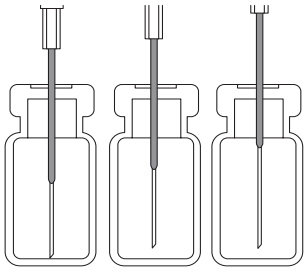
Maintaining air needles

The instrument uses six air needles of varying length to accommodate different plate heights in the instrument. An air needle is available for every well/vial plate. The needles vary in 6-mm intervals; the needle holder allows for an extra 6-mm variation in needle height.

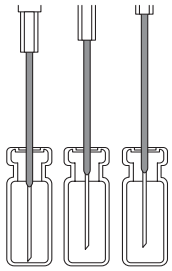
Ideally, the end of the air needle pierces the vial cap or septum during sample aspiration, but it should not extend far enough to contact the liquid sample. The standard-length air needle works well in most cases.

Examining the standard air needle

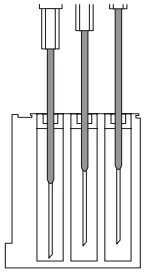
The standard air needle, which is 62 mm long, accommodates a wide range of high and low plates. The accompanying figures show the needle’s puncturing depths.



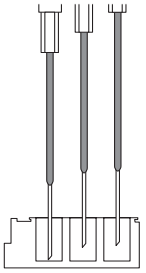
10-mL vial



2-mL vial



Greiner deep well with capmat



Greiner low well (air pressurization not recommended)

The air needle lowers deeply into 10-mL vials. When the vials are less than 60% full, the pressurize vial feature is available. The same is true of deep wells.

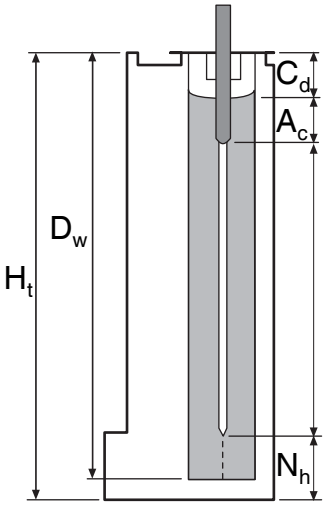
Tip: When deviating from standard settings, use an optional needle type.

Recommendation: Do not use needle pressurization for low well plates. The sample needle punctures the seal to prevent vacuum; the function of the air needle in such a case is insignificant.

Pairing air needles with titer plates or vials

Consider the following dimensions when choosing an air needle:

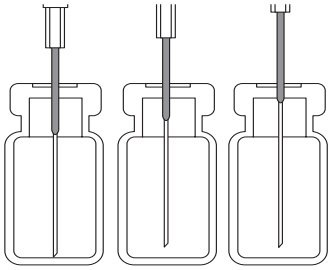
- Height of the titer plate, in mm (Ht)
- Well depth, in mm (Dw)
- Thickness of capmat or seal, in mm (Cd)
- Set needle height, in mm (Nh)
- Distance of the air needle point through the capmat or seal in mm, minimum 2 mm (Ac)



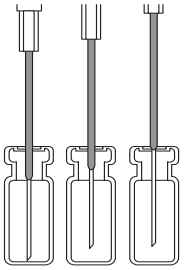
Ht – Dw must be between 2 and 6 mm, at which value you can calculate the protrusion length of the sample needle—the distance between the point of the sample needle and the point of the air needle—as Ht – Cd – Nh – Ac.

On the basis of protrusion length, choose the most suitable air needle.

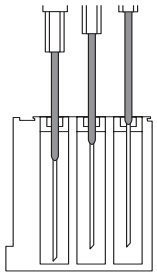
Air needle type	Protrusion length *from*	Protrusion length *to*
50 mm, yellow	34	40
56 mm, red	28	34
62 mm, white (standard needle)	22	28
68 mm, blue	16	22
74 mm, green	10	16
80 mm, black	4	10



10-mL vial, 55-mm air needle



2-mL vial, 62-mm air needle



Greiner deep well M53000 with capmat, 56-mm air needle

Example

For a Greiner deep well with Micronic capmat M53000, the instrument operates using a standard needle height.

Ht = 41.4 mm	The following is true:
Dw = 37.8 mm	41.4 - 37.8 = 3.6 *(is between 2 and 6 mm)*
Cd = 3.8 mm	Protrusion length = 41.4 - 3.8 - 6.0 - 2.0 = 29.6
Nh = 6.0 mm (standard)	
Ac = 2.0 mm (minimum)	
A 56-mm air needle is needed.	

Replacing air needles

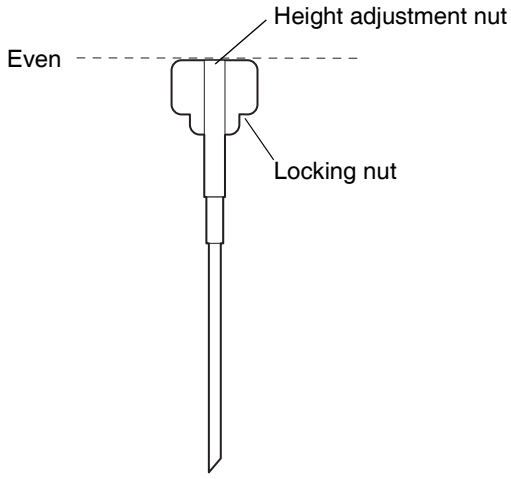
To replace the air needle

1. From the Maintain menu in the 2707 Console, click Replace and the needle.

   Result: The needle moves to the exchange position.

2. Follow the instructions in the Replace Needle warning box, and then click OK.
3. Loosen the needle connection nut (see the preceding figure).
4. Loosen the nut that connects the tubing to port 4 of the injection valve (see the preceding figure).
5. Grasp the sample needle's tubing, and withdraw the needle from the fitting.
6. Begin removing the air needle by unscrewing the chrome locking nut (see the preceding figure).
7. Pull the air needle downward and out of its fitting.
8. Remove the chrome locking nut from the old needle, and screw the new height adjustment nut into the chrome locking nut.

   Tip: Ensure that the O-ring seal is in the locking nut and that the thread of the height adjustment nut is even with the lower part of the locking nut.



9. Install the new air needle assembly.

   Requirement: Make sure the air seal encircles the needle.

10. Using the needle connection nut, tighten the needle assembly.

11. Connect the other end of the needle connection tubing to port 4 of the injection valve.

    Recommendation: To avoid blocking the tubing, finger tighten only.

12. In the new Replace Needle window, click Reset.

    Result: The air needle returns to the home position.

13. Clean the new needle by clicking “Wash needle” from the Control menu of the 2707 Console.

14. If needed, use the Adjust Needle Position function to finetune the x-y injection position.

15. In the Configuration Settings window of the 2707 Console, program needle height for the new needle.

    Caution: To prevent the needle from touching the bottoms of vials when using trays with 12 or 48 vials, make sure the needle height setting is > 2 mm.

Replacing a syringe

The instrument is fitted with a 500-µL syringe as standard equipment, but a 2500-µL syringe can be installed as part of the prep kit.

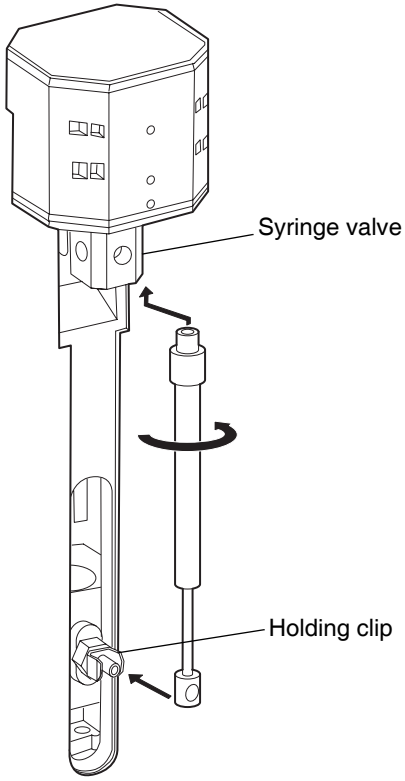
To replace a syringe

1. From the Maintain menu of the 2707 Console, click Replace > Syringe.

   Result: The syringe plunger lowers.

2. Unscrew the syringe from syringe valve.

   Requirement: Keep the connector in the valve intact.



3. Disconnect the plunger from the syringe drive by sliding it straight backward, out of the holding clip.

4. Remove the Teflon syringe gasket from the valve's syringe fitting port.

   Caution: To avoid valve damage, do not use a sharp tool for gasket removal.

5. Fill the new syringe with degassed wash solvent.

   Recommendations:

   - Use isopropanol as the wash solvent.
   - Remove air bubbles from the syringe.

6. Fit a new Teflon gasket on the syringe.

   Tip: The syringe includes a Teflon syringe gasket.

7. Connect the plunger of the filled syringe to the syringe drive by pushing it straight onto the clip.

   Requirement: Keep the top threaded end below the syringe valve.

8. Raise the syringe, and screw it firmly into the connector.

9. In the Replace Sample Syringe window, click Reset.

   Result: The syringe moves to the home position and dispenses its contents to waste.

10. Using the Control menu of the 2707 Console, perform a standard wash routine.

    Result: All tubing connected to the syringe valve refills and flushes.

11. Purge all air bubbles from the syringe and buffer tubing by repeatedly washing the needle or removing and repriming the syringe with degassed, nonaqueous organic solvent.

Replacing syringe plungers and plunger tips

To replace the plunger or plunger tip

1. From the Maintain menu of the 2707 Console, click Replace > Syringe.

   Result: The syringe plunger lowers.

2. Unscrew the syringe from syringe valve.

   Requirement: Keep the connector in the valve intact.

3. Disconnect the plunger from the syringe drive by sliding it straight back and out of the holding clip.
4. Slide the plunger out of the syringe barrel.
5. Using pliers, remove the plunger tip.
6. Dampen the new tip with an appropriate solvent (e.g., isopropanol).
7. Mount the new tip on the plunger.
8. Insert the plunger into the syringe barrel.
9. Fill the new syringe with degassed wash solvent.

   Recommendations:

   - Use isopropanol as the wash solvent.
   - Remove air bubbles from the syringe.
10. Connect the plunger of the filled syringe to the syringe drive by pushing it straight onto the clip.

    Requirement: Keep the top threaded end below the syringe valve.
11. Raise the syringe, and screw it firmly into the connector.
12. In the Replace Sample Syringe window, click Reset.

    Result: The syringe moves to the home position and dispenses its contents to waste.
13. Via the Control menu of the 2707 Console, perform a standard wash routine.

    Result: All tubing connected to the syringe valve refills and flushes.
14. Purge all air bubbles from the syringe and buffer tubing by repeatedly washing the needle or removing and repriming the syringe with degassed, nonaqueous organic solvent.

Replacing the syringe dispenser valve

The syringe valve is a 4-port selection valve. One port is unused. These are port assignments:

- Waste – Drain for the syringe dispenser.
- Wash – Port for aspirating wash liquid from the wash bottle

- Needle – Connects to the buffer tubing.

  Requirement: Make all connections to the syringe valve using finger-tight fittings.

To replace the syringe dispenser valve

Tip: Before replacing the syringe valve, place the syringe valve in the "Remove" position. In this position, the mounting screws are in line with the holes.

1. From the Maintain menu of the 2707 Console, click Replace > Syringe.

   Result: The syringe plunger lowers.

2. Unscrew the syringe from syringe valve.

   Requirement: Keep the connector in the valve intact.

3. Disconnect the plunger from the syringe drive by sliding it straight back and out of the holding clip.

4. In the Replace Sample Syringe window, click Reset.

5. In the 2707 Console, select Interactive display from the directory tree.

6. Click Control.

   Result: Syringe valve control is enabled.

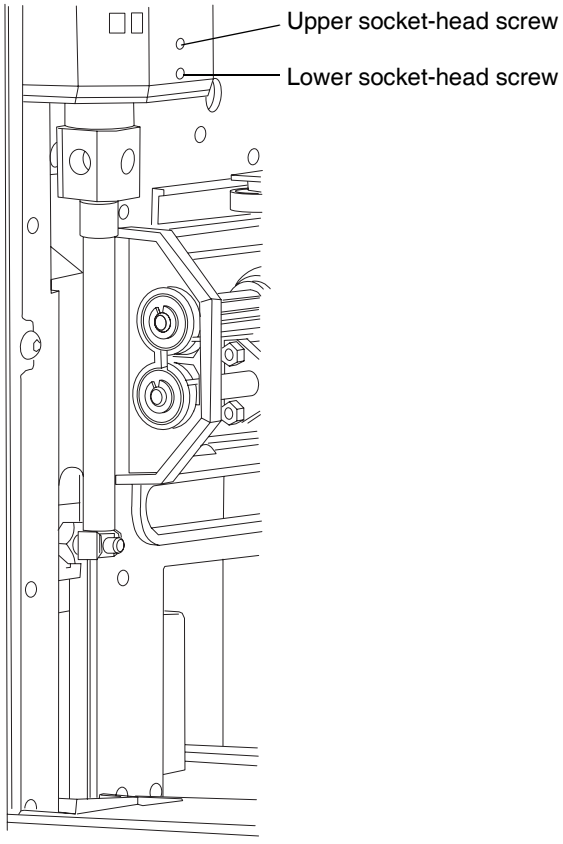
7. Click the syringe valve position text, and click Remove in the dialog box.

8. Press Enter.

   Result: The set screws align with the holes.

9. Using a 2-mm socket-head driver, loosen the lower socket-head screw 2 turns.

   Recommendation: Complete no more than 2 turns.



10. Using the same 2-mm socket-head driver, loosen the upper socket-head screw 2 turns.

    Recommendation: Complete no more than 2 turns.

11. Slide the syringe valve downward, out of the instrument.
12. Remove the syringe valve.
13. Remove the waste fitting at the rear of the valve.
14. Attach the waste fitting of the new valve.
15. Install the new syringe valve with the flat side of the top axle facing forward.
16. Install the set screws.

17. In the 2707 Console, exit the interactive display by selecting 2707 Auosampler from the directory tree.
18. In the Maintain menu of the 2707 Console, click Replace > Syringe.
19. At the syringe connection port, install the Teflon seal in the syringe valve.

    Recommendation: Install a new seal in the valve. If you choose to reuse the seal from the old valve, be sure to orient it in its original position.
20. Fill the new syringe with degassed wash solvent, preferably methanol.

    Recommendation: Remove air bubbles from the syringe.
21. Connect the plunger of the filled syringe to the syringe drive by pushing it straight onto the clip.

    Requirement: Keep the top threaded end below the syringe valve.
22. Raise the syringe, and screw it firmly into the connector.
23. In the Replace Sample Syringe window, click Reset.

    Result: The syringe moves to the home position and dispenses its contents to waste.
24. Using the Control menu of the 2707 Console, perform a standard wash routine.

    Result: All tubing connected to the syringe valve refills and flushes.
25. Purge all air bubbles from the syringe and buffer tubing by repeatedly washing the needle or removing and repriming the syringe with degassed, nonaqueous organic solvent.

Replacing fuses

Warning: When replacing fuses, disconnect the instrument from its power source and use only fuses of the size and rating indicated on the fuse panel or holder or the spare parts list.

The instrument has two 2.5 A fuses in its rear fusebox. Install fuses of the same type and rating.

Tips:

- An unlighted LED may indicate a blown fuse.

- If fuse problems recur, contact Waters Service.

4 Troubleshooting

Contents

Addressing instrument errors

When incidental fault conditions occur, the instrument generates an error message. Most faults require system initialization or reset. To reset the system, use the Control menu of the 2707 Console.

Warning: Ensure the instrument is connected to a grounded power source.

Running diagnostic tests

On startup, the instrument automatically runs a series of initialization steps. If an error has occurred, the indicator LED on the front of the instrument and messages at the workstation show the results of these steps.

To initiate the mechanism homing steps that occur upon startup, use the Control menu of the 2707 Console.

Displaying the statuses of signal connections

By displaying the statuses of the I/O signal connections or contact closures on the instrument's rear panel, the 2707 Console shows the instrument's signal connections in real time.

> **Tip:** A green LED symbol indicates that a signal cable is activating to the terminal. A red LED symbol indicates that no signal cable is being input to the terminal.

To display rear-panel interface connections, from the Troubleshoot menu in the 2707 Console click Rear Panel.

I/O connections

Pin number	Cable color	Signal connections	Description
1	White	Inject start (out)	Injector valve trigger switch closure (1 second); normally open
2	Green	Inject start (out)	Injector valve trigger switch closure (1 second); normally open
3	Red	Input 1	Programmable event input to hold or stop injections (active low)
4	Black	Input 2	Programmable event input to hold or stop injections (active low)
5	None	*Not used*	
6	Gray	*Not used*	
7	None	*Not used*	
8	Orange	Ground	For input 1 or 2
9	Brown	Ground	For input 1 or 2

Changing the rear-panel interface connections

Via the rear-panel display, you can open and close the output connection. Doing so is useful when starting or stopping an injection or troubleshooting system connectivity.

To change rear-panel interface connections

1. From the Troubleshoot menu in the 2707 Console, click Rear Panel.
2. In the Rear Panel dialog box, find the Inject Start signal connection, and then click the red or green LED symbol.

   Tip: The output signal indicates whether the selected signal connection is open or closed.

Understanding power surges

Power surges, line spikes, and transient energy sources can impede instrument operation. Ensure that the instrument's electrical supply is adequately protected from these conditions and properly grounded.

Understanding the status LED

The status LED on the instrument's front panel has a twofold purpose: to indicate overall status and to indicate when the instrument is powered-on or powered-off. When the instrument is working properly, the status LED is green.

LED mode and color	Indicates
Off	The instrument is off.
Steady green	The instrument initialized without error.
Flashing red	An error stopped the instrument. **Tip:** The console log has error information. Use the Control menu to reset. **See also:** The 2707 Autosampler online Help.

Conducting analytical troubleshooting

Analytical problems like bad reproducibility or carryover can occur in any HPLC system. You may have to try several procedures to find the cause. First determine whether the instrument or the rest of the system is causing the problem by doing the following:

- Replace the valve by a manual injection valve to discriminate between valve problems and other problems.
- Do a number of full loop injections. If the results are fine, the fault is in the instrument; if not, check the rest of the HPLC system.

External influences like temperature or light sensitivity can cause problems with analyses. Verify that the application was operating properly before the problem arose and that the system underwent no changes.

Following are number of causes and possible solutions for analysis problems. For further help, contact Waters Service.

When reproducibility fails to meet specifications, check the following:

Cause	Solution
Air in flow path	Perform an initial wash by clicking “Wash needle” in the 2707 Console or using the control panel.
Leaking syringe	If leakage occurs at the top of the syringe, determine whether the syringe is mounted properly and that its gasket is in place. If leakage occurs at the bottom of the syringe, replace the syringe or plunger tip.
Leaking syringe valve	Inspect the valve and replace if needed.
Rotor seal worn out	Replace the seal. Inspect the stator.
Dead volumes in tubing connections	Redo connections with new ferrules and nuts.
Broken degasser	Repair the component, and confirm operation.

If a blank gives a peak too high for the criteria:

Cause	Solution
Solubility problem	Modify the sample or wash solution.
Contaminated blank	Use a new blank.

If no injection occurs:

Cause	Solution
Blockage in flow path	1. Disconnect the needle from the valve. 2. Start a manual wash. 3. If solvent flows from the injection port, inspect the needle; if no solvent flows from the injection port, disconnect the buffer tubing from the injector valve. 4. Start a manual wash. 5. If solvent flows from the open end, inspect the rotor seal; if not, disconnect the buffer tubing from the syringe valve. 6. Start a manual wash. 7. If solvent flows from syringe valve, inspect the buffer tubing; if not, check for overtightened connections throughout the flow path and check the syringe valve.
Leakage in the injection valve	1. Disconnect the needle tubing and buffer tubing. 2. Connect port 1 to an HPLC pump. 3. Block port 6. 4. Start the pump at a low flow. 5. Observe ports 3 and 4 for leakage. 6. If leakage occurs at ports 3 and 4, inspect the rotor seal; if not, reinspect with a manual valve. **Tip:** Observe the maximum allowed pressure of 350 psi to prevent valve leakage.

A Safety Advisories

Waters instruments display hazard symbols designed to alert you to the hidden dangers of operating and maintaining the instruments. Their corresponding user guides also include the hazard symbols, with accompanying text statements describing the hazards and telling you how to avoid them. This appendix presents all the safety symbols and statements that apply to the entire line of Waters products.

Contents

Warning symbols

Warning symbols alert you to the risk of death, injury, or seriously adverse physiological reactions associated with an instrument's use or misuse. Heed all warnings when you install, repair, and operate Waters instruments. Waters assumes no liability for the failure of those who install, repair, or operate its instruments to comply with any safety precaution.

Task-specific hazard warnings

The following warning symbols alert you to risks that can arise when you operate or maintain an instrument or instrument component. Such risks include burn injuries, electric shocks, ultraviolet radiation exposures, and others.

When the following symbols appear in a manual's narratives or procedures, their accompanying text identifies the specific risk and explains how to avoid it.

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

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

Warning: (Risk of electric shock.)

Warning: (Risk of fire.)

Warning: (Risk of needle puncture.)

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.)

Warnings that apply to particular instruments, instrument components, and sample types

The following warnings can appear in the user manuals of particular instruments and on labels affixed to them or their component parts.

Burst warning

This warning applies to Waters instruments fitted with nonmetallic tubing.

Warning: Pressurized nonmetallic, or polymer, tubing can burst. Observe these precautions when working around such tubing:

- Wear eye protection.
- Extinguish all nearby flames.
- Do not use tubing that is, or has been, stressed or kinked.
- Do not expose nonmetallic tubing to incompatible compounds like tetrahydrofuran (THF) and nitric or sulfuric acids.
- Be aware that some compounds, like methylene chloride and dimethyl sulfoxide, can cause nonmetallic tubing to swell, which significantly reduces the pressure at which the tubing can rupture.

Mass spectrometer flammable solvents warning

This warning applies to instruments operated with flammable solvents.

Warning: Where significant quantities of flammable solvents are involved, a continuous flow of nitrogen into the ion source is required to prevent possible ignition in that enclosed space.

Ensure that the nitrogen supply pressure never falls below 400 kPa (4 bar, 58 psi) during an analysis in which flammable solvents are used. Also ensure a gas-fail connection is connected to the LC system so that the LC solvent flow stops if the nitrogen supply fails.

Mass spectrometer shock hazard

This warning applies to all Waters mass spectrometers.

Warning: To avoid electric shock, do not remove the mass spectrometer's protective panels. The components they cover are not user-serviceable.

This warning applies to certain instruments when they are in Operate mode.

Warning: High voltages can be present at certain external surfaces of the mass spectrometer when the instrument is in Operate mode. To avoid non-lethal electric shock, make sure the instrument is in Standby mode before touching areas marked with this high voltage warning symbol.

Biohazard warning

This warning applies to Waters instruments that can be used to process material that might contain biohazards: substances that contain biological agents capable of producing harmful effects in humans.

Warning: Waters's instruments and software can be used to analyze or process potentially infectious human-sourced products, inactivated microorganisms, and other biological materials. To avoid infection with these agents, assume that all biological fluids are infectious, observe good laboratory practices and, consult your organization's biohazard safety representative regarding their proper use and handling. Specific precautions appear in the latest edition of the US National Institutes of Health (NIH) publication, *Biosafety in Microbiological and Biomedical Laboratories* (BMBL).

Chemical hazard warning

This warning applies to Waters instruments that can process corrosive, toxic, flammable, or other types of hazardous material.

Warning: Waters instruments can be used to analyze or process potentially hazardous substances. To avoid injury with any of these materials, familiarize yourself with the materials and their hazards, observe Good Laboratory Practices (GLP), and consult your organization's safety representative regarding proper use and handling. Guidelines are provided in the latest edition of the National Research Council's publication, *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals.*

Caution symbol

The caution symbol signifies that an instrument's use or misuse can damage the instrument or compromise a sample's integrity. The following symbol and its associated statement are typical of the kind that alert you to the risk of damaging the instrument or sample.

Caution: To avoid damage, do not use abrasives or solvents to clean the instrument's case.

Warnings that apply to all Waters instruments

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

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

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

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

Avvertenza: eventuali modifiche o alterazioni apportate a questa unità e non espressamente approvate da un ente responsabile per la conformità annulleranno l'autorità dell'utente ad operare l'apparecchiatura.

Atencion: cualquier cambio o modificación efectuado en esta unidad que no haya sido expresamente aprobado por la parte responsable del cumplimiento puede anular la autorización del usuario para utilizar el equipo.

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

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

주의 : 기기 검교정 담당자의 승인 없이 무단으로 기기를 변경 또는 수정하는 경우에는, 그 기기 운영에 대한 허가가 취소될 수 있습니다.

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

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

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

Attention: Manipulez les tubes en polymère sous pression avec precaution:

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

Vorsicht: Bei der Arbeit mit Polymerschläuchen unter Druck ist besondere Vorsicht angebracht:

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

Attenzione: prestare attenzione durante l'utilizzo dei tubi di polimero pressurizzati:

- Indossare sempre occhiali da lavoro protettivi nei pressi di tubi di polimero pressurizzati.
- Estinguere ogni fonte di ignizione circostante.
- Non utilizzare tubi soggetti che hanno subito sollecitazioni eccessive o son stati incurvati.
- Non utilizzare tubi non metallici con tetraidrofurano (THF) o acido solforico o nitrico concentrato.
- Tenere presente che il cloruro di metilene e il dimetilsolfossido provocano rigonfiamento nei tubi non metallici, riducendo notevolmente la resistenza alla 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：当在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: 폴리머재질의 튜빙을 압력하에서 사용할 때는 다음 사항에 유의하십시오.

- 압력을 받은 폴리머 튜빙 부근에서는 반드시 보호안경을 착용할 것
- 모든 화기의 접근을 금함
- 늘리거나 뒤틀린 튜빙은 사용하지 말 것
- 비금속 튜빙을 테트라히드로퓨란(THF)이나 염산 및 황산과 함께 사용하지 말 것
- 디글로로메탄(methylene chloride)와 디메틸설폭시드(dimethyl sulfoxide)는 비금속 튜빙을 팽창시켜 쉽게 파열되므로 주의할 것

警告：ポリマーチューブに圧力をかけて取り扱う場合は、次のように注意してください。

- 加圧したポリマーチューブの付近では、常に保護めがねを着用してください。
- 付近の火はすべて消してください。
- 激しい応力やねじれを受けたチューブは使用しないでください。
- テトラヒドロフラン（THF）、濃硝酸、あるいは濃硫酸には、非金属製のチューブを使用しないでください。
- ジクロロメタンやジメチルスルホキシドは非金属製のチューブを膨張させ、チューブの破断圧力を大幅に低下させますので、注意してください。

Warning: The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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

Vorsicht: Der Benutzer wird darauf aufmerksam gemacht, dass bei unsachgemäßer Verwenddung des Gerätes unter Umständen nicht ordnungsgemäß funktionieren.

Attenzione: l'utente deve essere al corrente del fatto che, se l'apparecchiatura viene usta in un modo specificato dal produttore, la protezione fornita dall'apparecchiatura potrà essere invalidata.

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制造廠商指定的方式使用，那么該設備所提供的保護將被消弱。

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

경고 : 제조사가 지정한 것 이외의 방법으로 기기를 사용하는 경우에는, 사용자가 위험으로부터 보호될 수 없는 경우가 발생할 수 있음에 유념하십시오.

警告: ユーザは製造業者が指定していない方法で装置を使用した場合は装置が提供する保護が損なわれることがあるということを承知しているものとします。

Warning: To protect against fire hazard, replace fuses with those of the same type and rating.

Attention: Remplacez toujours les fusibles par d'autres du même type et de la même puissance afin d'éviter tout risque d'incendie.

Vorsicht: Zum Schutz gegen Feuergefahr die Sicherungen nur mit Sicherungen des gleichen Typs und Nennwertes ersetzen.

Attenzione: per una buona protezione contro i rischi di incendio, sostituire i fusibili con altri dello stesso tipo e amperaggio.

Advertencia: sustituya los fusibles por otros del mismo tipo y características para evitar el riesgo de incendio.

警告：為了避免火災的危險，應更換同种類型及規格的保險絲。

警告: 为了避免火灾的危险, 应更换同种类型及规格的保险丝。

경고 : 화재를 방지하기 위해서는 퓨즈 교체 시 같은 종류, 같은 등급의 것을 사용하십시오.

警告: 火災の危険防止のために、ヒューズの交換は同一タイプおよび定格のもので行なってください。

Warning: To avoid possible electrical shock, disconnect the power cord before servicing the instrument.

Attention: Afin d'éviter toute possibilité de commotion électrique, débranchez le cordon d'alimentation de la prise avant d'effectuer la maintenance de l'instrument.

Vorsicht: Zur Vermeidung von Stromschlägen sollte das Gerät vor der Wartung vom Netz getrennt werden.

Attenzione: per evitare il rischio di scossa elettrica, scollegare il cavo di alimentazione prima di svolgere la manutenzione dello strumento.

Precaución: para evitar descargas eléctricas, desenchufe el cable de alimentación del instrumento antes de realizar cualquier reparación.

警告：要避免觸電，請在修理或保養器材前把電源線拔出。

警告：为避免可能引起得触电危险，在修理前请切断电源连接。

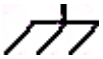
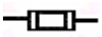
경고: 전기 충격의 가능성을 피하기 위해서는, 기기를 수리하기 이전에 전원 코드를 차단하십시오.

警告：感電の危険性を避けるために、装置の保守を行う前には装置の電源コードを引き抜いてください。

Electrical and handling symbols

Electrical symbols

These can appear in instrument user manuals and on the instrument's front or rear panels.

	Electrical power on
	Electrical power off
	Standby
	Direct current
	Alternating current
	Protective conductor terminal
	Frame, or chassis, terminal
	Fuse
	Recycle symbol: Do not dispose in municipal waste.

Handling symbols

These handling symbols and their associated text can appear on labels affixed to the outer packaging of Waters instrument and component shipments.

	Keep upright!
	Keep dry!
	Fragile!
	Use no hooks!

B Materials of Construction and Compliant Solvents

Preventing contamination

For information on preventing contamination, refer to *Controlling Contamination in LC/MS Systems* (part number 715001307), found on http://www.waters.com. Click Services and Support and then Support Center.

Naming solvents for mobile phase preparation

Following are the most common ingredients used to prepare mobile phases for reverse-phase LC/MS (API):

- Water
- Methanol
- Acetonitrile
- Formic acid
- Acetic acid
- Trifluoroacetic acid
- Ammonium acetate
- Ammonium formate

C Specifications

Contents:

Outlining general specifications

General	
Sound pressure level	< 65 dB
Working temperature	10 - 40°C (indoor use only)
Storage temperature	–25 - +60°C
Humidity	20 - 80% RH
Safety and EMC compatibility	According to EC-directives; CSA (UL) approved
Installation class	II
Pollution degree	2
External circuit insulation	Basic (single layer of insulation)
Altitude	Up to 2000 m
Dimensions	Without cooling: 300 mm (W) x 510 mm (D) x 360 mm (H) With cooling: 300 mm (W) x 575 mm (D) x 360 mm (H)
Weight	Without cooling: 19 kg With cooling: 21 kg
Maximum weight that can be placed on the instrument	65 kg
Electrical requirements	95 - 240 Volt AC ± 10%; 50 - 60 Hz; 200 VA
Viscosity range	0.1 - 5 cP

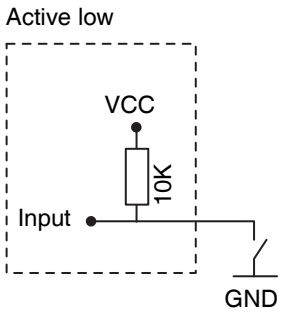
Sampling	
Sample capacity	2 microtiter plates according to SBS standards; 96-well high/low and 384-well low formats, 48- or 12-vial trays; any combination of plates is allowed, except for 384 Low left and 96 High right.
Vial/plate dimensions	Including septa or capmat: Maximum 47 mm height

Sampling	
Loop volume	1 - 5000 µL programmable, 10 mL loop optional
Dispenser syringe	500 µL standard or 2500 µL for prep option
Vial detection	Missing vial/well plate detection by sensor
Headspace pressure	Built-in compressor, but only for vials with septa
Switching time injection valve	Electrically < 100 msec
Piercing precision needle	± 0.6mm
Wash solvent	Integrated wash solvent bottle
Wetted parts in flow path	SS316, PTFE, Tefzel, glass, PEEK
Injection cycle time	< 60 sec in all injection modes for 1 injection ≤ 100 µL including 300 µL wash

Analytical performance	
Injection modes	Full loop, partial loop needle overfill, partial loop, pressure-assisted sample aspiration
Reproducibility (valid at 1.0 cP)	RSD ≤ 0.3% for full loop injections RSD ≤ 0.5% for partial loop needle overfill injections, injection volumes > 10 µL RSD ≤ 1.0% for partial loop injections, injection volumes > 10 µL
Carryover	< 0.05% with programmable needle wash

Programming	
Injection methods	Full loop, partial loop needle overfill, and partial loop
Injection volume	0 µL - 10000 µL (with 1 µL increment), depending on system settings
Maximum injection volume	Full loop = loop volume Partial loop needle overfill = ½ × of loop volume Partial loop = (loop volume - [3 × needle volume])/2
Analysis time	Maximum: 9 hr, 59 min, 59 sec

Programming	
Wash	Between injections
Priority sample	Programmable

Communication	
Outputs	Relay output, 28V AC/DC max, I_{max} = 0.25A
Inputs	2 programmable TTL inputs, programmable as Hold inject (default) and Stop inject 
Communication port	Ethernet

Options (factory installed)	
Sample tray cooling	Built-in Peltier cooling Range: 4°C to ambient - 3°C Air temperature in sample compartment: 4°C ± 2°C (at temperature sensor) (Temperature at 80% relative humidity and 25°C ambient temperature)

Options (user installable)	
Biocompatible sample flow path and valve	Inert sample needle (Silco steel) and biocompatible valve (PEEK)
Prep kit	2.5 mL syringe, prep valve, 10 mL sample loop, LSV needle, and sample tray for 10 mL vials

The instrument is standard fitted with the following tubing:

Tubing	Materials/dimensions
Standard sample needle and tubing (label 15 µL)	SS: 97 mm × 0.8 mm OD × 0.25 mm ID ETFE (Tefzel): 200 mm × 1/16” OD × 0.25 mm ID
Buffer tubing from high-pressure valve to syringe valve (label 1000 µL)	ETFE (Tefzel): 1275 mm × 1/16” OD × 1.0 mm ID
Tubing syringe valve to wash solvent bottle	PTFE: 400 mm × 1/8” OD × 1.6 mm ID
Tubing syringe valve to waste	PTFE: 400 mm × 1/8” OD × 1.6 mm ID
Clear	Plastic tubing for wash solvent
Blue	High-pressure steel tubing, 0.03-inch (0.75-mm) ID; connects the instrument to the pump
Red	High-pressure steel tubing, 0.009-inch (0.25-mm) ID; connects the instrument to the column
Drain	Two 0.25-inch clear lines; attach to the drip trays on the instrument's bottom: one drains solvent and sample spills, while the other drains water from the cooler, sample spills, and mobile phase leaks

Tip: When installing new tubing, be sure to:

- Avoid overtightening nuts, because doing so may block the flow path
- Use tubing volumes suited for the other items in the flow path

Outlining prep version specifications

Tip: This specification lists only items that differ from the standard instrument specification. The prep version of this instrument is designed for LSVs.

Sampling	
Sampling capacity	24 vials of 10 mL (LSV)
Vial dimensions (cap included)	Maximum vial height: 47 mm Minimum vial height: 32 mm
Loop volume	Not programmable; injection volume determines the aspirated sample volume
Dispenser syringe	2500 µL syringe
Injection volume	0 µL - 10000 µL, with 1 µL increments
Valve	Valco 0.75 bore valve
Sample loop	10 mL SS sample loop, 1/8” tubing with 1/16” tubing ends and fittings (Valco®)
Buffer tubing	2 mL
Needle	LSV needle with LSV air needle

Analytical performance	
Injection method	Partial loop needle overfill injection mode
Reproducibility	RSD ≤ 1.0% for partial loop needle overfill injections, injection volumes >10 µL up to 50% of the installed sample loop
Viscosity range	0.1 – 5 cP
Memory effect	< 0.1% with programmable needle wash

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