Agilent

Agilent InfinityLab LC Series

# 1260 Infinity III Binary Pump

# User Manual

# Notices

## Document Information

The information in this document also applies to 1260 Infinity II and 1290 Infinity II modules.

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# Contents

# In This Book

This manual covers the Agilent 1260 Infinity III Binary Pump (G7112B).

# 1 Introduction

This chapter gives an introduction to the module and instrument overview.

# Introduction to the Pump

The binary pump comprises two identical pumps integrated into one housing. Binary gradients are created by high-pressure mixing. A built-in degasser is available for applications that require best flow stability, especially at low flow rates, for maximum detector sensitivity. Pulse damper and mixer can be bypassed for low flowrate applications or whenever a minimal transient volume is desirable. Typical applications are high throughput methods with fast gradients on high resolution 2.1 mm columns. The pump is capable of delivering flow in the range of 0.1 – 5 mL/min against up to 600 bar. A solvent selection valve (optional) allows to form binary mixtures (isocratic or gradient) from one of two solvents per channel. Active seal wash (optional) is available for use with concentrated buffer solutions.

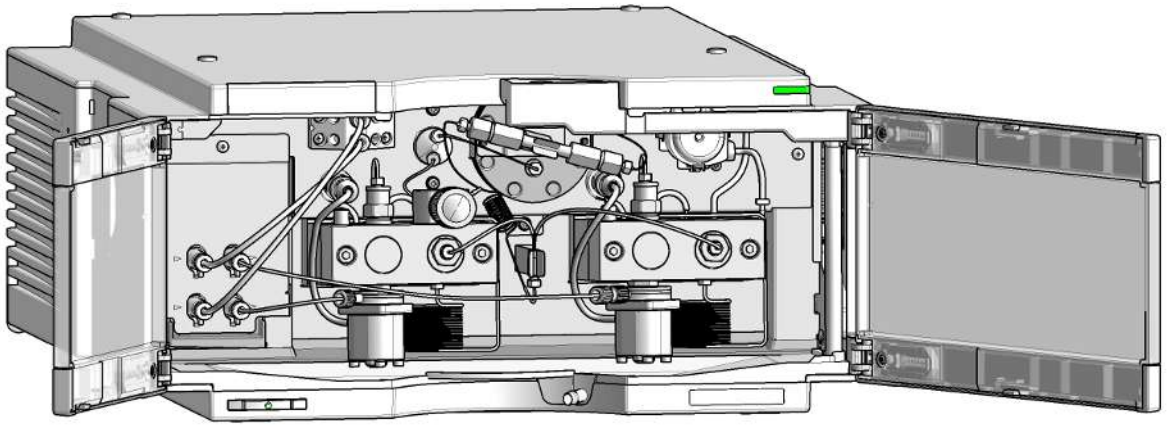


**Figure 1:** Overview of the binary pump

# Product Description of the 1260 Infinity III Binary Pump (G7112B)

The Agilent 1260 Infinity III Binary Pump is suited for LC applications using conventional or superficially porous particles columns, as well as STM column technology. Gradient formation is based on a high-pressure mixing principle. Standard or low delay volumes can be easily configured by the user. The binary pump offers reproducible gradients and high-performance, providing high-throughput and fast separations. The pump is suitable for routine applications, with UV or MS detection, where high speed and resolution with uncompromised data quality are required.

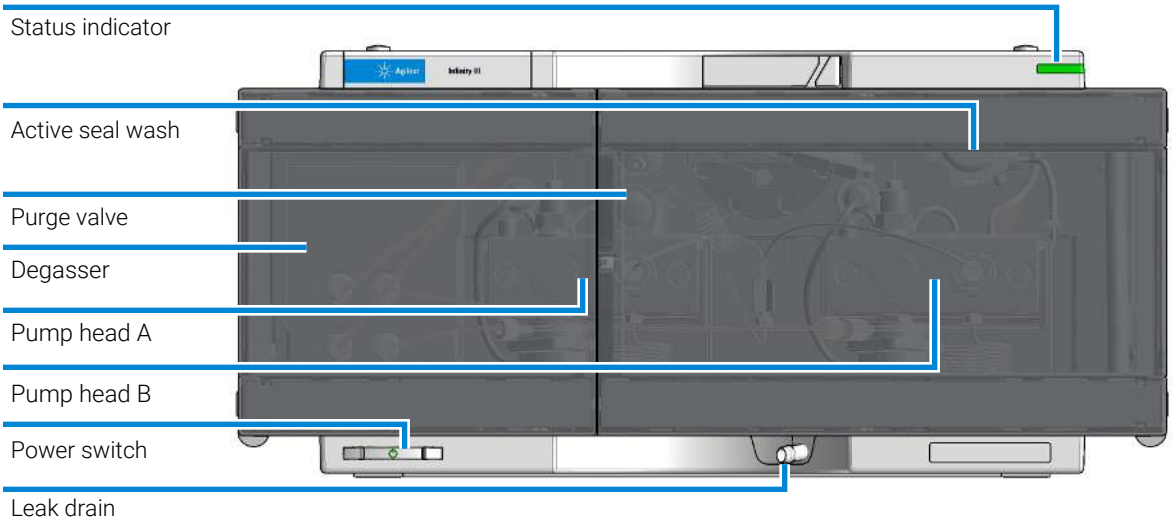



**Figure 2:** Overview of the Binary Pump

# Features of the 1260 Infinity III Binary Pump (G7112B)

- Configurable delay volume - down to 120 µL together with a flow range up to 5 mL/min provides universal applicability.
- Change from standard to low delay volume configuration is enabled.
- High gradient performance - even at low % B and narrow-bore flow rates.
- Integrated 2-channel-degasser.
- Fast and precise gradients using LC/MS, as well as UV-only systems.
- Fully exploits the speed and separation potential of Poroshell.
- InfinityLab Level Sensing adds weight controlled level sensing and solvent prediction of the equipped HPLC solvents to avoid downtime by running out solvent.

# Operating Principle

## Principle of Operation

The binary pump is based on a two-channel, dual-piston in-series design which comprises all essential functions that a solvent delivery system has to fulfill. Metering of solvent and delivery to the high-pressure side are performed by two pump assemblies which can generate pressure up to 600 bar.

Each channel comprises a pump assembly including pump drive, pump head, active inlet valve with replaceable cartridge, and outlet valve. The two channels are fed into a low-volume mixing chamber which is connected via a restriction capillary coil to a damping unit and a mixer. A pressure sensor monitors the pump pressure. A purge valve with integrated PTFE frit is fitted to the pump outlet for convenient priming of the pumping system.

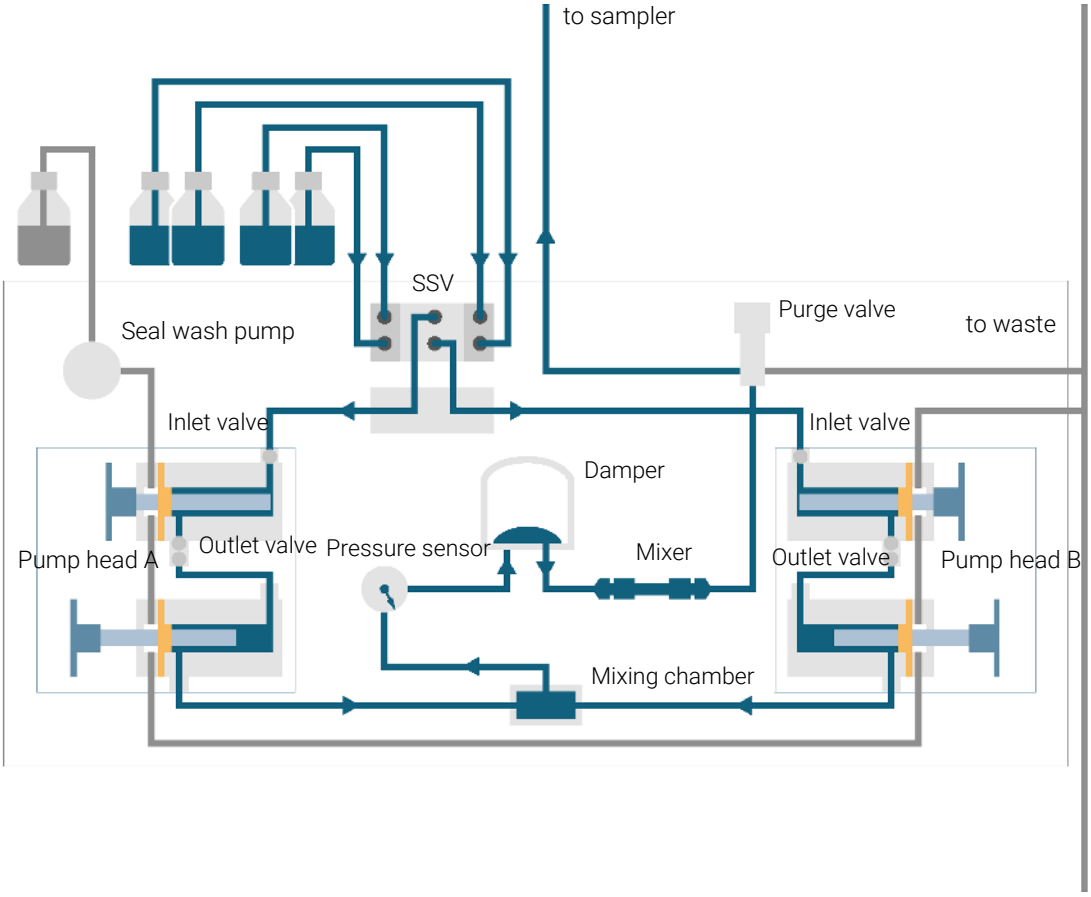



**Figure 3:** The hydraulic path of the Binary Pump with damper and mixer

Damper and mixer can be bypassed for lowest delay volume of the binary pump. This configuration is recommended for low flow rate applications with steep gradients.

Figure 4 on page 14 illustrates the flow path in low delay volume mode. For instructions on how to change between the two configurations, see Convert the Binary Pump to Low Delay Volume Mode on page 72.

**NOTE** Bypassing the mixer while the damper remains in line is not a supported configuration and may lead to undesired behavior of the binary pump.

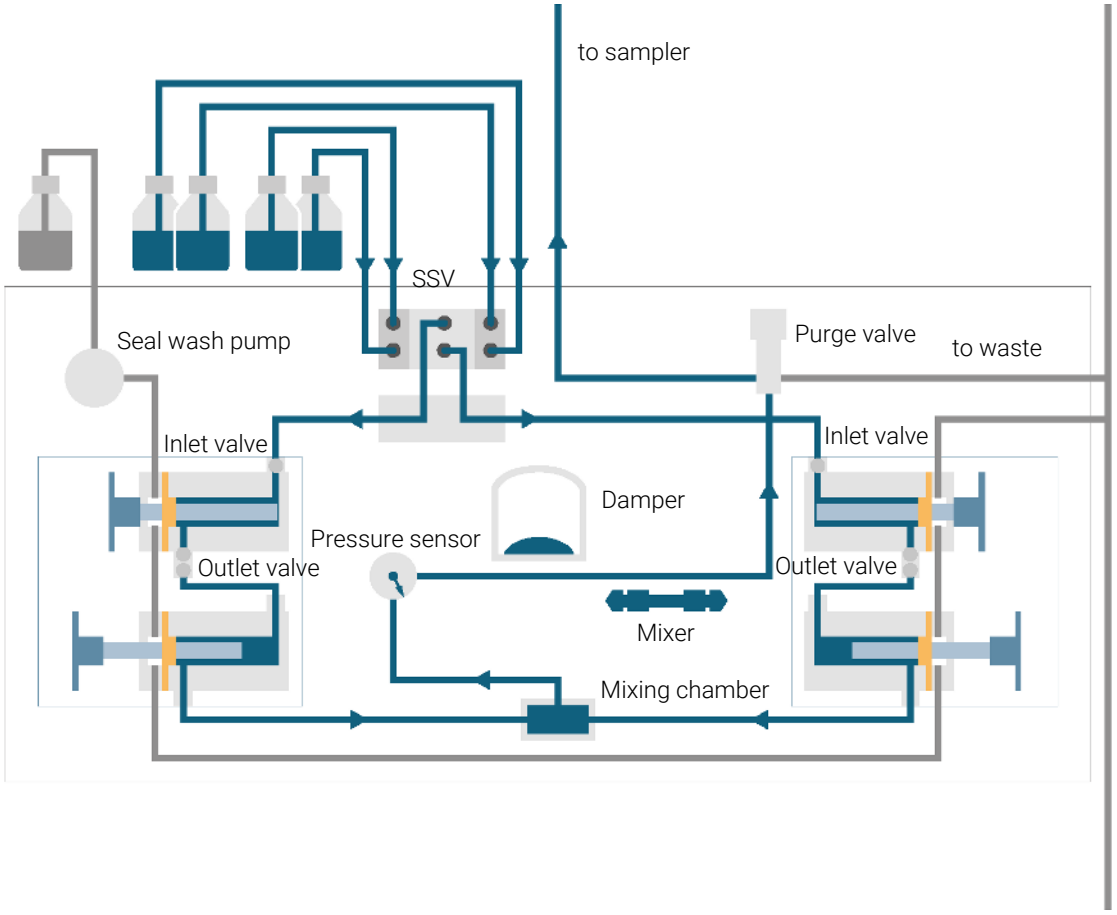



**Figure 4:** The hydraulic path of the Binary Pump with bypassed damper and mixer

For pump specifications, see Table 1 on page 24.

## Overview of the Hydraulic Path

The solvent from the bottle in the solvent cabinet enters the pump through an active inlet valve. Each side of the binary pump comprises two substantially identical pump units. Both pump units comprise a ball-screw drive and a pump head with two sapphire pistons for reciprocating movement.

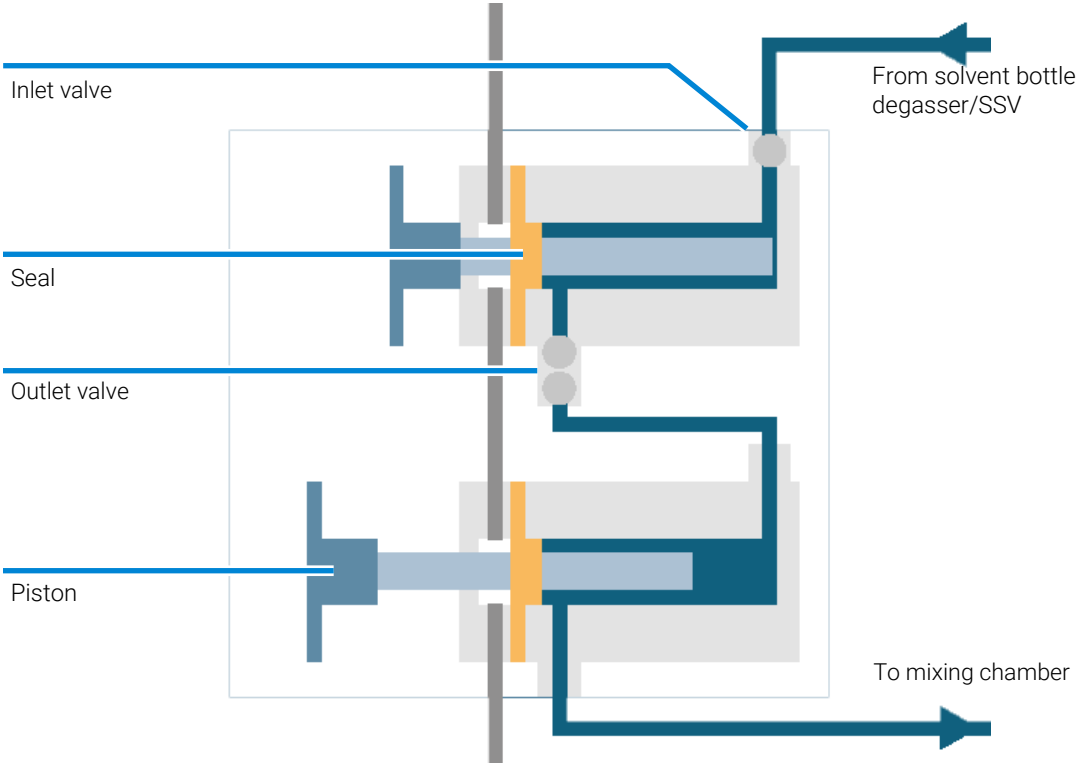



**Figure 5:** Pump head

A servo-controlled variable reluctance motor drives the two ball-screw drives in opposite directions. The gears for the ball-screw drives have different circumferences (ratio 2:1) allowing the first piston to move at double the speed of the second piston. The solvent enters the pump heads close to the bottom limit and leaves it at its top. The outer diameter of the piston is smaller than the inner diameter of the pump-head chamber allowing the solvent to fill the gap in between. The first piston has a stroke volume in the range of 20 µL to 100 µL depending on the flow rate. The microprocessor controls all flow rates in a range of 1 µL/min to 5 mL/min. The inlet of the first pumping unit is connected to the active inlet valve which is processor-controlled opened or closed allowing solvent to be drawn into the first pump unit.

The outlet of the first pump chamber is connected by a 500 µL absorber capillary to the second pump chamber. The outlets of the second chambers of both pump channels joined via a small mixing chamber. A coiled restriction capillary

connects the mixing chamber via a pressure pulse damper, a mixer and a pressure sensor to the purge valve assembly. The outlet of the purge valve assembly is then connected to the attached chromatographic system.

When turned on, the pump runs through an initialization procedure to determine the upper dead center of the first piston of both pump channels. The first piston moves slowly upwards to the mechanical stop of the pump head and from there it moves back a predetermined path length. The controller stores this piston position in memory. After this initialization the pump starts operation with the set parameters for the two pump channels.

The active inlet valve is opened and the down moving piston draws solvent into the first pump head. At the same time the second piston is moving upwards delivering into the system. After a controller defined stroke length (depending on the flow rate) the drive motors are stopped and the active inlet valve is closed. The motor direction is reversed and moves the first piston up until it reaches the stored upper limit and at the same time moving the second piston downwards.

Then the sequence starts again moving the pistons up and down between the two limits. During the delivery stroke of the first piston the solvent in the pump head is pressed through the outlet valve into the second pumping unit. The second piston draws in half of the volume displaced by the first piston and the remaining half volume is directly delivered into the system. During the drawing stroke of the first piston, the second piston delivers the drawn volume into the system.

For pump specifications, see Table 2 on page 24.

### What is Pump Elasticity Compensation?

The flow path of the pump consists of pump chambers, sapphire pistons, polymer seals, stainless steel tubing of different dimension, pressure sensor, and so forth. All of these parts deform when pressurized. The sum of this deformation is called pump elasticity.

Let us look at a practical example: Piston 1 draws solvent at ambient pressure. The movement direction is reversed and the piston 1 now compresses the solvent until the operating pressure of the HPLC system is reached. The outlet valve opens, and solvent is pumped by piston 1 into pump chamber 2. Due to two factors, the solvent volume that is delivered into the system at high pressure is smaller than it is supposed to be:

1. The solvent is compressible
2. The pump has a certain elasticity which causes its internal volume to increase with pressure.

In order to compensate for these two influences, their contributions must be known. An elasticity calibration allows separating pump properties from solvent properties and therefore allows transferring solvent properties, which have been obtained from one pump to another pump with different elasticity.

Elasticity calibration is done with a solvent, which properties (compressibility, thermal expansion) are well-known and documented: pure water. When pumping water and using its property data for controlling the pump, any deviations from the theoretical pressure profile during solvent recompression are caused by the elasticity of the pump.

The *Pump Elasticity Calibration* calculates correction factors to compensate for the individual elasticity of the pump that is being calibrated. The elasticity is different for every pump and may change with the replacement of parts in the flow path, e.g. pump seals.

All binary pumps are elasticity calibrated at the factory and require recalibration only after preventive maintenance or major repairs to the flow path. Replacement of capillaries or PTFE frits are not considered as a major repair.

**CAUTION**

Incorrect pump elasticity calibration.

Solvent compressibility calibrations acquired with a miscalibrated pump will work, but they are not transferable to other pumps. A correct pump elasticity calibration is an essential prerequisite for successful solvent compressibility calibrations.

— Calibrate the pump elasticity correctly.

### What is Solvent Compressibility Compensation?

Although the compressibility of liquids is orders of magnitude lower than the compressibility of gases, without correction a noticeable volume error would be seen if typical chromatographic solvents are compressed to operating pressures as high as 600 bar. In addition, the compressibility depends on pressure, temperature and the amount of dissolved gas. In order to minimize the influence of the latter, the use of a vacuum degasser is mandatory for a high flow and composition precision. Unfortunately, the influence of the temperature on compressibility is non-linear and cannot be calculated.

The Agilent 1260 Infinity III Binary Pump features a multi point compressibility calibration. The compressibility of a solvent is determined at different pressures from 0 – 600 bar and stored in an XML file. This file can be distributed to other pumps because the solvent compressibility is independent from the pump.

The binary pump and ChemStation come with predetermined solvent compressibility data for the most common HPLC solvents like water, acetonitrile, methanol, etc. Users can calibrate their own solvent mixtures with the help of an easy to use calibration procedure in the Agilent Lab Advisor software.

Let us use the practical example from the last section once again to understand how compressibility compensation works:

Piston 1 draws solvent at ambient pressure. The movement direction is reversed and piston 1 now compresses the solvent until the operating pressure of the HPLC system is reached. The outlet valve opens, and solvent is pumped by piston 1 into pump chamber 2.

Without any compensation, the delivered volume at operating pressure would be too low. In addition, it would take a noticeable amount of time to recompress the solvent to operating pressure. During this time frame, no solvent would be delivered into the system and as a result a high pressure fluctuation (known as *pressure ripple*) would be observed.

When both solvent compressibility at the current operating pressure and pump elasticity are known, the pump can automatically correct for the missing volume by drawing the appropriate larger solvent volume at ambient pressure and speed up the piston during the recompression phase in the first pump chamber. As a result, the pump delivers the accurate volume with any (calibrated) solvent at any pressure at a greatly reduced pressure ripple. For applications that require lowest transition volume of the pump, damper and mixer can be bypassed.

For compatibility with older methods from G1312A Binary Pumps, the previous one-point compressibility compensation is available, too. However, since the compressibility is a non-linear function, one single compressibility value per solvent will only give good results at one particular pressure.

### How Does Variable Stroke Volume Work?

The smaller the solvent volume in the pump chamber is, the faster it can be recompressed to operating pressure. The binary pump allows to manually or automatically adjust the pump stroke volume of the first piston in the range of 20 – 100 µL. Due to the compression of the solvent volume in the first pump chamber, each piston stroke of the pump will generate a small pressure pulsation, influencing the flow ripple of the pump. The amplitude of the pressure pulsation mainly depends on the stroke volume and the compressibility compensation for the solvent in use. Small stroke volumes generate less pressure pulsation than larger stroke volumes at the same flow rate. In addition, the frequency of the pressure pulsation will be higher. This will decrease the influence of flow pulsations on retention times.

In gradient mode, a smaller stroke volume results in less flow ripple and reduces the composition ripple.

The binary pump uses a processor-controlled ball screw system for driving its pistons. The normal stroke volume is optimized for the selected flow rate. Small flow rates use a small stroke volume while higher flow rates use a higher stroke volume.

The stroke volume for the pump is by default set to AUTO mode. This means that the stroke is optimized for the flow rate in use. A change to larger stroke volumes is possible but not recommended.

# 2 Site Requirements and Specifications

This chapter provides information on environmental requirements, physical and performance specifications.

# Site Requirements

A suitable environment is important to ensure optimal performance of the instrument.

## Power Consideration

The module power supply has wide ranging capability. It accepts any line voltage in the range described in Table 1 on page 24. Consequently there is no voltage selector in the rear of the module. There are also no externally accessible fuses, because automatic electronic fuses are implemented in the power supply.

**WARNING**

**Inaccessible power plug.**

**In case of emergency it must be possible to disconnect the instrument from the power line at any time.**

- **Make sure the power connector of the instrument can be easily reached and unplugged.**
- **Provide sufficient space behind the power socket of the instrument to unplug the cable.**

**WARNING**

**Incorrect line voltage at the module**

**Shock hazard or damage of your instrument can result if the devices are connected to line voltage higher than specified.**

- **Connect your module to the specified line voltage.**

**WARNING** **Module is partially energized when switched off, as long as the power cord is plugged in.**

**Repair work at the module can lead to personal injuries, e.g. shock hazard, when the cover is opened and the module is connected to power.**

- **Make sure that it is always possible to access the power plug.**
- **Remove the power cable from the instrument before opening the cover.**
- **Do not connect the power cable to the Instrument while the covers are removed.**

## Power Cords

Country-specific power cords are available for the module. The female end of all power cords is identical. It plugs into the power-input socket at the rear. The male end of each power cord is different and designed to match the wall socket of a particular country or region.

Agilent makes sure that your instrument is shipped with the power cord that is suitable for your particular country or region.

**WARNING** **Unintended use of power cords**

**Using power cords for unintended purposes can lead to personal injury or damage of electronic equipment.**

- **Never use a power cord other than the one that Agilent shipped with this instrument.**
- **Never use the power cords that Agilent Technologies supplies with this instrument for any other equipment.**
- **Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.**

**WARNING** **Absence of ground connection**

**The absence of ground connection can lead to electric shock or short circuit.**

- **Never operate your instrumentation from a power outlet that has no ground connection.**

**WARNING** **Electrical shock hazard**

**Solvents may damage electrical cables.**

- **Prevent electrical cables from getting in contact with solvents.**
- **Exchange electrical cables after contact with solvents.**

## Bench Space

The module dimensions and weight (see Table 1 on page 24) allow you to place the module on almost any desk or laboratory bench. It needs an additional 2.5 cm (1.0 inches) of space on either side and approximately 8 cm (3.1 inches) in the rear for air circulation and electric connections

If the bench shall carry a complete HPLC system, make sure that the bench is designed to bear the weight of all modules.

The module should be operated in a horizontal position.

**NOTE** Agilent recommends that you install the HPLC instrument in the InfinityLab Flex Bench rack. This option helps to save bench space as all modules can be placed into one single stack. It also allows to easily relocate the instrument to another lab.

## Condensation

**CAUTION** Condensation within the module

Condensation can damage the system electronics.

- Do not store, ship or use your module under conditions where temperature fluctuations could cause condensation within the module.
- If your module was shipped in cold weather, leave it in its box and allow it to warm slowly to room temperature to avoid condensation.

# Specifications of the 1260 Infinity III Binary Pump (G7112B)

**Table 1:** Physical specifications of the 1260 Infinity III Binary Pump (G7112B)

| Type | Specification | Comments |
|---|---|---|
| Weight | 17.8 kg (39.2 lbs) | |
| Dimensions (height × width × depth) | 180 × 396 × 436 mm (7.1 × 15.6 × 17.2 inches) | |
| Line voltage | 100 – 240 V~, ± 10 % | Wide-ranging capability |
| Line frequency | 50 or 60 Hz, ± 5 % | |
| Power consumption | 90 VA, 74 W | |
| Ambient operating temperature | 4 – 55 °C (39 – 131 °F) | |
| Ambient non-operating temperature | -40 – 70 °C (-40 – 158 °F) | |
| Humidity | < 95 % r.h. at 40 °C (104 °F) | Non-condensing |
| Operating altitude | Up to 3000 m (9842 ft) | |
| Safety standards: IEC, CSA, UL | Overvoltage category II, Pollution degree 2 | For indoor use only |
| ISM Classification | ISM Group 1 Class B | According to CISPR 11 |

**Table 2:** Performance specifications of the 1260 Infinity III Binary Pump (G7112B)

| Type | Specification | Comments |
|---|---|---|
| Hydraulic system | Two dual piston in series pumps with servo-controlled variable stroke drive, power transmission by gears and ball screws, floating pistons | |
| Designed for use with Agilent InfinityLab Assist | Intuitive User Interface, Automated Workflows, Predictive Maintenance & Assisted Troubleshooting | |
| Flow range | settable: 0.001 – 5 mL/min<br>recommended: 0.05 – 5.0 mL/min | Set points in 0.001 mL/min increments |

| Type | Specification | Comments |
|---|---|---|
| Flow precision | ≤ 0.07 % RSD or < 0.02 min SD, whichever is greater | Based on retention time at constant temperature |
| Flow accuracy | ± 1 % or 10 µL/min, whichever is greater | Pumping degassed $H_2O$ at 10 MPa (100 bar, 1450 psi) |
| Pressure operating range | Up to 60 MPa (600 bar, 8702 psi) up to 5 mL/min | |
| Pressure pulsation | < 2 % amplitude (typically < 1.3 %), or < 0.3 MPa (3 bar, 44 psi), whichever is greater<br>*Low delay volume configuration:* < 5 % amplitude (typically < 2 %) | |
| Compressibility compensation | Pre-defined, based on mobile phase compressibility | |
| Recommended pH range | 1.0 – 12.5 | Solvents with pH < 2.3 should not contain acids that attack stainless steel |
| Gradient formation | High-pressure binary mixing | |
| Delay volume | *Standard delay volume configuration:* 600 – 900 µL, (includes 400 µL mixer), dependent on back pressure<br><br>*Low delay volume configuration:* 120 µL | Measured with water at 1 mL/min (water/water with tracer) |
| Composition range | Settable: 0 – 100 %<br>Recommended: 1 – 99 % or 5 µL/min per channel, whichever is greater | |
| Composition precision | < 0.15 % RSD or < 0.04 min SD, whichever is greater | At 0.2 and 1 mL/min; based on retention time at constant temperature |
| Composition accuracy | ± 0.35 % absolute | At 2 mL/min, at 10 MPa (100 bar, 1450 psi) (water/water with tracer) |
| Integrated degassing unit | Number of channels: 2<br>Internal volume per channel: 0.45 mL | |
| Instrument control | LC & CE Drivers A.02.14 or above<br>Instrument Control Framework (ICF) A.02.04 or above<br>Lab Advisor software B.02.08 or above<br>InfinityLab Assist (G7180A) with firmware D.07.40 or above<br>Instant Pilot (G4208A) with firmware B.02.20 or above | For details about supported software versions refer to the compatibility matrix of your version of the LC and CE Drivers |

| Type | Specification | Comments |
|---|---|---|
| Communication | Controller Area Network (CAN)<br>Local Area Network (LAN)<br>Extended Remote Interface (ERI)<br>Universal Serial Bus (USB) | |
| Safety and maintenance | Extensive diagnostics, error detection and display through Agilent Lab Advisor, leak detection, safe leak handling, leak output signal for shutdown of the pumping system. Low voltage in major maintenance areas. | |
| GLP features | Early maintenance feedback (EMF) for continuous tracking of instrument usage in terms of seal wear and volume of pumped mobile phase with pre-defined and user settable limits and feedback messages. Electronic records of maintenance and errors. | |
| Housing | All materials are recyclable | |

# 3 Installation

The installation of the module will be done by an Agilent service representative. In this chapter, only installation of user-installable options and accessories are described.

# Installing Capillaries

This section provides information on how to install capillaries and fittings.

## Install Capillaries

Capillaries and connections depend on which system is installed.

**NOTE** As you move to smaller-volume, high-efficiency columns, you will want to use narrow id tubing, as opposed to the wider id tubing used for conventional HPLC instruments.

**NOTE** Agilent capillaries are color-coded for quick identification, see At-a-Glance Details About Agilent Capillaries on page 282.

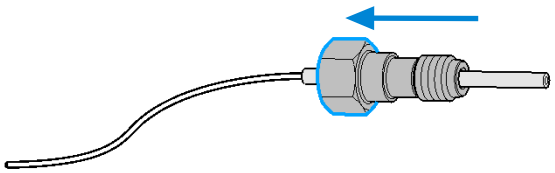
**Table 3:** Capillary connections for 1260 Infinity III systems

| p/n | From | To |
|---|---|---|
| G7120-60007 (Bottle Head Assembly) | Solvent Bottle | Infinity III Pump |
| 5500-1246 (Capillary ST 0.17 mm x 500 mm SI/SI) | Pump | Sampler |
| 5500-1217 (Capillary, ST, 0.17 mm x 900 mm SI/SX) | Pump | Vialsampler with ICC |
| 5500-1246 (Capillary ST 0.17 mm x 500 mm SI/SI) | Multisampler | MCT Valve/Heat Exchanger |
| 5500-1252 (Capillary, ST, 0.17 mm x 400 mm SL/SL) | Vialsampler | MCT Valve/Heat Exchanger |
| 5500-1240 (Capillary ST 0.17 mm x 105 mm SL/SL) | Vialsampler | ICC Heat Exchanger |
| 5500-1250 (Capillary, ST, 0.17 mm x 120 mm SL/SL, long socket) | ICC Heat Exchanger | Column |
| 5500-1193 (InfinityLab Quick Turn Capillary ST 0.17 mm x 105 mm, long socket) | MCT Heat Exchanger | Column |
| 5500-1191 (InfinityLab Quick Turn Capillary ST 0.12 mm x 280 mm, long socket) | Column/MCT Valve | Detector |
| 5062-8535 (Waste accessory kit (Flow Cell to waste)) | VWD | Waste |
| 5062-2462 (Tube PTFE 0.7 mm x 5 m, 1.6 mm od) | DAD/FLD | Waste |
| G5664-68712 (Analytical tubing kit 0.25 mm i.d. PTFE-ESD) | Detector | Fraction Collector |

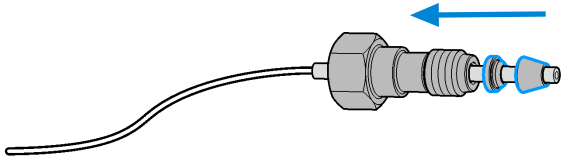
For correct installation of capillary connections it's important to choose the correct fittings, see Syntax for Capillary Description.

1 Select a nut that is long enough for the fitting you'll be using.

2 Slide the nut over the end of the tubing or capillary.



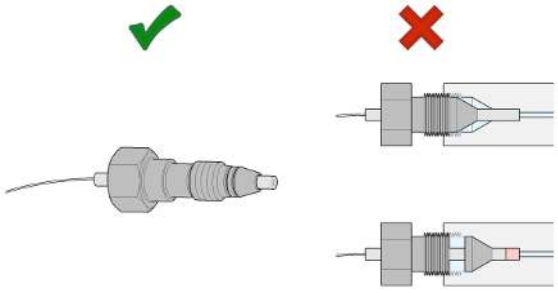
3 Carefully slide the ferrule components on after the nut and then finger-tighten the assembly while ensuring that the tubing is completely seated in the bottom of the end fitting.



4 Use a stable port installed to the module to gently tighten the fitting facing to the module. Or use the column to tighten the fitting facing to the column. This measure forces the ferrule to seat onto the tubing or capillary.

**NOTE** Do not overtighten. Over-tightening will shorten the lifetime of the fitting.

5 Loosen the nut and verify that the ferrule is correctly positioned on the tubing or capillary.



**NOTE** The first time that the Swagelok fitting is used on a column or an injection valve, the position of the ferrule is permanently set. If changing from a column or an injection valve to another, the fitting may leak or decrease the quality of the separation by contributing to band broadening.

For Bio and Bio-Inert Systems, the Swagelok instructions do not apply.

# Handling Leak and Waste

The Agilent InfinityLab LC Series has been designed for safe leak and waste handling. It is important that all security concepts are understood and instructions are carefully followed.

The solvent cabinet is designed to store a maximum volume of 8 L solvent. The maximum volume for an individual bottle stored in the solvent cabinet should not exceed 2 L. For details, see the usage guideline for the Agilent Infinity III Solvent Cabinets (a printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet).

All leak plane outlets are situated in a consistent position so that all Infinity and Infinity II/III modules can be stacked on top of each other. Waste tubes are guided through a channel on the right hand side of the instrument, keeping the front access clear from tubes.

The leak plane provides leak management by catching all internal liquid leaks, guiding them to the leak sensor for leak detection, and passing them on to the next module below, if the leak sensor fails. The leak sensor in the leak plane stops the running system as soon as the leak detection level is reached.

Solvent and condensate is guided through the waste channel into the waste container:

- from the detector's flow cell outlet
- from the Multisampler needle wash port
- from the Sample Thermostat (condensate)
- from the pump's Seal Wash Sensor (if applicable)
- from the pump's Purge Valve or Multipurpose Valve

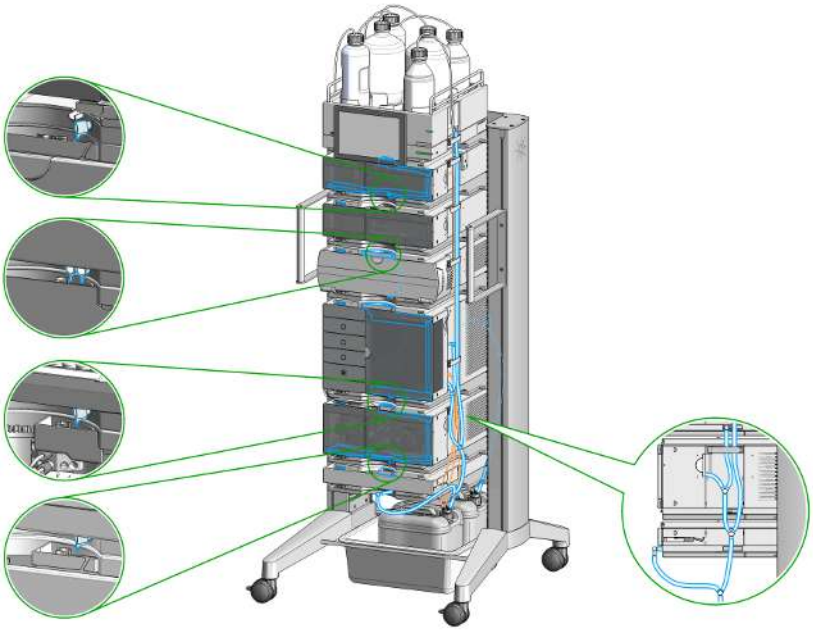


**Figure 6:** Infinity III Leak Waste Concept (Flex Bench installation)

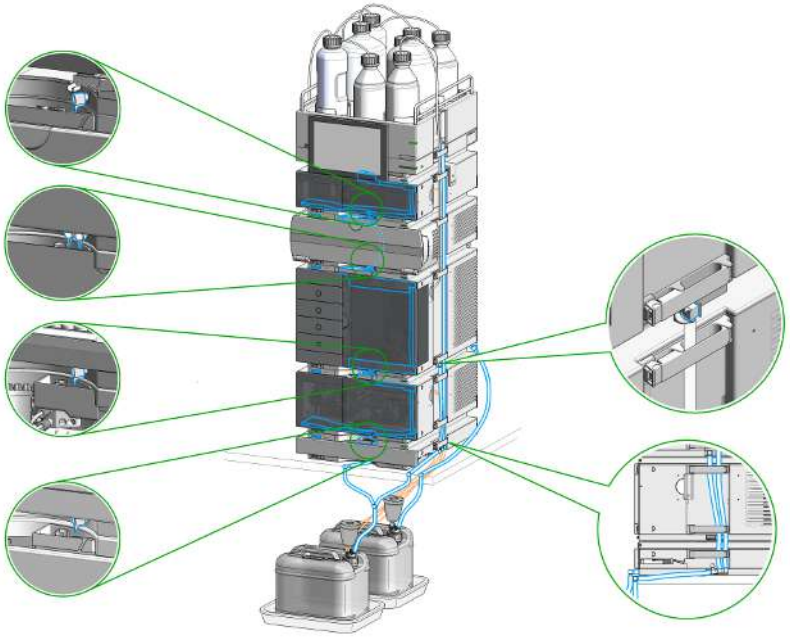


**Figure 7:** Infinity III Single Stack Leak Waste Concept (bench installation)

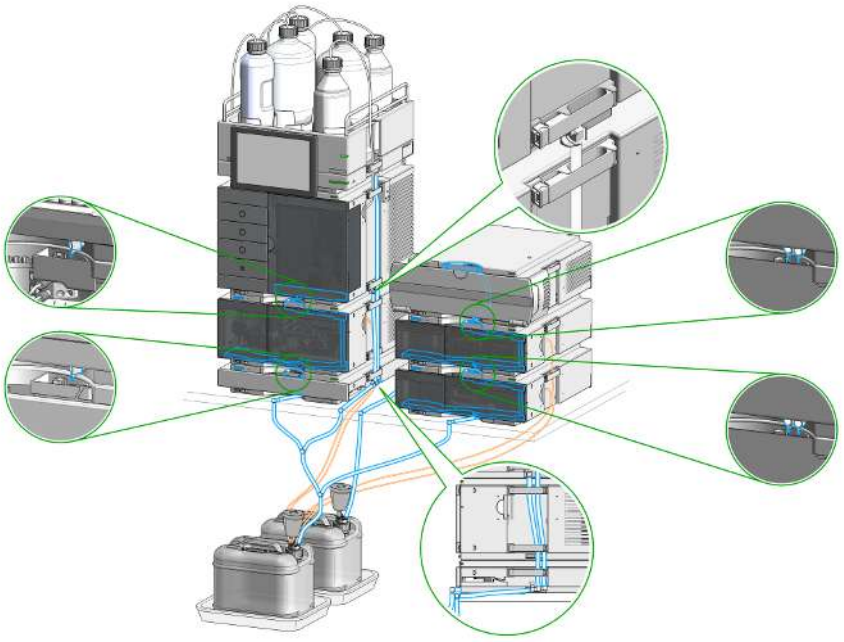


**Figure 8:** Infinity III Two Stack Leak Waste Concept (bench installation)

The waste tube connected to the leak plane outlet on each of the bottom instruments guides the solvent to a suitable waste container.

## Drain Connectors Installation

Drain Connectors have been developed to improve leak drainage for low flow leaks of high viscosity solvents (for example, isopropanol) in Agilent InfinityLab LC Series Systems. Install these parts to modules where they are missing (usually preinstalled).

- Make sure that dripping adapters are correctly installed on each module in the LC stack, excluding lowest module.
- Remove the dripping adapter if it is appeared to be installed on the lowest module in the LC stack and connect waste tube instead.
- Consider 5004-0000 (Drain Connectors Kit) if drain adaptor is missing on some module(s).

For illustration, see Handling Leak and Waste on page 32.

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| | 5004-0000 | Drain Connectors Kit |

### Content of Drain Connectors Kit (p/n 5004-0000)

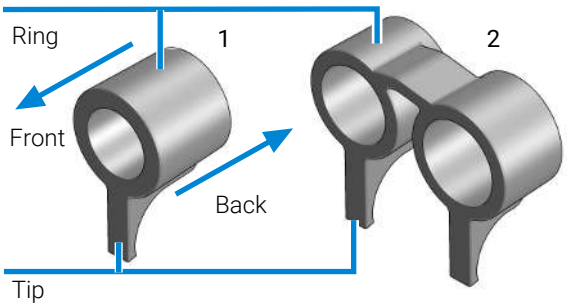



**Figure 9:** Overview of Drain Connectors: Single (left) and Double (right)

| Qty. | p/n | Description |
|---|---|---|
| Parts can be ordered only as a complete kit. | | |
| 3 | 5043-1834 | Single Drain Connector ID3.0-Long |
| 1 | 5043-1836 | Double Drain Connector-Long |

**Table 4:** Compatibility of drain connectors and modules

| Drain Connector Type | Compatible Module | Compatible Module Type |
|---|---|---|
| Double | G7116A/B | Column Compartment |
| Single | G7114A/B | Detector |
| | G7115A | |
| | G7117A/B/C | |
| | G7121A/B | |
| | G7162A/B | |
| | G7165A | |
| | G7129A/B/C | Sampler |
| | G7167A/B/C | |
| | G5668A | |
| | G7137A | |
| | G7157A | |
| | G4767A | |
| | G7122A | Degasser |
| | G7104A/C | Pump |
| | G7110B | |
| | G7111A/B | |
| | G7112B | |
| | G7120A | |
| | G7131A/C | |
| | G7132A | |
| | G5654A | |
| | G4782A | |

**Preparations**

- Leak drains of LC modules are clean and free of salt or solvent residuals.

**NOTE**

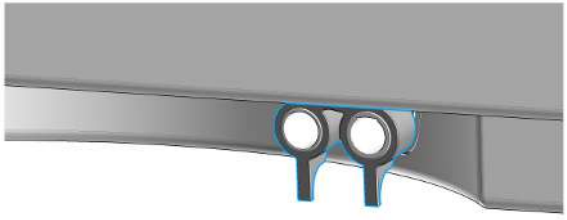
Do not install drain connectors on the bottom modules of the stack. Drain outlet of the bottom module has to be connected via waste tubing to a suitable waste container (see Leak and Waste Handling in the manual for a respective module).

**NOTE** In case of incorrect installation, drain connectors cannot fully perform the intended function.

**NOTE** It is not required to power off the HPLC stack to install Single and Double Drain Connectors. The installation of the connectors does not affect the analysis performed during the installation.

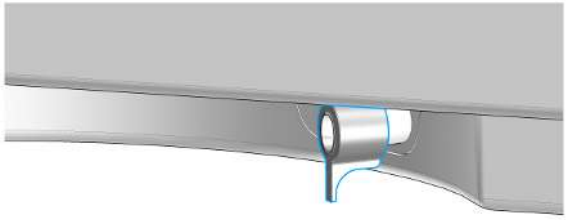
### Install the Double Drain Connector on the leak drain of the 1260 Infinity III Multicolumn Thermostat (G7116A)/ 1290 Infinity III Multicolumn Thermostat (G7116B)

1 Align the rings with the leak drain outlets of the module, press slightly with the fingers, and slide the connector along the leak drain outlets until it is aligned with the front of the leak drain.



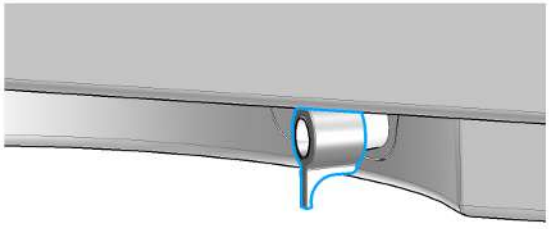
### Install Single Drain Connectors on other modules in the LC stack

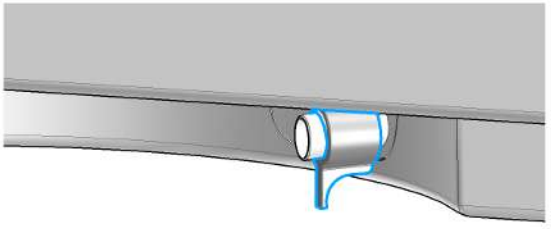
1 Align the ring with the leak drain outlet of the module, press slightly with the fingers, and slide the connector along the leak drain outlet until it is aligned with the front of the leak drain.



Make sure that the following requirements are covered:

- The tip of the drain connector points straight down.
- The leak drain outlets and the drain connectors are aligned properly.

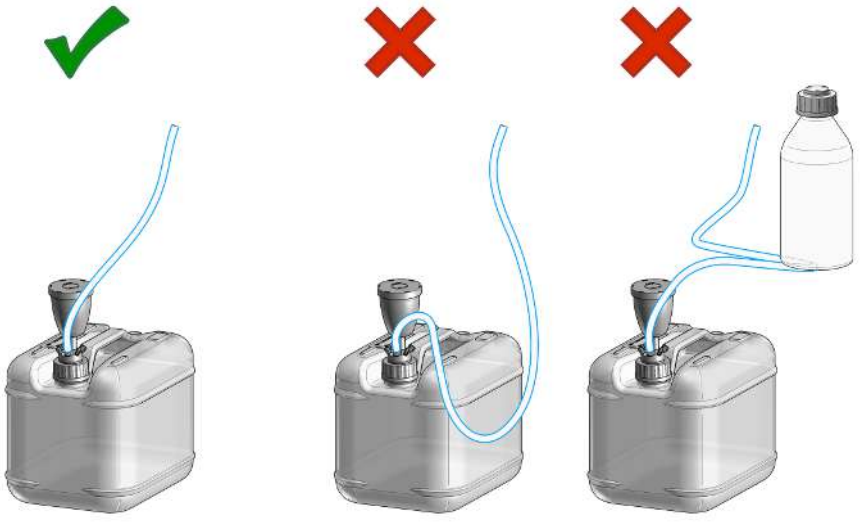




## Waste Concept

Agilent recommends using the 5043-1221 (6 L waste can with 1 Stay Safe cap GL45 with 4 ports) for optimal and safe waste disposal. If you decide to use your own waste solution, make sure that the tubes don't immerse in the liquid.

## Waste Guidance



**NOTE** The waste drainage must go straight into the waste containers. The waste flow must not be restricted at bends or joints.

## Leak Sensor

**CAUTION** Solvent incompatibility

The solvent DMF (dimethylformamide) leads to corrosion of the leak sensor. The material of the leak sensor, PVDF (polyvinylidene fluoride), is incompatible with DMF.

- Do not use DMF as mobile phase.
- Check the leak sensor regularly for corrosion.

# Connecting Modules and Control Software

**WARNING** Use of unsupplied cables

Using cables not supplied by Agilent Technologies can lead to damage of the electronic components or personal injury.

— Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.

# 4 Using the Module

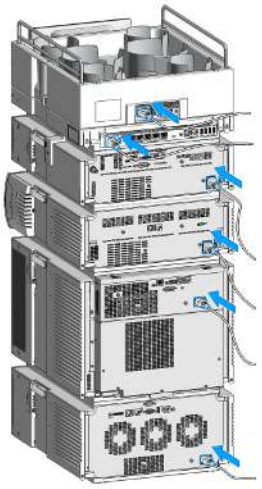
This chapter provides information on how to use the module.

# General Information

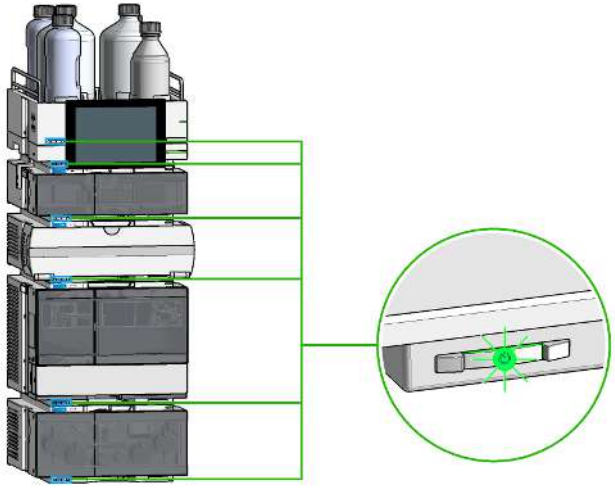
## Turn On/Off

This procedure exemplarily shows an arbitrary LC stack configuration.

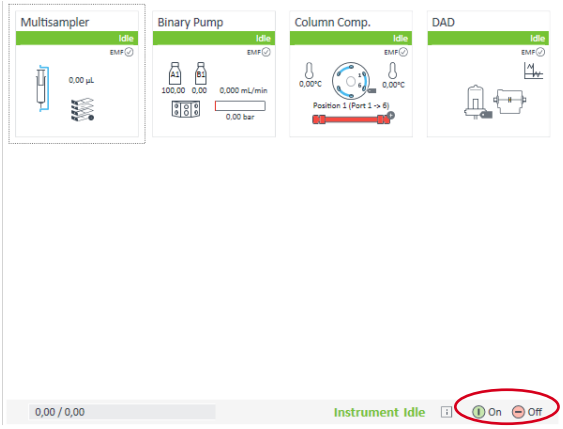
1



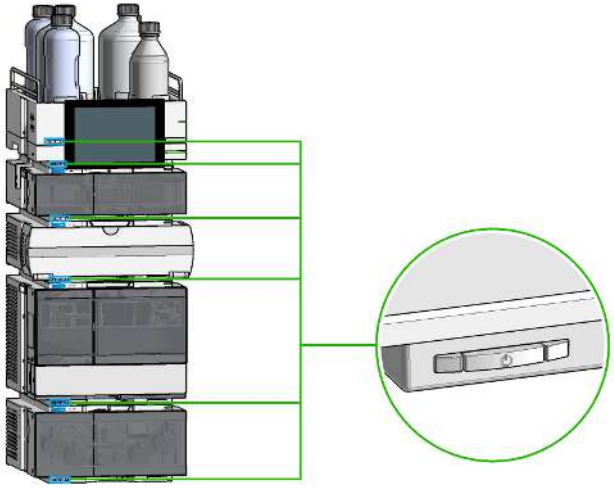
2 On/Off switch: On



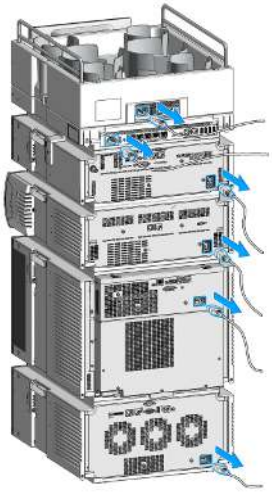
3 Turn instrument **On/Off** with the control software.



**4** On/Off switch: Off



**5**



## Status Indicators

The module status indicator indicates one of six possible module conditions.

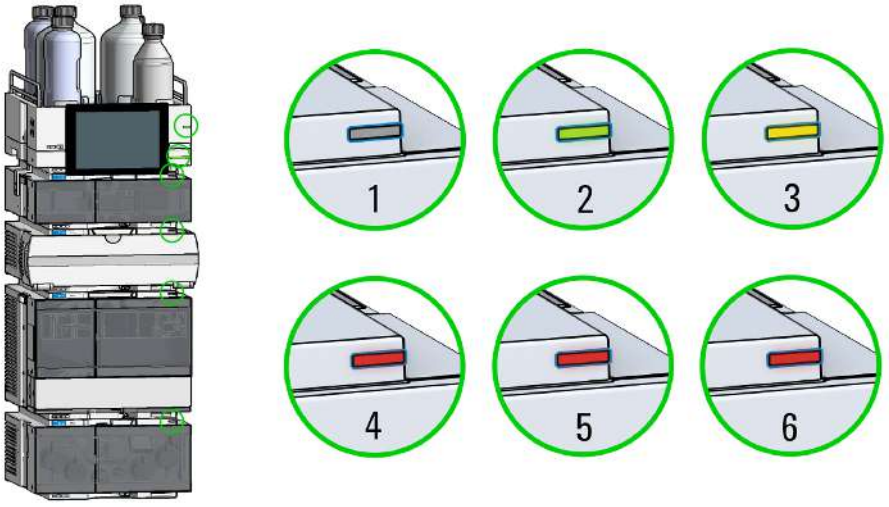



**Figure 10:** Arbitrary LC stack configuration (example)

| | |
|---|---|
| 1 | Idle |
| 2 | Run mode |
| 3 | Not-ready. Waiting for a specific pre-run condition to be reached or completed. |
| 4 | Error mode - interrupts the analysis and requires attention (for example, a leak or defective internal components). |
| 5 | Resident mode (blinking) - for example, during update of main firmware. |
| 6 | Bootloader mode (fast blinking). Try to re-boot the module or try a cold-start. Then try a firmware update. |

## InfinityLab Assist Hub Status Indicator

The Assist Hub status indicator displays the status of the entire system. If a module in the system is not ready (yellow), the Assist Hub status indicator also shows not ready (yellow). The same applies for the module conditions **Idle**, **Run mode**, and **Error mode**.

# Best Practices

## Daily / Weekly Tasks

### Daily Tasks

- Replace mobile phase based on water/buffer.
- Replace organic mobile phase latest every second day.
- Check seal wash solvent.

### Weekly Tasks

- Change seal wash solvent (10 % isopropanol in water) and bottle.
- If applications with salts were used, flush all channels with water and remove possible salt deposits manually.
- Inspect solvent filters for dirt or blockages. Exchange if no flow is coming out of the solvent line when removed from the degasser inlet.

## Power-Up/Shut-Down the Pump

### Power Up the Pump

- Use new or different mobile phase (as required).
- Purge pump heads with 2.5 – 3 mL/min for 5 min.
- Stabilize the system by running for 10 – 20 min.

### Long-Term Shut-Down of the System

- Flush system with water to remove buffer.
- Remove all samples from the sampler and store according to good laboratory practice.
- Use recommended solvents to store the system.

- Power off the system.

## Prepare the Pump

### Purge

Use the Purge function to:

- fill the pump,
- exchange a solvent,
- remove air bubbles in tubes and pump heads.

### Seal Wash

Seal Wash guarantees a maximum seal life time. Use Seal Wash:

- When using buffers with elevated salt concentrations
- When using volatile solvents with non-volatile additives

**CAUTION**

Contaminated seal wash solvent

— Do not recycle seal wash solvent to avoid contamination.

— Weekly exchange seal wash solvent.

## How to Deal With Solvents

- Use clean bottles only.
- Exchange water-based solvents daily.
- Select solvent volume to be used up within 1 – 2 days.
- Use only HPLC-grade solvents and water filtered through 0.2 µm filters.
- Label bottles correctly with bottle content, and filling date / expiry date.
- Use solvent inlet filters.
- Reduce risk of algae growth: use brown bottles for aqueous solvents, avoid direct sunlight.

## Hints for Successful Use of the Binary Pump

- Place solvent cabinet with the solvent bottles always on top (or at a higher level) of the pump.
- Flush the degasser with at least 5 mL per channel before operating the pump, especially when the pumping system had been turned off for a certain length of time (for example, overnight) and volatile solvent mixtures are used in the channels.
- Prevent blocking of solvent inlet filters (never use the pump without solvent inlet filters). Growth of algae should be avoided (see Prevent Blocking of Solvent Filters on page 51).
- Check purge valve frit and column frit in regular time intervals. A blocked purge valve frit can be identified by black, yellow or greenish layers on its surface or by a pressure greater than 10 bar in low delay volume configuration and 20 bar in standard configuration when pumping distilled water at a rate of 5 mL/min with an open purge valve.
- Whenever possible use a minimum flow rate of 5 µL/min per solvent channel to avoid crossflow of solvent into the unused pump channel.
- Whenever exchanging the pump seals, the purge valve frit should be exchanged, too.
- When using buffer solutions, flush the system with water before switching it off. The seal wash option should be used when installed, especially when buffer solutions with concentrations of 0.1 M or higher are being pumped for long periods of time.
- Check the pump pistons for scratches, grooves and dents when changing the piston seals. Damaged pistons cause micro leaks and will decrease the lifetime of the seals.
- After changing the piston seals, apply the seal wear-in procedure (see Seal Wear-in Procedure on page 169).
- Place the aqueous solvent on channel A and the organic solvent on channel B. The default compressibility settings are set accordingly.

## Prevent Blocking of Solvent Filters

Contaminated solvents or algae growth in the solvent bottle will reduce the lifetime of the solvent filter and will influence the performance of the module. This is especially true for aqueous solvents or phosphate buffers (pH 4 to 7). The following suggestions will prolong lifetime of the solvent filter and will maintain the performance of the module.

- Use a sterile, if possible amber, solvent bottle to slow down algae growth.
- Filter solvents through filters or membranes that remove algae.
- Exchange solvents every two days or refilter.
- If the application permits add 0.0001 – 0.001 M sodium azide to the solvent.
- Place a layer of argon on top of your solvent.
- Avoid exposure of the solvent bottle to direct sunlight.

**NOTE** Never use the system without solvent filter installed.

### Checking the Solvent Filters

The solvent filters are located on the low-pressure side of the binary pump. A blocked filter therefore does not necessarily affect the high pressure readings of the pump. The pressure readings cannot be used to check whether the filters are blocked or not. If the solvent cabinet is placed on top of the binary pump, the filter condition can be checked in the following way:

Remove the solvent inlet tube from the inlet port of the solvent selection valve or the degasser. If the filter is in good condition, the solvent will freely drip out of the solvent tube (due to hydrostatic pressure). If the solvent filter is partly blocked only very little solvent will drip out of the solvent tube.

**WARNING** **When opening capillary or tube fittings, solvents may leak out.**

**The handling of toxic and hazardous solvents and reagents can carry health risks.**

- **Observe appropriate safety procedures (for example, wear goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the solvent vendor, especially when toxic or hazardous solvents are used.**

### Cleaning the Solvent Filters

- Remove the blocked solvent filter from the bottle-head assembly and place it in a beaker with concentrated nitric acid (35%) for one hour.
- Thoroughly flush the filter with HPLC-grade water (remove all nitric acid, some capillary columns can be damaged by nitric acid).
- Replace the filter.

**NOTE** Never use the system without solvent filter installed.

## Normal Phase Applications

Current passive inlet valves and outlet ball valves used with 1260 and 1290 Infinity pumps do not work well with applications using non-polar solvents as for normal phase applications (e.g. hexane, heptane and $CO_2$). With such applications, pressure drops could be observed. They are a result of particles electrostatically charging up in insulating solvents and sticking to the balls inside the valves, such that the valves do not close properly any more after some time of use (can be hours).

For normal phase applications, a second type of valves is available, which has a design based on the existing one for 1260 and 1290 Infinity valves. These valves use a new material for valve balls, which is a conductive ceramic and replaces non-conductive ruby balls. The balls do not charge up electrostatically and show good performance in normal phase.

The valves are marked with N for non-polar or normal phase.

Agilent recommends using these valves for (and only for) normal phase applications.

**CAUTION** Corrosion of valves

**Normal phase balls/valves corrode quickly in aqueous solutions and acids (at or below pH 7).**

— **Do not use normal phase valves in applications running with aqueous solutions.**

The N-Valves have been tested successfully in using hexane at pressures below 100 bar; heptane can be used as a substitute for neurotoxic hexane.

## Seals for Normal Phase Applications

For running normal phase applications on 1200 Infinity Series pumps, yellow PE seals are required, which exist as piston seals and wash seals. Seal wash is very uncommon for normal phase applications (no buffers needed), but wash seals are needed for seal wash pump heads.

1290 Infinity pumps use PE seals by default. In combination with ceramic pistons, PE seals are used for both reversed phase (1200 bar) and normal phase applications.

1260 Infinity pumps use sapphire pistons and black PTFE piston and wash seals by default (600 bar). Such PTFE seals create small wear particles in normal phase applications, which can clog valves and other parts in the flow path.

PE seals have a limited life time when used with normal phase solvents and sapphire pistons. Agilent recommends a maximum pressure of 200 bar for this combination, which shall also be applied for pressure tests.

## Choice of Normal Phase Valves and Seals

**Table 5:** Recommended valves and seals for normal phase applications

| | 1260 Infinity | 1290 Infinity |
|---|---|---|
| Inlet valves | G1312-60166 (1260 Inlet Valve Type N) | G4220-60122 (1290 Inlet Valve Type N)<br>G4204-60122 (1290 Quat Inlet Valve Type N) |
| Outlet valves | G1312-60167 (Outlet Valve Type N/ SFC) | G4220-60128 (1290 Outlet Valve Type N) |
| Seals | 0905-1420 (PE seal (pack of 2))<br>0905-1718 (Wash Seal PE) | |

# Preparation of the System

## Prepare a Run

This procedure exemplarily shows how to prepare a run. Parameters as shown in the screenshots may vary, depending on the system installed.

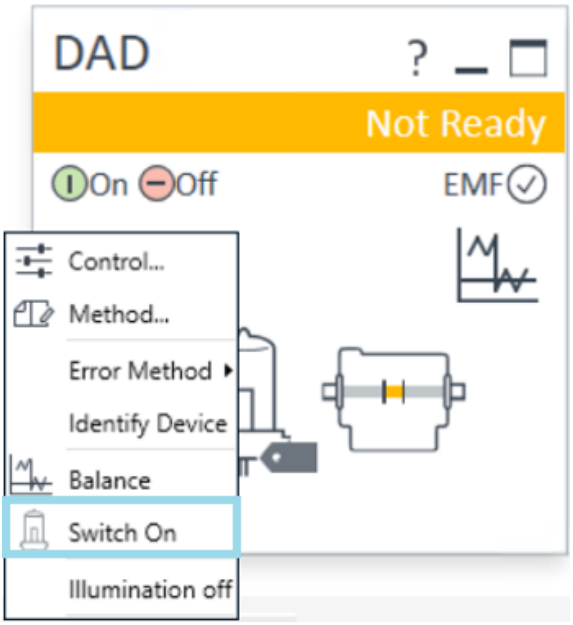
**WARNING**

**Toxic, flammable and hazardous solvents, samples and reagents**

**The handling of solvents, samples and reagents can hold health and safety risks.**

- **When working with these substances observe appropriate safety procedures (for example by wearing goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the vendor, and follow good laboratory practice.**
- **Do not use solvents with an auto-ignition temperature below 200 °C (392 °F). Do not use solvents with a boiling point below 56 °C (133 °F).**
- **Avoid high vapor concentrations. Keep the solvent temperature at least 40 °C (72 °F) below the boiling point of the solvent used. This includes the solvent temperature in the sample compartment. For the solvents methanol and ethanol keep the solvent temperature at least 25 °C (45 °F) below the boiling point.**
- **Do not operate the instrument in an explosive atmosphere.**
- **Do not use solvents of ignition Class IIC according IEC 60079-20-1 (for example, carbon disulfide).**
- **Reduce the volume of substances to the minimum required for the analysis.**
- **Never exceed the maximum permissible volume of solvents (8 L) in the solvent cabinet. Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for solvent cabinet.**
- **Ground the waste container.**
- **Regularly check the filling level of the waste container. The residual free volume in the waste container must be large enough to collect the waste liquid.**
- **To achieve maximal safety, regularly check the tubing for correct installation.**

1 Switch on the detector.

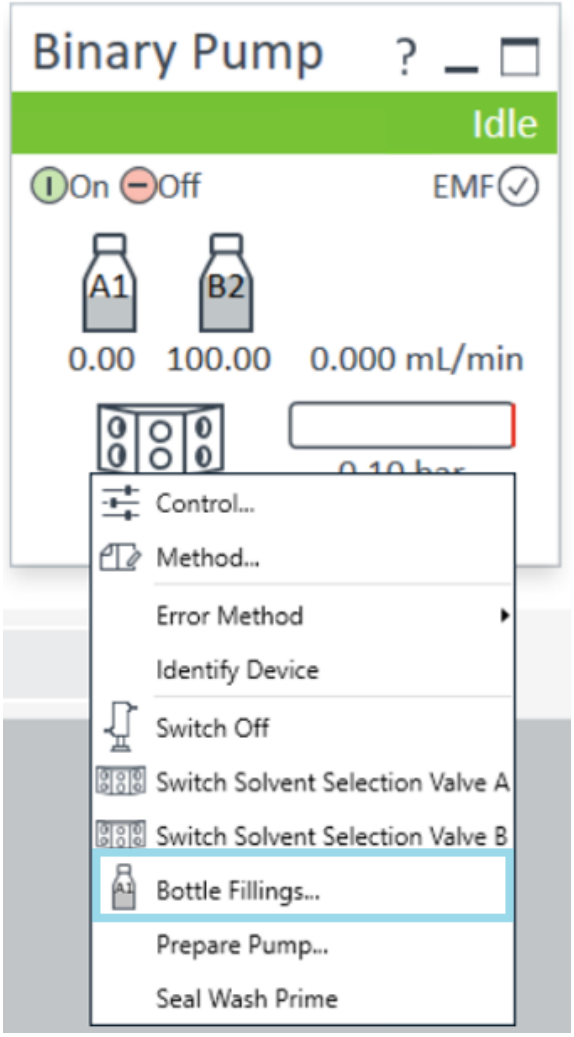


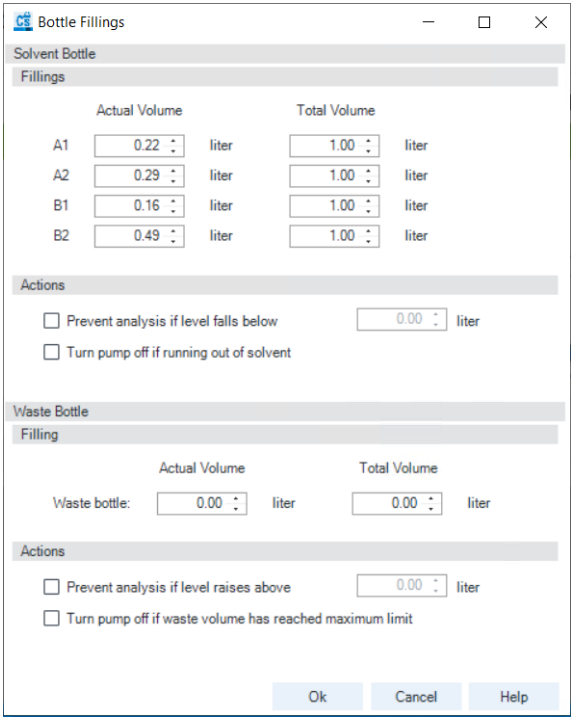

2 Fill the solvent bottles with adequate solvents for your application.

3 Place solvent tubings with bottle head assemblies into the solvent bottles.

4 Place solvent bottles into the solvent cabinet.

5 Solvent bottle filling dialog (in the software).





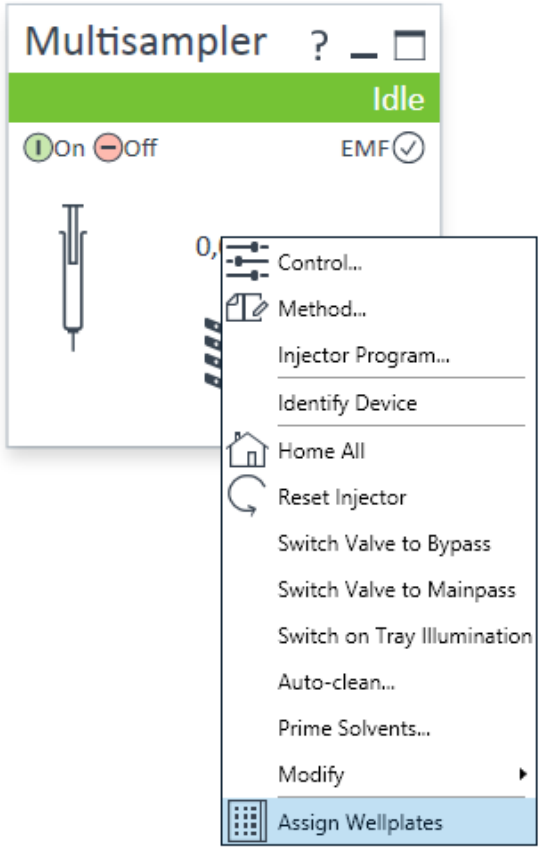

6 Purge the pump.

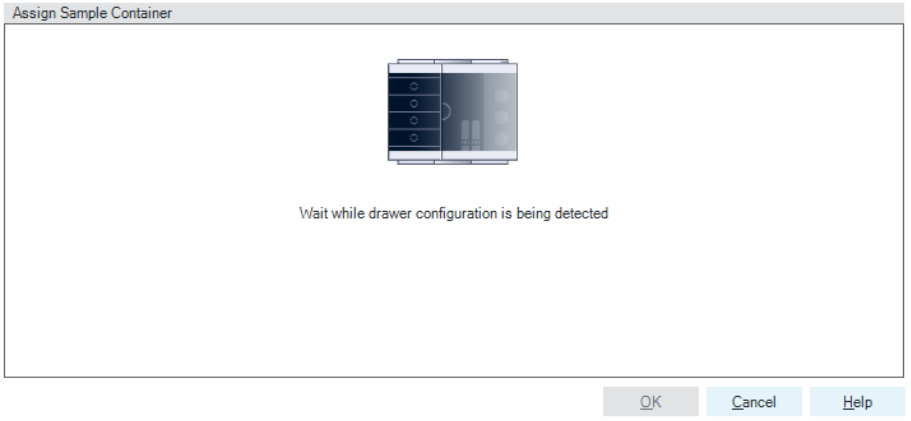
NOTE

For details on priming and purging, refer to the technical note *Best Practices for Using an Agilent LC System Technical Note (InfinityLab-BestPractice-en-SD-29000194.pdf, SD-29000194)*.

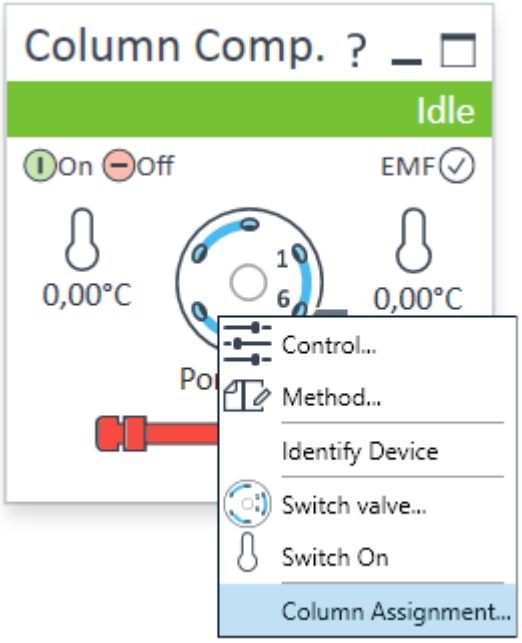
7 Change solvent type if necessary.

8 Choose the tray format of the sampler.

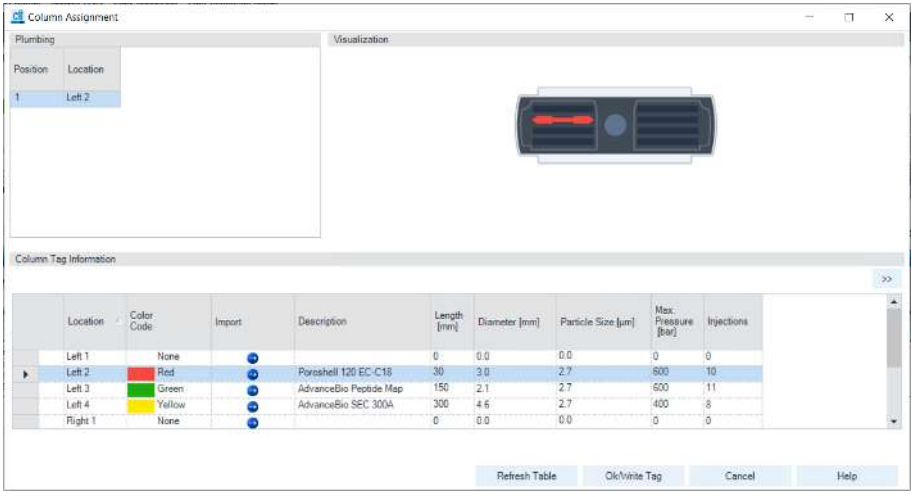


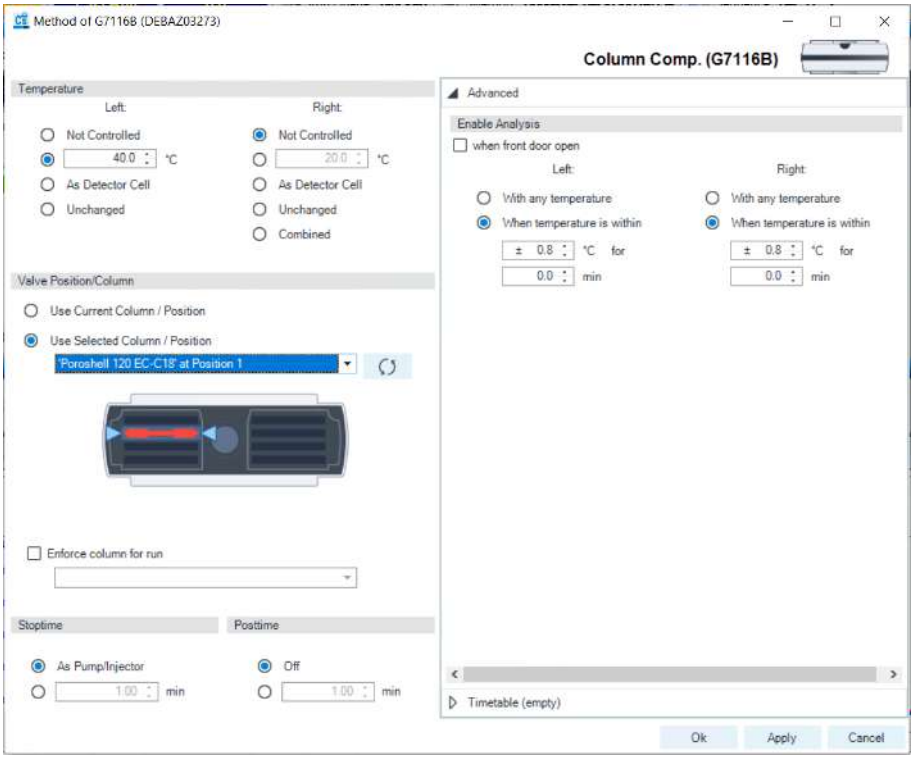
**9** Add a new column.



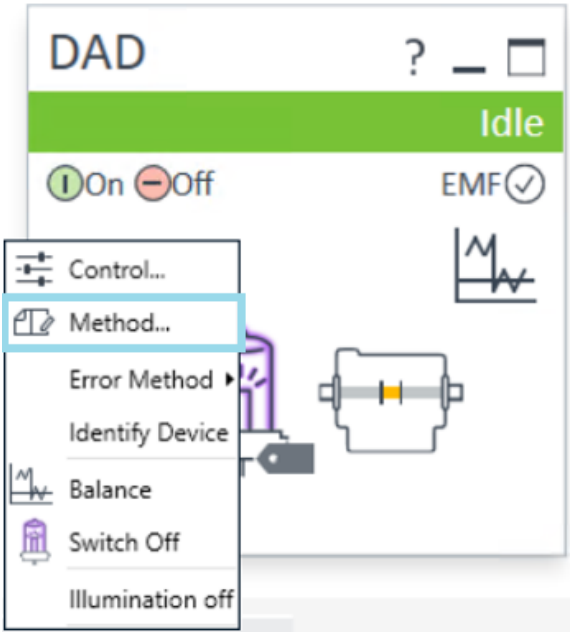

**10** Enter the column information.



**11** Select the column in the Method settings of the column compartment.




**12** Set the detector parameters according to the needs of your method.


DAD
Idle
On
Off
EMF
Control...
Method...
Error Method
Identify Device
Balance
Switch Off
Illumination off

## Prime and Purge the System

When the solvents have been exchanged or the pumping system has been turned off for a certain time (for example, overnight) oxygen will re-diffuse into the solvent channel between the solvent reservoir, vacuum degasser (when available in the system) and the pump. Solvents containing volatile ingredients will slightly lose these. Therefore priming of the pumping system is required before starting an application.

**Table 6:** Choice of priming solvents for different purposes

| Activity | Solvent | Comments |
|---|---|---|
| After an installation | Isopropanol | Best solvent to flush air out of the system |
| When switching between reverse phase and normal phase (both times) | Isopropanol | Best solvent to flush air out of the system |
| After an installation | Ethanol or Methanol | Alternative to Isopropanol (second choice) if no Isopropanol is available |
| To clean the system when using buffers | Bidistilled water | Best solvent to re-dissolve buffer crystals |
| After a solvent change | Bidistilled water | Best solvent to re-dissolve buffer crystals |
| After the installation of normal phase seals (P/N 0905-1420) | Hexane + 5% Isopropanol | Good wetting properties |

**NOTE** The pump should never be used for priming empty tubings (never let the pump run dry). Use a syringe to draw enough solvent for completely filling the tubings to the pump inlet before continuing to prime with the pump.

1 Open the purge valve of your pump (by turning it counterclockwise) and set flow rate to 3 – 5 mL/min.

2 Flush all tubes with at least 30 mL of solvent.

3 Set flow to required value of your application and close the purge valve.

**NOTE** Pump for approximately 10 minutes before starting your application.

# Preparation of the Module

## Setting up the Pump with the G4208A Instant Pilot

Generic operation of the G4208A Instant Pilot is covered in the G4208-90006 (Agilent Instant Pilot G4208A User's Guide) . Details about setting up module specific parameters can be found in the Instant Pilot online help.

The pump parameters are described in detail in Overview on page 63.

## Setting up the Pump with the Instrument Control Interface

### Overview

The instrument control interface offers the parameters described in the following sections, and can usually be accessed through Agilent instrument control software. For details, please see manuals and online help of respective user interfaces.

### Setup of Basic Pump Parameters

The most important parameters of the pump are listed in the following table.

**Table 7:** Basic pump parameters

| Parameter | Limits | Description |
|---|---|---|
| • Flow | 0.001 – 5 mL/min | Total flow rate of the pump. See When to Remove Damper and Mixer on page 72 for pump hardware modifications to achieve lowest delay volume. |
| • Stop Time | 0.01 min - no limit | The stop time of the pump usually controls the run time of the whole LC system. Use **no limit** to stop the run manually (useful for method development). |
| • Post Time | off - 99999 min | Time between the end of a run and the start of the next. Used for column equilibration after a gradient. |

| Parameter | Limits | Description |
|---|---|---|
| • **Pressure Limits** | **Max**: 0 – 600 bar<br>**Min**: 0 – 600 bar | **Max** must be bigger than **Min**! Set max pressure to the maximum operating pressure of your column. A min pressure setting of e.g. 10 bar will turn off your pump automatically when running out of solvent. A smarter way, however, is to use the bottle fillings function (see Bottle Filling on page 66). |
| • **Solvent A** | 0 – 100 % | Although channel A can be set to 0 %, it cannot be turned off. This channel should be used for the aqueous phase (water). |
| • **Solvent B** | off - 100 % | The percentage of channel B is automatically complemented by channel A to give 100 %. |
| • Solvent type | $H_2O$, ACN, MeOH, IPA | Select the solvent you are using in the respective solvent channel from the drop-down list. In case your solvent is not listed, perform a solvent compressibility calibration (see Running the Solvent Compressibility Calibration).<br>For details on solvent compressibility see G7112B_Binary Pump Solvent Compressibility Calibration. |
| • Solvent Comment | | Free text field for a description of the solvent. This description will show up in method printouts, etc. |
| • **Timetable** | max. number of lines depends on free space in pump memory | Use the timetable to build solvent gradients, flow gradients, or combinations of both. Gradients are always linear. Use multiple timetable entries to mimic exponential or parabolic gradients. |
| • **Display** | | There are three ways to display the timetable:<br>• in tabular form<br>• as flow/pressure graph<br>• as solvent percentage plot<br>Values can only be changed in tabular view. |

## Pump Control

The pump can be switched between following states: **On**, **Off** or to **Standby**. In **Standby**, the pump motor is still controlled. When the pump is switched on from standby, it does not re-initialize.

**CAUTION**

**Upon initialization, the pump ignores the Maximum Flow Gradient value.**

**This can result in a rapid and uncontrolled pressure increase.**

**— To prevent harm to the column, open the purge valve until the initialization is finished.**

The optional seal wash pump can be controlled by either switching it off, using it for a single time or specifying frequency and duration of periodic wash intervals.

## Auxiliary Pump Parameters

The auxiliary pump parameters are pre-set to fit most applications. Adjustments should only be made when required. Table 8 on page 65 shows the available auxiliary parameters with their default values.

**CAUTION**

**Upon initialization, the pump ignores the Maximum Flow Gradient value.**

**This can result in a rapid and uncontrolled pressure increase.**

**— To prevent harm to the column, open the purge valve until the initialization is finished.**

**Table 8:** Auxiliary pump parameters

| Parameter | Limits | Description |
|---|---|---|
| • Maximum Flow Gradient | 0.1 – 100 mL/min² default: 100 mL/min² | With this parameter flow rate changes can be ramped up and down slowly to avoid pressure shocks to the column. The default value is 100 mL/min² which in fact turns the function off. |
| • Minimum Stroke | 20 – 100 µL default: Auto | The volume one pump piston delivers per stroke. In general, a smaller stroke volume results in lower pump ripple. The **Auto** setting adjusts the strokes dynamically to the lowest possible value. The strokes can be set individually for pump heads A and B. |
| • Compressibility | 0 - 150·10$^{-6}$ /bar or enhanced compressibility calibration default: use enhanced comp. calibration | For best performance, check option **Use enhanced compressibility calibration**. With this option, the pump will use solvent data libraries provided by Agilent or data generated by using solvent compressibility calibrations (see Running the Solvent Compressibility Calibration). For details on solvent compressibility see G7112B_Binary Pump Solvent Compressibility Calibration. For backward compatibility to 400 bar pumps, the solvent compressibility can still be set manually for each channel when the box is unticked. |

## Data Curves

The binary pump provides the possibility to store the following operational data in the data file of the Agilent data system:

- Solvent percentage for each channel,
- pump flow,
- pressure

**NOTE**

The pressure data curve is *generated* from the pressure sensor readings, while %A, %B and flow are *calculated* from the method settings of the pump.

For details, please refer to the online help or manual of your instrument control software.

## Bottle Filling

The pump offers a powerful feature to monitor the liquid level in the solvent bottles. With total bottle volume and initial filling volume set correctly, the pump subtracts the consumed volume continuously from the initial value and stops the pump and method/sequence execution before the system runs dry or an analysis is corrupted.

**CAUTION**

**The bottle filling feature fails if multiple solvent inlets are put into one solvent bottle!**

- **In that case implement a minimum pressure limit to avoid that the pump runs dry when solvents are empty.**

Table 9 on page 66 lists the available bottle filling parameters.

**Table 9:** Bottle Filling Parameters

| Parameter | Limits | Description |
|---|---|---|
| • Total Volume | 0 – 1000 L<br>default: 0 L | This is the capacity (maximum possible volume) in liter of the solvent bottle. In combination with the actual volume, this parameter is used for calculating and displaying the relative liquid level. |
| • Actual Volume | 0 – 1000 L<br>default: 0 L | After filling the solvent bottles, enter the actual volumes into these boxes. The **Actual Volume** must not be larger than the **Total Volume** of the bottle. |
| • Prevent analysis... | default: unchecked | If this option is checked, the pump won't start a new run if the solvent level in one or more bottles is below the minimum volume. Enter a minimum volume in liter, which considers the position of the solvent inlet and size/shape of the solvent bottle such that no air is drawn if the actual volume gets close to this limit. |
| • Turn pump off... | default: unchecked | If this option is checked, the pump will turn off before air is aspirated. However, the residual solvent volume has been calculated for 1 L solvent bottles and may be too small for large bottles or other vessels. |

# 5 Optimizing the Performance of the Module

This chapter provides information on how to optimize the module.

# When to Use a Vacuum Degasser

A degasser removes air, which is dissolved in any solvent. When solvents are heated or mixed with other solvents, air can leave the solvent and form small bubbles. Over time, these bubbles accumulate and can cause pressure fluctuations which may finally result in retention time shifts.

All Agilent 1200 Infinity II/III Series Pumps have a built-in degasser. While a degasser is needed for low pressure mixing pumps like Agilent quaternary pumps, high pressure mixing pumps like Agilent binary pumps are more robust with respect to bubble formation. However, a degasser is recommended for best performance.

Additionally, a degasser is highly recommended for the following applications:

- Your detector is used with maximum sensitivity in the low UV wavelength range.
- Your application requires highest injection precision.
- Your application requires highest retention-time reproducibility (flow rates below 0.5 mL/min).
- The binary pump is used with bypassed damper and mixer.

The external G7122A Degasser is recommended for use with applications using highly volatile solvents like Hexane or DCM, solvents with special characteristics like THF, or applications using refractive index detection.

## Operational Hints for the Vacuum Degasser

If you are using the vacuum degasser for the first time, if the vacuum degasser was switched off for any length of time (for example, overnight), or if the vacuum degasser chambers are empty, you have to prime the vacuum degasser before running an analysis. Priming is usually done by pumping at a high flow rate (3 – 5 mL/min). Alternatively, a syringe can be used to draw the solvent through the (empty) degasser if the pump does not aspirate the solvent by itself.

# When to Use the Active Seal Wash Option

Concentrated buffer solutions will reduce the lifetime of the seals and pistons in your binary pump. The active seal wash option allows to maintain the seal lifetime by flushing the low pressure side of the seals with a wash solvent.

The seal wash option is strongly recommended if buffer concentrations of 0.1 M or higher are used regularly with the pump.

The active seal wash option kit can be ordered by quoting G1399A (Active Seal Wash Upgrade Product including Service) .

The seal wash option comprises a peristaltic pump, secondary seals, gaskets, seal holders and tubing for both pump heads. A bottle of premixed water/ isopropanol (90 /10 vol%) is placed in the solvent cabinet and connected to the peristaltic pump.

Always use a mixture of HPLC-grade water (90 %) and isopropanol (10 %) as wash solvent. This mixture prevents bacteria growth in the wash bottle and reduces the surface tension of the water.

**NOTE**

In order to avoid accumulation of buffer salts or impurities, regularly replace the washing solution using fresh solvents.

The operation of the peristaltic pump can be controlled from the data system or the Instant Pilot.

For adding a seal-wash option, please contact your local Agilent Technologies service representative.

# Choosing the Right Pump Seals

The standard seal for the pump can be used for most applications. However applications that use normal phase solvents (for example, hexane) are not suited for the standard seal and require a different seal when used for a longer time in the pump.

For applications that use normal phase solvents (for example, hexane) we recommend using polyethylene pump seals (0905-1420 (PE seal (pack of 2)) ) and 0905-1718 (Wash Seal PE) . For normal phase applications, these seals have less abrasion compared to the standard seals.

**NOTE** Polyethylene seals have a limited pressure range of 0 – 200 bar. When used above 200 bar their lifetime is reduced significantly.

# When to Use the Low Volume Mixer

The 5067-1565 (Low volume mixer (200 µL)) is designed for use with the Agilent InfinityLab LC Series 1260 Infinity II Binary LC System in low delay volume mode. This configuration is typically used for 2.1 mm i.d., 1.8 µm particle size columns, where emphasis is put on S/N ratio. The low volume mixer helps mixing gradients starting with a low concentration of organic solvents, which can cause noise on the baseline.

# When to Remove Damper and Mixer

The binary pump is equipped with a pressure pulsation damper and a static mixer. The total delay volume of the pump is 600 – 800 µL (depending on system pressure). The mixer has a volume of 400 µL.

For applications that require lowest delay volume (for example, fast gradient methods or gradient applications with low flow rates), damper and mixer can be bypassed.

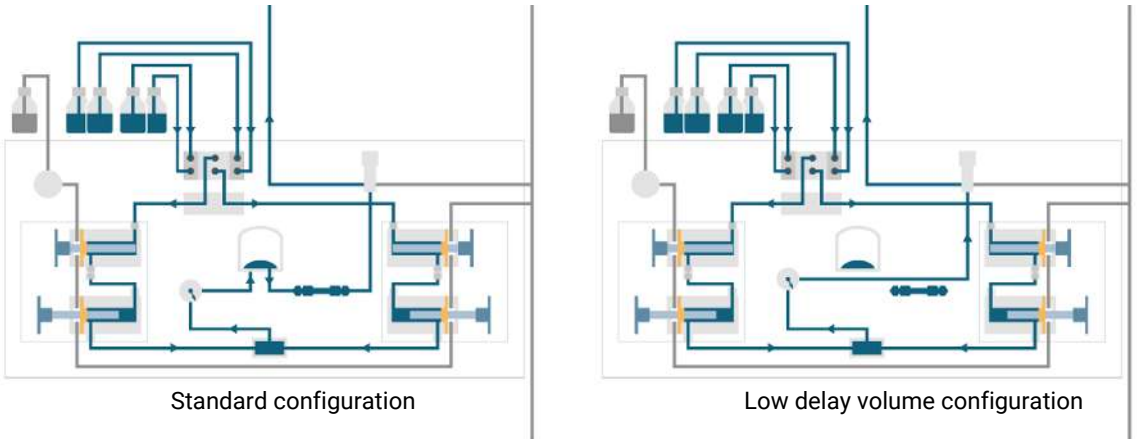



**Figure 11:** Flow path modifications of the Binary Pump

# Convert the Binary Pump to Low Delay Volume Mode

The binary pump is delivered in standard configuration (damper and mixer connected). This paragraph shows how to bypass damper and mixer and convert the pump to low delay volume mode.

Configurations where only damper or mixer are disconnected while the other part is still in line are not supported by Agilent Technologies.

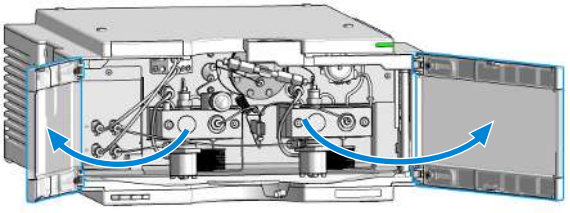
**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |
| 1 | | Wrench, 14 mm |
| 1 | | Hex driver open, 1/4 inch |

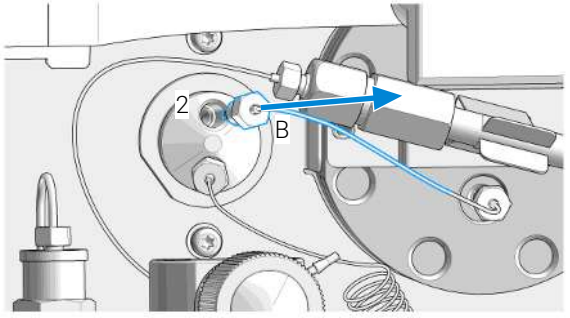
**Preparations**

- Flush the system (water if buffers were used, otherwise isopropanol).
- Turn the flow off.

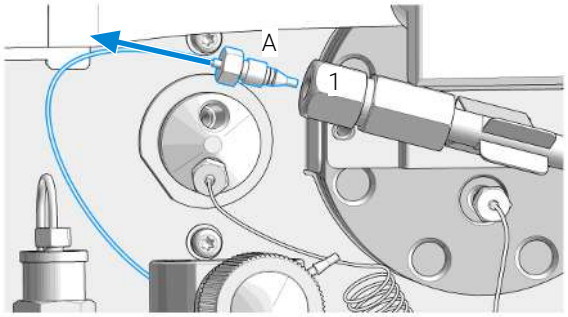
**1** Open the doors.



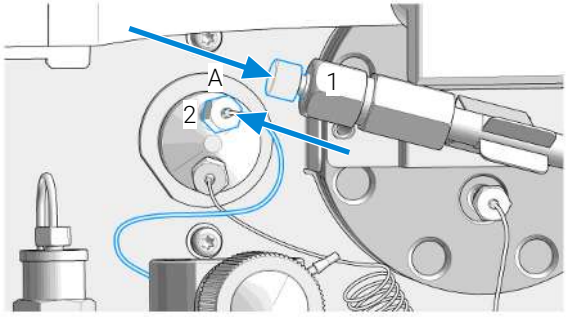
**2** Use the 1/4 inch hex driver to remove fitting B from port 2 of the pressure sensor. Fold capillary end B away. It remains unconnected.



3 Disconnect fitting A from outlet 1 of the mixer.




4 Connect fitting A to port 2 of the pressure sensor. Seal port 1 of the mixer with a plastic blank nut.



# How to Optimize the Compressibility Compensation Setting

When a solvent is metered at ambient pressure and compressed to a higher pressure, the volume decreases depending on its compressibility. Solvent compressibility is a non-linear function of pressure and temperature. It is specific for each solvent.

In order to deliver the desired flow accurately at all pressures, Agilent pumps use a compressibility compensation. For standard LC applications, e.g. using a 400 bar binary pump, an average compressibility value for the solvent is sufficient.

For the 600 bar 1260 Infinity III Binary Pump, the pressure-dependency of a solvent compressibility needs to be considered. It is determined at different pressures between 0 – 600 bar. The pump uses the obtained non-linear function to select the correct compressibility value for the actual pump pressure. Compressibility data for the most common solvents is readily available in the pump firmware.

The compensation algorithm is so powerful that the damper and mixer can be removed from the pump flow path at low flow rate while the pressure ripple and composition ripple remain at low levels.

For method compatibility reasons, the legacy compressibility compensation is still available.

## Solvent Compressibility Calibration

Unlisted or premixed solvents can be calibrated with the Solvent Compressibility Calibration function. For a detailed description, see G7112B_Binary Pump Solvent Compressibility Calibration.

## Optimization of Legacy Compressibility Settings

The compressibility compensation default settings are 50 × $10^{-6}$ /bar (best for most aqueous solutions) for pump head A and 115 × $10^{-6}$ /bar (to suit organic solvents) for pump head B. The settings represent average values for aqueous solvents (A side) and organic solvents (B side). Therefore it is always recommended to use the aqueous solvent on the A side of the pump and the organic solvent on the B side. Under normal conditions, the default settings reduce the pressure pulsation to below 2 % of system pressure, which is sufficient for most applications. If the compressibility values for the solvents used differ from the default settings, it is recommended to change the compressibility values accordingly. Compressibility settings can be optimized by using the values for various solvents described in Table 10 on page 76. If the solvent in use is not listed in the compressibility table, when using premixed solvents and if the default settings are not sufficient for your application, the following procedure can be used to optimize the compressibility settings:

1. Start channel A of the binary pump with the required flow rate.
2. Before starting the optimization procedure, the flow must be stable. Use degassed solvent only.

   Check the tightness of the system with the pressure test (see (System) Pressure Test on page 82).
3. Your pump must be connected to an Agilent data system or Instant Pilot, the pressure- and %-ripple can be monitored with one of these instruments.
4. Start the recording device in plot mode.
5. Starting with a compressibility setting of 40 × $10^{-6}$ /bar, increase the value in steps of 10. The compressibility compensation setting that generates the smallest pressure ripple is the optimum value for your solvent composition.
6. Repeat step 1 through step 5 for the B channel of your binary pump.

**Table 10:** Solvent compressibility

| Solvent (pure) | Compressibility ($10^{-6}$/bar) |
|---|---|
| Acetone | 126 |
| Acetonitrile | 115 |
| Benzene | 95 |
| Carbon tetrachloride [1] | 110 |

1 Please check section *"Solvent Information"* for compatibility to your specific LC system.

| Solvent (pure) | Compressibility ($10^{-6}$/bar) |
|---|---|
| Chloroform [1] | 100 |
| Cyclohexane | 118 |
| Ethanol | 114 |
| Ethyl acetate | 104 |
| Heptane | 120 |
| Hexane | 150 |
| Isobutanol | 100 |
| Isopropanol | 100 |
| Methanol | 120 |
| 1-Propanol | 100 |
| Toluene | 87 |
| Water | 46 |

# 6 Diagnostics and Troubleshooting

This chapter gives an overview of the maintenance, troubleshooting, and diagnostic features available.

# Diagnostic Features

This section gives an overview of the diagnostic features available.

## User Interfaces

**InfinityLab Assist**

InfinityLab Assist provides you with assisted troubleshooting and maintenance at your instrument.

If the system in use supports the InfinityLab Assist, follow the instructions provided. Else, the preferred solution is to use Agilent Lab Advisor Software.

- Depending on the user interface, the available tests and the screens/reports may vary.
- The preferred tool for troubleshooting and diagnostics should be Agilent Lab Advisor Software, see Agilent Lab Advisor Software on page 92.
- Screenshots used within these procedures are based on the Agilent Lab Advisor Software.

## Troubleshooting With HPLC Advisor

Baseline, Peak Shape, Pressure, Retention related issues, can be solved using the HPLC Advisor App. For more information, see Troubleshooting Reversed-Phase Chromatographic Techniques With HPLC Advisor.

If using an InfinityLab Assist, navigate to **Health** > **Troubleshooting** to help solve baseline, peak shape, pressure, and retention related issues.

# Maintenance and Troubleshooting Tools of the Module

This chapter explains all test functions that are available for the binary pump.

## Overview of the Module's Indicators and Test Functions

### Status Indicators

The module is provided with two status indicators which indicate the operational state of the module. The status indicators provide a quick visual check of the operation of the module.

### Error Messages

In the event of an electronic, mechanical or hydraulic failure, the module generates an error message in the user interface. For each message, a short description of the failure, a list of probable causes of the problem, and a list of suggested actions to fix the problem are provided (see chapter Error Information).

### Test Functions

A series of test functions are available for troubleshooting and operational verification after exchanging internal components (see Tests and Calibrations).

## Pressure Test

The Pressure Test is a quick test designed to determine the pressure tightness of the system (i.e. the high pressure flow path between pump and column). After exchanging flow path components (e.g. pump seals or injection seal), use this test to verify the system is pressure tight, see (System) Pressure Test on page 82.

## Solvent Compressibility Calibration

Solvent compressibility is a function of solvent type and pressure. In order to optimize flow accuracy and pressure ripple, the compressibility of the solvent must be considered. The binary pump firmware contains compressibility parameters for most commonly used solvents. A compressibility calibration function is available to generate compressibility data for unlisted solvents (see G7112B_Binary Pump Solvent Compressibility Calibration). The compressibility data are stored in an XML file and can be transferred to other InfinityLab LC Series binary pumps.

## Pump Elasticity Calibration

Various parts in the flow path of the binary pump have a certain elasticity which needs to be compensated to obtain the lowest pressure-, flow- and composition ripple possible. This is done by running an elasticity calibration after maintenance and major repairs. For details see Pump Elasticity Calibration on page 86.

## Pump Leak Rate Test

The Pump Leak Rate Test is a diagnostic test designed to determine the pressure tightness of the pump components. When a problem with the pump is suspected, use this test to help troubleshoot the pump and its pumping performance, see Pump Leak Rate Test on page 87.

## User Interfaces

Depending on the user interface, the available tests vary. Some descriptions are only available in the Service Manual.

| Test | Instant Pilot G4208A | Agilent Lab Advisor |
|---|---|---|
| Pressure Test | Yes | Yes |
| Valve Test | No | Yes |
| Solvent compressibility calibration | No | Yes |
| Pump elasticity calibration | No | Yes |

## (System) Pressure Test

**NOTE** This Lab Advisor test uses different names depending on the firmware revision used: FW revision > A.06.50: System Pressure Test

### Description

The system pressure test is a quick built-in test designed to demonstrate the leak tightness of the system. The test involves monitoring the flow profile while the pump delivers against a blank nut. The result is presented as the leak rate of the module and provides information about the leak tightness of the system between the outlet valves of the pump and the blank nut.

**NOTE** The blank nut can be positioned anywhere between the purge valve of the pump and the detector inlet to pressure test the desired part of the system.

**CAUTION** Blank nut placed at the outlet of flow cell

The applied pressure may cause permanent leaks or bursting of the flow cell.

— Never include the flow cell in the pressure test.

### Step 1

The test begins with the initialization of both pump heads. After initialization, the pump is starting the compression phase and the required flow rate is constantly monitored and adjusted. The pump continues to pump until a system pressure of around 600 bar is reached.

### Step 2

When the system pressure reaches 600 bar, the pump continues to pump at a flow rate that keeps the pressure constant. The flow that is needed to keep the pressure constant is directly translated into a leak rate.

## Positioning the Blank Nut

To test the complete system's pressure tightness, the blank nut should be positioned at the column compartment outlet (or the outlet of the last module before the detector).

If a specific component is suspected of causing a system leak, place the blank nut immediately before the suspected component, and then run the System Pressure Test again. If the test passes, the defective component is located after the blank nut. Confirm the diagnosis by placing the blank nut immediately after the suspected component. The diagnosis is confirmed if the test fails.

## Running the System Pressure Test

Running the test from the Agilent Lab Advisor

**When**

- The test should be used when problems with small leaks are suspected, or after maintenance of flow path components (e.g., pump seals, injection seal) to prove pressure tightness up to 600 bar

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5043-0277 | PEEK blank nut for bio-compatible devices |

**Preparations**

- Place two bottles of HPLC-grade water in channels A and B (A1 and B1 if the pump is equipped with a solvent selection valve)

**NOTE** Make absolutely sure that all parts of the flow path that are part of the test are very thoroughly flushed with water before starting to pressurize the system! Any trace of other solvents or the smallest air bubble inside the flow path definitely will cause the test to fail!

1 Select the system pressure test from the test selection menu.

2 Start the test and follow the instructions.

**NOTE** Make sure to release the pressure by opening the purge valve when the test has completed. Otherwise the pump may generate an overpressure error.

## Evaluating the Results

The sum of all leaks between the pump and the blank nut will add up to the total leak rate. Note that small leaks may cause the test to fail, but solvent may not be seen leaking from a module.

**NOTE** Please notice the difference between an *error* in the test and a *failure* of the test! An *error* is caused by the abnormal termination during the operation of the test whereas a *failure* of a test indicates that the test results were not within the specified limits.

### If the pressure test fails:

- Ensure all fittings between the pump and the blank nut are tight. Repeat the pressure test.

NOTE

Often it is only a damaged blank nut itself (poorly shaped from overtightening) that causes the test to fail. Before investigating on any other possible sources of failure make sure that the blank nut you are using is in good condition and properly tightened!

- If the test fails again, insert the blank nut at the outlet of the previous module in the stack (e.g. autosampler, port 6 of the injection valve), and repeat the pressure test. Exclude each module one by one to determine which module is leaking.
- If the pump is determined to be the source of the leak, run the valve test to identify the defective pump component.

### Potential Causes of Pressure Test Failure

After isolating and fixing the cause of the leak, repeat the pressure test to confirm the system is pressure tight.

**Table 11:** Potential Cause (Pump)

| Potential Cause (Pump) | Corrective Action |
|---|---|
| Purge valve open. | Close the purge valve. |
| Loose or leaky fitting. | Tighten the fitting or exchange the capillary. |
| Damaged pump seals or pistons. | Run the valve test to identify the defective component. |
| Loose purge valve. | Tighten the purge valve nut (14 mm wrench). |

**Table 12:** Potential Cause (Autosampler)

| Potential Cause (Autosampler) | Corrective Action |
|---|---|
| Loose or leaky fitting. | Tighten or exchange the fitting or capillary. |
| Rotor seal (injection valve). | Exchange the rotor seal. |
| Damaged metering seal or piston. | Exchange the metering seal. Check the piston for scratches. Exchange the piston if required. |
| Needle seat. | Exchange the needle seat. |

**Table 13:** Potential Cause (Column Compartment)

| Potential Cause (Column Compartment) | Corrective Action |
|---|---|
| Loose or leaky fitting. | Tighten or exchange the fitting or capillary. |
| Rotor seal (column switching valve). | Exchange the rotor seal. |

# Pump Elasticity Calibration

## Description

The flow path components of the binary pump have an inherent and pressure dependent elasticity which differs from pump to pump. When this elasticity/ pressure function is known, a correction algorithm can be applied. This results in significantly improved pump performance in low delay volume mode (damper and mixer bypassed).

The pump elasticity calibration uses a solvent with well known properties (HPLC-grade water) to determine the pump elasticity over the entire operating pressure range and stores the calibration values in the non-volatile RAM of the pump mainboard.

The initial calibration is done at the factory. It only needs to be repeated after replacement of major pump parts (mainboard, pump drive). The test allows to define which pump head will be calibrated.

**NOTE**

Results of the pump elasticity calibration rely on known compressibility parameters for pure water. If the water is not HPLC-grade, not well degassed or degasser and pump are not flushed properly, the pump elasticity calibration will fail. The pump elasticity calibration has to be performed for each pump head individually.

**CAUTION**

Incorrect pump elasticity calibration.

Solvent compressibility calibrations acquired with a miscalibrated pump will work, but they are not transferable to other pumps. A correct pump elasticity calibration is an essential prerequisite for successful solvent compressibility calibrations.

— Calibrate the pump elasticity correctly.

### Running the Pump Elasticity Calibration

*Running the Pump Elasticity Calibration from the Agilent Lab Advisor Software*

**When**

- The initial calibration is done at the factory. It only needs to be repeated after replacement of major pump parts (mainboard, pump drive).

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | G1312-67500 | Restriction capillary |

**Preparations**

- Place all bottle heads in to a bottle of HPLC-grade water.

**NOTE** Make absolutely sure that the pump is very thoroughly flushed with the solvent to be calibrated before starting the procedure! Any trace of other solvents or the smallest air bubble inside the flow path definitely will cause the calibration to fail!

**NOTE** If a solvent selection valve is installed flush all four solvent channels to avoid that air from a dry solvent intake tube is drawn into the flow path upon initialization.

1 Select the pump elasticity calibration from the test selection menu.

2 Start the test and follow the instructions.

**NOTE** Make sure to release the pressure by opening the purge valve when the test has completed. Otherwise the pump may generate an overpressure error.

## Pump Leak Rate Test

### Introduction

The Pump Leak Rate Test is used for verifying the internal tightness of the pump and helps identifying parts which may have caused a leak.

Minimum firmware revisions:

- D.07.01

## Running the Test from Lab Advisor

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5043-0277 | PEEK blank nut for bio-compatible devices |

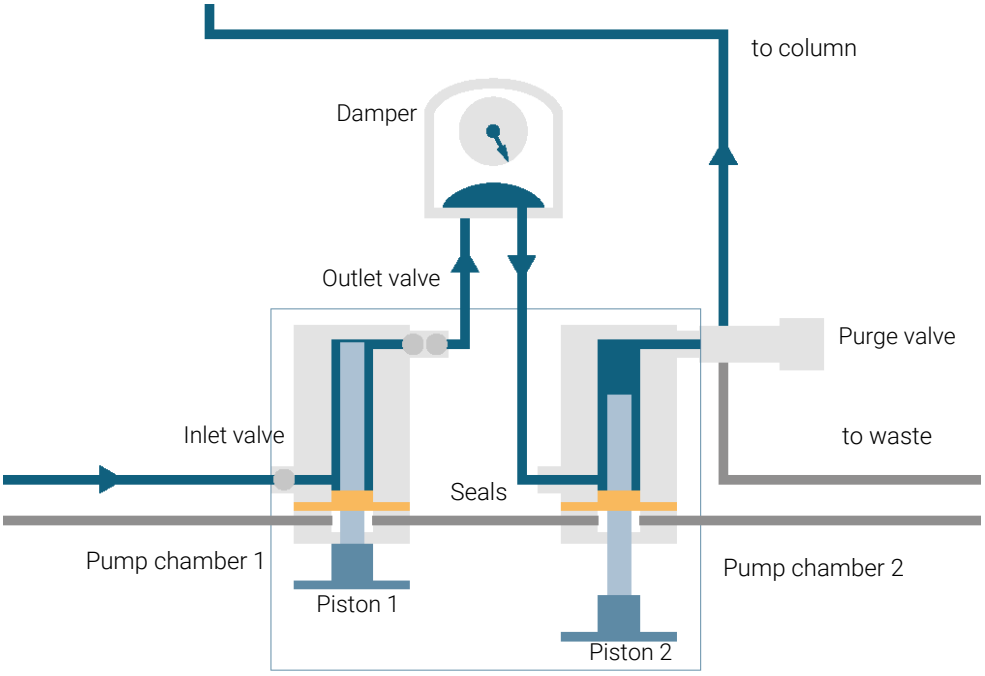
1 Select the **Pump Leak Rate Test** from the **Test Selection** menu.

2 Start the test and follow the instructions.

**NOTE** Make sure to release the pressure by slowly opening the purge valve when the test has finished.

## Evaluating the Results

Results of the leak rate test are the leak rates measured for pistons 1 and 2 as described for the test principle. If any of the leak rates exceeds 3 µL/min, the test will fail.



## Potential Causes of Leak Rate Test Failure

**NOTE** For binary pumps, secondary pump chambers are connected. A leak observed in any of these chambers may be caused by the other secondary pump chamber.

### Secondary Leak

If a leak is found for movement of piston 2 (secondary leak), the following reasons are possible:

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | System not flushed properly | • Flush system for several minutes |
| 2 | Degassing efficiency is low | • Check degasser performance |
| 3 | Purge valve not closed or defect | • Check purge valve |
| 4 | Blank nut not installed tightly | • Tighten or replace blank nut |
| 5 | Outlet valve leaking (read below) | • Replace outlet valve |
| 6 | Leak at piston 2 or seal in chamber 2 | • Inspect piston, replace piston and/or seal |

## Primary Leak

If a leak is found for movement of piston 1 (primary leak), any leak described for piston movement 2 will cause a failure for piston 1 as well, as the liquid can move through the outlet valve to chamber 2. Such cases need to be identified as described before. Additionally, following causes are possible:

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Leak at piston 1 or seal in chamber 1 | • Inspect piston, replace piston and/or seal |
| 2 | Leak at inlet valve | • Replace inlet valve or inlet valve cartridge (AIV only) |

## Internal Outlet Valve Leak

A leak of the outlet valve will be identified separately (internal outlet valve leak) by calculating the difference between leak rate 1 and leak rate 2. If the second leak rate is higher than the first one, this is due to a flow back through the outlet valve.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Leak at outlet valve | • Replace the part which has failed and re-run the test. |

# Agilent Lab Advisor Software

The Agilent Lab Advisor Software (basic license, shipped with an Agilent LC pump) is a standalone product that can be used with or without a chromatographic data system. Agilent Lab Advisor helps to manage the lab for high-quality chromatographic results by providing a detailed system overview of all connected analytical instruments with instrument status, Early Maintenance Feedback counters (EMF), instrument configuration information, and diagnostic tests. With the push of a button, a detailed diagnostic report can be generated. Upon request, the user can send this report to Agilent for a significantly improved troubleshooting and repair process.

The Agilent Lab Advisor software is available in two versions:

- Lab Advisor Basic
- Lab Advisor Advanced

Lab Advisor Basic is included with every Agilent 1200 Infinity Series and Agilent InfinityLab LC Series instrument.

The Lab Advisor Advanced features can be unlocked by purchasing a license key, and include real-time monitoring of instrument actuals, all various instrument signals, and state machines. In addition, all diagnostic test results, calibration results, and acquired signal data can be uploaded to a shared network folder. The Review Client included in Lab Advisor Advanced makes it possible to load and examine the uploaded data no matter on which instrument it was generated. This makes Data Sharing an ideal tool for internal support groups and users who want to track the instrument history of their analytical systems.

The optional Agilent Maintenance Wizard Add-on provides an easy-to-use, step-by-step multimedia guide for performing preventive maintenance on Agilent 1200 Infinity LC Series instrument.

The tests and diagnostic features that are provided by the Agilent Lab Advisor software may differ from the descriptions in this manual. For details, refer to the Agilent Lab Advisor software help files.

# 7 Error Information

This chapter describes the meaning of error messages, and provides information on probable causes and suggested actions how to recover from error conditions.

# What Are Error Messages

Error messages are displayed in the user interface when an electronic, mechanical, or hydraulic (flow path) failure occurs that requires attention before the analysis can be continued (for example, repair, or exchange of consumables is necessary). In the event of such a failure, the red status indicator at the front of the module is switched on, and an entry is written into the module logbook.

If an error occurs outside a method run, other modules will not be informed about this error. If it occurs within a method run, all connected modules will get a notification, all LEDs get red and the run will be stopped. Depending on the module type, this stop is implemented differently. For example, for a pump, the flow will be stopped for safety reasons. For a detector, the lamp will stay on in order to avoid equilibration time. Depending on the error type, the next run can only be started if the error has been resolved, for example liquid from a leak has been dried. Errors for presumably single time events can be recovered by switching on the system in the user interface.

Special handling is done in case of a leak. As a leak is a potential safety issue and may have occurred at a different module from where it has been observed, a leak always causes a shutdown of all modules, even outside a method run.

In all cases, error propagation is done via the CAN bus or via an APG/ERI remote cable (see documentation for the APG/ERI interface).

If using the InfinityLab Assist, instrument errors will generate a notification. To view the probable causes and recommended actions for this error, click on Help button displayed on the notification.

# General Error Messages

General error messages are generic to all Agilent series HPLC modules and may show up on other modules as well.

## Timeout

### Error ID: 62

The timeout threshold was exceeded.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | The analysis was completed successfully, and the timeout function switched off the module as requested. | • Check the logbook for the occurrence and source of a not-ready condition. Restart the analysis where required. |
| 2 | A not-ready condition was present during a sequence or multiple-injection run for a period longer than the timeout threshold. | • Check the logbook for the occurrence and source of a not-ready condition. Restart the analysis where required. |

# Shutdown

## Error ID: 63

An external instrument has generated a shutdown signal on the remote line.

The module continually monitors the remote input connectors for status signals. A LOW signal input on pin 6 of the Enhanced Remote Interface (ERI) connector generates the error message.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Leak detected in another module with a CAN connection to the system. | • Fix the leak in the external instrument before restarting the module. |
| 2 | Leak detected in an external instrument with a remote connection to the system. | • Fix the leak in the external instrument before restarting the module. |
| 3 | Shut-down in an external instrument with a remote connection to the system. | • Check external instruments for a shut-down condition. |
| 4 | The degasser failed to generate sufficient vacuum for solvent degassing. | • Check the vacuum degasser for an error condition. Refer to the Service Manual for the degasser or the pump that has the degasser built-in.<br>• Check the external vacuum degasser module (if installed) for an error condition. Refer to the *Service Manual* for the degasser or the pump that has the degasser built-in. |

# Remote Timeout

## Error ID: 70

A not-ready condition is still present on the remote input. When an analysis is started, the system expects all not-ready conditions (for example, a not-ready condition during detector balance) to switch to run conditions within one minute of starting the analysis. If a not-ready condition is still present on the remote line after one minute the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Not-ready condition in one of the instruments connected to the remote line. | • Ensure the instrument showing the not-ready condition is installed correctly, and is set up correctly for analysis. |
| 2 | Defective remote cable. | • Exchange the remote cable. |
| 3 | Defective components in the instrument showing the not-ready condition. | • Check the instrument for defects (refer to the instrument's documentation). |

# Lost CAN Partner

## Error ID: 71

During an analysis, the internal synchronization or communication between one or more of the modules in the system has failed.

The system processors continually monitor the system configuration. If one or more of the modules is no longer recognized as being connected to the system, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | CAN cable disconnected. | • Ensure all the CAN cables are connected correctly.<br>• Ensure all CAN cables are installed correctly. |
| 2 | Defective CAN cable. | • Exchange the CAN cable. |
| 3 | Defective mainboard in another module. | • Switch off the system. Restart the system, and determine which module or modules are not recognized by the system. |

# Leak

## Error ID: 64

A leak was detected in the module.

The signals from the two temperature sensors (leak sensor and board-mounted temperature-compensation sensor) are used by the leak algorithm to determine whether a leak is present. When a leak occurs, the leak sensor is cooled by the solvent. This changes the resistance of the leak sensor which is sensed by the leak sensor circuit on the mainboard.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Loose fittings. | • Ensure all fittings are tight. |
| 2 | Broken capillary. | • Exchange defective capillaries. |
| 3 | Loose or leaking purge valve, active inlet valve, or outlet valve. | • Ensure pump components are seated correctly. If there are still signs of a leak, exchange the appropriate seal (purge valve, active inlet valve, outlet valve). |
| 4 | Defective pump seals. | • Exchange the pump seals. |

# Leak Sensor Open

## Error ID: 83

The leak sensor in the module has failed (open circuit).

The current through the leak sensor is dependent on temperature. A leak is detected when solvent cools the leak sensor, causing the leak sensor current to change within defined limits. If the current falls outside the lower limit, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Leak sensor not connected to the on/off switch board. | • Please contact your Agilent service representative. |
| 2 | Defective leak sensor. | • Please contact your Agilent service representative. |
| 3 | Leak sensor incorrectly routed, being pinched by a metal component. | • Please contact your Agilent service representative. |
| 4 | On/Off switch assembly defective. | • Please contact your Agilent service representative. |

# Leak Sensor Short

## Error ID: 82

The leak sensor in the module has failed (short circuit).

The current through the leak sensor is dependent on temperature. A leak is detected when solvent cools the leak sensor, causing the leak sensor current to change within defined limits. If the current increases above the upper limit, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Defective leak sensor. | • Please contact your Agilent service representative. |
| 2 | Leak sensor incorrectly routed, being pinched by a metal component. | • Please contact your Agilent service representative. |
| 3 | On/Off switch assembly defective. | • Please contact your Agilent service representative. |
| 4 | Cable or contact problem. | • Please contact your Agilent service representative. |

# Compensation Sensor Open

## Error ID: 81

The ambient-compensation sensor (NTC) on the power switch board in the module has failed (open circuit).

The resistance across the temperature compensation sensor (NTC) on the power switch board is dependent on ambient temperature. The change in resistance is used by the leak circuit to compensate for ambient temperature changes. If the resistance across the sensor increases above the upper limit, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Loose connection between the on/off switch board and the mainboard. | • Please contact your Agilent service representative. |
| 2 | Defective on/off switch assembly. | • Please contact your Agilent service representative. |

# Compensation Sensor Short

## Error ID: 80

The ambient-compensation sensor (NTC) on the power switch board in the module has failed (open circuit).

The resistance across the temperature compensation sensor (NTC) on the power switch board is dependent on ambient temperature. The change in resistance is used by the leak circuit to compensate for ambient temperature changes. If the resistance across the sensor increases above the upper limit, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Defective on/off switch assembly. | • Please contact your Agilent service representative. |
| 2 | Loose connection between the on/off switch board and the mainboard. | • Please contact your Agilent service representative. |

# Fan Failed

## Error ID: 68

The cooling fan in the module has failed.

The hall sensor on the fan shaft is used by the mainboard to monitor the fan speed. If the fan speed falls below a certain limit for a certain length of time, the error message is generated.

This limit is given by 2 revolutions/second for longer than 5 seconds.

Depending on the module, assemblies (e.g. the lamp in the detector) are turned off to assure that the module does not overheat inside.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Fan cable disconnected. | • Please contact your Agilent service representative. |
| 2 | Defective fan. | • Please contact your Agilent service representative. |
| 3 | Defective mainboard. | • Please contact your Agilent service representative. |
| 4 | Improperly positioned cables or wires obstructing fan blades. | • Please contact your Agilent service representative. |

# ERI Messages

## Error ID: 11120, 11121

The ERI (Enhanced Remote Interface) provides two error events related to over current situations on the +5 V and +24 V lines.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | The load on the ERI is too high. | • Reduce the load. |

# Pump Error Messages

## Solvent Zero Counter

### Error ID: 2055, 2524

The error message is triggered if the remaining volume in a solvent bottle falls below the set limit.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Volume in bottle below specified volume. | • Refill bottles and reset solvent counters. |
| 2 | Incorrect setting. | • Make sure the set solvent volume matches the actual bottle filling<br>• Make sure the set solvent volume matches the actual bottle filling and set the shutoff limit to a reasonable value (e.g. 100 mL for 1 L bottles). |

# Pressure Above Upper Limit

## Error ID: 2014, 2500

The system pressure has exceeded the upper pressure limit.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Upper pressure limit set too low. | • Ensure the upper pressure limit is set to a value suitable for the analysis. |
| 2 | Blockage in the flowpath (after the pressure sensor). | • Check for blockage in the flow path. The following components are particularly subject to blockage: inline filter frit, needle (autosampler), seat capillary (autosampler), sample loop (autosampler), column frits and capillaries with small internal diameters (e.g. 50 ID).<br>• Check for blockage in the flow path. The following components are particularly subject to blockage: inline filter frit, needle (autosampler), seat capillary (autosampler), sample loop (autosampler), column frits and capillaries with small internal diameters (e.g. 50 µm ID). |
| 3 | Defective pressure sensor. | • Please contact your Agilent service representative. |
| 4 | Defective mainboard. | • Please contact your Agilent service representative. |

# Pressure Below Lower Limit

## Error ID: 2015, 2501

The system pressure has fallen below the lower pressure limit.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Solvent bottle empty. | • Replenish solvent. |
| 2 | Lower pressure limit set too high. | • Ensure the lower pressure limit is set to a value suitable for the analysis. |
| 3 | Air bubbles in the mobile phase. | • Make sure that the degasser is in flow path and works correctly. Purge the module.<br>• Make sure that the degasser is in flow path and works correctly.<br>• Purge the module.<br>• Ensure solvent inlet filters are not blocked. |
| 4 | Leak. | • Inspect the pump head, capillaries and fittings for signs of a leak.<br>• Purge the module. Run a pressure test to determine whether the seals or other module components are defective. |
| 5 | Defective pressure sensor. | • Please contact your Agilent service representative. |
| 6 | Defective mainboard. | • Please contact your Agilent service representative. |

# Pressure Signal Missing

## Error ID: 2016

The pressure signal is missing.

The pressure signal must be within a specific voltage range. If the pressure signal is missing, the processor detects a voltage of approximately -120 mV across the pressure sensor.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Pressure sensor disconnected. | • Please contact your Agilent service representative. |
| 2 | Defective pressure sensor. | • Please contact your Agilent service representative. |

# Valve Failed

## Error ID: 2040

*Valve 0 Failed:* valve A1

*Valve 1 Failed:* valve A2

*Valve 2 Failed:* valve B2

*Valve 3 Failed:* valve B1

One of the solvent selection valves in the module failed to switch correctly.

The processor monitors the valve voltage before and after each switching cycle. If the voltages are outside expected limits, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Solvent selection valve disconnected. | • Please contact your Agilent service representative. |
| 2 | Connection cable (inside instrument) not connected. | • Please contact your Agilent service representative. |
| 3 | Connection cable (inside instrument) defective. | • Please contact your Agilent service representative. |
| 4 | Solvent selection valve defective. | • Exchange the solvent selection valve. |

# Electronic Fuse of SSV Open

## Error ID: 2049

*Valve Fuse 0:* Channels A1 and A2

*Valve Fuse 1:* Channels B1 and B2

One of the solvent-selection valves in the module has drawn excessive current causing the selection-valve electronic fuse to open.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Defective solvent selection valve. | • Restart the pump. If the error message appears again, exchange the solvent selection valve. |
| 2 | Defective connection cable (front panel to main board). | • Please contact your Agilent service representative. |
| 3 | Defective mainboard. | • Please contact your Agilent service representative. |

# AIV Fuse

## Error ID: 2044

*Inlet-Valve Fuse 0:* Pump channel A

*Inlet-Valve Fuse 1:* Pump channel B

One of the active-inlet valves in the module has drawn excessive current causing the inlet-valve electronic fuse to open.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Defective active inlet valve. | • Restart the module. If the error message appears again, exchange the active inlet valve. |
| 2 | Defective connection cable (front panel to mainboard). | • Please contact your Agilent service representative. |
| 3 | Defective mainboard. | • Please contact your Agilent service representative. |

# Motor-Drive Power

## Error ID: 2041, 2042

*Motor-Drive Power:* Pump channel A

*B: Motor-Drive Power:* Pump channel B

The current drawn by the pump motor exceeded the maximum limit.

Blockages in the flow path are usually detected by the pressure sensor, which result in the pump switching off when the upper pressure limit is exceeded. If a blockage occurs before the pressure sensor, the pressure increase cannot be detected and the module will continue to pump. As pressure increases, the pump drive draws more current. When the current reaches the maximum limit, the module is switched off, and the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Flow path blockage in front of the pressure sensor. | • Ensure the capillaries and frits between the pump head and pressure sensor inlet are free from blockage. |
| 2 | Blocked (passive or active) inlet valve. | • Exchange the (passive or active) inlet valve. |
| 3 | Blocked outlet valve. | • Exchange the outlet valve. |
| 4 | High friction (partial mechanical blockage) in the pump drive assembly. | |
| 5 | Defective pump drive assembly. | • Please contact your Agilent service representative. |
| 6 | Defective mainboard. | • Please contact your Agilent service representative. |
| 7 | Restriction capillary blocked at pre-mixing union. | • Exchange restriction capillary. |

# Encoder Missing

## Error ID: 2046, 2050

*Encoder Missing:* Pump channel A

*B: Encoder Missing:* Pump channel B

The optical encoder on the pump motor in the module is missing or defective.

The processor checks the presence of the pump encoder connector every 2 s. If the connector is not detected by the processor, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Defective or disconnected pump encoder connector. | • Please contact your Agilent service representative. |
| 2 | Defective pump drive assembly. | • Please contact your Agilent service representative. |

# Servo Restart Failed

## Error ID: 2201, 2211

*Servo Restart Failed:* Pump channel A

*B: Servo Restart Failed:* Pump channel B

The pump motor in the module was unable to move into the correct position for restarting.

When the module is switched on, the first step is to switch on the C phase of the variable reluctance motor. The rotor should move to one of the C positions. The C position is required for the servo to be able to take control of the phase sequencing with the commutator. If the rotor is unable to move, or if the C position cannot be reached, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Mechanical blockage of the module. | |
| 2 | Disconnected or defective cable. | • Please contact your Agilent service representative. |
| 3 | Blocked (passive or active) inlet valve. | • Exchange the (passive or active) inlet valve. |
| 4 | Defective pump drive assembly. | • Please contact your Agilent service representative. |
| 5 | Defective mainboard. | • Please contact your Agilent service representative. |

# Pump Head Missing

## Error ID: 2202, 2212

*Pump Head Missing:* Pump channel A

*B: Pump Head Missing:* Pump channel B

The pump-head end stop in the pump was not found.

When the pump restarts, the metering drive moves forward to the mechanical end stop. Normally, the end stop is reached within 20 s, indicated by an increase in motor current. If the end point is not found within 20 s, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Pump head not installed correctly (screws not secured, or pump head not seated correctly). | • Install the pump head correctly. Ensure nothing (e.g. capillary) is trapped between the pump head and body. |
| 2 | Broken piston. | • Exchange the piston. |

# Index Limit

## Error ID: 2203, 2213

*Index Limit:* Pump channel A

*B: Index Limit:* Pump channel B

The time required by the piston to reach the encoder index position was too short (pump).

During initialization, the first piston is moved to the mechanical stop. After reaching the mechanical stop, the piston reverses direction until the encoder index position is reached. If the index position is reached too fast, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Irregular or sticking drive movement. | • Remove the pump head, and examine the seals, pistons, and internal components for signs of wear, contamination or damage. Exchange components as required. |
| 2 | Defective pump drive assembly. | • Please contact your Agilent service representative. |

# Index Adjustment

## Error ID: 2204, 2214

*Index Adjustment:* Pump channel A

*B: Index Adjustment:* Pump channel B

The encoder index position in the module is out of adjustment.

During initialization, the first piston is moved to the mechanical stop. After reaching the mechanical stop, the piston reverses direction until the encoder index position is reached. If the time to reach the index position is too long, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Irregular or sticking drive movement. | • Remove the pump head, and examine the seals, pistons, and internal components for signs of wear, contamination or damage. Exchange components as required. |
| 2 | Defective pump drive assembly. | • Please contact your Agilent service representative. |

# Index Missing

## Error ID: 2205, 2215

*Index Missing:* Pump channel A

*B: Index Missing:* Pump channel B

The encoder index position in the module was not found during initialization.

During initialization, the first piston is moved to the mechanical stop. After reaching the mechanical stop, the piston reverses direction until the encoder index position is reached. If the index position is not recognized within a defined time, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Disconnected or defective encoder cable. | • Please contact your Agilent service representative. |
| 2 | Defective pump drive assembly. | • Please contact your Agilent service representative. |

# Initialization Failed

## Error ID: 2207, 2217

*Initialization Failed:* Pump channel A

*B: Initialization Failed:* Pump channel B

The module failed to initialize successfully within the maximum time window.

A maximum time is assigned for the complete pump-initialization cycle. If the time is exceeded before initialization is complete, the error message is generated.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Blocked (passive or active) inlet valve. | • Exchange the (passive or active) inlet valve. |
| 2 | Defective pump drive assembly. | • Please contact your Agilent service representative. |
| 3 | Defective mainboard. | • Please contact your Agilent service representative. |

# Degasser: Signal Fail

## Error ID: 8016

The pump board gets no or wrong pressure signals from the built-in degasser:

- No valid pressure signal is shown during startup of the degasser
- Measured pressure is higher than 32000 hPa

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Degasser sensor defect. | • Please contact your Agilent service representative. |
| 2 | Degasser sensor not connected to mainboard. | • Please contact your Agilent service representative. |

# Degasser: Vacuum Cannot Be Maintained

## Error ID: 8014

Pressure in degasser vacuum chamber exceeds 180 mbar limit during normal operation.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Liquid in degasser tubing. | • Please contact your Agilent service representative. |
| 2 | Leak in degasser tubing or chamber. | • Please contact your Agilent service representative. |
| 3 | Degasser vacuum pump defect. | • Please contact your Agilent service representative. |

# Degasser: Limit Not Reached

## Error ID: 8053

Degasser is not ready within 16 min after startup, because the pressure inside the vacuum chamber exceeds 150 bar.

| Probable cause | | Suggested actions |
|---|---|---|
| 1 | Liquid in degasser tubing. | • Please contact your Agilent service representative. |
| 2 | Leak in degasser tubing or chamber. | • Please contact your Agilent service representative. |
| 3 | Degasser vacuum pump defect. | • Please contact your Agilent service representative. |

# 8 Maintenance

It is necessary to perform periodic inspection of the instrument to ensure its safe use. It is possible to have these periodic inspections performed by Agilent service representatives on a contractual basis. For information regarding the maintenance inspection contract, contact your Agilent representative.

# Safety Information Related to Maintenance

**WARNING** Fire and damage to the module

Wrong fuses

- Make sure that only fuses with the required rated current and of the specified type (super-fast, fast, time delay etc) are used for replacement.
- The use of repaired fuses and the short-circuiting of fuse-holders must be avoided.

**WARNING** Personal injury or damage to the product

Agilent is not responsible for any damages caused, in whole or in part, by improper use of the products, unauthorized alterations, adjustments or modifications to the products, failure to comply with procedures in Agilent product user guides, or use of the products in violation of applicable laws, rules or regulations.

- Use your Agilent products only in the manner described in the Agilent product user guides.

**WARNING** Electrical shock

Repair work at the module can lead to personal injuries, e.g. shock hazard, when the cover is opened.

- Do not remove the cover of the module.
- Only certified persons are authorized to carry out repairs inside the module.

**WARNING** Sharp metal edges

Sharp-edged parts of the equipment may cause injuries.

- To prevent personal injury, be careful when getting in contact with sharp metal areas.

**WARNING** **Toxic, flammable and hazardous solvents, samples and reagents**

**The handling of solvents, samples and reagents can hold health and safety risks.**

- **When working with these substances observe appropriate safety procedures (for example by wearing goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the vendor, and follow good laboratory practice.**
- **The volume of substances should be reduced to the minimum required for the analysis.**
- **Do not operate the instrument in an explosive atmosphere.**

**CAUTION** Safety standards for external equipment

- If you connect external equipment to the instrument, make sure that you only use accessory units tested and approved according to the safety standards appropriate for the type of external equipment.

# Introduction to Maintenance

The pump is designed for easy maintenance. The most frequent maintenance procedures such as piston seal replacement and purge valve frit exchange can be done from the front side without removing the pump from the system stack.

These procedures are described in Overview of Maintenance and Simple Repair on page 130.

# Overview of Maintenance and Simple Repair

Figure 12 on page 130 shows the main user accessible assemblies of the binary pump. The pump heads and its parts require normal maintenance (for example, seal exchange) and can be accessed from the front (simple repairs). Replacement of valve cartridges or filters don't require to remove the pump from the system stack.

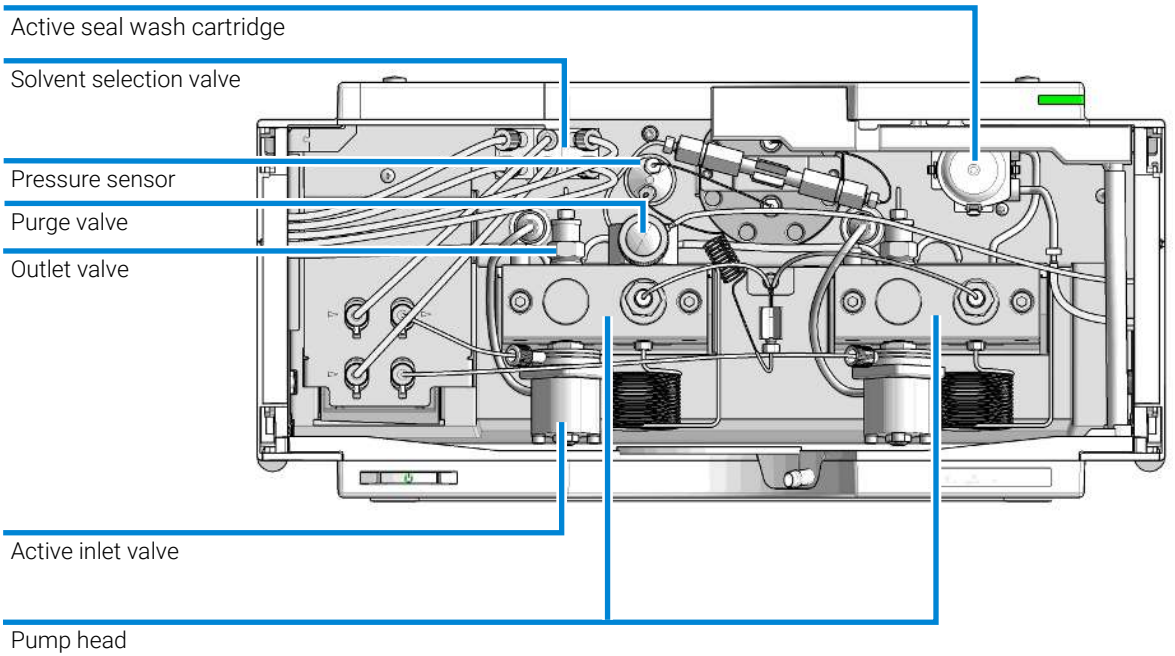



**Figure 12:** Overview of Maintenance and Simple Repairs

| | |
|---|---|
| 1 | Purge valve, see Exchange the Purge Valve Frit or the Purge Valve on page 136 |
| 2 | Outlet valve, see Exchange the Outlet Valve on page 179 |
| 3 | Active inlet valve, see Exchange the Active Inlet Valve (AIV) or its Cartridge on page 170 |
| 4 | Pump head, see Maintenance of a Pump Head with Seal Wash Option on page 154 |
| 5 | Solvent selection valve, see Exchange the Solvent Selection Valve on page 184 |

# Maintenance Procedures

The procedures described in this section can be done with the binary pump in place in the system stack.

**Table 14:** Maintenance procedures

| Procedure | Typical Frequency | Notes |
|---|---|---|
| Exchange the Purge Valve Frit or the Purge Valve on page 136 | Yearly, or if the frit shows indication of contamination or blockage<br>If internally leaking | A pressure drop of > 10 bar in low delay volume configuration and > 20 bar in standard configuration across the frit (5 mL/min $H_2O$ with purge valve open) indicates blockage<br>Solvent dripping out of waste outlet when valve is closed |
| Remove the Pump Head Assembly on page 142 | During yearly maintenance | Necessary to get access to pump seals and pistons |
| Maintenance of a Pump Head Without Seal Wash Option on page 144 | Yearly, or if pump performance indicates seal wear | Leaks at lower pump head side, unstable retention times, pressure ripple unstable — run **Pump Leak Rate Test** for verification<br>Seal life time shorter than normally expected — check pistons while changing the seals |
| Maintenance of a Pump Head with Seal Wash Option on page 154 | Yearly, or if pump performance indicates seal wear | Only necessary when Seal Wash Option is installed. Leaks at lower pump head side, loss of wash solvent |
| Exchange the Active Inlet Valve (AIV) or its Cartridge on page 170 | If leaking externally<br>If solenoid is defective | Error messages “Inlet Valve Fuse” or “Inlet Valve Missing” |
| Exchange the Outlet Valve on page 179 | If internally leaking | Pressure ripple unstable, run **Pump Leak Rate Test** for verification |
| Exchange the Solvent Selection Valve on page 184 | If internally leaking<br>If solenoid is defective | Cross port flow<br>Error message “Valve Failed” |

# Cleaning the Module

To keep the module case clean, use a soft cloth slightly dampened with water, or a solution of water and mild detergent. Avoid using organic solvents for cleaning purposes. They can cause damage to plastic parts.

**WARNING** **Liquid dripping into the electronic compartment of your module can cause shock hazard and damage the module**

- **Do not use an excessively damp cloth during cleaning.**
- **Drain all solvent lines before opening any connections in the flow path.**

**NOTE** A solution of 70 % isopropanol and 30 % water might be used if the surface of the module needs to be disinfected.

# Remove and Install Doors

**When**

- The instrument doors or the hinges are broken.

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5023-3138 | Reversible Screwdriver + Blade 1,0 x 5,5 |

**Parts required** (Infinity III)

| Qty. | p/n | Description |
|---|---|---|
| | 5004-3180 | Door Kit Infinity III 180mm |

**Parts required** (Infinity II)

| Qty. | p/n | Description |
|---|---|---|
| | 5004-0180 | Door Kit Infinity II 180mm |

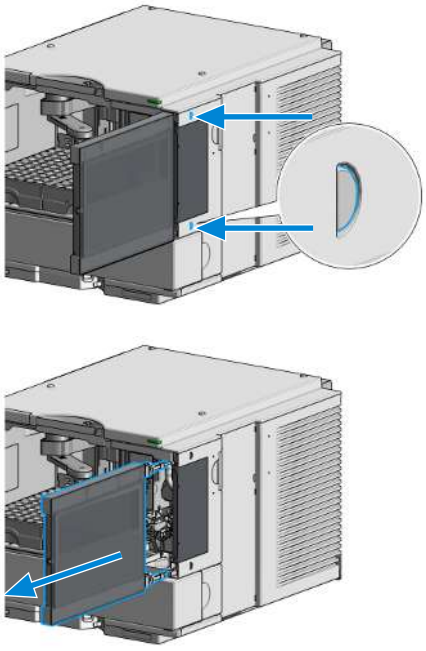
**Preparations**

- Finish any pending acquisition job.

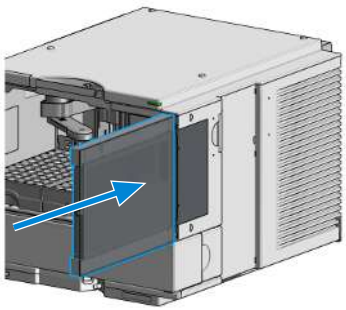
**NOTE**

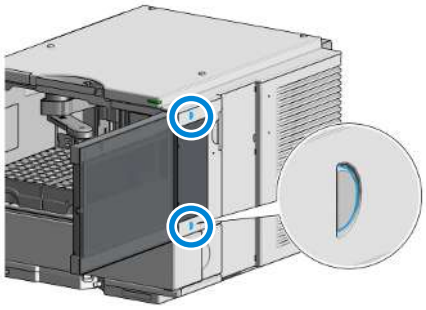
The figures shown in this procedure exemplarily show the Infinity III Vialsampler module. The principle of how to remove and/or install doors works in the same way for all Infinity III modules.

1 Press the release buttons and pull the front door out.



2 For the Installation of the front door, insert the hinges into their guides and push the door in until the release buttons click into their final position.





# Exchange the Purge Valve Frit or the Purge Valve

**When**

- Frit – when piston seals are exchanged or when contaminated or blocked (pressure drop of > 10 bar in low delay volume configuration and > 20 bar in standard configuration across the frit at a flow rate of 5 mL/min of water with purge valve opened)
- Purge valve – if internally leaking

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |
| 1 | 8710-1924 | Open-end wrench 14 mm |
| 1 | | Pair of tweezers , **OR** |
| 1 | | Toothpick |

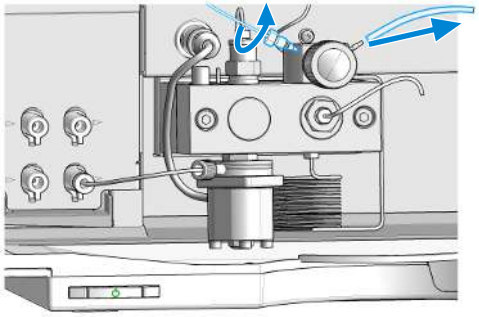
**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 01018-22707 | PTFE Frit (5/Pk) |
| 1 | G7111-60061 | Purge valve |
| 1 | 5067-4728 | Seal cap assembly |

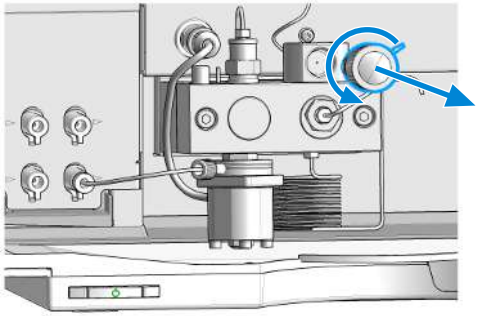
**Preparations**

- Switch off pump at the main power switch
- Open the doors
- Use an optional solvent shutoff valve or lift up solvent filters in solvent reservoirs for avoiding leakages

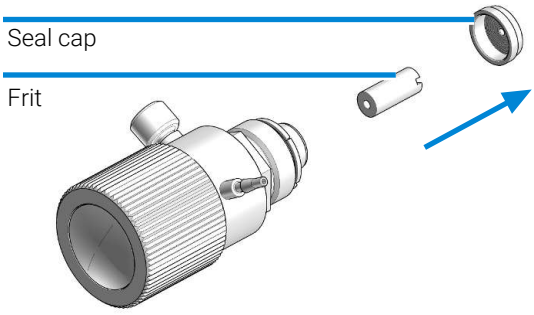
**1** Using a 1/4 inch wrench disconnect the pump outlet capillary from the purge valve. Disconnect the waste tube. Beware of leaking solvents due to hydrostatic pressure.



2 Using the 14 mm wrench, unscrew the purge valve and remove it from the purge valve holder.

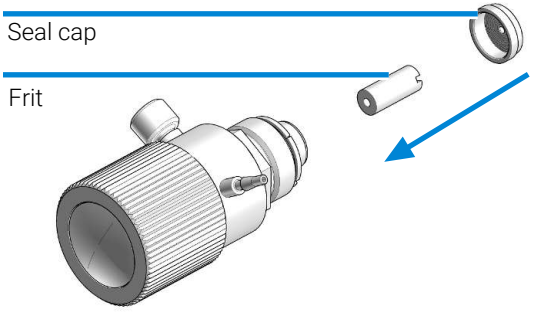


3 Remove the seal cap from the purge valve.




4 Using a pair of tweezers or a toothpick remove the frit.

5 Place a new frit into the purge valve with the orientation of the frit as shown below (slit in frit points to the front).

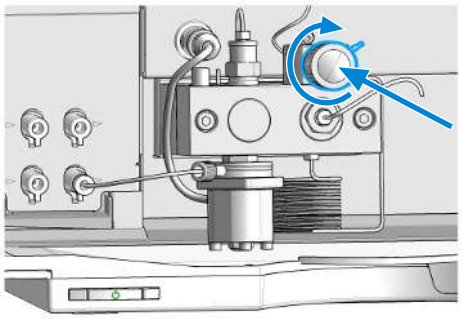


6 Reinstall the seal cap including the gold seal.

**NOTE**

Before reinstallation always check the gold seal in the seal cap. A deformed seal cap should be exchanged.

7 Insert the purge valve into the purge valve holder.

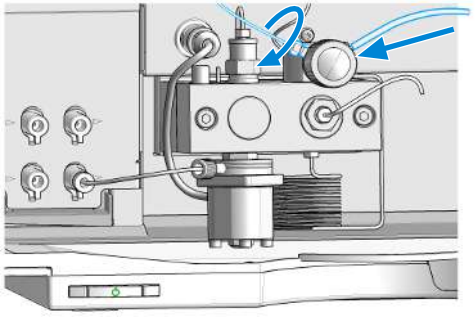


**CAUTION**

Damage to the purge valve

- Do not lift the pump using the purge valve as a handle, it might get leaky.
- Do not try to turn the purge valve into the correct position when already fixed to the pump. The rubber o-ring might break.
- Anticipate the correct position of the connections before tightening the valve.

8 Tighten the purge valve and reconnect outlet capillary and waste tubing.



9 Run the System Pressure Test (see System Pressure Test on page 188).

# Replace the O-Ring on the Purge Valve

**When**

- If the original o-ring is damaged and needs to be replaced

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |
| 1 | 8710-1924 | Open-end wrench 14 mm |
| 1 | | Pair of tweezers , **OR** |
| 1 | | Toothpick |

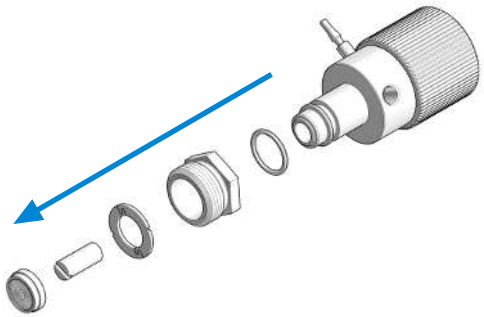
**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5067-6595 | 1260 PV O-ring FKM 5/pack |
| 1 | 01018-22707 | PTFE Frit (5/Pk) (optional) |
| 1 | 5067-4728 | Seal cap assembly (optional) |

**Preparations**

- Switch off pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters in solvent reservoirs for avoiding leakages.
- Remove the purge valve from the pump head.

**1** Disassemble the purge valve.

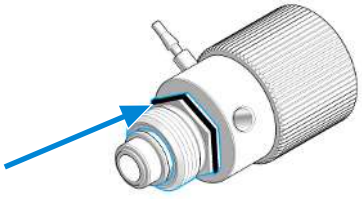


**2** Remove the old o-ring from the purge valve.

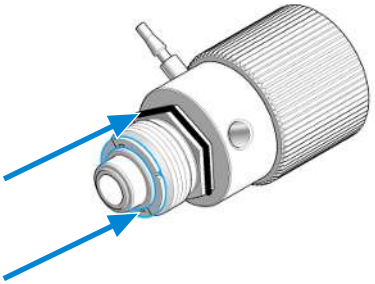
**3** Clean the purge valve parts.

4 Place the new o-ring on the Screw Purge Valve.

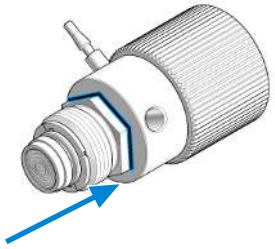
5 Place the screw with o-ring on the Purge Valve Body.



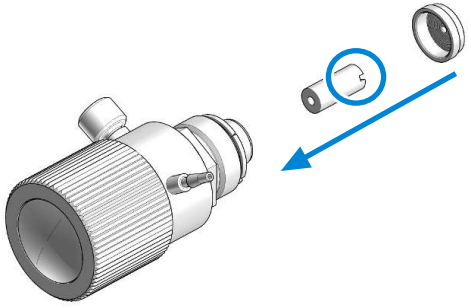
6 Place the mounting ring on the screw and push down the o-ring.



7 Push the screw up and guide the o-ring into the gap.



8 Place a new frit into the purge valve with the orientation of the frit as shown below (slit in frit points to the front). Reinstall the seal cap including the gold seal.



NOTE

Before reinstallation always check the gold seal in the seal cap. A deformed seal cap should be exchanged.

9 Install the purge valve to the pump. Make sure not to turn the purge valve body when the screw is fixed to the pump. The o-ring will take damage.

10 Run the System Pressure Test (see System Pressure Test on page 188).

# Remove the Pump Head Assembly

**When**

- Exchanging pump seals
- Exchanging pistons
- Exchanging seals of the seal wash option

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |
| 1 | | Hexagonal key, 4 mm |
| 1 | 5023-0240 | Hex driver, ¼", slitted |

**Preparations**

- Switch off the pump at the main power switch.

**CAUTION**

Damage of the pump drive

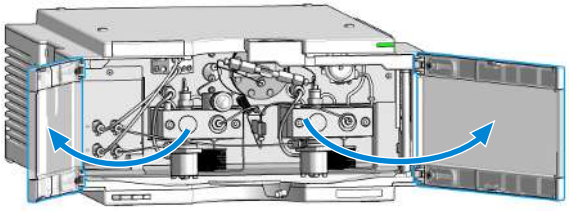
Starting the pump when the pump head is removed may damage the pump drive.

— Never start the pump when the pump head is removed.

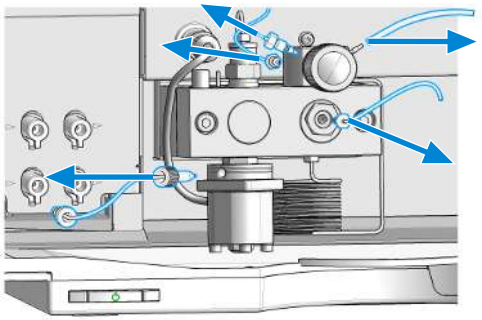
**NOTE**

Both pump head assemblies use the same internal components. In addition, pump head A is fitted with the purge valve. The following procedure describes the removal and disassembly of pump head A (left). For pump head B (right) proceed in the same way and skip steps that deal with the purge valve.

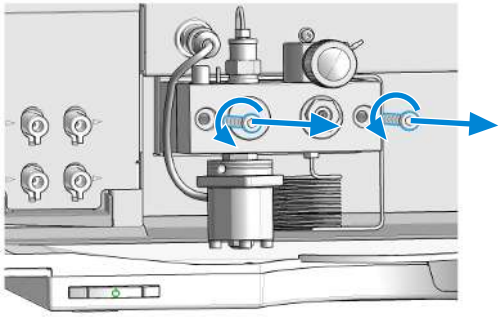
**1** Open the doors.



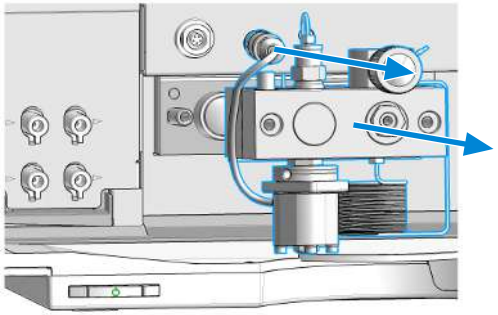
2 Disconnect the capillaries at the back of the purge valve holder, the pump head adapter and the tube at the active inlet valve. Beware of leaking solvents.



3 Using a 4 mm hexagonal key stepwise loosen and remove the two pump head screws.



4 Unplug the active inlet valve cable from the connector. Remove the pump head assembly from the module.



# Maintenance of a Pump Head Without Seal Wash Option

**When**

- In case of maintenance or pump head internal leaks

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |
| 1 | | Hexagonal key, 4 mm |
| 1 | 01018-23702 | Insert tool |

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5063-6589 | PTFE seal (pack of 2) , **OR** |
| 1 | 0905-1420 | PE seal (pack of 2) |
| 1 | 5063-6586 | Sapphire piston, 100 µL |

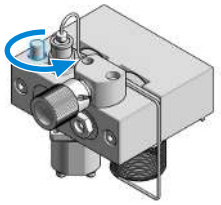
**Preparations**

- Switch off the pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters for avoiding leakages.
- Remove the Pump Head Assembly.

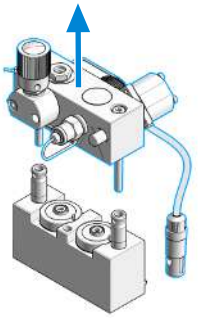
**NOTE**

Both pump head assemblies use the same internal components. In addition, pump head A is fitted with the purge valve. The following procedure describes the removal and disassembly of pump head A (left). For pump head B (right) proceed in the same way and skip steps that deal with the purge valve.

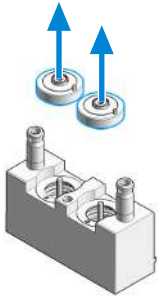
1 Place the pump head on a flat surface. Loosen the lock screw (two turns).



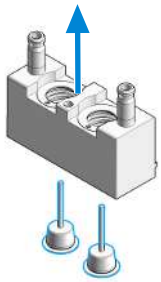
2 While holding the lower half of the assembly (piston housing), carefully pull the pump chamber housing away from the piston housing.



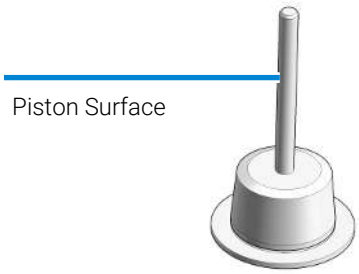
3 Remove the support rings from the piston housing.



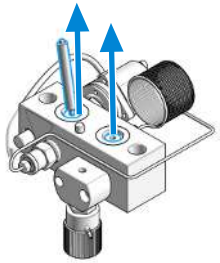
4 Lift the housing away from the pistons.



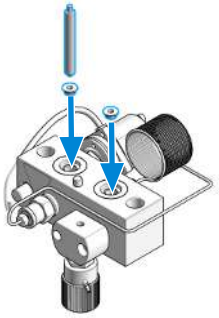
5 Check the piston surface and remove any deposits or layers: clean the piston surface with abrasive paper and rinse with 2-propanol. Replace piston if scratched.



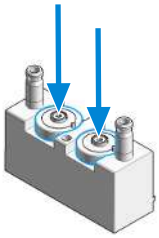

6 Using the steel side of the insert tool, carefully remove the seal from the pump housing.



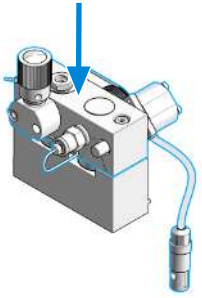
7 Using the plastic side of the insert tool, insert new seals into the pump head.



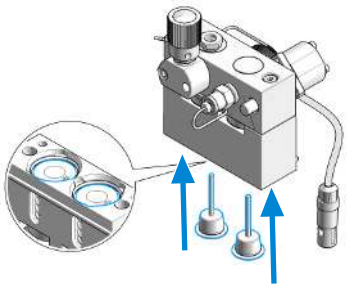
8 Place the support rings on the piston housing. Note the correct position of the pins.



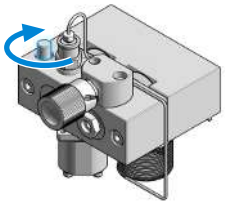
9 Place the pump housing onto the piston housing.



**10** Insert the pistons and carefully press them into the seals.



**11** Tighten the lock screw.



**12** Install the pump head, see Reinstall the Pump Head Assembly on page 166.

# Maintenance of a Pump Head Without Seal Wash Option (Infinity III Support Ring Design)

**When**

- In case of maintenance or pump head internal leaks

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |
| 1 | | Hexagonal key, 4 mm |
| 1 | 01018-23702 | Insert tool |

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5063-6589 | PTFE seal (pack of 2) , **OR** |
| 1 | 0905-1420 | PE seal (pack of 2) |
| 1 | 5063-6586 | Sapphire piston, 100 µL |

**NOTE**

Consider replacement of G4220-24134 (Backup Seal) in case of compromised performance (pressure ripple too high).

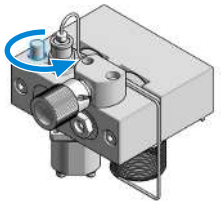
**Preparations**

- Switch off the pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters for avoiding leakages.
- Remove the Pump Head Assembly.

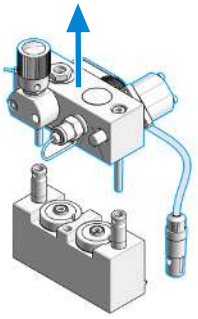
**NOTE**

Both pump head assemblies use the same internal components. In addition, pump head A is fitted with the purge valve. The following procedure describes the removal and disassembly of pump head A (left). For pump head B (right) proceed in the same way and skip steps that deal with the purge valve.

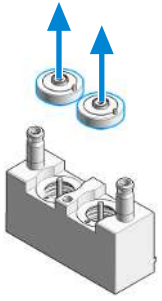
1 Place the pump head on a flat surface. Loosen the lock screw (two turns).



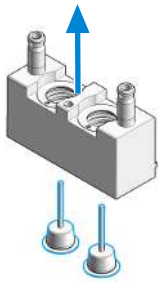
2 While holding the lower half of the assembly (piston housing), carefully pull the pump chamber housing away from the piston housing.



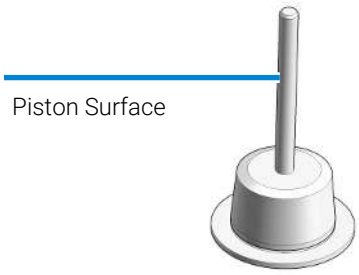
3 Remove the support rings from the piston housing.



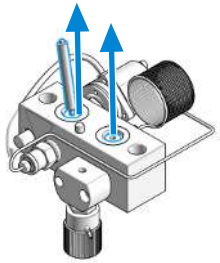
4 Lift the housing away from the pistons.



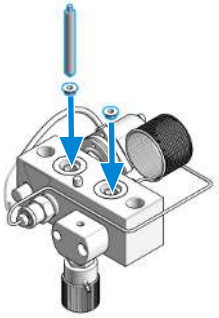
5 Check the piston surface and remove any deposits or layers: clean the piston surface with abrasive paper and rinse with 2-propanol. Replace piston if scratched.



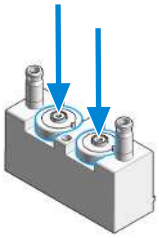

6 Using the steel side of the insert tool, carefully remove the seal from the pump housing.



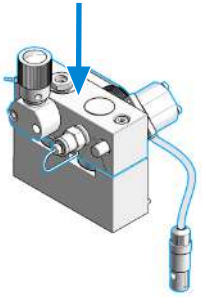
7 Using the plastic side of the insert tool, insert new seals into the pump head.



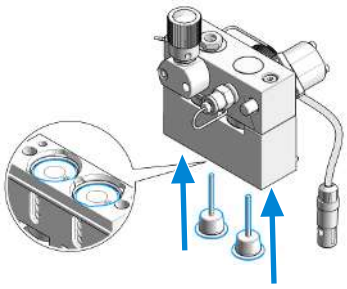
8 Place the support rings on the piston housing. Note the correct position of the pins.



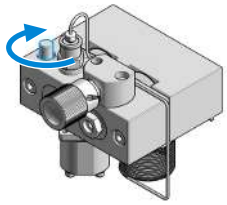
9 Place the pump housing onto the piston housing.



**10** Insert the pistons and carefully press them into the seals.



**11** Tighten the lock screw.



**12** Install the pump head, see Reinstall the Pump Head Assembly on page 166.

# Maintenance of a Pump Head with Seal Wash Option

**When**

- In case of maintenance or pump head internal leaks

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | | Hexagonal key, 4 mm |
| 1 | 01018-23702 | Insert tool |
| 1 | | Screwdriver, small flat head |

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5063-6589 | PTFE seal (pack of 2) , **OR** |
| 1 | 0905-1420 | PE seal (pack of 2) |
| 1 | 5062-2484 | Gasket, seal wash (pack of 6) |
| 1 | 0905-1175 | Wash seal (PTFE) , **OR** |
| 1 | 0905-1718 | Wash Seal PE |
| 1 | 5063-6586 | Sapphire piston, 100 µL |

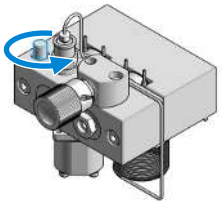
**Preparations**

- Switch off the pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters for avoiding leakages.
- Remove the Pump Head Assembly.
- Remove the wash solvent tubings from the support ring inlet and outlet.

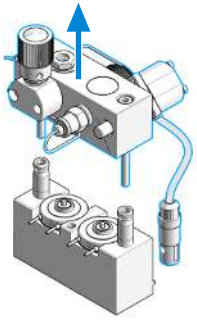
**NOTE**

Both pump head assemblies use the same internal components. In addition, pump head A is fitted with the purge valve. The following procedure describes the removal and disassembly of pump head A (left). For pump head B (right) proceed in the same way and skip steps that deal with the purge valve.

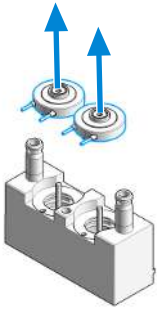
1 Place the pump head on a flat surface. Loosen the lock screw (two turns).



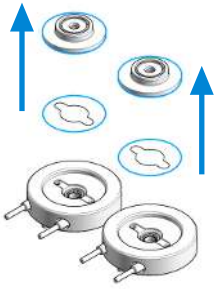
2 While holding the lower half of the assembly (piston housing), carefully pull the pump housing away from the piston housing.



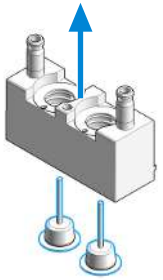
3 Remove the seal holder and the seal wash support rings from the piston housing.



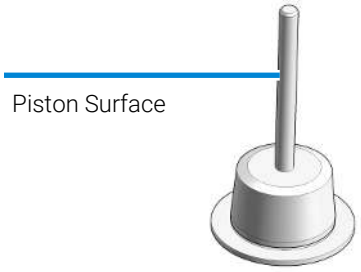
4 Remove the seal holder from the support ring assembly.



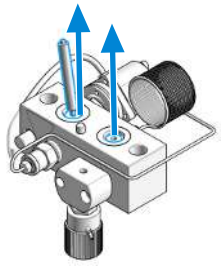
5 Lift the housing away from the pistons.



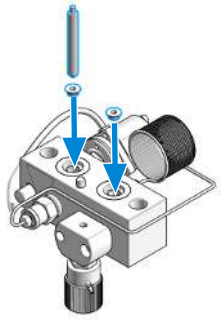
6 Check the piston surface and remove any deposits or layers: clean the piston surface with abrasive paper and rinse with 2-propanol. Replace piston if scratched.



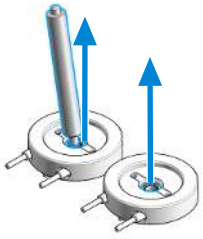
7 Using the steel side of the insert tool, carefully remove the seal from the pump housing.



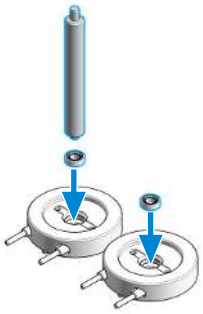
8 Using the plastic side of the insert tool, insert new seals into the pump head.



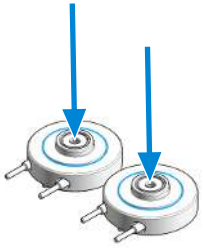
9 Using the steel side of the insert tool, remove the seal wash gasket and the wash seal from the support ring.



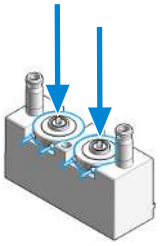
**10** Using the plastic side of the insert tool, press the new wash seal (spring pointing upwards) into the recess of the support ring.



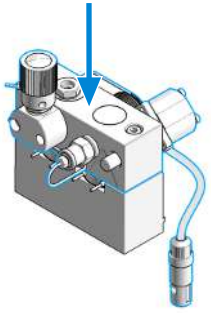
**11** Place a seal wash gasket in the recess of the support ring. Use a matching orientation of gasket and support ring. Put the seal holder on top of the gasket.



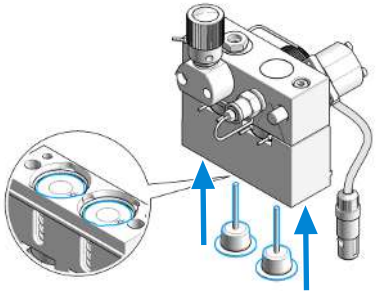
**12** Place the support rings on the piston housing. Note the correct position of the pins on the support ring.



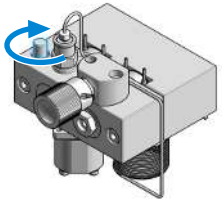
**13** Place the pump chamber housing onto the piston housing.



**14** Insert the pistons and carefully press them into the seals.



**15** Tighten the lock screw.



**16** Install the pump head, see Reinstall the Pump Head Assembly on page 166.

# Maintenance of a Pump Head with Seal Wash Option (Infinity III Support Ring Design)

**When**

- In case of maintenance or pump head internal leaks

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | | Hexagonal key, 4 mm |
| 1 | 01018-23702 | Insert tool |
| 1 | | Screwdriver, small flat head |

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5063-6589 | PTFE seal (pack of 2) , **OR** |
| 1 | 0905-1420 | PE seal (pack of 2) |
| 1 | 5062-2484 | Gasket, seal wash (pack of 6) |
| 1 | 0905-1175 | Wash seal (PTFE) , **OR** |
| 1 | 0905-1718 | Wash Seal PE |
| 1 | 5063-6586 | Sapphire piston, 100 µL |

**NOTE**

Consider replacement of G4220-24134 (Backup Seal) in case of compromised performance (pressure ripple too high).

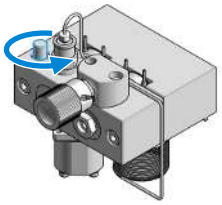
**Preparations**

- Switch off the pump at the main power switch.
- Open the doors of the module.
- Use an optional solvent shutoff valve or lift up solvent filters for avoiding leakages.
- Remove the Pump Head Assembly.
- Remove the wash solvent tubings from the support ring inlet and outlet.

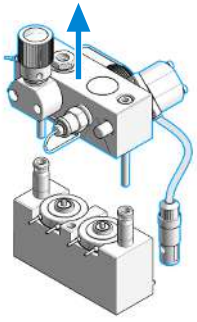
**NOTE**

Both pump head assemblies use the same internal components. In addition, pump head A is fitted with the purge valve. The following procedure describes the removal and disassembly of pump head A (left). For pump head B (right) proceed in the same way and skip steps that deal with the purge valve.

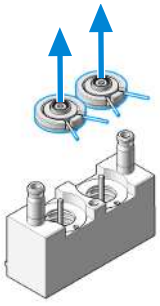
1 Place the pump head on a flat surface. Loosen the lock screw (two turns).



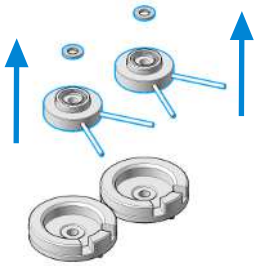
2 While holding the lower half of the assembly (piston housing), carefully pull the pump housing away from the piston housing.



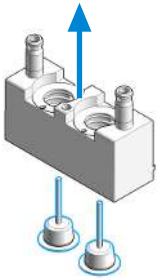
3 Remove the seal holder and the seal wash support rings from the piston housing.



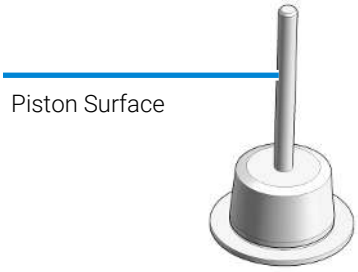
4 Remove the seal holder from the support ring assembly.



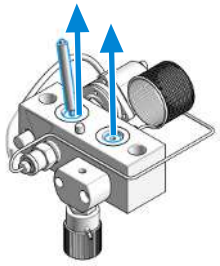
5 Lift the housing away from the pistons.



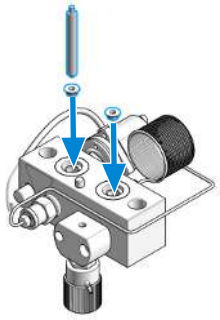
6 Check the piston surface and remove any deposits or layers: clean the piston surface with abrasive paper and rinse with 2-propanol. Replace piston if scratched.



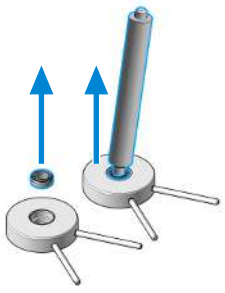
7 Using the steel side of the insert tool, carefully remove the seal from the pump housing.



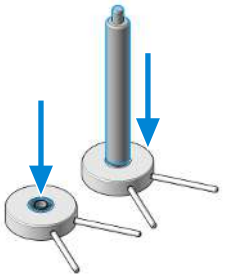
8 Using the plastic side of the insert tool, insert new seals into the pump head.



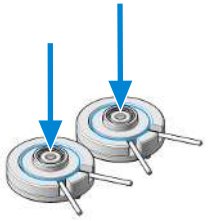
9 Using the steel side of the insert tool, remove the wash seal from the support ring.



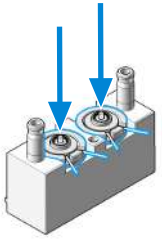
**10** Using the plastic side of the insert tool, press the new wash seal (spring pointing upwards) into the recess of the support ring.



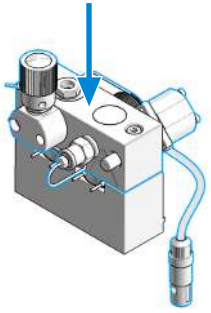
**11** Put the seal holder in the recess of the support ring.



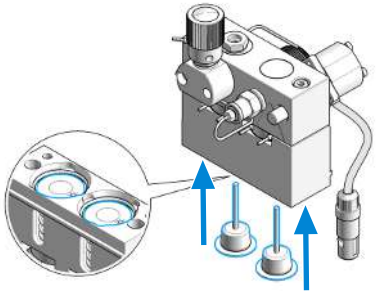
**12** Place the support rings on the piston housing. Note the correct position of the pins on the support ring.



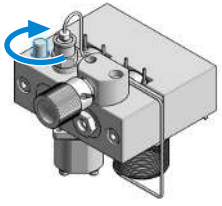
**13** Place the pump chamber housing onto the piston housing.



**14** Insert the pistons and carefully press them into the seals.



**15** Tighten the lock screw.



**16** Install the pump head, see Reinstall the Pump Head Assembly on page 166.

# Reinstall the Pump Head Assembly

**When**

- When reassembling the pump

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |
| 1 | | Hexagonal key, 4 mm |
| 1 | 5023-0240 | Hex driver, ¼", slitted |

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 79846-65501 | PTFE lubricant |

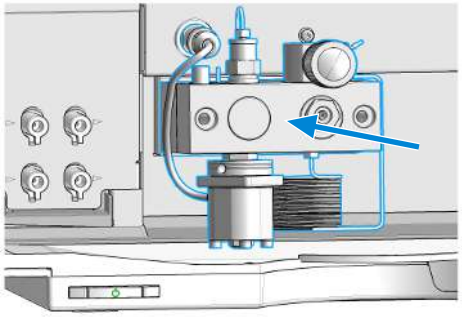
**CAUTION**

Damage of the pump drive

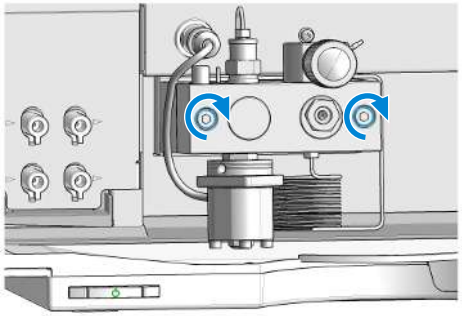
Starting the pump when the pump head is removed may damage the pump drive.

— Never start the pump when the pump head is removed.

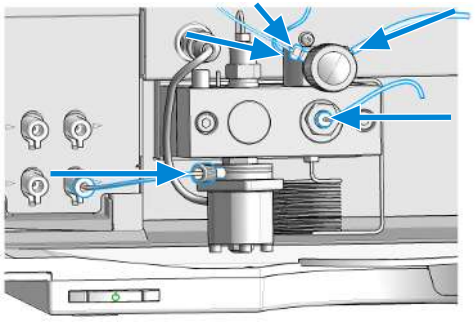
1 Slide the pump head assembly onto the pump drive. Reconnect the active inlet valve cable to the connector.



2 Using a 4 mm hexagonal key, tighten the pump head screws stepwise with increasing torque.



3 Reconnect all tubings and capillaries.

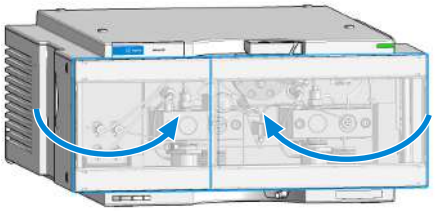


4 If a standard seal has been installed, run the Seal Wear-in Procedure on page 169, which includes a replacement of the purge valve frit.

5 For the normal phase seal, the purge valve frit should be replaced, see Exchange the Purge Valve Frit or the Purge Valve on page 136.

6 Run the Leak Rate Test (see Leak Rate Test on page 190).

7 Close the doors.



# Seal Wear-in Procedure

NOTE Procedure can be executed automatically in LabAdvisor

1 Put a bottle with 100 ml of isopropanol in the solvent cabinet and place the solvent intake filter of the pump head you want to wear in into this bottle.

2 Screw the 0100-1847 (PEEK adapter 1/4-28 to 10-32) onto the active inlet valve and connect the inlet tube from the bottle head directly to it.

3 Connect the 5022-2159 (Restriction capillary, SST 0.12 mm ID, 2 m long) to the purge valve. Connect its other end to a waste container.

4 Open the purge valve and purge the system for 5 min with isopropanol at a flow rate of 2 mL/min.

5 Close the purge valve, set the flow to a value that gives a pressure of 580 bar. Pump 15 min at this pressure to wear the seals in. The pressure can be monitored with the Instant Pilot, chromatographic data system or any other controlling device connected to your pump.

6 Turn OFF the pump, slowly open the purge valve to release the pressure from the system, disconnect the restriction capillary and reconnect the outlet capillary to the purge valve. Reconnect the intake tubing to the solvent selection valve and the connecting tube from the solvent selection valve (if installed) to the AIV.

7 Purge your system with the solvent used for your next application.

# Exchange the Active Inlet Valve (AIV) or its Cartridge

**When**

- If internally leaking (backflow)

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-1924 | Open-end wrench 14 mm |

**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | G1312-60025 | Active inlet valve without cartridge |
| 1 | G1312-60020 | Cartridge for active inlet valve 600 bar |

**Preparations**

- Switch off the pump at the main power switch

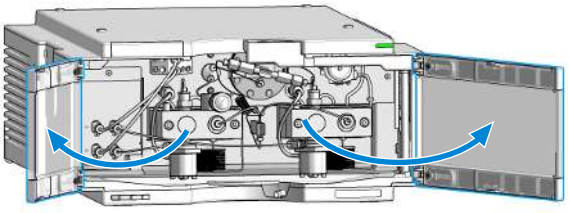
**CAUTION**

Ensure correct fit of the active inlet valve

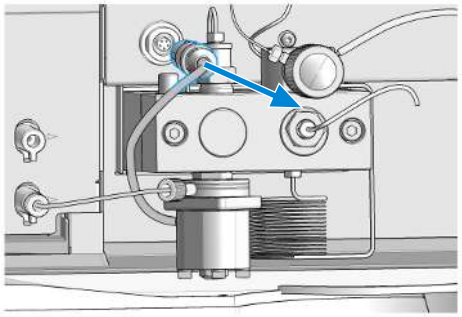
Overtightening will destroy the active inlet valve cartridge.

— Tighten the active inlet valve properly.

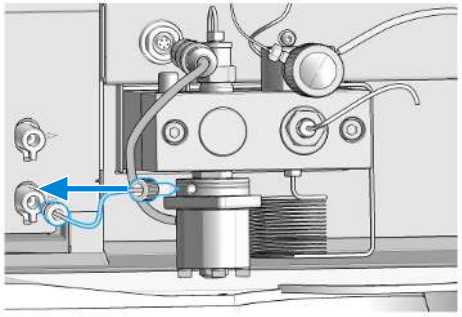
**1** Open the doors.



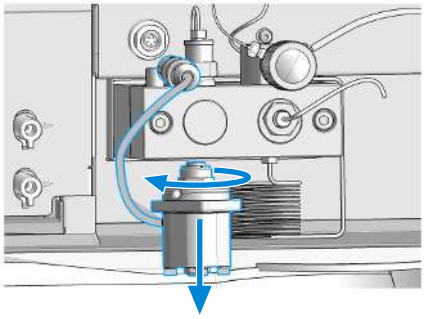
2 Unplug the active inlet valve cable from the connector.



3 Disconnect the solvent inlet tube at the active inlet valve (beware of leaking solvents).

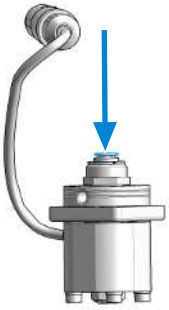


4 Using a 14 mm wrench, loosen the active inlet valve and remove the valve from the pump head.

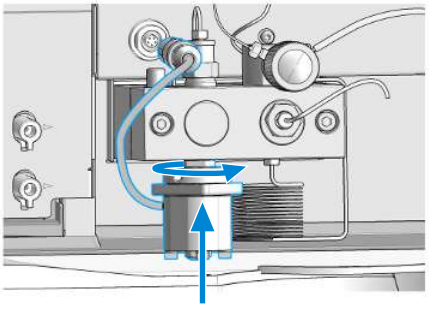


5 Using a pair of tweezers, remove the valve cartridge from the defective active inlet valve.

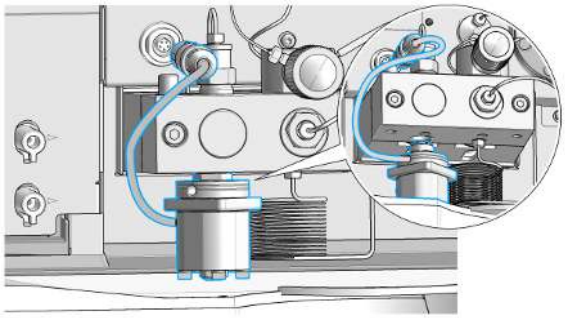
6 Push the cartridge into the new active inlet valve.



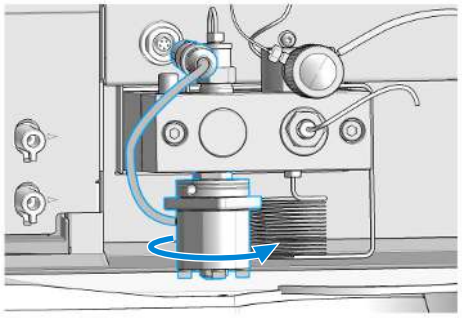
7 Screw the new valve into the pump head. With the 14 mm wrench, turn the nut until it is hand tight.



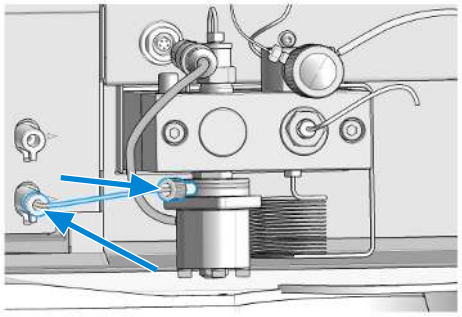
8 Position the valve so that the solvent inlet tube connection points towards the front.



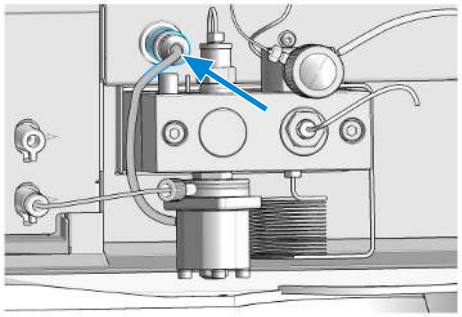
9 Using the 14 mm wrench, tighten the nut by turning the valve in its final position (not more than a quarter turn). Do not overtighten the valve.



10 Reconnect the inlet tube to the valve.

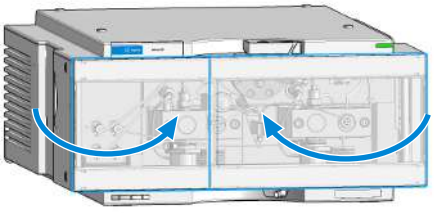


**11** Reconnect the Active Inlet Valve cable to the connector in the Z-panel.



**12** Run the Leak Rate Test (see Leak Rate Test on page 190).

**13** Close the doors.



**NOTE** After an exchange of the valve it may be required to pump several mL of the solvent used in the current application before the flow stabilizes at a pressure ripple as low as it used to be when the system was still working properly.

# Exchange the Seal Wash Cartridge

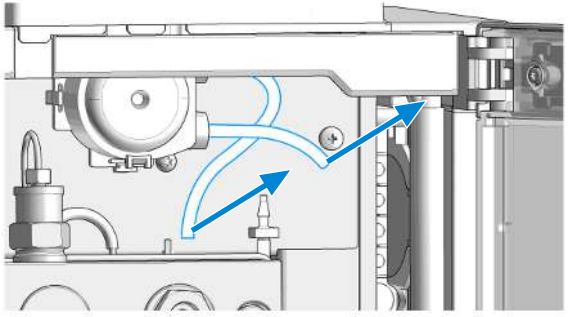
**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5065-4445 | Peristaltic pump cartridge |

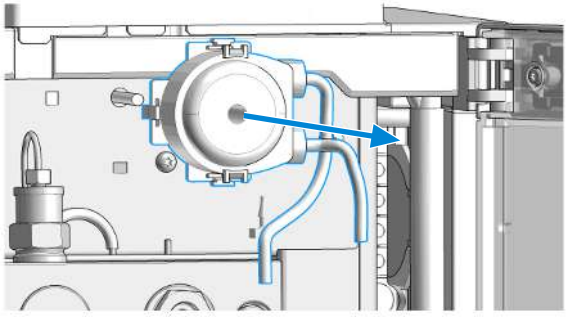
**Preparations**

- Switch off pump at the main power switch.
- Open the doors.

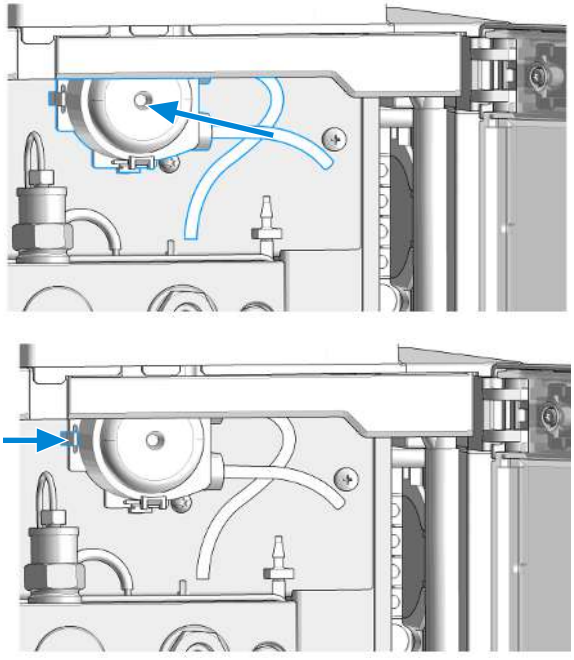
1 Remove the wash solvent tubings from the support ring outlet and from the adapter leading to the waste bottle.



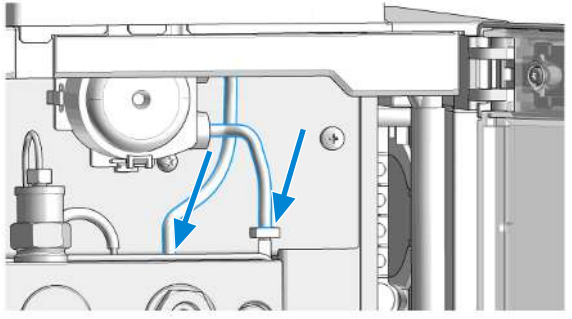
2 Unclip the peristaltic pump cartridge from the module housing and remove it.



3 Put the new peristaltic pump cartridge onto the rod of the pump motor and push the plastic clips into the module housing.



4 Connect the peristaltic pump tubes to the support rings outlet and to the adapter leading to the waste bottle.

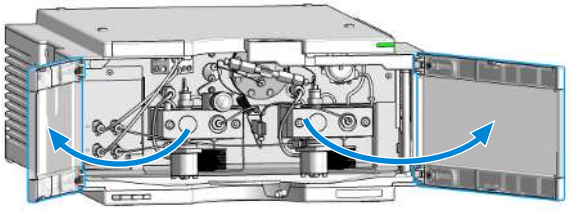


# Replace Leak Handling System Parts

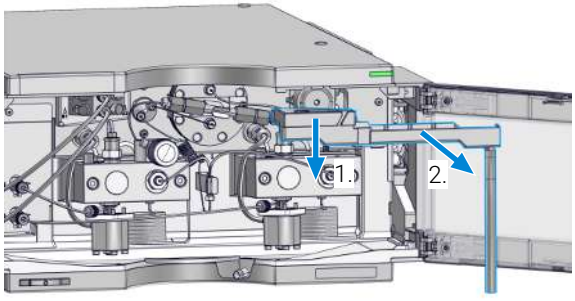
**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 5063-6527 | Tubing, Silicon Rubber, 1.2 m, ID/OD 6 mm/ 9 mm<br>approximately 85 mm required |

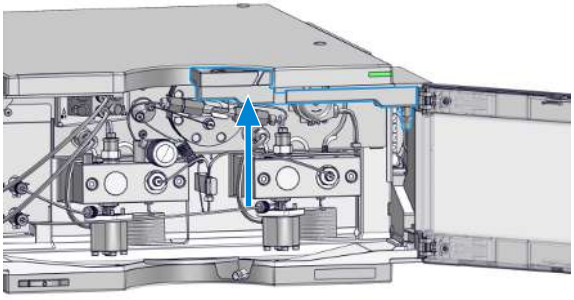
1 Open the doors.



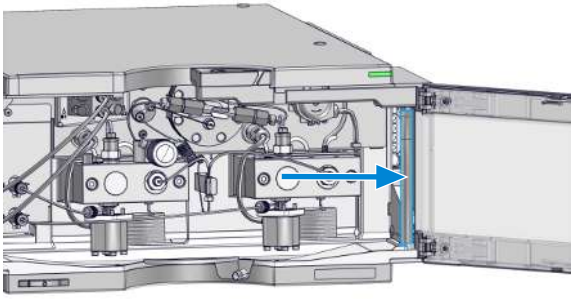
2 Press the Leak Adapter down (1.) and remove it together with the tubing (2.).



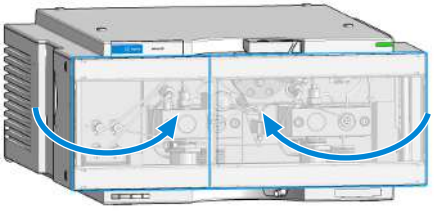
3 Install the Leak Adapter by pressing it into the Main Cover.



4 Insert the Tubing (approximately 85 mm required for replacement) between Leak Adapter outlet and Leak Panel.



5 Close the doors.



# Exchange the Outlet Valve

**When**

- if leaking internally

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-1924 | Open-end wrench 14 mm |
| 1 | 8710-0510 | Open-end wrench 1/4-5/16 inch |
| 1 | 5067-5688 | Torque wrench 1 - 25 Nm with 14 mm wrench |

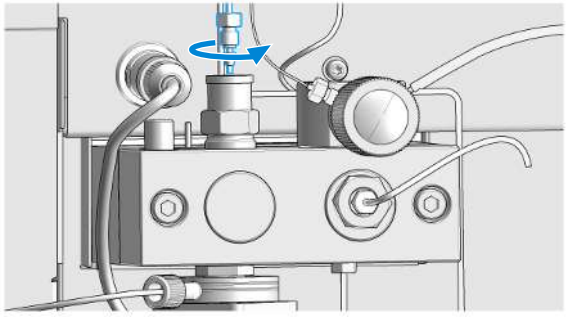
**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | G1312-60067 | Outlet valve , **OR** |
| 1 | G1312-60167 | Outlet Valve Type N/SFC |

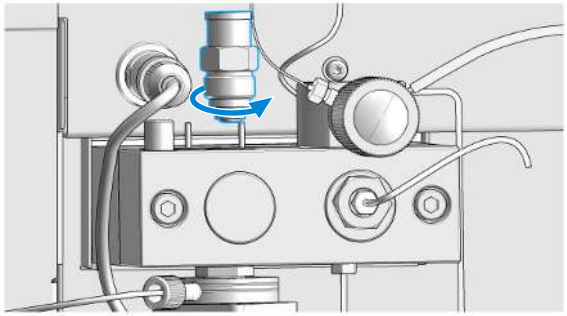
**Preparations**

- Switch off the pump at the main power switch

**1** Using a ¼ inch wrench disconnect the absorber capillary from the outlet valve.



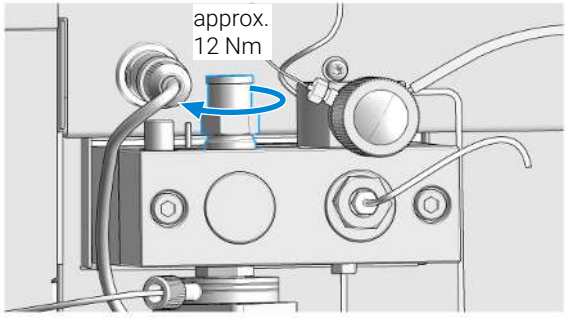
2 Unscrew the valve with the 14 mm wrench and remove it from the pump body.



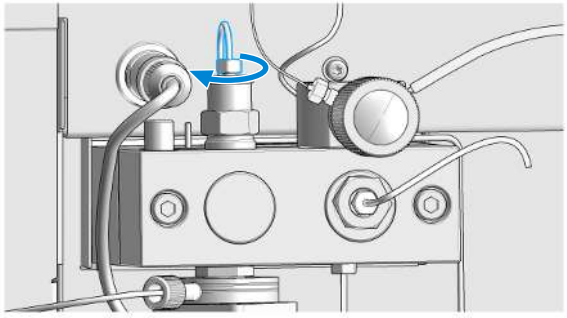
NOTE

Do not disassemble the outlet valve, as this can damage the valve.

3 Reinstall the outlet valve and tighten it using a torque wrench (approx.12 Nm).




4 Reconnect the capillary.



5 Run the Leak Rate Test (see Leak Rate Test on page 190).

# Installation of the Solvent Selection Valve Upgrade Kit

A solvent selection valve allows you to choose between four different solvents that can be used with a binary pump. The valve switches between two solvents A1 and A2 for channel A of the left pump head and two solvents B1 and B2 for channel B of the right pump head.

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0899 | Screwdriver Pozidrive Shaft |

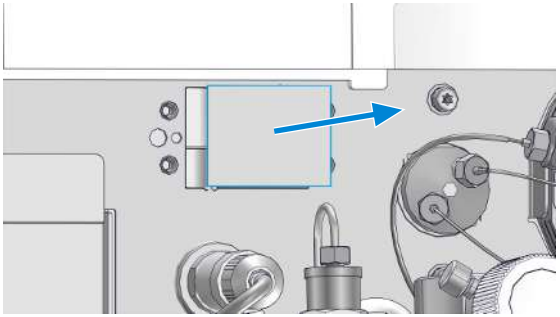
**Parts required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | G1381-60001 | Solvent Selection Valve Upgrade Kit includes: |
| 1 | | Valve Assembly (1 Valve Holder, 1 Cable, 1 Cable Holder, 4 Screws, 4 Plugs) |
| 2 | | Bottles |
| 2 | | Bottle Heads |
| 2 | | Tubings |
| 1 | | Distance sheet SSV |

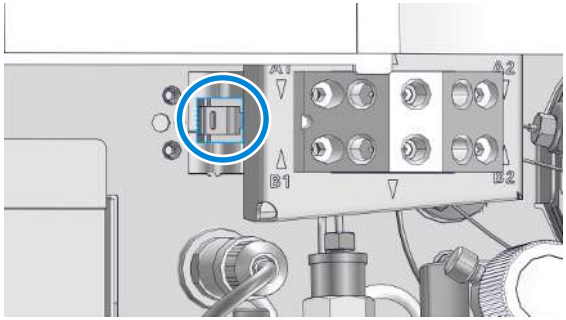
**Preparations**

- Remove the solvent tubes from the Degasser

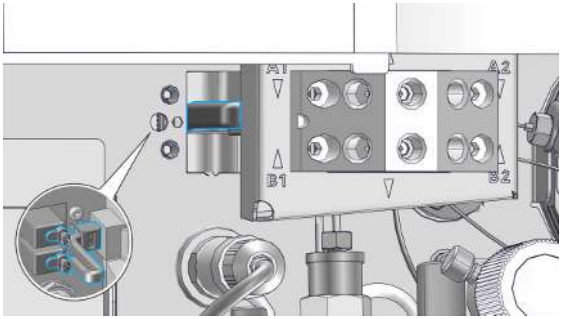
**1** Break out the metal sheet piece to get access to the connection socket inside (behind the pump front metal panel).



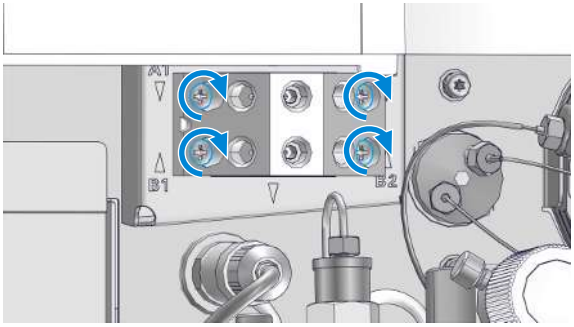
2 Guide the SSV cable through the slots in the distance sheet and route it through the slot in the pump front metal panel to the internal connection socket.



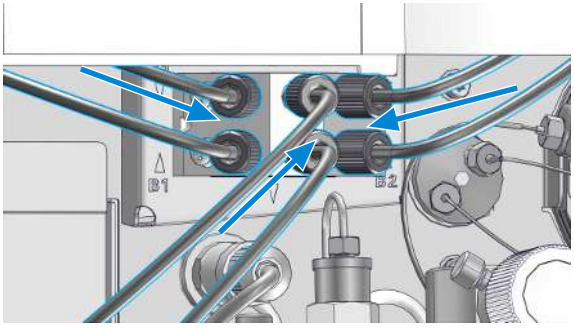

3 Carefully plug in the connector of the solvent selection valve into the internal connection socket on the left side of the slot behind the pump front metal panel.



4 Install the solvent selection assembly by fixing the indicated screws with distance sheet under the SSV body.




5 Connect the outlet of solvent A (upper row) to the top degasser inlet and the outlet of solvent B (lower row) to the bottom degasser inlet. Put the solvent bottles into the solvent cabinet. Connect the bottle heads of solvents A1 and A2 to the inlets in the upper row, see labels on valve assembly. Connect the bottle heads of solvents B1 and B2 to the inlets in the lower row, see labels on valve assembly.




**NOTE** Block unused channels of the SSV using a plug (5041-8365 (Blank plug) ) to avoid leaks or air entering the solvent channels.

**NOTE** Before using of the system with a new installed valve it may be required to pump several mL of solvent to get the flow stabilized at a pressure ripple as low as it used to be when the system was still working properly.

# Exchange the Solvent Selection Valve

**When**

- If leaking internally (crossflow between the ports), or if one of the channels is blocked

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | 8710-0899 | Screwdriver Pozidrive Shaft |

**Parts required**

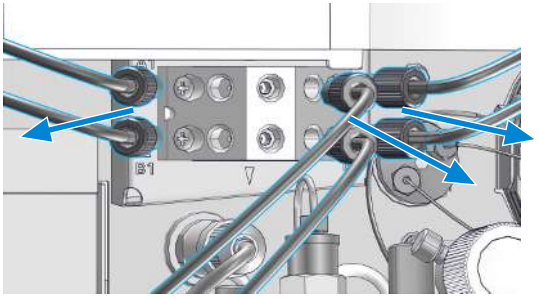
| Qty. | p/n | Description |
|---|---|---|
| 1 | 5067-5895 | Solvent selection valve |

**Preparations**

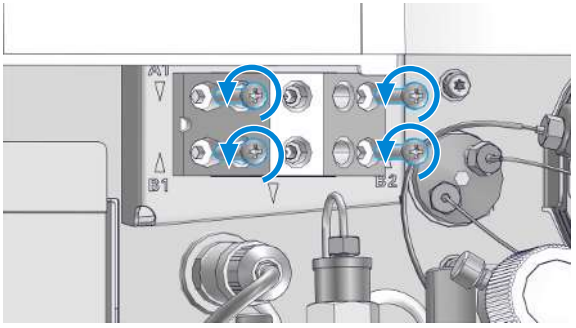
- Switch off the pump at the main power switch

1 Lift solvent bottles out of the solvent cabinet and place them on the table. Disconnect the solvent tubes from the solvent selection valve and empty the tubes into the bottles. Place the bottles back into the solvent cabinet.

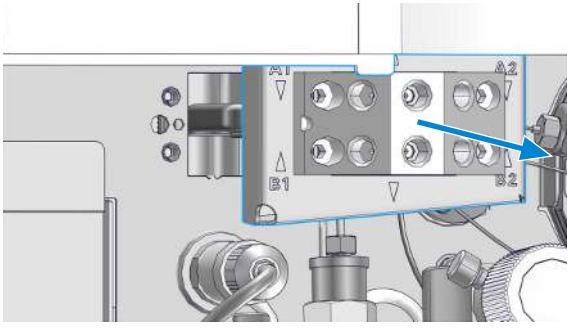
2 Disconnect all tubings from the solvent selection valve.



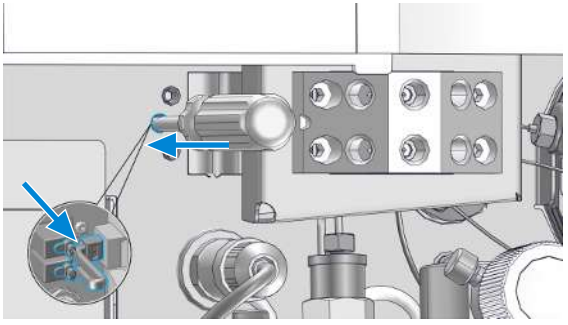
3 Using a screwdriver, loosen the holding screws of the valve holder.




4 Carefully pull the valve holder out.

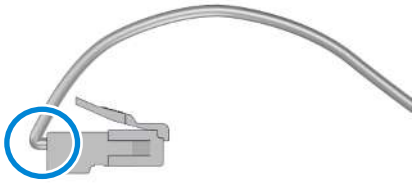



5 Disconnect the valve cable from the internal connection socket by pressing the fixing clip through the left side middle hole with the screwdriver.

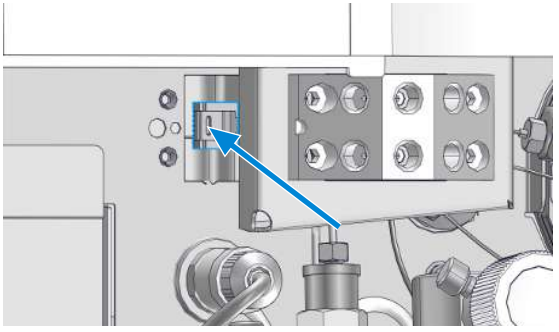


6 Completely remove the old valve.

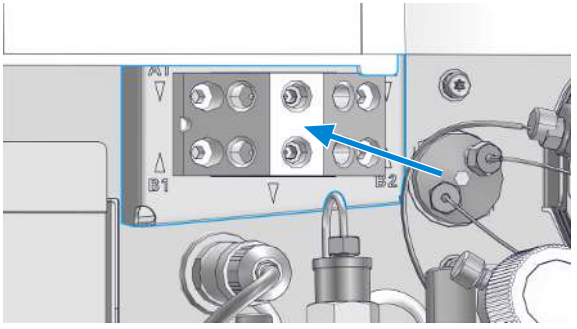
7 Bend the cable at the connector of the new valve.



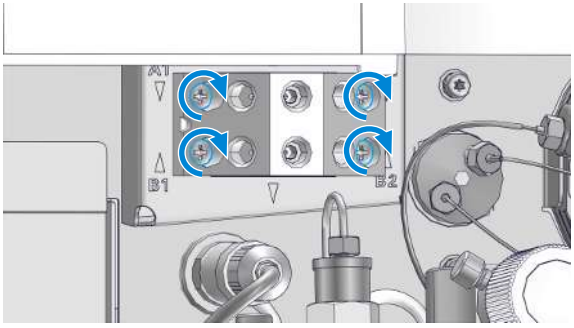
8 Guide the cable and connector into the hole and push the connector into the socket.



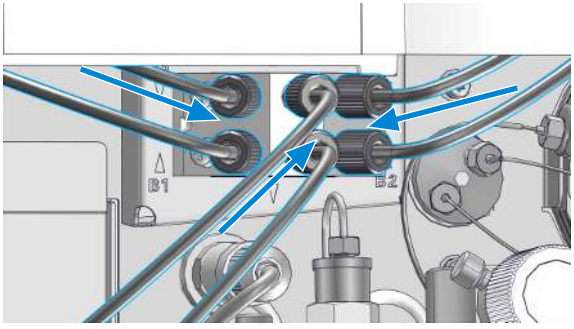
9 Exchange the defective solvent selection valve.



**10** Tighten the screws of the valve holder.




**11** Reconnect all tubings to the solvent selection valve.




**NOTE** After an exchange of the valve it may be required to pump several mL of solvent before the flow stabilizes at a pressure ripple as low as it used to be when the system was still working properly.

# System Pressure Test

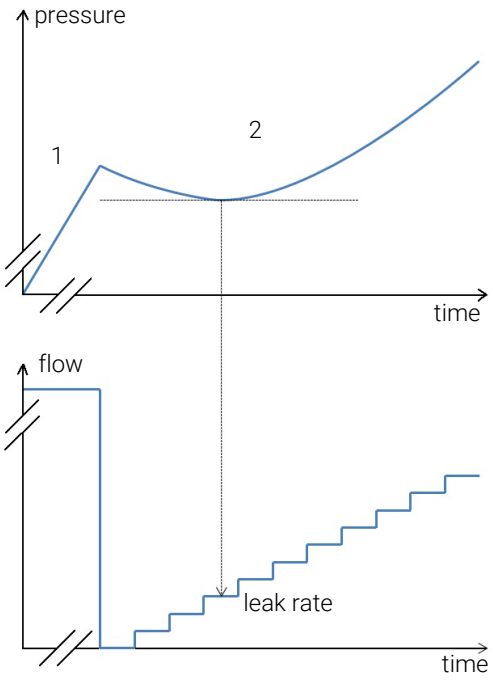
## Introduction

The System Pressure Test is used for checking the tightness of the LC system and identifying leaks between the pump and a position in the flow path following the pump blocked by a blank nut.

## Test Principle

A solvent can be chosen from available solvent channels and a maximum pressure can be defined at which the test will be run. In contrast to older revisions of this test, any solvent can be used.

Before the test, the pump and system are flushed with solvent in order to remove air bubbles, as air bubbles are compressed during the test and therefore would appear as leaks. Using a degasser is highly recommended. Then the flow path is blocked by a blank nut at any position between the purge valve and the column outlet.




In the first phase of the test, the pump delivers flow at a rate of 200 µL/min until a pressure of 50 bar below the defined maximum pressure is reached. In the second phase, the pump delivers a small flow which is increased stepwise. If there is a leak in the system, the pressure will drop initially, as the low flow cannot compensate the leak flow. As soon as the pump flow rate exceeds the leak flow rate, the pressure will increase again and the test is stopped at about 20 bar below the maximum pressure. The point in phase 2, where the lowest pressure is reached and stays constant for a short time corresponds to the leak rate, that is provided as a test result. A leak rate smaller than 3 µL/min is good enough for operating the pump reliably.

# Leak Rate Test

## Introduction

The Leak Rate Test is used for verifying the internal tightness of the pump and helps identifying parts which may have caused a leak.

## System requirements

Minimum software revisions:

- Lab Advisor B.02.08

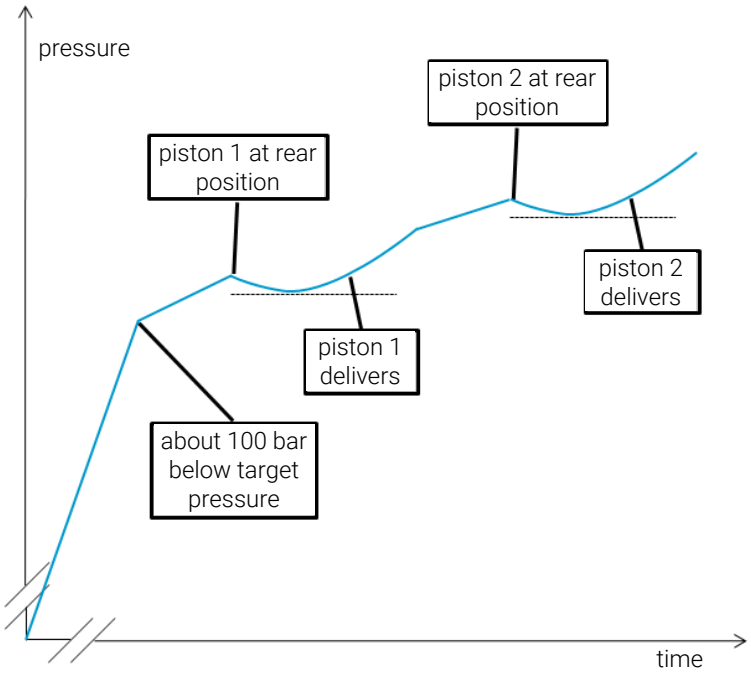
Minimum firmware revisions:

- D.07.01

## Test Principle

A solvent can be chosen from available solvent channels and a maximum target pressure can be defined at which the test will be run. Typically, this is the maximum pressure specified for the pump. The test can be run with any solvent compatible to the pump.

Before the test, the pump is flushed with solvent in order to remove air bubbles, as air bubbles are compressed during the test and therefore would appear as leaks. Using a degasser is highly recommended.




Initially, the pressure is increased to about 100 bar below the target pressure, which has been set for the test.

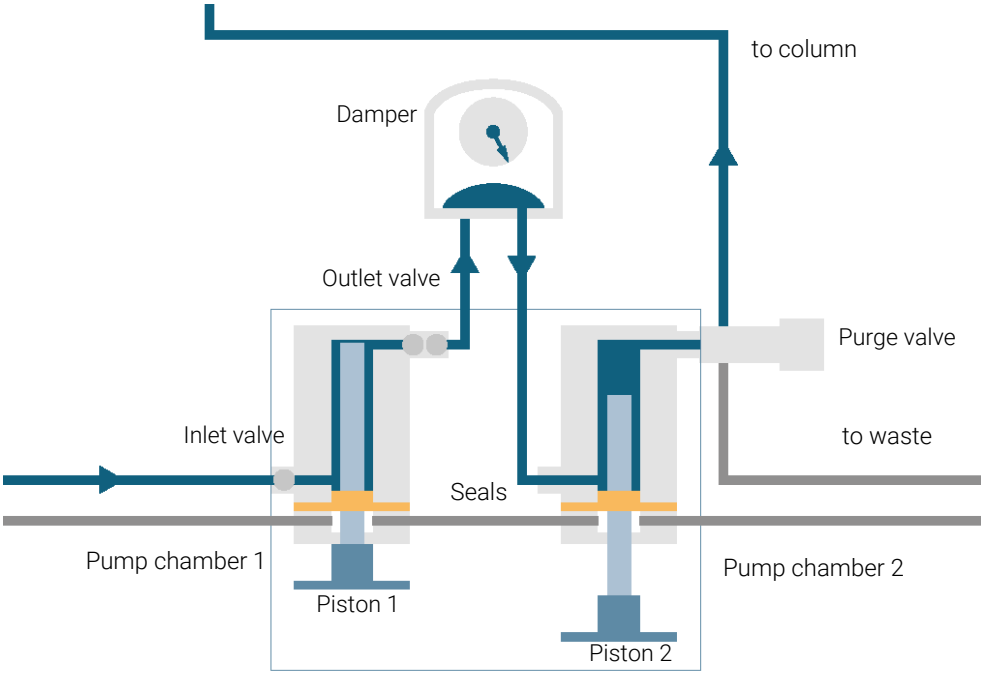
Then piston 1 is brought to its rear position. An increasing flow is delivered by piston 1. In case of a leak, the pressure will drop initially as long as the flow rate delivered by the piston is lower than the leak rate. As soon as the flow rate of the piston exceeds the leak rate, the measured pressure will increase again. Therefore the minimum pressure of that curve segment corresponds to the flow and leak rate at that time and the leak rate is measured. Compare to the description of the system pressure test (System Pressure Test on page 188).

Subsequently, piston 2 is moved to its rear position, then piston 2 delivers and the measurement is done as described for piston 1.

For a binary pump (G1312B/C, G7112B, K1312B, G4782A), the test is run for both pump heads for channels A and B.

## Evaluating the Results

Results of the leak rate test are the leak rates measured for pistons 1 and 2 as described for the test principle. If any of the leak rates exceeds 3 µL/min, the test will fail.



# Replace the Module Firmware

**When**

Install a newer firmware

- It fixes known problems of older versions, or
- It introduces new features, or
- It ensures keeping all systems at the same (validated) revision

**When**

Install an older firmware

- It ensures keeping all systems at the same (validated) revision, or
- It ensures compatibility after adding a new module to the system, or
- A third-party control software requires a special version

**Software required**

- Agilent Lab Advisor software

**Tools required**

| Qty. | p/n | Description |
|---|---|---|
| 1 | | Firmware, tools and documentation from Agilent web site |

**Preparations**

- Read update documentation provided with the Firmware Update Tool.

To upgrade/downgrade the module's firmware carry out the following steps:

1 Download the required module firmware, the latest FW Update Tool and the documentation from the Agilent web.
https://www.agilent.com/en-us/firmwareDownload?whid=69761

2 For loading the firmware into the module follow the instructions in the documentation.

### Module Specific Information

There is no specific information for this module.

# 9 Parts and Materials for Maintenance

This chapter provides information on parts for maintenance.

# Accessory Kit G7111-68755

The G7111-68755 (Accessory Kit) contains the following items:

| Qty. | p/n | Description |
|---|---|---|
| 2 | 5043-1013 | Tubing Clip |
| 1 | 5181-1519 | CAN cable, Agilent module to module, 1 m |
| 1 | 5500-1246 | Capillary ST 0.17 mm x 500 mm SI/SI |
| 1 | 5500-1217 | Capillary, ST, 0.17 mm x 900 mm SI/SX |
| 3 | 5063-6527 | Tubing, Silicon Rubber, 1.2 m, ID/OD 6 mm/9 mm |
| 1 | G1311-90107 | Algae note |
| 3 | 5500-1169 | Tubing connector, Y-shaped, ID 6.4 mm |
| 3 | 5500-1155 | Tube Connector, 90 degree, ID 6.4 |
| 1 | 5043-1372 | Tubing Connector Leak 3-1 |
| 2 | 5043-1373 | Tubing Connector Leak Cap |
| 2 | 0890-1195 | Flexible sleeving 1.45 mm/2.5 mm, PTFE |

# Pump Head Assembly Without Seal Wash Option

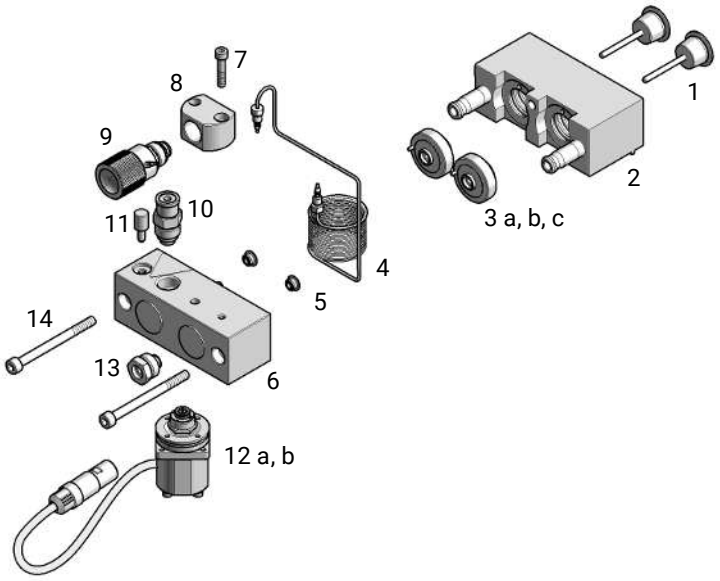



**Figure 13:** Pump head assembly without seal wash option

The Pump Head 1200 SL without Seal Wash contains:

| # | p/n | Description |
|---|---|---|
| 1 | 5063-6586 | Sapphire piston, 100 µL |
| 2 | G1311-60002 | Piston housing |
| 3 a | 5067-1560 | Support Ring SL, no seal wash<br>(shown as one piece with 3b and 3c) |
| 3 b | 5062-2484 | Gasket, seal wash (pack of 6) |
| 3 c | 5042-8952 | Seal holder<br>Ceramic |
| 4 | G1312-87300 | Absorber capillary |
| 5 | 5063-6589 | PTFE seal (pack of 2), **OR** |

| # | p/n | Description |
|---|---|---|
| 5 | 0905-1420 | PE seal (pack of 2) |
| 6 | G1311-25200 | Pump chamber housing |
| 7 | 0515-0175 | Mounting screw for manual purge valve holder, M4, 20 mm long |
| 8 | G1312-23200 | Holder for manual purge valve |
| 9 | G7111-60061 | Purge valve |
| 10 | G1312-60067 | Outlet valve (standard), **OR** |
| 10 | G1312-60167 | Outlet Valve Type N/SFC |
| 11 | 5042-1303 | Lock screw |
| 12 a | G1312-60025 | Active inlet valve without cartridge |
| 12 b | G1312-60020 | Cartridge for active inlet valve 600 bar |
| 13 | G1312-23201 | Adapter |
| 14 | 0515-2118 | Screw, ST, M5 x 0.8 , 60 mm, Hex 4 mm |

For piston seals, see Choosing the Right Pump Seals on page 70.

# Pump Head Assembly Without Seal Wash Option (Infinity III Support Ring Design)

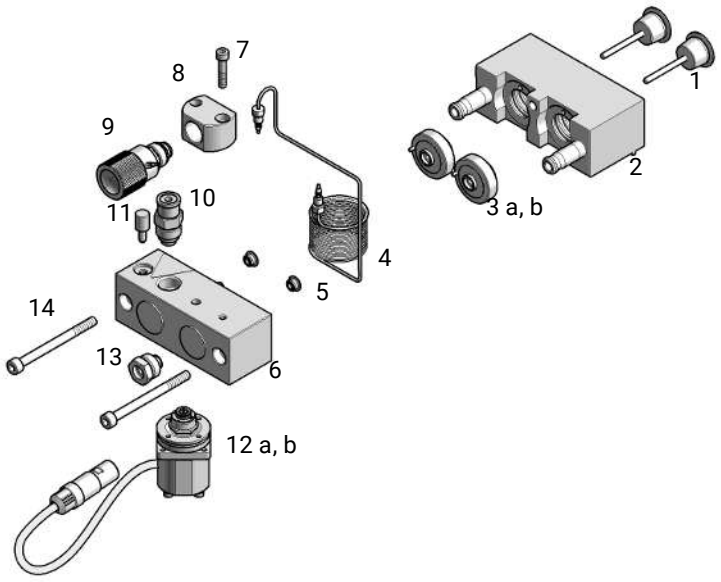



**Figure 14:** Pump head assembly without seal wash option

The G1312-60056 (Pump Head 1200 SL without Seal Wash FF) contains:

| # | p/n | Description |
|---|---|---|
| 1 | 5063-6586 | Sapphire piston, 100 µL |
| 2 | G1311-60002 | Piston housing |
| 3 a | G1312-60013 | Support Ring without Seal Wash Function |
| 3 b | G4220-24134 | Backup Seal |
| 4 | G1312-87300 | Absorber capillary |
| 5 | 5063-6589 | PTFE seal (pack of 2), **OR** |
| 5 | 0905-1420 | PE seal (pack of 2) |

| # | p/n | Description |
|---|---|---|
| 6 | G1311-25200 | Pump chamber housing |
| 7 | 0515-0175 | Mounting screw for manual purge valve holder, M4, 20 mm long |
| 8 | G1312-23200 | Holder for manual purge valve |
| 9 | G7111-60061 | Purge valve |
| 10 | G1312-60067 | Outlet valve (standard), **OR** |
| 10 | G1312-60167 | Outlet Valve Type N/SFC |
| 11 | 5042-1303 | Lock screw |
| 12 a | G1312-60025 | Active inlet valve without cartridge |
| 12 b | G1312-60020 | Cartridge for active inlet valve 600 bar |
| 13 | G1312-23201 | Adapter |
| 14 | 0515-2118 | Screw, ST, M5 x 0.8 , 60 mm, Hex 4 mm |

The G1312-60056 (Pump Head 1200 SL without Seal Wash FF) includes items 1-6, 11 and 14.

For piston seals, see Choosing the Right Pump Seals on page 70.

# Pump Head Assembly with Seal Wash Option

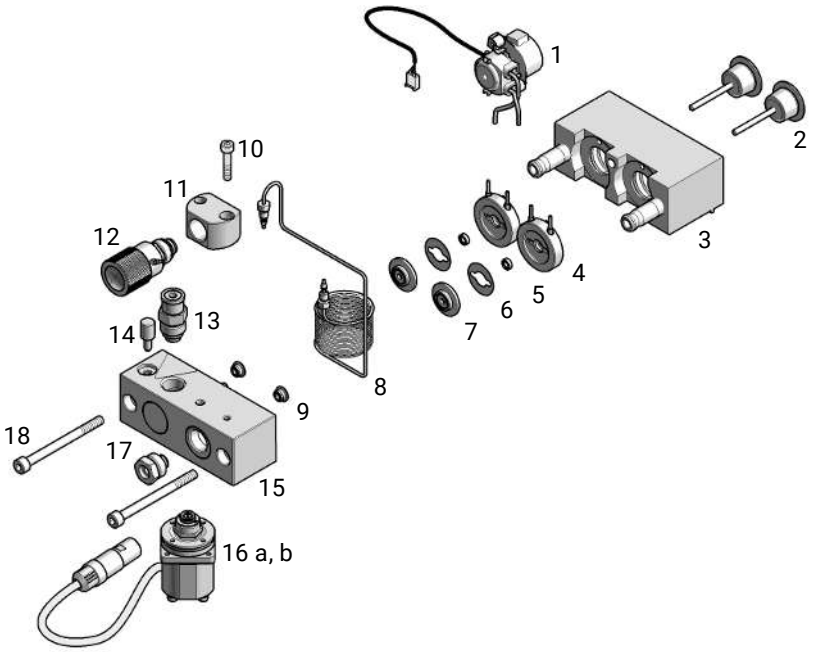



**Figure 15:** Pump head assembly with seal wash option

The Pump Head Assembly with Seal Wash contains:

| # | p/n | Description |
|---|---|---|
| 1 | 5065-9953 | Seal wash pump assembly includes 5042-8507 Peristaltic pump (silicone tubing) |
| | 5067-5744 | Infinity II & III Cabinet Kit 180 |
| | 5065-9978 | Silicone tubing, 1 mm i.d., 3 mm o.d., 5 m, re-order number for seal wash option |
| 2 | 5063-6586 | Sapphire piston, 100 µL |
| 3 | G1311-60002 | Piston housing |
| 4 | 01018-60027 | Support ring seal wash |
| 5 | 0905-1175 | Wash seal (PTFE), **OR** |

| # | p/n | Description |
|---|---|---|
| 5 | 0905-1718 | Wash Seal PE |
| 6 | 5062-2484 | Gasket, seal wash (pack of 6) |
| 7 | 5042-8952 | Seal holder |
| 8 | G1312-87300 | Absorber capillary |
| 9 | 5063-6589 | PTFE seal (pack of 2), **OR** |
| 9 | 0905-1420 | PE seal (pack of 2) |
| 10 | 0515-0175 | Mounting screw for manual purge valve holder, M4, 20 mm long |
| 11 | G1312-23200 | Holder for manual purge valve |
| 12 | G7111-60061 | Purge valve |
| 13 | G1312-60067 | Outlet valve (standard), **OR** |
| 13 | G1312-60167 | Outlet Valve Type N/SFC |
| 14 | 5042-1303 | Lock screw |
| 15 | G1311-25200 | Pump chamber housing |
| 16 a | G1312-60025 | Active inlet valve without cartridge |
| 16 b | G1312-60020 | Cartridge for active inlet valve 600 bar |
| 17 | G1312-23201 | Adapter |
| 18 | 0515-2118 | Screw, ST, M5 x 0.8 , 60 mm, Hex 4 mm |

For piston seals, see Choosing the Right Pump Seals on page 70.

# Pump Head Assembly with Seal Wash Option (Infinity III Support Ring Design)

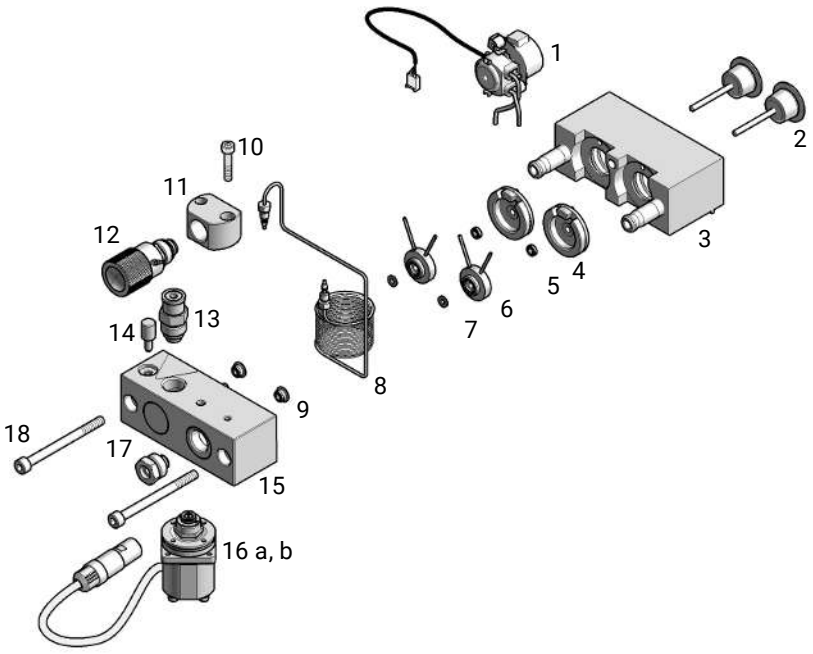



**Figure 16:** Pump head assembly with seal wash option

The G1312-60045 (Pump Head Assembly with Seal Wash FF) contains:

| # | p/n | Description |
|---|---|---|
| 1 | 5065-9953 | Seal wash pump assembly includes 5042-8507 Peristaltic pump (silicone tubing) |
| | 5067-5744 | Infinity II & III Cabinet Kit 180 |
| | 5065-9978 | Silicone tubing, 1 mm i.d., 3 mm o.d., 5 m, re-order number for seal wash option |
| 2 | 5063-6586 | Sapphire piston, 100 µL |
| 3 | G1311-60002 | Piston housing |
| 4 | G1312-60006 | Support Ring with Seal Wash Function |

| # | p/n | Description |
|---|---|---|
| 5 | 0905-1175 | Wash seal (PTFE), **OR** |
| 5 | 0905-1718 | Wash Seal PE |
| 6 | G1312-60009 | Seal Holder |
| 7 | G4220-24134 | Backup Seal |
| 8 | G1312-87300 | Absorber capillary |
| 9 | 5063-6589 | PTFE seal (pack of 2), **OR** |
| 9 | 0905-1420 | PE seal (pack of 2) |
| 10 | 0515-0175 | Mounting screw for manual purge valve holder, M4, 20 mm long |
| 11 | G1312-23200 | Holder for manual purge valve |
| 12 | G7111-60061 | Purge valve |
| 13 | G1312-60067 | Outlet valve (standard), **OR** |
| 13 | G1312-60167 | Outlet Valve Type N/SFC |
| 14 | 5042-1303 | Lock screw |
| 15 | G1311-25200 | Pump chamber housing |
| 16 a | G1312-60025 | Active inlet valve without cartridge |
| 16 b | G1312-60020 | Cartridge for active inlet valve 600 bar |
| 17 | G1312-23201 | Adapter |
| 18 | 0515-2118 | Screw, ST, M5 x 0.8 , 60 mm, Hex 4 mm |

The G1312-60045 (Pump Head Assembly with Seal Wash FF) includes items 1-9, 14 and 18.

For piston seals, see Choosing the Right Pump Seals on page 70.

# Outlet Valve

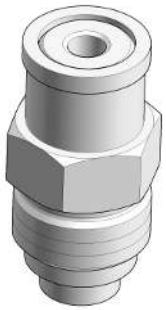
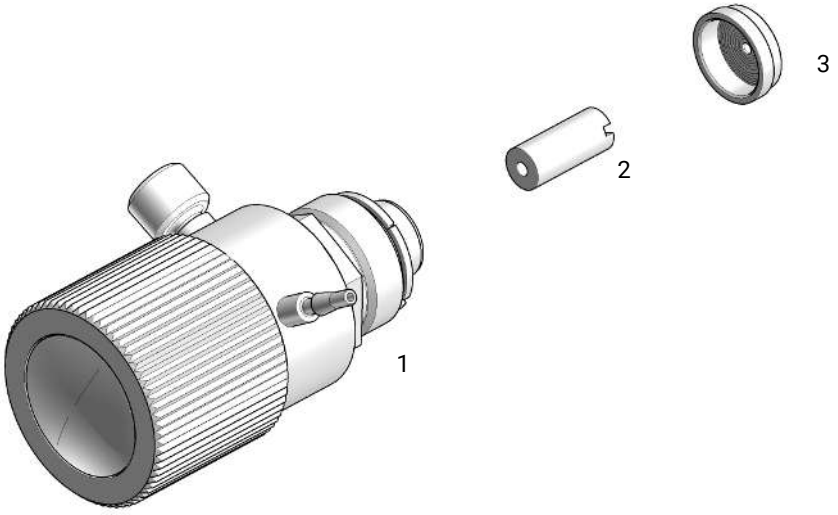


**Figure 17:** Outlet valve

| p/n | Description |
|---|---|
| G1312-60067 | Outlet valve (standard), **OR** |
| G1312-60167 | Outlet Valve Type N/SFC |

# Purge Valve Assembly




| # | p/n | Description |
|---|---|---|
| 1 | G7111-60061 | Purge valve |
| 2 | 01018-22707 | PTFE Frit (5/Pk) |
| 3 | 5067-4728 | Seal cap assembly |
| | 5067-6595 | 1260 PV O-ring FKM 5/pack |

# Active Inlet Valve Assembly

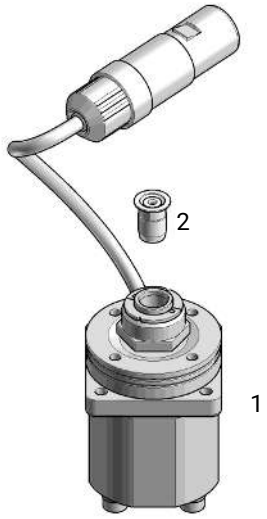



**Figure 18:** Active Inlet Valve Assembly

| # | p/n | Description |
|---|---|---|
| 1 | G1312-60025 | Active inlet valve without cartridge |
| 2 | G1312-60020 | Cartridge for active inlet valve 600 bar |

# Active Seal Wash Option

The G1399B (Active Seal Wash Option kit) contains the following parts:

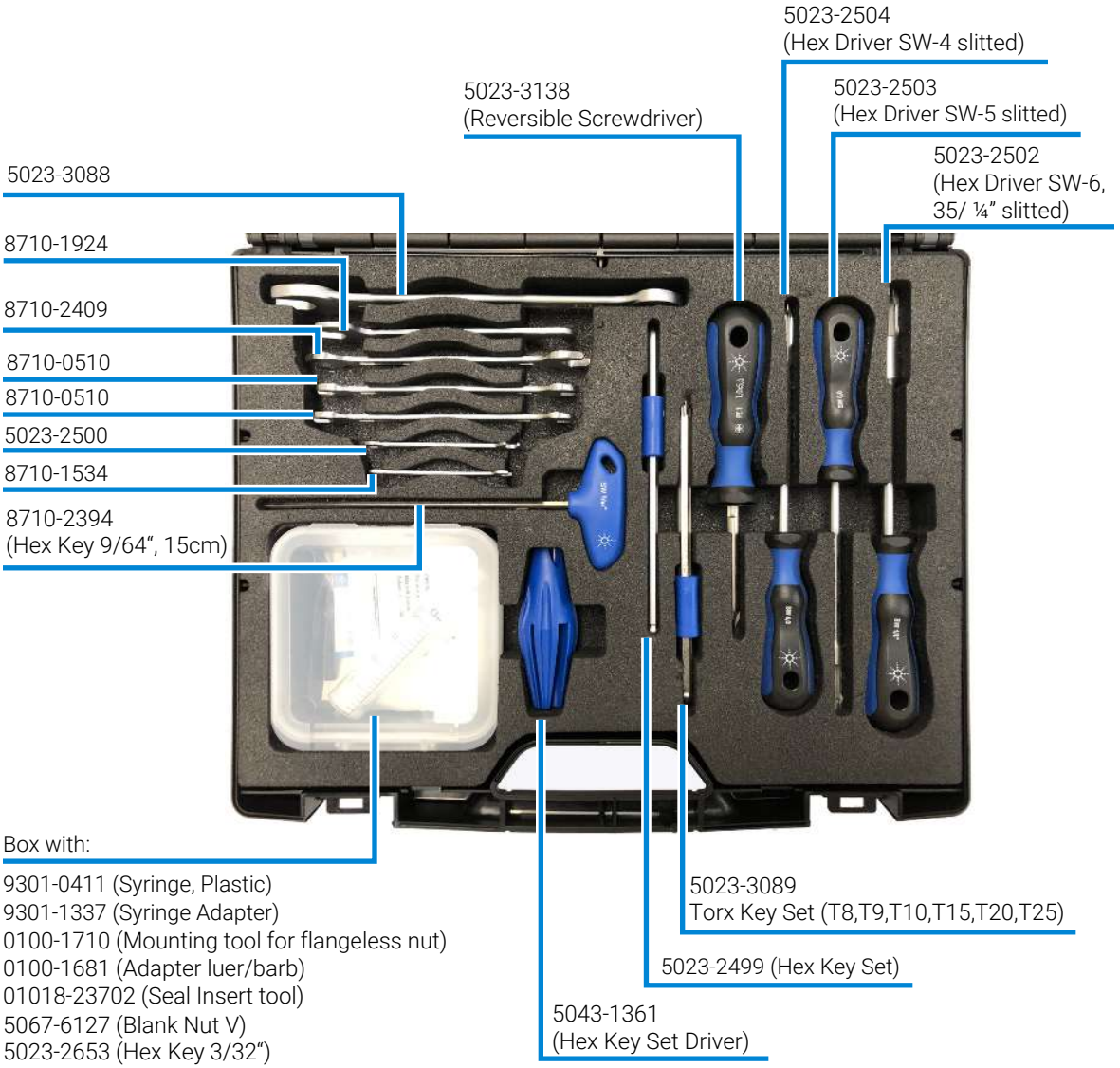
| Qty. | p/n | Description |
|---|---|---|
| 1 | 5062-2484 | Gasket, seal wash (pack of 6) |
| 1 | 01018-23702 | Insert tool |
| 4 | 01018-60027 | Support ring seal wash |
| 2 | 0515-1508 | Screws for Seal Wash Pump Motor |
| 1 | 5065-9978 | Silicone tubing, 1 mm i.d., 3 mm o.d., 5 m, re-order number |
| 4 | 0905-1175 | Wash seal (PTFE) |
| 1 | 5063-6589 | PTFE seal (pack of 2) |
| 1 | 1460-2763 | Compression Spring ST |
| 2 | 1520-0260 | Shock mount |
| 1 | 1540-0455 | Edge protector |
| 1 | 5041-2120 | Folding box |
| 1 | 5065-4445 | Peristaltic pump cartridge |
| 1 | 5042-6422 | Seal wash Pump Fittings x2 |
| 1 | 5065-9943 | Stepper Motor for the Peristaltic Pump |
| 1 | G3010-01203 | RFI Strip 10×30 |

# 1260 Infinity II Max Uptime Kit

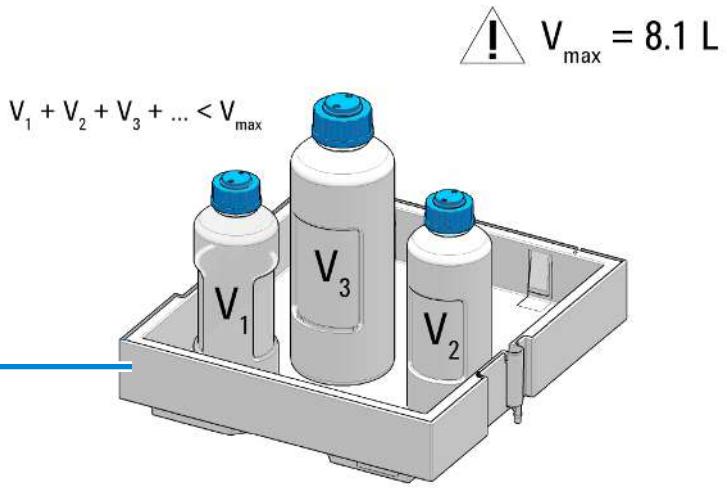
This kit will be sold optionally with the pump and is not essential for operation. You can reorder the individual parts.

| Qty. | p/n | Description |
|---|---|---|
| 1 | 01018-22707 | PTFE Frit (5/Pk) |
| 1 | 0890-1763 | Capillary PEEK 0.18 mm x 1.5 m |
| 3 | 5022-2184 | Union, stand LC flow, no fitting |
| 2 | 5041-2168 | Glass filter, solvent inlet, 20 µm |
| 1 | 5065-4426 | Colored finger-tight PEEK fittings, 10/PK |
| 3 | 5500-1193 | InfinityLab Quick Turn Capillary ST 0.17 mm x 105 mm, long socket<br>Quick Turn |
| 1 | 5500-1217 | Capillary, ST, 0.17 mm x 900 mm SI/SX |
| 2 | 5500-1246 | Capillary ST 0.17 mm x 500 mm SI/SI |
| 2 | 5500-1250 | Capillary, ST, 0.17 mm x 120 mm SL/SL, long socket |
| 1 | 8710-1930 | Plastic and PEEK tubing cutter |
| 1 | 8710-2391 | Rheotool socket wrench ¼ inch |
| 1 | 5500-1191 | InfinityLab Quick Turn Capillary ST 0.12 mm x 280 mm, long socket |
| 6 | G7167-68703 | Fitting Intermediate Kit |
| 1 | G7111-90120 | Technical Note 1260 Infinity II & III Max Uptime Kit |

# HPLC System Tool Kit



# Solvent Cabinet




| # | p/n | Description |
|---|---|---|
| 1 | 5067-6871 | Solvent Cabinet Kit |

For details refer to: 01200-90150 (Usage Guideline for the Solvent Cabinet)

# Bottle Head Assembly

The G7120-60007 (Bottle Head Assembly) contains:

| p/n | Description |
|---|---|
| 5063-6598 | Tefzel ferrules and SSL lock rings, 1/8 inch, 10/pck |
| 5063-6599 | PPS nuts, 1/8 inch, 1/4-28 thread, 10/pck |
| | Wire marker |
| 5062-2483 | Solvent tubing, 3.1 mm OD, 5 m |
| 5062-8517 | Inlet filter adapter (4/Pk) |
| 5041-2168 | Glass filter, solvent inlet, 20 µm |

# Hydraulic Path with Solvent Selection Valve

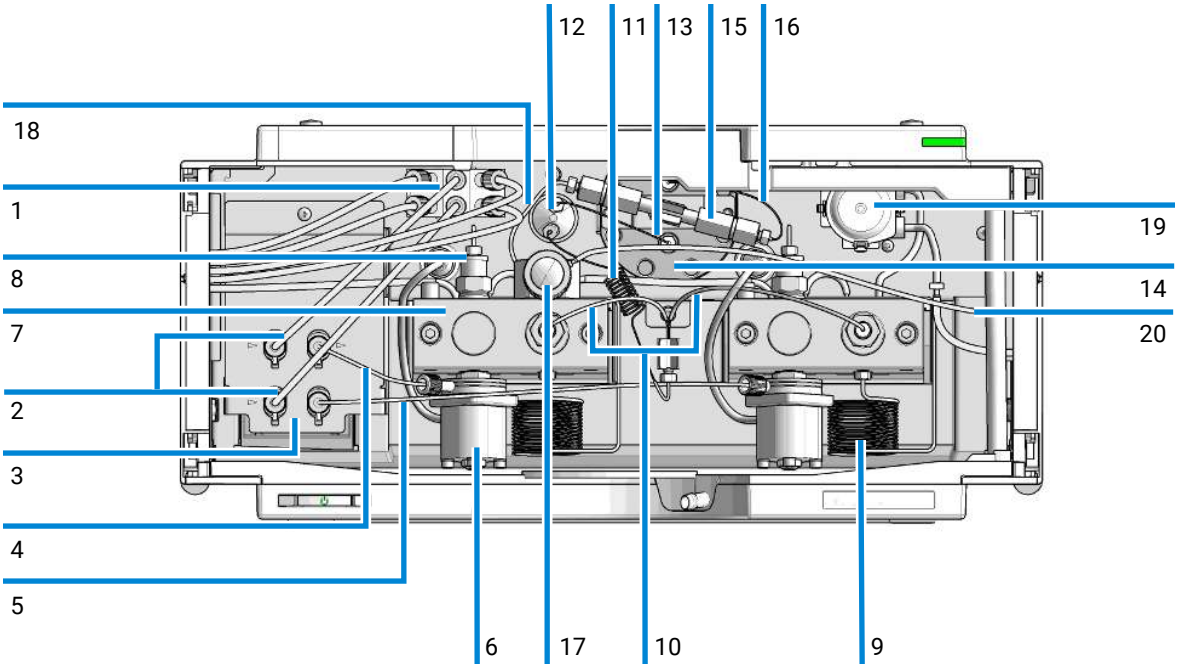



**Figure 19:** Hydraulic Path with Solvent Selection Valve

| # | Qty. | p/n | Description |
|---|---|---|---|
| 1 | 1 | 5067-5895 | Solvent selection valve |
| | 1 | 5041-8365 | Blank plug<br>for unused SSV channels |
| 2 | 2 | G7111-60100 | Solvent Tubes including labels<br>Solvent selection valve to degasser |
| 3 | 1 | G7112-60070 | Degasser Unit 2 Channels |
| 4 | 1 | G1311-67304 | Connecting tube<br>Degasser to Channel A |
| 5 | 1 | G7112-67300 | Connecting Tube<br>Degasser to Channel B |
| 6 | 1 | G1312-60025 | Active inlet valve without cartridge |

| # | Qty. | p/n | Description |
|---|---|---|---|
| 7 | 1 | G1312-60045 | Pump Head Assembly with Seal Wash FF |
| 8 | 1 | G1312-60067 | Outlet valve (standard), **OR** |
| 8 | 1 | G1312-60167 | Outlet Valve Type N/SFC |
| 9 | 1 | G1312-87300 | Absorber capillary |
| 10 | 1 | G1312-67302 | Capillary, channel A and B pump head outlet to mixing chamber (included) |
| 11 | 1 | G1312-87301 | Restriction capillary (mixing capillary to pressure sensor) |
| 12 | 1 | 5067-1527 | Pressure sensor |
| 13 | 1 | G1312-87305 | Capillary SSL, 0.17 x 150 mm (pressure sensor to damper) |
| 14 | 1 | G1312-60031 | Damper |
| 15 | 1 | G1312-87330 | Mixer (capillary pump only) |
| 16 | 1 | G1312-87306 | Capillary SSL, 0.17 x 105 mm (connections to solvent mixer) |
| | 1 | G1312-04100 | Bracket for solvent mixer |
| 17 | 1 | G7111-60061 | Purge valve |
| 18 | 1 | 5500-1246 | Capillary ST 0.17 mm x 500 mm SI/SI |
| | 1 | 5500-1217 | Capillary, ST, 0.17 mm x 900 mm SI/SX |
| 19 | 1 | 5064-5444 | Peristaltic pump cartridge, silicone tubing |
| | 1 | 5065-9978 | Silicone tubing, 1 mm i.d., 3 mm o.d., 5 m, re-order number for seal wash option |
| 20 | 1 | 5062-2461 | Waste tube, 5 m (reorder pack) |

# Hydraulic Path Without Solvent Selection Valve

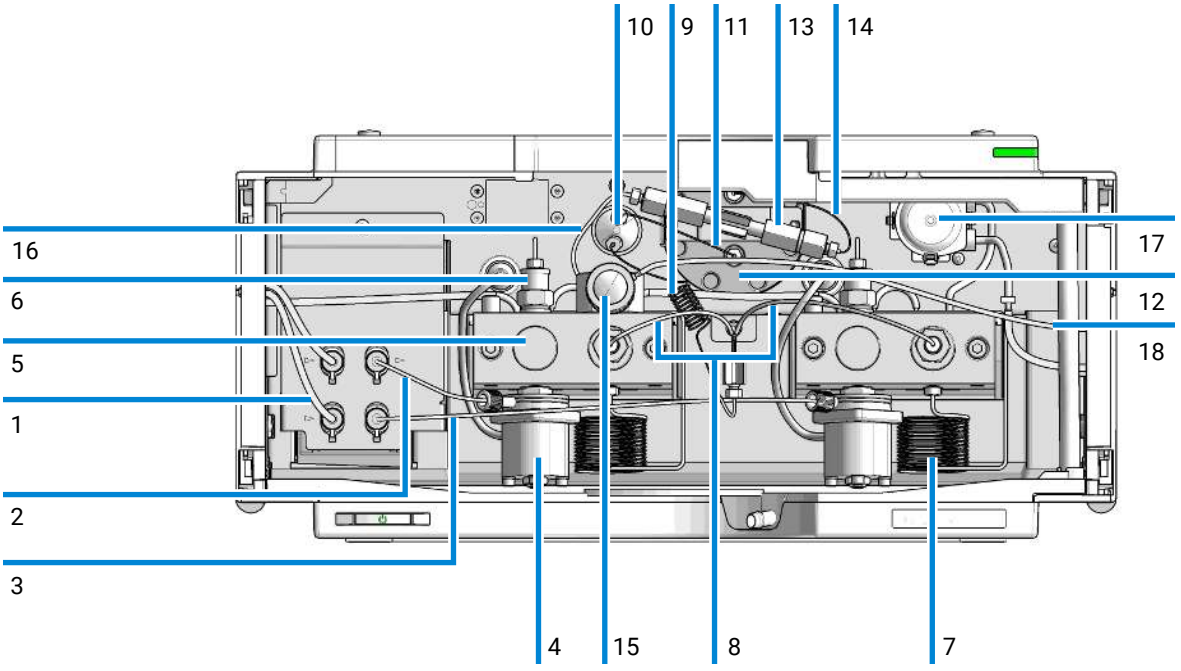



**Figure 20:** Hydraulic Path without Solvent Selection Valve, with Active Seal Wash

| # | p/n | Description |
|---|---|---|
| 1 | G7112-60070 | Degasser Unit 2 Channels |
| 2 | G1311-67304 | Connecting tube<br>Degasser to Channel A |
| 3 | G7112-67300 | Connecting Tube<br>Degasser to Channel B |
| 4 | G1312-60025 | Active inlet valve without cartridge |
| 5 | G1312-60056 | Pump Head 1200 SL without Seal Wash FF |
| 6 | G1312-60067 | Outlet valve<br>(standard), **OR** |
| 6 | G1312-60167 | Outlet Valve Type N/SFC |

| # | p/n | Description |
|---|---|---|
| 7 | G1312-87300 | Absorber capillary |
| 8 | G1312-67302 | Capillary, channel A and B pump head outlet to mixing chamber (included) |
| 9 | G1312-87301 | Restriction capillary (mixing capillary to pressure sensor) |
| 10 | 5067-1527 | Pressure sensor |
| 11 | G1312-87305 | Capillary SSL, 0.17 x 150 mm (pressure sensor to damper) |
| 12 | G1312-60031 | Damper |
| 13 | G1312-87330 | Mixer (capillary pump only) |
| 14 | G1312-87306 | Capillary SSL, 0.17 x 105 mm (connections to solvent mixer) |
| | G1312-04100 | Bracket for solvent mixer |
| 15 | G7111-60061 | Purge valve |
| 16 | 5500-1246 | Capillary ST 0.17 mm x 500 mm SI/SI |
| | 5500-1217 | Capillary, ST, 0.17 mm x 900 mm SI/SX |
| 17 | 5065-4445 | Peristaltic pump cartridge |
| 18 | 5062-2461 | Waste tube, 5 m (reorder pack) |
| | 5065-9978 | Silicone tubing, 1 mm i.d., 3 mm o.d., 5 m, re-order number for seal wash option |

# Cover Parts

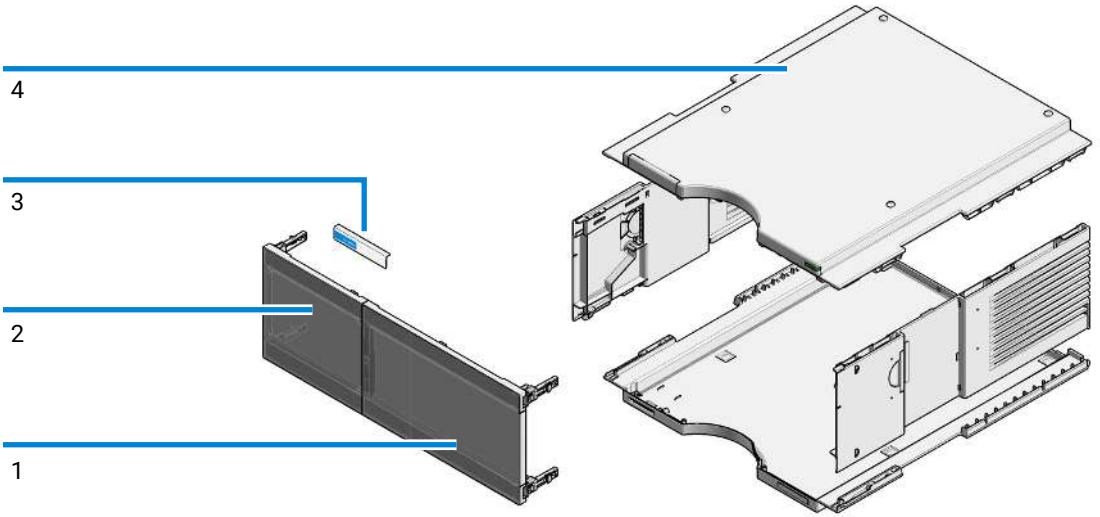



**Figure 21:** Cover Parts

| # | p/n | Description |
|---|---|---|
| 1 | 5360-0018 | Door 180mm right Infinity III |
| 2 | 5360-0017 | Door 180mm left Infinity III |
| 3 | 5431-0117 | Name Plate Infinity III 1260 |
| 4 | G7104-68713 | Infinity II & III Cabinet Kit 180<br>(includes sides, bottom, top, leak adapter top and status indicator insert) |

# 10 Identifying Cables

This chapter provides information on cables used with the modules.

# Cable Overview

**NOTE** Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.

### Analog cables

| p/n | Description |
|---|---|
| 35900-60750 | Agilent 35900A A/D converter |
| 01046-60105 | Analog cable (BNC to general purpose, spade lugs) |

### Remote cables

| p/n | Description |
|---|---|
| 5188-8029 | ERI<br>to general purpose |
| 5188-8044 | Remote Cable ERI – ERI |
| 5188-8045 | Remote Cable APG – ERI |
| 5188-8059 | ERI-Extension-Cable 1.2 m |
| 5061-3378 | Remote Cable<br>to 35900 A/D converter |
| 01046-60201 | Agilent module to general purpose |
| 5188-8057 | Fraction Collection ERI remote Y-cable |

### CAN cables

| p/n | Description |
|---|---|
| 5181-1516 | CAN cable, Agilent module to module, 0.5 m |
| 5181-1519 | CAN cable, Agilent module to module, 1 m |

### LAN cables

| p/n | Description |
|---|---|
| 5023-0203 | Cross-over network cable, shielded, 3 m<br>(for point to point connection) |
| 5023-0202 | Twisted pair network cable, shielded, 7 m<br>(for point to point connection) |

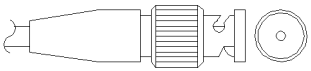
### RS-232 cables

| p/n | Description |
|---|---|
| RS232-61601 | RS-232 cable, 2.5 m<br>Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It is also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9. |
| 5181-1561 | RS-232 cable, 8 m |

### USB cables

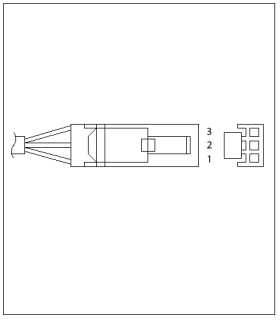
| p/n | Description |
|---|---|
| 5188-8050 | USB A M-USB Mini B 3 m (PC-Module) |
| 5188-8049 | USB A F-USB Mini B M OTG (Module to Flash Drive) |

# Analog Cables

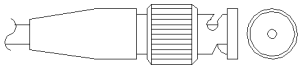


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

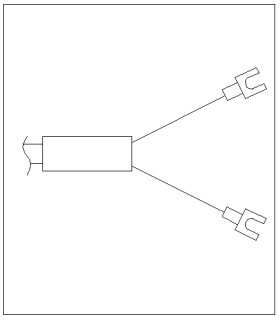
## Agilent Module to 35900 A/D converters

| p/n 35900-60750 | 35900 | Pin Agilent module | Signal Name |
|---|---|---|---|
|  | 1 | | Not connected |
| | 2 | Shield | Analog - |
| | 3 | Center | Analog + |

## Agilent Module to BNC Connector

| p/n 8120-1840 | Pin BNC | Pin Agilent module | Signal Name |
|---|---|---|---|
|  | Shield | Shield | Analog - |
| | Center | Center | Analog + |

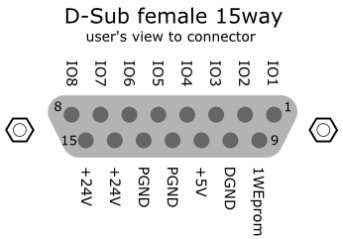
## Agilent Module to General Purpose

| p/n 01046-60105 | Pin | Pin Agilent module | Signal Name |
|---|---|---|---|
|  | 1 | | Not connected |
| | 2 | Black | Analog - |
| | 3 | Red | Analog + |

# Remote Cables

## ERI (Enhanced Remote Interface)

- 5188-8029 ERI to general purpose (D-Sub 15 pin male - open end)
- 5188-8044 ERI to ERI (D_Sub 15 pin male - male)
- 5188-8059 ERI-Extension-Cable 1.2 m (D-Sub15 pin male / female)




| p/n 5188-8029 | pin | Color code | Enhanced Remote | Classic Remote | Active (TTL) |
|---|---|---|---|---|---|
| | 1 | white | IO1 | START REQUEST | Low |
| | 2 | brown | IO2 | STOP | Low |
| | 3 | green | IO3 | READY | High |
| | 4 | yellow | IO4 | PEAK DETECT | Low |
| | 5 | grey | IO5 | POWER ON | High |
| | 6 | pink | IO6 | SHUT DOWN | Low |
| | 7 | blue | IO7 | START | Low |
| | 8 | red | IO8 | PREPARE | Low |
| | 9 | black | 1wire DATA | | |
| | 10 | violet | DGND | | |
| | 11 | grey-pink | +5V ERI out | | |
| | 12 | red-blue | PGND | | |
| | 13 | white-green | PGND | | |
| | 14 | brown-green | +24V ERI out | | |
| | 15 | white-yellow | +24V ERI out | | |
| | NC | yellow-brown | | | |

**NOTE** Configuration is different with old firmware revisions.
The configuration for IO4 and IO5 is swapped for modules with firmware lower than D.07.10.

**NOTE** Peak Detection is used for LCMS systems connected with the Fraction Collection Remote Y-Cable (5188-8057).

- 5188-8045 ERI to APG (Connector D_Subminiature 15 pin (ERI), Connector D_Subminiature 9 pin (APG))

| p/n 5188-8045 | Pin (ERI) | Signal | Pin (APG) | Active (TTL) |
|---|---|---|---|---|
|  | 10 | GND | 1 | |
| | 1 | Start Request | 9 | Low |
| | 2 | Stop | 8 | Low |
| | 3 | Ready | 7 | High |
| | 5 | Power on | 6 | High |
| | 4 | Future | 5 | |
| | 6 | Shut Down | 4 | Low |
| | 7 | Start | 3 | Low |
| | 8 | Prepare | 2 | Low |
| | Ground | Cable Shielding | NC | |

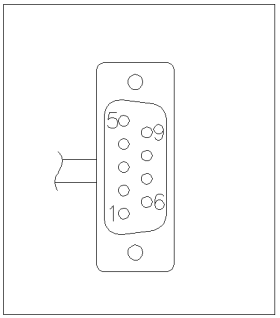
- 5188-8057 ERI to APG and RJ45 (Connector D_Subminiature 15 pin (ERI), Connector D_Subminiature 9 pin (APG), Connector plug Cat5e (RJ45))

**Table 15:** 5188-8057 ERI to APG and RJ45

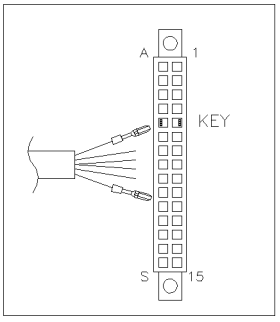
| p/n 5188-8057 | Pin (ERI) | Signal | Pin (APG) | Active (TTL) | Pin (RJ45) |
|---|---|---|---|---|---|
|  | | | | | |
| | 10 | GND | 1 | | 5 |
| | 1 | Start Request | 9 | High | |
| | 2 | Stop | 8 | High | |
| | 3 | Ready | 7 | High | |
| | 4 | Fraction Trigger | 5 | High | 4 |
| | 5 | Power on | 6 | High | |
| | 6 | Shut Down | 4 | High | |
| | 7 | Start | 3 | High | |
| | 8 | Prepare | 2 | High | |
| | Ground | Cable Shielding | NC | | |

One end of these cables provides an Agilent Technologies APG (Analytical Products Group) remote connector to be connected to Agilent modules. The other end depends on the instrument to be connected to.

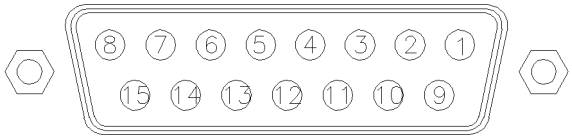
## Agilent Module to Agilent 35900 A/D Converters

| p/n 5061-3378 | Pin 35900 A/D | Pin Agilent module | Signal Name | Active (TTL) |
|---|---|---|---|---|
|  | 1 - White | 1 - White | Digital ground | |
| | 2 - Brown | 2 - Brown | Prepare run | Low |
| | 3 - Gray | 3 - Gray | Start | Low |
| | 4 - Blue | 4 - Blue | Shut down | Low |
| | 5 - Pink | 5 - Pink | Not connected | |
| | 6 - Yellow | 6 - Yellow | Power on | High |
| | 7 - Red | 7 - Red | Ready | High |
| | 8 - Green | 8 - Green | Stop | Low |
| | 9 - Black | 9 - Black | Start request | Low |

## Agilent Module to General Purpose

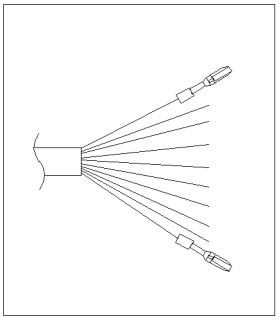
| p/n 01046-60201 | Wire Color | Pin Agilent module | Signal Name | Active (TTL) |
|---|---|---|---|---|
|  | White | 1 | Digital ground | |
| | Brown | 2 | Prepare run | Low |
| | Gray | 3 | Start | Low |
| | Blue | 4 | Shut down | Low |
| | Pink | 5 | Not connected | |
| | Yellow | 6 | Power on | High |
| | Red | 7 | Ready | High |
| | Green | 8 | Stop | Low |
| | Black | 9 | Start request | Low |

# BCD Cables

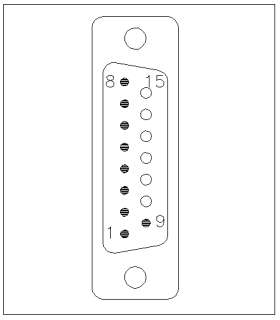



One end of these cables provides a 15-pin BCD connector to be connected to the Agilent modules. The other end depends on the instrument to be connected to

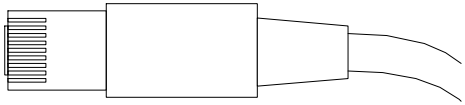
## Agilent Module to General Purpose

| p/n G1351-81600 | Wire Color | Pin Agilent module | Signal Name | BCD Digit |
|---|---|---|---|---|
|  | Green | 1 | BCD 5 | 20 |
| | Violet | 2 | BCD 7 | 80 |
| | Blue | 3 | BCD 6 | 40 |
| | Yellow | 4 | BCD 4 | 10 |
| | Black | 5 | BCD 0 | 1 |
| | Orange | 6 | BCD 3 | 8 |
| | Red | 7 | BCD 2 | 4 |
| | Brown | 8 | BCD 1 | 2 |
| | Gray | 9 | Digital ground | Gray |
| | Gray/pink | 10 | BCD 11 | 800 |
| | Red/blue | 11 | BCD 10 | 400 |
| | White/green | 12 | BCD 9 | 200 |
| | Brown/green | 13 | BCD 8 | 100 |
| | not connected | 14 | | |
| | not connected | 15 | + 5 V | Low |

## Agilent Module to 3396 Integrators

| p/n 03396-60560 | Pin 3396 | Pin Agilent module | Signal Name | BCD Digit |
|---|---|---|---|---|
|  | 1 | 1 | BCD 5 | 20 |
| | 2 | 2 | BCD 7 | 80 |
| | 3 | 3 | BCD 6 | 40 |
| | 4 | 4 | BCD 4 | 10 |
| | 5 | 5 | BCD0 | 1 |
| | 6 | 6 | BCD 3 | 8 |
| | 7 | 7 | BCD 2 | 4 |
| | 8 | 8 | BCD 1 | 2 |
| | 9 | 9 | Digital ground | |
| | NC | 15 | + 5 V | Low |

# CAN/LAN Cables



Both ends of this cable provide a modular plug to be connected to Agilent modules CAN or LAN connectors.

### Can Cables

| p/n | Description |
|---|---|
| 5181-1516 | CAN cable, Agilent module to module, 0.5 m |
| 5181-1519 | CAN cable, Agilent module to module, 1 m |

### LAN Cables

| p/n | Description |
|---|---|
| 5023-0203 | Cross-over network cable, shielded, 3 m<br>(for point to point connection) |
| 5023-0202 | Twisted pair network cable, shielded, 7 m<br>(for point to point connection) |

# RS-232 Cables

| p/n | Description |
|---|---|
| RS232-61601 | RS-232 cable, 2.5 m<br>Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It is also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9. |
| 5181-1561 | RS-232 cable, 8 m |

# USB

To connect a USB Flash Drive use a USB OTG cable with Mini-B plug and A socket.

| p/n | Description |
|---|---|
| 5188-8050 | USB A M-USB Mini B 3 m (PC-Module) |
| 5188-8049 | USB A F-USB Mini B M OTG (Module to Flash Drive) |

# 11 Hardware Information

This chapter describes the module in more detail on hardware and electronics.

# General Hardware Information

This section provides detailed hardware information on firmware that is valid for this module.

## Firmware Description

The firmware of the instrument consists of two independent sections:

- a non-instrument specific section, called *resident system*
- an instrument specific section, called *main system*

### Resident System

This resident section of the firmware is identical for all Agilent 1100/1200/1220/1260/1290 series modules. Its properties are:

- the complete communication capabilities (CAN, LAN, USB and RS- 232)
- memory management
- ability to update the firmware of the 'main system'

### Main System

Its properties are:

- the complete communication capabilities (CAN, LAN, USB and RS- 232)
- memory management
- ability to update the firmware of the 'resident system'

In addition the main system comprises the instrument functions that are divided into common functions like

- run synchronization through APG/ERI remote,
- error handling,
- diagnostic functions,

- or module specific functions like
  - internal events such as lamp control, filter movements,
  - raw data collection and conversion to absorbance.

### Firmware Updates

Firmware updates can be done with the Agilent Lab Advisor software with files on the hard disk (latest version should be used).

Required tools, firmware and documentation are available from the Agilent web: https://www.agilent.com/en-us/firmwareDownload?whid=69761

The file naming conventions are:

PPPP_RVVV_XXX.dlb, where

- PPPP is the product number, for example, 1315B for the G1315B DAD,
- R the firmware revision, for example, A for G1315B or B for the G1315C DAD,
- VVV is the revision number, for example 650 is revision 6.50,
- XXX is the build number of the firmware.

For instructions on firmware updates refer to section *Replacing Firmware* in chapter *Maintenance* or use the documentation provided with the *Firmware Update Tools*.

**NOTE** Update of main system can be done in the resident system only. Update of the resident system can be done in the main system only.
Main and resident firmware must be from the same set.

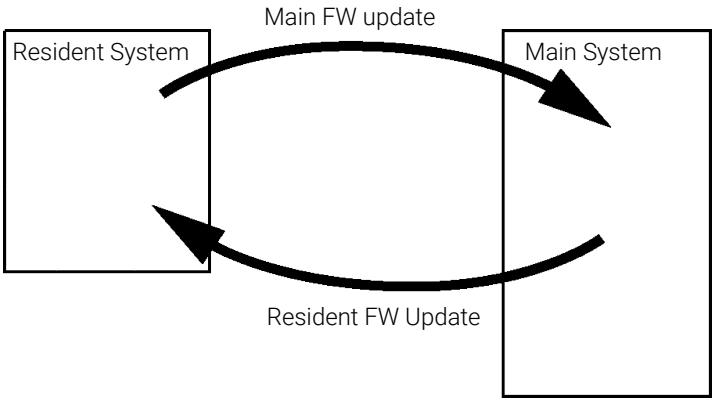



**Figure 22:** Firmware update mechanism

**NOTE**

Some modules are limited in downgrading due to their mainboard version or their initial firmware revision. For example, a G1315C DAD SL cannot be downgraded below firmware revision B.01.02 or to a A.xx.xx.
Some modules can be re-branded (e.g. G1314C to G1314B) to allow operation in specific control software environments. In this case, the feature set of the target type is used and the feature set of the original one is lost. After re-branding (e.g. from G1314B to G1314C), the original feature set is available again.
All this specific information is described in the documentation provided with the firmware update tools.

The firmware update tools, firmware and documentation are available from the Agilent web.

- https://www.agilent.com/en-us/firmwareDownload?whid=69761

## Electrical Connections

- The CAN bus is a serial bus with high-speed data transfer. The two connectors for the CAN bus are used for internal module data transfer and synchronization.
- The ERI connector may be used in combination with other analytical instruments from Agilent Technologies if you want to use features such as start, stop, common shut down, prepare, and so on.

- With the appropriate software, the LAN connector may be used to control the module from a computer through a LAN connection. This connector is activated and can be configured with the configuration switch.
- With the appropriate software, the USB connector may be used to control the module from a computer through a USB connection.
- The power input socket accepts a line voltage of 100 – 240 VAC ± 10 % with a line frequency of 50 or 60 Hz. Maximum power consumption varies by module. There is no voltage selector on your module because the power supply has wide-ranging capability. There are no externally accessible fuses because automatic electronic fuses are implemented in the power supply.

**WARNING** **Electric shock due to insufficient insulation of connected instruments**

**Personal injury or damage to the instrument**

— **Any other instruments connected to this instrument shall be approved to a suitable safety standard and must include reinforced insulation from the mains.**

**NOTE** Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.

## Rear View of the Module

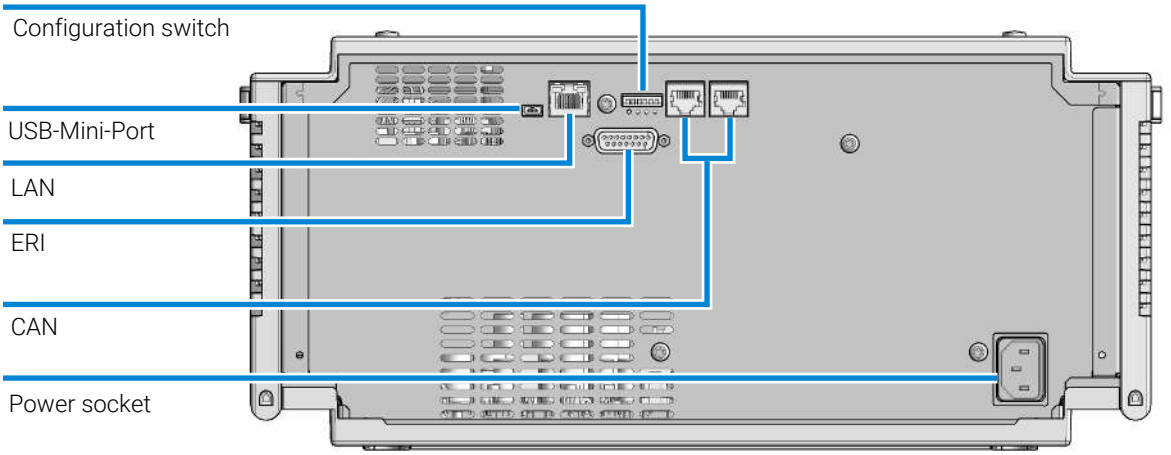



**Figure 23:** Rear view of the pump – electrical connections and label

## Serial Number Information

The serial number information on the instrument labels provide the following information:

| | |
|---|---|
| CCXZZ00000 | Format |
| CC | Country of manufacturing<br>• DE = Germany<br>• JP = Japan<br>• CN = China |
| X | Alphabetic character A-Z (used by manufacturing) |
| ZZ | Alpha-numeric code 0-9, A-Z, where each combination unambiguously denotes a module (there can be more than one code for the same module) |
| 00000 | Serial number |

## Interfaces

The Agilent InfinityLab LC Series modules provide the following interfaces:

**Table 16:** Agilent InfinityLab LC Series interfaces

| Module | CAN | USB | LAN (on-board) | RS-232 | Analog | APG (A) / ERI (E) | Special |
|---|---|---|---|---|---|---|---|
| Pumps | | | | | | | |
| G7104A/C | 2 | No | Yes | Yes | 1 | A | |
| G7110B | 2 | Yes | Yes | No | No | E | |
| G7111A/B, G5654A | 2 | Yes | Yes | No | No | E | |
| G7112B | 2 | Yes | Yes | No | No | E | |
| G7120A, G7132A | 2 | No | Yes | Yes | 1 | A | |
| G7161A/B | 2 | Yes | Yes | No | No | E | |
| Samplers | | | | | | | |
| G7129A/B/C | 2 | Yes | Yes | No | No | E | |
| G7167A/B/C, G7137A, G5668A, G3167A | 2 | Yes | Yes | No | No | E | |
| G7157A | 2 | Yes | Yes | No | No | E | |
| Detectors | | | | | | | |
| G7114A/B | 2 | Yes | Yes | No | 1 | E | |
| G7115A | 2 | Yes | Yes | No | 1 | E | |
| G7117A/B/C | 2 | Yes | Yes | No | 1 | E | |
| G7121A/B | 2 | Yes | Yes | No | 1 | E | |
| G7162A/B | 2 | Yes | Yes | No | 1 | E | |
| G7165A | 2 | Yes | Yes | No | 1 | E | |
| Fraction Collectors | | | | | | | |
| G7158B | 2 | Yes | Yes | No | No | E | |
| G7159B | 2 | Yes | Yes | No | No | E | |

| Module | CAN | USB | LAN (on-board) | RS-232 | Analog | APG (A) / ERI (E) | Special |
|---|---|---|---|---|---|---|---|
| G7166A | 2 | No | No | No | No | No | Requires a host module with on-board LAN with minimum FW B.06.40 or C.06.40, or with additional G1369C LAN Card |
| G1364E/F, G5664B | 2 | Yes | Yes | No | No | E | THERMOSTAT for G1330B |
| Others | | | | | | | |
| G1170A | 2 | No | No | No | No | No | Requires a host module with on-board LAN or with additional G1369C LAN Card. |
| G7116A/B | 2 | No | No | No | No | No | Requires a host module with on-board LAN or with additional G1369C LAN Card. |
| G7122A | No | No | No | Yes | No | A | |
| G7170B | 2 | No | No | No | No | No | Requires a host module with on-board LAN with minimum FW B.06.40 or C.06.40, or with additional G1369C LAN Card |

**NOTE**

LAN connection is made between at least one of the Agilent modules and the Control PC.

- If an Assist Hub is installed, connect the LAN to the Lab LAN port of this module.
- If an Assist Hub is NOT installed and a detector (DAD/MWD/FLD/VWD/RID) is installed, connect the LAN to this module.
- If an Assist Hub is NOT installed and there are multiple detectors with spectral capabilities, consider using additional LAN connections for each detector.
- If an Assist Hub is installed, connect additional LAN connections from the detectors and pumps to the Assist Hub.

- CAN connectors as interface to other modules
- LAN connector as interface to the control software
- RS-232C as interface to a computer

- USB (Universal Series Bus) as interface to a computer
- REMOTE connector as interface to other Agilent products
- Analog output connector for signal output

## Overview Interfaces

### CAN

The CAN is inter-module communication interface. It is a 2-wire serial bus system supporting high speed data communication and real-time requirement.

### LAN

The modules have either an interface slot for a LAN card (e.g. Agilent G1369B/C LAN Interface) or they have an on-board LAN interface (e.g. detectors G1315C/D DAD and G1365C/D MWD). This interface allows the control of the module/ system via a PC with the appropriate control software. Some modules have neither on-board LAN nor an interface slot for a LAN card (e.g. G1170A Valve Drive or G4227A Flexible Cube). These are hosted modules and require a Host module with firmware B.06.40 or later or with additional G1369C LAN Card.

**NOTE**

LAN connection is made between at least one of the Agilent modules and the Control PC.

- If an Assist Hub is installed, connect the LAN to the Lab LAN port of this module.
- If an Assist Hub is NOT installed and a detector (DAD/MWD/FLD/VWD/RID) is installed, connect the LAN to this module.
- If an Assist Hub is NOT installed and there are multiple detectors with spectral capabilities, consider using additional LAN connections for each detector.
- If an Assist Hub is installed, connect additional LAN connections from the detectors and pumps to the Assist Hub.

### USB

The USB interface replaces the RS-232 Serial interface in new generation modules. For details on USB refer to USB (Universal Serial Bus) on page 243.

### Analog Signal Output

The analog signal output can be distributed to a recording device. For details refer to the description of the module's mainboard.

### Remote (ERI)

The ERI (Enhanced Remote Interface) connector may be used in combination with other analytical instruments from Agilent Technologies if you want to use features as common shut down, prepare, and so on.

It allows easy connection between single instruments or systems to ensure coordinated analysis with simple coupling requirements.

The subminiature D connector is used. The module provides one remote connector which is inputs/outputs (wired- or technique).

To provide maximum safety within a distributed analysis system, one line is dedicated to SHUT DOWN the system's critical parts in case any module detects a serious problem. To detect whether all participating modules are switched on or properly powered, one line is defined to summarize the POWER ON state of all connected modules. Control of analysis is maintained by signal readiness READY for next analysis, followed by START of run and optional STOP of run triggered on the respective lines. In addition PREPARE and START REQUEST may be issued. The signal levels are defined as:

- standard TTL levels (0 V is logic true, + 5.0 V is false),
- fan-out is 10,
- input load is 2.2 kOhm against + 5.0 V, and
- output are open collector type, inputs/outputs (wired- or technique).

NOTE

All common TTL circuits operate with a 5 V power supply. A TTL signal is defined as "low" or L when between 0 V and 0.8 V and "high" or H when between 2.0 V and 5.0 V (with respect to the ground terminal).

**Table 17:** ERI signal distribution

| Pin | Signal | Description |
|---|---|---|
| 1 | START REQUEST | (L) Request to start injection cycle (for example, by start key on any module). Receiver is the autosampler. |
| 2 | STOP | (L) Request to reach system ready state as soon as possible (for example, stop run, abort or finish and stop injection). Receiver is any module performing run-time controlled activities. |

| Pin | Signal | Description |
|---|---|---|
| 3 | READY | (H) System is ready for next analysis. Receiver is any sequence controller. |
| 4 | POWER ON | (H) All modules connected to system are switched on. Receiver is any module relying on operation of others. |
| 5 | | Not used |
| 6 | SHUT DOWN | (L) System has serious problem (for example, leak: stops pump). Receiver is any module capable to reduce safety risk. |
| 7 | START | (L) Request to start run / timetable. Receiver is any module performing run-time controlled activities. |
| 8 | PREPARE | (L) Request to prepare for analysis (for example, calibration, detector lamp on). Receiver is any module performing pre-analysis activities. |

### Special Interfaces

There is no special interface for this module.

## ERI (Enhanced Remote Interface)

ERI replaces the AGP Remote Interface that is used in the HP 1090/1040/1050/1100 HPLC systems and Agilent 1100/1200/1200 Infinity HPLC modules. All new InfinityLab LC Series products using the communication board core electronics use ERI. This interface is already used in the Agilent Universal Interface Box 2 (UIB2)

### ERI Description

The ERI interface contains eight individual programmable input/output pins. In addition, it provides 24 V power and 5 V power and a serial data line to detect and recognize further add-ons that could be connected to this interface. This way the interface can support various additional devices like sensors, triggers (in and out) and small controllers, etc.

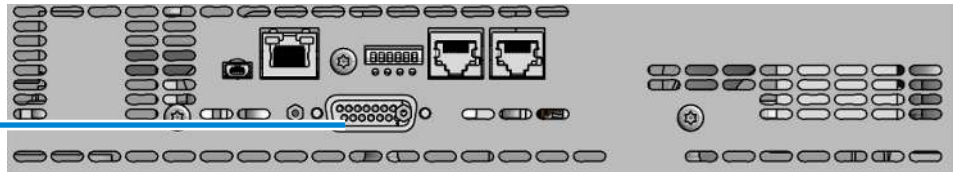
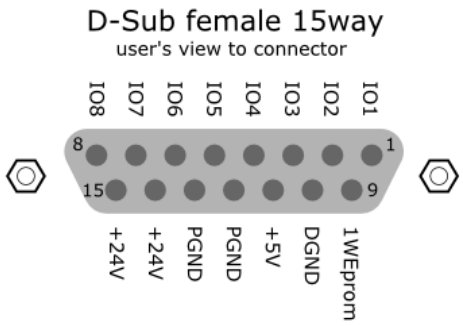



**Figure 24:** Location of the ERI interface




| Pin | Enhanced Remote |
|---|---|
| 1 | IO 1 (START REQUEST) |
| 2 | IO 2 (STOP) |
| 3 | IO 3 (READY) |
| 4 | IO 4 (POWER ON) |
| 5 | IO 5 (NOT USED) |
| 6 | IO 6 (SHUT DOWN) |
| 7 | IO 7 (START) |
| 8 | IO 8 (PREPARE) |
| 9 | 1 wire DATA |
| 10 | DGND |
| 11 | +5 V ERI out |
| 12 | PGND |
| 13 | PGND |
| 14 | +24 V ERI out |
| 15 | +24 V ERI out |

## IO (Input/Output) Lines

- Eight generic bi-directional channels (input or output).
- Same as the APG Remote.
- Devices like valves, relays, ADCs, DACs, controllers can be supported/ controlled.

### 1-Wire Data (Future Use)

This serial line can be used to read out an EPROM or write into an EPROM of a connected ERI-device. The firmware can detect the connected type of device automatically and update information in the device (if required).

### 5V Distribution (Future Use)

- Available directly after turning on the hosting module (assures that the firmware can detect certain basic functionality of the device).
- For digital circuits or similar.
- Provides 500 mA maximum.
- Short-circuit proof with automatic switch off (by firmware).

### 24V Distribution (Future Use)

- Available by firmware command (defined turn on/off).
- For devices that need higher power
  - Class 0: 0.5 A maximum (12 W)
  - Class 1: 1.0 A maximum (24 W)
  - Class 2: 2.0 A maximum (48 W)
- Class depends on hosting module's internal power overhead.
- If a connected device requires more power the firmware detects this (overcurrent detection) and provides the information to the user interface.
- Fuse used for safety protection (on board).
- Short circuit will be detected through hardware.

## USB (Universal Serial Bus)

USB (Universal Serial Bus) - replaces RS232, supports:

- a PC with control software (for example Agilent Lab Advisor)
- USB Flash Disk

## Instrument Layout

The industrial design of the module incorporates several innovative features. It uses Agilent's E-PAC concept for the packaging of electronics and mechanical assemblies. This concept is based upon the use of expanded polypropylene (EPP) layers of foam plastic spacers in which the mechanical and electronic boards components of the module are placed. This pack is then housed in a metal inner cabinet which is enclosed by a plastic external cabinet. The advantages of this packaging technology are:

- virtual elimination of fixing screws, bolts or ties, reducing the number of components and increasing the speed of assembly/disassembly,
- the plastic layers have air channels molded into them so that cooling air can be guided exactly to the required locations,
- the plastic layers help cushion the electronic and mechanical parts from physical shock, and
- the metal inner cabinet shields the internal electronics from electromagnetic interference and also helps to reduce or eliminate radio frequency emissions from the instrument itself.

## Early Maintenance Feedback (EMF)

Maintenance requires the exchange of components that are subject to wear or stress. Ideally, the frequency at which components are exchanged should be based on the intensity of use of the module and the analytical conditions, and not on a predefined time interval. The early maintenance feedback (EMF) feature monitors the use of specific components in the instrument, and provides feedback when the user-selectable limits have been exceeded. The visual feedback in the user interface provides an indication that maintenance procedures should be scheduled.

### EMF Counters

EMF counters increment with use and can be assigned a maximum limit which provides visual feedback in the user interface when the limit is exceeded. Some counters can be reset to zero after the required maintenance procedure.

### Using the EMF Counters

The user-settable EMF limits for the EMF Counters enable the early maintenance feedback to be adapted to specific user requirements. The useful maintenance cycle is dependent on the requirements for use. Therefore, the definition of the maximum limits needs to be determined based on the specific operating conditions of the instrument.

### Setting the EMF Limits

The setting of the EMF limits must be optimized over one or two maintenance cycles. Initially the default EMF limits should be set. When instrument performance indicates maintenance is necessary, take note of the values displayed by the EMF counters. Enter these values (or values slightly less than the displayed values) as EMF limits, and then reset the EMF counters to zero. The next time the EMF counters exceed the new EMF limits, the EMF flag will be displayed, providing a reminder that maintenance needs to be scheduled.

# Module-Specific Hardware Information

## Setting the 6-bit Configuration Switch

The 6-bit configuration switch is located at the rear of the module with communication board electronics. Switch settings provide configuration parameters for LAN and instrument specific initialization procedures.

All modules with communication board electronics:

- Default is ALL switches DOWN (best settings).
  - Default IP address for LAN 192.168.254.11
- For specific LAN modes switches 4-5 must be set as required.
- For boot resident/cold start modes switches 1+2 or 6 must be UP.

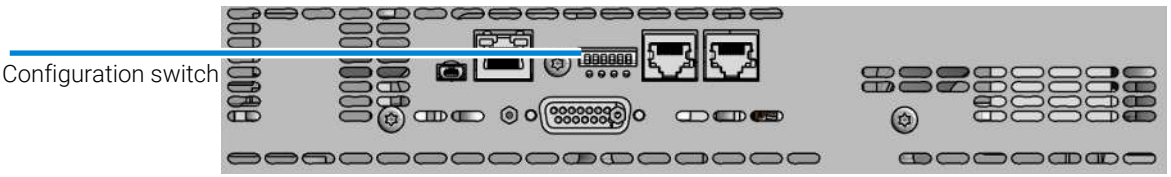



**Figure 25:** Location of configuration switch

**Table 18:** 6-bit configuration switch

| SW1 | SW2 | SW3 | SW4 | SW5 | SW6 | Mode | Init Mode |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | COM | Use Default IP Address (192.168.254.11, Subnet mask: 255.255.255.0) |
| 0 | 0 | 0 | 0 | 1 | 0 | COM | Use Stored IP Address |
| 0 | 0 | 0 | 1 | 0 | 0 | COM | USE DHCP to request IP Address (Host name will be the MAC address) |
| 1 | 0 | 0 | 0 | 0 | 0 | Test | Boot Main System/Keep Data |
| 1 | 1 | 0 | 0 | 0 | 0 | Test | Boot Resident System/Keep Data |

| SW1 | SW2 | SW3 | SW4 | SW5 | SW6 | Mode | Init Mode |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 1 | Test | Boot Main System/Revert to Default Data |
| 1 | 1 | 0 | 0 | 0 | 1 | Test | Boot Resident System/Revert to Default Data |

### Legend:

0 (switch down), 1 (switch up), SW (switch)

## Special Settings

### Boot-Resident/Main

Firmware update procedures may require this mode in case of firmware loading errors (main/resident firmware part).

If you use the following switch settings and power the instrument up again, the instrument firmware stays in the resident/main mode. In resident mode, it is not operable as a module. It only uses basic functions of the operating system for example, for communication. In this mode the main firmware can be loaded (using update utilities).

### Forced Cold Start

A forced cold start can be used to bring the module into a defined mode with default parameter settings.

- Boot Main System / Revert to Default Data

  The instrument will boot to main mode and changes to the module's default parameter. May be also required to load resident firmware into the module.
- Boot Resident System / Revert to Default Data

  The instrument will boot to resident mode and changes to the module's default parameter. May be also required to load main firmware into the module.

**CAUTION**

Loss of data

Forced cold start erases all methods and data stored in the non-volatile memory. Exceptions are calibration settings, diagnosis and repair log books which will not be erased.

— Save your methods and data before executing a forced cold start.

# 12 LAN Configuration

This chapter provides information on connecting the module to the control software.

# What You Have to Do First

The module has an on-board LAN communication interface.

**NOTE** This chapter is generic and may show figures that differ from your module. The functionality is the same.

1 Note the MAC (Media Access Control) address for further reference. The MAC or hardware address of the LAN interfaces is a world wide unique identifier. No other network device will have the same hardware address. The MAC address can be found on a label at the rear of the module underneath the configuration switch (see Figure 27 on page 250).


Part number of the detector mainboard
Revision Code, Vendor, Year and Week of assembly
MAC address
Country of Origin

**Figure 26:** MAC label

2 Connect the instrument's LAN interface to

- the PC network card using a crossover network cable (point-to-point) or
- a hub or switch using a standard LAN cable.

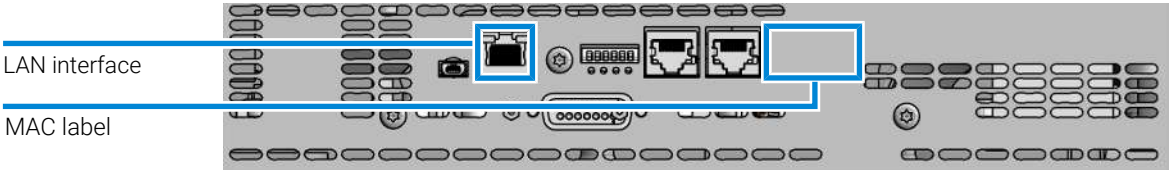



**Figure 27:** Location of LAN interfaces and MAC label

# TCP/IP Parameter Configuration

To operate properly in a network environment, the LAN interface must be configured with valid TCP/IP network parameters. These parameters are:

- IP address
- Subnet Mask
- Default Gateway

The TCP/IP parameters can be configured by the following methods:

- by automatically requesting the parameters from a network-based DHCP Server (using the so-called Dynamic Host Configuration Protocol). This mode requires a LAN-onboard Module or a G1369C LAN Interface card, see Setup (DHCP) on page 255
- by manually setting the parameters using Telnet
- by manually setting the parameters using the Local Controller

The LAN interface differentiates between several initialization modes. The initialization mode (short form 'init mode') defines how to determine the active TCP/IP parameters after power-on. The parameters may be derived non-volatile memory or initialized with known default values. The initialization mode is selected by the configuration switch, see Table 19 on page 253.

# Configuration Switch

The configuration switch can be accessed at the rear of the module.

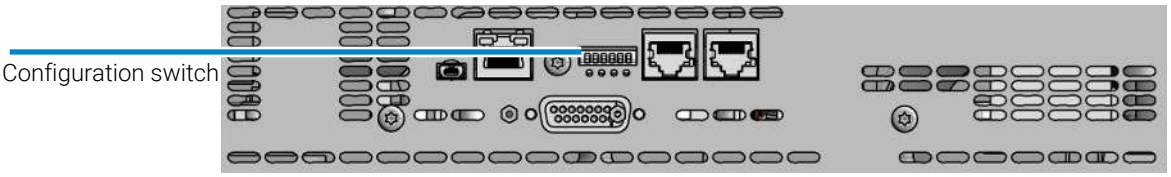



**Figure 28:** Location of configuration switch

The module is shipped with all switches set to OFF, as shown above.

**NOTE** To perform any LAN configuration, SW1 and SW2 must be set to OFF.

# Initialization Mode Selection

The following initialization (init) modes are selectable:

**Table 19:** Initialization mode switches

| | SW1 | SW2 | SW3 | SW4 | SW5 | SW6 | Init Mode |
|---|---|---|---|---|---|---|---|
|   | 0 | 0 | 0 | 0 | 0 | 0 | Use Default IP Address |
| | 0 | 0 | 0 | 0 | 1 | 0 | Use Stored IP Address |
| | 0 | 0 | 0 | 1 | 0 | 0 | Use DHCP |
| | Note: The setting '0' (down) is essential. | | | | | | |

## Legend:

0 (switch down), 1 (switch up), SW (switch)

Default IP address for LAN is 192.168.254.11.

DHCP address is the module's LAN MAC address.

## Using Stored

When initialization mode **Using Stored** is selected, the parameters are taken from the non-volatile memory of the module. The TCP/IP connection will be established using these parameters. The parameters were configured previously by one of the described methods.

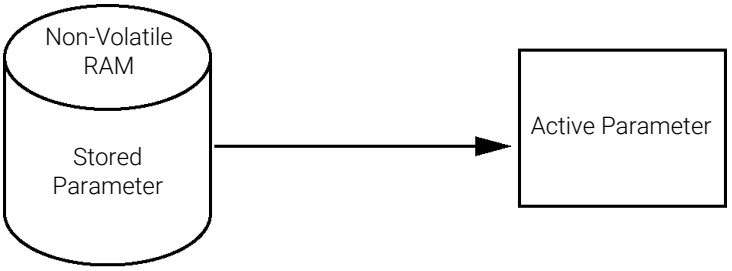



**Figure 29:** Using Stored (principle)

### Using Default

When **Using Default** is selected, the factory default parameters are taken instead. These parameters enable a TCP/IP connection to the LAN interface without further configuration, see Table 20 on page 254.

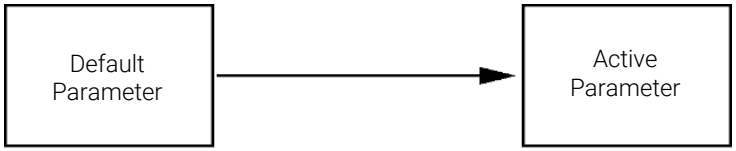



**Figure 30:** Using Default (principle)

**NOTE** Using the default address in your local area network may result in network problems. Take care and change it to a valid address immediately.

**Table 20:** Using default parameters

| | |
|---|---|
| IP address: | 192.168.254.11 |
| Subnet Mask: | 255.255.255.0 |
| Default Gateway | not specified |

Since the default IP address is a so-called local address, it will not be routed by any network device. Thus, the PC and the module must reside in the same subnet.

The user may open a Telnet session using the default IP address and change the parameters stored in the non-volatile memory of the module. He may then close the session, select the initialization mode Using Stored, power-on again and establish the TCP/IP connection using the new parameters.

When the module is wired to the PC directly (e.g. using a cross-over cable or a local hub), separated from the local area network, the user may simply keep the default parameters to establish the TCP/IP connection.

**NOTE** In the **Using Default** mode, the parameters stored in the memory of the module are not cleared automatically. If not changed by the user, they are still available, when switching back to the mode Using Stored.

# Dynamic Host Configuration Protocol (DHCP)

## General Information (DHCP)

The Dynamic Host Configuration Protocol (DHCP) is an auto configuration protocol used on IP networks. The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card G1369C, and “B”-firmware (B.06.40 or above) or modules with "D"-firmware. All modules should use latest firmware from the same set.

When the initialization mode “DHCP” is selected, the card tries to download the parameters from a DHCP Server. The parameters obtained become the active parameters immediately. They are not stored to the non-volatile memory of the card.

Besides requesting the network parameters, the card also submits its hostname to the DHCP Server. The hostname equals the MAC address of the card, e.g. *0030d3177321*. It is the DHCP server's responsibility to forward the hostname/address information to the Domain Name Server. The card does not offer any services for hostname resolution (e.g. NetBIOS).

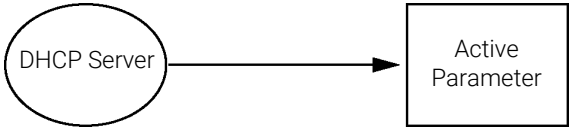



**Figure 31:** DHCP (principle)

**NOTE**

- It may take some time until the DHCP server has updated the DNS server with the hostname information.
- It may be necessary to fully qualify the hostname with the DNS suffix, e.g. *0030d3177321.country.company.com*.
- The DHCP server may reject the hostname proposed by the card and assign a name following local naming conventions.

# Setup (DHCP)

The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card G1369C, and “B”-firmware (B.06.40 or above) or modules with "D"-firmware. All modules should use latest firmware from the same set.

1 Note the MAC address of the LAN interface (provided with G1369C LAN Interface Card or mainboard). This MAC address is on a label on the card or at the rear of the mainboard, for example, *0030d3177321*.

On the Local Controller the MAC address can be found under **Details** in the LAN section.

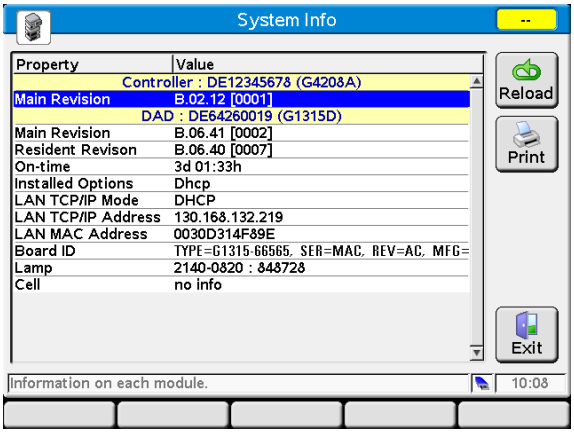



**Figure 32:** LAN setting on Instant Pilot

2 Set the configuration switch to DHCP either on the G1369C LAN Interface Card or the mainboard of above mentioned modules.

**Table 21:** G1369C LAN Interface Card (configuration switch on the card)

| SW 4 | SW 5 | SW 6 | SW 7 | SW 8 | Initialization Mode |
|---|---|---|---|---|---|
| ON | OFF | OFF | OFF | OFF | DHCP |

**Table 22:** LC Modules with 8-bit configuration switch (B-firmware) (configuration switch at rear of the instrument)

| SW 6 | SW 7 | SW 8 | Initialization Mode |
|---|---|---|---|
| ON | OFF | OFF | DHCP |

3 Turn on the module that hosts the LAN interface.

4 Configure your Control Software (e.g. OpenLAB CDS ChemStation Edition, Lab Advisor, Firmware Update Tool) and use MAC address as host name, e.g. *0030d3177321*.

The LC system should become visible in the control software (see Note in section General Information (DHCP) on page 255).

# Manual Configuration

Manual configuration only alters the set of parameters stored in the non-volatile memory of the module. It never affects the currently active parameters. Therefore, manual configuration can be done at any time. A power cycle is mandatory to make the stored parameters become the active parameters, given that the initialization mode selection switches are allowing it.

## With Telnet

Whenever a TCP/IP connection to the module is possible (TCP/IP parameters set by any method), the parameters may be altered by opening a Telnet session.

1 Open the system (DOS) prompt window by clicking on Windows START button and select "Run...". Type "cmd" and press OK.

2 Type the following at the system (DOS) prompt:

- `c:\>telnet <IP address>` or
- `c:\>telnet <host name>`

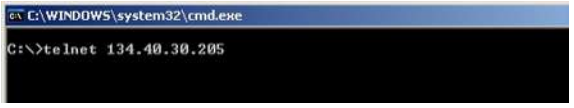



**Figure 33:** Telnet - Starting a session

where <IP address> may be the assigned address from a Bootp cycle, a configuration session with the Handheld Controller, or the default IP address (see Configuration Switch on page 252).

When the connection was established successfully, the module responds with the following:

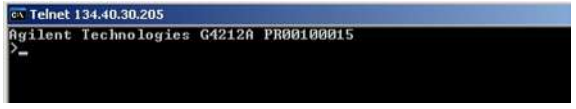



**Figure 34:** A connection to the module is made

3 Type `?` and press enter to see the available commands.

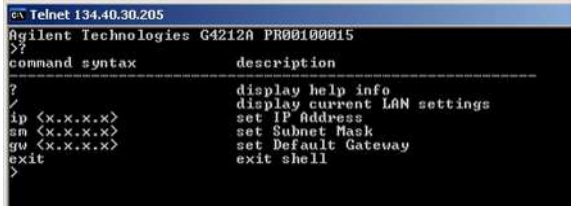



**Figure 35:** Telnet commands

**Table 23:** Telnet commands

| Value | Description |
|---|---|
| ? | displays syntax and descriptions of commands |
| / | displays current LAN settings |
| ip <x.x.x.x> | sets new ip address |
| sm <x.x.x.x> | sets new subnet mask |
| gw <x.x.x.x> | sets new default gateway |
| exit | exits shell and saves all changes |

4 To change a parameter follows the style:

- parameter value, for example: `ip 134.40.28.56`

Then press [Enter], where parameter refers to the configuration parameter you are defining, and value refers to the definitions you are assigning to that parameter. Each parameter entry is followed by a carriage return.

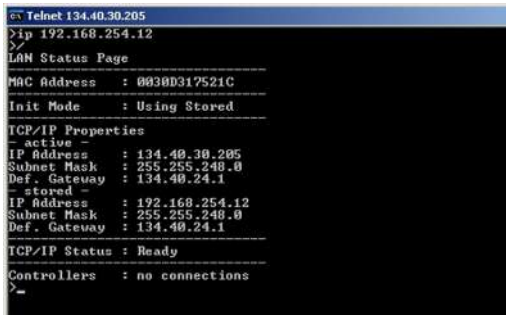
5 Use the "/" and press Enter to list the current settings.


Telnet - Current settings in "Using Stored" mode

information about the LAN interface
MAC address, initialization mode
Initialization mode is Using Stored
active TCP/IP settings

TCP/IP status - here ready
connected to PC with controller software (e.g. Agilent ChemStation), here not connected

6 Change the IP address (in this example 192.168.254.12) and type "/" to list current settings.




Telnet - Change IP settings

change of IP setting to Initialization mode is Using Stored

active TCP/IP settings

stored TCP/IP settings in non-volatile memory

connected to PC with controller software (e.g. Agilent ChemStation), here not connected

7 When you have finished typing the configuration parameters, type `exit` and press Enter to exit with storing parameters.

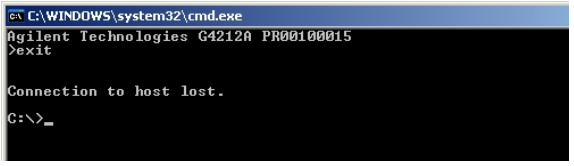



**Figure 36:** Closing the Telnet session

**NOTE** If the Initialization Mode Switch is changed now to “Using Stored” mode, the instrument will take the stored settings when the module is re-booted. In the example above it would be 192.168.254.12.

## With the Instant Pilot (G4208A)

To configure the TCP/IP parameters before connecting the module to the network, the Instant Pilot (G4208A) can be used.

1 From the Welcome screen press the **More** button.

2 Select **Configure.**

3 Press the module button of the module that hosts the LAN interface (usually the detector).

4 Scroll down to the LAN settings.

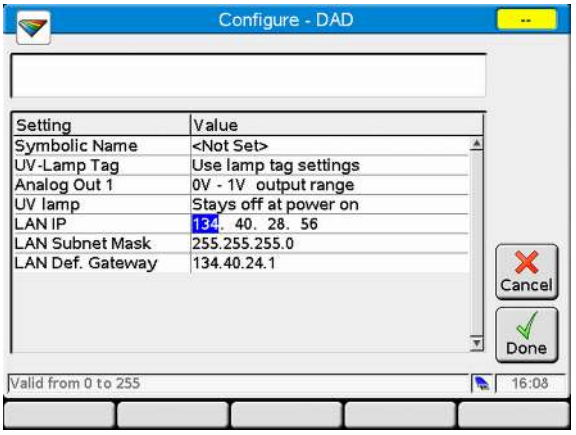



**Figure 37:** Instant Pilot - LAN configuration (edit mode)

5 Press the **Edit** button (only visible if not in Edit mode), perform the required changes and press the **Done** button.

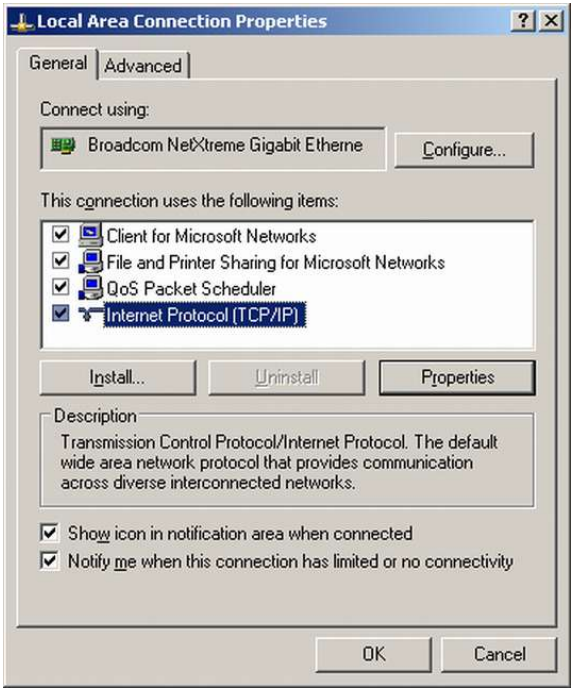
6 Leave the screen by clicking **Exit**.

# PC and User Interface Software Setup

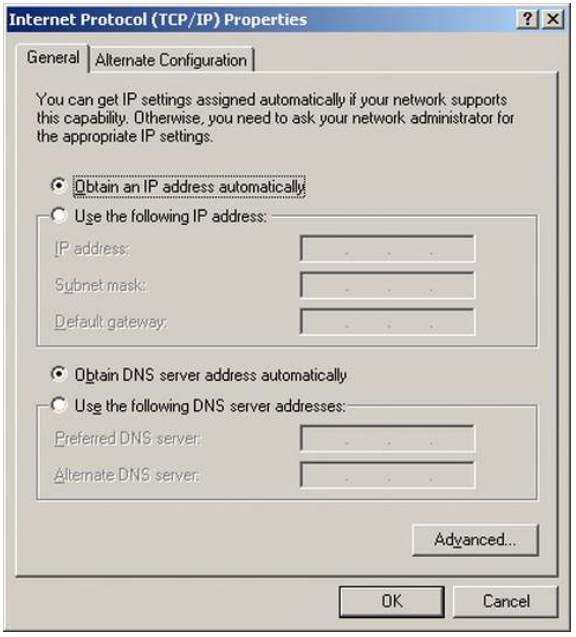
## PC Setup for Local Configuration

This procedure describes the change of the TCP/IP settings on your PC to match the module's default parameters in a local configuration (see Table 20 on page 254).

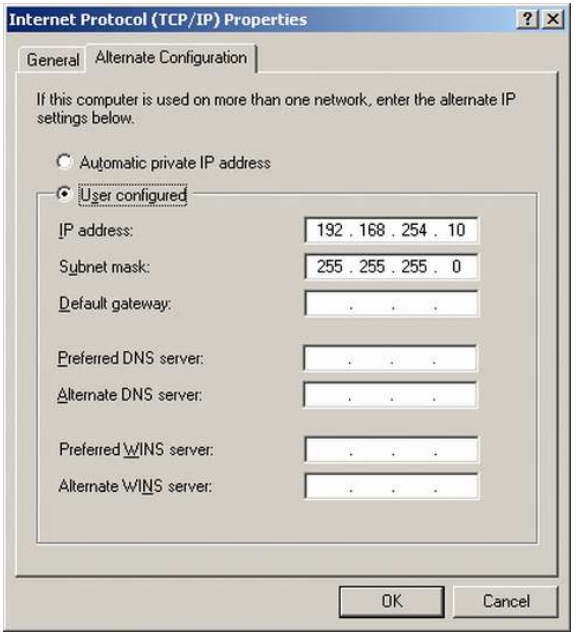
1 Open the Local Area Connection Properties and select Internet Protocol (TCP/IP). Then click on Properties.



2 You may enter here the fixed IP address of the module or use the Alternative Configuration.



3 We will use the direct LAN access via Cross-over LAN cable with the module's IP address.




4 Click on **OK** to save the configuration.

# 13 Appendix

This chapter provides additional information on safety, legal and web.

# General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

**WARNING**

**Ensure the proper usage of the equipment.**

**The protection provided by the equipment may be impaired.**

- **The operator of this instrument is advised to use the equipment in a manner as specified in this manual.**

## Safety Standards

This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

## General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

## Before Applying Power

**WARNING** Wrong voltage range, frequency or cabling

Personal injury or damage to the instrument

- Verify that the voltage range and frequency of your power distribution matches to the power specification of the individual instrument.
- Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.
- Make all connections to the unit before applying power.

**WARNING** Use of unsupplied cables

Using cables not supplied by Agilent Technologies can lead to damage of the electronic components or personal injury.

- Never use cables other than the ones supplied by Agilent Technologies to ensure proper functionality and compliance with safety or EMC regulations.

**NOTE** Note the instrument's external markings described under Safety Symbols on page 273.

## Ground the Instrument

**WARNING** Missing electrical ground

Electrical shock

- If your product is provided with a grounding type power plug, the instrument chassis and cover must be connected to an electrical ground to minimize shock hazard.
- The ground pin must be firmly connected to an electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

## Do Not Operate in an Explosive Atmosphere

**WARNING**

**Presence of flammable gases or fumes**

**Explosion hazard**

- **Do not operate the instrument in the presence of flammable gases or fumes.**

## Do Not Remove the Instrument Cover

**WARNING**

**Instrument covers removed**

**Electrical shock**

- **Do Not Remove the Instrument Cover**
- **Only Agilent authorized personnel are allowed to remove instrument covers. Always disconnect the power cables and any external circuits before removing the instrument cover.**

## Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Agilent Sales and Service Office for service and repair to ensure that safety features are maintained.

## In Case of Damage

**WARNING**

**Damage to the module**

**Personal injury (for example electrical shock, intoxication)**

- **Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.**

## Solvent Information

**WARNING** **Toxic, flammable and hazardous solvents, samples and reagents**

**The handling of solvents, samples and reagents can hold health and safety risks.**

- **When working with these substances observe appropriate safety procedures (for example by wearing goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet supplied by the vendor, and follow good laboratory practice.**
- **Do not use solvents with an auto-ignition temperature below 200 °C (392 °F). Do not use solvents with a boiling point below 56 °C (133 °F).**
- **Avoid high vapor concentrations. Keep the solvent temperature at least 40 °C (72 °F) below the boiling point of the solvent used. This includes the solvent temperature in the sample compartment. For the solvents methanol and ethanol keep the solvent temperature at least 25 °C (45 °F) below the boiling point.**
- **Do not operate the instrument in an explosive atmosphere.**
- **Do not use solvents of ignition Class IIC according IEC 60079-20-1 (for example, carbon disulfide).**
- **Reduce the volume of substances to the minimum required for the analysis.**
- **Never exceed the maximum permissible volume of solvents (8 L) in the solvent cabinet. Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for solvent cabinet.**
- **Ground the waste container.**
- **Regularly check the filling level of the waste container. The residual free volume in the waste container must be large enough to collect the waste liquid.**
- **To achieve maximal safety, regularly check the tubing for correct installation.**

**NOTE** For details, see the usage guideline for the solvent cabinet. A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available in the Agilent Information Center or via the Internet.

### Recommendations on the Use of Solvents

Observe the following recommendations on the use of solvents.

- Brown glass ware can avoid growth of algae.
- Follow the recommendations for avoiding the growth of algae, see Algae Growth in HPLC Systems on page 272
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.22 µm filters.
- Avoid or minimize the use of solvents that may corrode parts in the flow path. Consider specifications for the pH range given for different materials such as flow cells, valve materials etc. and recommendations in subsequent sections.
- Avoid the use of the following steel-corrosive solvents:
  - solutions of alkali halides and their respective acids (for example, lithium iodide, potassium chloride, and so on),
  - high concentrations of inorganic acids like sulfuric acid and nitric acid, especially at higher temperatures (if your chromatography method allows, replace by phosphoric acid or phosphate buffer which are less corrosive against stainless steel),
  - halogenated solvents or mixtures which form radicals and/or acids, for example:

    $2CHCl_3 + O_2 \rightarrow 2COCl_2 + 2HCl$

    This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol,
  - chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, diisopropyl ether) should be filtered through dry aluminium oxide which adsorbs the peroxides,
  - solvents containing strong complexing agents (e.g. EDTA),
  - mixtures of carbon tetrachloride with 2-propanol or THF.
- Avoid the use of dimethyl formamide (DMF). Polyvinylidene fluoride (PVDF), which is used in leak sensors, is not resistant to DMF.

# Algae Growth in HPLC Systems

The presence of algae in HPLC systems can cause many problems that may be incorrectly diagnosed as instrument or application problems. Algae grow in aqueous media, preferably in a pH range from 4 to 8. Their growth is accelerated by buffers, for example phosphate or acetate. Since algae grow through photosynthesis, light will also stimulate their growth. Even in distilled water small-sized algae grow after some time.

## Instrumental Problems Associated With Algae

Algae deposit and grow everywhere within the HPLC system, causing the following problems:

- Blocked solvent filters, or deposits on inlet or outlet valves, resulting in unstable flow, composition or gradient problems, or a complete failure of the pump.
- Plugging of small-pore, high-pressure solvent filters, usually placed before the injector, resulting in high system pressure.
- Blockage of PTFE frits, leading to increased system pressure.
- Plugging of column filters, giving high system pressure.
- Dirty flow cell windows of detectors, resulting in higher noise levels (since the detector is the last module in the flow path, this problem is less common).

## How to Prevent and/or Reduce the Algae Problem

- Always use freshly prepared solvents, especially use demineralized water, which was filtered through 0.2 µm filters.
- Never leave mobile phase in the instrument for several days without flow.
- Always discard old mobile phase.
- Use the amber solvent bottle (9301-6526 (Solvent bottle, amber, 1000 mL) ) supplied with the instrument for your aqueous mobile phase.
- If possible add a few mg/L sodium azide or a few percent organic solvent to the aqueous mobile phase.

## Magnets

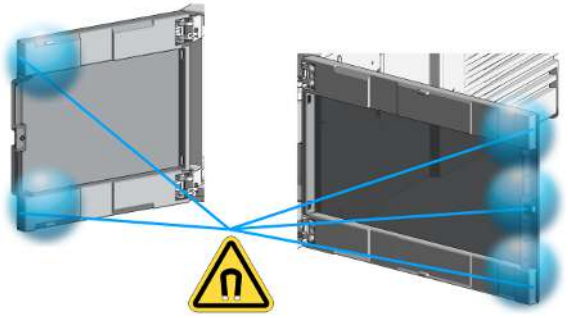


**Figure 38:** Magnets in doors of pumps, autosamplers, detectors, and fraction collectors

## Safety Symbols

**Table 24:** Symbols

| | |
|---|---|
|  | The apparatus is marked with this symbol when the user shall refer to the instruction manual in order to protect risk of harm to the operator and to protect the apparatus against damage. |
|  | Indicates dangerous voltages. |
|  | Indicates a protected ground terminal. |
|  | The apparatus is marked with this symbol when hot surfaces are available and the user should not touch it when heated up. |
|  | Indicates flammable material used. Consult the Agilent Information Center / User Manual before attempting to install or service this equipment. Follow all safety precautions. |
|  | Confirms that a manufactured product complies with all applicable European Community directives. The European Declaration of Conformity is available at: http://regulations.corporate.agilent.com/DoC/search.htm |

| | |
|---|---|
|  | Manufacturing date. |
| REF | Product Number |
| SN | Serial Number |
|  | Power symbol indicates On/Off.<br>The apparatus is not completely disconnected from the mains supply when the on/off switch is in the Off position |
|  | Pacemaker<br>Magnets could affect the functioning of pacemakers and implanted heart defibrillators. A pacemaker could switch into test mode and cause illness. A heart defibrillator may stop working. If you wear these devices keep at least 55 mm distance to magnets. Warn others who wear these devices from getting too close to magnets. |
|  | Magnetic field<br>Magnets produce a far-reaching, strong magnetic field. They could damage TVs and laptops, computer hard drives, credit and ATM cards, data storage media, mechanical watches, hearing aids and speakers. Keep magnets at least 25 mm away from devices and objects that could be damaged by strong magnetic fields. |
|  | Indicates a pinching or crushing hazard |
|  | Indicates a piercing or cutting hazard. |

**WARNING**

**A WARNING**

**alerts you to situations that could cause physical injury or death.**

- **Do not proceed beyond a warning until you have fully understood and met the indicated conditions.**

**CAUTION**

A CAUTION

alerts you to situations that could cause loss of data, or damage of equipment.

- Do not proceed beyond a caution until you have fully understood and met the indicated conditions.

# Material Information

This section provides detailed information about materials used in the HPLC system and general information about solvent/material compatibility.

## Materials in Flow Path

Following materials are used in the flow path of this module:

**Table 25:** Materials in flow path

| Part | Materials |
|---|---|
| Degasser chamber | TFE/PDD Copolymer, PFA (internal tubings), PEEK (inlets), FEP (tubings), ETFE (fittings) |
| SSV | PEEK, FFKM |
| Active inlet valve | SST, sapphire, ruby, ceramic, PTFE |
| Outlet valve | SST, gold, ruby, $ZrO_2$-based ceramic, tantalum |
| Adapter | SST, gold |
| Pump head (body) | SST |
| Pistons | Sapphire |
| Piston seals/wash seals | PTFE, SST (reversed phase) or UHMW-PE, SST (normal phase) |
| Pressure sensor | SST |
| Purge valve | SST, gold, PTFE, ceramic |
| Damping unit | SST, gold |
| Capillaries/fittings | SST |
| Tubings | PTFE |

# General Information About Solvent/Material Compatibility

Materials in the flow path are carefully selected based on Agilent's experiences in developing highest-quality instruments for HPLC analysis over several decades. These materials exhibit excellent robustness under typical HPLC conditions. For any special condition, please consult the material information section or contact Agilent.

## Disclaimer

Subsequent data was collected from external resources and is meant as a reference. Agilent cannot guarantee the correctness and completeness of such information. Data is based on compatibility libraries, which are not specific for estimating the long-term life time under specific but highly variable conditions of UHPLC systems, solvents, solvent mixtures, and samples. Information also cannot be generalized due to catalytic effects of impurities like metal ions, complexing agents, oxygen etc. Apart from pure chemical corrosion, other effects like electro corrosion, electrostatic charging (especially for nonconductive organic solvents), swelling of polymer parts etc. need to be considered. Most data available refers to room temperature (typically 20 – 25 °C, 68 – 77 °F). If corrosion is possible, it usually accelerates at higher temperatures. If in doubt, please consult technical literature on chemical compatibility of materials.

## MP35N

MP35N is a nonmagnetic, nickel-cobalt-chromium-molybdenum alloy demonstrating excellent corrosion resistance (for example, against nitric and sulfuric acids, sodium hydroxide, and seawater) over a wide range of concentrations and temperatures. In addition, this alloy shows exceptional resistance to high-temperature oxidation. Due to excellent chemical resistance and toughness, the alloy is used in diverse applications: dental products, medical devices, nonmagnetic electrical components, chemical and food processing equipment, marine equipment. Treatment of MP35N alloy samples with 10 % NaCl in HCl (pH 2.0 ) does not reveal any detectable corrosion. MP35N also demonstrates excellent corrosion resistance in a humid environment. Although the influence of a broad variety of solvents and conditions has been tested, users should keep in mind that multiple factors can affect corrosion rates, such as temperature, concentration, pH, impurities, stress, surface finish, and dissimilar metal contacts.

## Polyphenylene Sulfide (PPS)

Polyphenylene sulfide has outstanding stability even at elevated temperatures. It is resistant to dilute solutions of most inorganic acids, but it can be attacked by some organic compounds and oxidizing reagents. Nonoxidizing inorganic acids, such as sulfuric acid and phosphoric acid, have little effect on polyphenylene sulfide, but at high concentrations and temperatures, they can still cause material damage. Nonoxidizing organic chemicals generally have little effect on polyphenylene sulfide stability, but amines, aromatic compounds, and halogenated compounds may cause some swelling and softening over extended periods of time at elevated temperatures. Strong oxidizing acids, such as nitric acid (> 0.1 %), hydrogen halides (> 0.1 %), peroxy acids (> 1 %), or chlorosulfuric acid degrade polyphenylene sulfide. It is not recommended to use polyphenylene sulfide with oxidizing material, such as sodium hypochlorite and hydrogen peroxide. However, under mild environmental conditions, at low concentrations and for short exposure times, polyphenylene sulfide can withstand these chemicals, for example, as ingredients of common disinfectant solutions.

## PEEK

PEEK (Polyether-Ether Ketones) combines excellent properties regarding biocompatibility, chemical resistance, mechanical and thermal stability. PEEK is therefore the material of choice for UHPLC and biochemical instrumentation.

It is stable in the specified pH range (for the Bio-Inert LC system: pH 1 – 13 , see bio-inert module manuals for details), and inert to many common solvents.

There are still some known incompatibilities with chemicals such as chloroform, methylene chloride, THF, DMSO, strong acids (nitric acid > 10 %, sulfuric acid > 10 %, sulfonic acids, trichloroacetic acid), halogens or aqueous halogen solutions, phenol and derivatives (cresols, salicylic acid, and so on).

When used above room temperature, PEEK is sensitive to bases and various organic solvents, which can cause it to swell. Under such conditions, normal PEEK capillaries are sensitive to high pressure. Therefore, Agilent uses stainless steel clad PEEK capillaries in bio-inert systems. The use of stainless steel clad PEEK capillaries keeps the flow path free of steel and ensures pressure stability up to 600 bar. If in doubt, consult the available literature about the chemical compatibility of PEEK.

### Polyimide

Agilent uses semi-crystalline polyimide for rotor seals in valves and needle seats in autosamplers. One supplier of polyimide is DuPont, which brands polyimide as Vespel, which is also used by Agilent.

Polyimide is stable in a pH range between 1 and 10 and in most organic solvents. It is incompatible with concentrated mineral acids (e.g. sulphuric acid), glacial acetic acid, DMSO and THF. It is also degraded by nucleophilic substances like ammonia (e.g. ammonium salts in basic conditions) or acetates.

### Polyethylene (PE)

Agilent uses UHMW (ultra-high molecular weight)-PE/PTFE blends for yellow piston and wash seals, which are used in 1290 Infinity pumps, 1290 Infinity II/III pumps, the G7104C and for normal phase applications in 1260 Infinity pumps.

Polyethylene has a good stability for most common inorganic solvents including acids and bases in a pH range of 1 to 12.5 . It is compatible with many organic solvents used in chromatographic systems like methanol, acetonitrile and isopropanol. It has limited stability with aliphatic, aromatic and halogenated hydrocarbons, THF, phenol and derivatives, concentrated acids and bases. For normal phase applications, the maximum pressure should be limited to 200 bar.

### Tantalum (Ta)

Tantalum is inert to most common HPLC solvents and almost all acids except fluoric acid and acids with free sulfur trioxide. It can be corroded by strong bases (e.g. hydroxide solutions > 10 %, diethylamine). It is not recommended for the use with fluoric acid and fluorides.

### Stainless Steel (SST)

Stainless steel is inert against many common solvents. It is stable in the presence of acids and bases in a pH range of 1  to 12.5 . It can be corroded by acids below pH 2.3 . It can also corrode in following solvents:

- Solutions of alkali halides, their respective acids (for example, lithium iodide, potassium chloride) and aqueous solutions of halogens.
- High concentrations of inorganic acids like nitric acid, sulfuric acid, and organic solvents especially at higher temperatures (replace, if your chromatography method allows, by phosphoric acid or phosphate buffer, which are less corrosive against stainless steel).

- Halogenated solvents or mixtures, which form radicals and/or acids, for example:

  $2\ CHCl_3 + O_2 \rightarrow 2\ COCl_2 + 2\ HCl$

  This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol.
- Chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, diisopropyl ether). Such ethers should be filtered through dry aluminum oxide, which adsorbs the peroxides.
- Solutions of organic acids (acetic acid, formic acid, and so on) in organic solvents. For example, a 1 % solution of acetic acid in methanol will attack steel.
- Solutions containing strong complexing agents (for example, EDTA, ethylenediaminetetraacetic acid).
- Mixtures of carbon tetrachloride with isopropanol or THF.

### Titanium (Ti)

Titanium is highly resistant to oxidizing acids (for example, nitric, perchloric and hypochlorous acid) over a wide range of concentrations and temperatures. This is due to a thin oxide layer on the surface, which is stabilized by oxidizing compounds. Non-oxidizing acids (for example, hydrochloric, sulfuric and phosphoric acid) can cause slight corrosion, which increases with acid concentration and temperature. For example, the corrosion rate with 3 % HCl (about pH 0.1 ) at room temperature is about 13 µm/year. At room temperature, titanium is resistant to concentrations of about 5 % sulfuric acid (about pH 0.3 ). Addition of nitric acid to hydrochloric or sulfuric acids significantly reduces corrosion rates. Titanium is sensitive to acidic metal chlorides like $FeCl_3$ or $CuCl_2$. Titanium is subject to corrosion in anhydrous methanol, which can be avoided by adding a small amount of water (about 3 %). Slight corrosion is possible with ammonia > 10 %.

### Diamond-Like Carbon (DLC)

Diamond-Like Carbon is inert to almost all common acids, bases, and solvents. There are no documented incompatibilities for HPLC applications.

### Fused Silica and Quartz ($SiO_2$)

Fused silica is used in Max Light Cartridges. Quartz is used for classical flow cell windows. It is inert against all common solvents and acids except hydrofluoric acid and acidic solvents containing fluorides. It is corroded by strong bases and should not be used above pH 12 at room temperature. The corrosion of flow cell windows can negatively affect measurement results. For a pH greater than 12, the use of flow cells with sapphire windows is recommended.

### Gold

Gold is inert to all common HPLC solvents, acids, and bases within the specified pH range. It can be corroded by complexing cyanides and concentrated acids like aqua regia.

### Zirconium Oxide ($ZrO_2$)

Zirconium Oxide is inert to almost all common acids, bases, and solvents. There are no documented incompatibilities for HPLC applications.

### Platinum/Iridium

Platinum/Iridium is inert to almost all common acids, bases, and solvents. There are no documented incompatibilities for HPLC applications.

### Fluorinated Polymers (PTFE, PFA, FEP, FFKM, PVDF)

Fluorinated polymers like PTFE (polytetrafluorethylene), PFA (perfluoroalkoxy), and FEP (fluorinated ethylene propylene) are inert to almost all common acids, bases, and solvents. FFKM is perfluorinated rubber, which is also resistant to most chemicals. As an elastomer, it may swell in some organic solvents like halogenated hydrocarbons.

TFE/PDD copolymer tubings, which are used in all Agilent degassers except G1322A/G7122A, are not compatible with fluorinated solvents like Freon, Fluorinert, or Vertrel. They have limited life time in the presence of hexafluoroisopropanol (HFIP). To ensure the longest possible life with HFIP, it is best to dedicate a particular chamber to this solvent, not to switch solvents, and not to let dry out the chamber. For optimizing the life of the pressure sensor, do not leave HFIP in the chamber when the unit is off.

The tubing of the leak sensor is made of PVDF (polyvinylidene fluoride), which is incompatible with the solvent DMF (dimethylformamide).

### Sapphire, Ruby, and $Al_2O_3$-Based Ceramics

Sapphire, ruby, and ceramics based on aluminum oxide $Al_2O_3$ are inert to almost all common acids, bases, and solvents. There are no documented incompatibilities for HPLC applications.

# At-a-Glance Details About Agilent Capillaries

The following section provides useful information about Agilent capillaries and its characteristics.

## Syntax for capillary description

Type - Material - Capillary dimensions - Fitting Left/Fitting right

**Table 26:** Example for a capillary description

| Code provided with the part | Meaing of the code |
|---|---|
| Color code:  | Material of the product is MP35N, the inner diameter is 0.20 or 0.25 mm |
| Capillary | The part is a connection capillary |
| MP35N | Material of the part is MP35N |
| 0.25 x 80 mm | The part has an inner diameter of 0.25 mm and a length of 80 mm |
| SI/SI | Left fitting: Swagelok + 1.6 mm Port id, Intermediate<br>Right fitting: Swagelok + 1.6 mm Port id, Intermediate |

To get an overview of the code in use, see

- Color: Table 27 on page 283
- Type: Table 28 on page 283
- Material: Table 29 on page 284
- Dimension: Table 30 on page 284
- Fittings: Table 31 on page 285

## Color Coding Guide

**Table 27:** Color-coding key for Agilent capillary tubing

| Internal diameter in mm | | Color code |
|---|---|---|
| 0.015 | | Orange |
| 0.025 | | Yellow |
| 0.05 | | Beige |
| 0.075 | | Black |
| 0.075 | MP35N | Black with orange stripe |
| 0.1 | | Purple |
| 0.12 | | Red |
| 0.12 | MP35N | Red with orange stripe |
| 0.17 | | Green |
| 0.17 | MP35N | Green with orange stripe |
| 0.20 /0.25 | | Blue |
| 0.20 /0.25 | MP35N | Blue with orange stripe |
| 0.3 | | Grey |
| 0.50 | | Bone White |

**NOTE** As you move to smaller-volume, high efficiency columns, you'll want to use narrow id tubing, as opposed to the wider id tubing used for conventional HPLC instruments.

## Abbreviation Guide for Type

**Table 28:** Type (gives some indication on the primary function, like a loop or a connection capillary)

| Key | Description |
|---|---|
| Capillary | Connection capillaries |
| Loop | Loop capillaries |
| Seat | Autosampler needle seats |

| Key | Description |
|---|---|
| Tube | Tubing |
| Heat exchanger | Heat exchanger |

## Abbreviation Guide for Material

**Table 29:** Material (indicates which raw material is used for the capillary)

| Key | Description |
|---|---|
| ST | Stainless steel |
| Ti | Titanium |
| PK | PEEK |
| FS/PK | PEEK-coated fused silica [2] |
| PK/ST | Stainless steel-coated PEEK [3] |
| PFFE | PTFE |
| FS | Fused silica |
| MP35N | Nickel-cobalt-chromium-molybdenium alloy |

## Abbreviation Guide for Capillary Dimensions

**Table 30:** Capillary dimensions (indicates inner diameter (id), length, and volume of the capillary)

| Description |
|---|
| id (mm) x Length (mm) |
| Volume (µL) |

2 Fused silica in contact with solvent

3 Stainless steel-coated PEEK

## Abbreviation Guide for Fitting Left/Fitting Right

**Table 31:** Fitting left/fitting right (indicates which fitting is used on both ends of the capillary)

| Key | Description |
|---|---|
| W | Swagelok + 0.8 mm Port id |
| S | Swagelok + 1.6 mm Port id |
| M | Metric M4 + 0.8 mm Port id |
| E | Metric M3 + 1.6 mm Port id |
| U | Swagelok union |
| L | Long |
| X | Extra long |
| H | Long head |
| G | Small head SW 4 |
| N | Small head SW 5 |
| F | Finger-tight |
| V | 1200 bar |
| B | Bio |
| P | PEEK |
| I | Intermediate |

# Waste Electrical and Electronic Equipment (WEEE) Directive

This product complies with the European WEEE Directive marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

**NOTE**

Do not dispose of in domestic household waste
To return unwanted products, contact your local Agilent office, or see https://www.agilent.com for more information.

# Radio Interference

Cables supplied by Agilent Technologies are screened to provide optimized protection against radio interference. All cables are in compliance with safety or EMC regulations.

## Test and Measurement

If test and measurement equipment is operated with unscreened cables, or used for measurements on open set-ups, the user has to assure that under operating conditions the radio interference limits are still met within the premises.

# Sound Emission

## Sound Pressure

Sound pressure Lp < 70 db(A) according to DIN EN ISO 7779

## Schalldruckpegel

Schalldruckpegel Lp < 70 db(A) nach DIN EN ISO 7779

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https://www.agilent.com

## In This Book

This manual contains technical reference information about the Agilent 1260 Infinity III Binary Pump (G7112B). The manual describes the following:

- introduction,
- site requirements and specifications,
- using the binary pump,
- optimizing performance,
- troubleshooting and diagnostics,
- maintenance,
- parts and materials for maintenance,
- identifying cables,
- hardware information,
- appendix.

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