Agilent 1290 Infinity Quaternary Pump

User Manual

Agilent Technologies

Notices

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CAUTION

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WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

In This Guide...

This manual covers the Agilent 1290 Infinity Quaternary Pump (G4204A).

1 Introduction

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

2 Site Requirements and Specifications

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

3 Installing the Module

This chapter gives information about the preferred stack setup for your system and the installation of your Agilent 1290 Infinity Quaternary Pump.

4 Using the Pump

This chapter explains the operational parameters of the Agilent 1290 Infinity Quaternary Pump.

5 How to Optimize the Performance of Your Module

This chapter gives hints on how to optimize the performance or use additional devices.

6 Troubleshooting and Diagnostics

Overview about the troubleshooting and diagnostic features.

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.

8 Test Functions and Calibrations

This chapter will describe the tests for the module.

9 Maintenance

This chapter describes the maintenance of the Agilent 1290 Infinity Quaternary Pump.

10 Parts and Materials

This chapter provides information on parts for maintenance.

11 Identifying Cables

This chapter provides information on cables used with the Agilent 1200 Infinity Series modules.

12 Hardware Information

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

13 LAN Configuration

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

14 Appendix

This chapter provides additional information on safety, legal and web.

Contents

1
Introduction

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

Features

The G4204A Quaternary Pump is designed for highest performance, GLP compliance and easy maintenance. It includes the following features:

- Optional seal wash for continued high lifetime of pump seals for buffer applications.
- Optional Jet Weaver for optimum mixing performance with a minimum of delay volume.
- Automatic purge function for ease of use and unattended preparation of the system.
- Auto tuning of the delivery cycle for compensation of elasticity and solvent volume change effects (compressibility, thermal expansion).
- Solvent selection for optimum flow accuracy.
- Fast defill function for improved intake and delivery performance.
- Two pistons in series design for increased reliability.
- High resolution piston movement control for smooth and reliable motion.

For specifications, see “Performance Specifications” on page 28.

Overview of the Quaternary Pump

The Agilent 1290 Infinity Quaternary Pump has a built-in 4-channel vacuum degasser for best flow stability, especially at low flow rates and maximum detector sensitivity. It uses a multi-channel gradient valve (MCGV) for formation of quaternary gradients at low pressure. The low-pressure Inlet Weaver based on patented Agilent microfluidic technology ensures highest mixing performance and lowest mixing noise. The pump head offers a high power range with a maximum pressure of 1200 bar and a maximum flow rate of 5 mL/min. The Multi Purpose Valve can be used for automatic purging, using an optional Jet Weaver high-performance mixer, automatic back-flushing of the filter or for diagnostic.

The Agilent 1290 Infinity Quaternary Pump is suitable for a wide range of columns and HPLC und UHPLC applications starting from typical 250 x 4.6 mm HPLC columns going down to high resolution 50 x 2.1 mm UHPLC columns and can be used in a flow range between 0.05 – 5 mL/min. Active seal wash is optionally available for use with concentrated buffer solutions.

Operating Principle

The pump head comprises two pump chambers in series with independent high-resolution motion control. A pressure sensor in the flow path monitors the pressure. The pump control uses this signal for minimizing the pressure ripple in order to achieve highest flow precision. A stable flow can be delivered even in case of eventual small internal leaks, which can be compensated automatically. A heat exchanger between two pump chambers strongly reduces thermal effects due to solvent compression under very high pressures.

As solvents are compressed by the pump head and expand further down the flow path, for example in the column, the volumetric flow is changed depending on the compressibility of the liquid. Agilent control software allows specifying pure solvents, pre-mixed solvents and solvent gradients. Associated Agilent solvent libraries are used by the pump control for enhanced flow accuracy, which is required for cross-instrument or cross-system reproducibility and method compatibility.

A high resolution encoder unit is attached to the pump drives, which divides a single turn into 65000 steps. Each step corresponds to a volume of about 300 pL, which allows an extremely precise control.

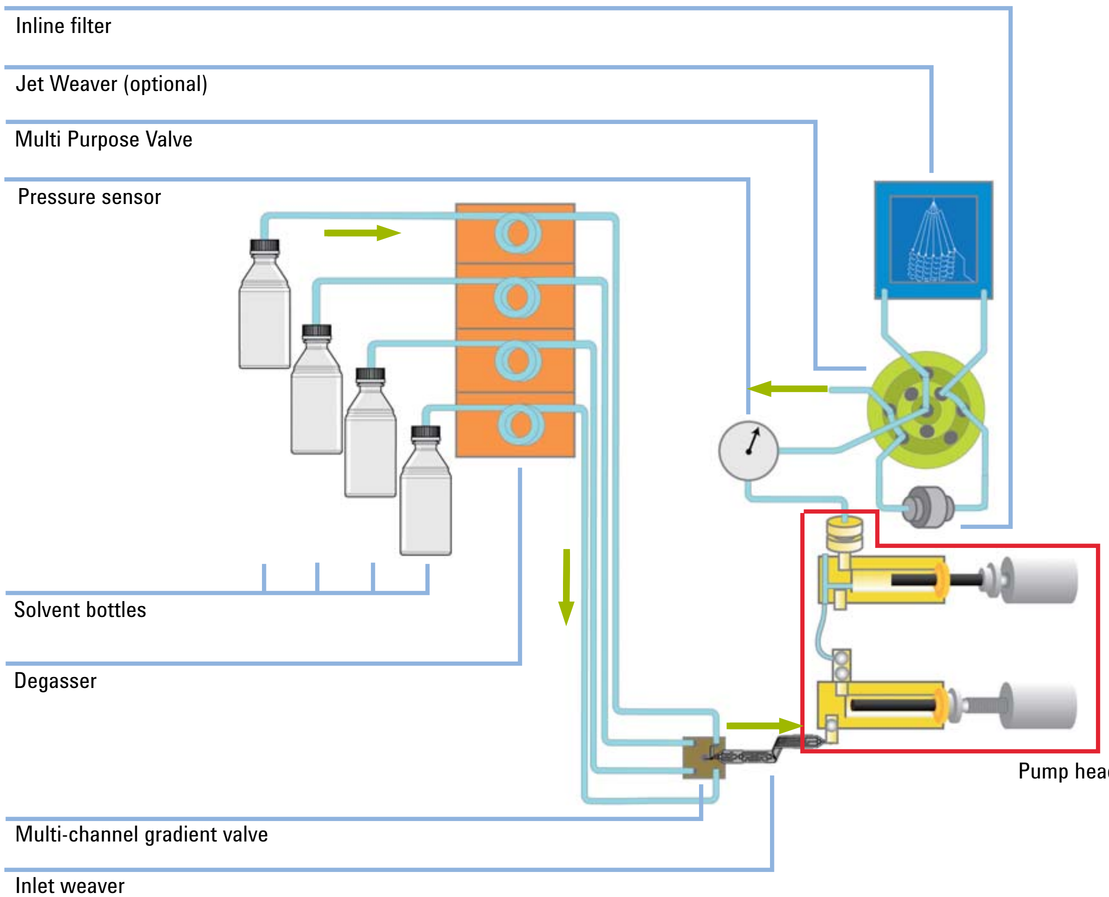


Figure 1 The hydraulic path

Positions of the Multi Purpose Valve

The Multi Purpose Valve allows easy software controlled switching between different modes of operation.

Normal Operating Mode Without Mixer

In normal operating mode, the flow comes from the pump head, passes the pressure sensor and arrives at the central port of the Multi Purpose Valve. The flow passes the inline filter and leaves the valve through port 4 to the system (autosampler etc.).

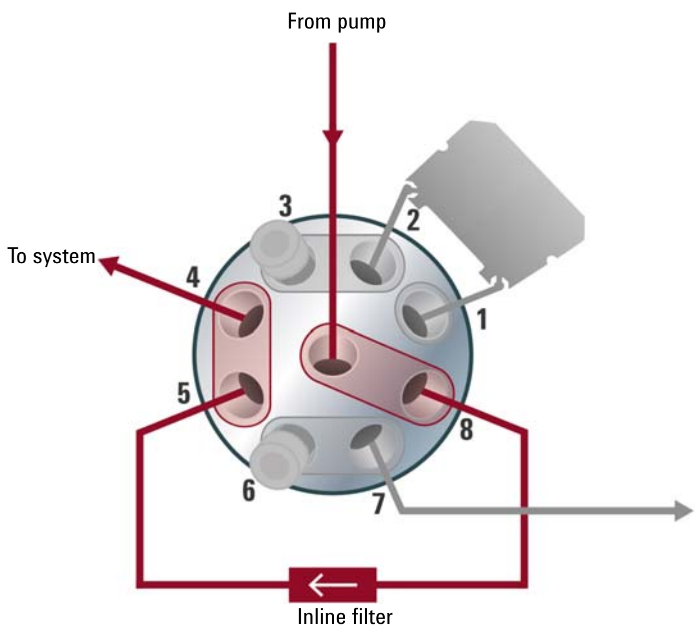


Figure 2 Valve position in normal operating mode without mixer

Purge Mode

In purge mode, the flow is diverted to the waste container.

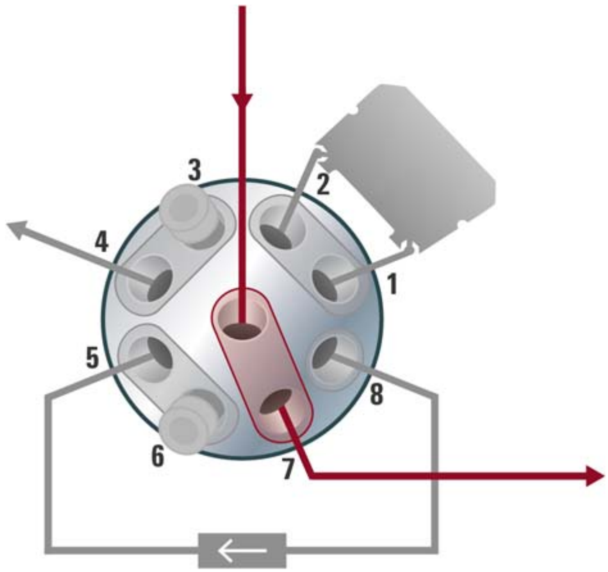


Figure 3 Valve position in purge mode

Normal Operating Mode With Mixer

In this mode, the flow passes an optional Jet Weaver and the inline filter. This configuration is recommended for special applications which require an increased mixing efficiency.

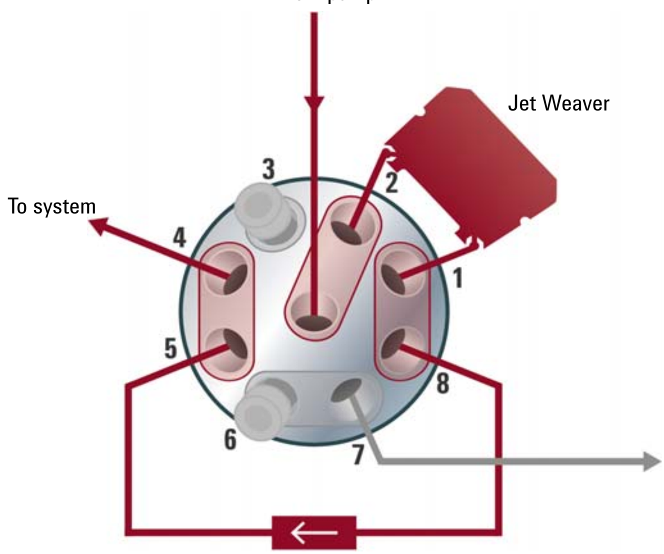


Figure 4 Valve position in normal operating mode with mixer

Filter Flush Mode

This mode is used for cleaning the inline filter by back-flushing it. The flow goes to port 5, passes the inline filter in opposite direction and leaves to the waste through port 7.

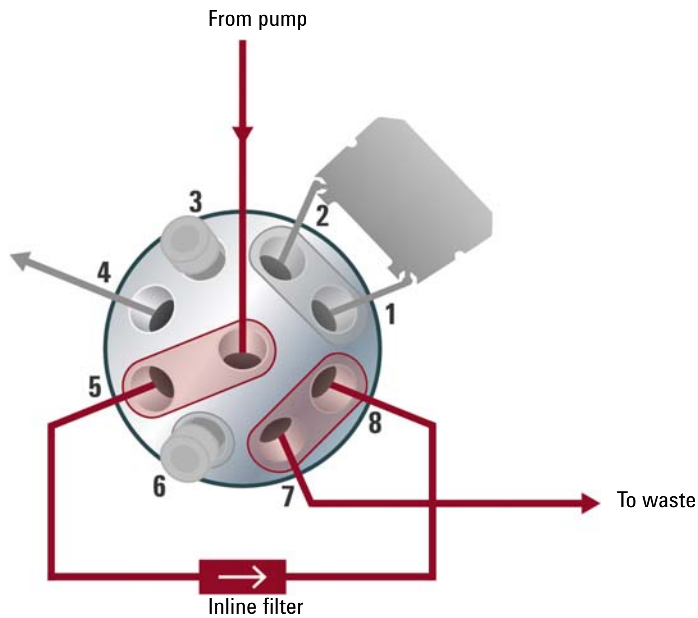


Figure 5 Valve position in filter flush mode

Service Mode

In service mode, the flow is diverted to port 3, where for example a restriction capillary can be installed for diagnostic tests.

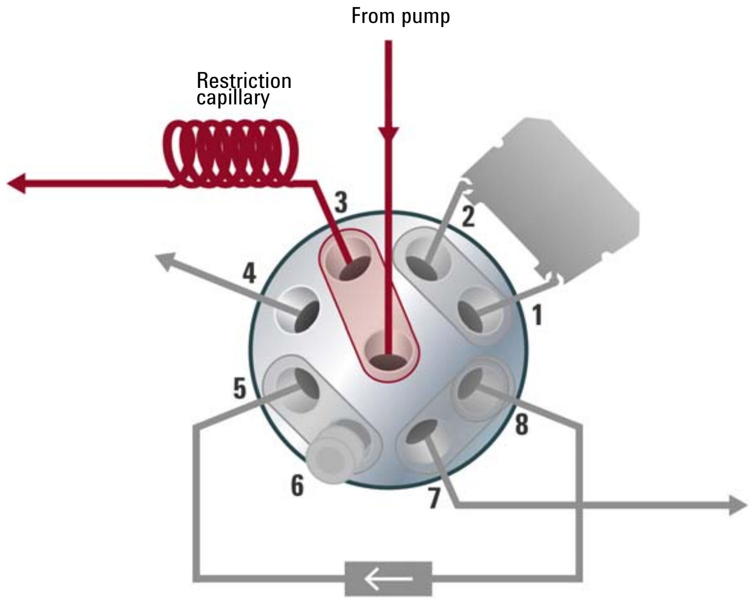


Figure 6 Valve position in service mode

System Overview

Leak and Waste Handling

The 1200 Infinity Series has been designed for safe leak and waste handling. It is important that all security concepts are understood and instructions are carefully followed.

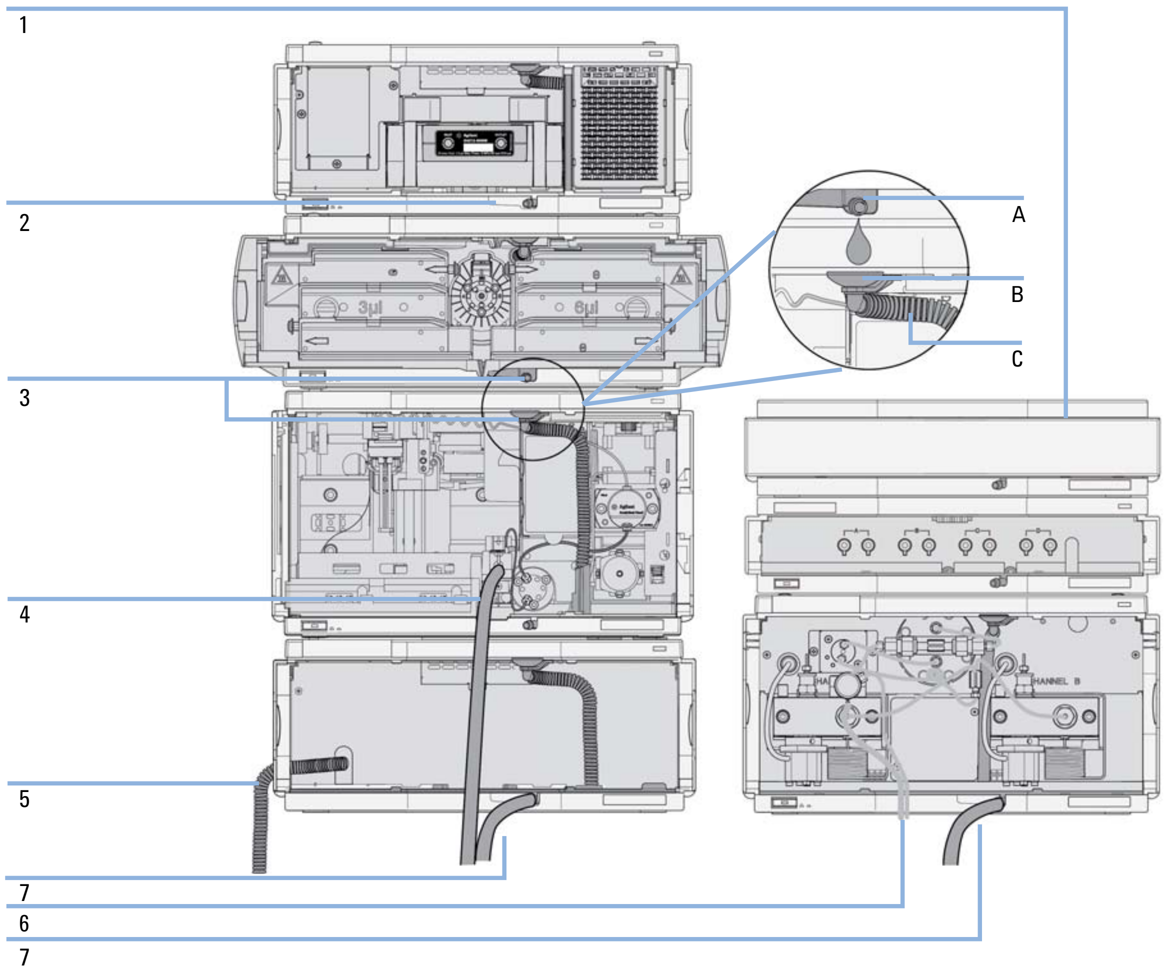


Figure 7 Leak and waste handling concept (overview - typical stack configuration as an example)

The solvent cabinet (1) is designed to store a maximum volume of 6 L solvent. The maximum volume for an individual bottle stored in the solvent cabinet should not exceed 2.5 L. For details, see the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets (a printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet).

The leak pan (2) (individually designed in each module) guides solvents to the front of the module. The concept covers also leakages on internal parts (e.g. the detector's flow cell). The leak sensor in the leak pan stops the running system as soon as the leak detection level is reached.

The leak pan's outlet port (3, A) guides excessive overfill from one module to the next, as the solvent flows into the next module's leak funnel (3, B) and the connected corrugated waste tube (3, C). The corrugated waste tube guides the solvent to the next lower positioned module's leak tray and sensor.

The waste tube of the sampler's needle wash port (4) guides solvents to waste.

The condense drain outlet of the autosampler cooler (5) guides condensate to waste.

The waste tube of the purge valve (6) guides solvents to waste.

The waste tube connected to the leak pan outlet on each of the bottom instruments (7) guides the solvent to a suitable waste container.

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 Considerations

The module power supply has wide ranging capability. It accepts any line voltage in the range described in Table 1 on page 27. 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

Hazard of electrical shock or damage of your instrumentation

can result, if the devices are connected to a line voltage higher than specified.

→ Connect your instrument to the specified line voltage only.

WARNING

The 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. electrical shock, when the cover is opened and the module is connected to power.

→ Always unplug the power cable before opening the cover.

→ Do not connect the power cable to the instrument while the covers are removed.

CAUTION

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.

Power Cords

Different power cords are offered as options with 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.

WARNING

Absence of ground connection or use of unspecified power cord

The absence of ground connection or the use of unspecified power cord can lead to electric shock or short circuit.

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

→ Never use a power cord other than the Agilent Technologies power cord designed for your region.

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.

WARNING

Unintended use of supplied power cords

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

→ Never use the power cords that Agilent Technologies supplies with this instrument for any other equipment.

Bench Space

The module dimensions and weight (see Table 1 on page 27) 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.

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.

Physical Specifications

Table 1 Physical Specifications

Type	Specification	Comments
Weight	15.2 kg (33.4 lbs)	
Dimensions (height × width × depth)	200 x 345 x 435 mm (8 x 13.5 x 17 inches)	
Line voltage	100 – 240 V~, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	220 VA / 180 W / 615 BTU/h	Maximum
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 2000 m (6562 ft)	
Non-operating altitude	Up to 4600 m (15092 ft)	For storing the module
Safety standards: IEC, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.

Performance Specifications

Table 2 Performance specifications

Type	Specification	Comments
Hydraulic system	Dual pistons in series pump with proprietary servo-controlled variable stroke design, power transmission by ball screws, smooth motion control of pistons for active damping.	
Settable flow range	0.001—5 mL/min, in 0.001 mL/min increments.	Executed in 300 pL/step increments
Flow precision	≤0.07 % RSD or 0.01 min SD, whatever is greater (0.2—5.0 mL/min).	Based on retention time at constant room temperature.
Flow accuracy	±1 % or ± 10 µL/min, whatever is greater.	Pumping degassed H_2O at 10 MPa (100 bar)
Maximum operating pressure	Operating range up to 120 MPa (1200 bar), up to 2 mL/min, ramping down to 80 MPa (800 bar) up to 5 mL/min.	
Pressure pulsation	<1 % amplitude or < 0.5 MPa (5 bar), whatever is greater.	At 1 mL/min water
Compressibility compensation	Automatic, pre-defined, based on mobile phase selection.	
Gradient formation	Low pressure quaternary mixing	
Delay volume	Standard configuration: <350 µL With optional V380 Jet Weaver: <500 µL	
Composition range	Settable range: 0 – 100 %	Recommended range: 1 – 99 % or 5 µL/min per channel, whatever is greater.

Table 2 Performance specifications

Type	Specification	Comments
Composition precision	<0.15 % RSD, or 0.02 min SD, whatever is greater (1 mL/min).	Based on retention time at constant room temperature
Composition accuracy	±0.40 % absolute (1 – 99 % B, 0.5 – 2.0 mL/min with water/caffeine tracer, 400 bar)	
Integrated degassing unit	Number of channels: 4 Internal volume per channel: 1.5 mL	
Control	Agilent ChemStation for LC (C.01.04 or above) OpenLAB (A.04.04) Masshunter (B.05.01 or above)	
Local control	Agilent Instant Pilot (G4208A) (B.02.08 or above)	
Communications	Controller-area network (CAN), RS232C, APG remote: ready, start, stop and shutdown signals, LAN	
Safety and maintenance	Extensive diagnostics, error detection and display through Agilent LabAdvisor, 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 recyclable.	

3
Installing the Module

This chapter gives information about the preferred stack setup for your system and the installation of your Agilent 1290 Infinity Quaternary Pump.

Unpacking the Module

Damaged Packaging

If the delivery packaging shows signs of external damage, please call your Agilent Technologies sales and service office immediately. Inform your service representative that the instrument may have been damaged during shipment.

CAUTION

"Defective on arrival" problems

If there are signs of damage, please do not attempt to install the module. Inspection by Agilent is required to evaluate if the instrument is in good condition or damaged.

→ Notify your Agilent sales and service office about the damage.

→ An Agilent service representative will inspect the instrument at your site and initiate appropriate actions.

Delivery Checklist

Ensure all parts and materials have been delivered with your module. The delivery checklist is included to your shipment. For parts identification please check the illustrated parts breakdown in "Parts and Materials" on page 201. Please report any missing or damaged parts to your local Agilent Technologies sales and service office.

Optimizing the Stack Configuration

If your module is part of a complete Agilent 1290 Infinity Liquid Chromatograph, you can ensure optimum performance by installing the following configurations. These configurations optimize the system flow path, ensuring minimum delay volume.

For other possible configurations, please refer to the Agilent 1290 Infinity System Manual.

One Stack Configuration

Ensure optimum performance by installing the modules of the Agilent 1290 Infinity Quaternary LC System in the following configuration (see Figure 8 on page 35 and Figure 9 on page 36). This configuration optimizes the flow path for minimum delay volume and minimizes the bench space required.

The Agilent 1290 Infinity Quaternary Pump should always be installed at the bottom of the stack.

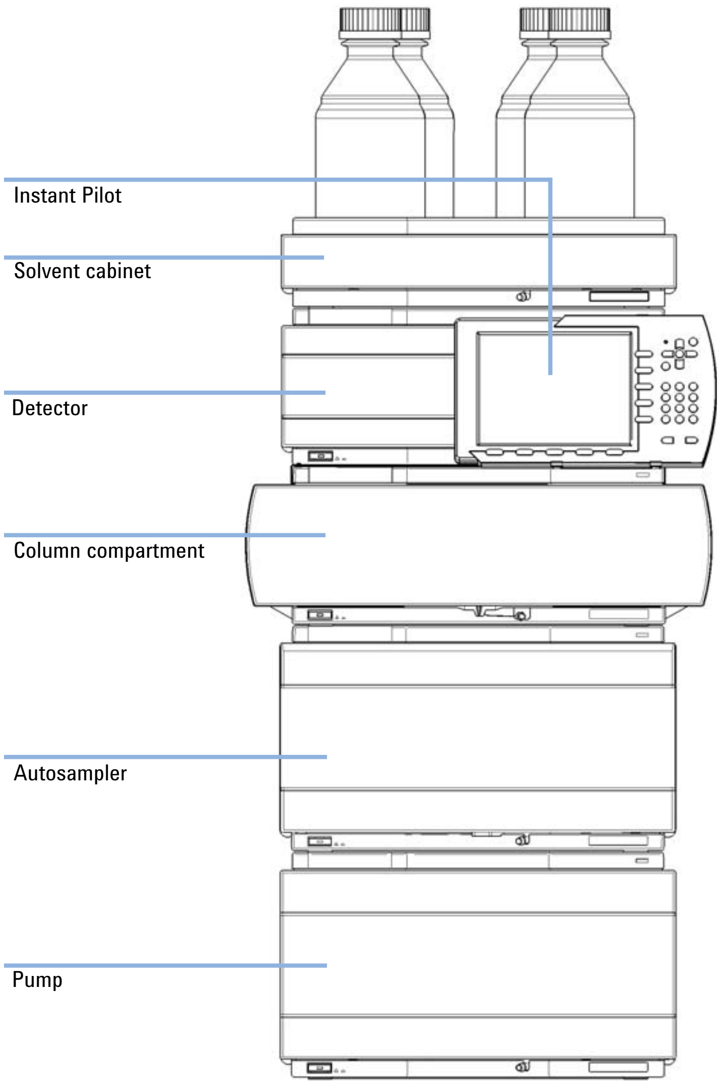


Figure 8 Recommended stack configuration for 1290 Infinity with quaternary pump (front view)

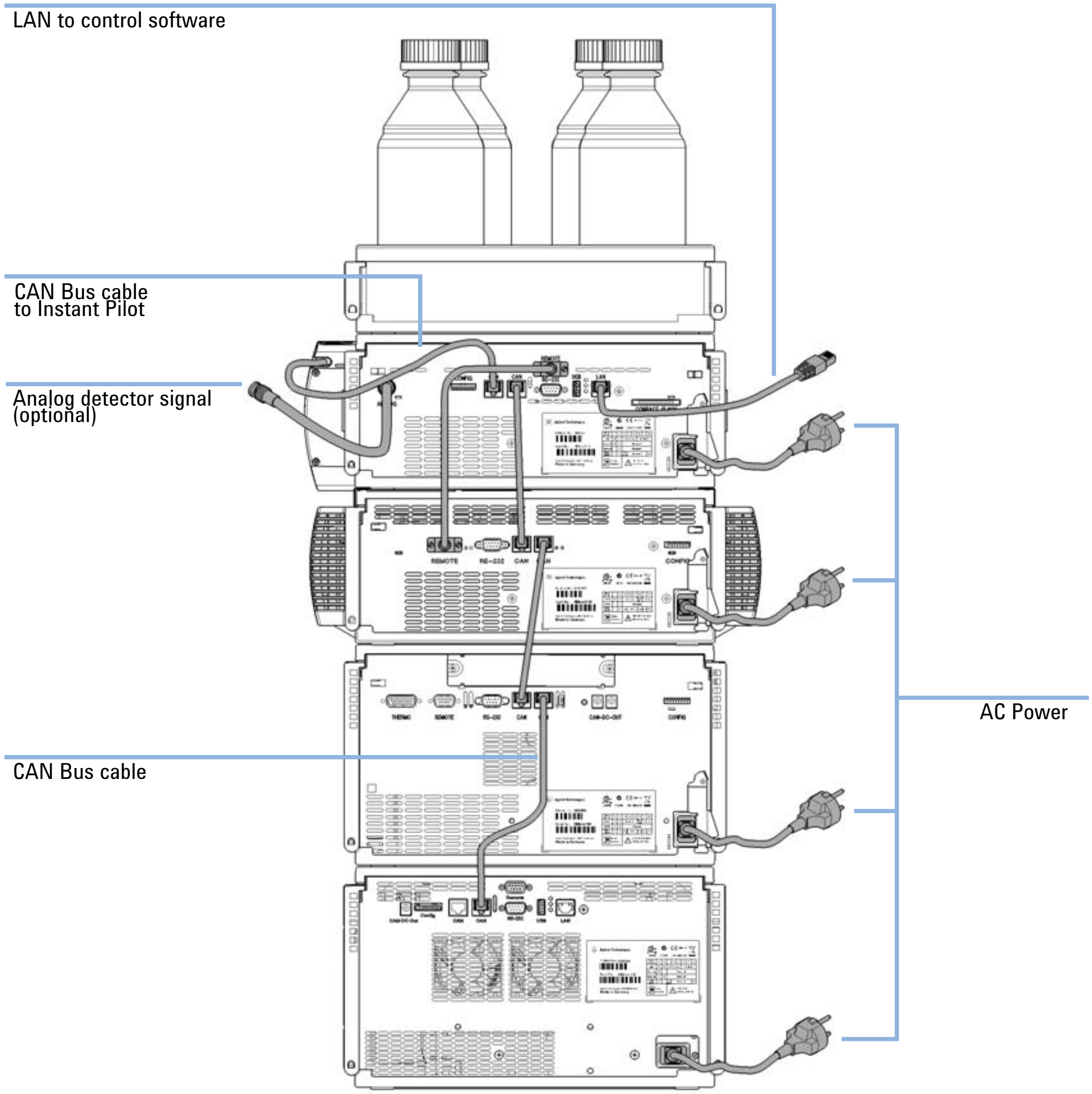


Figure 9 Recommended stack configuration for 1290 Infinity with quaternary pump (rear view)

Two Stack Configuration

In case the autosampler thermostat is added to the system, a two-stack configuration is recommended, which places both heavy modules (1290 Infinity pump and thermostat) at the bottom of each stack and avoids high stacks. Some users prefer the lower height of this arrangement even without the autosampler thermostat. A slightly longer capillary is required between the pump and autosampler. (See Figure 10 on page 37 and Figure 11 on page 38).

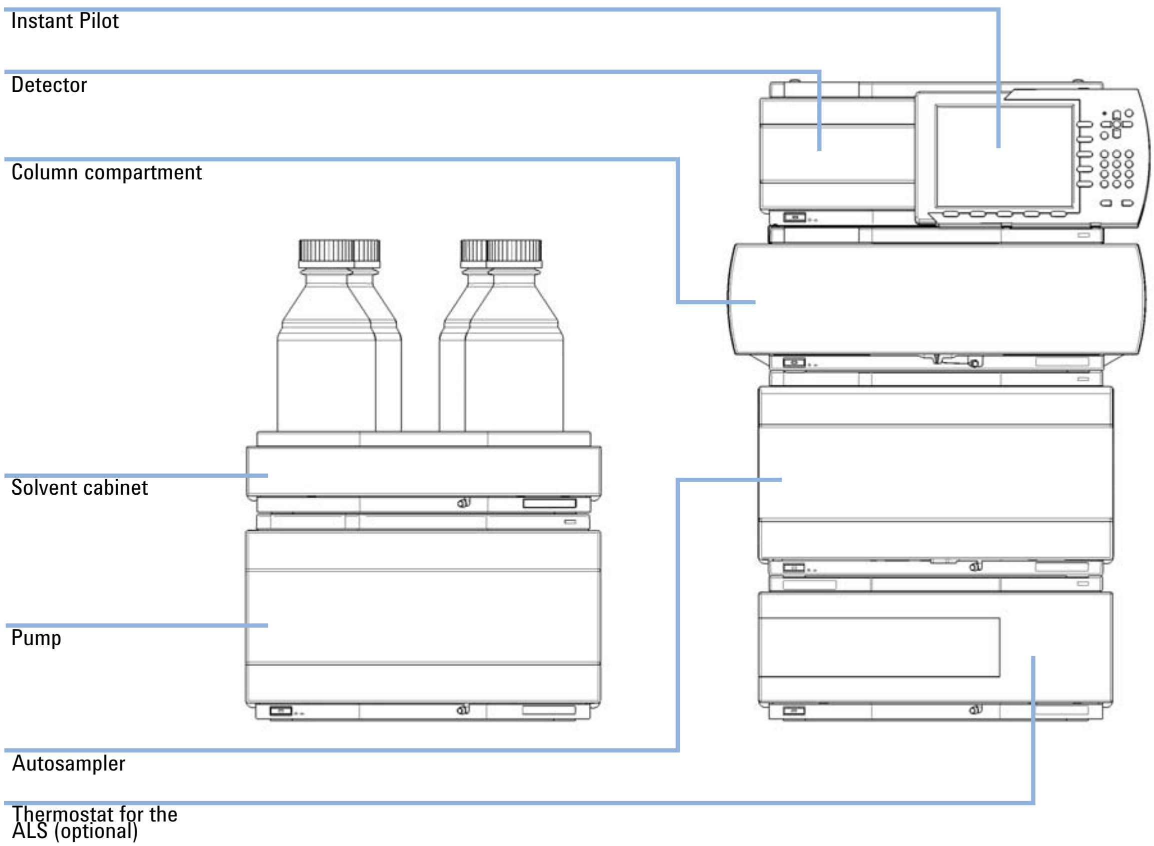


Figure 10 Recommended two stack configuration for 1290 Infinity with quaternary pump (front view)

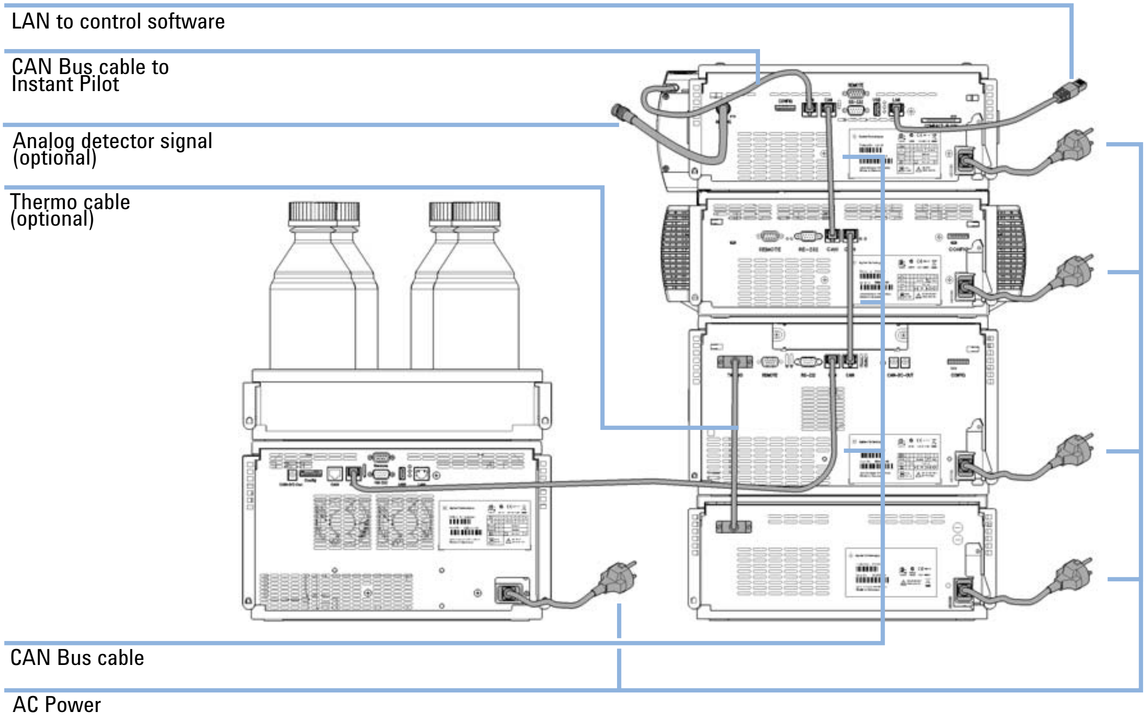


Figure 11 Recommended two stack configuration for 1290 Infinity with quaternary pump (rear view)

Installation Information on Leak and Waste Handling

The Agilent 1200 Infinity Series has been designed for safe leak and waste handling. It is important that all security concepts are understood and instructions are carefully followed.

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.

→ Never exceed the maximal permissible volume of solvents (6 L) in the solvent cabinet.

→ Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.

→ Arrange the bottles as specified in the usage guideline for the solvent cabinet.

→ A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet.

NOTE

Recommendations for Solvent Cabinet

For details, see the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.

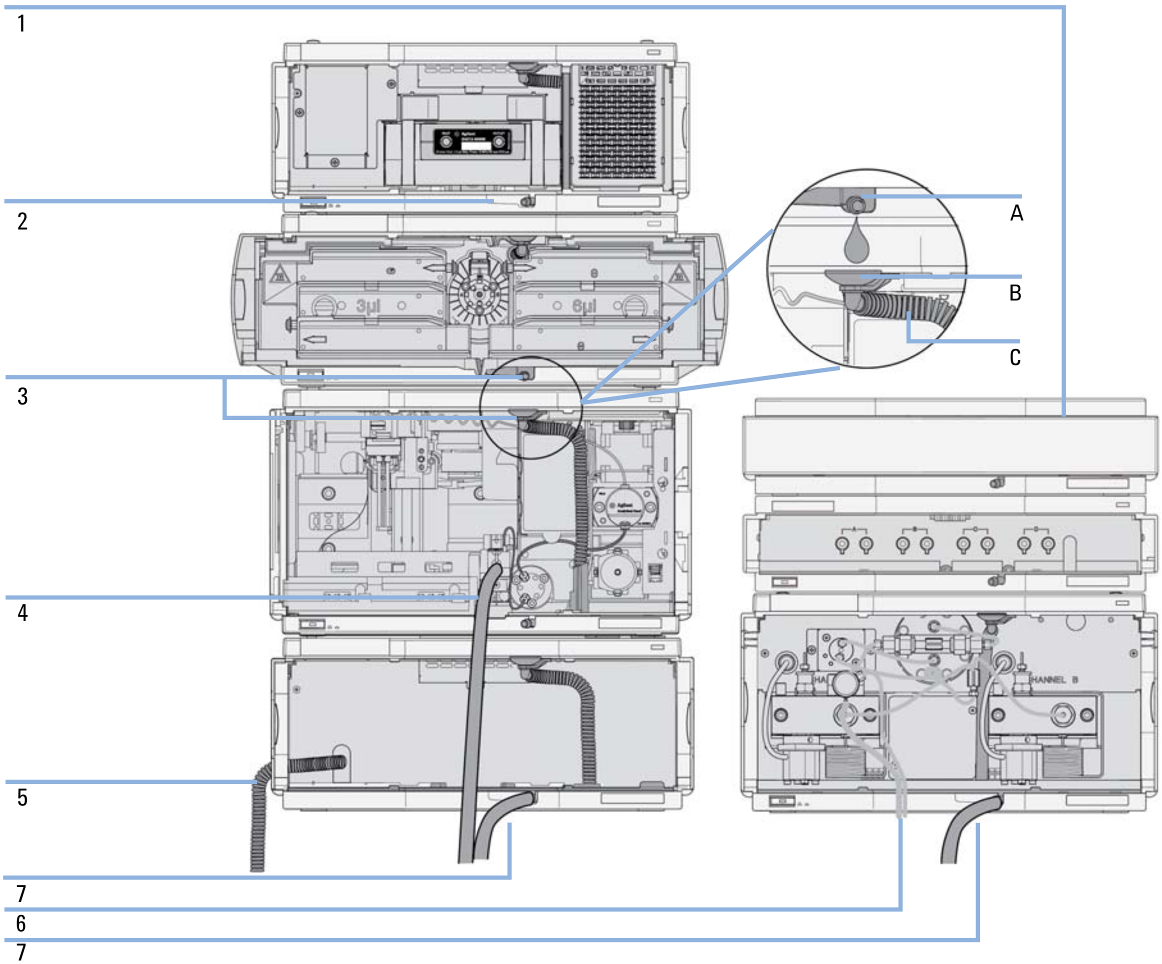


Figure 12 Leak and waste handling (overview - typical stack configuration as an example)

1	Solvent cabinet
2	Leak pan
3	Leak pan's outlet port (A), leak funnel (B) and corrugated waste tube (C)
4	Waste tube of the sampler’s needle wash
5	Condense drain outlet of the autosampler cooler
6	Waste tube of the purge valve
7	Waste tube

1 Stack the modules according to the adequate stack configuration.

   The leak pan outlet of the upper module must be vertically positioned above the leak tray of the lower module, see Figure 12 on page 40.

2 Connect data and power cables to the modules, see section *Installing the Module* below.

3 Connect capillaries and tubes to the modules, see section *Flow Connections to the module* below or the relevant system manual.

WARNING

Toxic, flammable and hazardous solvents, samples and reagents

→ Keep solvent path free from blockages.

→ Keep the flow path closed (in case the pump in the system is equipped with a passive inlet valve, solvent may leak out due to hydrostatic pressure, even if your instrument is off).

→ Avoid loops.

→ Tubes must not sag.

→ Do not bend tubes.

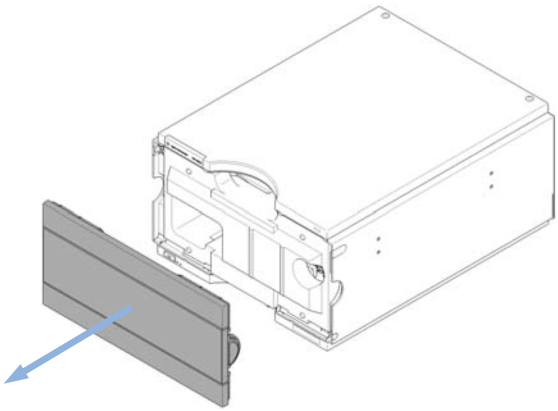
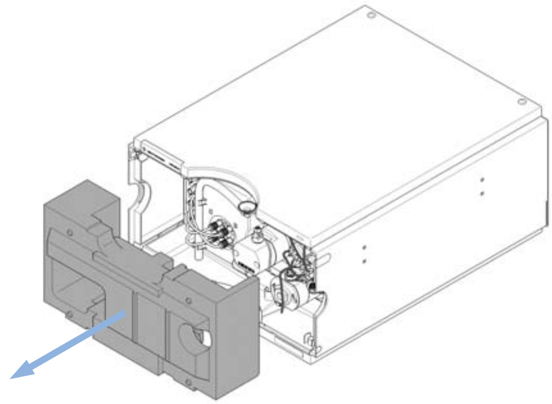
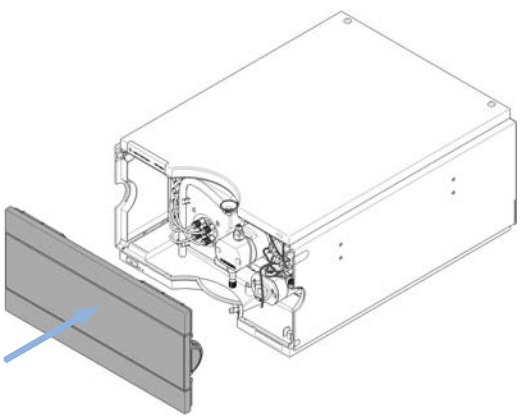
→ Do not immerse tube end in waste liquid.

→ Do not intubate tubes in other tubes.

→ For correct tubing follow instructions on label attached to the module.

Figure 13 Warning label (illustration for correct waste tubing)

Removing the Transport Foam

<table>
<tr><td>1 Open the front cover of the module.
</td><td>2 Carfully remove the protective foam.
</td></tr>
<tr><td>3 Close the front cover.
</td><td></td></tr>
</table>

Installing the Pump

Parts required	#	Description
	1	Pump
	1	Power cord
	1	Agilent Control Software and/or Instant Pilot G4208

Preparations	
	Locate bench space
	Provide power connections
	Unpack the pump

1 Place the module on the bench in a horizontal position.
2 Ensure the power switch on the front of the module is OFF (switch stands out).

Figure 14 Front view of the quaternary pump

3 Connect the power cable to the power connector at the back of the module.

4 Connect the required interface cables to the rear of the pump.

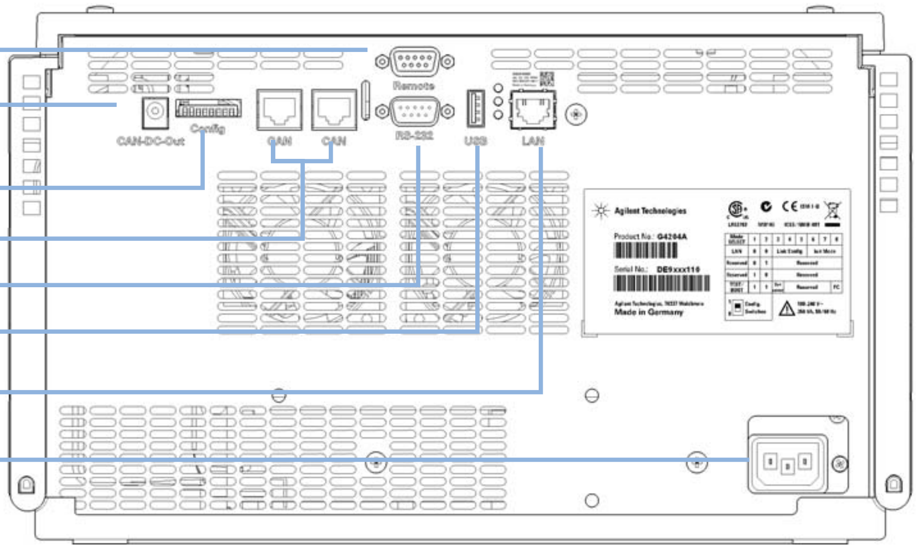


Figure 15 Rear view of the quaternary pump

NOTE In an Agilent 1290 Infinity System, the individual modules are connected by CAN cables. An Agilent 1200 Series Instant Pilot can be connected to the CAN bus of any module. Connection to an Agilent data system is established through the built-in LAN port of the detector. The LAN port of the detector must be used as the detector generates the highest data rate of all modules. For more information about connecting the Instant Pilot or Agilent Data System, please refer to the respective user manual. For setting up the LAN access, see "LAN Configuration" on page 259.

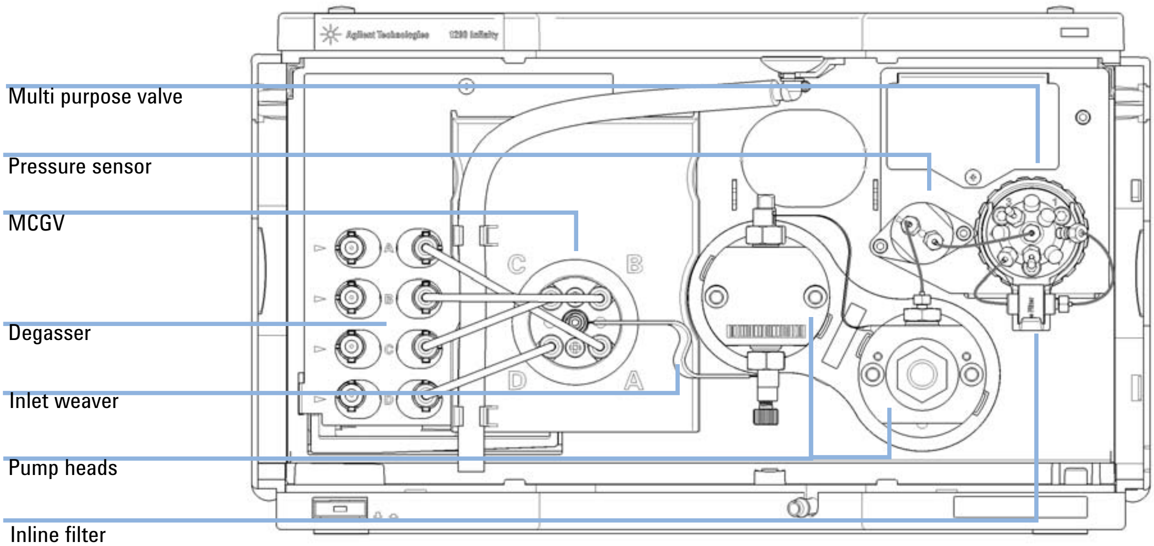
5 Turn on the power by pushing the button at the lower left hand side of the module.

The power button stays pressed in and the status LED should be green.

NOTE When the line power button stands out and the green light is off, the module is turned off.

NOTE The module was shipped with default configuration settings. For changing these settings, refer to section *Setting the 8-bit configuration switch*.

Flow Connections to the Pump



The pump is shipped with tubing and capillary connections installed between degassing unit, MCGV, pump heads, pressure sensor, filter and Multi Purpose Valve. This section describes the installation of additional flow connections.

Parts required	p/n	Description
		Other modules
	G4220-68755	Accessory Kit
	5067-4644	Solvent Cabinet Kit 1290 Infinity Pump

Preparations Pump is installed in the LC system.

WARNING

Toxic, flammable and hazardous solvents, samples and reagents

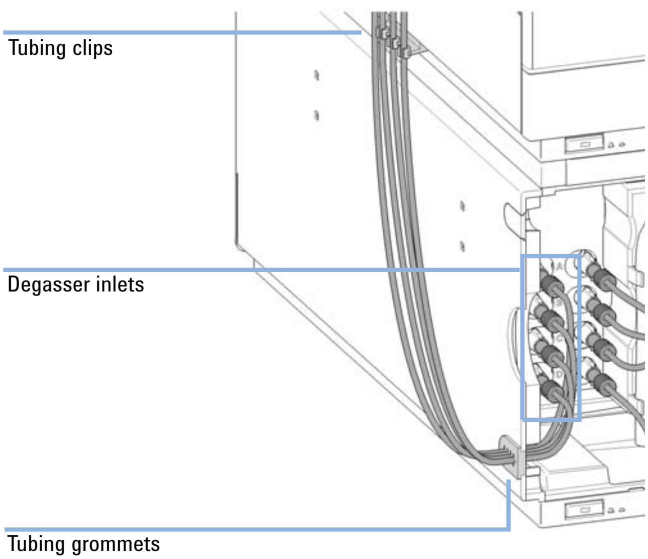
The handling of solvents, samples and reagents can hold health and safety risks.

→ 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.

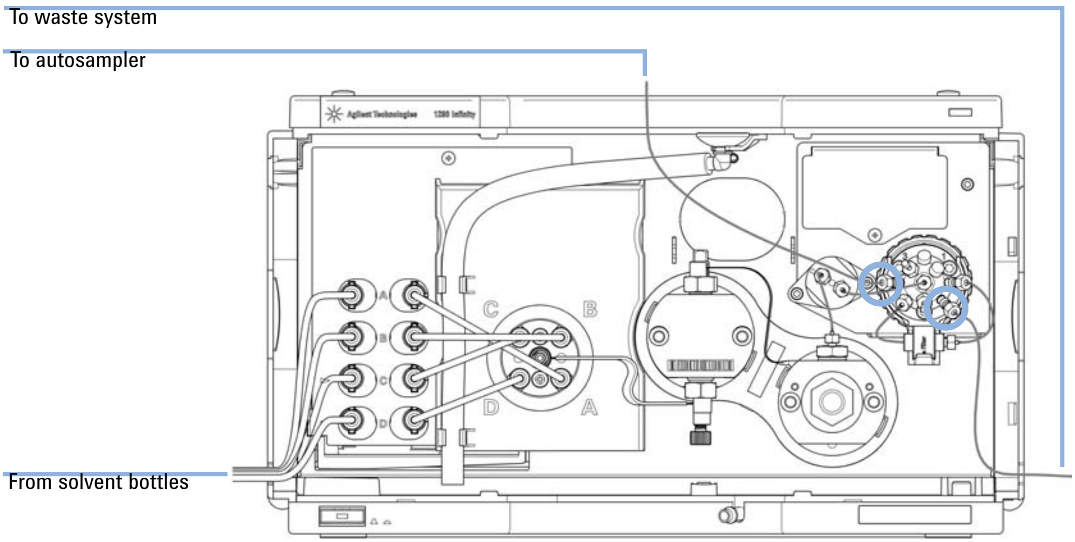
→ Do not operate the instrument in an explosive atmosphere.

1 Remove the front cover by pressing the snap fasteners on both sides.
2 Place the solvent cabinet on top of the UHPLC stack.
3 Put the bottle-head assemblies into empty solvent reservoirs and place the bottle in the solvent cabinet.
4 Route tubing connections along the left side of the UHPLC stack using tube clips.
5 Connect the inlet tubes of the bottle-head assemblies to the inlet connectors A to D at the left hand side of the vacuum degasser. Fix the tubes in the tubing grommets of the pump.



6 Connect the capillary from the autosampler to port 4 of the Multi Purpose Valve.

7 Connect the waste tubing to port 7 of the Multi Purpose Valve and place it in your waste system.

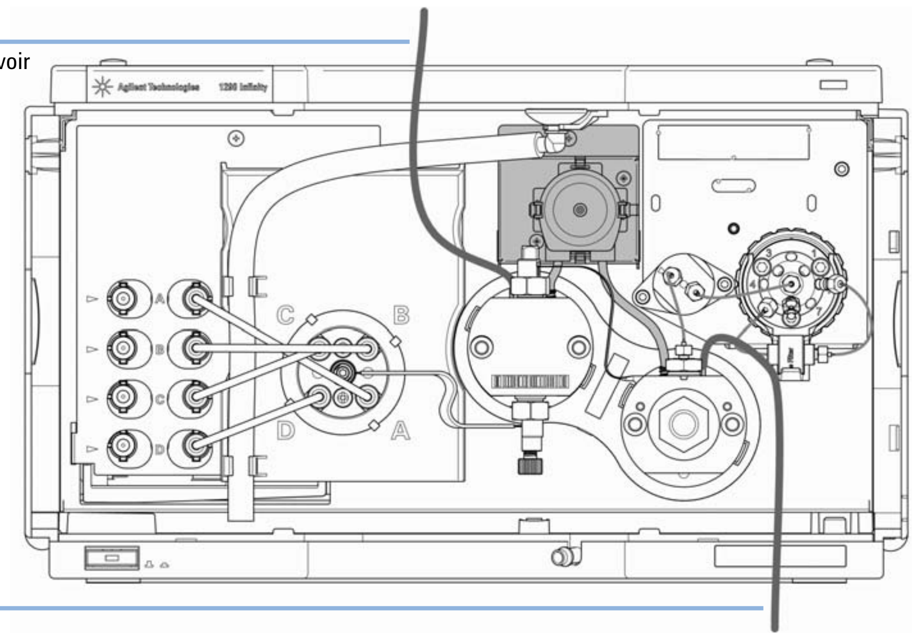


8 If the pump is not part of an Agilent 1290 Infinity system stack or placed on the bottom of a stack, connect the waste tube to the waste outlet of the pump leak handling system.

9 Fill solvent reservoirs with your mobile phase.

10 Prime your system before first use (see “Priming the Pump” on page 68).

Installation of Seal Wash Option



The 1290 Infinity Quaternary Pump is optionally available with a seal wash function. This option is recommended when using buffers or other non-volatile solvents or additives that could deposit on pistons and seals. It is used for regularly cleaning these parts automatically.

1. Place a wash solvent reservoir into the solvent cabinet. A mixture of distilled water and isopropanol (90/10) is a good choice for many applications.
2. Put the solvent inlet tube into the solvent reservoir, close it and connect the tube to the seal wash pump.
3. Route the outlet of the wash tube into a waste container.

4
Using the Pump

This chapter explains the operational parameters of the Agilent 1290 Infinity Quaternary Pump.

Leak and Waste Handling

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.
- → Never exceed the maximal permissible volume of solvents (6 L) in the solvent cabinet.
- → Do not use bottles that exceed the maximum permissible volume as specified in the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.
- → Arrange the bottles as specified in the usage guideline for the solvent cabinet.
- → A printed copy of the guideline has been shipped with the solvent cabinet, electronic copies are available on the Internet.
- → Ground the waste container.
- → The residual free volume in the appropriate waste container must be large enough to collect the waste liquid.
- → Check the filling level of the waste container regularly.
- → To achieve maximal safety, check the correct installation regularly.
- → Do not use solvents with an auto-ignition temperature below 200 °C (392 °F).

NOTE

Recommendations for Solvent Cabinet

For details, see the usage guideline for the Agilent 1200 Infinity Series Solvent Cabinets.

For details on correct installation, see section *Installation Information on Leak and Waste Handling* in the service manual.

Preparing the Pump

For best performance of the pump:

- Place solvent cabinet with the solvent bottles always on top (or at a higher level) of the pump.
- For optimum performance, always use the built-in degasser.
- When using the pump with vacuum degassing unit, flush the degassing unit 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 “Algae Growth in HPLC Systems” on page 54.
- Check pump outlet filters and column frit in regular time intervals. A blocked pump outlet filter can be identified by black, yellow or greenish layers on its surface.
- When using buffer solutions, flush the system with water before switching it off.
- The optional seal wash function should be used when buffer solutions with concentrations of 0.1 M or higher are being pumped for long periods of time.
- Never leave an unused pump with water in a channel for an extended period of time (2-3 days). Always flush with organic solvent or add 10 % isopropanol to water.

Algae Growth in HPLC Systems

The presence of algae in HPLC systems can cause a variety of problems that may be incorrectly diagnosed as instrument or application problems. Algae grow in aqueous media, preferably in a pH range of 4-8. 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:

- 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.
- Small pore high pressure solvent filters, usually placed before the injector to plug resulting in high system pressure.
- PTFE frits blockage leading to increased system pressure.
- Column filters to plug giving high system pressure.
- Flow cell windows of detectors to become dirty 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 about 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 (Solvent bottle, amber (9301-1450)) 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.

Setting up the Pump with the Instrument Control Interface

Overview

Parameters described in following sections is offered by the instrument control interface and can usually be accessed through Agilent instrument control software. For details, please refer to manuals and online help of respective user interfaces.

Instrument Configuration

Use the **Instrument Configuration** dialog box to examine and, if necessary, modify your instrument configuration. The **Configurable Modules** panel contains a list of all modules available for configuration. The **Selected Modules** panel contains the list of configured modules.

Auto Configuration: Under **Communication settings**, select either the **Host Name** option or the **IP address** option and enter the appropriate value for the host computer to enable automatic detection of the hardware configuration. The system configures the instrument automatically with no further manual configuration necessary.

The Quaternary Pump configuration parameters are in two sections:

- **Communication**
- **Options**

Communication: The parameters in this dialog box are detected automatically during autoconfiguration.

- **Device name**,
- **Type ID**,
- **Serial number**,
- **Firmware revision**,
- Button **Connection settings**

Options:

- **Pressure Unit**:

  select the pressure units from the drop-down list (bar, psi or MPa).

- **Seal wash installed**:

  This check box is marked to indicate that an optional seal wash has been detected during autoconfiguration.

- **Installed mixer**:

  The installed mixer is detected during autoconfiguration. For manual configuration, click the down-arrow and select the installed mixer from the list or choose **No mixer installed**.

Configure Solvent Type Catalogs: Displays the **Solvent Type Catalogs** dialog box, which allows you to import and export solvent calibration data. See "Importing Solvent Calibration Tables" on page 88.

Please refer to the online help of your user interface for more detailed information.

The Pump User Interface (Dashboard Panel)

Module Graphic

The items in the pump graphic have the following meaning and function:

	Indicates that an External Contacts board is installed.
  	The level of solvent in the bottle is denoted by the green area; when the solvent level falls below the specified volume, the area turns yellow; when the bottle is empty, the area turns red. Clicking on the solvent bottle displays the **Bottle Fillings** dialog box. The tooltip for the bottle shows the solvent name.
	The pressure setpoints. The red line shows the current maximum pressure limit; the green area shows the current pressure (also shown as text).

The current solvent flow rate (in mL/min) is displayed above the pressure display.

Instrument Signals

The following pump signals are displayed:

Flow	The current solvent flow rate (in mL/min).
Pressure	The current pump ressure (in bar, psi or MPa, see "Instrument Configuration" on page 56).
Tuning	Indicates the tuning efforts of 1290 Infinity pumps. For pumps operating as expected, the signal should stay in a range of -1 to +1 within the full scale of -2 to +2.
Pressure Limit	The current maximum pressure limit.
Composition A:B	The contributions of channels A and B to the current solvent composition.
Composition C:D	The contributions of channels C and D to the current solvent composition.
Mixer	The installed mixer type.
Valve position	The current valve position.

Context Menu

The context menu of the dashboard panel contains the following commands:

	**Control**	Displays the pump's **Control** dialog box.
	**Method**	Displays the pump's **Method Setup** dialog box.
	Set Error Method	Sets the method that is loaded if an error occurs to the method that is currently available in the hardware.
	Identify Device	Causes the LED on the front of the module to blink for a few seconds.
	**Switch Pump On/Off**	Toggles the status of the pump, on or off.
	Bottle Fillings	Displays the **Bottle Fillings** dialog box.
	Purge On/Off	Allows you to control the purging of the system.
	Prime On/Off	Allows you to prime the pump heads for initially drawing solvent.
	Conditioning On/Off	Allows you to switch pump conditioning on and off. The conditioning function is useful for removing small air bubbles inside the pump flow path.
	Flush Filter On/Off	Allows you flushing a clogged inline filter, which is connected to the Multi Purpose Valve, see "Filter Flush Mode" on page 17. Use the pump self-test for checking the filter back pressure.

Control Settings

The Quaternary Pump control parameters are in six sections:

- **Pump**
- **Seal Wash**
- **Automatic Turn On**
- **Purge**
- **Prime**
- **Conditioning**

Table 3 Pump control parameters

Parameter	Limits	Description
Pump		Enables you to switch the pump **On**, **Off** or to a **Standby** condition. In the **Standby** condition, the pump motor is still active, and when the pump is switched on again, does not need to be re-initialized.
Seal Wash		The seal wash can be set up to be run once (**Single wash**) or periodically (**Periodic**). • **Off**: no seal wash is used. • **Single wash**: the seal will be purged for a specified time. • **Periodic**: a periodic wash will be applied for a defined period in minutes. The option is available only when the pump has seal wash capability. The seal wash capability is detected by the module itself. If seal wash is installed, it is recommended to use it in order to increase the primary seal lifetime.
Seal Wash Run Mode		Allows you to define when to use the seal wash: • **Off**: The seal wash is inactive. • **On when pump is on**: The seal wash is active only when the pump is on. • **On all the time**: The seal wash is active when the pump is on or in standby mode.
Automatic Turn On		Module can be turned on at a specified date/time. This feature can only be used if the module power switch is turned on.

Table 3 Pump control parameters

Parameter	Limits	Description
Purge	**Time**: 0 – 100.00 min in steps of 0.01 . **Flow**: 0.000 – 5.000 mL/min for each channel, in steps of 0.001	Setup and activation of **Purge** parameters. The automatic purge valve can be used for purging the system. The process has been automated for ease of use. • **Off**: Turns off the purge. • **On**: The device is purged. • **Purge Flow**, **Time** and **Composition** during purge have to be defined. As soon as the duration time of the purge ends, the module automatically switches to analytical conditions again.
Prime		Select **On** to start priming, **Off** to turn priming off. The **Prime** function is helpful for filling empty solvent lines or if air has entered the pump heads. The module draws solvent, at high speed with both pump drives simultaneously, and dispenses it against the waste position of the Multi Purpose Valve. This is done 20 times, before the process comes to an end.
Conditioning	at least 200 bar (> 500 bar is better).	Use this function if you see excessive pressure or composition ripple, and you are sure that the solvent type (aqueous/organic or specific solvent/solvent mix) is correctly set, and there is no evidence of leakage in the pump. Conditioning may be necessary if the pump may contain air, for example after running out of solvent, after a long period of standby or after service or repair.

Method Parameter Settings

The Quaternary Pump method setup parameters are in nine sections:

- **Flow**
- **Solvents A to D**
- **Stoptime**
- **Posttime**
- **Pressure Limits**
- **Timetable**
- **Advanced**
- **Blend Assist**
- **External Contacts**

Table 4 Method parameters

Parameter	Limits	Description
Flow	0.00 – 5.00 mL/min in steps of 0.001 . Recommended flow range: 0.05 – 5.00 mL/min .	The flow is the rate of movement of eluent along the column. It is important that the flow rate is kept constant to ensure precise retention time, and peak measurements. Variations in flow rate can occur as a result of the partial failure of the pumping system, air in the pumping system, a change in the mobile phase viscosity or a temperature change.
Enable Blend Assist		Mark this check box to switch on Blend Assist, which allows you to set up solvent mixtures from stock solutions. When this check box is marked, the **Blend Assist** section of the method setup is available.
Solvents		**Blend Assist Disabled**: When **Blend Assist** is disabled, you can set the percentages of solvents B, C and D to any value from 0 through 100 %. **Solvent A** always delivers the remaining volume: 100 - (%B + %C + %D). The check boxes allows you to turn the solvent channels on (checked) or off (cleared). Click the solvent name down arrow and select the solvent from the list of calibrated solvents and solvent mixtures. For solvent mixtures, specify the percentage of additive. You can enter your own name for the solvent or solvent mixture in the adjacent field. **Blend Assist Enabled**: When **Blend Assist** is enabled, the table shows the solvent blends that have been set up in the **Blend Assist** section of the method setup. • **Solvent**: The solvent or blend of solvents as set up in the Blend Assist section. • **Used**: Mark this check box if you want to use this solvent or blend in the method. • **%**: Enter the percentage of the solvent or blend in this field. • **Name**: Type a name for the solvent or blend in this field.

Table 4 Method parameters

Parameter	Limits	Description
Stoptime	0.01 – 99999 min or **As Injector/No Limit** (an infinite run time).	The stoptime sets a time limit for your analysis. After the stoptime, all gradients are stopped and the pump parameters return to their initial values. The pump can be used as a stoptime master for the complete analytical system. The pump also stops the detectors if they have a **No Limit** stoptime setting. If no limit is given, a method will have to be stopped manually.
Posttime	0.01 – 99999 min or **Off** (0.0 min).	Your instrument remains in a not ready state during the posttime to delay the start of the next analysis. You can use the **Posttime** to allow your column to equilibrate after changes in solvent composition (for example after gradient elution).
Pressure Limits	**Max**: 1200 bar (17400 psi) for flow rates up to 2 mL/min . For flow rates between 2 mL/min and 5 mL/min , the maximum pressure ramps down to 800 bar (11600 psi). **Min**: any value between 0 and the upper pressure limit setting.	Sets the maximum and minimum pressure limits for the pump. • **Max** is the maximum pressure limit at which the pump will switch itself off, protecting the analytical system against over-pressure. • **Min** is the minimum limit at which the pump will switch itself off, for example, if any solvent reservoir is empty, this prevents system damage by pumping air.
Timetable		See “Timetable Settings” on page 66
Advanced		See “Advanced Settings” on page 65
External Contacts		The **External Contacts** section enables you to set up the switching of the external contacts. **NOTE** The **External Contacts** section is present only when a BCD/external contacts board is installed.

Advanced Settings

The Quaternary Pump advanced method setup parameters are in five sections:

- **Minimum Stroke**
- **Compressibility**
- **Maximum Flow Gradient**
- **Primary Channel**
- **Mixer Selection**

Table 5 Advanced method parameters

Parameter	Limits	Description
Minimum Stroke	20 – 100 µL	The Stroke Volume is used for optimizing between performance of the module and seal life time. For performance a low stroke volume is beneficial, as it divides disturbances into smaller packages, but a larger volume is extending the life time of the pump seals. If **Automatic** is activated, the pump tries to achieve an optimized stroke volume for the Jet Weaver geometry.
Compressibility		The compressibility of the mobile phase has an effect on the performance of the pump. For best flow accuracy and mixing performance, you can set the parameter according to the mobile phase being used. **Use solvent types**: • Select this check box (recommended) for using the enhanced and automatic compressibility calibration. Then select the calibrated solvent from the drop-down lists using the combo boxes in the **Solvents** section. Using this checkbox hides compressibility fields for manual settings. • Clear this check box to display the compressibility fields, which allow you to enter manual compressibility values, which are constant over pressure. This setting is available for method backward compatibility e.g. from 1260 Infinity pumps. For best performance, use solvent types.
Maximum Flow Gradient	1.000 – 1000.000 mL/min/min in steps of 0.001 mL/min/min Default value: 100.000 mL/min/min	You can set a limit on the rate of change of the solvent flow to protect your analytical column. You can set individual values for **Flow ramp up** and **Flow ramp down**.

Table 5 Advanced method parameters

Parameter	Limits	Description
Primary Channel		Using **Automatic** is recommended. The primary channel can be specified as A to D for optimizing highly specific methods. It is split up to deliver the first and last solvent package created by the MCGV in order to optimize composition precision. The primary channel does not change during a gradient, as long as the channel is used. Using **Automatic** chooses the channel with the highest percentage at start conditions before a gradient.
Mixer Selection		Click the down-arrow and select the mixer to use from the list: • **Use any mixer**: The currently installed mixer is used, irrespective of its type. • **Do not use mixer**: The valve is set to bypass the mixer so that it is not in the flow path. • **<Mixer Name>**: Only the specified mixer may be used; it the mixer is not found, the pump goes into a Not Ready state.

Timetable Settings

Use the **Timetable** to program changes in the pump parameters during the analysis by entering a time in the **Time** field and appropriate values in the following fields of the timetable. Changes in flow rate occur linearly from either time zero or the time of the last defined change; other parameters change instantaneously at the time defined in the timetable.

Show **Advanced Timetable** toggles the timetable display between standard mode and advanced mode.

The following parameters can be changed:

- **Change Contacts**
- **Change Flow**
- **Change Max. Pressure Limit**
- **Change Solvent Composition** - You can only use solvents, which have been enabled in the solvents section.
- **Function centric view** - This checkbox allows you displaying parameter changes instead of a time table.

Blend Assist

The **Blend Assist** table allows you to blend two or more solvents or solvent mixtures from stock solutions. The blends must be of pure solvents or pure solvents with additives. For example, you can blend 100 % water with 10 % isopropanol in water.

- **Channel**: The channel name.
- **Type**: The type of solvent
  - **Solvent <n>**: Pure solvent
  - **Solvent <n> Additive**: Solvent mixture
- **Calibration**: Click the down arrow and select the solvent or solvent mixture from the list.
- **Name**: Enter a name for the solvent or solvent mixture in this field.
- **Stock conc.**: For solvent mixtures, specify the concentration of the additive in the stock solution in this field. Pure solvents are always 100 %.
- **Final conc.**: Enter the concentration of the additive that you want to achieve in this field. The pure solvent and solvent mixture will be blended to achieve the **Final conc.** For the relationship of stock concentration and concentration in the mixture, the composition accuracy needs to be considered (see “Performance Specifications” on page 28).
- **Conc. unit**: The concentration can be defined as mM (mmol/L) or as %.

Priming the Pump

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 degassing unit (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.

1 Initiate a purge in the controlling software with a Purge flow set to 3 – 5 ml/min per channel.

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

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	Isopropanol is miscible with both normal phase and reverse phase solvents.
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 cristals
After a solvent change	Bidistilled water	Best solvent to re-dissolve buffer cristals
Before turning off system for an extended period of time	Organic or 10 % isopropanol in water	

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.

If the system has been run dry or air has diffused into the pump it might require additional steps to get rid of the air again. Following the procedure below will give the best and fastest results.

1 Change solvent to isopropanol.

2 Turn on the Prime function.

3 Purge the system with 10 ml, composition 50/50 and for 10 min.

4 Attach a column suitable for isopropanol and set the Max. pressure limit to the limit of the column.

5 Run the system at composition 50/50 and a flow rate that gives a pressure close to the limit of the column.

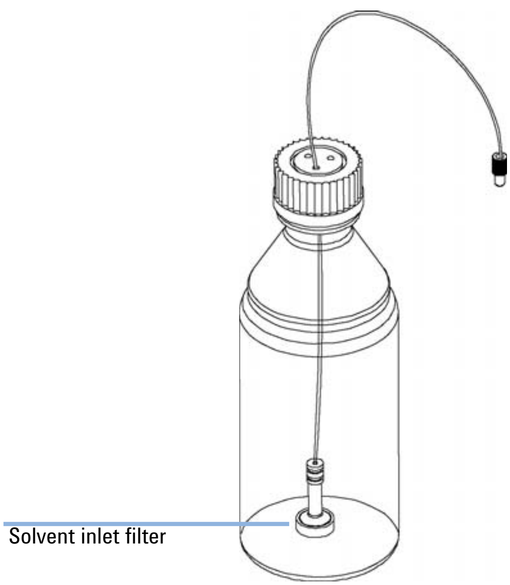
6 Observe the pressure fluctuations. The system is air free as soon as the pressure is stable.

7 Change solvents and column according to the analytical conditions and purge the system to change solvents.

Flushing the Filter

For highest performance and robustness, the 1290 Infinity Quaternary Pump uses 3 solvent filters:

1. Solvent inlet filter, 20 µm pore size (5041-2168) as part of Bottle Head Assembly (G4220-60007) have a large pore size of about 20 µm and filter out particles before they reach the pump.

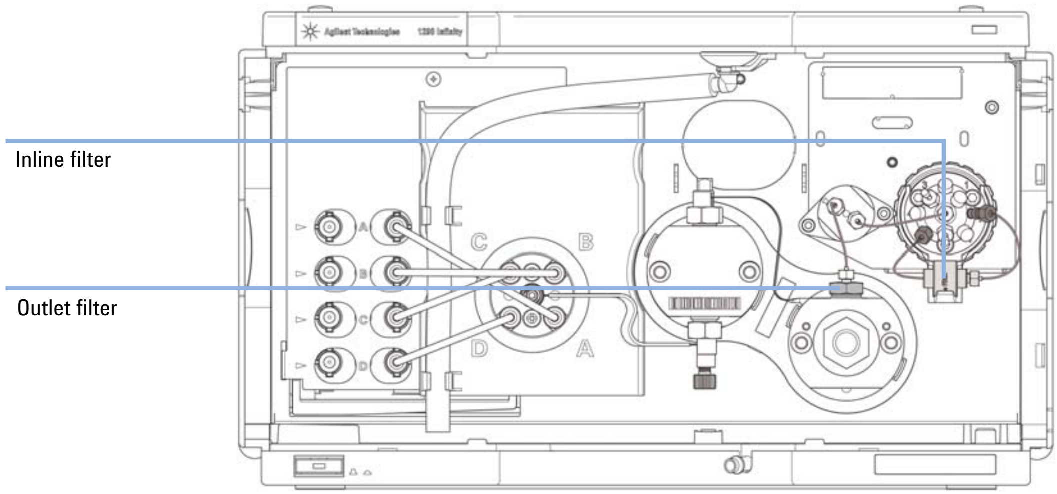


2. An outlet filter (average pore size 5 µm; Outlet filter 1290 Infinity Quaternary Pump (G4204-60004)) between pump head and pressure sensor filters out particles which may be created in the pump by wear of piston or wash seals.

   This filter can be replaced as required.

3 An inline filter connected to the Multi Purpose Valve with a small pore size of about 0.3 µm (In-Line Filter Assembly for 1290 Infinity Quaternary Pump (5067-5407)).

This filter can be flushed using the graphical user interface or replaced as required.



In the instrument control panel of Agilent user interfaces, use the context menu and select **Flush Filter On**, see also “Context Menu” on page 60.

Solvent Information

Introduction

Observe the following recommendations on the use of solvents.

- Follow recommendations for avoiding the growth of algae, see "Algae Growth in HPLC Systems" on page 54.
- Small particles can permanently block capillaries and valves. Therefore, always filter solvents through 0.4 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 like flow cells, valve materials etc. and recommendations in subsequent sections.

Materials in Flow Path

Following materials are used in the flow path of this module:

Part	Materials
Degasser chamber	TFE/PDD copolymer, PFA (internal tubings); PEEK (inlets); FEP (tubings); ETFE (fittings)
Ultra clean tubings[1]	PFA (tubings), PEEK (fittings)
Microfluidic structures[2]	SST
MCGV	PEEK, FEP, PFA, Al_2O_3-based ceramic, ruby, sapphire, SST
Passive inlet valve	SST, gold, ruby, ZrO_2-based ceramic, tantalum
Outlet valve	SST, gold, ruby, ZrO_2-based ceramic, tantalum
Pump head	SST
Pistons	ZrO_2-based ceramic
Piston/wash seals	UHMW-PE, SST
Pressure sensor	SST
Multi Purpose Valve	Polyimide, SST, DLC

[1] Ultra clean tubings are available for the use with high-end MS detectors. They are also compatible to THF.

[2] Inlet Weaver, Jet Weaver, Heat Exchanger

Material Information

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 conditions, please consult the material information section or contact Agilent.

Disclaimer

Subsequent data were collected from external resources and are 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 can also not 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 non-conductive 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.

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 a pH range between 1 – 12, and inert to many common solvents.

There is still a number of known incompatibilities with chemicals such as chloroform, methylene chloride, THF, DMSO, strong acids (nitric acid > 10 %, sulphuric acid > 10 %, sulfonic acids, trichloroacetic acid), halogenes or aequous halogene solutions, phenol and derivatives (cresols, salicylic acid etc.).

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 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 to 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 (ST)

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 so on) 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, di-isopropylether). Such ethers should be filtered through dry aluminium 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, ethylene diamine tetra-acetic acid).
- Mixtures of carbon tetrachloride with 2-propanol or THF.

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 1290 Infinity Flow Cells and capillaries. 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)

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, 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.

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.

Solvent Handling

Handling of Buffers

The following recommendations should be observed when using buffer solutions:

- Buffers and aqueous solutions are possible sources of algae contamination, for avoiding related problems, please read "Algae Growth in HPLC Systems" on page 54.
- For buffer concentrations of 0.1 M or higher using the seal wash option is strongly recommended.
- Filter buffer solutions to avoid increased wear or blockages that are caused by undissolved crystals. Always use solvent inlet filters.
- Avoid conditions where mixing of buffers and organic solvents may cause precipitation, as this impairs the reproducibility of chromatographic experiments and may also reduce the system life time. For example in reversed phase chromatography, avoid buffers (especially phosphate buffers) with a concentration higher than 20 mmol/L. For phosphate buffers, avoid compositions containing more than 65 % acetonitrile or other organic solvents.
- Use a minimum flow rate of 5 µL/min or 1 % composition per solvent channel (whatever is greater) to avoid cross-flow. Cross-flow can be caused by micro leaks in pump heads and can result in buffer precipitation in pump heads, channel blocking, or reduced pump head life time through wear of seals and pistons.
- When installing tubing connections to the MCGV, use lower channels (A/D) for aqueous solvents and upper channels for organic solvents. This will re-dissolve precipitates more easily.
- Never leave buffers in a system without flow. Before shutting down a system, flush it extensively with warm water to avoid clogging of valves, capillaries, or flow cells or reducing the life time of your column. If the system is not used for some time, for example more than a day depending on lab temperature, fill all solvent lines with organic solvent or water with at least 10 % isopropanol.
- Regularly maintain the LC system.

Handling of Acetonitrile

Acetonitrile is a solvent that is frequently used in reversed-phase chromatography. Despite of its common use, it can be a source of issues if not handled correctly. Acetonitrile degrades through polymerization and such polymers can stick to surfaces in LC systems and e.g. cause issues with valve performance and therefore affect retention time precision. Polymers can also show up as background noise in MS detectors.

When using acetonitrile:

- Use high-quality solvents from renowned suppliers.
- Use fresh solvents and filter them.
- Minimize exposure to light and air/oxygen.
- Choose a bottle size which fits to your application and usage.
- Acids accelerate polymerization. If possible avoid such additives or refresh solvents more frequently.
- Pure acetonitrile polymerizes faster. If your application allows, add about 5 % water and adjust gradient compositions.
- Do not leave acetonitrile in unused systems to avoid aging. If not in use, flush all solvent lines with a mixture of water and 10 % isopropanol.
- In case of blocked valves, flush the system with hot water. Knock at valves, flush them (see “Releasing a Stuck Inlet Valve” on page 149) or ultrasonicate them, e.g. in methanol.

Handling of Acids

Acids can corrode stainless steel and other materials in the flow path of LC systems. For stainless steel, the minimum pH is 2.3 for corrosive acids and pH 1 for non-corrosive acids.

Please note that for non-volatile acids like phosphoric acid or perchloric acid concentrations increase after evaporation of water. This means that originally diluted acids can damage parts over time, e.g. because of liquid, which has left the solvent path through micro leaks. Such systems should be flushed regularly with pure water and may require shorter maintenance cycles. Using a seal wash option should be considered for protecting pump heads.

5
How to Optimize the Performance of Your Module

This chapter gives hints on how to optimize the performance or use additional devices.

Using the Degasser

The quaternary pump has a built-in degasser, which should always be included to the flow path.

Operational Hints for the Multi Channel Gradient Valve (MCGV)

In a mixture of salt solutions and organic solvent the salt solution might be well dissolved in the organic solvent without showing precipitations. However in the mixing point of the gradient valve, at the boundary between the two solvents, micro precipitation is possible. Gravity forces the salt particles to fall down. Normally the A channel of the valve is used for the aqueous/salt solution and the B channel of the pump is used for the organic solvent. If used in this configuration the salt will fall back into the aqueous solution and will be dissolved. When using the pump in a different configuration (e.g., D - salt solution, A - organic solvent) the salt can fall into the port of the organic solvent and may lead to performance problems.

NOTE

When using salt solutions and organic solvents it is recommended to connect the salt solution to one of the bottom ports of the MCGV and the organic solvent to one of the upper gradient valve ports. It is best to have the organic channel directly above the salt solution channel. Regular flushing with water of all MCGV channels is recommended to remove all possible salt deposits in the valve ports.

NOTE

Precipitations formed during the mixing of buffers and organic solvents which do not dissolve salts may cause a loss of pump performance (flow/retention time stability), a blockage or internal leak of the pump. Avoid the use of such solvent combinations, as they can cause irreproducible chromatographic results.

Delay Volume and Extra-Column Volume

The *delay volume* is defined as the system volume between the point of mixing in the pump and the top of the column.

The *extra-column volume* is defined as the volume between the injection point and the detection point, excluding the volume in the column.

Delay Volume

In gradient separations, this volume causes a delay between the mixture changing in the pump and that change reaching the column. The delay depends on the flow rate and the delay volume of the system. In effect, this means that in every HPLC system there is an additional isocratic segment in the gradient profile at the start of every run. Usually the gradient profile is reported in terms of the mixture settings at the pump and the delay volume is not quoted even though this will have an effect on the chromatography. This effect becomes more significant at low flow rates and small column volumes and can have a large impact on the transferability of gradient methods. It is important, therefore, for fast gradient separations to have small delay volumes, especially with narrow bore columns (e.g., 2.1 mm i.d.) as often used with mass spectrometric detection.

The delay volume in a system includes the volume in the pump from the point of mixing, connections between pump and autosampler, volume of the flow path through the autosampler and connections between autosampler and column.

For the 1290 Infinity Quaternary Pump, all pump parts downstream the MCGV contribute to the delay volume, i.e. inlet weaver, pump heads, capillary connections, filters and the optional Jet Weaver.

How to Configure the Optimum Delay Volume

The design of the 1290 Infinity Quaternary Pump offers a strongly decreased delay volume compared to standard 600 bar pressure pumps. For the 1290 Infinity Quaternary Pump, mixing is done in the multi-channel gradient valve at ambient pressure. As all pump parts in the flow path after mixing contribute to the delay volume, this includes also pump heads of the quaternary pump, flow connections, filters, mixers etc. Therefore the delay volume of a quaternary pump is by design larger than that of a binary pump.

All listed components including the inlet weaver and pump heads ensure a good mixing performance resulting in excellent composition precision and accuracy, highly reproducible retention times and low baseline noise. This ensures best results for most applications.

Per default, the 1290 Infinity Quaternary Pump does not require and include a Jet Weaver, as solvents are mixed in the MCGV and mixing is further improved in the inlet weaver, pump heads and subsequent parts in the flow path. Therefore, no Jet Weaver is required for most applications.

The V380 Jet Weaver high performance mixer is optionally available for demanding applications, which use solvents in different channels (for example A versus B), that differ strongly in their UV/Vis absorption, for example by using trifluoroacetic acid (TFA) as a modifier, which has a high absorbance. Solvent packages created by the pump may persist until the solvent reaches the detector flow cell. Absorption fluctuations can then show up as baseline noise, also referred to as mixing noise. Applications like impurity quantitation or lowest level compound detection require minimizing this noise. The V380 Jet Weaver strongly improves mixing and therefore reduces baseline noise and improves sensitivity in detection. Patented Agilent microfluidic technology offers high mixing performance at a low internal volume of 380 µL, which is the physical volume of all channels. It contributes with 150 µL to the pump delay volume (< 350 µL without Jet Weaver), which is the partial mixer volume that creates a composition change corresponding to the delay volume.

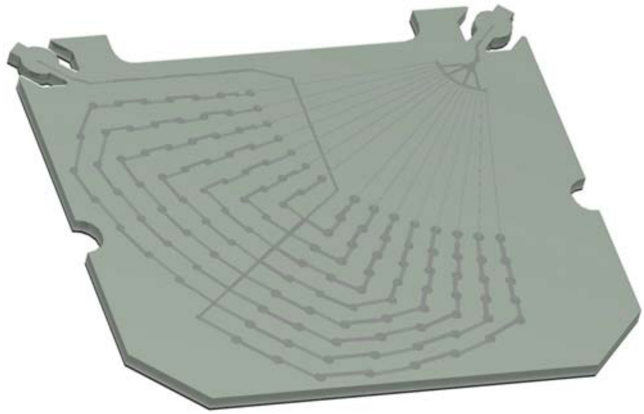


Figure 16 The Jet Weaver mixer

The installation procedure is illustrated in "Installing the Jet Weaver" on page 141.

How to Achieve Higher Resolution

Increased resolution in a separation will improve the qualitative and quantitative data analysis, allow more peaks to be separated or offer further scope for speeding up the separation. This section explains how resolution can be increased by examining the following points:

- Optimize selectivity
- Smaller particle-size packing
- Longer Columns
- Shallower gradients, faster flow

Resolution between two peaks is described by the resolution equation:

$$Rs = \frac{1}{4}\sqrt{N}\,\frac{(\alpha - 1)}{\alpha}\,\frac{(k_2 + 1)}{k_2}$$

where

- R_s=resolution,
- N=plate count (measure of column efficiency),
- α=selectivity (between two peaks),
- k_2=retention factor of second peak (formerly called capacity factor).

The term that has the most significant effect on resolution is the selectivity, α, and practically varying this term involves changing the type of stationary phase (C18, C8, phenyl, nitrile etc.), the mobile phase and temperature to maximize the selectivity differences between the solutes to be separated. This is a substantial piece of work which is best done with an automated method development system which allows a wide range of conditions on different columns and mobile phases to be assessed in an ordered scouting protocol. This section considers how to get higher resolution with any chosen stationary and mobile phases. If an automated method development system was used in the decision on phases it is likely that short columns were used for fast analysis in each step of the scouting.

The resolution equation shows that the next most significant term is the plate count or efficiency, N, and this can be optimized in a number of ways. N is inversely proportional to the particle size and directly proportional to the length of a column and so smaller particle size and a longer column will give a higher plate number. The pressure rises with the inverse square of the particle size and proportionally with the length of the column. This is the reason that the 1290 Infinity LC system was designed to go to 1200 bar so that it can run sub-two-micron particles and column length can be increased to 100 mm or 150 mm. There are even examples of 100 mm and 150 mm columns linked to give 250 mm length. Resolution increases with the square root of N so doubling the length of the column will increase resolution by a factor of 1.4. What is achievable depends on the viscosity of the mobile phase as this relates directly to the pressure. Methanol mixtures will generate more back pressure than acetonitrile mixtures. Acetonitrile is often preferred because peak shapes are better and narrower in addition to the lower viscosity but methanol generally yields better selectivity (certainly for small molecules less than about 500 Da). The viscosity can be reduced by increasing the temperature but it should be remembered that this can change the selectivity of the separation. Experiment will show if this leads to increase or decrease in selectivity. As flow and pressure are increased it should be remembered that frictional heating inside the column will increase and that can lead to slightly increased dispersion and possibly a small selectivity change both of which could be seen as a reduction in resolution. The latter case might be offset by reducing the temperature of the thermostat by a few degrees and again experiment will reveal the answer.

The van Deemter curve shows that the optimum flow rate through an STM column is higher than for larger particles and is fairly flat as the flow rate increases. Typical, close to optimum, flow rates for STM columns are: 2 ml/min for 4.6 mm i.d.; and 0.4 ml/min for 2.1 mm i.d. columns.

In isocratic separations, increasing the retention factor, k, results in better resolution because the solute is retained longer. In gradient separations the retention is described by k^* in the following equation:

$$k^* = \frac{t_G}{\Delta\%B} \cdot \frac{F}{V_m} \cdot \frac{100}{S}$$

where:

- k^* = mean k value,
- t_G = time length of gradient (or segment of gradient) (min),
- F = flow (ml/min),
- V_m = column delay volume,
- $\Delta\%B$ = change in fraction of solvent B during the gradient,
- S = constant (ca. 4-5 for small molecules).

This shows that k and hence resolution can be increased by having a shallower gradient (2 to 5 %/min change is a guideline), higher flow rate and a smaller volume column. This equation also shows how to speed up an existing gradient – if the flow is doubled but the gradient time is halved, k^* remains constant and the separation looks the same but happens in half the time. Recently published research has shown how a shorter STM column (at temperatures above 40 °C) can generate higher peak capacity than a longer STM column by virtue of running it faster. (Refer to *Petersson et al., J.Sep.Sci, 31, 2346-2357, 2008, Maximizing peak capacity and separation speed in liquid chromatography*).

Using Solvent Calibration Tables

Importing Solvent Calibration Tables

RC.NET based Agilent graphical user interfaces (ChemStation, EZChrom Elite, OpenLab etc.) include data for most commonly used solvents in HPLC. This data contains solvent properties and is used for optimum pump control in order to ensure best flow and composition accuracy.

If your solvent is not included to the software, please check the Agilent web site
http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?whid=69761
for additional libraries (registration required), which also provides updates and optimized data.

If your solvent is neither available in the user interface nor in the library, please use generic solvents. "Generic aqueous" gives good results for most solvent mixtures with at least 50 % water, which have similar properties as pure water. For other solvents with high organic percentage, "Generic organic" gives a good approximation.

Importing Solvent Calibration in ChemStation

1 Go to menu **Instrument > Instrument configuration**.
2 In the **Instrument Configuration** screen choose your module and click **Configure**.
3 Click **Configure Solvent Type Catalogs**.
4 In **Solvent Type Catalogs** click **Import**.
5 Navigate to the location of the solvent calibration table and click **Open**.
6 The new solvent will now appear in the **Solvent Type Catalogs**.
7 The imported solvent is now available for selection as a solvent type, see Table 4 on page 63.

6
Troubleshooting and Diagnostics

Overview about the troubleshooting and diagnostic features.

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).

Diagnostic Signals

The module has several signals (internal temperatures, voltages and currents of lamps) that can be used for diagnosing baseline problems. These can be added like normal signals in the Agilent ChemStation software.

Status indicators

Two status indicators are located on the front of the module. The lower left indicates the power supply status, the upper right indicates the module status.

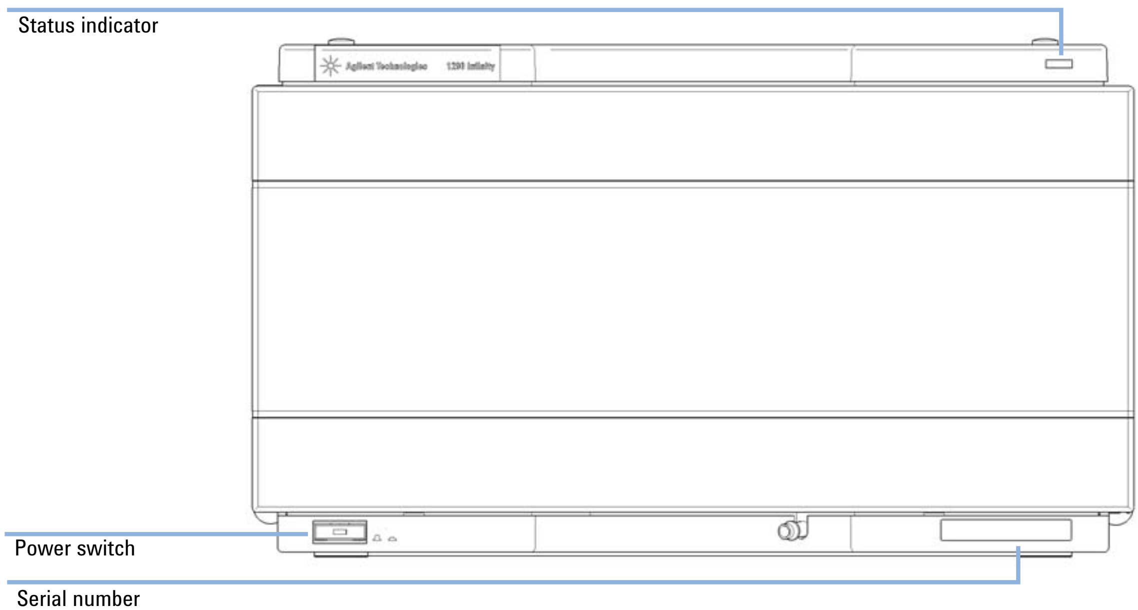


Figure 17 Location of status indicators

Power Supply Indicator

The power supply indicator is integrated into the main power switch. When the indicator is illuminated (*green*) the power is *ON*.

Module Status Indicator

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

- When the status indicator is *OFF* (and power switch light is on), the module is in a *prerun* condition, and is ready to begin an analysis.
- A *green* status indicator, indicates the module is performing an analysis (*run* mode).
- A *yellow* indicator indicates a *not-ready* condition. The module is in a not-ready state when it is waiting for a specific condition to be reached or completed (for example, immediately after changing a set point), or while a self-test procedure is running.
- An *error* condition is indicated when the status indicator is *red*. An error condition indicates the module has detected an internal problem which affects correct operation of the module. Usually, an error condition requires attention (e.g. leak, defective internal components). An error condition always interrupts the analysis.

  If the error occurs during analysis, it is propagated within the LC system, i.e. a red LED may indicate a problem of a different module. Use the status display of your user interface for finding the root cause/module of the error.
- A *blinking* indicator indicates that the module is in resident mode (e.g. during update of main firmware).
- A *fast blinking* indicator indicates that the module is in a low-level error mode. In such a case try to re-boot the module or try a cold-start (see “Special Settings” on page 256). Then try a firmware update (see “Replacing Module Firmware” on page 195). If this does not help, a main board replacement is required.

Available Tests vs User Interfaces

- Depending on the user interface, the available tests and the screens/reports may vary (see chapter *"Test Functions and Calibrations"*).
- Preferred tool should be the Agilent Lab Advisor software, see “Agilent Lab Advisor Software” on page 94.
- The Agilent ChemStation B.04.02 and above may not include any maintenance/test functions.
- Screenshots used within these procedures are based on the Agilent Lab Advisor software.

Agilent Lab Advisor Software

The Agilent Lab Advisor Software is a standalone product that can be used with or without 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. By 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 Infinity II Series pump.

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 allows 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 and Infinity II Series instruments.

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 which 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 remote cable (see documentation for the APG interface).

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: 0062

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: 0063

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 4 of the remote 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.

Remote Timeout

Error ID: 0070

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: 0071

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. • Ensure all CAN cables are installed correctly.
2 Defective CAN cable.	Exchange the CAN cable.
3 Defective main board in another module.	Switch off the system. Restart the system, and determine which module or modules are not recognized by the system.

Leak Sensor Short

Error ID: 0082

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.

Leak Sensor Open

Error ID: 0083

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 main 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.

Compensation Sensor Open

Error ID: 0081

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 power switch board and the main board	Please contact your Agilent service representative.
2 Defective power switch board	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Compensation Sensor Short

Error ID: 0080

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 falls below the lower limit, the error message is generated.

Probable cause	Suggested actions
1 Defective power switch board	Please contact your Agilent service representative.
2 Loose connection between the power switch board and the main board	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Fan Failed

Error ID: 0068

The cooling fan in the module has failed.

The hall sensor on the fan shaft is used by the main board 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.

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 main board.	Please contact your Agilent service representative.

Leak

Error ID: 0064

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 main board.

Probable cause	Suggested actions
1 Loose fittings.	Ensure all fittings are tight.
2 Broken capillary.	Exchange defective capillaries.

Pump Error Messages

These errors are pump specific.

Pressure of quaternary pump above upper limit

Error ID: 29163

The pressure has exceeded the upper pressure limit.

- Parameter: Measured pressure

Probable cause	Suggested actions
1 Blockage in flow path after the pressure sensor.	• Check for blockages in the LC system, e.g. purge valve, Jet Weaver, degraded column, column frits, needle, needle seat, capillaries etc. • Check for particles in the solvent.
2 Inappropriate settings (pressure limit, flow rate).	• Decrease flow rate. • Increase pressure limit.

Pressure below lower limit

Error ID: 29176

The pressure has dropped below the lower limit.

- Parameter: None

Probable cause	Suggested actions
1 Leak	Check for leaks.
2 Bottle empty	Check bottle filling.
3 Wrong solvent (viscosity)	Check solvent.
4 Inappropriate setting	Check flow rate and lower pressure limit.
5 Column degradation	Replace column.

Target pressure not reached for quaternary pump degasser

Error ID: 29221

The target pressure of the quaternary pump degasser has not been reached within the expected time.

- Parameter: Pressure in mbar

Probable cause	Suggested actions
1 Condensation in degasser chamber due to temperature fluctuation.	Equilibrate and restart module.
2 Degasser is defect.	Please contact your Agilent service representative.

Solvent counter exceeded limit

Error ID: 29146

The counter for the solvent volume has exceeded the limit, which has been set in the user interface.

Probable cause	Suggested actions
1 No solvent present.	Refill solvent bottle.
2 Inappropriate setting.	Check solvent counter setting in user interface.

Waste counter limit exceeded

Error ID: 29147

The counter for the waste volume has exceeded the limit, which has been set in the user interface.

- Parameter: None

Probable cause	Suggested actions
1 The waste container is full.	Empty waste container.
2 Inappropriate setting for waste counter.	• Reset waste counter. • Adjust waste counter limit.

Flow rate limit exceeded

Error ID: 29164

The flow rate of the quaternary pump has exceeded the limit, while the pump runs in pressure controlled mode, e.g. during a pressure test.

- Parameter: None

Probable cause	Suggested actions
1 Leak	Check for leaks in the pump and flow path.
2 Bottle empty.	Fill solvent bottle.
3 Shutoff valve closed (if applicable).	Open shutoff valve.
4 Drift of pressure sensor (unlikely for short tests taking some minutes).	Replace pressure sensor.

Quaternary pump shutdown during analysis

Error ID: 29199

The quaternary pump has been shut down by the control software or control module during an analysis.

- Parameter: 0 for off, 1 for standby.

Probable cause	Suggested actions
1 Pump has been shut down.	Restart pump.

Reading the pump encoder tag failed

Error ID: 29201

Reading the pump encoder tag has failed.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Defect connection between encoder and main board.	Please contact your Agilent service representative.
2 Missing or defect tag Defect connection between tag and encoder.	Please contact your Agilent service representative.

Writing the pump encoder tag failed

Error ID: 29200

Writing the pump encoder tag has failed.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Defect connection between encoder and main board.	Please contact your Agilent service representative.
2 Defect tag Defect connection between tag and encoder.	Please contact your Agilent service representative.

Pump drive blocked or encoder failed

Error ID: 29214

Pump drive blocked or encoder failed.

- Parameter: None

Probable cause	Suggested actions
1 Blockage of the pump drive Drive encoder failed.	Please contact your Agilent service representative.

Drive current too low

Error ID: 29205

The current consumption of the pump drive is too low.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Drive motor defect.	Please contact your Agilent service representative.
2 Wrong/missing connection of pump drive to main board.	Please contact your Agilent service representative.

Drive current too high

Error ID: 29236

The current consumption of the pump drive is too high.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Blockage of system before pressure sensor.	Check for blockage of e.g. outlet valve filter frit, Multi Purpose Valve, heat exchanger.
2 Drive motor defect.	Please contact your Agilent service representative.

Drive timeout

Error ID: 29204

Movement of drive during initialization is blocked mechanically.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Blockage in flow path	Remove capillary connection to system, check outlet filter, check valves, check pump head.
2 Blockage of pump drive Drive motor defect.	Please contact your Agilent service representative.

Overcurrent of pump drive

Error ID: 29202

The current consumption of the pump drive is too high.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Blockage of system before pressure sensor.	Check for blockage of e.g. outlet valve filter frit, Multi Purpose Valve, heat exchanger.
2 Drive motor defect.	Please contact your Agilent service representative.

Deliver underrun

Error ID: 29233

Internal error.

- Parameter: None

Probable cause	Suggested actions
1 Internal error.	Please contact your Agilent service representative.
2 Firmware issue	Use a minimum firmware revision of B.06.55

Defect connection between main board and pump drive encoder

Error ID: 29208

Defect connection between main board and pump drive encoder.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Defect connection between main board and pump drive encoder.	Please contact your Agilent service representative.
2 Defect encoder.	Please contact your Agilent service representative.

Pump drive encoder defect

Error ID: 29209

Defect pump drive encoder.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Defect encoder.	Please contact your Agilent service representative.

Multi Purpose Valve failed

Error ID: 29231

Lost steps of the purge valve encoder.

- Parameter: None

Probable cause	Suggested actions
1 Multi purpose valve drive mechanically blocked or defect.	• Check installation of multi purpose valve head. • Replace multi purpose valve head.

Reading of multi purpose valve tag failed

Error ID: 29240

Reading the multi purpose valve tag failed.

- Parameter: None

Probable cause	Suggested actions
1 Reading of multi purpose valve tag failed.	Check cable connection.
2 Multi purpose valve head tag defect or empty.	Replace multi purpose valve head.
3 Multi purpose valve tag reader is defect.	Please contact your Agilent service representative.

Pump drive encoder rollover

Error ID: 29232

Invalid pump drive encoder signals have been detected.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Pump drive encoder is defect.	Please contact your Agilent service representative.

Drive position limit

Error ID: 29234

Internal error.

- Parameter: 1 – 4 referring to pump drive

Probable cause	Suggested actions
1 Internal error.	Please contact your Agilent service representative.

Insufficient power of drive encoder LED

Error ID: 29235

Insufficient power of drive encoder LED.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Pump drive encoder is defect.	Please contact your Agilent service representative.

Drive encoder error

Error ID: 29237, 29238, 29239, 29215

An error has occurred for the pump drive encoder.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Pump drive encoder is defect.	Please contact your Agilent service representative.

Writing the multi purpose valve tag failed

Error ID: 29241

Writing the multi purpose valve tag failed.

- Parameter: None

Probable cause	Suggested actions
1 Multi purpose valve head tag defect.	Replace multi purpose valve head.
2 Multi purpose valve tag head reader is defect.	Please contact your Agilent service representative.

Unknown multi purpose valve type

Error ID: 29242

The type information of the multi purpose valve is invalid.

- Parameter: None

Probable cause	Suggested actions
1 Wrong valve head installed.	Check or replace multi purpose valve head.
2 Valve head has invalid RFID tag content.	Check or replace multi purpose valve head.

Pump drive encoder error

Error ID: 29211

The pump drive encoder has generated no signal.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Pump drive encoder is defect.	Please contact your Agilent service representative.

Pump drive error

Error ID: 29212, 29213

The pump drive failed during calibration.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Pump drive encoder is defect.	Please contact your Agilent service representative.

Maximum stroke is too short

Error ID: 29203

The maximum stroke is too short.

During initialization the pump defines the operation position of the pump drives and therefore the pistons. First the pump drive moves backwards to find a mechanical stop within the ball screw. Afterwards, pistons move forwards for finding the maximum available stroke volume. These values are expected within a pre-defined range. "Maximum stroke too short" means that the outer drive position is too close. This can be caused by a drive initialization without pump head or if the pump head has not been installed properly (screws are loose).

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Wiper shifted	Please contact your Agilent service representative.
2 Pump head blocks piston movement	Replace, clean or repair pump head.
3 Pump drive motor is mechanically blocked.	Please contact your Agilent service representative.

Pump drive stop not found

Error ID: 29207

The pump drive stop has not been found.

- Parameter: 1 – 2 referring to pump drive

Probable cause	Suggested actions
1 Pump drive spindle is defect.	Please contact your Agilent service representative.

Timeout: Wait for Composition

Error ID: 29180

A target condition (composition) has been sent to the instrument which should have been reached within an expected time frame but didn't. Either the limit, time frame or the current value of the variable has been modified later directly or indirectly.

Probable cause	Suggested actions
1 Incorrect parameters have been sent to the instrument by the control software or manual changes.	Verify control software, macros, manual commands.

Timeout: Wait for run volume

Error ID: 29181

A target condition (run volume, which is the volume delivered since the method run start) has been sent to the instrument which should have been reached within an expected time frame but didn't. Either the limit, time frame or the current value of the variable has been modified later directly or indirectly (for example the flow rate).

Probable cause	Suggested actions
1 Incorrect parameters have been sent to the instrument by the control software or manual changes.	Verify control software, macros, manual commands.

Timeout: Wait for Volume

Error ID: 29182

A target condition (volume, which is the delivered flow since the limit has been set) has been sent to the instrument which should have been reached within an expected time frame but didn't. Either the limit, time frame or the current value of the variable has been modified later directly or indirectly (for example the flow rate).

Probable cause	Suggested actions
1 Incorrect parameters have been sent to the instrument by the control software or manual changes.	Verify control software, macros, manual commands.

Timeout: Wait for Flow

Error ID: 29183

A target condition (flow rate) has been sent to the instrument which should have been reached within an expected time frame but didn't. Either the limit, time frame or the current value of the variable has been modified later directly or indirectly.

Probable cause	Suggested actions
1 Incorrect parameters have been sent to the instrument by the control software or manual changes.	Verify control software, macros, manual commands.

Timeout: Wait for Pressure

Error ID: 29185

A target condition (pressure) has been sent to the instrument which should have been reached within an expected time frame but didn't. Either the limit, time frame or the current value of the variable has been modified later directly or indirectly.

Probable cause	Suggested actions
1 Incorrect parameters have been sent to the instrument by the control software or manual changes.	Verify control software, macros, manual commands.
2 Leak	Run system pressure test for identifying and localizing the leak. Tighten leak.

Drive Encoder failed

Error ID: 29210

Drive encoder failed during pump drive calibration.

Probable cause	Suggested actions
1 Internal error.	Contact Agilent support.

Drive phases differ too much in electric resistance

Error ID: 29216

Pump drive calibration has failed due to a strong difference electric resistances for different motor phases.

Probable cause	Suggested actions
1 Pump drive cable defect.	Please contact your Agilent service representative.
2 Pump drive defect.	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Degasser's pressure limit violation

Error ID: 29220

Pressure too far above the limit.

Probable cause	Suggested actions
1 Leak in degasser chamber or degasser tubing.	Please contact your Agilent service representative.
2 Defect vacuum pump.	Please contact your Agilent service representative.
3 Degasser chamber empty or connected to air.	Block unused degasser channels.

Seal wash pump was missing when tried to turn on

Error ID: 29223

The seal wash pump has not been detected (while being configured or detected before)

Probable cause	Suggested actions
1 Defect cable connection to seal wash pump.	Check cable connection.
2 Defect seal wash pump motor.	Please contact your Agilent service representative.
3 Defective main board.	Please contact your Agilent service representative.

Valve hardware overcurrent (MCGV)

Error ID: 29227

Power consumption too high for one of the MCGV valves.

Probable cause	Suggested actions
1 Cable defect.	Replace MCGV.
2 Valve defect	Replace MCGV.
3 Defective main board.	Please contact your Agilent service representative.

8
Test Functions and Calibrations

This chapter will describe the tests for the module.

Currently, no diagnostic procedures are available.

9
Maintenance

This chapter describes the maintenance of the Agilent 1290 Infinity Quaternary Pump.

Introduction to Maintenance

Figure 18 on page 125 shows the main user-accessible assemblies of the Agilent 1290 Infinity Quaternary Pump. These parts can be accessed from the front (simple repairs) and don’t require to remove the pump from the system stack.

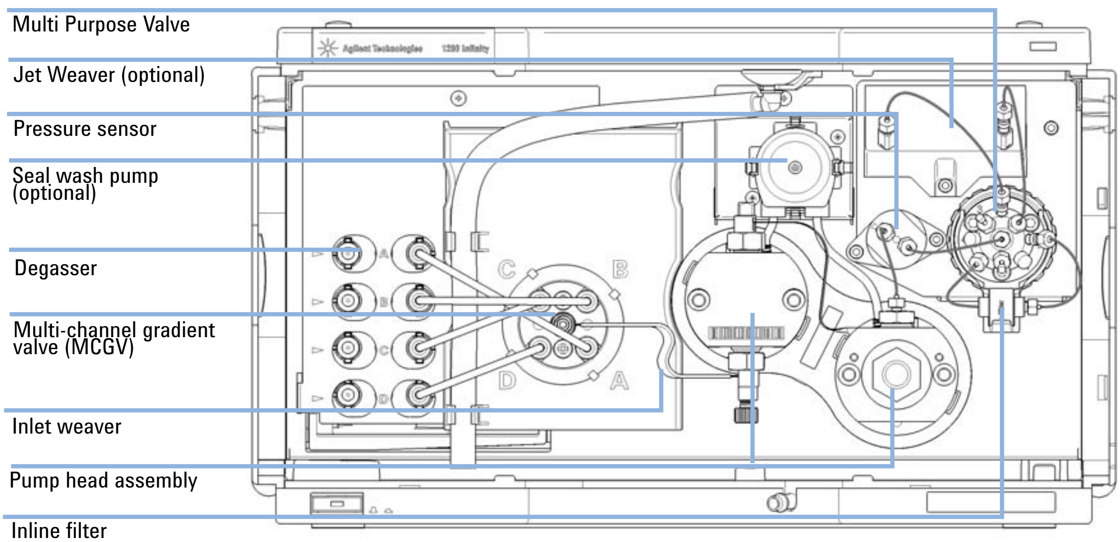


Figure 18 Overview of Maintenance Parts

Warnings and Cautions

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.

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

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.

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.

Overview of Maintenance

The following pages describe maintenance (simple repairs) of the module that can be carried out without opening the main cover.

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.

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.

Installing Fittings and Capillaries

WARNING

Solvent can spray under high pressure.

→ Observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing), when opening flow path.

CAUTION

Deformation of fittings and seals

Liquid drops under high pressure up to 1200 bar act like solid parts. Tightening connections under high pressure can deform or destroy fittings and seals.

→ Never tighten flow connections under pressure.

NOTE

The lifetime of a fitting depends on how firmly it has been tightened; firm tightening reduces the lifetime.

If fitting has been overtightened, replace it.

1 Install fittings and capillaries.
2 Tighten fittings and capillaries.

Replacing the Pressure Sensor

When No or invalid pressure signal

Tools required

p/n	Description
8710-2412	Hex key 2.5 mm, 15 cm long, straight handle
8710-0510	Wrench open 1/4 — 5/16 inch
	Screwdriver

Parts required

#	p/n	Description
1	G4220-60001	Pressure sensor 1200 bar

Preparations Turn off pump flow, switch off pump

NOTE

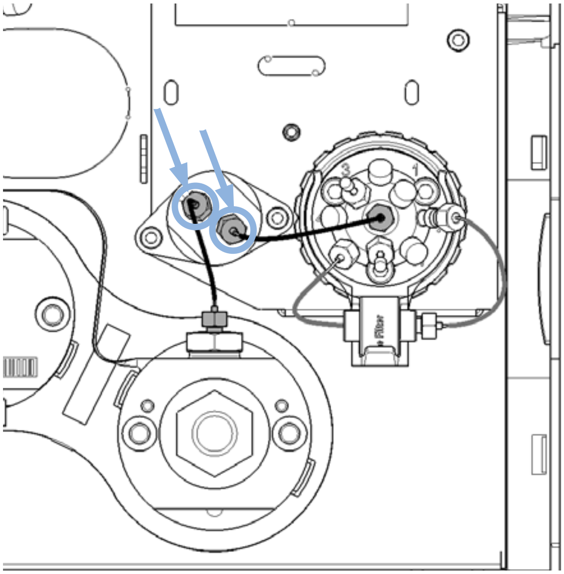
This procedure describes how to replace the pressure sensor.

In case the cable to the sensor shall be replaced as well, please contact your Agilent service representative.

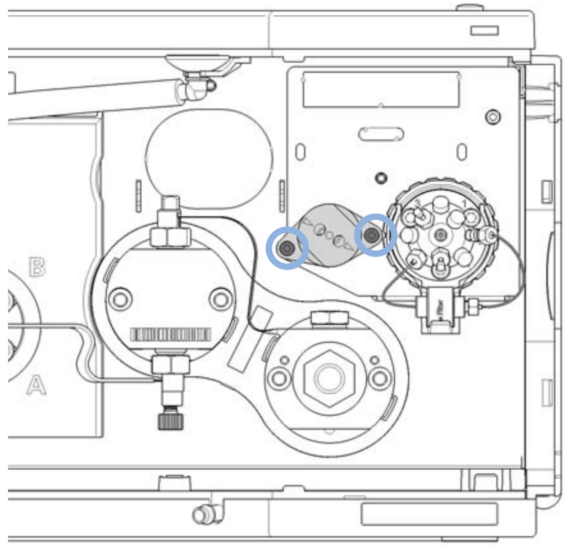
NOTE

Working on connections to the pressure sensor may slightly change the displayed pressure. In case of a pressure offset at ambient pressure, a pressure offset calibration may be run.

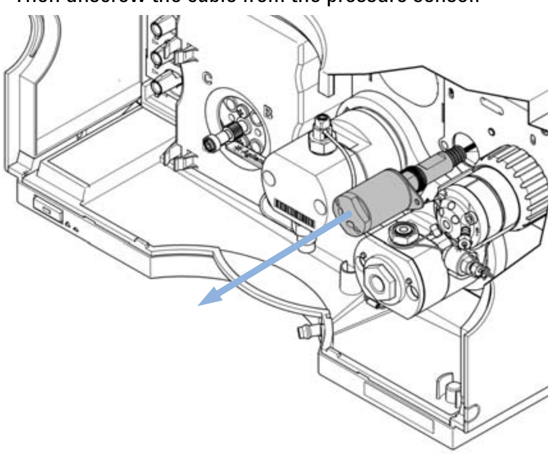
1 Remove capillary connections between the pressure sensor and the Multi Purpose Valve, and between the pressure sensor and the outlet filter of the secondary pump head, respectively.



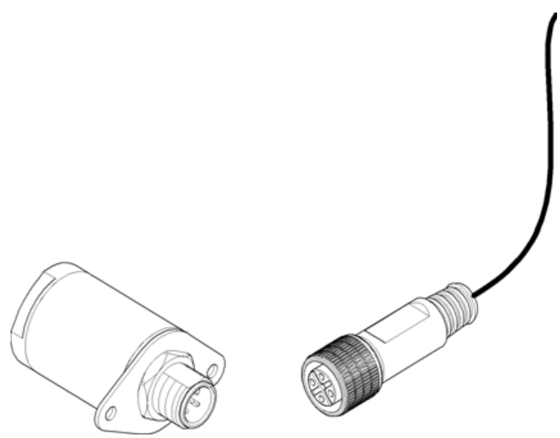
2 Remove the screws that fix the pressure sensor to the chassis.



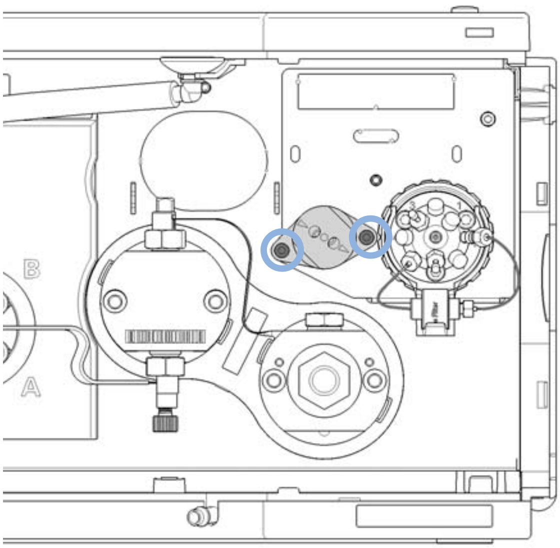
3 Carefully pull out the pressure sensor for about 2 cm. Then unscrew the cable from the pressure sensor.



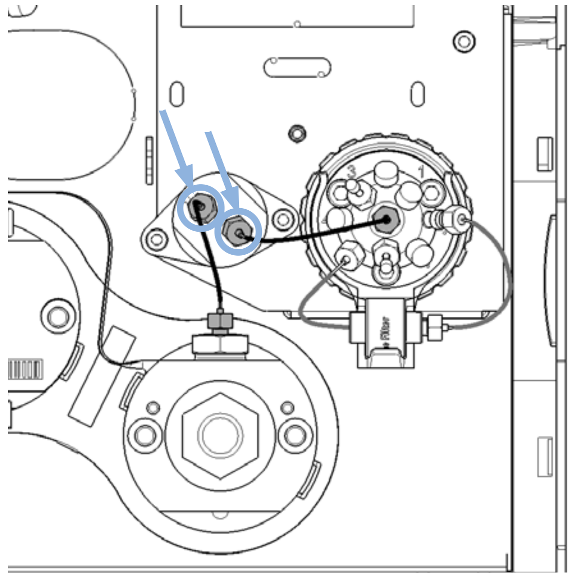
4 Connect the new pressure sensor to the pressure sensor connector.



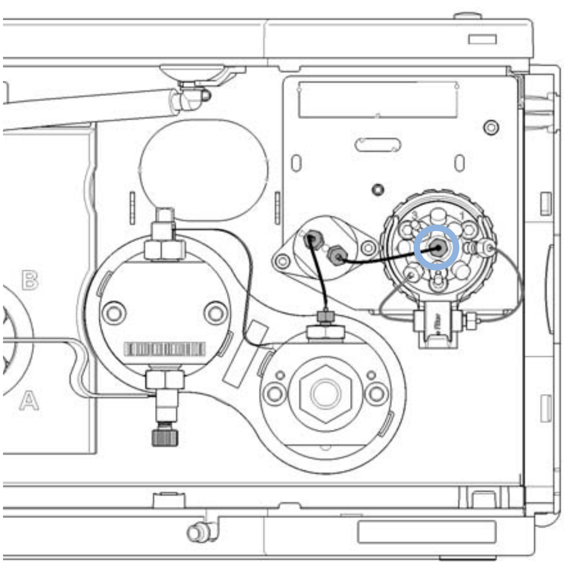
5 Fix the pressure sensor to the instrument chassis.



6 Connect the capillary from the pump head outlet to the pressure sensor inlet. Two arrow signs on the pressure sensor indicate the flow direction.



7 If applicable, connect the outlet of the pressure sensor to the central port of the Multi Purpose Valve.



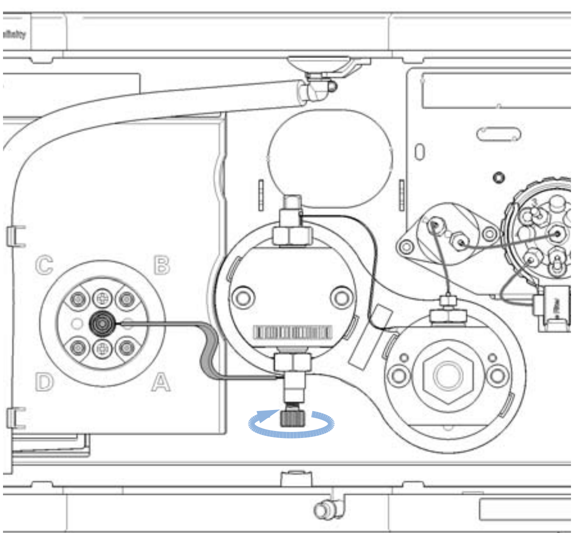
Replacing the Inlet Weaver

Parts required	p/n	Description
	G4204-81090	1290 Infinity Quaternary Pump Inlet Weaver Assembly

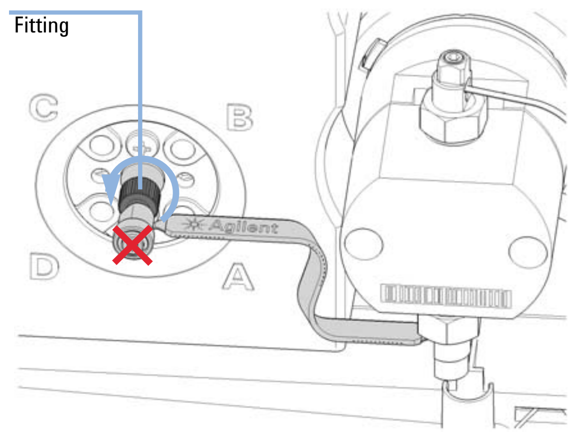
Preparations

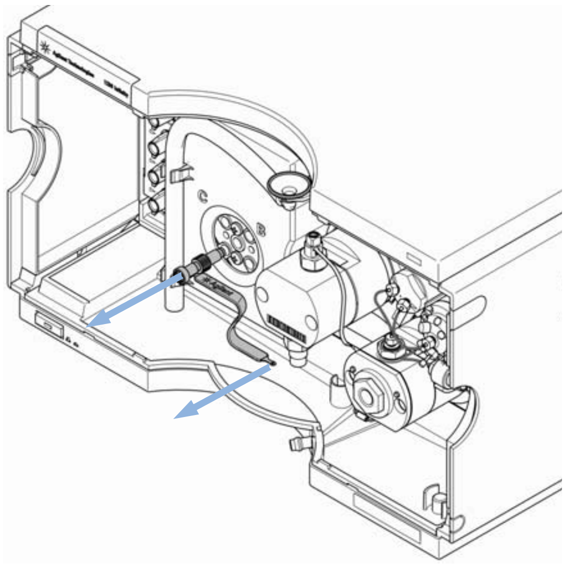
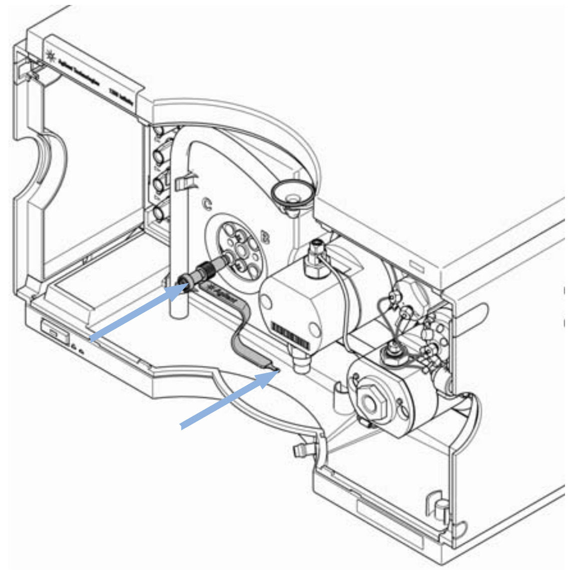
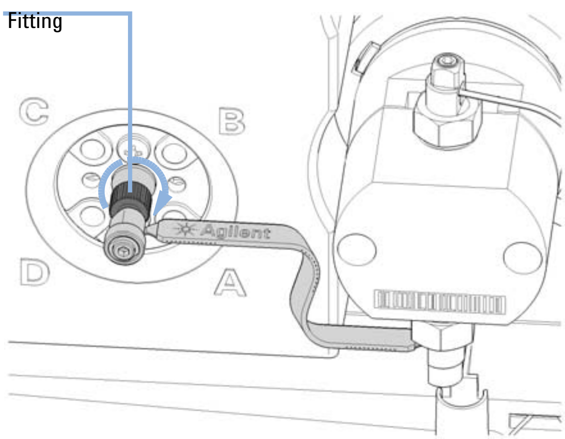
- Switch off pump at the main power switch
- Remove the front cover
- Use an optional solvent shutoff valve or lift up solvent filters inside solvent bottles for avoiding leakages
- For easy access to the inlet weaver assembly, remove tubing connections between MCGV and degasser

1 Open the screw at the bottom of the inlet valve.



2 Open the fitting at the center of the multi-channel gradient valve (MCGV). Do not open the screw marked with the red cross. Remove the inlet weaver from the MCGV.



3 Pull the inlet weaver out of the inlet valve. 	**4** Insert the new inlet weaver to the inlet valve. Fix the weaver with the plastic screw. 
5 Fix the fitting of the new inlet weaver to the MCGV. 	**6** Reconnect tubings between MCGV and degasser.

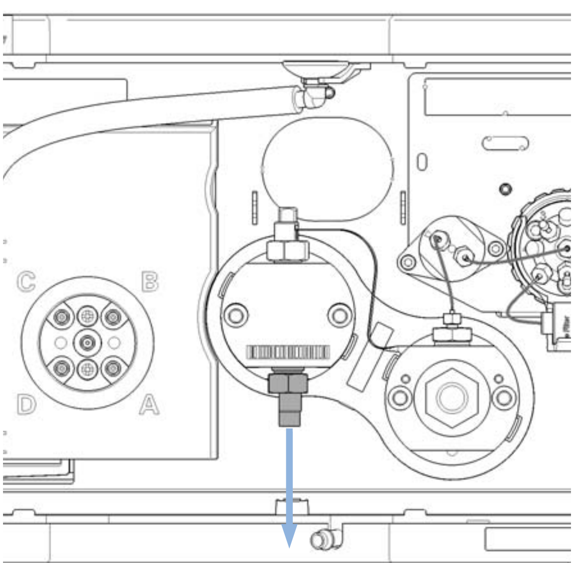
Replacing the Inlet Valve

When	If Inlet valve is defective.	
Tools required	**p/n**	**Description**
		Wrench, 14 mm
	G4220-20012	Torque wrench 2 – 25 Nm
Parts required	**p/n**	**Description**
	G4204-60022	Inlet Valve 1290 Infinity Quaternary Pump

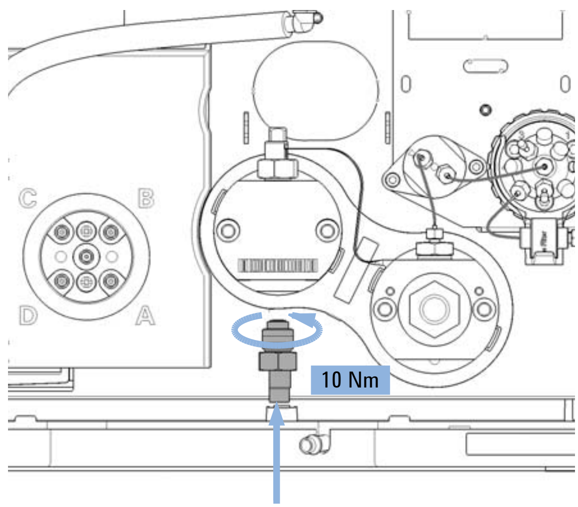
Preparations

- Switch off pump at the main power switch
- Remove the front cover
- Use an optional solvent shutoff valve or lift up solvent filters inside solvent bottles for avoiding leakages
- Remove the inlet weaver, see "Replacing the Inlet Weaver" on page 134

1 With a 14 mm wrench, unscrew the inlet valve and remove it.



2 Install the new inlet valve and tighten it using a torque wrench with a 14 mm bit set to 10 Nm.



Next Steps:

3 Insert the inlet weaver, see "Replacing the Inlet Weaver" on page 134.

4 Purge the system to remove air.

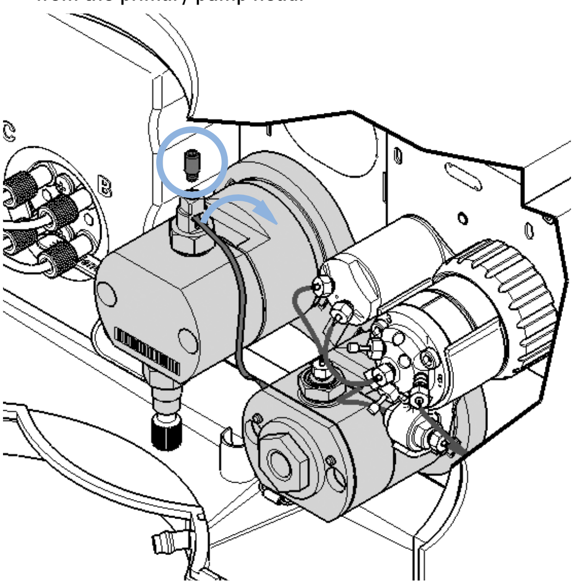
Replacing the Outlet Valve

When	If Outlet valve is defective.	
Tools required	**p/n**	**Description**
	8710-0510	Wrench open 1/4 — 5/16 inch
	8710-2603	Spanner-double open ended 12X14 mm Chrome
	G4220-20012	Torque wrench 2 – 25 Nm
	G4220-20041	Bit Torx 10x25 mm
Parts required	**p/n**	**Description**
	G4220-60028	Outlet valve (primary pump head)
	G4220-20020	Internal gold seal for Outlet Valve

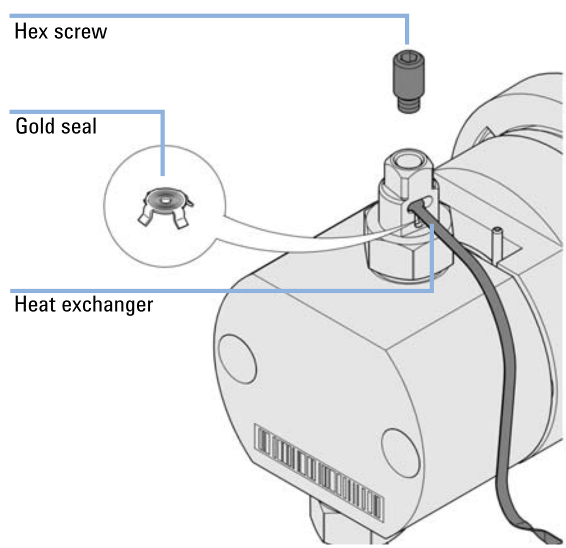
Preparations

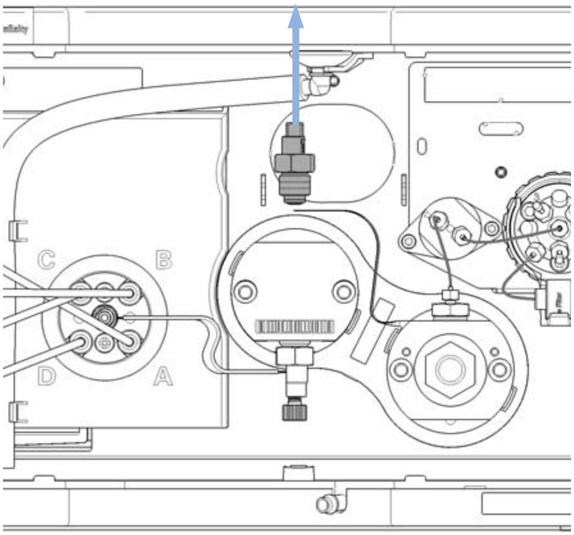
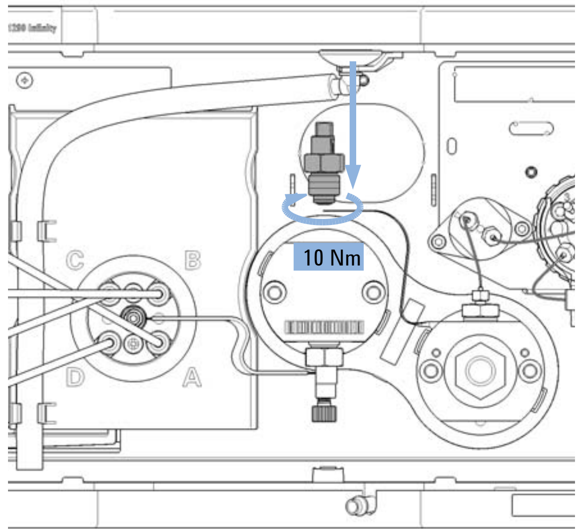
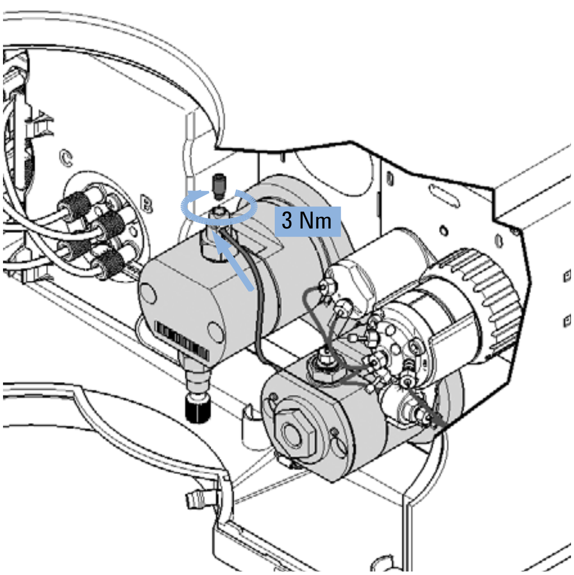
- Switch off pump at the main power switch
- Remove the front cover
- Use an optional solvent shutoff valve or lift up solvent filters inside solvent bottles for avoiding leakages

1 Open the 2.5 mm hex screw at the top of the primary pump head, which fixes the connection capillary of the heat exchanger. Then lift up the capillary and remove it from the primary pump head.



2 A gold seal between outlet valve and heat exchanger capillary is used for a tight connection. The seal can be replaced separately as needed.



3 Unscrew the outlet valve with a 14 mm wrench. 	**4** Insert the new outlet valve and tighten it using a torque wrench with a 14 mm bit set to 10 Nm. 
5 Insert the heat exchanger capillary into the outlet of the outlet valve. Using a torque wrench with a 2.5 mm hex bit, set 3 Nm and close the hex screw at the top of the outlet. 	**6** Purge the system to remove air.

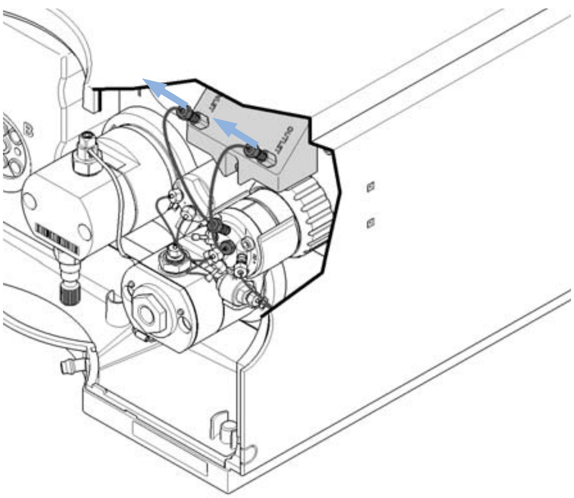
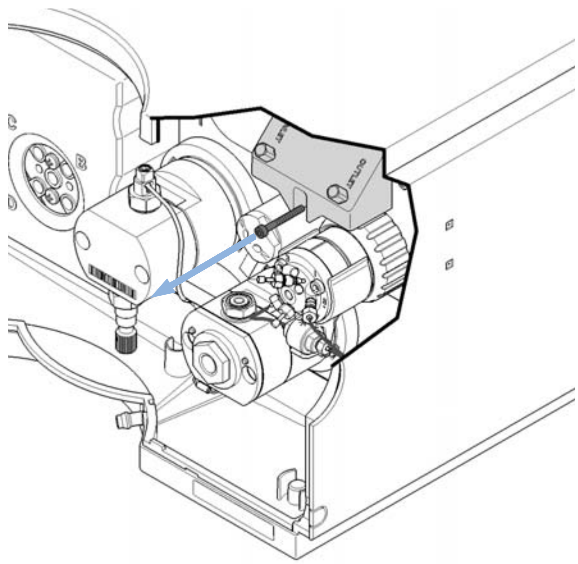
Removing the Jet Weaver

Tools required	p/n	Description
	8710-0510	Wrench open 1/4 — 5/16 inch
	8710-0899	Pozidriv screwdriver

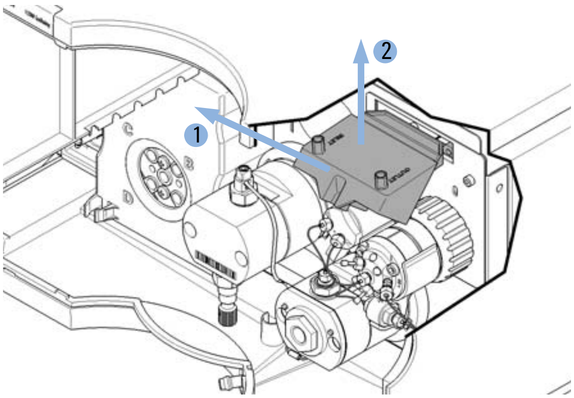
Parts required	#	p/n	Description
	2	0100-1259	Plastic fittings

Preparations

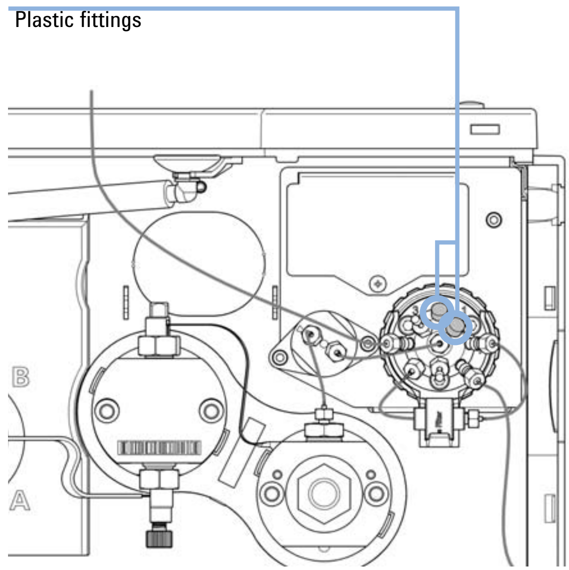
- Select **Do not use mixer** in ChemStation.
- Switch off the pump at the main power switch.

1 Remove capillary connections from the Jet Weaver to the Multi Purpose Valve. 	**2** Open the screw, which fixes the Jet Weaver to the front panel. 

3 Lift up the Jet Weaver (1) and pull it out of the front panel (2).



4 If no other Jet Weaver shall be installed, use plastic fittings for closing unused ports of the valve and install the metal lid.

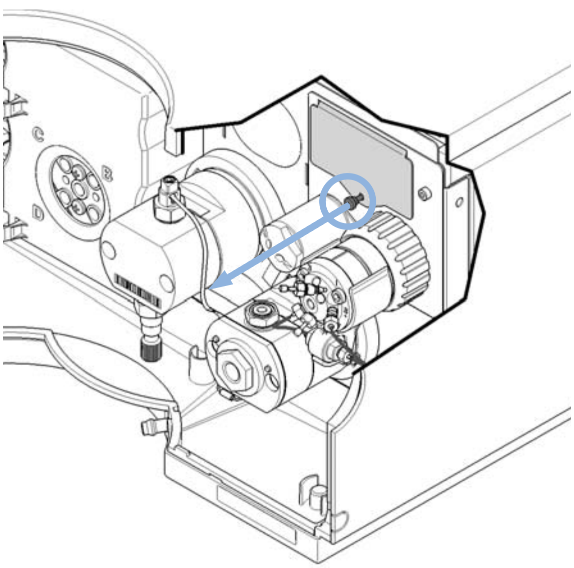


OR
Otherwise continue at "Installing the Jet Weaver" on page 141.

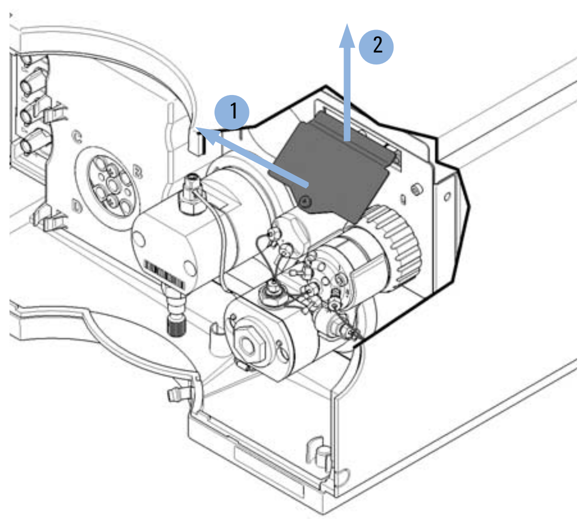
Installing the Jet Weaver

When	The optional Jet Weaver 380 µL for 1290 Infinity Quaternary Pump (G4204-68000) is available for applications which require highest mixing performance, see chapter *Optimizing Performance*.		
Tools required	**Description**		
	Screwdriver Pozidriv #1		
Parts required	**#**	**p/n**	**Description**
	1	G4204-68000	Jet Weaver 380 µL for 1290 Infinity Quaternary Pump containing
	2	5067-5416	Capillary ST 0.17 x 120 mm, SLV/SV Jet Weaver to Multi Purpose Valve
Preparations	Switch off the pump at the main power switch		

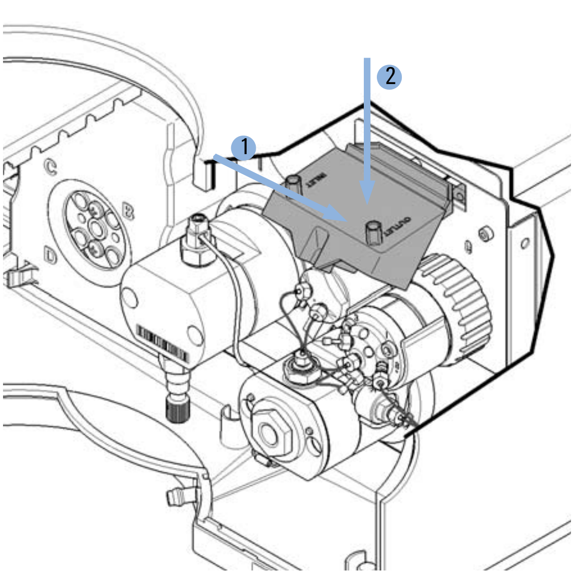
1 Open the screw of the Jet Weaver metal lid.



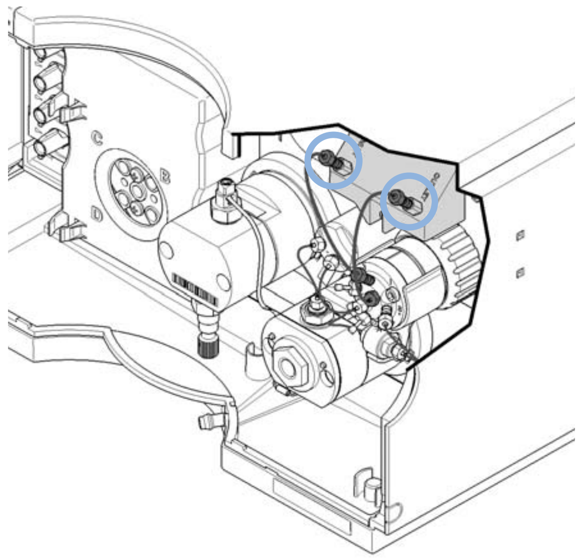
2 Remove the metal lid by lifting it up (1) and pulling it out of the front panel (2).



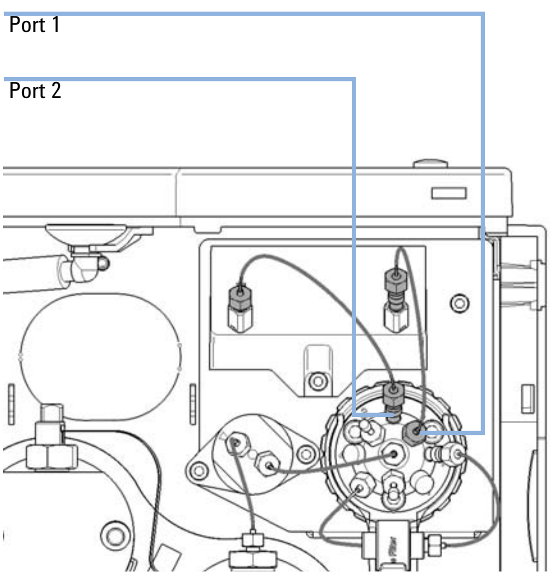
3 Insert the Jet Weaver to the opening in the front panel (1) and push it down (2).



4 Mount both capillary connections to the Jet Weaver observing the correct orientation.



5 Connect the inlet capillary of the Jet Weaver to port 2 of the Multi Purpose Valve. Connect the outlet capillary to port 1.

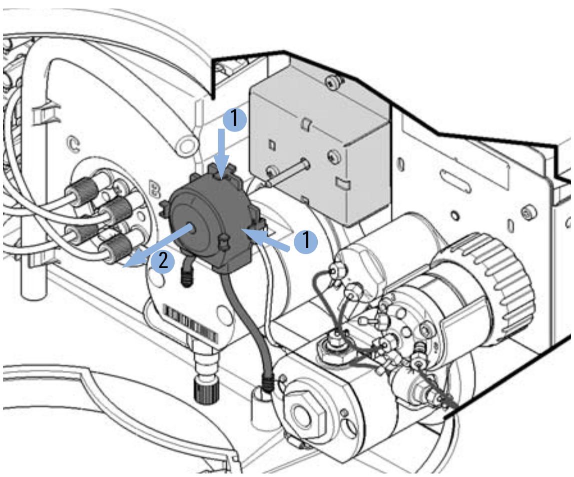


6 Configure the Jet Weaver as mixer in the user interface, see “Instrument Configuration” on page 56.

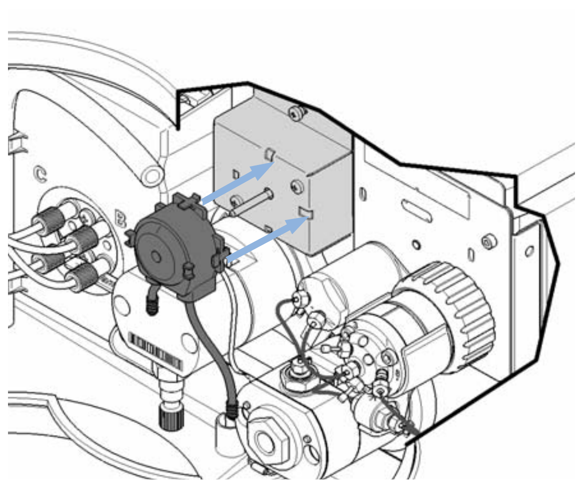
Replacing the Seal Wash Pump

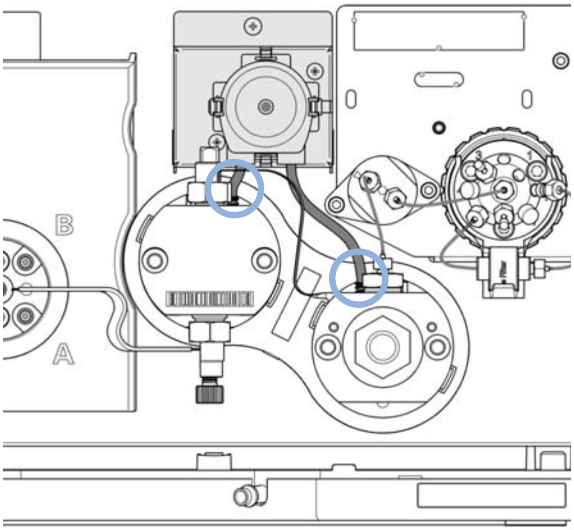
When	In case of wear of the seal wash pump		
Parts required	**#**	**p/n**	**Description**
	1	5067-4793	Peristaltic Pump with Fixation Springs
Preparations	Remove the flow connections from and to the seal wash pump.		

1 For removing the seal wash pump, press the clips (1) and pull the pump to the front (2).



2 Insert the pump clips to the holes in the module housing.



3 Fix tubings of the peristaltic pump to the primary pump head outlet and secondary pump head inlet. 	

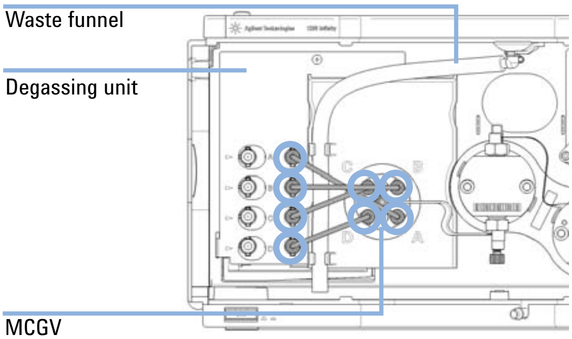
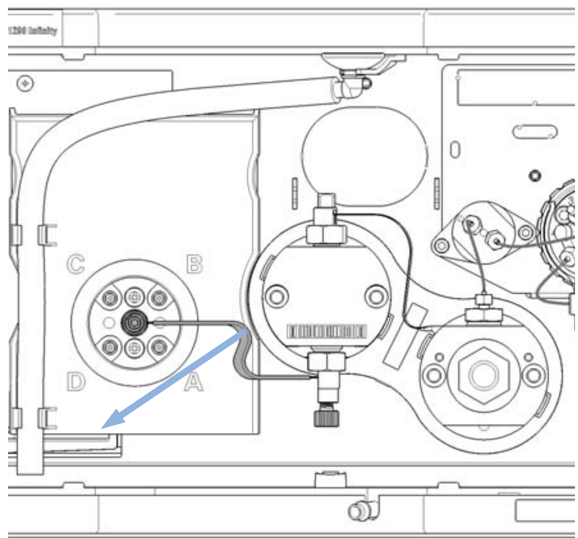
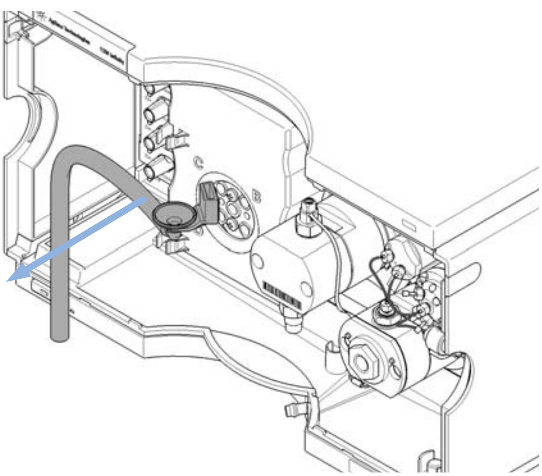
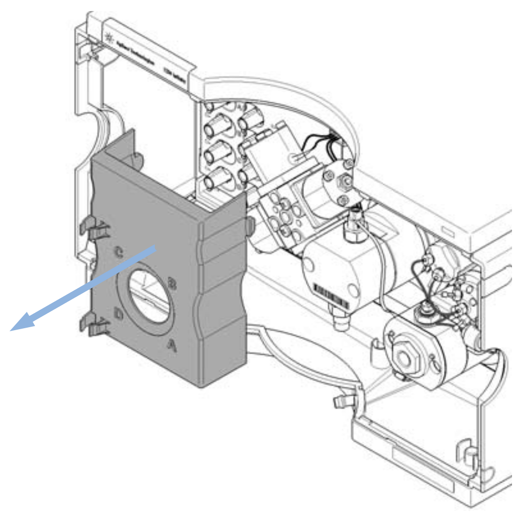
Replacing the Multi-Channel Gradient Valve (MCGV)

Tools required	**p/n**	**Description**
	0100-1710	Mounting Tool for Tubing Connections
	8710-0899	Pozidriv screwdriver
Parts required	**p/n**	**Description**
	G1311-67701	Multi channel gradient valve (MCGV)

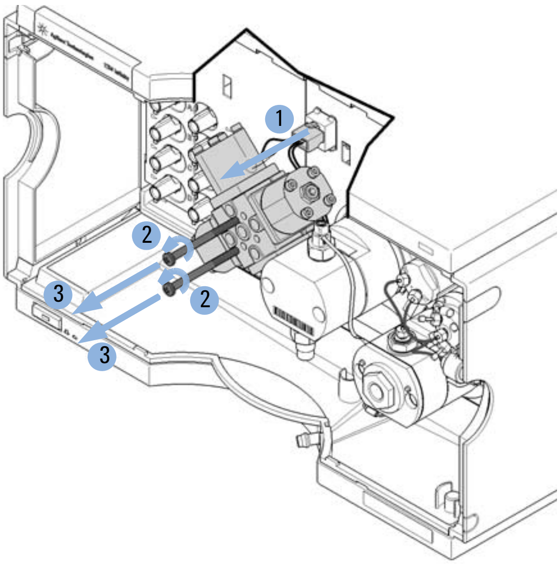
Preparations

- Switch off pump at the main power switch
- Remove the front cover
- Use an optional solvent shutoff valve or lift up solvent filters inside solvent bottles for avoiding leakages

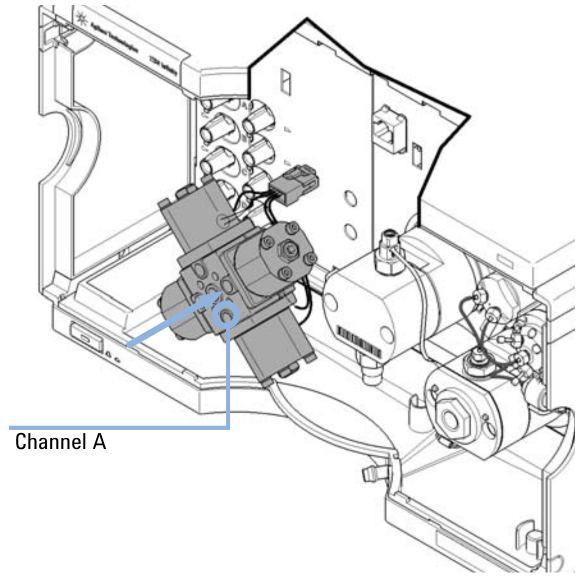
NOTE For best performance and life time, use lower channels A and D for aqueous solvents in buffer applications, see "Operational Hints for the Multi Channel Gradient Valve (MCGV)" on page 81 for details.

1 Use the mounting tool for removing tubing connections between the degassing unit and the MCGV. 	**2** Remove the inlet weaver, see "Replacing the Inlet Weaver" on page 134. 
3 Remove the waste funnel. 	**4** Remove the cover from the MCGV. 

5 Disconnect the MCGV cable (1), unscrew the two screws (2, 3) and remove the valve.



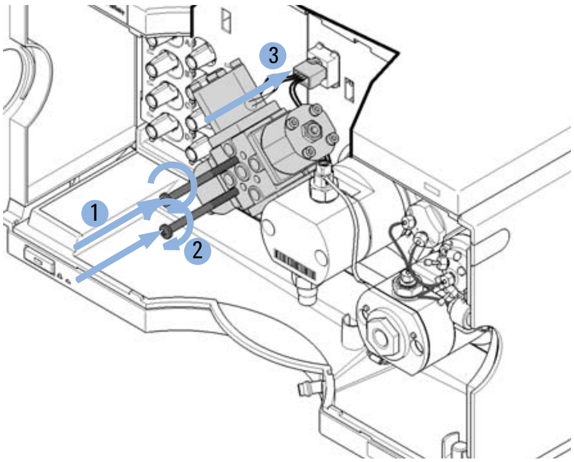
6 Place the new MCGV into position.



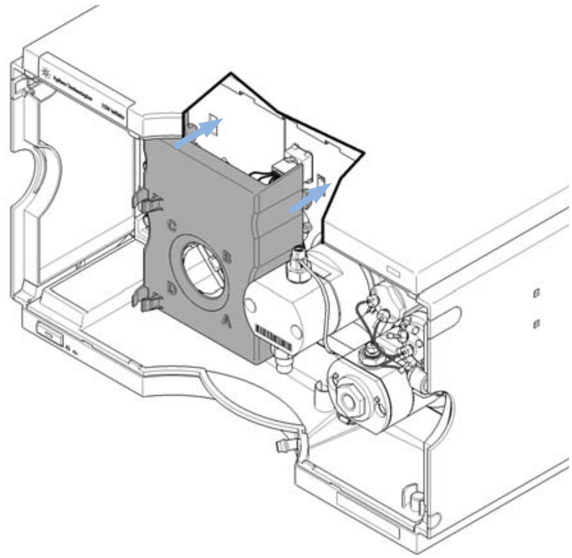
NOTE

Make sure that channel A of the MCGV is put at the bottom-right position.

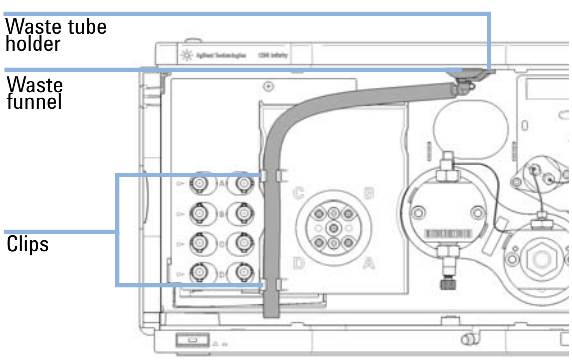
7 Tighten the two screws (1, 2) and connect the cable to its connector (3).



8 Install the MCGV cover.



9 Reconnect the waste funnel with the waste tube holder in the top cover. Insert waste tube in the holder in the leak pan and clip tube to the MCGV cover.



Next Steps:

10 Install the inlet weaver, see "Replacing the Inlet Weaver" on page 134.

11 Reconnect solvent tubes for channels A-D from the MCGV to the degasser outlets.

Releasing a Stuck Inlet Valve

Tools required	p/n	Description
	9301-0411	Syringe, Plastic
	0100-1681	Syringe adapter luer/barb
	0100-1710	Mounting Tool for Tubing Connections
		Beaker

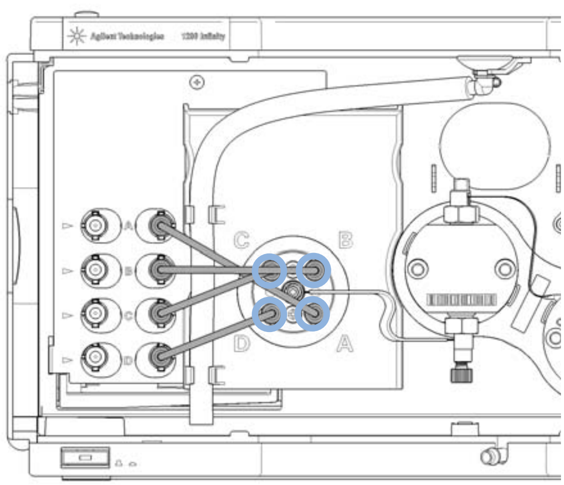
CAUTION

Pressure damages the multi-channel gradient valve (MCGV) and/or degasser

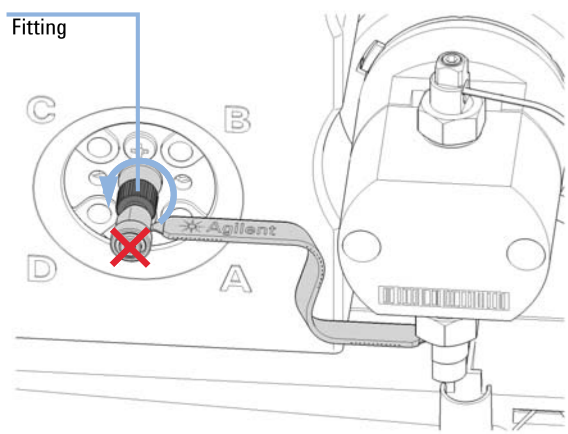
→ Never apply pressure to the MCGV or degasser.

→ Directly connect the syringe to the inlet weaver.

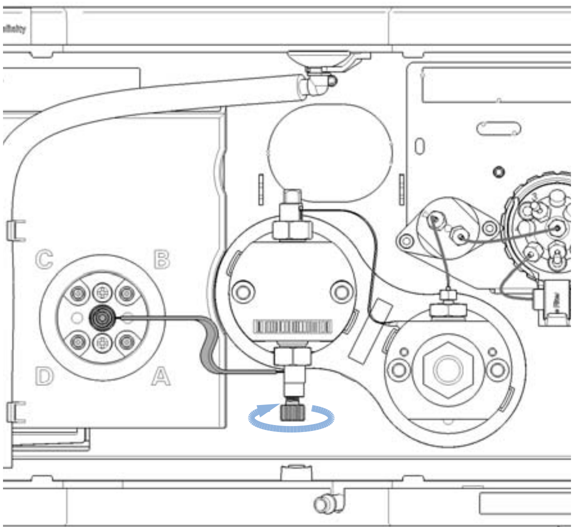
1 Remove tubing connections channels A, B, C and D to the MCGV such that you can access the inlet weaver.



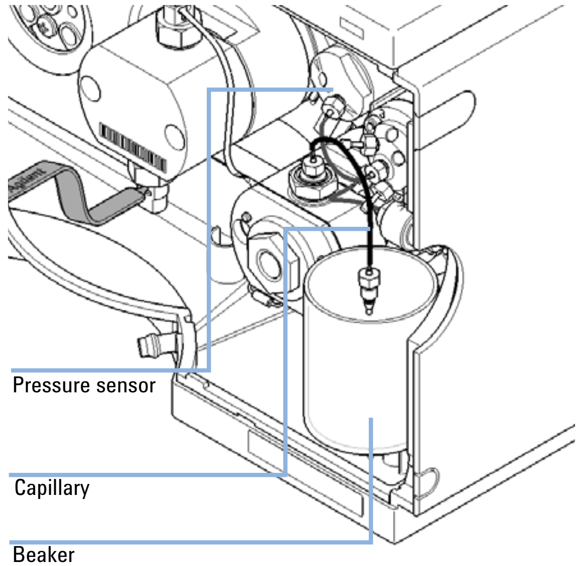
2 Open the fitting at the center of the multi-channel gradient valve (MCGV). Do not open the screw marked with the red cross. Remove the inlet weaver from the MCGV.



3 Slightly open the black plastic screw at the bottom of the inlet valve, and rotate the inlet weaver to the front. Then retighten the screw.



4 Disconnect the capillary from the pressure sensor inlet and route the capillary to a small beaker.

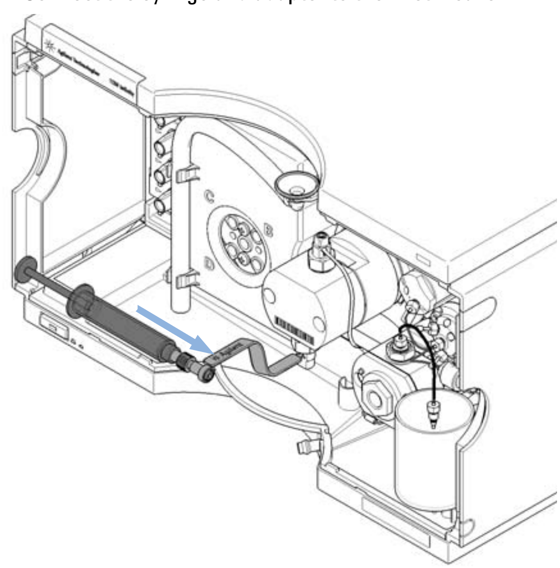


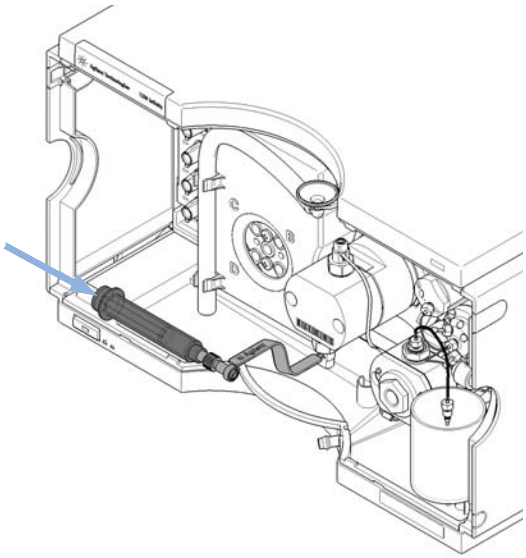
5 Fill the syringe with a suitable wash solvent.

NOTE

For salt deposits, warm water is a good choice. For organic deposits, use ethanol or acetone.

6 Connect the syringe and adapter to the inlet weaver.



7 Push the syringe for flushing the inlet valve and pump head. 	**8** Restore original connections. Flush the system for several minutes.

Replacing the Pump Head

When	For preventive maintenance or in case of problems with the pump performance	
Tools required	**p/n**	**Description**
	G4220-20012	Torque wrench 2 – 25 Nm
	G4220-20013	4 mm hex bit
	G4220-20015	Adapter ¼ in square to hex
Parts required	**p/n**	**Description**
	G4204-60200	1290 Infinity Quaternary Pump Head Assembly with Seal Wash Option
	G4204-60400	1290 Infinity Quaternary Pump Head Assembly without Seal Wash Option

Preparations

- Switch off pump at the main power switch
- Remove the front cover
- Use an optional solvent shutoff valve or lift up solvent filters inside solvent bottles for avoiding leakages

CAUTION

Limitation of life time

The pump head assembly is an exchange part which cannot be reassembled with standard tools. Disassembling the pump head will strongly limit its life time.

→ Do not disassemble the pump head assembly.

CAUTION

Damage of connections

Disassembling the flow connection between the two pump heads of the pump head assembly (solvent channel) can damage the connection and cause leaks.

→ Do not disconnect the flow connection between the pump heads.

CAUTION

Damage of internal parts

→ Do not apply a strong force to the screws of the pump head.

→ Use a torque hex key for that purpose.

CAUTION

Damage of the pump piston

Removing pump heads in a position other than the maintenance position can damage the pump piston.

→ Before switching off the pump, bring it to the maintenance position.

CAUTION

Damage of pump drives

The pump drive can be damaged if the pump initializes after switching it on without having the pump head installed properly.

→ Use the Lab Advisor maintenance procedure for replacing pump heads.

→ Install the pump head correctly before switching on the pump.

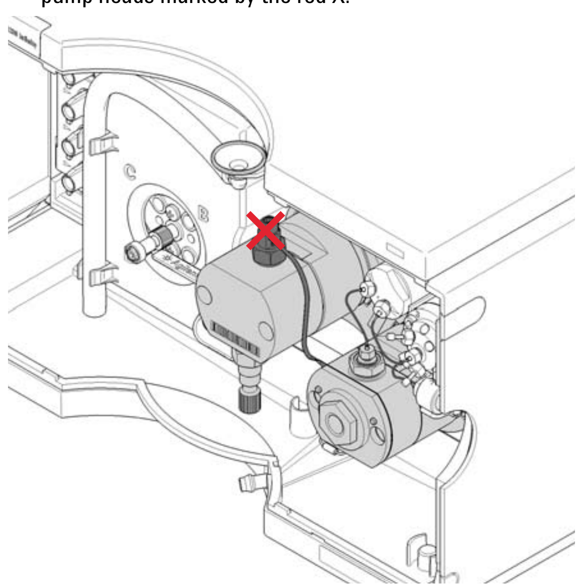
NOTE

One pump head assembly consists of two pump heads including valves and the outlet filter, which are both removed at the same time.

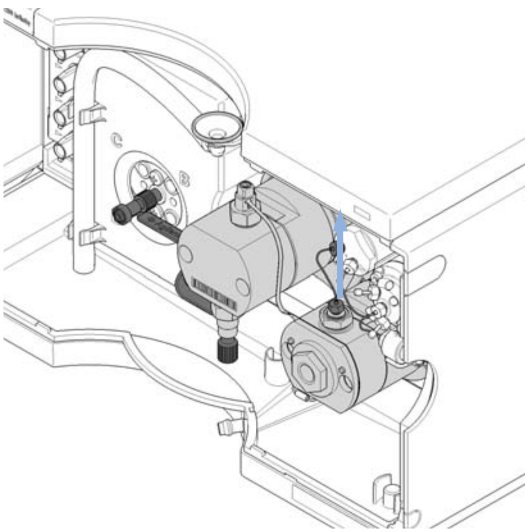
1 In Lab Advisor go to **Tools > Remove/Install Pump Head** and follow instructions given on the screen.

2 If applicable, remove flow connections of the seal wash option.

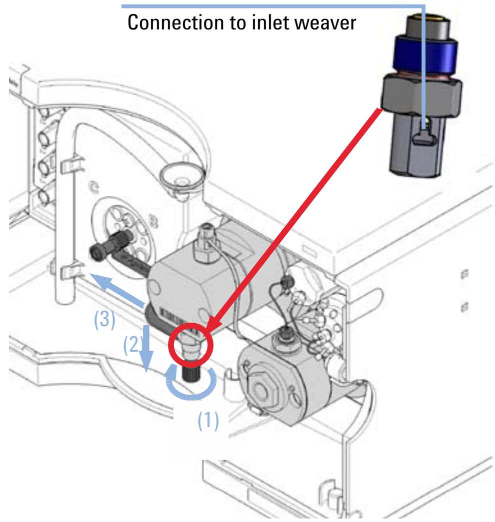
3 DO NOT REMOVE the capillary connection between the pump heads marked by the red X.



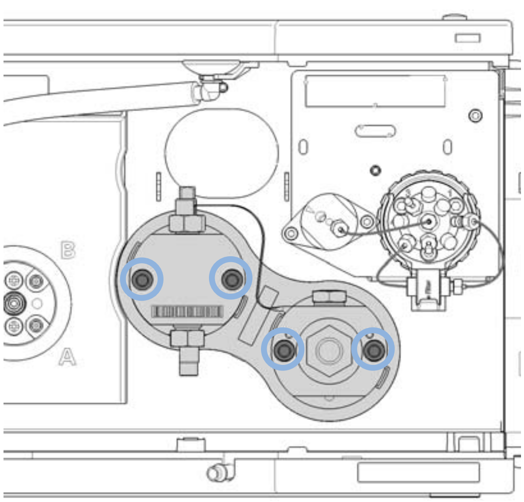
4 Remove the capillary connection from the outlet filter on the secondary pump head to the pressure sensor.



5 Open the black plastic screw of the inlet valve at the bottom of the left primary pump head (1) and remove the inlet weaver by first pushing it downwards (2) and then pulling it out to the left (3).



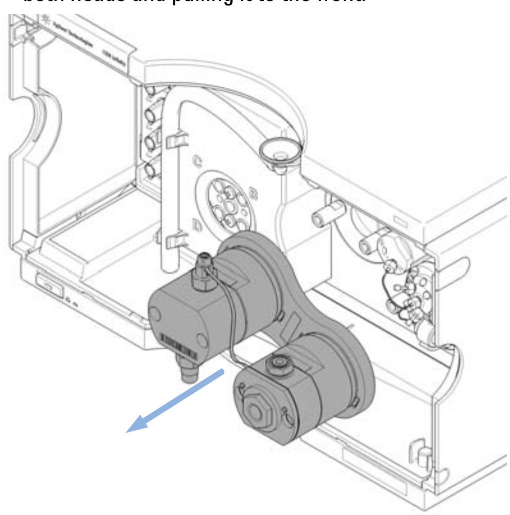
6 Open the four screws holding the pump heads.



NOTE

Open all screws step by step, not screw by screw.

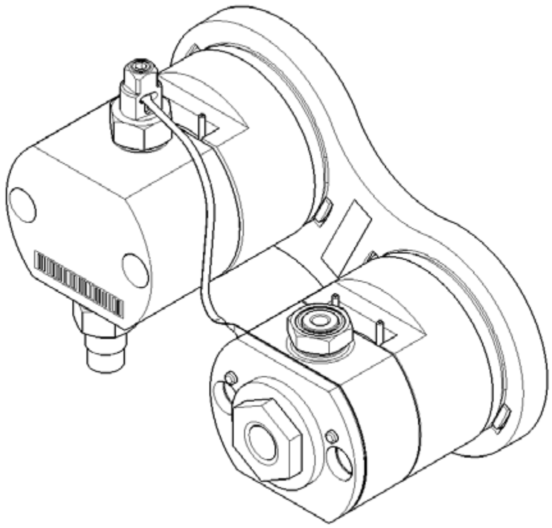
7 Remove the complete pump head assembly by holding both heads and pulling it to the front.



NOTE

Do not further disassemble the pump head.

8 Use a new pre-tested pump head assembly including valves and an outlet filter.



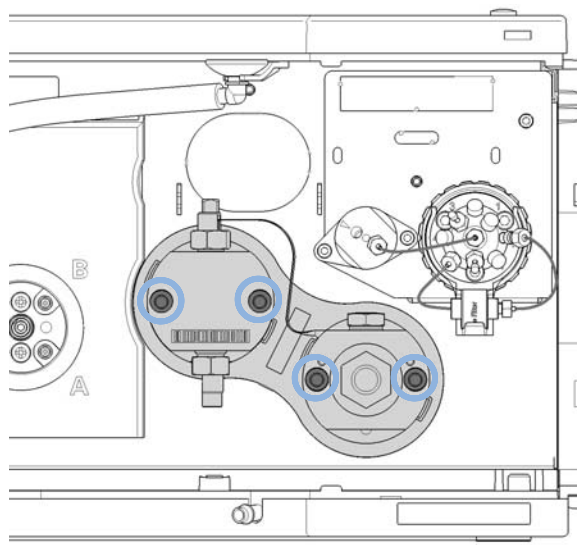
CAUTION

Damage to the pump head

Using a wrong torque will damage the pump head.

→ **For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.**

9 Install the new pump head assembly by tightening the screws step by step. Apply 5 Nm using a torque hex key, which is included to the 1290 Infinity Service Kit p/n 5067-4699.

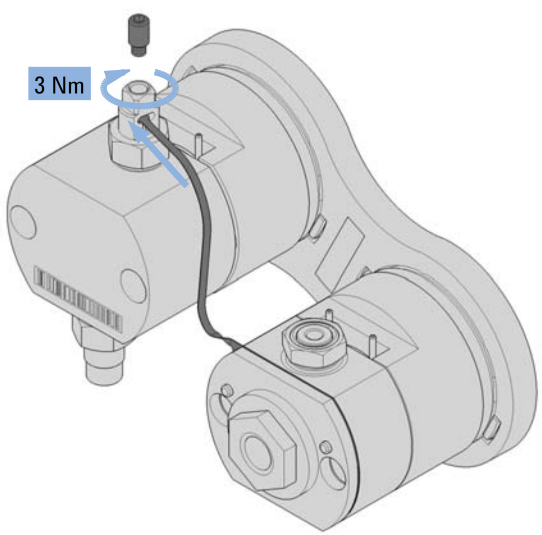


CAUTION

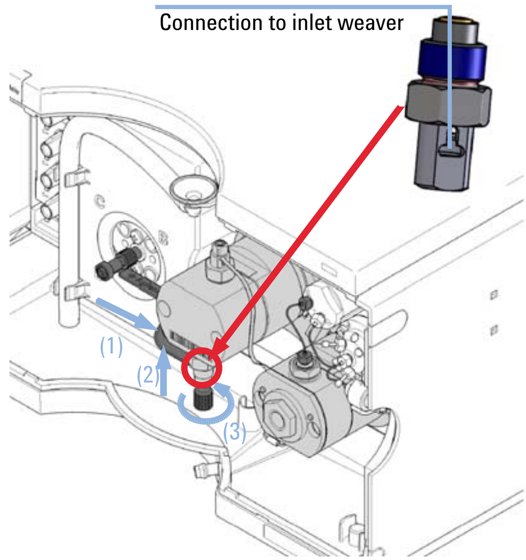
Damage to the pump head
Using a wrong torque will damage the pump head.

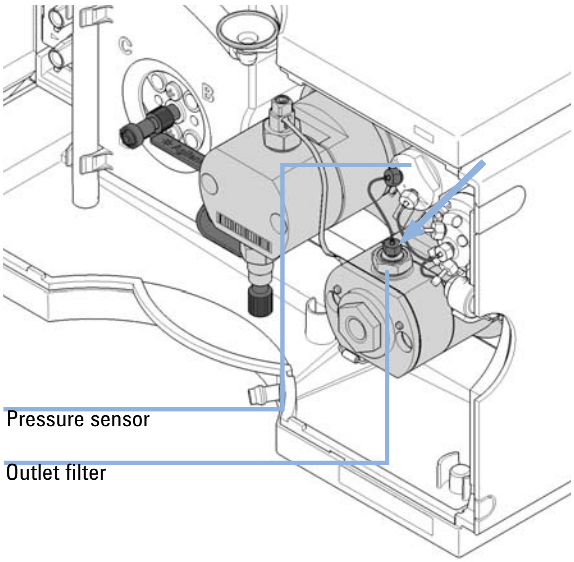
→ **For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.**

10 Insert the heat exchanger capillary into the outlet of the primary pump head. Using a torque key, which is included to the 1290 Infinity Service Kit p/n 5067-4699, set 3 Nm and close the hex screw at the top of the outlet.



11 Insert the new inlet weaver to the inlet valve (1, 2). Fix the weaver with the plastic screw to the inlet valve (3).



12 Connect the capillary from the pressure sensor to the pump head outlet filter.  	

Disassembling the Pump Head

When If parts inside the pump head need to be replaced

Tools required

p/n	Description
G4220-20012	Torque wrench 2 – 25 Nm
G4220-20013	4 mm hex bit
G4220-20014	2.5 mm Hex Bit
G4220-20015	Adapter ¼ in square to hex
8710-0510	Wrench open 1/4 — 5/16 inch

Preparations Remove the pump head assembly as described in "Replacing the Pump Head" on page 152

CAUTION

Damaged pump head

Disassembling or reassembling the pump head with tools other than the ones recommended can damage pump heads and significantly reduce their life time.

→ Follow all instructions step by step.

→ Use recommended tools like the pump head alignment tool and a torque wrench.

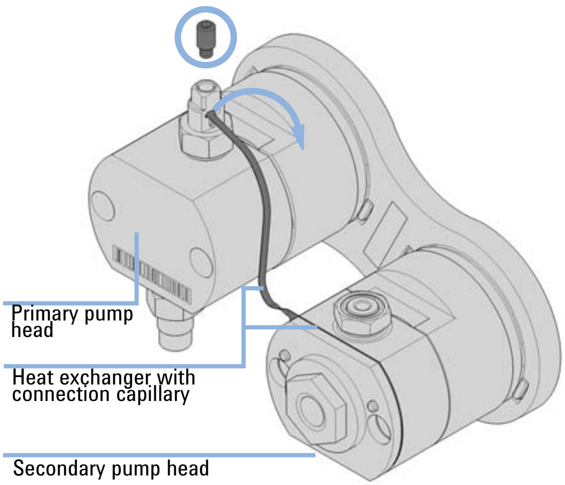
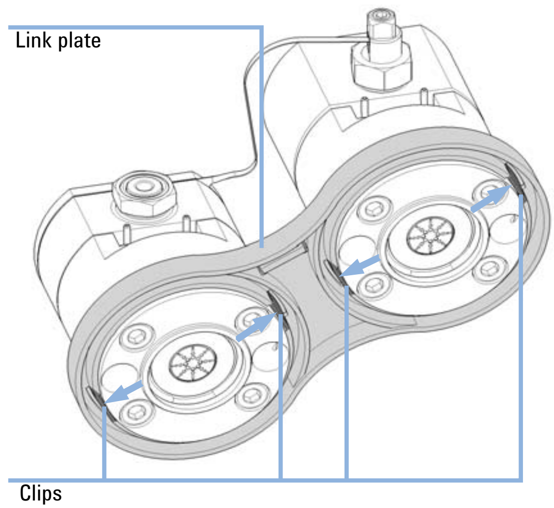
NOTE

This section describes the maintenance of the 1290 Infinity Quaternary Pump head. Agilent recommends using refurbished pump heads for maintenance and repair instead of disassembling pump heads. Such pump heads are available through Agilent service.

The 1290 Infinity pump service kit (5067-4699) includes all tools required for the procedures described in subsequent sections.

NOTE

The primary pump head does not have a heat exchanger. Seal wash parts are optional for both pump heads.

1 Open the 2.5 mm hex or Tx 10 screw at the top of the primary pump head, which fixes the connection capillary of the heat exchanger. Then lift up the capillary and remove it from the primary pump head. 	**2** Remove both pump heads from the link plate by pushing the clips at the rear of the plate. 

Disassembling the Primary Pump Head

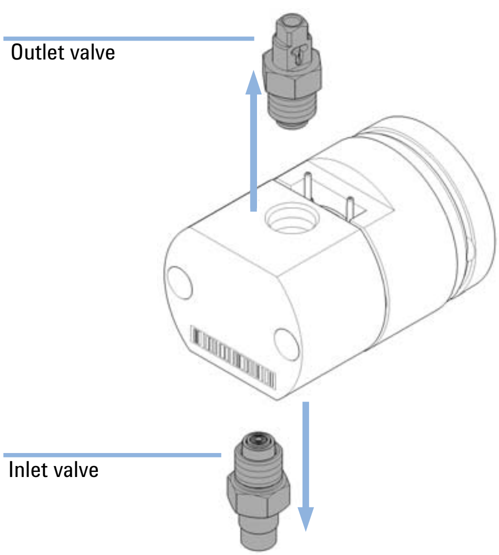
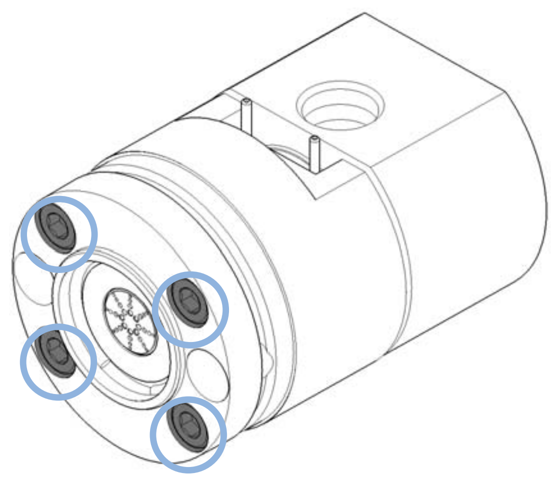
CAUTION

Damage of pump piston

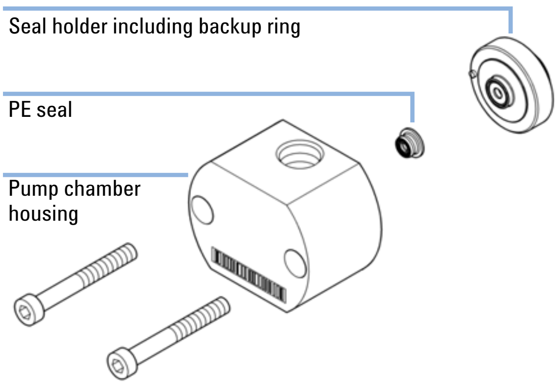
The pump piston is made of ZrO_2-based ceramic, which is a very hard and resistant material, but it is sensitive to shearing forces from the side.

→ Do not try to remove the pump piston from the rear.

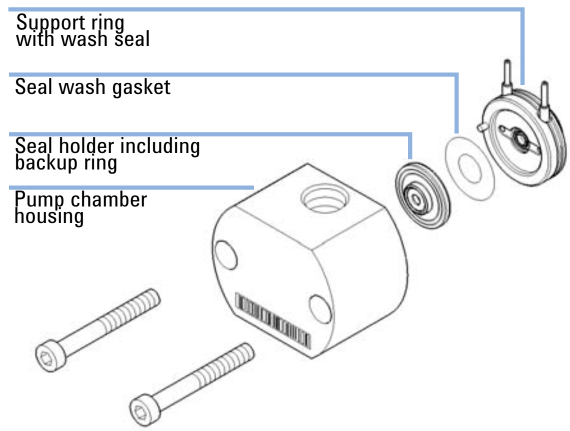
→ Do not use the piston for removing pump seals.

1 Remove the outlet valve at the top of the pump head and the inlet valve at the bottom of the primary pump head. 	**2** For disassembling the pump head, remove the 4 hex screws at the rear of the pump head. 

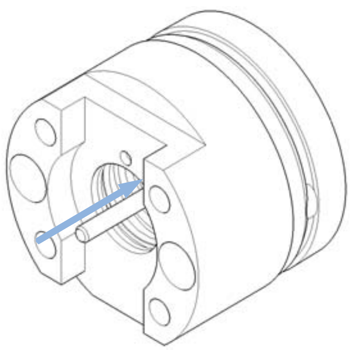
3 Remove the front part of the pump head including pump chamber housing with pump seal and support ring.



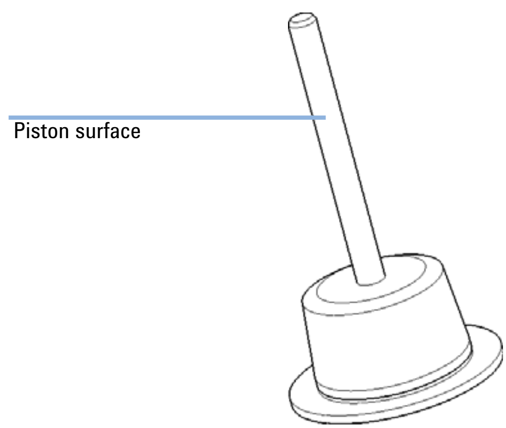
4 Remove the front part of the pump head including pump chamber housing with pump seal and support ring. If the seal wash option is installed, also remove the seal holder including backup ring, and the gasket.



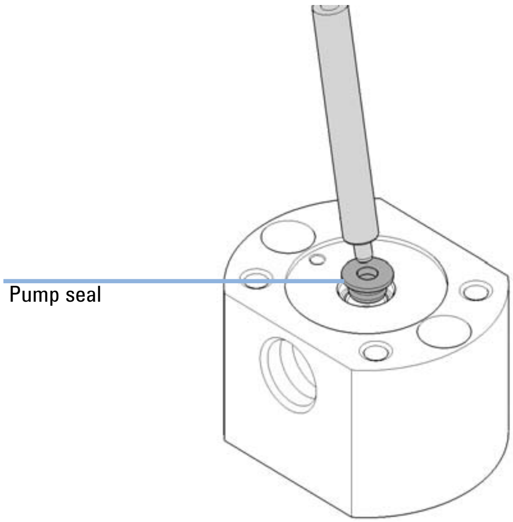
5 Remove the piston from the piston housing by pushing it to the rear, then pull it out from the rear.



6 Check the pump pistons for scratches grooves and dents.



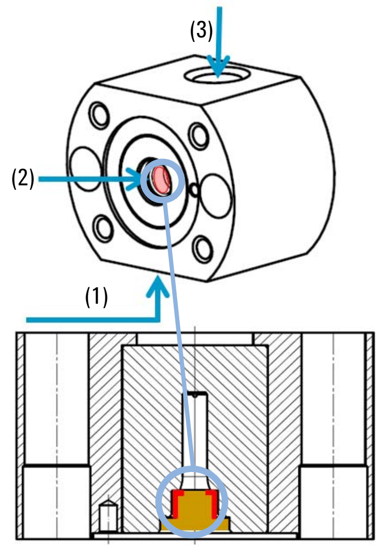
7 Use the steel side of the insert tool for removing the pump seal from the pump chamber housing.



NOTE

Do not use the pump piston for that purpose, as this can break it!

8 To flush out particles from the pump head, use pressurized air ((1), (2) and (3)).



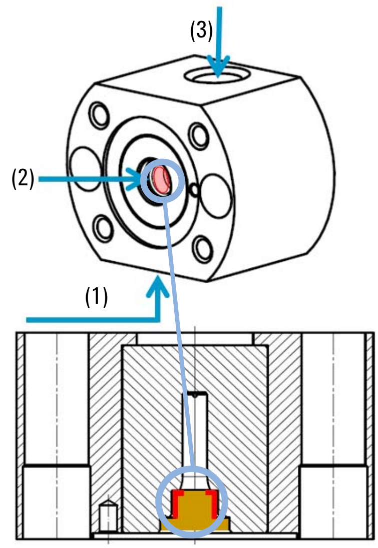
NOTE

Pump head parts in contact with the piston seal need to be cleaned properly in order to get a smooth surface and a tight connection.

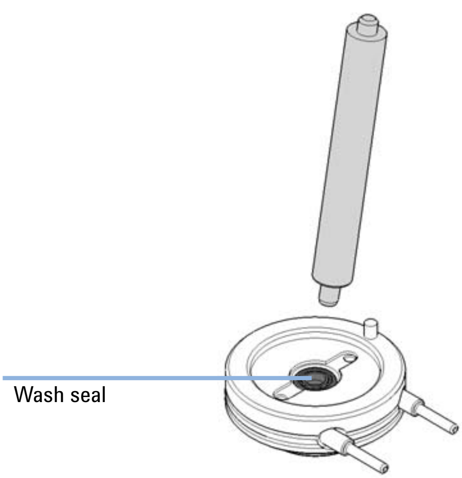
9 To remove wear, use isopropanol.

10 To clean the piston and the pump head sufrace, use the ultra fine abrasive mesh (p/n 8660-0852).

11 To dry the pump head and to remove residues, use pressurized air ((1), (2) and (3)).



12 If the wash seal shall be replaced by a new one, use the steel side of the insert tool for removing it.



Disassembling the Secondary Pump Head

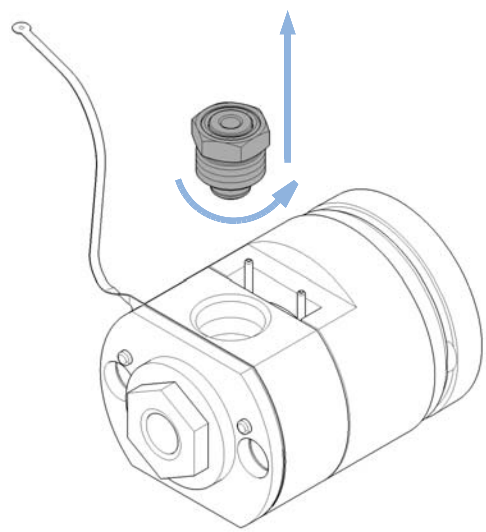
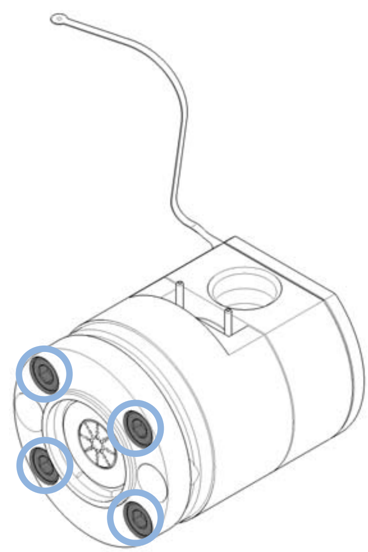
CAUTION

Damage of pump piston

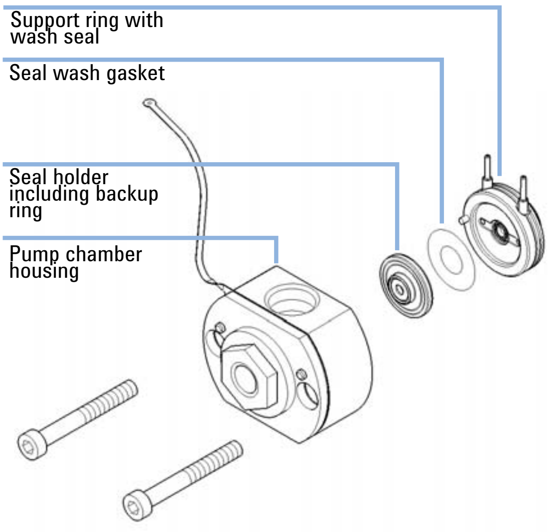
The pump piston is made of ZrO_2-based ceramic, which is a very hard and resistant material, but it is sensitive to shearing forces from the side.

→ Do not try to remove the pump piston from the rear.

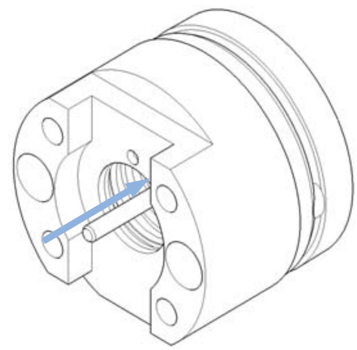
→ Do not use the piston for removing pump seals.

1 Remove the outlet filter at the top of the pump head. 	**2** For disassembling the pump head, remove the 4 hex screws at the rear of the pump head. 

3 Remove the front part of the pump head including pump chamber housing with pump seal and seal holder. If the seal wash option is installed, also remove the support ring with wash seal and gasket.



4 Remove the piston from the piston housing by pushing it to the rear, then pull it out from the rear.

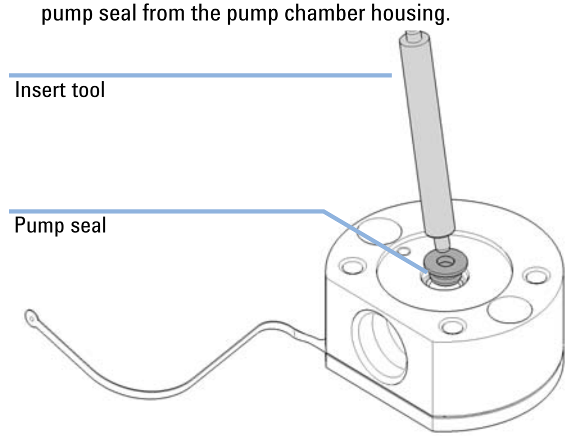


5 Check the pump pistons for scratches, grooves and dents when changing the piston seals.

NOTE

Damaged pistons cause micro leaks and will decrease the lifetime of the seals.

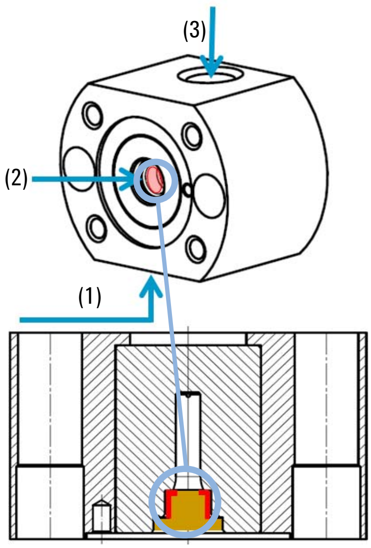
6 Use the steel side of the insert tool for removing the pump seal from the pump chamber housing.



NOTE

Do not use the pump piston for that purpose, as this can break it!

7 To flush out particles from the pump head, use pressurized air ((1), (2) and (3)).

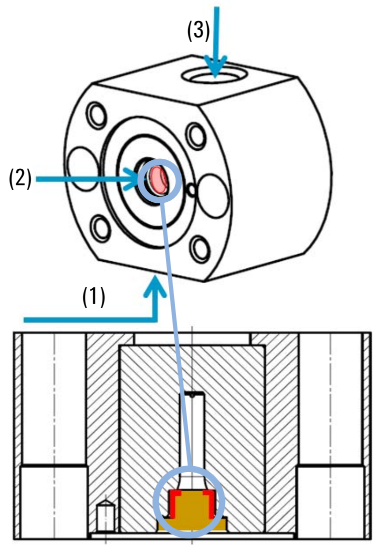
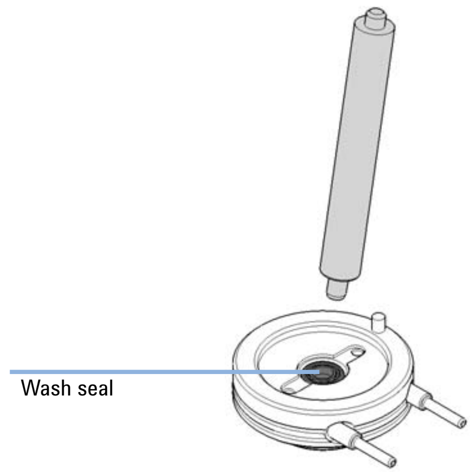


NOTE

Pump head parts in contact with the piston seal need to be cleaned properly in order to get a smooth surface and a tight connection.

8 To remove wear, use isopropanol.

9 To clean the piston and the pump head sufrace, use the ultra fine abrasive mesh (p/n 8660-0852).

10 To dry the pump head and to remove residues, use pressurized air ((1), (2) and (3)). 	**11** If the wash seal shall be replaced by a new one, use the steel side of the insert tool for removing it. 

Replacing the Heat Exchanger

Tools required	p/n	Description
		Wrench, 19 mm
	5023-2501	Screwdriver Torx-T10

Parts required	p/n	Description
	G4220-81013	Heat Exchanger (secondary pump head only)
	G4220-20028	Headless screw for 1290 Infinity pump heads
	G4220-20001	Spacer Fitting

Preparations

- Remove the pump head assembly from the pump
- Remove the secondary pump head from the link plate

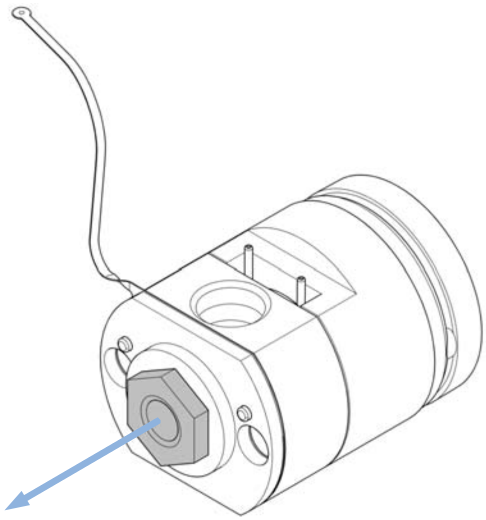
CAUTION

Loss of small spacer fitting

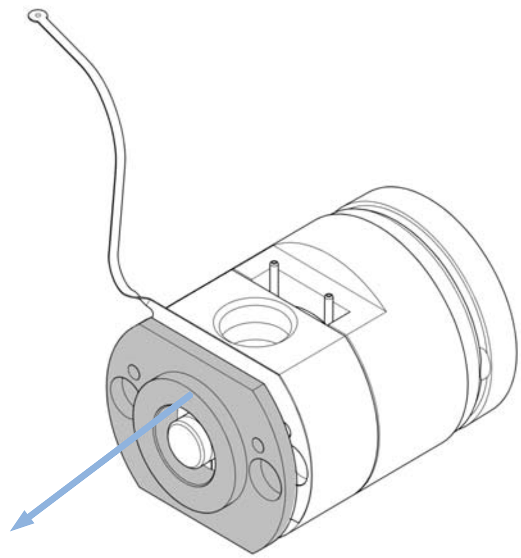
Inside the secondary pump head is a small spacer fitting, which can be dropped easily when removing the heat exchanger.

→ The heat exchanger does not need to be removed for pump head maintenance.

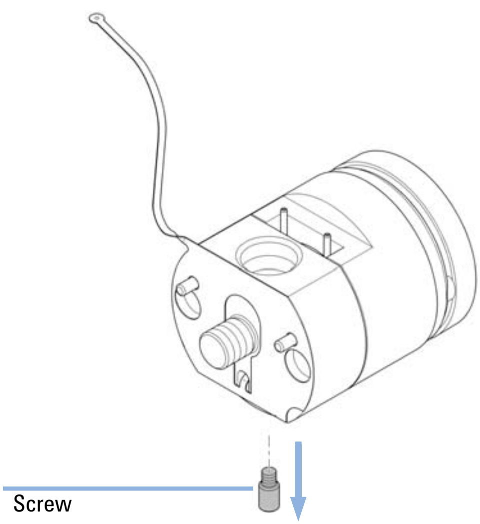
1 Remove the 19 mm screw at the front of the secondary pump head.



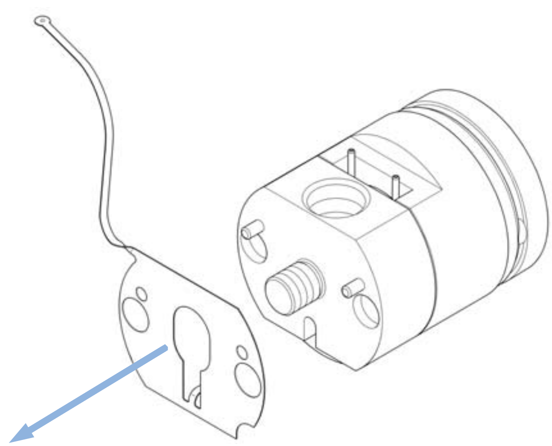
2 Remove the front plate.



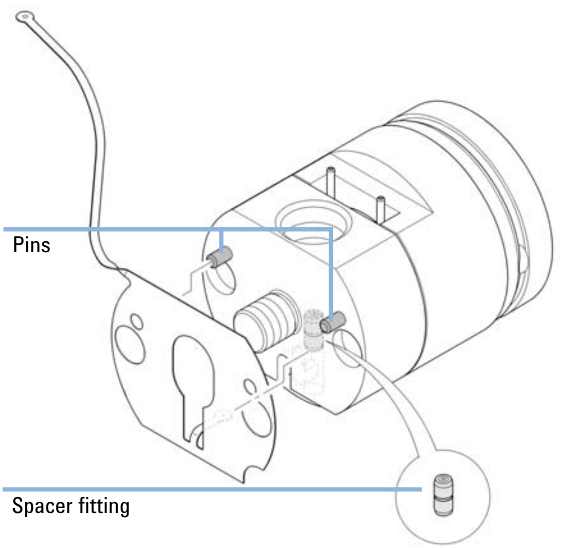
3 Remove the screw at the bottom of the pump head. Do not drop the golden spacer fitting.



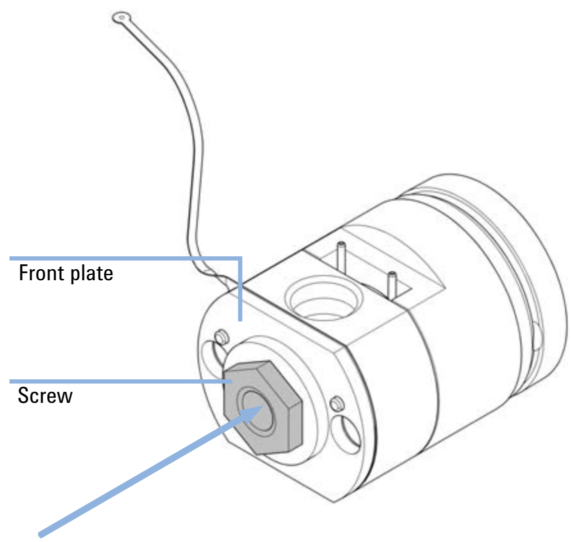
4 Lift out the heat exchanger.



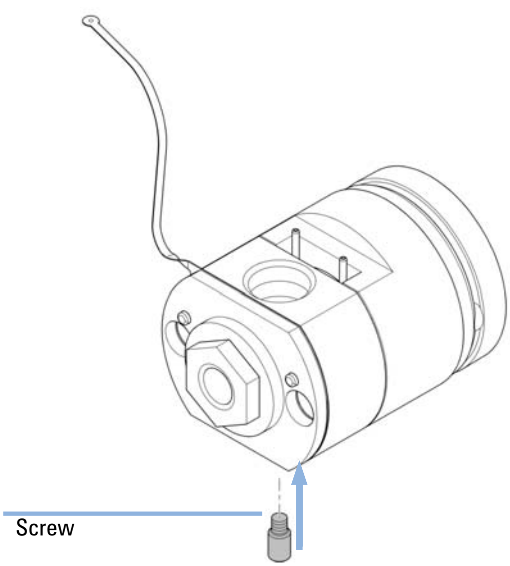
5 If removed, first insert the spacer fitting. Then insert the new heat exchanger to the opening in the pump head and lift it over the pins.



6 Use the 19 mm screw for fixing the front plate.



7 Insert and fix the screw.

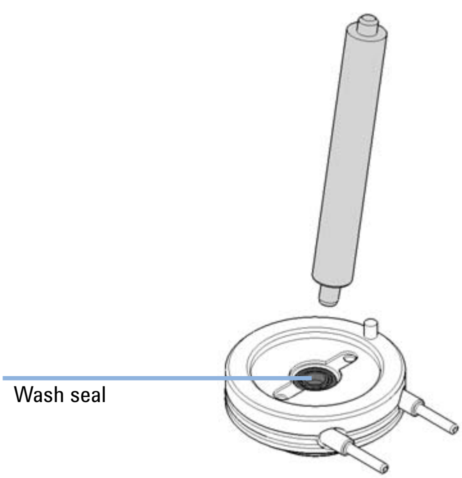


Replacing Wash Seal and Gasket

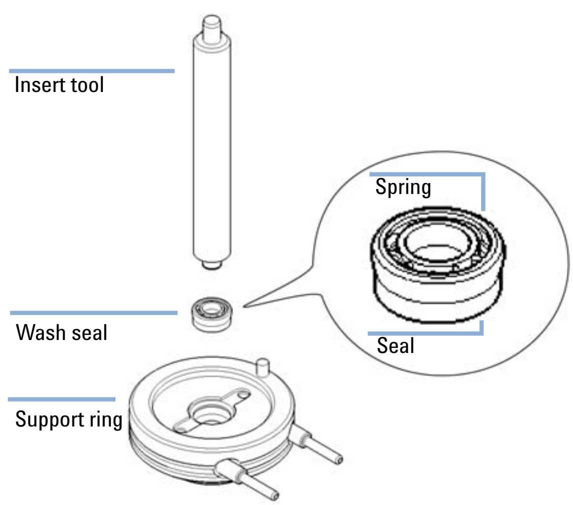
Tools required	p/n	Description
	01018-23702	Insert tool

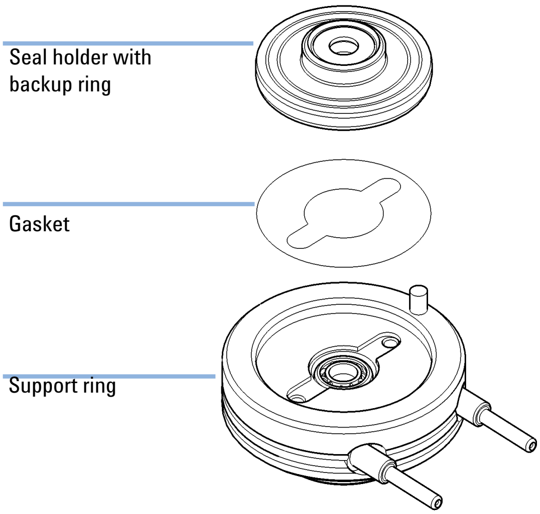
Parts required	p/n	Description
	0905-1718	Wash Seal PE
	5062-2484	Gasket, seal wash (pack of 6)

1 Use the steel side of the insert tool for removing the wash seal.



2 Use the soft plastic side of the insert tool for inserting the wash seal into the support ring. Wet the wash seal with isopropanol or another suitable solvent before insertion.



3 Put the gasket into the support ring and insert the seal holder. 	

Assembling the Pump Head

When	Before installing the pump head.	
Tools required	**p/n**	**Description**
		Pump head alignment tool
	G4220-20012	Torque wrench 2 – 25 Nm
	G4220-20013	4 mm hex bit
	G4220-20041	Bit Torx 10x25 mm
	G4220-20015	Adapter ¼ in square to hex
	01018-23702	Insert tool
Parts required	**p/n**	**Description**
	0905-1719	PE Seal

See chapter *"Parts"* for details.

CAUTION

Damage of the pump piston

The pump piston is very sensitive to shearing forces from the side.

→ Use the alignment piston of the pump head alignment tool for the alignment procedure described below.

CAUTION

Wrong orientation of pins on support ring

Assembling the pump head without paying attention to the correct orientation of the pins on the support ring can lead to leaks or damage of the piston and pump head.

→ Observe pins on the support ring, which help assembling the parts of the pump head in the correct orientation.

CAUTION

Damage of the pump head assembly

When installing the pump head assembly, the pump drives need to be in maintenance position, where they are retracted. Using the pump drive in default position will damage the pump head assembly.

➔ Bring the pump drive to the maintenance position.

CAUTION

Damage to the pump head

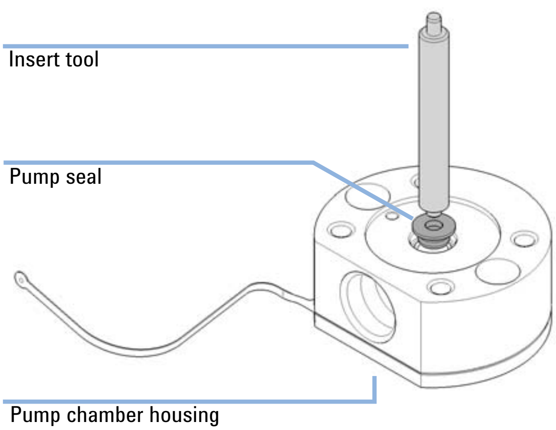
Using a wrong torque will damage the pump head.

➔ For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.

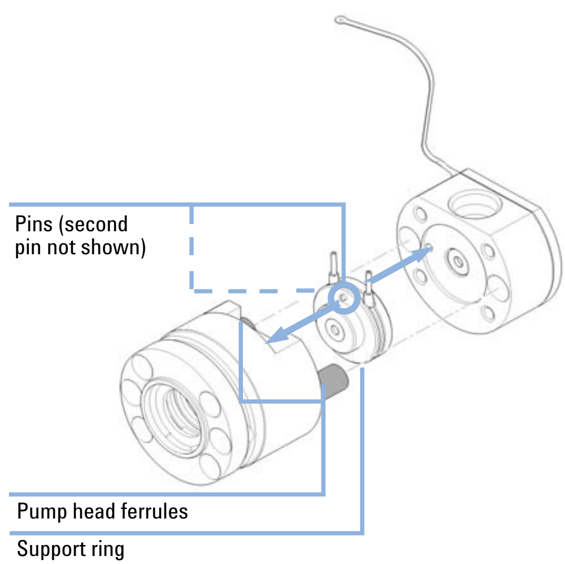
NOTE

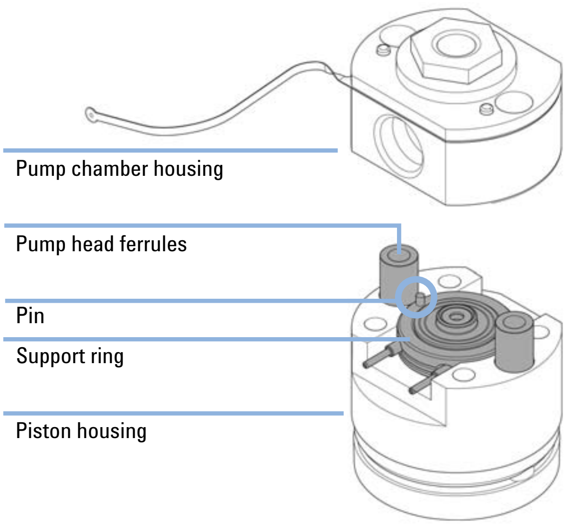
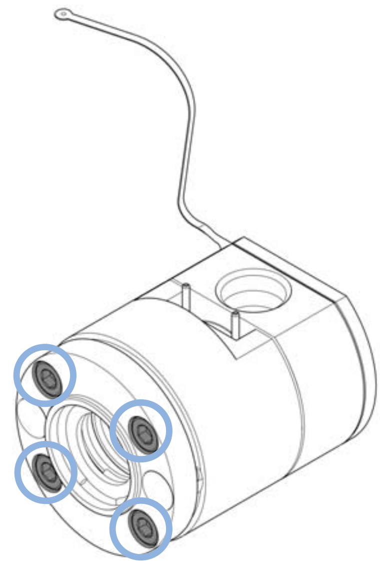
This procedure describes how to assemble the secondary pump head using the pump head alignment tool. Assembling the primary pump head can be done accordingly. The secondary pump head has the heat exchanger capillary, which must fit into the openings of the alignment tool, whereas the primary pump head does not have a heat exchanger.

1 Use the soft plastic side of the insert tool for inserting the piston seal to the pump chamber housing. Wet the piston seal with isopropanol or another suitable solvent before insertion.

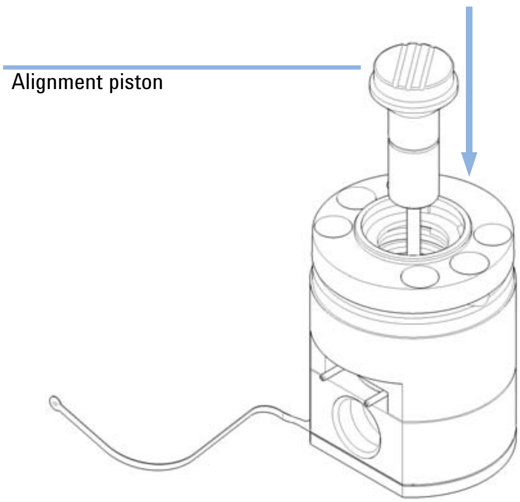


2 Insert the support ring and pump head ferrules into the piston housing. Observe the pins on the support ring, which help you assembling the pump head correctly.



3 Assemble the pump head by putting the pump chamber housing on top of the support ring. Observe correct orientation of the pin.  **NOTE** Do NOT install the inlet and outlet valves and the outlet filter at this stage.	**4** Loosely close the 4 screws at the rear of the pump head. The screws will be fixed tightly later. 

5 Insert the alignment piston of the pump head alignment tool. Lubricate the alignment piston with isopropanol or another suitable solvent before insertion.



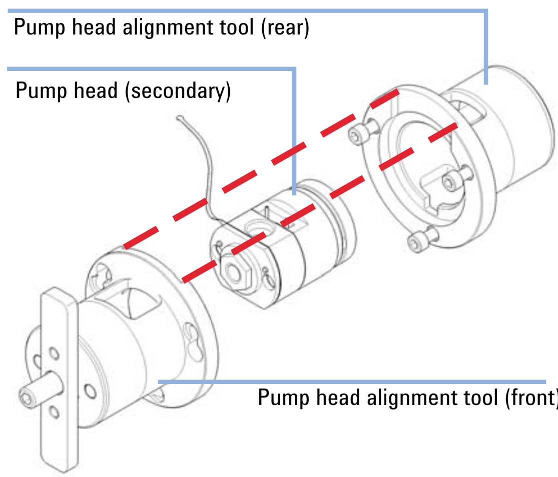
CAUTION

Damage to the pump head.

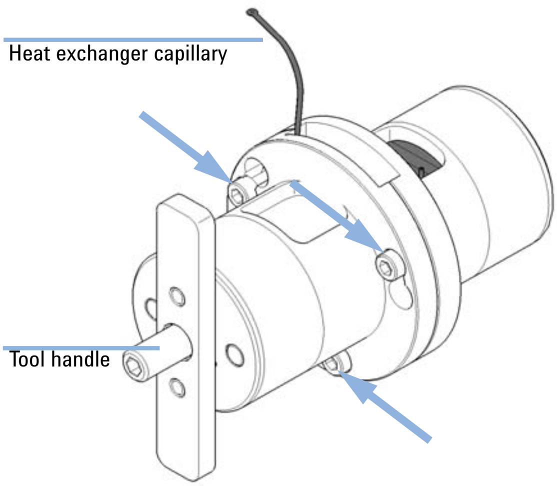
→ **Using the alignment tool is mandatory.**

→ **Not using will break the pump head.**

6 Insert the pump head to the pump head alignment tool, which is included to the 1290 Infinity Service Kit p/n 5067-4699. There are openings for the seal wash support ring and heat exchanger of the secondary pump head. Observe the correct orientation of all parts.



7 Close the tool by closing the 3 screws at the connection ring.



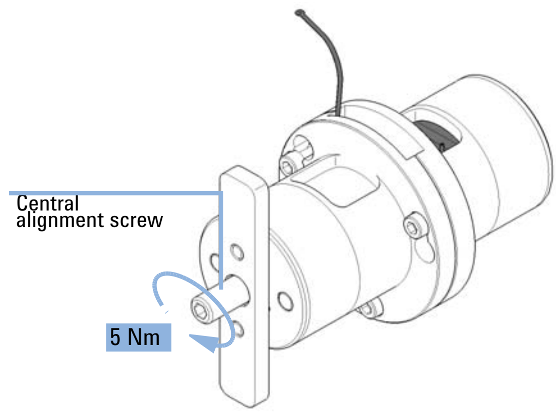
CAUTION

Damage to the pump head

Using a wrong torque will damage the pump head.

→ **For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.**

8 Using a torque key, which is included to the 1290 Infinity Service Kit p/n 5067-4699, set 5 Nm and fix the central alignment screw.



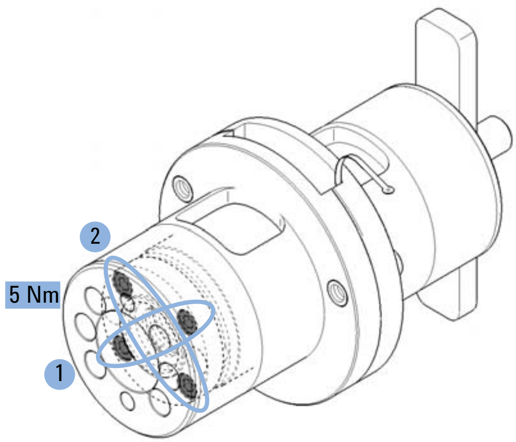
CAUTION

Damage to the pump head

Using a wrong torque will damage the pump head.

→ **For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.**

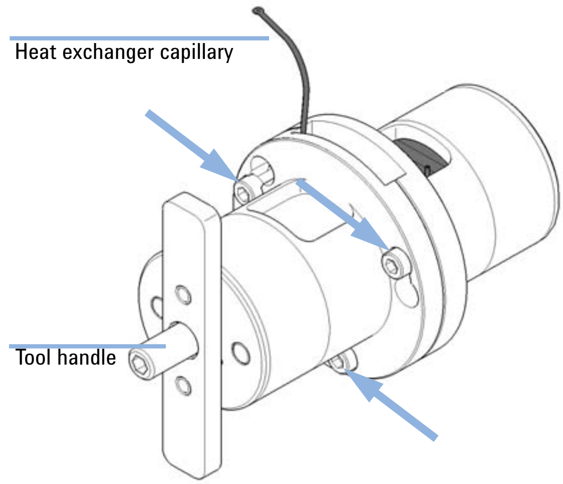
9 Using a torque key, which is included to the 1290 Infinity Service Kit p/n 5067-4699, set 5 Nm and fix the 4 screws at the rear of the alignment tool. Tighten screws crosswise.



NOTE

This procedure will align pump head parts to their correct positions and close the pump head tightly.

10 Open the 3 screws which have closed the pump head alignment tool and take out the aligned pump head. In case the pump head sticks inside the alignment tool, you can use the handle and insert it to the rear of the tool for pushing out the pump head.

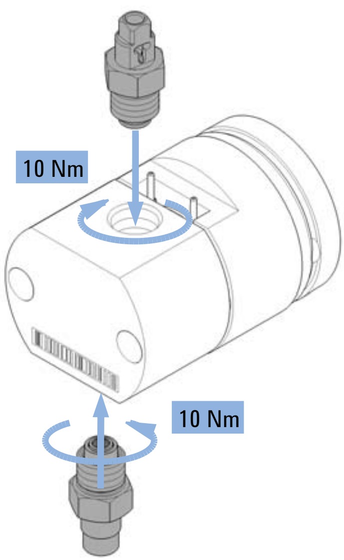


CAUTION

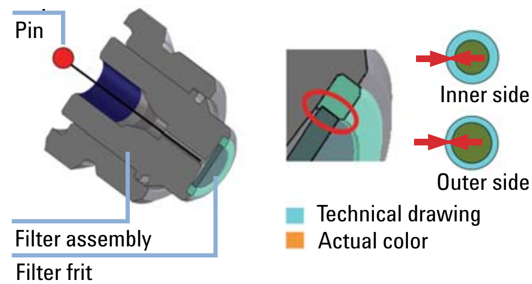
Damage to the pump head
Using a wrong torque will damage the pump head.

→ **For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.**

11 For the primary pump head, install the inlet valve and outlet valve using the torque wrench, which is included to the 1290 Infinity Service Kit p/n 5067-4699. Set 10 Nm for the inlet valve and 10 Nm for the outlet valve.



12 Push in a thin pin for removing the old filter frit from the filter assembly. Insert a new filter frit (p/n 5067-5716) in the correct orientation (observe different thickness of holder on either side).

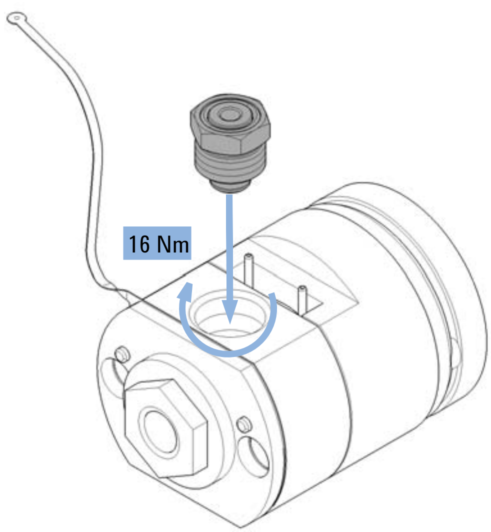


CAUTION

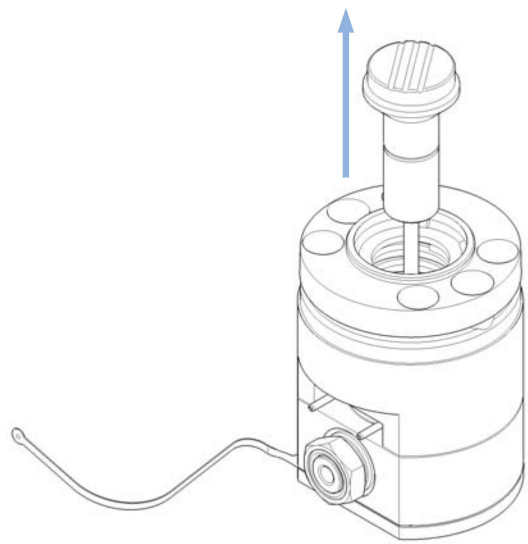
Damage to the pump head
Using a wrong torque will damage the pump head.

→ **For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.**

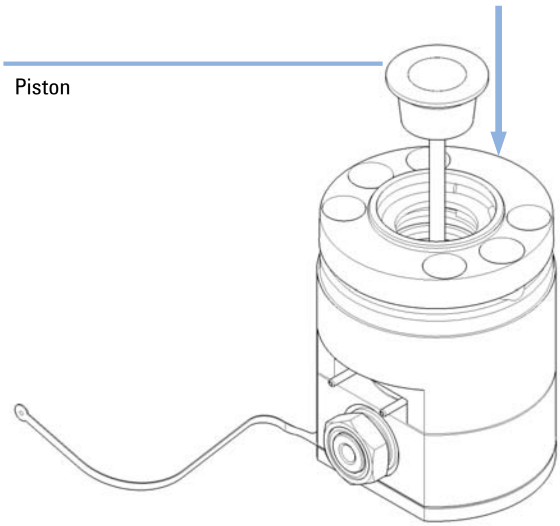
13 For the secondary pump head, install the outlet filter using the torque wrench (14 mm hex bit), which is included to the 1290 Infinity Service Kit p/n 5067-4699, set to 16 Nm.



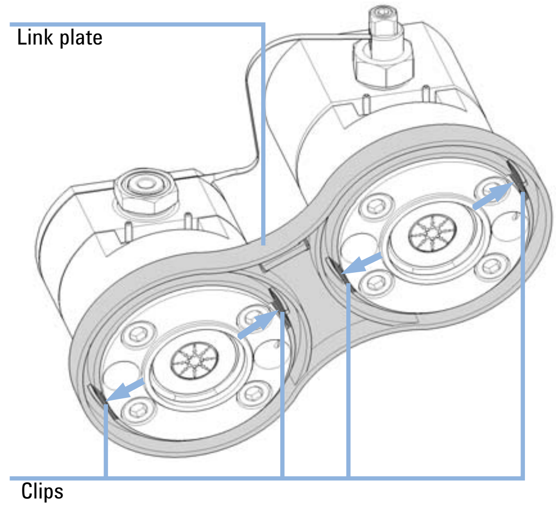
14 Remove the alignment piston.



15 Lubricate the pump piston with isopropanol or another suitable solvent, and insert it.



16 Insert both pump heads to the link plate and make sure that the clips snap in that fix the pump heads.



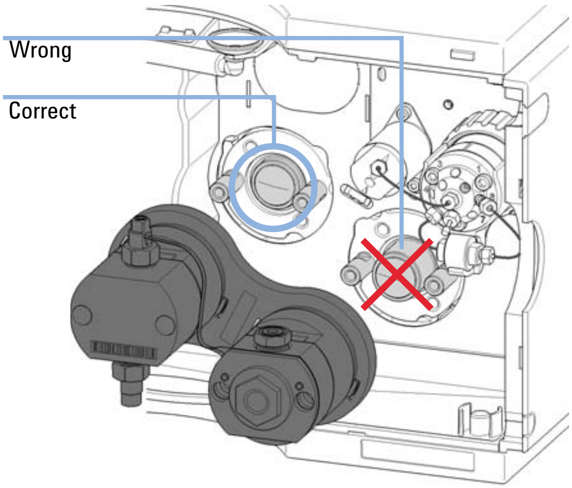
NOTE

Observe the correct orientation of the primary and the secondary pump head. This is important for correct fixation of the heat exchanger and the capillaries, as described in the following steps.

NOTE

Mind the orientation of the ID tag.

17 Bring the pump drive to the maintenance position using the Lab Advisor user interface, see "Replacing the Pump Head" on page 152. Both pump drives must be retracted.



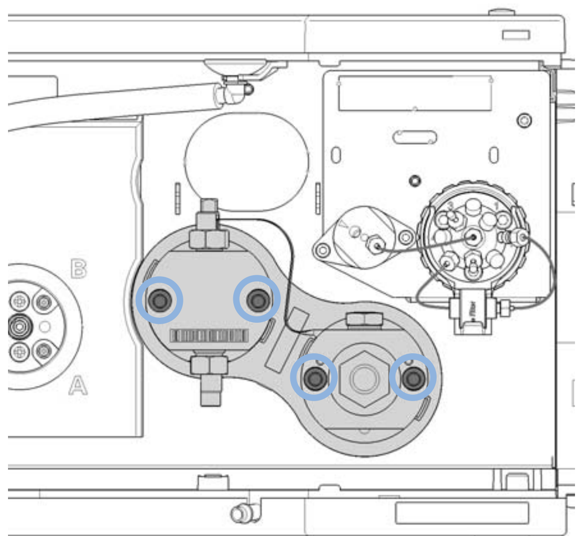
CAUTION

Damage to the pump head

Using a wrong torque will damage the pump head.

→ **For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.**

18 Install the new pump head assembly by tightening the screws step by step. Apply 5 Nm using a torque hex key, which is included to the 1290 Infinity Service Kit p/n 5067-4699.



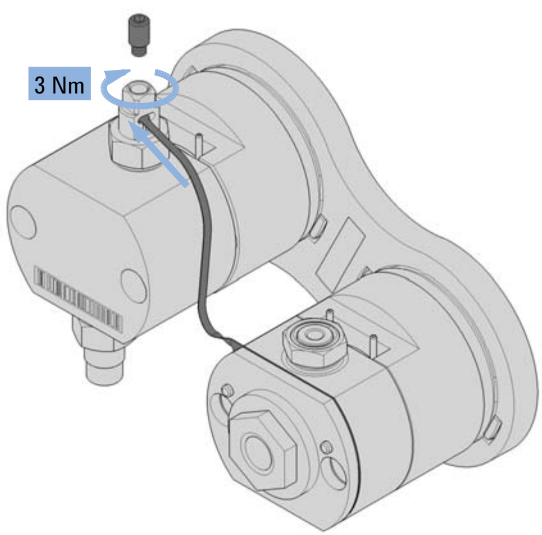
CAUTION

Damage to the pump head

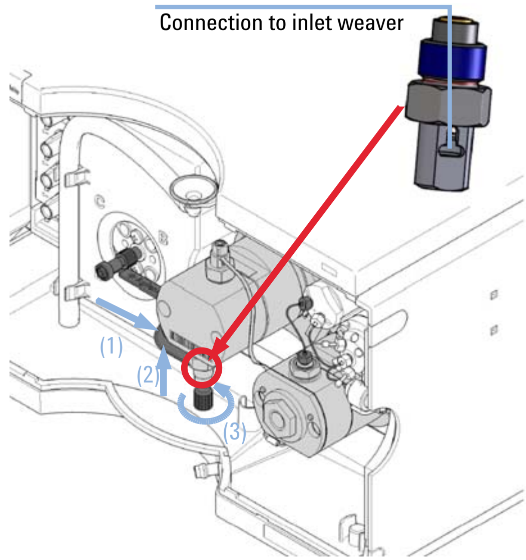
Using a wrong torque will damage the pump head.

→ **For handling the torque wrench, setting and applying the right torque, consult the manual of your torque wrench.**

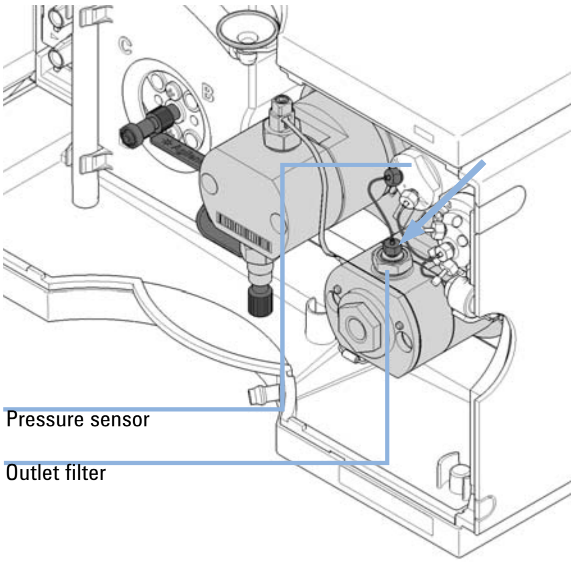
19 Insert the heat exchanger capillary into the outlet of the primary pump head. Using a torque key, which is included to the 1290 Infinity Service Kit p/n 5067-4699, set 3 Nm and close the hex screw at the top of the outlet.



20 Insert the new inlet weaver to the inlet valve (1, 2). Fix the weaver with the plastic screw to the inlet valve (3).



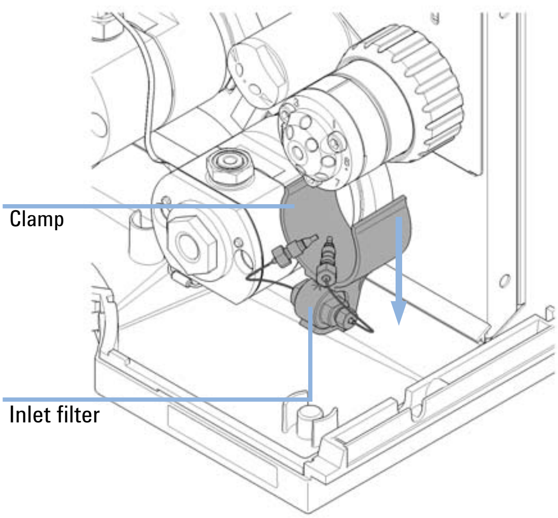
21 Connect the capillary from the pressure sensor to the pump head outlet filter.



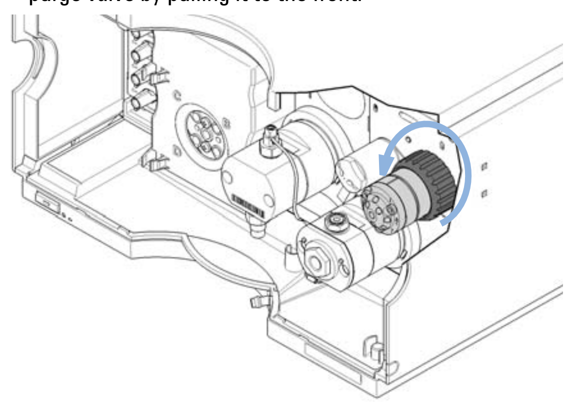
Replacing the Multi Purpose Valve

Tools required	**p/n**	**Description**
	5023-0240	Hex driver, ¼", slitted
Parts required	**p/n**	**Description**
	0100-1259	Blank nut (plastic)
	01080-83202	Blank nut (stainless steel)
	5067-4174	Multi Purpose Valve Head
Preparations	Remove all capillary connections from the Multi Purpose Valve.	

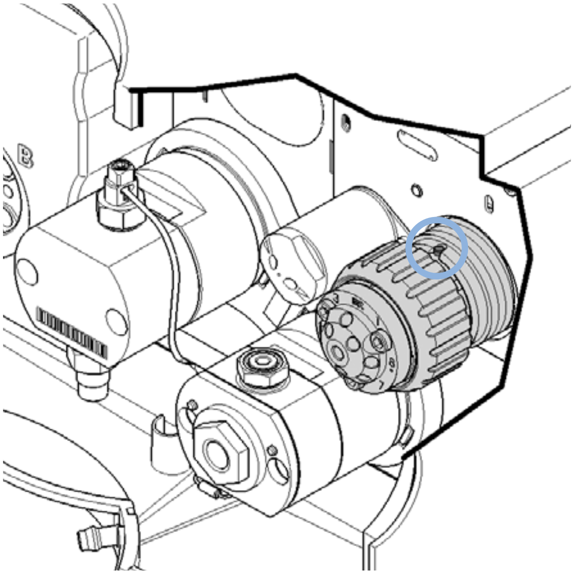
1 Remove the clamp with the inline filter.

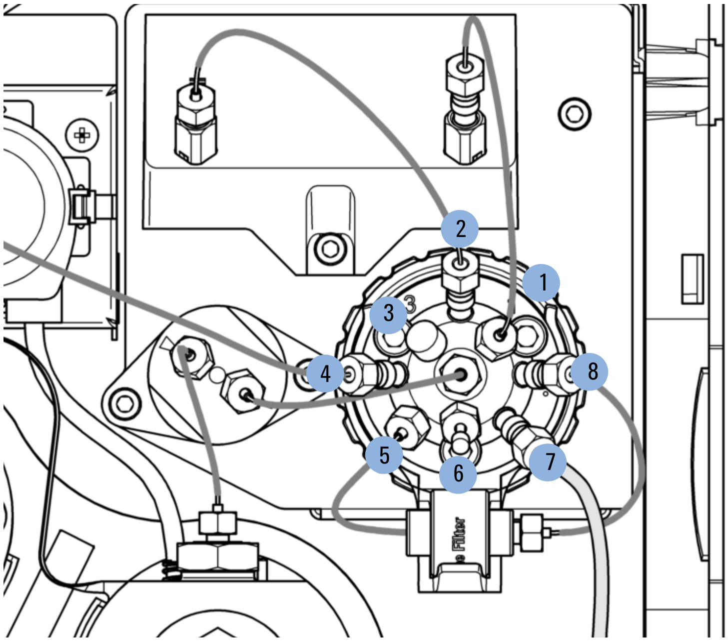


2 Unscrew the black union nut and remove the head of the purge valve by pulling it to the front.



3 Put the new valve head onto the valve drive such that the lobe fits to the groove. Screw the valve head onto the valve drive using the union nut.





The central (C) port is connected to the outlet of the pressure sensor.

- Port 1 is connected to the outlet of the optional Jet Weaver
- Port 2 is connected to the inlet of the optional Jet Weaver
- Port 3 is blocked by a blank nut (plastic)
- Port 4 is connected to the system (typically autosampler)
- Port 5 is connected to the outlet of the inline filter
- Port 6 is blocked by a blank nut (SST)
- Port 7 is connected to the waste capillary
- Port 8 is connected to the inlet of the inline filter

Block unused ports with blank nuts.

Replacing Parts of the Multi Purpose Valve

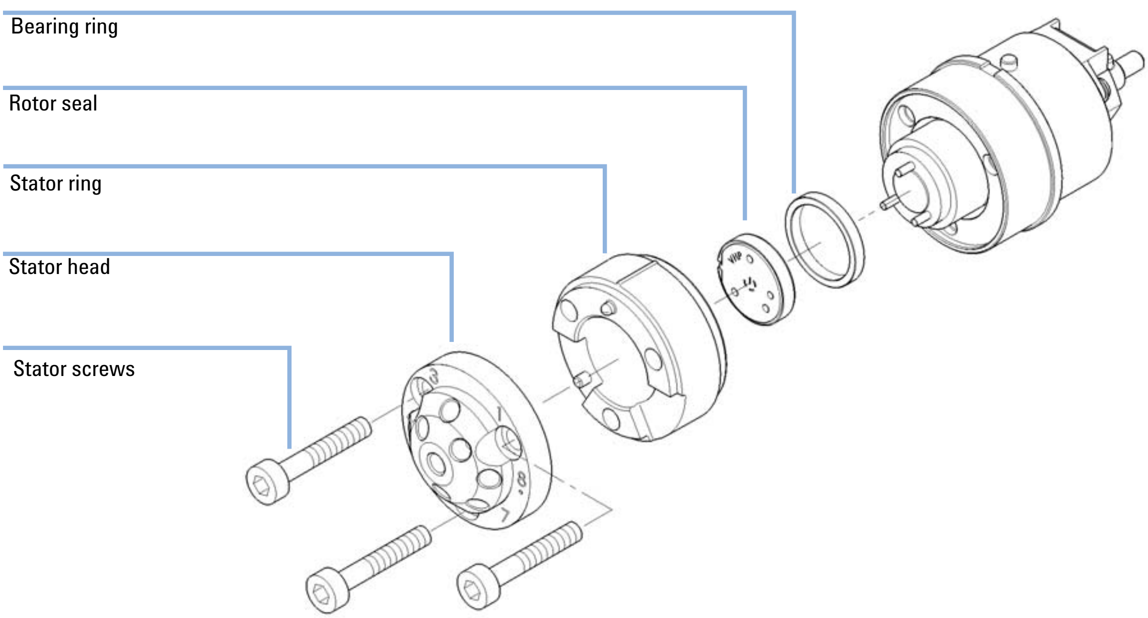
	p/n	Description
Tools required	**p/n**	**Description**
	8710-2394	9/64 inch hex key

	p/n	Description
Parts required	**p/n**	**Description**
	1534-4045	Bearing ring
	5068-0123	Rotor seal, Multi Purpose Valve 1290 Infinity Quaternary Pump, 1200 bar
	5068-0120	Stator ring
	5068-0001	Stator head
	1535-4857	Stator screws, 10/Pk

Preparations

- Remove capillary connections from ports 1, 3 and 6.
- Remove the clamp with the inline filter.

1 Use the 9/64 inch hex key for opening the valve head.
2 Replace parts as required.
3 Reassemble the valve head and mount it to the valve drive.



Replacing the Outlet Filter

When For removing blockages and leaks in the high pressure filter assembly. The outlet filter should be replaced as required depending on the system usage. Other parts are covered by the Agilent Preventive Maintenance (PM) Service.

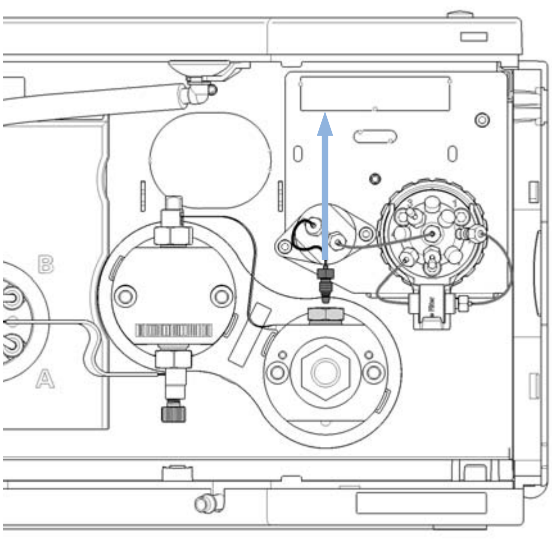
Tools required

p/n	Description
8710-0510	Wrench open 1/4 — 5/16 inch
8710-1924	Wrench open 14 mm
	Torque wrench
	Torque wrench head, 14 mm for torque wrench

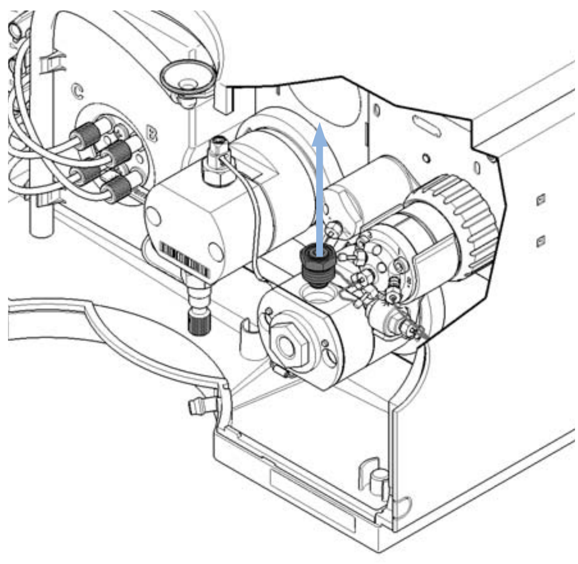
Parts required

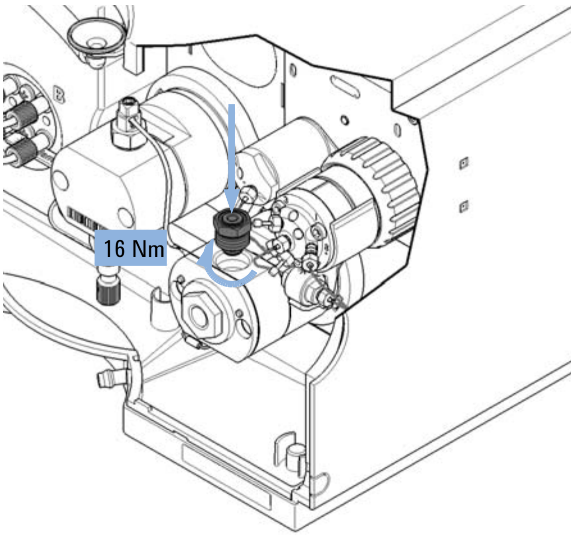
p/n	Description
G4204-60004	Outlet filter 1290 Infinity Quaternary Pump

1 Remove the capillary from the outlet filter to the pressure sensor.



2 Remove the outlet filter using a 14 mm wrench.



3 Mount the new outlet filter. Using a torque wrench set to 16 Nm is recommended.  	**4** Mount the capillary connection to the pressure sensor.

Replacing Parts of the Inline Filter

Tools required	**p/n**	**Description**
	8710-0510	Wrench open 1/4 — 5/16 inch
Parts required	**p/n**	**Description**
	5067-5407	In-Line Filter Assembly for 1290 Infinity Quaternary Pump
	5067-4748	Capillary ST, 0.17 mm x 90 mm Multi Purpose Valve to inline filter
	5023-0271	Frit 0.3 µm for inline filter, 5/pk

CAUTION

Stuck Capillary in Multi Purpose Valve

Shortcutting the inline filter by directly connecting its right capillary to valve port 5 can damage the Multi Purpose Valve.

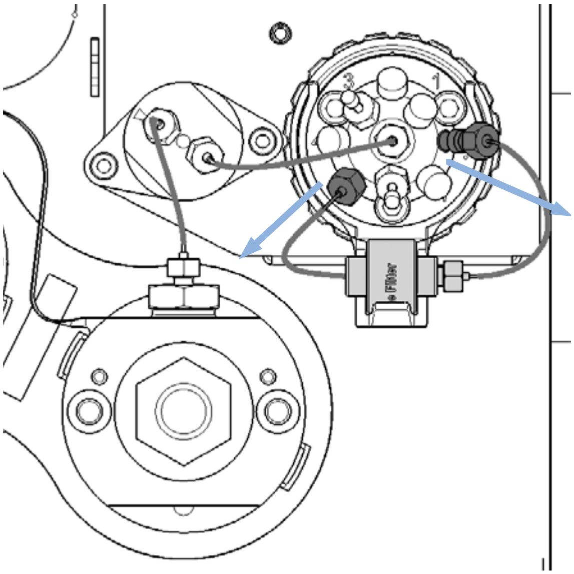
The size/position of this capillary in its fitting is incompatible, so it may get stuck irreversibly to the valve.

→ Do not shortcut the filter by directly connecting its right capillary to valve port 5 in case the inline filter cannot or shall not be used.

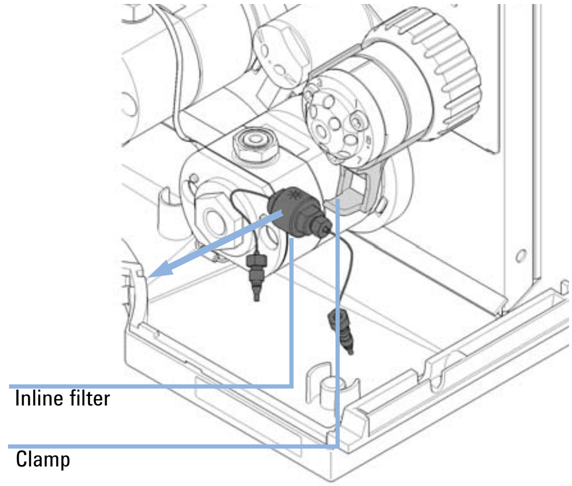
NOTE

The inline filter can be cleaned using the back-flush function in the user interface of your Agilent instrument control software.

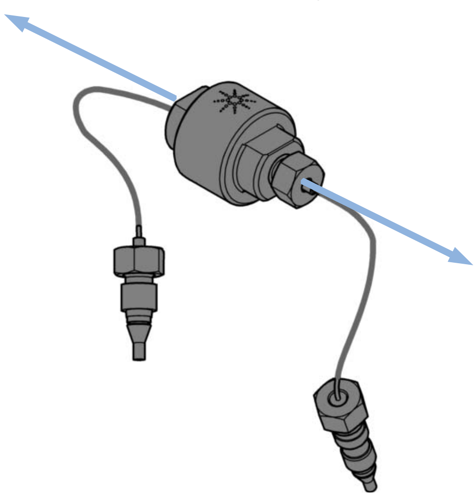
1 Remove the capillaries from the Multi Purpose Valve to the inline filter.



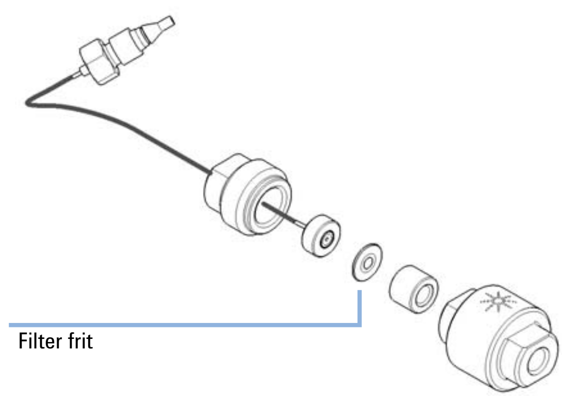
2 Remove the inline filter from the clamp attached to the Multi Purpose Valve.



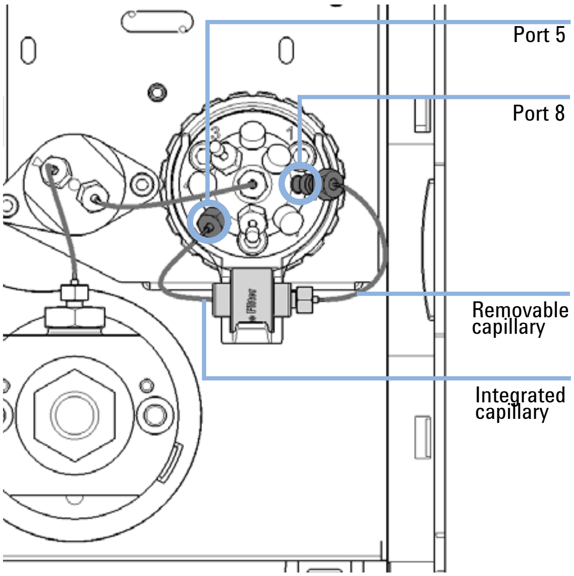
3 Use two 5/16 wrenches for opening the inline filter.



4 Replace the filter frit and reassemble the inline filter.



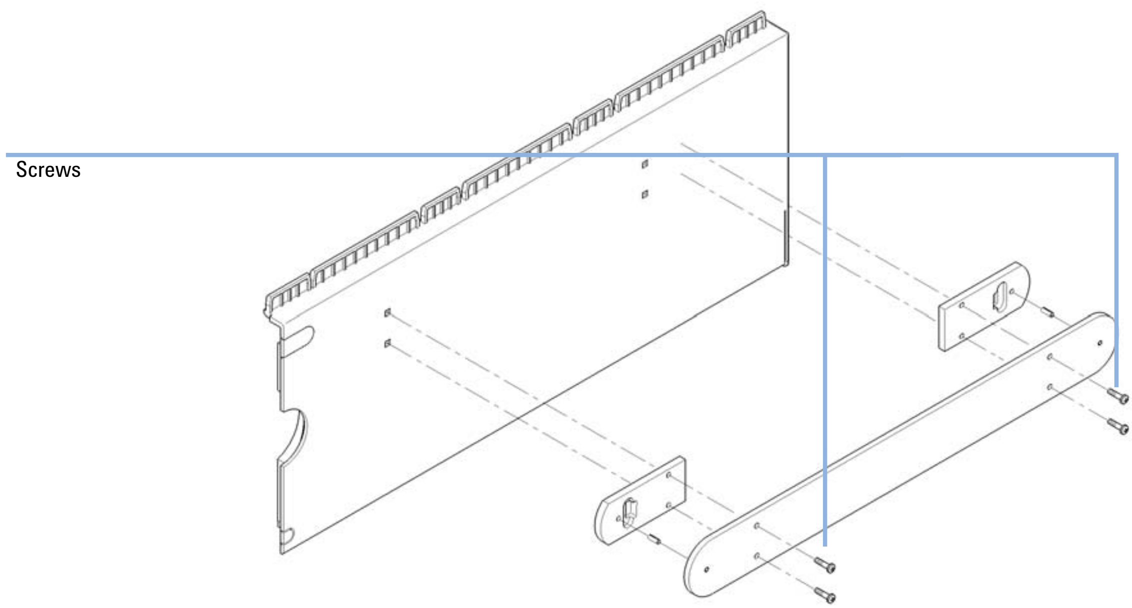
5 Put the inline filter to the clamp and install its capillaries. The integrated capillary is connected to port 5 of the Multi Purpose Valve. The removable capillary is connected to port 8.



Installing the Valve Rail Kit

When	This rail is needed for the installation of external valves.		
Tools required	**Description**		
	Pozidrive screwdriver #1		
Parts required	**#**	**p/n**	**Description**
	1	5067-4634	Valve Rail Kit

1 The valve rail is fixed to the pump cover by 4 screws. The position of the lower screws is marked on the module cover. First tighten these screws, and then tighten the upper screws.



Replacing Module Firmware

When	The installation of newer firmware might be necessary • if a newer version solves problems of older versions or • to keep all systems on the same (validated) revision. The installation of older firmware might be necessary • to keep all systems on the same (validated) revision or • if a new module with newer firmware is added to a system or • if third party control software requires a special version.

Tools required	**Description**
	LAN/RS-232 Firmware Update Tool
OR	Agilent Lab Advisor software
OR	Instant Pilot G4208A (only if supported by module)

Parts required	**#**	**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 LAN/RS-232 FW Update Tool and the documentation from the Agilent web.

  - http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?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.

Preparing the Pump Module for Transport

When	If the module shall be transported or shipped.	
Parts required	**p/n**	**Description**
	9301-0411	Syringe; Plastic
	9301-1337	Syringe adapter
	G4204-44000	Transport protection foam

CAUTION

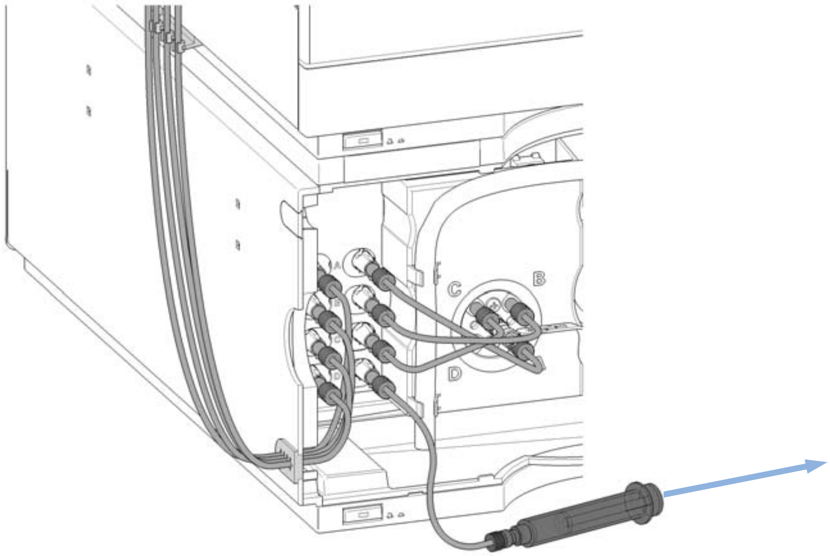
Mechanical damage

→ For shipping the module, insert the Protective Foam to protected the module from mechanical damage.

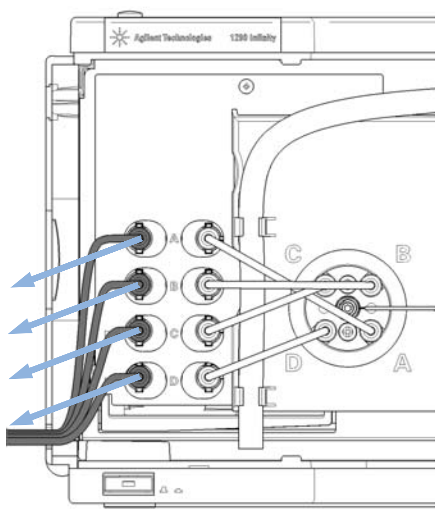
→ Be careful not to damage tubing or capillary connections while inserting the module in the Protective Foam.

1 Flush all solvent channels with isopropanol.
2 Remove solvent inlet tubes from solvent reservoirs and tubing clips at other modules.
3 If applicable, remove tubings between the seal wash function and solvent bottle/waste.
4 Remove cable and capillary connections to other modules.
5 Remove the module from the stack.
6 Remove the waste tube.

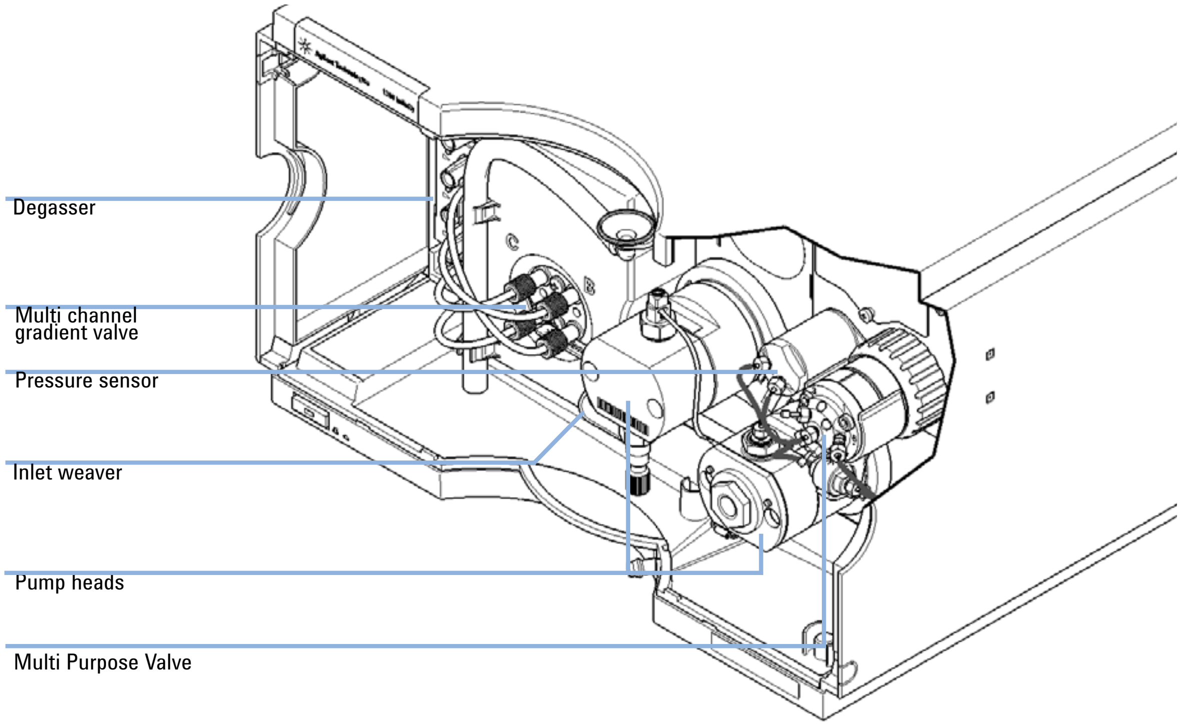
7 Disconnect the degasser outlet tubings at the MCGV one after another. Use a syringe for removing liquid from the degasser and the solvent tubings.



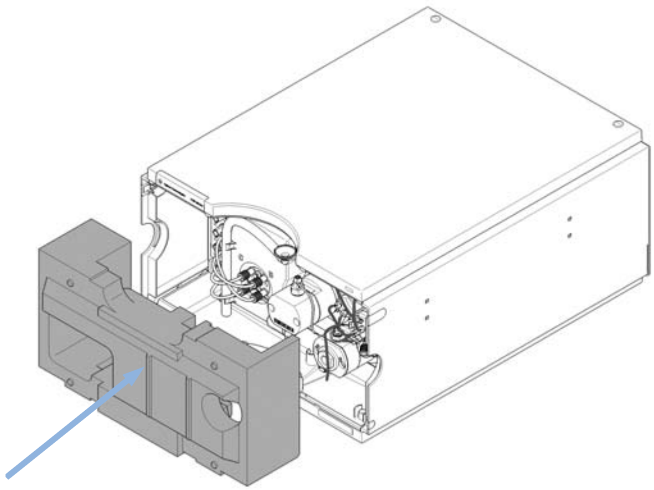
8 Reconnect the degasser outlet tubings to the MCGV. Remove the degasser inlet tubings.



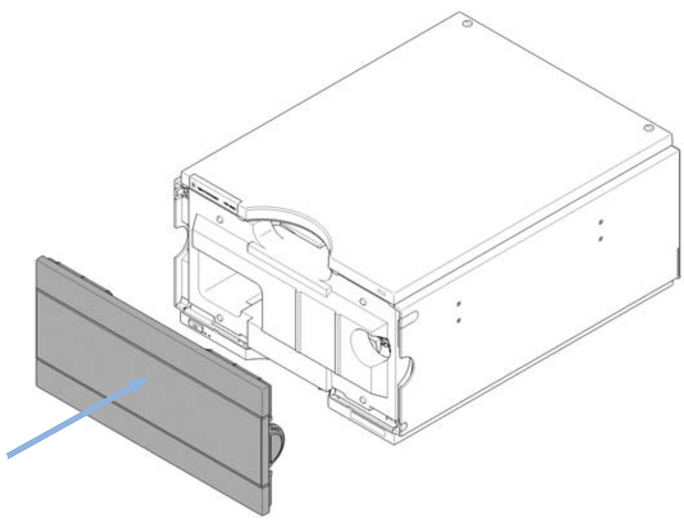
9 You may keep internal tubing and capillary connections.



10 Carefully insert the protective foam to the front part of the instrument. Do not damage any tubing or capillary connections.



11 Close the front cover.



12 For transport or shipment, put the module and accessory kit to the original shipment box.

10
Parts and Materials

This chapter provides information on parts for maintenance.

Overview of Main Assemblies

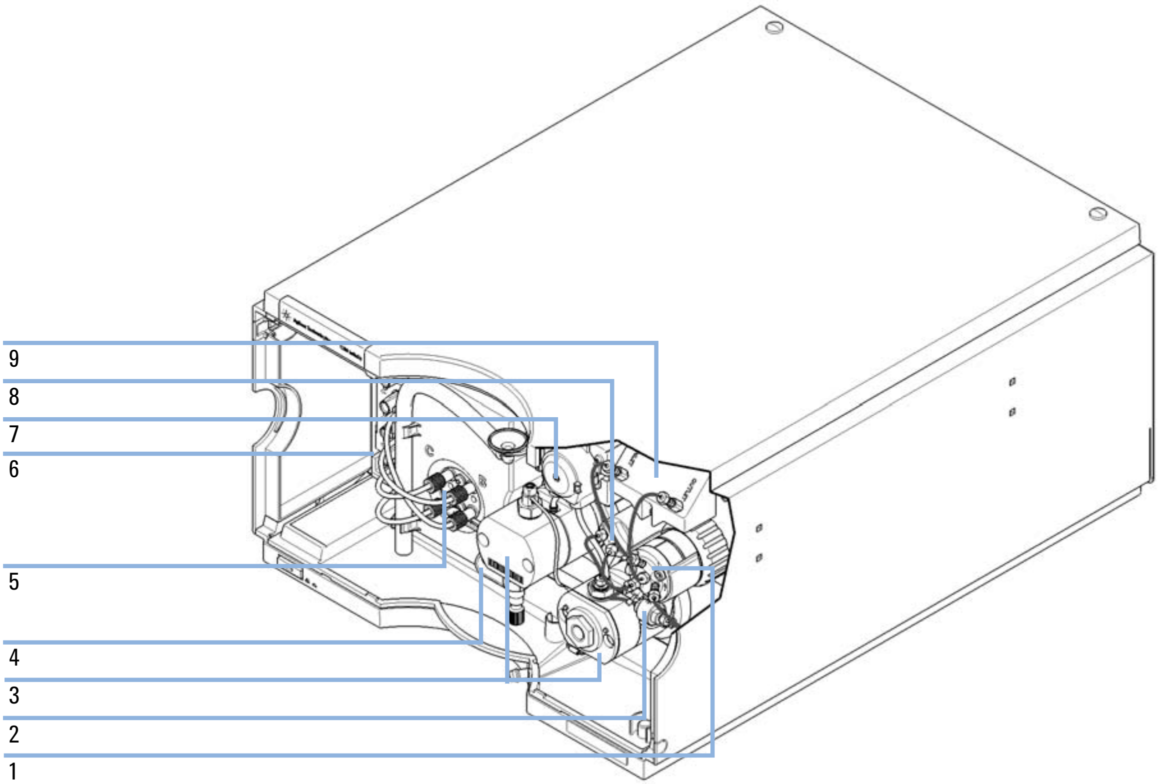


Figure 19 Overview of maintenance parts

Item		p/n	Description
	1	5067-4174	Multi Purpose Valve Head
	2	5067-5407	In-Line Filter Assembly for 1290 Infinity Quaternary Pump
		5023-0271	Frit 0.3 µm for inline filter, 5/pk
		G4204-40000	Clamp for In-Line Filter
	3	G4204-60200	1290 Infinity Quaternary Pump Head Assembly with Seal Wash Option
OR		G4204-60400	1290 Infinity Quaternary Pump Head Assembly without Seal Wash Option
OR	4	G4204-81090	1290 Infinity Quaternary Pump Inlet Weaver Assembly
OR		5067-5443	Inlet tubing
	5	G1311-67701	Multi channel gradient valve (MCGV)
		5041-8365	Blank plug for MCGV
	6	G1311-60070	Degasser 4 Channels for Quaternary Pump
	7	5067-4793	Peristaltic Pump with Fixation Springs (OPTIONAL)
	8	G4220-60001	Pressure sensor 1200 bar
	9	G4204-68000	Jet Weaver 380 µL for 1290 Infinity Quaternary Pump (OPTIONAL)

Flow Connections

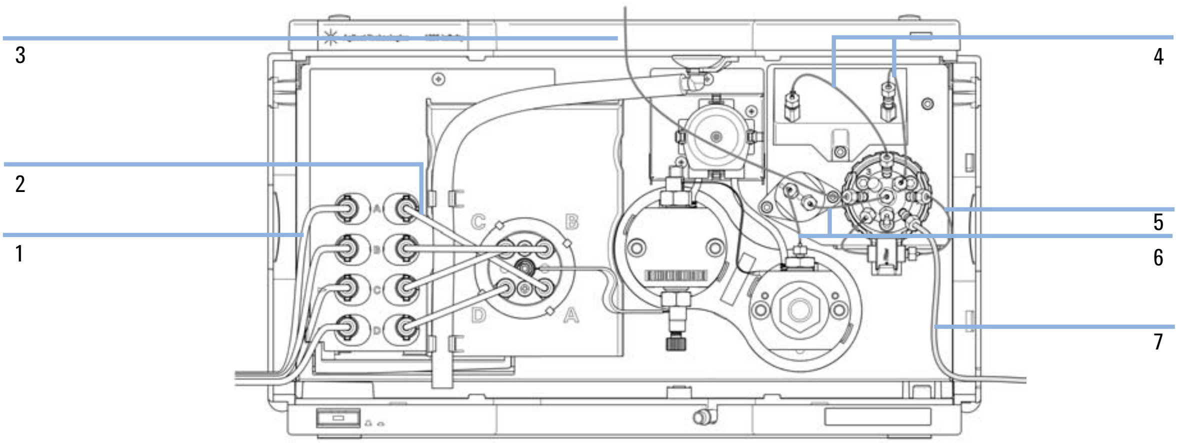


Figure 20 Flow connections of the pump

Item	p/n	Description
1	G4220-60007	Bottle Head Assembly
2	G4220-60035	Tubing kit 140 mm, 2/pk degasser to MCGV
3	5067-4657	Capillary ST, 0.17 mm x 300 mm pump to autosampler
4	5067-5416	Capillary ST 0.17 x 120 mm, SLV/SV for Jet Weaver
5	5067-4748	Capillary ST, 0.17 mm x 90 mm Multi Purpose Valve to inline filter
6	5067-4656	Capillary ST, 0.25 mm x 80 mm pressure sensor to outlet filter and Multi Purpose Valve
7	5067-4755	Flexible Waste Tube, 5 m
	G4220-68070	Ultra Clean Tubing Kit for G4220A (includes bottle head assemblies and tubing connections within the pump)
	G4220-60070	Tubing Kit 140 mm - Ultra Clean Tubing (tubes from SSV to shutoff valve or degassing unit to MCGV)
	G4220-60017	Bottle Head Assembly Ultra Clean Tubing (bottle heads and tubing to shutoff panel / degasser)

Seal Wash Option

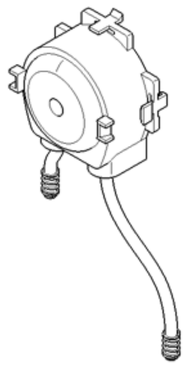


Figure 21 Seal Wash Pump

Item	p/n	Description
1	5067-4793	Peristaltic Pump with Fixation Springs
2	5065-9978	Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m

Pump Head Assembly Parts

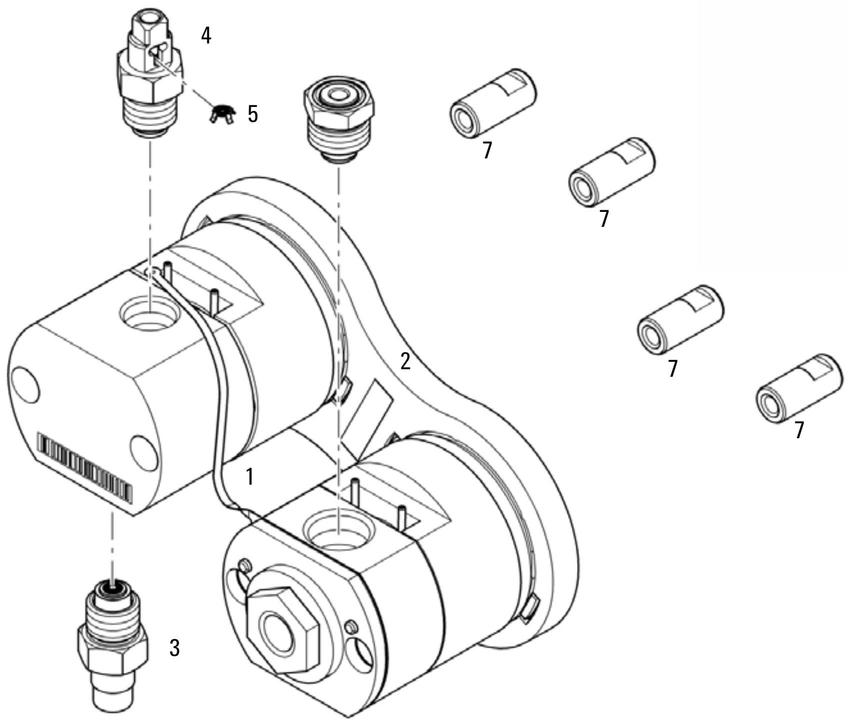


Figure 22 Pump head assembly parts

Item	p/n	Description
	G4204-60200	1290 Infinity Quaternary Pump Head Assembly with Seal Wash Option
	G4204-60400	1290 Infinity Quaternary Pump Head Assembly without Seal Wash Option
1	G4220-81013	Heat Exchanger (secondary pump head only)
2	G4220-40001	Link Plate
3	G4204-60022	Inlet Valve 1290 Infinity Quaternary Pump
4	G4220-60028	Outlet valve (primary pump head)
5	G4220-20020	Internal gold seal for Outlet Valve
6	G4204-60004	Outlet filter 1290 Infinity Quaternary Pump
7	G4220-23704 (4x)	Stay bolt

Primary Pump Head Parts

Primary Pump Head with Seal Wash (Quaternary Pump)

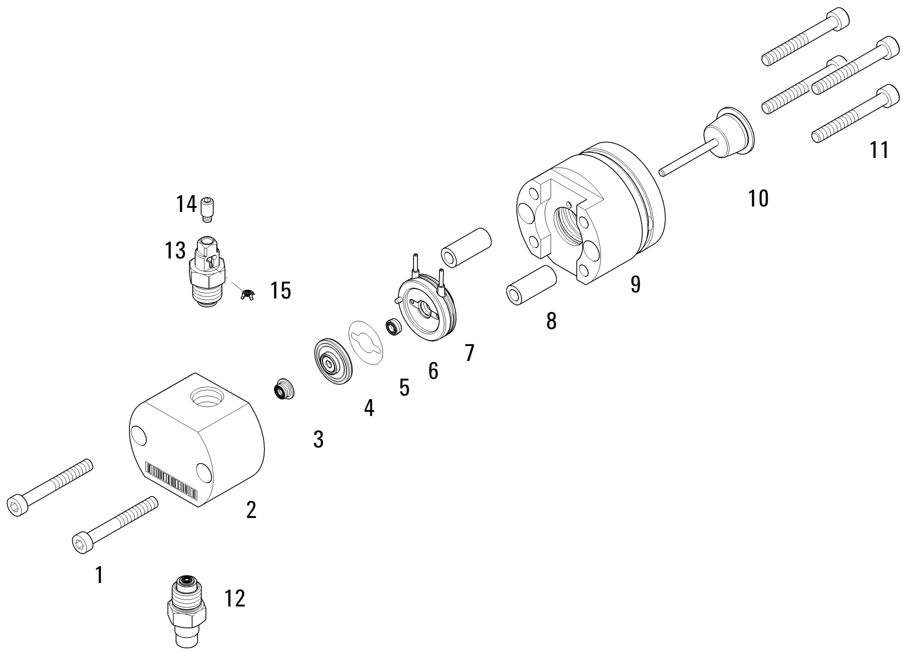


Figure 23 Primary pump head (Quaternary Pump) with seal wash

Item	p/n	Description
1, 11	0515-1218 (6x)	Screw M5, 40 mm long
2		Pump Chamber Housing (order pump head)
3	0905-1719	PE Seal
4	G4220-60016	Seal holder including backup ring
5	5062-2484	Gasket, seal wash (pack of 6)
6	0905-1718	Wash Seal PE
7	G4220-63010	Support Ring (Seal Wash)
8	(2x)	Pump Head Ferrules (order pump head)
9		Piston Housing (order pump head)
10	5067-5678	Piston 1290 Infinity Pumps, ceramic
12	G4204-60022	Inlet Valve 1290 Infinity Quaternary Pump
	G4204-40006	Fixation screw inlet weaver to PIV (not shown)
13	G4220-60028	Outlet valve (primary pump head)
14	G4220-20028	Headless screw for 1290 Infinity pump heads
15	G4220-20020	Internal gold seal for Outlet Valve

Primary Pump Head Without Seal Wash (Quaternary Pump)

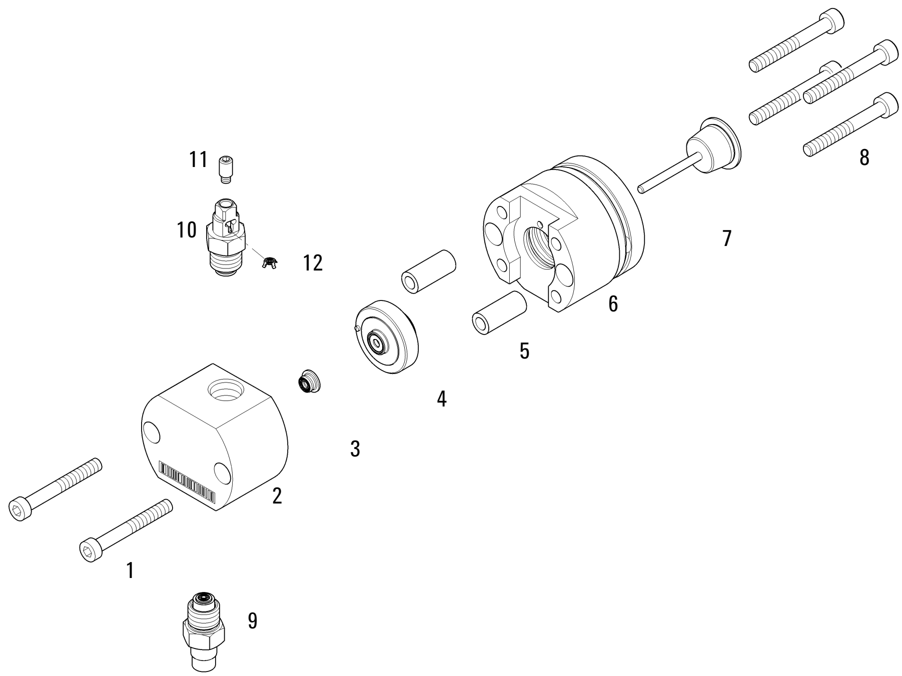


Figure 24 Primary pump head (Quaternary Pump) without seal wash

Item	p/n	Description
1, 8	0515-1218 (6x)	Screw M5, 40 mm long
2		Pump Chamber Housing (order pump head)
3	0905-1719	PE Seal
4	G4220-60015	Support ring including backup ring
5	(2x)	Pump Head Ferrules (order pump head)
6		Piston Housing (order pump head)
7	5067-5678	Piston 1290 Infinity Pumps, ceramic
9	G4204-60022	Inlet Valve 1290 Infinity Quaternary Pump
	G4204-40006	Fixation screw inlet weaver to PIV (not shown)
10	G4220-60028	Outlet valve (primary pump head)
11	G4220-20028	Headless screw for 1290 Infinity pump heads
12	G4220-20020	Internal gold seal for Outlet Valve

Secondary Pump Head Parts

Secondary Pump Head With Seal Wash (Quaternary Pump)

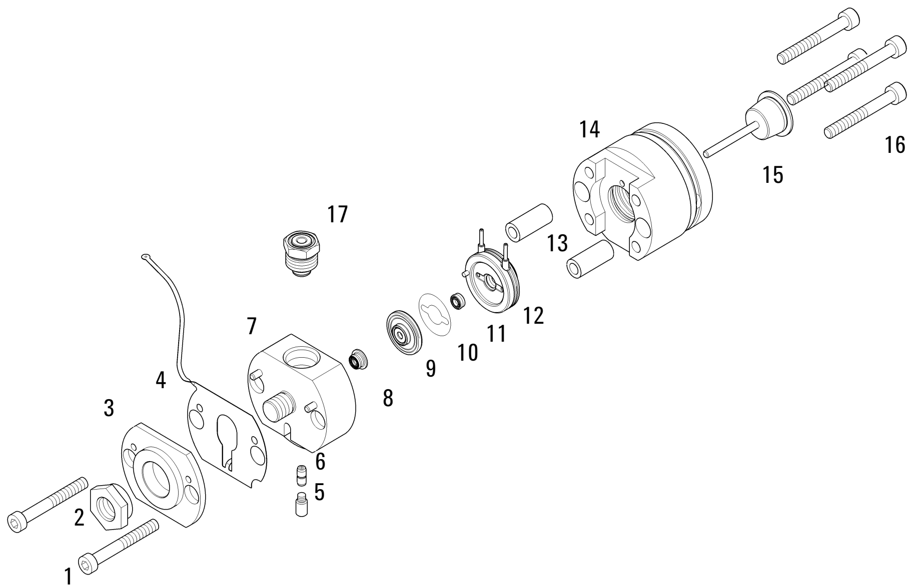


Figure 25 Secondary pump head (Quaternary Pump) with seal wash

Item	p/n	Description
1, 16	0515-1218 (6x)	Screw M5, 40 mm long
2	G4220-20003	Pump Head Screw
3		Pump Head Front Plate (order pump head)
4	G4220-81013	Heat Exchanger (secondary pump head only)
5	G4220-20028	Headless screw for 1290 Infinity pump heads
6	G4220-20001	Spacer Fitting
7		Pump Chamber Housing (order pump head)
8	0905-1719	PE Seal
9	G4220-60016	Seal holder including backup ring
10	5062-2484	Gasket, seal wash (pack of 6)
11	0905-1718	Wash Seal PE
12	G4220-63010	Support Ring (Seal Wash)
13	(2x)	Pump Head Ferrules (order pump head)
14		Piston Housing (order pump head)
15	5067-5678	Piston 1290 Infinity Pumps, ceramic
17	G4204-60004	Outlet filter 1290 Infinity Quaternary Pump

Secondary Pump Head Without Seal Wash (Quaternary Pump)

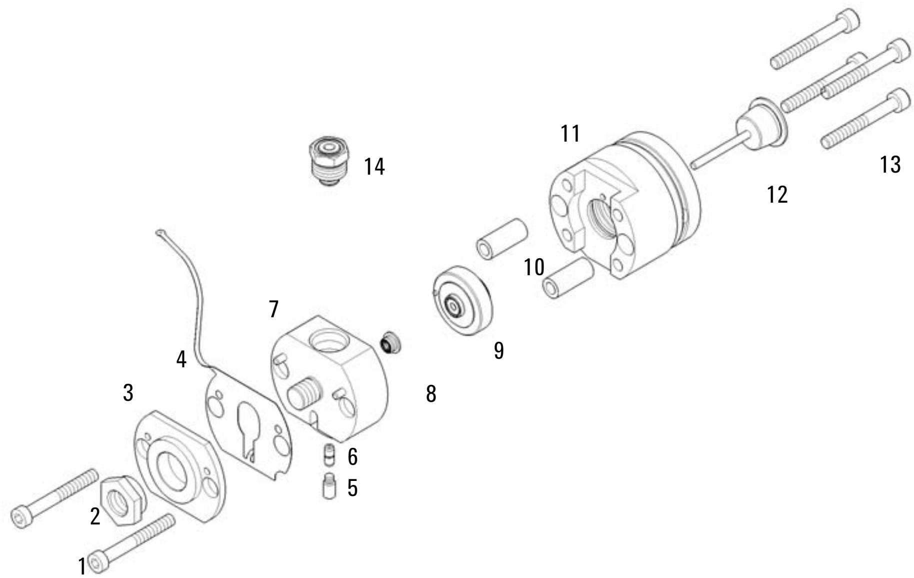


Figure 26 Secondary pump head (Quaternary Pump) without seal wash

Item	p/n	Description
1, 13	0515-1218 (6x)	Screw M5, 40 mm long
2	G4220-20003	Pump Head Screw
3		Pump Head Front Plate (order pump head)
4	G4220-81013	Heat Exchanger (secondary pump head only)
5	G4220-20028	Headless screw for 1290 Infinity pump heads
6	G4220-20001	Spacer Fitting
7		Pump Chamber Housing (order pump head)
8	0905-1719	PE Seal
9	G4220-60015	Support ring including backup ring
10	(2x)	Pump Head Ferrules (order pump head)
11		Piston Housing (order pump head)
12	5067-5678	Piston 1290 Infinity Pumps, ceramic
14	G4204-60004	Outlet filter 1290 Infinity Quaternary Pump

Multi Purpose Valve

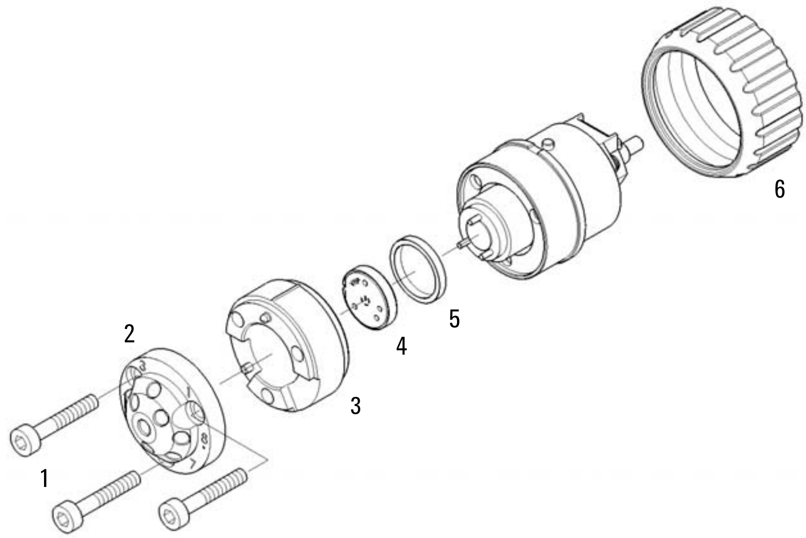


Figure 27 Multi-purpose valve parts

Item	p/n	Description
	5067-4174	Multi Purpose Valve Head
1	1535-4857 (3x)	Stator screws, 10/Pk
2	5068-0001	Stator head
3	5068-0120	Stator ring
4	5068-0123	Rotor seal, Multi Purpose Valve 1290 Infinity Quaternary Pump, 1200 bar
5	1535-4045	Bearing ring
6	5068-0106	Spanner nut

Solvent Cabinet

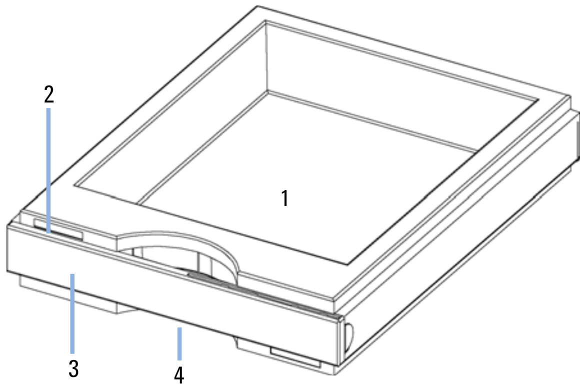


Figure 28 Solvent Cabinet Parts (1)

Figure 29 Solvent Cabinet Parts (2)

Item	p/n	Description
1	5065-9981	Solvent cabinet 1200 Infinity, including all plastic parts
2	5043-0207	Name plate 1260
3	5065-9954	Front panel, solvent cabinet
4	5042-8907	Leak panel
5	9301-1450	Solvent bottle, amber
6	9301-1420	Solvent bottle, transparent
7	G4220-60007	Bottle Head Assembly

Cover Parts

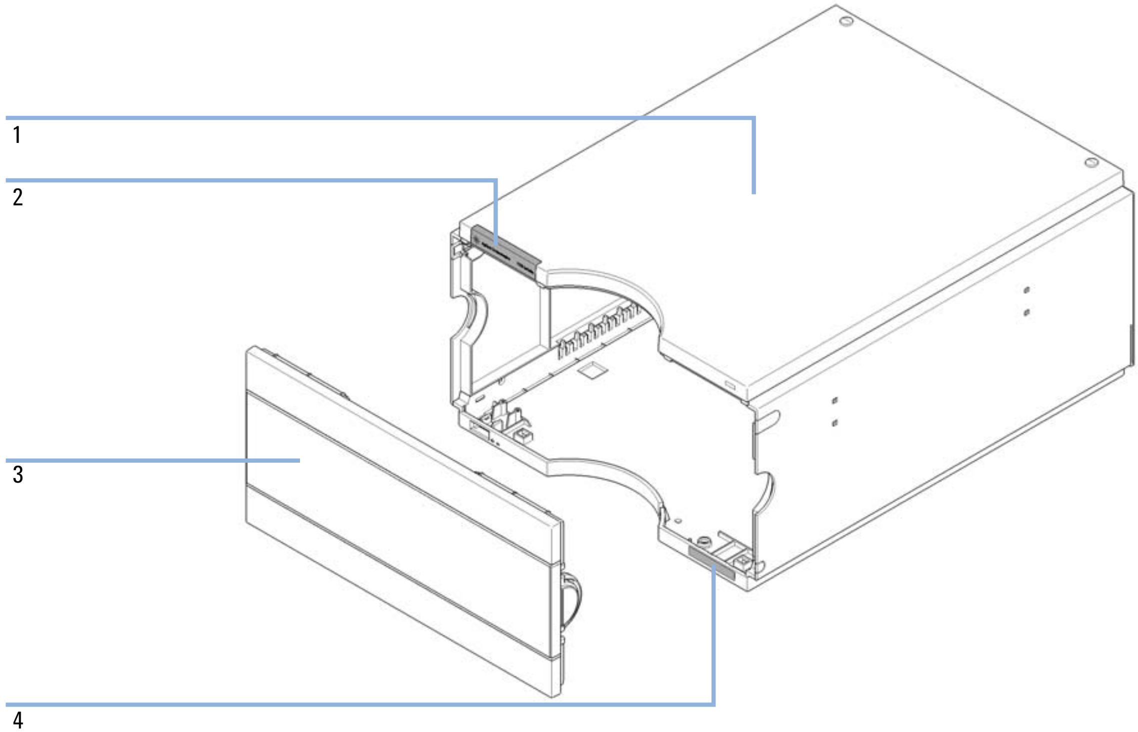


Figure 30 Cover parts

Item	p/n	Description
1	5067-5396	1290 Infinity Quaternary Pump Cover Kit (base, top, left, right)
2	5042-9964	Name plate for Agilent 1290 series
3	5067-4683	Front Panel
4	5042-8914	Serial number plate

Leak Parts

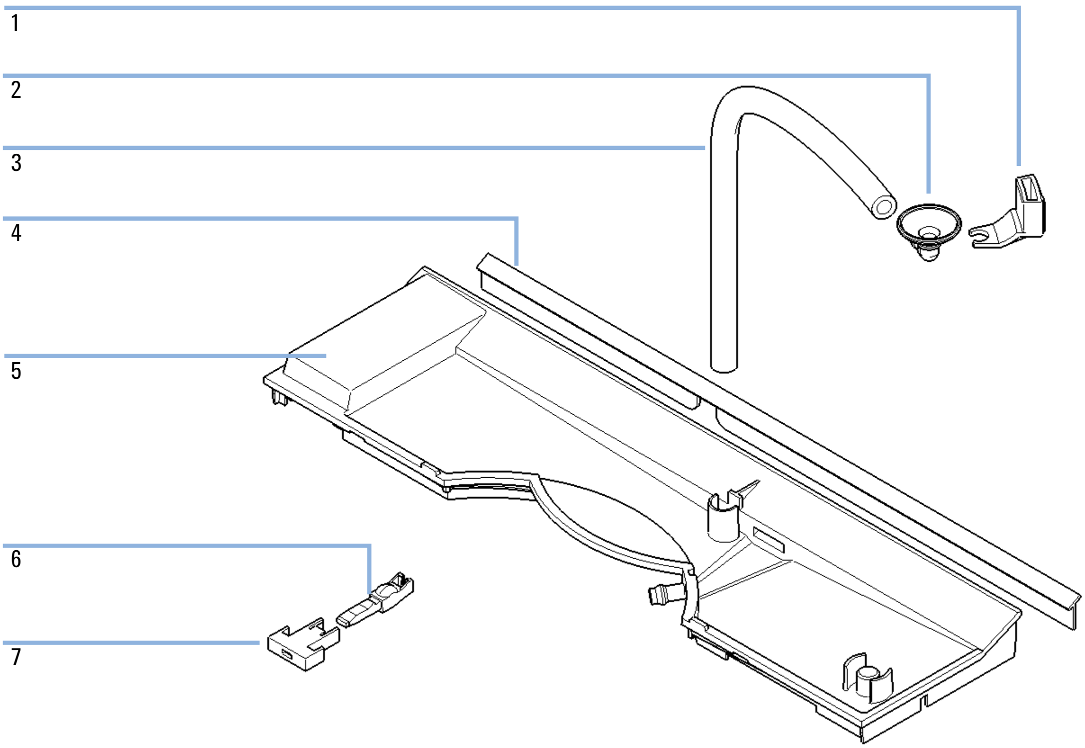


Figure 31 Leak parts

Item	p/n	Description
1	5041-8389	Leak funnel holder
2	5041-8388	Leak funnel
3	5062-2463	Corrugated tubing, PP, 6.5 mm id, 5 m
4	G1361-47100	Sealing lip
5	5042-9922	Leak panel
6	G4280-40016	Power Switch Coupler ZL
7	5041-8381	Power switch button

Accessory Kit

The Accessory Kit 1290 Infinity Quaternary Pump (G4204-68705) contains:

Item	p/n	Description
1	0100-1816	Fitting Waste Tube to Purge Valve
2	5067-4755	Flexible Waste Tube, 5 m
3	5063-6527	Leak tubing assembly, 1 m
4	5181-1519	CAN cable, Agilent module to module, 1 m
5	5042-9967	Tubing clip (set of 5 clips)
6	5067-4657	Capillary ST, 0.17 mm x 300 mm Pump to Autosampler
7	5067-4670	SST cap. 0.17 mm ID 600 mm pre-swaged
8	5067-5443	Inlet tubing
9	9301-6476	Syringe with luerlock 5 mL Polypropylene
10	5042-9972 (4x)	Tubing grommet
11	5023-0271	Frit 0.3 µm for inline filter, 5/pk

Others

HPLC System Tool Kit

The HPLC System Tool Kit (G4203-68708) contains some accessories and tools needed for installation and repair of the module.

p/n	Description
0100-1681	Adapter syringe/seal wash tube
0100-1710	Mounting Tool for Tubing Connections
01018-23702	Insert tool
5023-0240	Hex driver, ¼", slitted
8710-0060	Hex-key wrench, 9/64 inch
8710-0510 (2x)	Wrench open 1/4 — 5/16 inch
8710-0641	Hex key set 1 – 5 mm
8710-0899	Pozidriv screwdriver
8710-1534	Wrench, 4 mm both ends, open end
8710-1924	Wrench open 14 mm
8710-2392	Hex key 4 mm15 cm long T-handle
8710-2393	Hex key 1.5 mm, straight handle 10 cm
8710-2394	Hex key 9/64 inch 15 cm long T-handle
8710-2409	Wrench open end, 5/16 – 3/8 inch
8710-2411	Hex key 3 mm12 cm long
8710-2412	Hex key 2.5 mm, 15 cm long, straight handle
8710-2438	Hex key 2.0 mm
8710-2509	Screwdriver Torx TX8
8710-2594	Double open end wrench 4 mm x 5 mm
9301-0411	Syringe, Plastic
9301-1337	Adapter syringe/solvent tube with fitting

1290 Infinity Pump Service Kit

1290 Infinity pump service kit (5067-4699), contains:

p/n	Description
G4220-20012	Torque wrench 2 – 25 Nm
G4220-20013	4 mm hex bit
G4220-20014	2.5 mm Hex Bit
G4220-20015	Adapter ¼ in square to hex
G4204-44000	Transport protection foam
5023-0285	Replacement kit for 1290 Infinity pump head alignment tool (piston/handle)

11
Identifying Cables

This chapter provides information on cables used with the Agilent 1200 Infinity Series 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 module to 3394/6 integrators
35900-60750	Agilent 35900A A/D converter
01046-60105	Analog cable (BNC to general purpose, spade lugs)

Remote cables

p/n	Description
03394-60600	Agilent module to 3396A Series I integrators
	3396 Series II / 3395A integrator, see details in section "Remote Cables" on page 232
03396-61010	Agilent module to 3396 Series III / 3395B integrators
5061-3378	Remote Cable
01046-60201	Agilent module to general purpose

BCD cables

p/n	Description
03396-60560	Agilent module to 3396 integrators
G1351-81600	Agilent module to general purpose

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

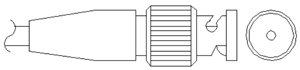
LAN cables

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

RS-232 cables

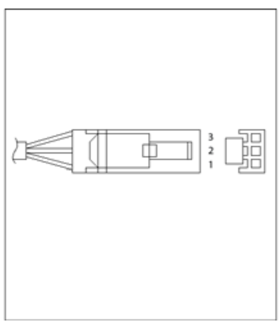
p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61601	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between 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

Analog cables

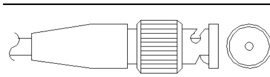


One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

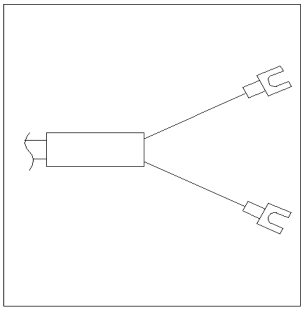
Agilent Module to 3394/6 Integrators

p/n 35900-60750	Pin 3394/6	Pin Agilent module	Signal Name
	1		Not connected
	2	Shield	Analog -
	3	Center	Analog +

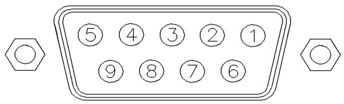
Agilent Module to BNC Connector

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

Agilent Module to General Purpose

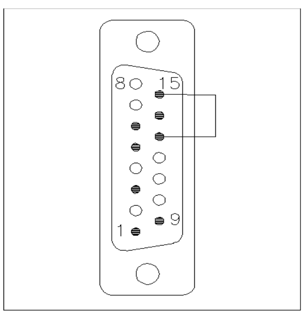
p/n 01046-60105	Pin	Pin Agilent module	Signal Name
	1		Not connected
	2	Black	Analog -
	3	Red	Analog +

Remote Cables



One end of these cables provides a 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.

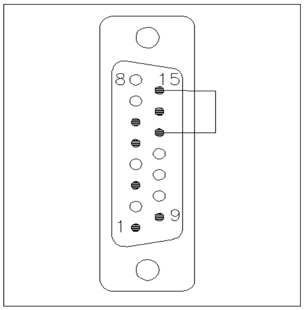
Agilent Module to 3396A Integrators

p/n 03394-60600	Pin 3396A	Pin Agilent module	Signal Name	Active (TTL)
	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	5,14	7 - Red	Ready	High
	1	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low
	13, 15		Not connected	

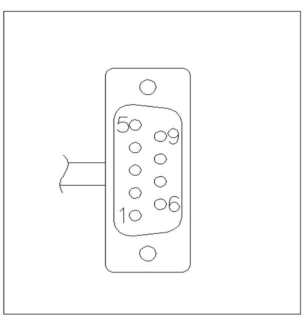
Agilent Module to 3396 Series II / 3395A Integrators

Use the cable Agilent module to 3396A Series I integrators (03394-60600) and cut pin #5 on the integrator side. Otherwise the integrator prints START; not ready.

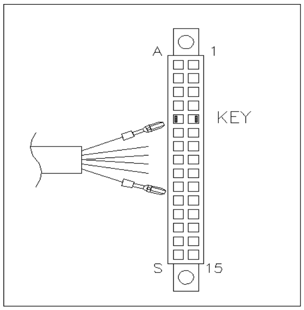
Agilent Module to 3396 Series III / 3395B Integrators

p/n 03396-61010	Pin 33XX	Pin Agilent module	Signal Name	Active (TTL)
	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	14	7 - Red	Ready	High
	4	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low
	13, 15		Not connected	

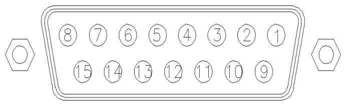
Agilent Module to Agilent 35900 A/D Converters

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

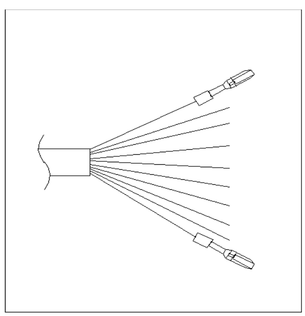
p/n 01046-60201	Wire Color	Pin Agilent module	Signal Name	Active (TTL)
	White	1	Digital ground	
	Brown	2	Prepare run	Low
	Gray	3	Start	Low
	Blue	4	Shut down	Low
	Pink	5	Not connected	
	Yellow	6	Power on	High
	Red	7	Ready	High
	Green	8	Stop	Low
	Black	9	Start request	Low

BCD Cables

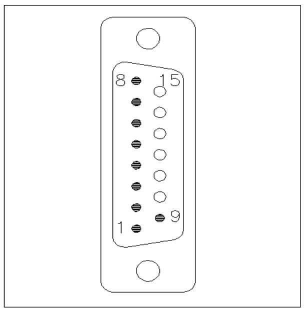


One end of these cables provides a 15-pin BCD connector to be connected to the Agilent modules. The other end depends on the instrument to be connected to

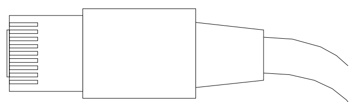
Agilent Module to General Purpose

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 Cable



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 (for point to point connection)
5023-0202	Twisted pair network cable, shielded, 7 m (for point to point connection)

RS-232 Cable Kit

p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61601	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's 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

Agilent 1200 Module to Printer

p/n	Description
5181-1529	Cable Printer Serial & Parallel, is a SUB-D 9 pin female vs. Centronics connector on the other end (NOT FOR FW UPDATE). For use with G1323 Control Module.

12
Hardware Information

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

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 and RS-232C)
- memory management
- ability to update the firmware of the 'main system'

Main System

Its properties are:

- the complete communication capabilities (CAN, LAN and RS-232C)
- 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 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 using the following tools (latest version should be used):

- Agilent Lab Advisor software with files on the hard disk (*)
- Firmware Update Tool with local files on the hard disk (*)
- Instant Pilot (G4208A) with files on a USB Flash Disk

(*) Required tools, firmware and documentation are available from the Agilent web:
http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?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.

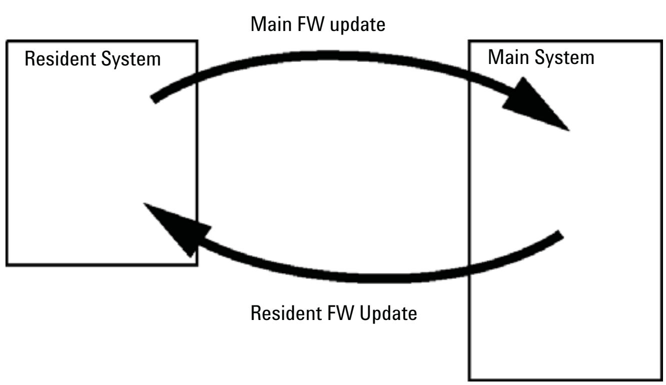


Figure 32 Firmware Update Mechanism

NOTE

Some modules are limited in downgrading due to their main board 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 are use and the feature set of the original are lost. After re-branding (e.g. from G1314B to G1314C), the original feature set is available again.

All these specific informations are described in the documentation provided with the firmware update tools.

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

- http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?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 REMOTE 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 RS-232C connector may be used to control the module from a computer through a RS-232C connection. This connector is activated and can be configured with the configuration switch.
- 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.

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

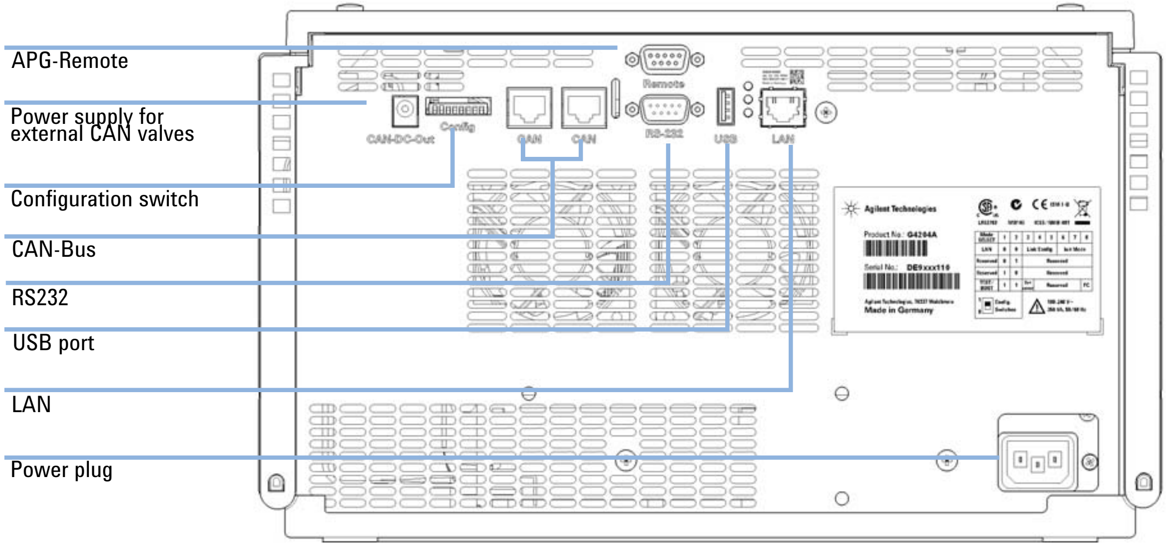


Figure 33 Rear of quaternary pump

Interfaces

The Agilent 1200 Infinity Series modules provide the following interfaces:

Table 7 Agilent 1200 Infinity Series Interfaces

Module	CAN	LAN/BCD (optional)	LAN (on-board)	RS-232	Analog	APG Remote	Special
Pumps							
G1310B Iso Pump G1311B Quat Pump G1311C Quat Pump VL G1312B Bin Pump K1312B Bin Pump Clinical Ed. G1312C Bin Pump VL 1376A Cap Pump G2226A Nano Pump G5611A Bio-inert Quat Pump	2	Yes	No	Yes	1	Yes	
G4220A/B Bin Pump G4204A Quat Pump	2	No	Yes	Yes	No	Yes	CAN-DC- OUT for CAN slaves
G1361A Prep Pump	2	Yes	No	Yes	No	Yes	CAN-DC- OUT for CAN slaves
Samplers							
G1329B ALS G2260A Prep ALS	2	Yes	No	Yes	No	Yes	THERMOSTAT for G1330B/K1330B
G1364B FC-PS G1364C FC-AS G1364D FC-μS G1367E HiP ALS K1367E HiP ALS Clinical Ed. G1377A HiP micro ALS G2258A DL ALS G5664A Bio-inert FC-AS G5667A Bio-inert Autosampler	2	Yes	No	Yes	No	Yes	THERMOSTAT for G1330B/K1330B CAN-DC- OUT for CAN slaves
G4226A ALS	2	Yes	No	Yes	No	Yes	

Table 7 Agilent 1200 Infinity Series Interfaces

Module	CAN	LAN/BCD (optional)	LAN (on-board)	RS-232	Analog	APG Remote	Special
Detectors							
G1314B VWD VL G1314C VWD VL+	2	Yes	No	Yes	1	Yes	
G1314E/F VWD K1314F Clinical Ed.	2	No	Yes	Yes	1	Yes	
G4212A/B DAD K4212B DAD Clinical Ed.	2	No	Yes	Yes	1	Yes	
G1315C DAD VL+ G1365C MWD G1315D DAD VL G1365D MWD VL	2	No	Yes	Yes	2	Yes	
G1321B FLD K1321B FLD Clinical Ed. G1321C FLD	2	Yes	No	Yes	2	Yes	
G1362A RID	2	Yes	No	Yes	1	Yes	
G4280A ELSD	No	No	No	Yes	Yes	Yes	EXT Contact AUTOZERO
Others							
G1170A Valve Drive	2	No	No	No	No	No	1
G1316A/C TCC K1316C TCC Clinical Ed.	2	No	No	Yes	No	Yes	
G1322A DEG K1322A DEG Clinical Ed.	No	No	No	No	No	Yes	AUX
G1379B DEG	No	No	No	Yes	No	Yes	
G4225A DEG K4225A DEG Clinical Ed.	No	No	No	Yes	No	Yes	

Table 7 Agilent 1200 Infinity Series Interfaces

Module	CAN	LAN/BCD (optional)	LAN (on-board)	RS-232	Analog	APG Remote	Special
G4227A Flex Cube	2	No	No	No	No	No	CAN-DC- OUT for CAN slaves [2]
G4240A CHIP CUBE	2	Yes	No	Yes	No	Yes	CAN-DC- OUT for CAN slaves THERMOSTAT for G1330A/B (NOT USED), K1330B

[1] Requires a HOST module with on-board LAN (e.g. G4212A or G4220A with minimum firmware B.06.40 or C.06.40) or with additional G1369C LAN Card

NOTE The detector (DAD/MWD/FLD/VWD/RID) is the preferred access point for control via LAN. The inter-module communication is done via CAN.

- CAN connectors as interface to other modules
- LAN connector as interface to the control software
- RS-232C as interface to a computer
- REMOTE connector as interface to other Agilent products
- Analog output connector(s) 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 an 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 Flex Cube). These are hosted modules and require a Host module with firmware B.06.40 or later or with additional G1369C LAN Card.

NOTE If an Agilent detector (DAD/MWD/FLD/VWD/RID) is in the system, the LAN should be connected to the DAD/MWD/FLD/VWD/RID (due to higher data load). If no Agilent detector is part of the system, the LAN interface should be installed in the pump or autosampler.

RS-232C (Serial)

The RS-232C connector is used to control the module from a computer through RS-232C connection, using the appropriate software. This connector can be configured with the configuration switch module at the rear of the module. Refer to *Communication Settings for RS-232C*.

NOTE There is no configuration possible on main boards with on-board LAN. These are pre-configured for

- 19200 baud,
- 8 data bit with no parity and
- one start bit and one stop bit are always used (not selectable).

The RS-232C is designed as DCE (data communication equipment) with a 9-pin male SUB-D type connector. The pins are defined as:

Table 8 RS-232C Connection Table

Pin	Direction	Function
1	In	DCD
2	In	RxD
3	Out	TxD
4	Out	DTR
5		Ground
6	In	DSR
7	Out	RTS
8	In	CTS
9	In	RI

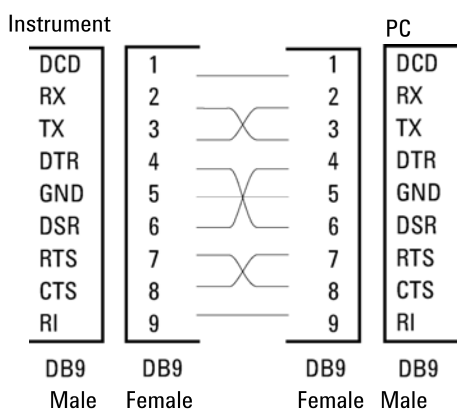


Figure 34 RS-232 Cable

Analog Signal Output

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

APG Remote

The APG Remote 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.

Remote control 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 9 Remote Signal Distribution

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

Special Interfaces

The module includes a DC-Out (24 VDC) power line that is intended to be used with certain modules that operate as CAN slaves, for example external valves. The line has a limited output of 1.7 A and is self resetting.

Setting the 8-bit Configuration Switch

The 8-bit configuration switch is located at the rear of the module. Switch settings provide configuration parameters for LAN, serial communication protocol and instrument specific initialization procedures.

All modules with on-board LAN:

- Default is ALL switches DOWN (best settings).
  - Bootp mode for LAN and
  - 19200 baud, 8 data bit / 1 stop bit with no parity for RS-232
- For specific LAN modes switches 3-8 must be set as required.
- For boot/test modes switches 1+2 must be UP plus required mode.

NOTE For normal operation use the default (best) settings.

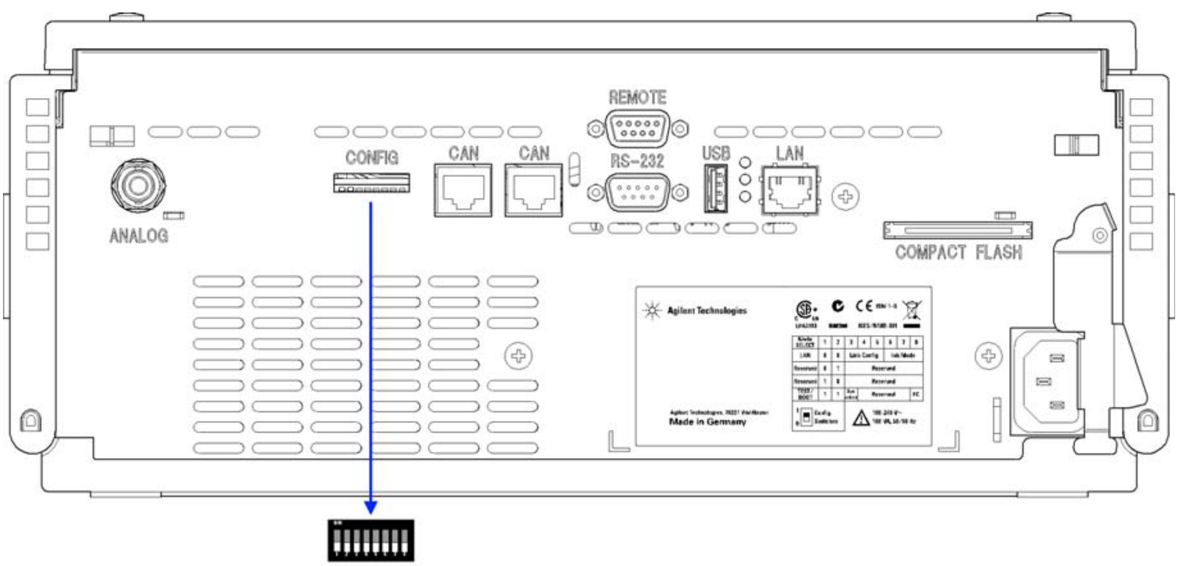


Figure 35 Location of Configuration Switch (example shows a G4212A DAD)

NOTE To perform any LAN configuration, SW1 and SW2 must be set to OFF. For details on the LAN settings/configuration refer to chapter LAN Configuration.

Table 10 8-bit Configuration Switch (with on-board LAN)

	Mode		Function					
	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8
LAN	*0*	*0*	Link Configuration			Init Mode Selection		
Auto-negotiation			*0*	x	x	x	x	x
10 MBit, half-duplex			1	*0*	*0*	x	x	x
10 MBit, full-duplex			1	*0*	1	x	x	x
100 MBit, half-duplex			1	1	*0*	x	x	x
100 MBit, full-duplex			1	1	1	x	x	x
Bootp			x	x	x	*0*	*0*	*0*
Bootp & Store			x	x	x	*0*	*0*	1
Using Stored			x	x	x	*0*	1	*0*
DHCP			x	x	x	1	*0*	*0*
Using Default			x	x	x	*0*	1	1
TEST	1	1	System					NVRAM
Boot Resident System			1					x
Revert to Default Data (Coldstart)			x	x	x			1

Legend:

0 (switch down), 1 (switch up), x (any position)

NOTE

When selecting the mode TEST, the LAN settings are: Auto-Negotiation & Using Stored.

NOTE

For explanation of "Boot Resident System" and "Revert to Default Data (Coldstart)" refer to "Special Settings" on page 256.

Special Settings

The special settings are required for specific actions (normally in a service case).

NOTE The tables include both settings for modules – with on-board LAN and without on-board LAN. They are identified as LAN and no LAN.

Boot-Resident

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

If you use the following switch settings and power the instrument up again, the instrument firmware stays in the 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).

Table 11 Boot Resident Settings (On-board LAN)

Mode Select	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
TEST/BOOT	1	1	1	0	0	0	0	0

Forced Cold Start

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

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.

If you use the following switch settings and power the instrument up again, a forced cold start has been completed.

Table 12 Forced Cold Start Settings (On-board LAN)

Mode Select	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
TEST/BOOT	1	1	0	0	0	0	0	1

Early Maintenance Feedback

Maintenance requires the exchange of components which are subject to wear or stress. Ideally, the frequency at which components are exchanged should be based on the intensity of usage of the module and the analytical conditions, and not on a predefined time interval. The early maintenance feedback (**EMF**) feature monitors the usage 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 need 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.

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.

13 LAN Configuration

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

What You Have To Do First

The module has an on-board LAN communication interface.

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 37 on page 260).

Figure 36 MAC label

2 Connect the instrument's LAN interface (see Figure 37 on page 260) to

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

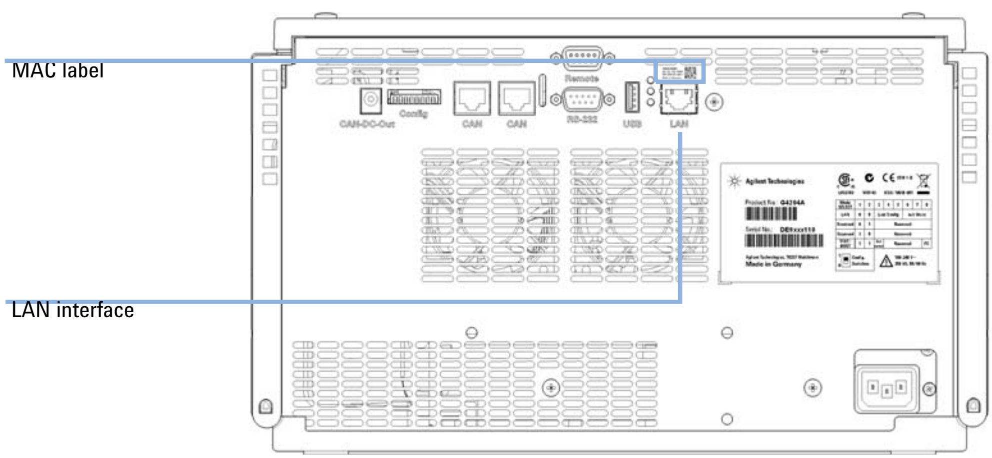


Figure 37 Location of LAN interfaces and MAC label

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 BOOTP Server (using the so-called Bootstrap Protocol)
- 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 268
- by manually setting the parameters using Telnet
- by manually setting the parameters using the Instant Pilot (G4208A)

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 from a Bootp cycle, non-volatile memory or initialized with known default values. The initialization mode is selected by the configuration switch, see Table 14 on page 263.

Configuration Switch

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

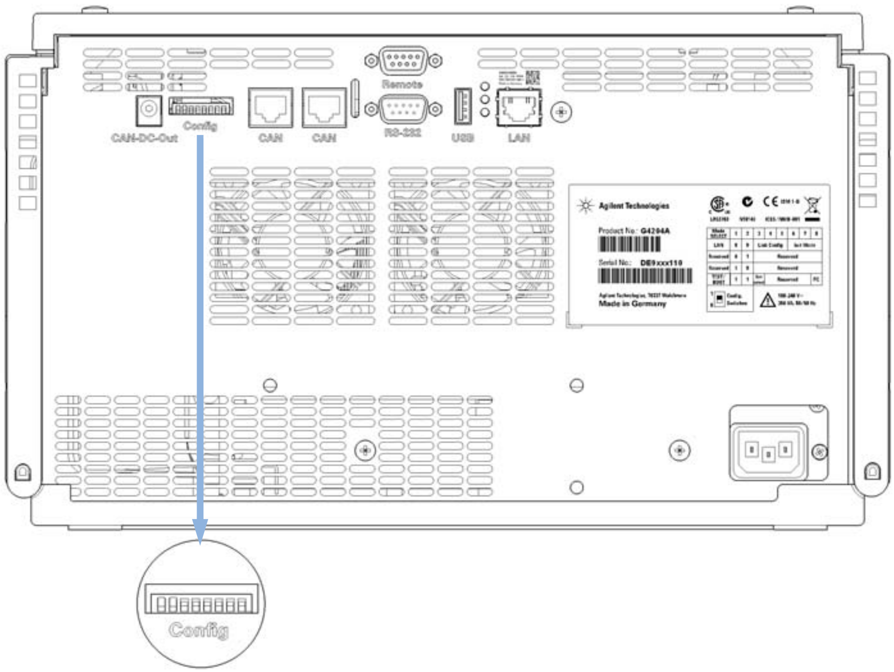


Figure 38 Location of Configuration Switch

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.

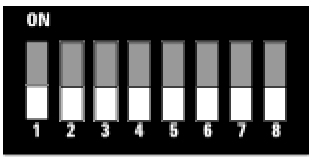
Table 13 Factory Default Settings

Initialization ('Init') Mode	Bootp, all switches down. For details see "Initialization Mode Selection" on page 263
Link Configuration	speed and duplex mode determined by auto-negotiation, for details see "Link Configuration Selection" on page 270

Initialization Mode Selection

The following initialization (init) modes are selectable:

Table 14 Initialization Mode Switches

	SW 6	SW 7	SW 8	Init Mode
	OFF	OFF	OFF	Bootp
	OFF	OFF	ON	Bootp & Store
	OFF	ON	OFF	Using Stored
	OFF	ON	ON	Using Default
	ON	OFF	OFF	DHCP [1]

1 Requires firmware B.06.40 or above. Modules without LAN on board, see G1369C LAN Interface Card

Bootp

When the initialization mode **Bootp** is selected, the module tries to download the parameters from a **Bootp** Server. The parameters obtained become the active parameters immediately. They are not stored to the non-volatile memory of the module. Therefore, the parameters are lost with the next power cycle of the module.

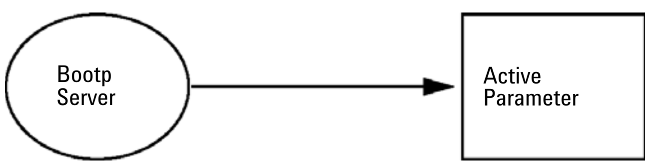


Figure 39 **Bootp** (Principle)

Bootp & Store

When **Bootp & Store** is selected, the parameters obtained from a **Bootp** Server become the active parameters immediately. In addition, they are stored to the non-volatile memory of the module. Thus, after a power cycle they are still available. This enables a kind of bootp once configuration of the module.

Example: The user may not want to have a **Bootp** Server be active in his network all the time. But on the other side, he may not have any other configuration method than **Bootp**. In this case he starts the **Bootp** Server temporarily, powers on the module using the initialization mode **Bootp & Store**, waits for the **Bootp** cycle to be completed, closes the **Bootp** Server and powers off the module. Then he selects the initialization mode Using Stored and powers on the module again. From now on, he is able to establish the TCP/IP connection to the module with the parameters obtained in that single **Bootp** cycle.

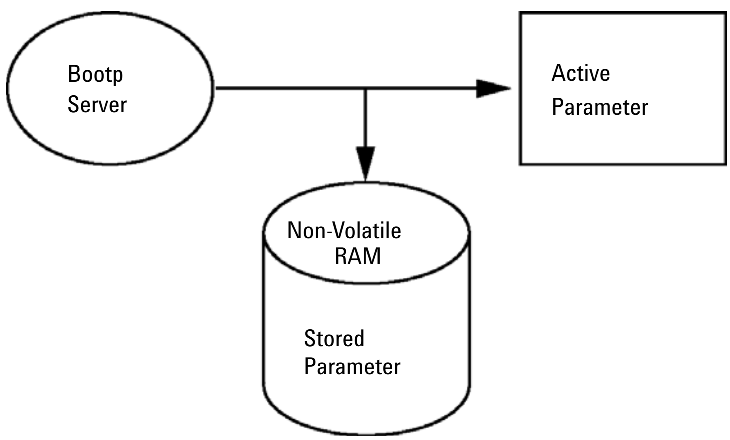


Figure 40 Bootp & Store (Principle)

NOTE Use the initialization mode **Bootp & Store** carefully, because writing to the non-volatile memory takes time. Therefore, when the module shall obtain its parameters from a **Bootp** Server every time it is powered on, the recommended initialization mode is **Bootp**!

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.

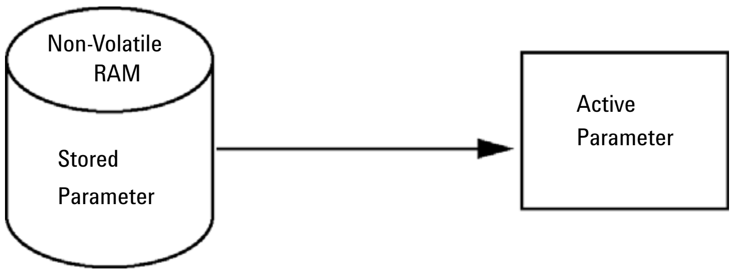


Figure 41 Using Stored (Principle)

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 15 on page 265.

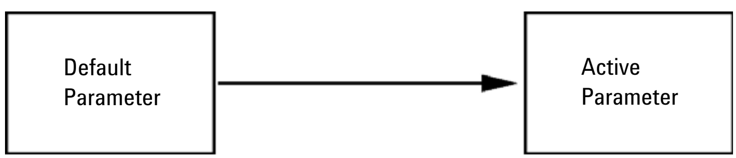


Figure 42 Using Default (Principle)

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 15 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, and “B”-firmware (B.06.40 or above).

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).

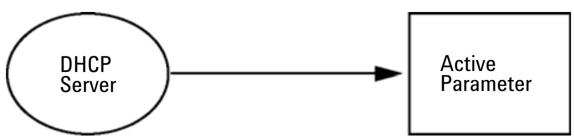


Figure 43 DHCP (Principle)

NOTE

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

Setup (DHCP)

Software required The modules in the stack must have at least firmware from set A.06.34 and the above mentioned modules B.06.40 or above (must from the same firmware set).

1 Note the MAC address of the LAN interface (provided with G1369C LAN Interface Card or Main Board). This MAC address is on a label on the card or at the rear of the main board, e.g. *0030d3177321*.

   On the Instant Pilot the MAC address can be found under **Details** in the LAN section.

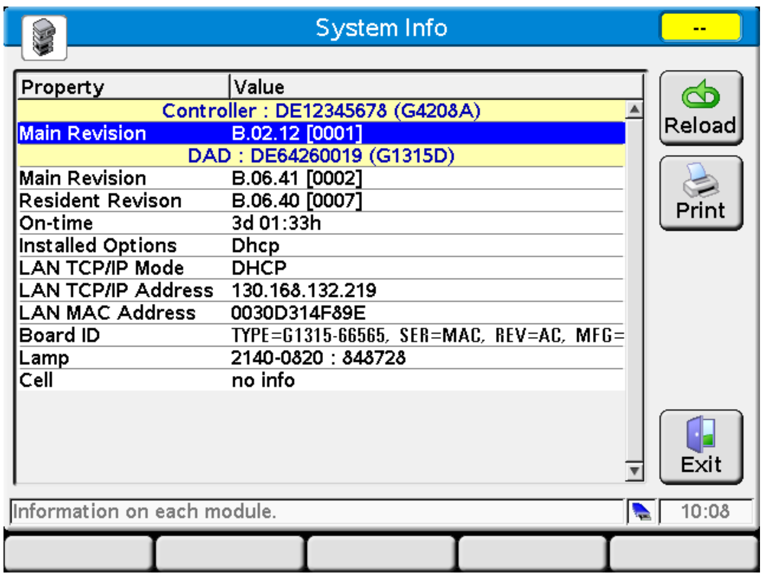


Figure 44 LAN Setting on Instant Pilot

2 Set the Configuration Switch to DHCP either on the G1369C LAN Interface Card or the main board of above mentioned modules.

Table 16 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 17 LC Modules inclusive 1120/1220 (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. Agilent ChemStation, 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 267).

Link Configuration Selection

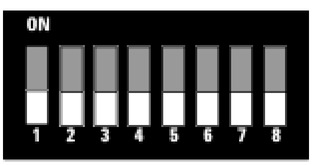
The LAN interface supports 10 or 100 Mbps operation in full- or half-duplex modes. In most cases, full-duplex is supported when the connecting network device - such as a network switch or hub - supports IEEE 802.3u auto-negotiation specifications.

When connecting to network devices that do not support auto-negotiation, the LAN interface will configure itself for 10- or 100-Mbps half-duplex operation.

For example, when connected to a non-negotiating 10-Mbps hub, the LAN interface will be automatically set to operate at 10-Mbps half-duplex.

If the module is not able to connect to the network through auto-negotiation, you can manually set the link operating mode using link configuration switches on the module.

Table 18 Link Configuration Switches

	SW 3	SW 4	SW 5	Link Configuration
	OFF	-	-	speed and duplex mode determined by auto-negotiation
	ON	OFF	OFF	manually set to 10 Mbps, half-duplex
	ON	OFF	ON	manually set to 10 Mbps, full-duplex
	ON	ON	OFF	manually set to 100 Mbps, half-duplex
	ON	ON	ON	manually set to 100 Mbps, full-duplex

Automatic configuration with Bootp

NOTE All examples shown in this chapter will not work in your environment. You need your own IP-, Subnet-Mask- and Gateway addresses.

NOTE Assure that the detector configuration switch is set properly. The setting should be either **BootP** or **BootP & Store**, see Table 14 on page 263.

NOTE Assure that the detector connected to the network is powered off.

NOTE If the Agilent BootP Service program is not already installed on your PC, then install it from your Agilent ChemStation DVD, located in folder **BootP**.

About Agilent BootP Service

The Agilent BootP Service is used to assign the LAN Interface with an IP address.

The Agilent BootP Service is provided on the ChemStation DVD. The Agilent BootP Service is installed on a server or PC on the LAN to provide central administration of IP addresses for Agilent instruments on a LAN. The BootP service must be running TCP/IP network protocol and cannot run a DHCP server.

How BootP Service Works

When an instrument is powered on, an LAN Interface in the instrument broadcasts a request for an IP address or host name and provides its hardware MAC address as an identifier. The Agilent BootP Service answers this request and passes a previously defined IP address and host name associated with the hardware MAC address to the requesting instrument.

The instrument receives its IP address and host name and maintains the IP address as long as it is powered on. Powering down the instrument causes it to lose its IP address, so the Agilent BootP Service must be running every time the instrument powers up. If the Agilent BootP Service runs in the background, the instrument will receive its IP address on power-up.

The Agilent LAN Interface can be set to store the IP address and will not lose the IP address if power cycled.

Situation: Cannot Establish LAN Communication

If a LAN communication with BootP service cannot be established, check the following on the PC:

- Is the BootP service started? During installation of BootP, the service is not started automatically.
- Does the Firewall block the BootP service? Add the BootP service as an exception.
- Is the LAN Interface using the BootP-mode instead of "Using Stored" or "Using Default" modes?

Installation of BootP Service

Before installing and configuring the Agilent BootP Service, be sure to have the IP addresses of the computer and instruments on hand.

1 Log on as Administrator or other user with Administrator privileges.
2 Close all Windows programs.
3 Insert the Agilent ChemStation software DVD into the drive. If the setup program starts automatically, click **Cancel** to stop it.
4 Open Windows Explorer.
5 Go to the BootP directory on the Agilent ChemStation DVD and double-click **BootPPackage.msi**.
6 If necessary, click the **Agilent BootP Service...** icon in the task bar.
7 The **Welcome** screen of the **Agilent BootP Service Setup Wizard** appears. Click **Next**.
8 The **End-User License Agreement** screen appears. Read the terms, indicate acceptance, then click **Next**.
9 The **Destination Folder** selection screen appears. Install BootP to the default folder or click **Browse** to choose another location. Click **Next**.

   The default location for installation is:

   C:\Program Files\Agilent\BootPService\

10 Click **Install** to begin installation.

11 Files load; when finished, the **BootP Settings** screen appears.

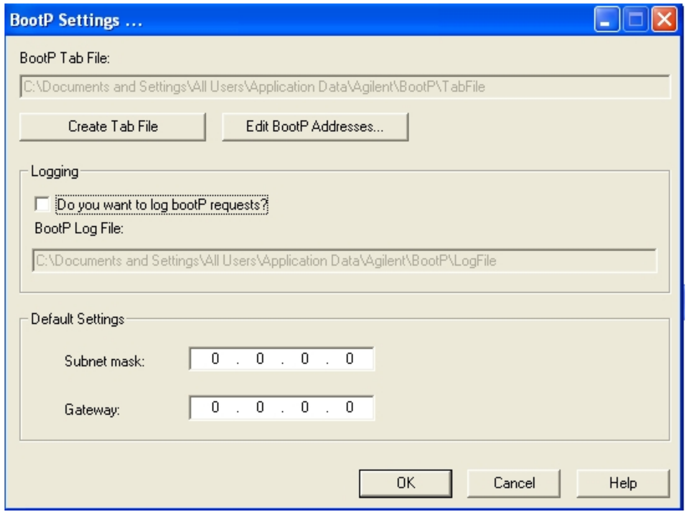


Figure 45 BootP Settings screen

12 In the **Default Settings** part of the screen, if known, you can enter the subnet mask and gateway.

Defaults can be used:

- The default subnet mask is 255.255.255.0
- The default gateway is 192.168.254.11

13 On the **BootP Settings** screen, click **OK**. The **Agilent BootP Service Setup** screen indicates completion.

14 Click **Finish** to exit the **Agilent BootP Service Setup** screen.

15 Remove the DVD from the drive.

This completes installation.

16 Start BootP Service in the Windows® services: On the Windows® desktop click right on **Computer** icon, select **Manage > Services and Applications > Services**. Select the **Agilent BootP Service** and click **Start**.

Two Methods to Determine the MAC Address

Enabling logging to discover the MAC address using BootP

If you want to see the MAC address, select the **Do you want to log BootP requests?** check box.

1 Open BootP Settings from **Start > All Programs > Agilent BootP Service > EditBootPSettings**.

2 In **BootP Settings...** check **Do you want to log BootP requests?** to enable logging.

Figure 46 Enable BootP logging

The log file is located in

C:\Documents and Settings\All Users\Application Data\Agilent\BootP\LogFile

It contains a MAC address entry for each device that requests configuration information from BootP.

3 Click **OK** to save the values or **Cancel** to discard them. The editing ends.

4 After each modification of the BootP settings (i.e. **EditBootPSettings**) a stop or start of the BootP service is required for the BootP service to accept changes. See "Stopping the Agilent BootP Service" on page 279 or "Restarting the Agilent BootP Service" on page 280.

5 Uncheck the **Do you want to log BootP requests?** box after configuring instruments; otherwise, the log file will quickly fill up disk space.

Determining the MAC address directly from the LAN Interface card label

1 Turn off the instrument.

2 Read the MAC address from the label and record it.

The MAC address is printed on a label on the rear of the module.

See Figure 36 on page 260 and Figure 37 on page 260.

3 Turn on the instrument.

Assigning IP Addresses Using the Agilent BootP Service

The Agilent BootP Service assigns the Hardware MAC address of the instrument to an IP address.

Determining the MAC address of the instrument using BootP Service

1 Power cycle the Instrument.

2 After the instrument completes self-test, open the log file of the BootP Service using Notepad.

   - The default location for the logfile is C:\Documents and Settings\All Users\Application Data\Agilent\BootP\LogFile.
   - The logfile will not be updated if it is open.

   The contents will be similar to the following:

```
02/25/10 15:30:49 PM

Status: BootP Request received at outermost layer

Status: BootP Request received from hardware address: 0010835675AC

Error: Hardware address not found in BootPTAB: 0010835675AC

Status: BootP Request finished processing at outermost layer
```

3 Record the hardware (MAC) address (for example, 0010835675AC).

4 The Error means the MAC address has not been assigned an IP address and the Tab File does not have this entry. The MAC address is saved to the Tab File when an IP address is assigned.

5 Close the log file before turning on another instrument.

6 Uncheck the **Do you want to log BootP requests?** box after configuring instruments to avoid having the logfile use up excessive disk space.

Adding each instrument to the network using BootP

1 Follow **Start > All Programs > Agilent BootP Service** and select **Edit BootP Settings**. The BootP Settings screen appears.

2 Uncheck the **Do you want to log BootP requests?** once all instruments have been added.

The **Do you want to log BootP requests?** box must be unchecked when you have finished configuring instruments; otherwise, the log file will quickly fill up disk space.

3 Click **Edit BootP Addresses...** The **Edit BootP Addresses** screen appears.

4 Click **Add...** The **Add BootP Entry** screen appears.

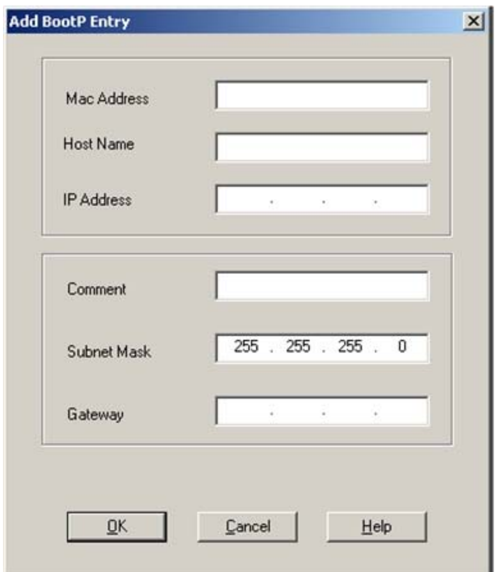


Figure 47 Enable BootP logging

5 Make these entries for the instrument:

- MAC address
- Host name, Enter a Hostname of your choice.

  The Host Name must begin with "alpha" characters (i.e. LC1260)
- IP address
- Comment (optional)

- Subnet mask
- Gateway address (optional)

The configuration information entered is saved in the Tab File.

6 Click **OK**.

7 Leave **Edit BootP Addresses** by pressing **Close**.

8 Exit **BootP Settings** by pressing **OK**.

9 After each modification of the BootP settings (i.e. EditBootPSettings) a stop or start of the BootP service is required for the BootP service to accept changes. See "Stopping the Agilent BootP Service" on page 279 or "Restarting the Agilent BootP Service" on page 280.

10 Power cycle the Instrument.

OR

If you changed the IP address, power cycle the instrument for the changes to take effect.

11 Use the PING utility to verify connectivity by opening a command window and typing:

Ping 192.168.254.11 for example.

The Tab File is located at

C:\Documents and Settings\All Users\Application Data\Agilent\BootP\TabFile

Changing the IP Address of an Instrument Using the Agilent BootP Service

Agilent BootP Service starts automatically when your PC reboots. To change Agilent BootP Service settings, you must stop the service, make the changes, and then restart the service.

Stopping the Agilent BootP Service

1 From the Windows control panel, select **Administrative Tools > Services**. The **Services** screen appears.

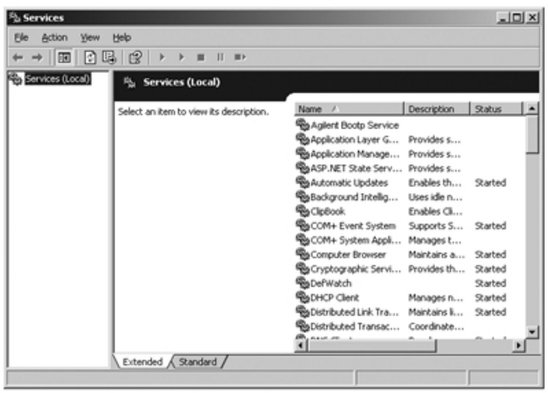


Figure 48 Windows Services screen

2 Right-click **Agilent BootP Service**.

3 Select **Stop**.

4 Close the **Services and Administrative Tools** screen.

Editing the IP address and other parameters in EditBootPSettings

1 Select **Start > All Programs > Agilent BootP Service** and select **Edit BootP Settings**. The **BootP Settings** screen appears.

2 When the **BootP Settings** screen is first opened, it shows the default settings from installation.

3 Press **Edit BootP Addresses...** to edit the Tab File.

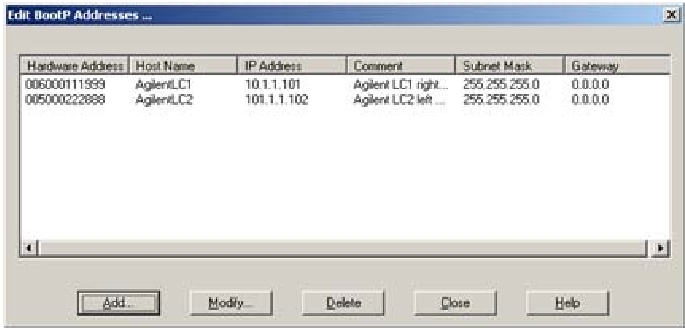


Figure 49 Edit BootP Adresses screen

4 In the **Edit BootP Addresses...** screen press **Add...** to create a new entry or select an existing line from the table and press **Modify...** or **Delete** to change the IP address, comment, subnet mask, for example, in the Tab File.

If you change the IP address, it will be necessary to power cycle the instrument for the changes to take effect.

5 Leave **Edit BootP Addresses...** by pressing **Close**.

6 Exit BootP Settings by pressing OK.

Restarting the Agilent BootP Service

1 In the Windows control panel, select **Administrative Tools > Services**. The **Services** screen appears, see Figure 48 on page 279.

2 Right-click **Agilent BootP Service** and select **Start**.

3 Close the **Services and Administrative Tools** screens.

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.

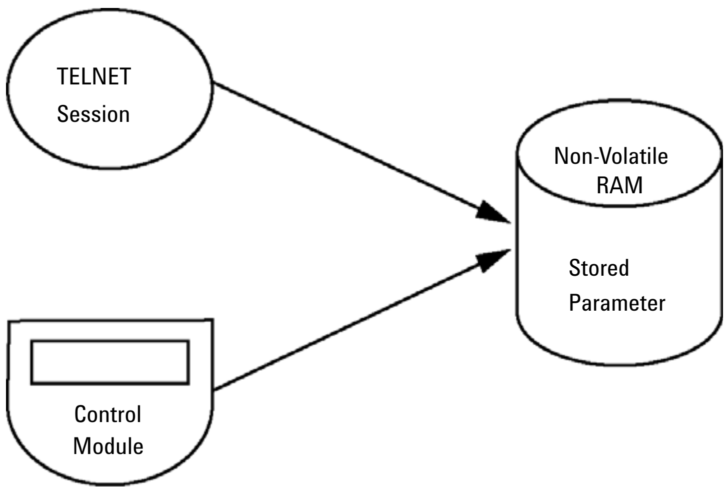


Figure 50 Manual Configuration (Principle)

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>`

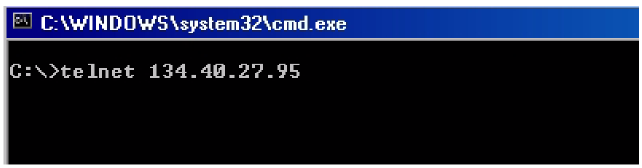


Figure 51 Telnet - Starting a session

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 262).

When the connection was established successfully, the module responds with the following:

Figure 52 A connection to the module is made

3 Type
? and press enter to see the available commands.

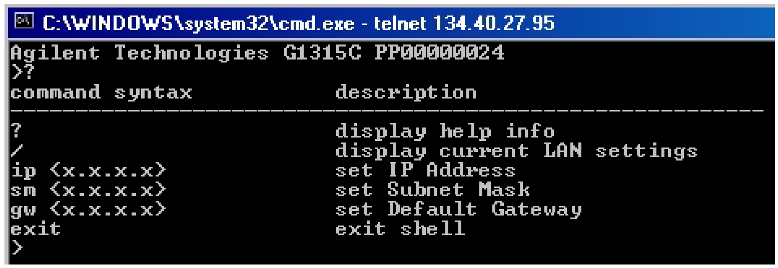


Figure 53 Telnet Commands

Table 19 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 134.40.27.230`

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.

```
C:\WINDOWS\system32\cmd.exe - telnet 134.40.27.95
>/
LAN Status Page
--------------------------------
MAC Address    : 0030D30A0838
--------------------------------
Init Mode      : Using Stored
--------------------------------
TCP/IP Properties
- active -
IP Address     : 134.40.27.95
Subnet Mask    : 255.255.248.0
Def. Gateway   : 134.40.24.1
--------------------------------
TCP/IP Status : Ready
--------------------------------
Controllers    : no connections
>_
```

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

Figure 54 Telnet - Current settings in "Using Stored" mode

6 Change the IP address (in this example 134.40.27.99) and type “/” to list current settings.

```
C:\WINDOWS\system32\cmd.exe - telnet 134.40.27.95
>ip 134.40.27.99
>/
LAN Status Page
--------------------------------
MAC Address    : 0030D30A0838
--------------------------------
Init Mode      : Using Stored
--------------------------------
TCP/IP Properties
- active -
IP Address     : 134.40.27.95
Subnet Mask    : 255.255.248.0
Def. Gateway   : 134.40.24.1
- stored -
IP Address     : 134.40.27.99
Subnet Mask    : 255.255.248.0
Def. Gateway   : 134.40.24.1
--------------------------------
TCP/IP Status : Ready
--------------------------------
Controllers    : no connections
>_
```

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

Figure 55 Telnet - Change IP settings

7 When you have finished typing the configuration parameters, type **`exit`** and press **Enter** to exit with storing parameters.

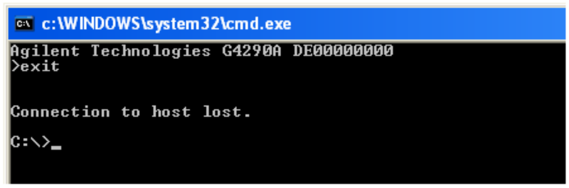


Figure 56 Closing the Telnet Session

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 134.40.27.99.

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 **DAD** button.

4 Scroll down to the LAN settings.

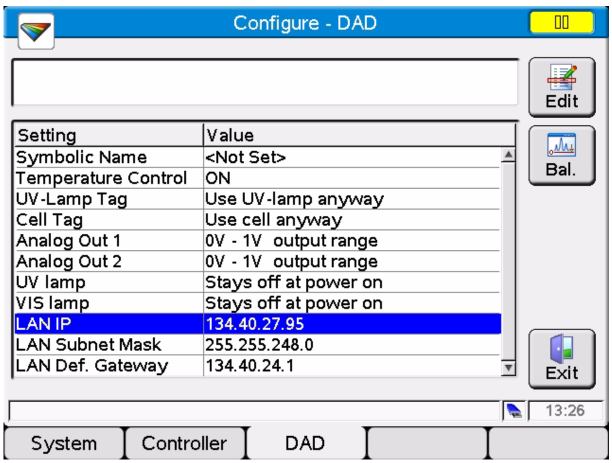


Figure 57 Instant Pilot - LAN Configuration

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 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 also "Initialization Mode Selection" on page 263).

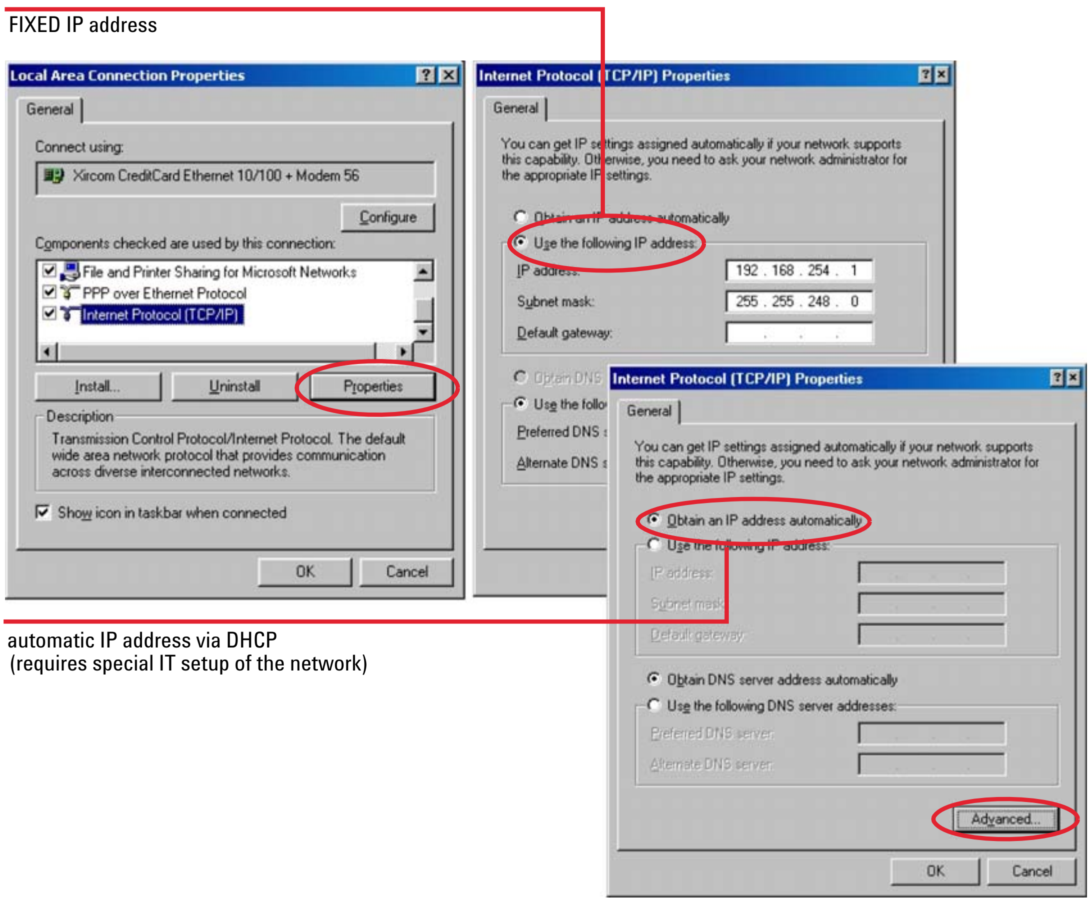


Figure 58 Changing the TCP/IP settings of the PC

User Interface Software Setup

Install you user interface software according the provided *User Interface Software Setup Guide*.

14 Appendix

This chapter provides additional information on safety, legal and web.

General Safety Information

Safety Symbols

Table 20 Safety Symbols

Symbol	Description
	The apparatus is marked with this symbol when the user should 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.
	Indicates eye damage may result from directly viewing the light produced by the deuterium lamp used in this product.
	The apparatus is marked with this symbol when hot surfaces are available and the user should not touch it when heated up.

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.

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.

Operation

Before applying power, comply with the installation section. Additionally the following must be observed.

Do not remove instrument covers when operating. Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers, and devices connected to it must be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any intended operation.

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

Some adjustments described in the manual, are made with power supplied to the instrument, and protective covers removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided whenever possible. When inevitable, this has to be carried out by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or make any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged, even though the instrument has been disconnected from its source of supply. Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing and adjusting.

When working with solvents, observe appropriate safety procedures (for example, goggles, safety gloves and protective clothing) as described in the material handling and safety data sheet by the solvent vendor, especially when toxic or hazardous solvents are used.

The Waste Electrical and Electronic Equipment (WEEE) Directive (2002-96-EC)

Abstract

The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC), adopted by EU Commission on 13 February 2003, is introducing producer responsibility on all Electric and Electronic appliances from 13 August 2005.

NOTE

This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a “Monitoring and Control instrumentation” product.

Do not dispose off in domestic household waste

To return unwanted products, contact your local Agilent office, or see www.agilent.com for more information.

Radio Interference

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

Test and Measurement

If test and measurement equipment is operated with equipment unscreened cables and/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

Manufacturer's Declaration

This statement is provided to comply with the requirements of the German Sound Emission Directive of 18 January 1991.

This product has a sound pressure emission (at the operator position) < 70 dB.

- Sound Pressure Lp < 70 dB (A)
- At Operator Position
- Normal Operation
- According to ISO 7779:1988/EN 27779/1991 (Type Test)

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http://www.agilent.com

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In This Book

This manual contains technical reference information about the Agilent 1290 Infinity Quaternary Pump G4204A.

The manual describes the following:

- Introduction,
- Site requirements and specifications,
- installation,
- configuration,
- using and optimizing,
- troubleshooting and diagnostic,
- error information,
- test functions,
- maintenance,
- parts identification,
- hardware information,
- safety and related information.

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