Agilent 1220 Infinity LC VL

User Manual

Agilent Technologies

Notices

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Agilent Technologies
Hewlett-Packard-Strasse 8
76337 Waldbronn

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In This Book

This manual contains information on how to use, maintain, repair and upgrade the Agilent 1220 Infinity LC VL System.

1 Introduction

This chapter provides an overview of the Agilent 1220 Infinity LC available configurations, site requirements and specifications.

2 Installation

This chapter provides an overview on shipment content and installation.

3 Agilent 1220 Infinity LC Description

This chapter provides general information about the functionality and use of the Agilent 1220 Infinity LC system and its components.

4 Test Functions and Calibration

This chapter describes the tests, calibrations and tools that are available with the Instrument Utilities software or the Lab Advisor.

5 Error Information

This chapter provides information on the error messages that might be displayed, and gives the possible causes and suggestions on their solutions.

6 Preventive Maintenance and Repair

Preventive Maintenance (PM) is an Agilent Technologies recommended procedure designed to reduce the likelihood of electro-mechanical failures. Failure to perform preventive maintenance may reduce the long-term reliability of your Agilent 1220 Infinity LC.

Contents

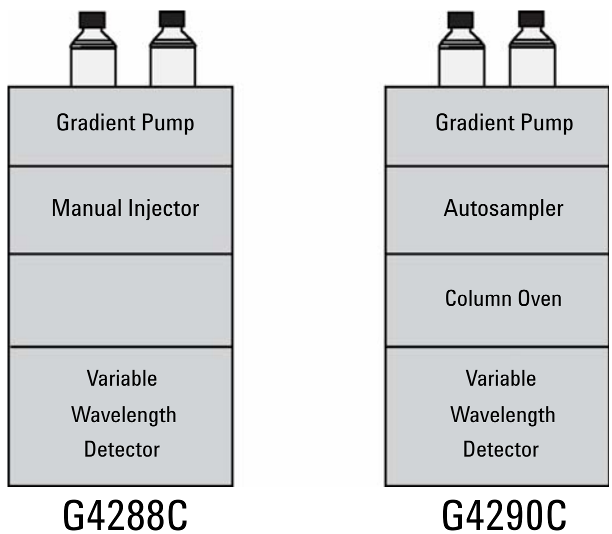
1
Introduction

This chapter provides an overview of the Agilent 1220 Infinity LC available configurations, site requirements and specifications.

Agilent 1220 Infinity LC VL Configurations

Available configurations of Agilent 1220 Infinity LC VL

The Agilent 1220 Infinity LC VL is available in two different configurations. Possible components include dual-channel gradient pump (with degasser), manual injector, autosampler, column oven and detector. Each configuration comes with at least one pump, one injection system and one detector and includes Agilent Instrument Utilities Software.



A Solvent Selection Valve (SSV) Upgrade Kit (*G4280-68708*) is available.

Site Requirements

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

Power Considerations

The Agilent 1220 Infinity LC power supply has wide-ranging capabilities. Consequently, there is no voltage selector at the instrument.

WARNING

Instrument is partially energized when switched off

The power supply still uses some power even when the power switch on the front panel is turned OFF. Repair work at the detector can lead to personal injuries, e. g. shock hazard, when the detector cover is opened and the instrument is connected to power.

→ To disconnect the detector from the power line, unplug the power cord.

WARNING

Incorrect line voltage to the instrument

Shock hazard or damage to your instrumentation can result if the devices are connected to a line voltage higher than specified.

→ Connect your instrument only to the specified line voltage.

CAUTION

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

Make sure that there is easy access to the power cable of the instrument so that the instrument can quickly and easily be disconnected from the line voltage.

→ Provide sufficient space next to the power socket of the instrument to allow the cable to be unplugged.

Power Cord

Different power cords are offered as options with the system. The female ends of all power cords are identical. The female end plugs into the power-input socket at the rear left side of the instrument. 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 instrument 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 cables not supplied by Agilent

Using cables that have not been 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.

Bench Space

The dimensions and weight of the Agilent 1220 Infinity LC allow it to be placed on almost any desk or laboratory bench. It needs an additional 2.5 cm (1.0 inch) of space on either side and approximately 8 cm (3.1 inches) at the rear for air circulation and electric connections.

Make sure that the bench intended to carry the Agilent 1220 Infinity LC is designed to bear the weight of the instrument.

The Agilent 1220 Infinity LC should be operated upright.

Environment

Your Agilent 1220 Infinity LC will work within specifications at ambient temperatures and relative humidity as described in the following sections.

ASTM drift tests require a temperature change below 2 °C/hour (3.6 °F/hour) measured over one hour period. Our published drift specification is based on these conditions. Larger ambient temperature changes will result in larger drift.

Better drift performance depends on better control of the temperature fluctuations. To realize the highest performance, minimize the frequency and the amplitude of the temperature changes to below 1 °C/hour (1.8 °F/hour). Turbulences around one minute or less can be ignored.

CAUTION

Condensation within the module

Condensation will 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	30 kg 66 lbs	
Dimensions (height × width × depth)	640×370×420 mm 25.2×14.6×16.5 inches	
Line voltage	100 – 240 VAC, ± 10%	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5%	
Power consumption	240 VA / 210 W / 717 BTU	Maximum
Ambient operating temperature	0–55 °C (32–131 °F)	
Ambient non-operating temperature	-40–70 °C (-4–158 °F)	
Humidity	< 95%, at 25–40 °C (77–104 °F)	Non-condensing
Operating altitude	Up to 2000 m (6500 ft)	
Non-operating altitude	Up to 4600 m (14950 ft)	For storing the instrument
Safety standards: IEC, CSA, UL, EN	Installation Category II, Pollution Degree 2. For indoor use only.	
Housing	All materials recyclable.	

Performance Specifications

Performance Specifications Agilent 1220 Infinity LC

Table 2 Performance Specifications Agilent 1220 Infinity LC

Type	Specification
Safety features	Extensive diagnostics, error detection and display, leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in major maintenance areas.
Control and data evaluation	Agilent EZChrom Compact, Agilent ChemStation, Agilent Instrument Utilities, Agilent Lab Advisor
Communications	Controller-area network (CAN), RS-232C, APG Remote: ready, start, stop and shut-down signals, LAN
GLP features	Early maintenance feedback (EMF), electronic records of maintenance and errors

Performance Specifications Agilent 1220 Infinity LC Pump

Table 3 Performance Specifications Agilent 1220 Infinity LC Pump

Type	Specification
Hydraulic system	Dual plunger in series pump with proprietary servo-controlled variable stroke drive, floating plungers and passive inlet valve
Settable flow range	0.001 – 10 ml/min, in 0.001 ml/min increments
Flow range	0.2 – 10.0 ml/min

Table 3 Performance Specifications Agilent 1220 Infinity LC Pump

Type	Specification
Flow precision	<0.07% RSD, or < 0.02 min SD whatever is greater, based on retention time at constant room temperature
Flow accuracy	± 1% or 10 µl/min whatever is greater
Pressure	Operating range 0 – 40 MPa (0 – 400 bar, 0 – 5880 psi) up to 5 ml/min Operating range 0 – 20 MPa (0 – 200 bar, 0 – 2950 psi) up to 10 ml/min
Pressure pulsation	< 2 % amplitude (typically < 1 %), at 1 ml/min isopropanol, at all pressures > 1 MPa (10 bar)
Compressibility compensation	User-selectable, based on mobile phase compressibility
Recommended pH range	1.0 – 12.5, solvents with pH < 2.3 should not contain acids which attack stainless steel
Gradient formation (optional)	Low pressure dual mixing/gradient capability using proprietary high-speed proportioning valve Delay volume 800 – 1100 µl, dependent on back pressure
Composition Range	0 – 95 % or 5 – 100 %, user selectable
Composition Precision	< 0.2 % RSD, at 0.2 and 1 ml/min

Performance Specifications Agilent 1220 Infinity LC Autosampler

Table 4 Performance Specifications Agilent 1220 Infinity LC Autosampler

Type	Specification
Pressure	Operating range 0 – 40 MPa (0 – 400 bar, 0 – 5880 psi)
Injection range	0.1 – 100 µl in 0.1 µl increments Up to 1500 µl with multiple draw (hardware modification required)

Table 4 Performance Specifications Agilent 1220 Infinity LC Autosampler

Type	Specification
Replicate injections	1 – 99 from one vial
Precision	< 0.25% RSD from 5 – 100 µl, < 1% RSD 1 – 5 µl variable volume
Minimum sample volume	1 µl from 5 µl sample in 100 µl microvial, or 1 µl from 10 µl sample in 300 µl microvial
Carryover	Typically < 0.1%, < 0.05% with external needle cleaning
Sample viscosity range	0.2 – 50 cp
Sample capacity	100 × 2-ml vials in 1 tray 40 × 2-ml vials in ½ tray 15 × 6-ml vials in ½ tray (Agilent vials only)
Injection cycle time	Typically 50 s depending on draw speed and injection volume

Performance Specifications Agilent 1220 Infinity LC Column Oven

Table 5 Performance Specifications Agilent 1220 Infinity LC Column Oven

Type	Specification
Temperature range	5 degrees above ambient to 60 °C
Temperature stability	± 0.15 °C, constant Composition and Flow Rate
Temperature accuracy	± 0.8°C
Column capacity	one 25-cm column
Internal volume	6 µl

Performance Specifications Agilent 1220 Infinity LC VWD

Table 6 Performance Specifications Agilent 1220 Infinity LC VWD

Type	Specification	Comment
Detection type	Double-beam photometer	
Light source	Deuterium lamp	
Wavelength range	190–600 nm	
Noise	$\pm$ 0.35 $\times$ 10^{-5} AU at 230 nm	2 sec time constant, under specified conditions
Drift	3 $\times$ 10^{-4} AU/hr at 254 nm	See NOTE below the table.
Linearity	> 2 AU (5%) upper limit	See NOTE below the table.
Wavelength accuracy	± 1 nm	Self-calibration with deuterium lines, verification with holmium oxide filter
Band width	6.5 nm typical	
Flow cells	Standard: 14-µl volume, 10-mm cell path length and 40 bar (588 psi) maximum pressure High pressure: 14-µl volume, 10-mm cell path length and 400 bar (5880 psi) maximum pressure Semi-micro: 5-µl volume, 6-mm cell path length and 40 bar (588 psi) maximum pressure Micro: 2-µl volume, 3-mm cell path length and 40 bar (588 psi) maximum pressure	Can be repaired on component level

NOTE

ASTM: “Standard Practice for Variable Wavelength Photometric Detectors Used in Liquid Chromatography”.Reference conditions: cell path length 10 mm, response time 2 s, flow 1 ml/min LC-grade methanol. Linearity measured with caffeine at 272 nm nm.

2
Installation

This chapter provides an overview on shipment content and installation.

NOTE To install the Agilent 1220 Infinity LC System, it is highly recommended to follow the installation instructions step by step.

Unpacking Your System

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 Agilent 1220 Infinity LC may have been damaged during shipment.

CAUTION

Signs of damage

→ Do not attempt to install the Agilent 1220 Infinity LC.

Delivery Checklist

Ensure all parts and materials have been delivered with the Agilent 1220 Infinity LC. The delivery checklist is shown below. Please report missing or damaged parts to your local Agilent Technologies sales and service office.

Table 7 Agilent 1220 Infinity Checklist

Description	Quantity
Agilent 1220 Infinity LC	1
Power cable	1
Flow cell	Installed
Instrument Utilities DVD	1
Installation guide	1
Accessory kit (see below)	1

Accessory Kit Contents for G4288C

Table 8 Accessory Kit Contents for G4288C

Description	Part Number	Quantity
Accessory kit complete	*G4288-68755*	
Fitting, onepiece, fingertight	*0100-2562*	1
PTFE tubing, 0.052" ID	*0890-1195*	5 m
Flexible tubing (to waste)	*0890-1711*	3 m
Crossover patch cable	*5023-0203*	1
Waste accessory kit	*5062-8535*	1
PTFE/silicon septa, 16 mm, pre-slit (pack of 100)	*5188-2758*	1
Syringe, 50 µL	*5190-1501*	1
Syringe, plastic	*9301-0411*	1
Syringe adapter	*9301-1337*	1
Screw-cap vial, clear, 6 mL (pack of 100)	*9301-1377*	1
Screw caps for 6 mL vials (pack of 100)	*9301-1379*	1
Solvent reservoir, 1 L	*9301-1420*	1
Solvent reservoir, amber, 1 L	*9301-1450*	1
Bottle head assembly	*G1311-60003*	2

Accessory Kit Contents for G4290C

Table 9 Accessory Kit Contents for G4290C

Description	Part Number	Quantity
Accessory kit complete	*G4290-68755*	
Fitting, onepiece, fingertight	*0100-2562*	1
PTFE tubing, 0.052" ID	*0890-1195*	5 m

Table 9 Accessory Kit Contents for G4290C

Description	Part Number	Quantity
Flexible tubing (to waste)	*0890-1711*	3 m
Crossover patch cable	*5023-0203*	1
Waste accessory kit	*5062-8535*	1
Syringe, plastic	*9301-0411*	1
Syringe adapter	*9301-1337*	1
Solvent reservoir, 1 L	*9301-1420*	1
Solvent reservoir, amber, 1 L	*9301-1450*	1
Bottle head assembly	*G1311-60003*	2

Optional Tool Kit for Agilent 1220 Infinity LC

Table 10 Optional Tool Kit for Agilent 1220 Infinity LC

Description	Part Number	Quantity
Tool kit complete	*G4296-68715*	
Mounting tool for flangeless nut	*0100-1710*	1
Wrench, 1/4 inch to 5/16 inch	*8710-0510*	2
Wrench, open, 14 mm	*8710-1924*	1
Wrench, 1/2 inch & 9/16 inch	*8720-0025*	1
Seal insert tool	*01018-23702*	1
Hex key, 4 mm, 15 cm long, T-handle	*8710-2392*	1
Hex key, 9/64 inch, 15 cm long, T-handle	*8710-2394*	1
Hex key, 3 mm, 12 cm long	*8710-2411*	1

Table 10 Optional Tool Kit for Agilent 1220 Infinity LC

Description	Part Number	Quantity
Hex key, 2.5 mm, 12 cm long, straight handle	*8710-2412*	1
Screwdriver, Pozidriv shaft	*8710-0899*	1

LAN Configuration

To do first

The Agilent 1220 Infinity LC 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 left side of the Instrument next to the configuration switch.

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

2 Connect the instrument's LAN interface to

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

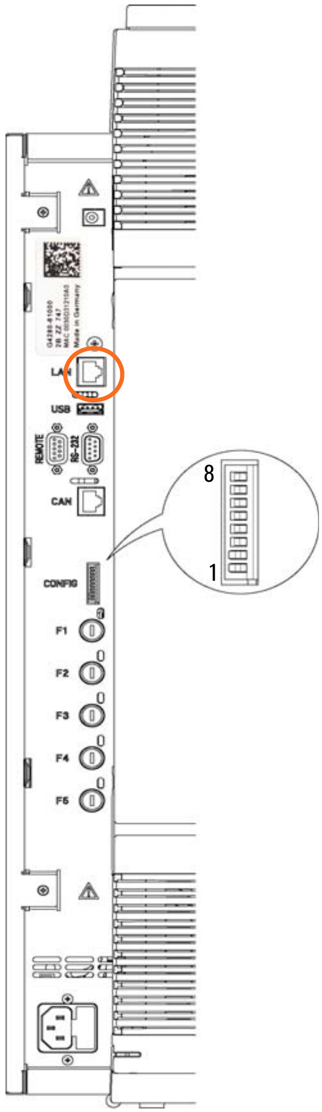


Figure 1 Location of LAN interface and MAC label

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 manually setting the parameters using Telnet

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.

Configuration Switches

The configuration switch can be accessed at the rear left side of the instrument.

The Agilent 1220 Infinity LC is shipped with switches 7 and 8 set to **ON**, which means that the instrument is set to a default fixed IP address: 192.168.254.11

NOTE To configure the LAN, SW1 and SW2 must be set to **OFF**.

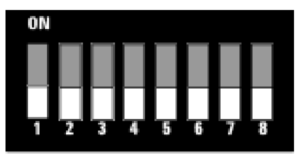
Table 11 Factory Default Settings

Initialization ('Init') Mode	Using Default, switches 7 and 8 set to **ON**.
Link Configuration	Speed and duplex mode determined by auto-negotiation

Initialization mode selection

The following initialization (init) modes are selectable:

Table 12 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

Bootp

When the initialization mode *Bootp* is selected, the Agilent 1220 Infinity LC 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 Agilent 1220 Infinity; therefore, the parameters are lost with the next power cycle of the instrument.

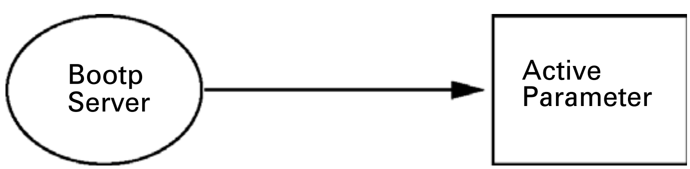


Figure 2 Bootp (Principle)

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 Agilent 1220 Infinity LC. Thus, after a power cycle they are still available. This enables a kind of *bootp once* configuration of the Agilent 1220 Infinity LC.

Example: You may not want to have a Bootp Server active in his network all the time. But, on the other hand, You may not have any configuration method other than Bootp. If this is the case you start the Bootp Server temporarily, power on the Agilent 1220 Infinity LC using the initialization mode *Bootp & Store*, wait for the Bootp cycle to be completed, close the Bootp Server and power off the Agilent 1220 Infinity LC. Then you select the *Using Stored* initialization mode and power on the Agilent 1220 Infinity LC again. From now on, you can establish the TCP/IP connection to the instrument using the parameters obtained in that single Bootp cycle.

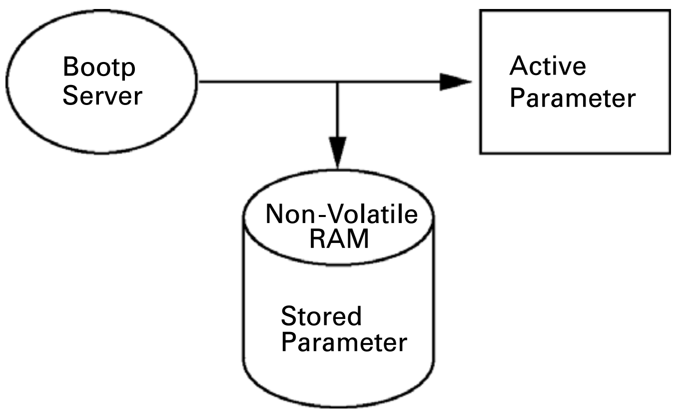


Figure 3 Bootp & Store (Principle)

NOTE Use the initialization mode *Bootp & Store* carefully, because writing to the non-volatile memory takes time. Therefore, when you want the Agilent 1220 Infinity LC to obtain its parameters from a Bootp Server each 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 Agilent 1220 Infinity LC. The TCP/IP connection is established using these parameters. The parameters must have been configured previously by one of the described methods.

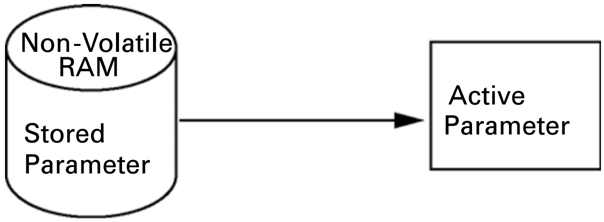


Figure 4 Using Stored (Principle)

Using Default

When *Using Default* is selected, the factory default parameters are taken. These parameters enable a TCP/IP connection to the LAN interface without further configuration.

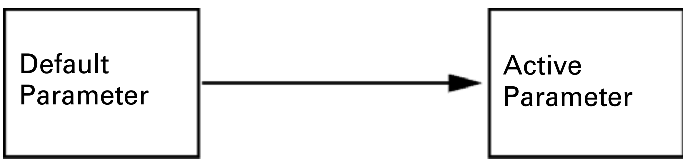


Figure 5 Using Default (Principle)

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

Table 13 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 is not routed by any network device. Thus, the PC and the Agilent 1220 Infinity LC must reside in the same subnet.

You may open a Telnet session using the default IP address and change the parameters stored in the non-volatile memory of the Agilent 1220 Infinity LC. You 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 Agilent 1220 Infinity LC is wired to the PC directly (e.g. using a cross-over cable or a local hub), separated from the local area network, you 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 Agilent 1220 Infinity LC are not cleared automatically. If you do not change them, they are still available when switching back to the *Using Stored* mode.

Link configuration selection

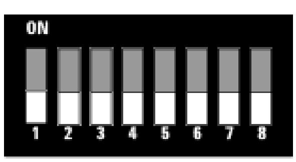
The LAN interface supports 10 or 100 Mbps operation in full- or half-duplex modes. In most cases, full-duplex is supported when the connecting network device - such as a network switch or hub - supports IEEE 802.3u auto-negotiation specifications.

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 Agilent 1220 Infinity LC 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 Agilent 1220 Infinity LC.

Table 14 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

Storing the settings permanently with Bootp

If you want to change parameters of the Compact LC using the Bootp follow the instructions below.

1. Turn off the Agilent 1220 Infinity LC.
2. Change the Configuration Switch settings of the Agilent 1220 Infinity LC to *Bootp & Store* mode.
3. Start the Agilent Bootp Service and open its window.
4. If necessary, modify the parameters for the Agilent 1220 Infinity LC according to your needs using the existing configuration.
5. Press **OK** to exit the Bootp Manager.
6. Turn on the Agilent 1220 Infinity LC and view the Bootp Server window.

   After some time the Agilent Bootp Service will display the request from the LAN interface. The parameters are now stored permanently in the non-volatile memory of the Compact LC.
7. Close the Agilent Bootp Service and turn off the Agilent 1220 Infinity LC.
8. Change the Configuration Switch settings of the Agilent 1220 Infinity LC to *Using Stored* mode.
9. Power cycle the Agilent 1220 Infinity LC.

   The Agilent 1220 Infinity LC can now be accessed via LAN without the Agilent Bootp Service.

Manual Configuration

Manual configuration alters the set of parameters stored in the non-volatile memory only of the Agilent 1220 Infinity LC; it does not affect the currently active parameters. Therefore, manual configuration can be done at any time. A power cycle is mandatory to activate the stored parameters if the initialization mode selection switches allow it.

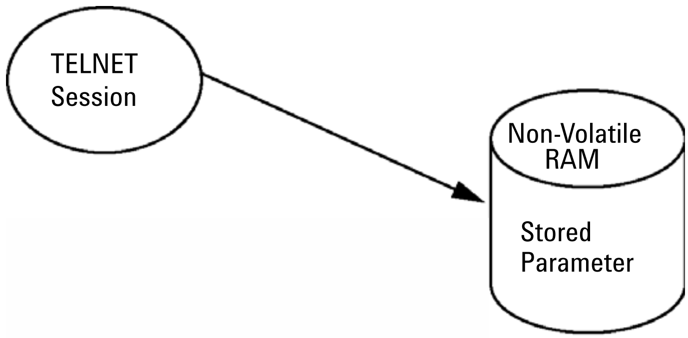


Figure 6 Manual Configuration (Principle)

With Telnet

Whenever a TCP/IP connection to the Agilent 1220 Infinity LC 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 click **OK**.

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

   - **c:\>telnet <IP address>** or
   - **c:\>telnet <host name>**

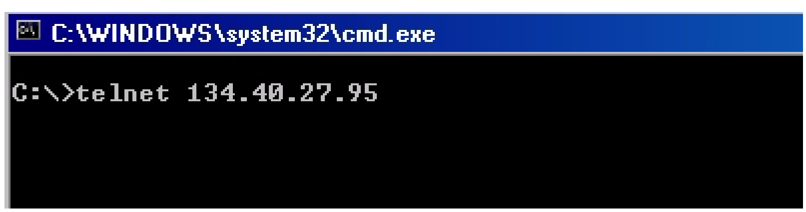


Figure 7 Telnet - Starting a session

where <IP address> may be the assigned address from a Bootp cycle or the default IP address.

When the connection was established successfully, the Agilent 1220 Infinity LC responds with the following:

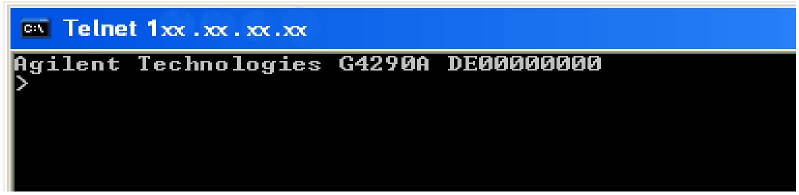


Figure 8 A connection to the module is made

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

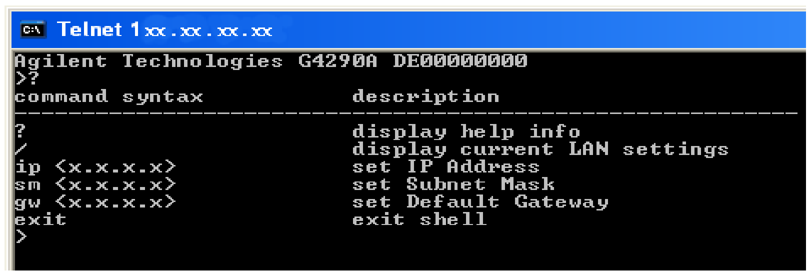


Figure 9 Telnet Commands

Table 15 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

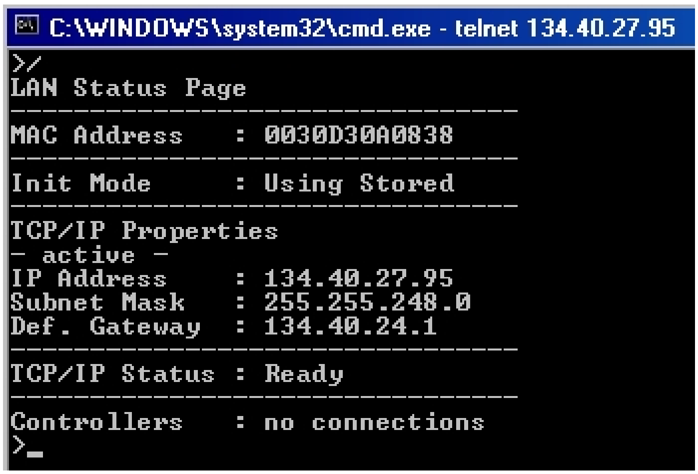
4 To change a parameter, use the syntax:

- 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.



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 10 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.

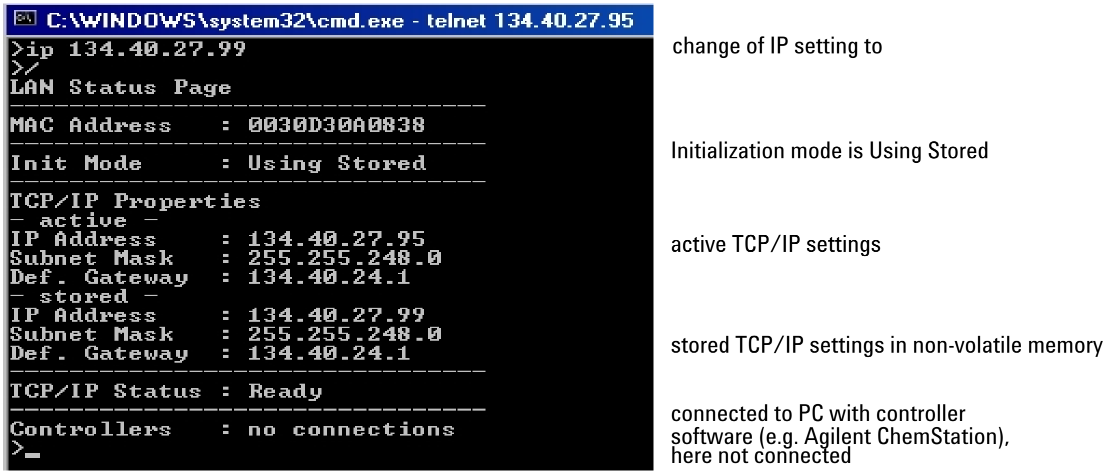


Figure 11 Telnet - Change IP settings

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

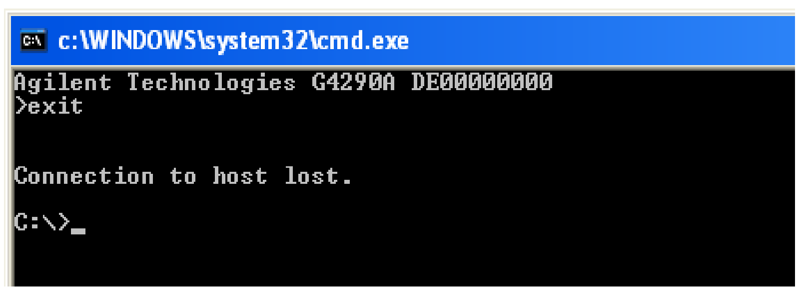


Figure 12 Closing the Telnet Session

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.

Automatic configuration with Bootp

When **automatic configuration with Bootp** is selected and the LAN interface is powered on, it broadcasts a BOOTP (Bootstrap Protocol) request that contains its MAC (hardware) address. A BOOTP server daemon searches its database for a matching MAC address, and if successful, sends the corresponding configuration parameters to the compact LC as a BOOTP reply. These parameters become the active TCP/IP parameters immediately and the TCP/IP connection can be established.

Configuring the Agilent Bootp service program

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

NOTE Ensure that the Agilent 1220 Infinity LC configuration switch is set to either **Bootp** or **Bootp & Store**.

NOTE Ensure that your instrument is powered off.

NOTE If the Agilent Bootp Service program is not already installed on your PC, install it from the folder \Bootp on your software CD-ROM.

1 The Agilent Bootp Service is placed in the start-up group and is started automatically during the boot process of the PC.
2 Open the Bootp Settings window and enter the default settings for your setup.
3 Launch the Manager.

   The Bootp Manager screen opens, showing all network hardware that has been added (initially empty).
4 Click **Add** to enter the enter the module-specific information:
   - MAC address (from the label on the instrument)
   - host name

- IP address
- comment (instrument name/location)
- subnet mask (if different)
- gateway (if required)

5 Click **OK**.

The parameters are added to the Bootp Manager and to the TabFile.

6 Click **Exit Manager** and **OK** to exit the Agilent Bootp Service.

7 Turn on the instrument, wait about 30-60 seconds and view the LogFile (see Figure 13 on page 35).

It should display the request from the detector with the hardware (MAC) address.

```
02/03/05 16:33:56 PM
Status: BOOTP Request received at outer most layer
Status: BOOTP Request received from hardware address: 0030D30A0838
Status: found 134.40.27.95 WADI1171:
Status: Host IP Address is: 134.40.29.56
Status: Reply to BOOTP Request has been sent
Status: BOOTP Request finished processing at outer most layer
```

Figure 13 LogFile - the detector has received the parameter

NOTE When using this **Bootp** mode, the parameters are not written into the non-volatile memory of the detector.

3
Agilent 1220 Infinity LC Description

This chapter provides general information about the functionality and use of the Agilent 1220 Infinity LC system and its components.

Agilent 1220 Infinity LC electronics

All electrical connectors are placed on the rear left side of the instrument.

Available connectors:

- Power connector, female end
- LAN connector (Agilent 1220 Infinity LC to controlling PC)
- CAN connectors (Agilent 1220 Infinity LC to additional Agilent 1200 Series Module)
- USB connector (for future use)
- RS232 connector
- APG Remote connector
- 12V DC Output
- 8 bit configuration switch (see "LAN Configuration" on page 22)
- 5 Main Board fuses 250Vac, T3.15A *2110-1417*
  - Fuse F1 (Degasser, Pump, Injector Motors)
  - Fuse F2 (Injector sensors, Column Oven, Ext 24V Connector)
  - Fuse F3 (Processor Core, +5V, +15V, -15V supply on Mainboard)
  - Fuse F4 (VWD incl. D2-Lamp)
  - Fuse F5 (VWD Heater, FAN)

    Next to each fuse is a LED. Red LED indicates the fuse is blown.

    If one of the fuses is blown, the green LED of the power switch flashes.
- Fuse Netfilter 250Vac, T10AH *2110-1004*

Solvent Delivery System

This chapter provides an overview on the operational principles of the Solvent Delivery System (Pump and optional Degasser).

Overview

The pump is based on a two-channel, dual-plunger in-series design that provides all essential functions that a solvent delivery system has to fulfill. Metering of solvent and delivery to the high-pressure side are performed by one pump assembly that can generate a pressure up to 400 bar.

The solvents are degassed by a vacuum degasser, and solvent compositions are generated on the low-pressure side by a high-speed proportioning valve. The dual-channel gradient pump includes a built-in dual-channel online vacuum degasser.

The pump assembly includes a pump head with an inlet valve and an outlet valve. A damping unit is connected between the two plunger chambers. A purge valve, including a PTFE frit, is fitted at the pump outlet for convenient priming of the pump head.

Degasser

The dual-channel gradient pump comes with a built-in online degasser. The degasser is switched on automatically when the pump is switched on, even if the flow is set to 0 mL/min. A constant vacuum of 75 Torr (100 mbar) is created in the vacuum chamber of the two channels. The solvent flows through a Teflon AF tube, with an internal volume of 1.5 mL/channel inside the vacuum chamber.

Principles of Operation

The liquid runs from the solvent reservoir through the degasser to the DCGV, and from there to the inlet valve. The pump assembly comprises two substantially identical plunger/chamber units. Both plunger/chamber units comprise a ball-screw drive and a pump head containing one reciprocating sapphire plunger.

A servo-controlled variable-reluctance motor drives the two ball-screw drives in opposite directions. The gears for the ball-screw drives have different circumferences (ratio 2:1), allowing the first plunger to move at twice the speed of the second plunger. The solvent enters the pump head close to the bottom limit and leaves it at its top. The outer diameter of the plunger is smaller than the inner diameter of the pump head chamber, allowing the solvent to fill the gap in between. The first plunger has a stroke volume in the range of 20–100 µL depending on the flow rate. The microprocessor controls all flow rates in a range of 1 µL–10 mL/min. The inlet of the first plunger/chamber unit is connected to the inlet valve, which is opened or closed allowing solvent to be drawn into the first plunger pump unit.

The outlet of the first plunger/chamber unit is connected through the outlet ball valve and the damping unit to the inlet of the second plunger/chamber unit. The outlet of the purge valve assembly is then connected to the chromatographic system.

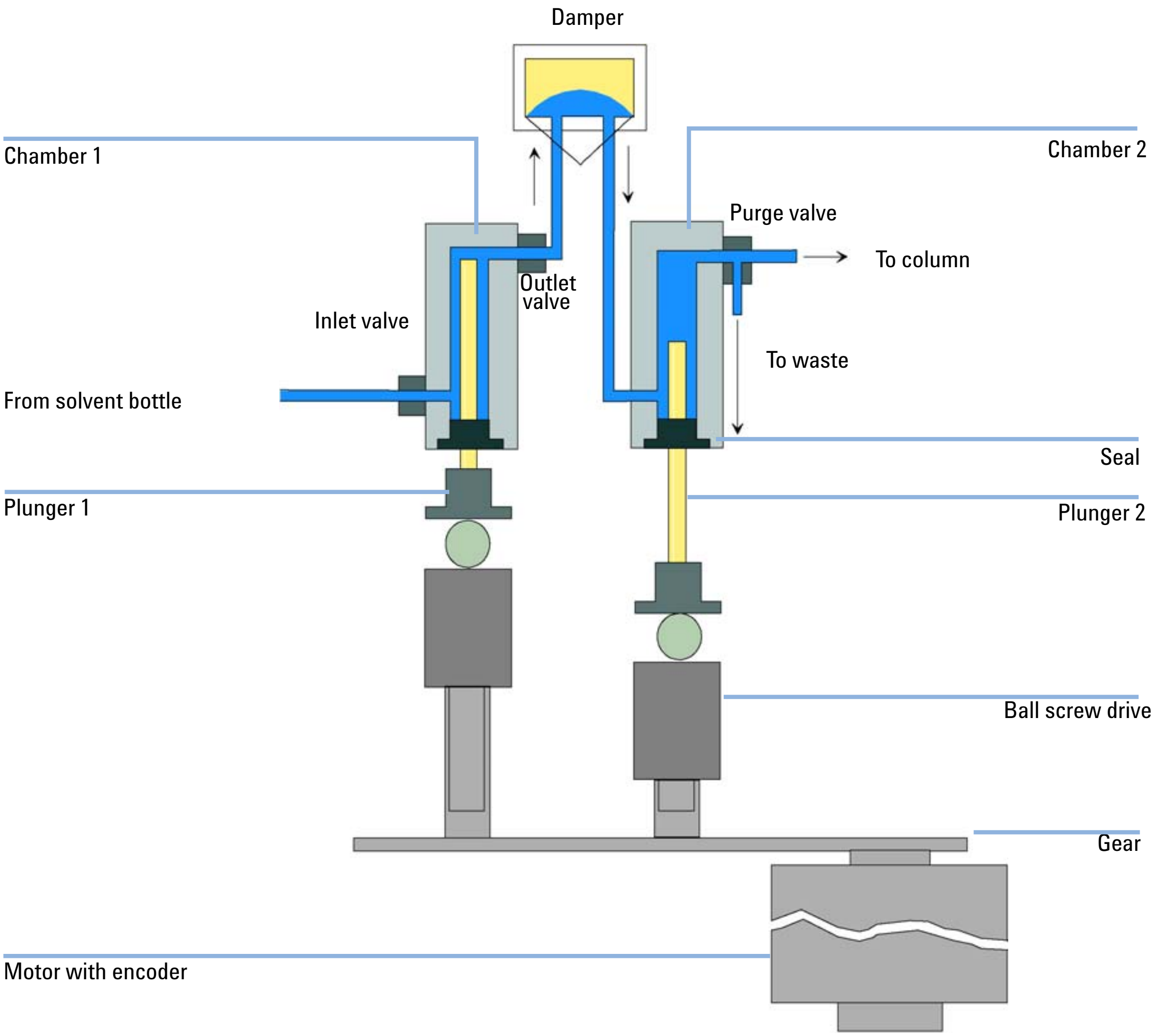


Figure 14 Principle of the pump

When turned on, the pump runs through an initialization procedure to determine the upper dead center of the first plunger. The first plunger moves slowly upwards into the mechanical stop of chamber, and from there it moves back a predetermined distance. The controller stores this plunger position in memory. After this initialization, the pump starts operation with the set parameters. The inlet valve is opened and the down-moving plunger draws solvent into the first chamber. At the same time, the second plunger moves upwards, delivering into the system. After a controller-defined stroke length (depending on the flow rate), the drive motor is stopped and the inlet valve is closed. The motor direction is reversed and moves the first plunger up until it reaches the stored upper limit and at the same time moves the second plunger downwards. The sequence then starts again, moving the plungers up and down between the two limits. During the up movement of the first plunger, the solvent in the chamber is pushed through the outlet ball valve into the second chamber. The second plunger draws in half of the volume displaced by the first plunger and the remaining half volume is directly delivered into the system. During the drawing stroke of the first plunger, the second plunger delivers the drawn volume into the system.

For solvent compositions from the solvent bottles A and B, the controller divides the length of the intake stroke into certain fractions in which the gradient valve connects the specified solvent channel to the pump input.

Table 16 Gradient Pump Details

Delay volume	800 – 1100 µL, dependent on back pressure
Materials in contact with mobile phase	
MCGV	PTFE
Pump head	SST, gold, sapphire, ceramic
Active inlet valve	SST, gold, sapphire, ruby, ceramic, PTFE
Outlet valve	SST, gold, sapphire, ruby
Adapter	SST, gold
Purge valve	SST, gold, PTFE, ceramic, PEEK
Damping unit	Gold, SST
Degasser chamber	TFE/PDD Copolymer, FEP, PEEK, PPS

Compressibility Compensation

Principles of compressibility compensation

The compressibility of the solvents in use affects retention-time stability when the back pressure in the system changes (for example, ageing of the column). To minimize this effect, the pump provides a compressibility compensation feature that optimizes the flow stability according to the solvent type. The compressibility compensation is set to a default value and can be changed through the user interface.

Without compressibility compensation, the following happens during a stroke of the first plunger: the pressure in the plunger chamber increases and the volume in the chamber is compressed, depending on backpressure and solvent type. The volume displaced into the system is reduced by the compressed volume.

When a compressibility value is set, the processor calculates a compensation volume that is depending on the backpressure in the system and the selected compressibility. This compensation volume is added to the normal stroke volume and compensates for the previously described *loss* of volume during the delivery stroke of the first plunger.

Optimizing the compressibility compensation setting

The default compressibility compensation setting is 46×10^{-6} /bar. This setting represents an average value. Under normal conditions, the default setting reduces the pressure pulsation to values (below 1% of system pressure) that are sufficient for most applications and for all gradient analyses. For applications using sensitive detectors, the compressibility settings can be optimized by using the values for the various solvents. If the solvent in use is not listed in the compressibility tables, when using isocratic mixtures of solvents and if the default settings are not sufficient for your application, the following procedure can be used to optimize the compressibility settings.

NOTE When using mixtures of solvents, it is not possible to calculate the compressibility of the mixture by interpolating the compressibility values of the pure solvents used in that mixture or by applying any other calculation. In these cases, the following empirical procedure has to be applied to optimize your compressibility setting.

1 Start the pump with the required flow rate.
2 Before starting the optimization procedure, the flow must be stable. Use degassed solvent only. Check the tightness of the system with the pressure test.
3 Your pump must be connected to control software with which the pressure and %-ripple can be monitored.
4 The compressibility compensation setting that generates the smallest pressure ripple is the optimum value for your solvent composition.

Table 17 Solvent Compressibility

Solvent (pure)	Compressibility (10^{-6}/bar)
Acetone	126
Acetonitrile	115
Benzene	95
Carbon tetrachloride	110
Chloroform	100
Cyclohexane	118
Ethanol	114
Ethyl acetate	104
Heptane	120
Hexane	150
Isobutanol	100
Isopropanol	100
Methanol	120
1-Propanol	100
Toluene	87
Water	46

Variable Stroke Volume

Due to the compression of the pump-chamber volume, each plunger stroke of the pump generates a small pressure pulsation, influencing the flow ripple of the pump. The amplitude of the pressure pulsation is dependent mainly on the stroke volume and the compressibility compensation for the solvent in use. Small stroke volumes generate pressure pulsations of smaller amplitude than larger stroke volumes at the same flow rate. In addition, the frequency of the pressure pulsations are higher. This decreases the influence of flow pulsations on quantitative results.

In gradient mode, smaller stroke volumes result in less flow ripple and improve composition ripple.

The pump uses a processor-controlled spindle system to drive its plungers. The normal stroke volume is optimized for the selected flow rate. Low flow rates use a small stroke volume, while higher flow rates use a larger stroke volume.

When the stroke volume for the pump is set to AUTO mode, the stroke is optimized for the flow rate in use. A change to larger stroke volumes is possible but not recommended.

Using the Pump

Hints for successful use of the Agilent 1220 Infinity LC pump

- When using salt solutions and organic solvents in the Agilent 1120 Infinity LC pump, it is recommended to connect the salt solution to one of the lower gradient valve ports and the organic solvent to one of the upper gradient valve port. It is best to have the organic channel directly above the salt solution channel. Regular flushing with water of all DCGV channels is recommended to remove all possible salt deposits in the valve ports.
- Before operating the pump, flush the vacuum degasser (optional) with at least two volumes (3 ml), especially when the pump has been turned off for some 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 filter). Growth of algae should be avoided.
- Check the purge valve frit and column frit regularly. A blocked purge valve frit can be identified by black or yellow layers on its surface, or by a pressure greater than 10 bar when pumping distilled water at a rate of 5 ml/min with an open purge valve.
- When using the pump at low flow rates (for example, 0.2 ml/min), check all 1/16-inch fittings for any signs of leaks.
- When exchanging the pump seals, also exchange the purge valve frit.
- When using buffer solutions, flush the system with water before switching it off.
- Check the pump plungers for scratches when changing the plunger seals. Scratched plungers will lead to micro leaks and will decrease the lifetime of the seal.
- After changing the plunger seals, pressurize the system according to the wear-in procedure.

Preventing blockage of solvent filters

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

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

NOTE Never use the system without a solvent filter installed.

Injection System

This chapter provides an overview of the operational principles of the Injection Systems: Manual Injector and Autosampler.

Manual Injector

The Agilent 1220 Infinity LC manual injector uses a Rheodyne, 6-port sample injection valve (part number *5067-4202*). Sample is loaded into the external 20-µl sample loop through the injection port at the front of the valve. The valve has a PEEK™ injection seal. A make-before-break passage in the stator ensures flow is not interrupted when the valve is switched between the INJECT and LOAD positions, and back again.

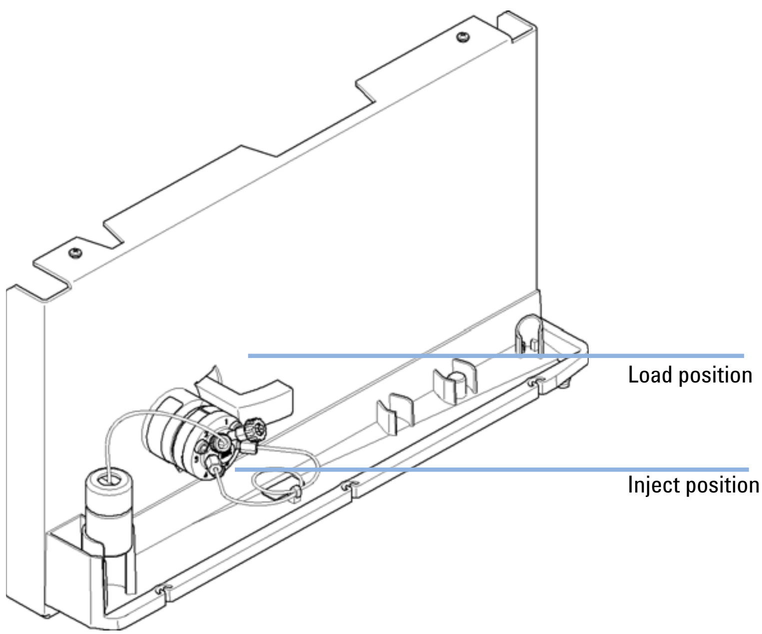


Figure 15 Rheodyne 6-port sample injection valve

Using the Manual Injector

The Injection Seal

The manual injector is supplied with a PEEK™ injection seal as standard.

Injecting Sample

WARNING

Ejection of mobile phase

When using sample loops larger than 100 µl, mobile phase may be ejected from the needle port as the mobile phase in the sample loop decompresses.

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

LOAD Position

In the LOAD position (see Figure 16 on page 48), the pump is connected directly to the column (ports 2 and 3 connected), and the needle port is connected to the sample loop. At least 2 to 3 sample-loop volumes (more if better precision is required) of sample should be injected through the needle port to provide good precision. The sample fills the loop, and excess sample is expelled through the vent tube connected to port 6.

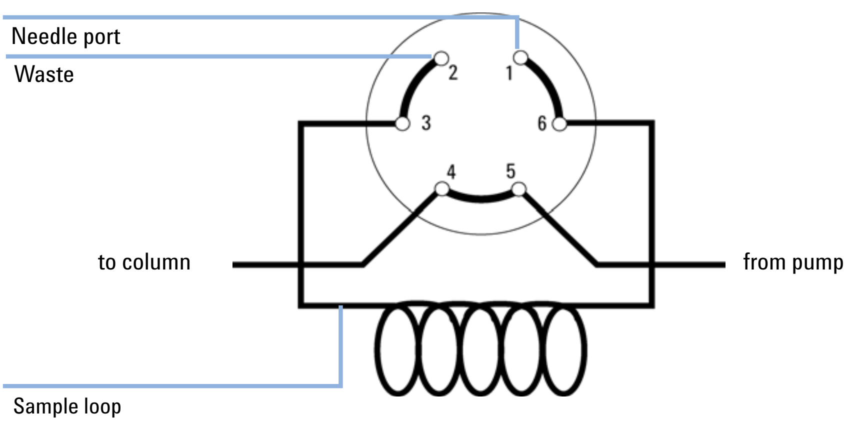


Figure 16 LOAD Position

INJECT Position

In the INJECT position (see Figure 17 on page 49), the pump is connected to the sample loop (ports 1 and 2 connected). All of the sample is washed out of the loop onto the column. The needle port is connected to the vent tube (port 5).

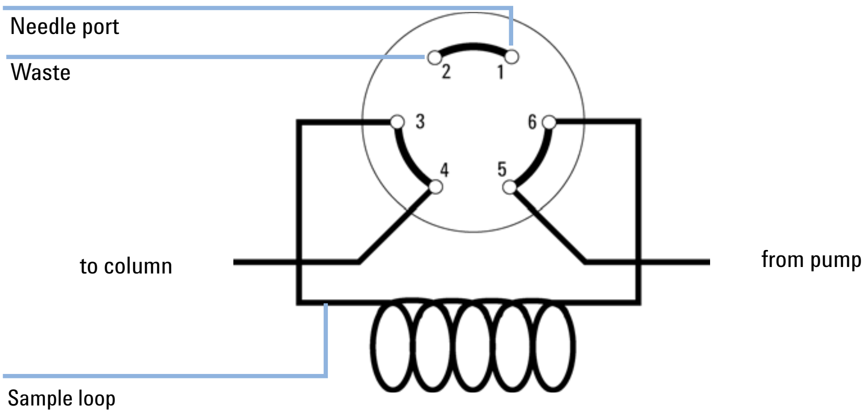


Figure 17 INJECT Position

Needles

CAUTION

Needle can damage valve

→ Always use the correct size needle.

The manual injector is not supplied with syringes or needles.

Use needles with 0.028-inch outer diameter (22 gauge) × 2-inch long needle, without electro-taper, and with 90° point style (square tip).

Autosampler

Introduction to the Autosampler

Three sample-rack sizes are available for the autosampler. The standard full-size rack holds 100 × 1.8 ml vials, while the two half-size racks provide space for 40 × 1.8 ml vials and 15 × 6 ml vials respectively. Any two half-size rack trays can be installed in the autosampler simultaneously.

The autosamplers transport mechanism uses an X-Z-Theta movement to optimize vial pick-up and return. Vials are picked up by the gripper arm, and positioned below the sampling unit. The gripper transport mechanism and sampling unit are driven by motors. Movement is monitored by optical sensors and optical encoders to ensure correct operation. The metering device is always flushed after injection to ensure minimum carry-over.

The analytical head device provides injection volumes from 0.1 – 100 µl.

The six-port injection valve unit (only 5 ports are used) is driven by a high-speed hybrid stepper motor. During the sampling sequence, the valve unit bypasses the autosampler, and directly connects the flow from the pump to the column. During injection and analysis, the valve unit directs the flow through the autosamplers which ensures that the sample is injected completely into the column, and that any sample residue is removed from the metering unit and needle from before the next sampling sequence begins.

Sampling Sequence

The movements of the autosampler components during the sampling sequence are monitored continuously by the autosampler processor. The processor defines specific time windows and mechanical ranges for each movement. If a specific step of the sampling sequence can't be completed successfully, an error message is generated.

Solvent is bypassed from the autosamplers by the injection valve during the sampling sequence. The sample vial is selected by a gripper arm from a static sample rack, or from external vial positions. The gripper arm places the sample vial below the injection needle. The required volume of sample is drawn into the sample loop by the metering device. Sample is applied to the column when the injection valve returns to the mainpass position at the end of the sampling sequence.

The sampling sequence occurs in the following order:

1 The injection valve switches to the bypass position.
2 The plunger of the metering device moves to the initialization position.
3 The gripper arm moves from the home position, and selects the vial. At the same time, the needle lifts out of the seat.
4 The gripper arm places the vial below the needle.
5 The needle lowers into the vial.
6 The metering device draws the defined sample volume.
7 The needle lifts out of the vial.
8 If the automated needle wash is selected, the gripper arm replaces the sample vial, positions the wash vial below the needle, lowers the needle into the vial, then lifts the needle out of the wash vial.
9 The gripper arm checks if the safety flap is in position.
10 The gripper arm replaces the vial, and returns to the home position. Simultaneously, the needle lowers into the seat.
11 The injection valve switches to the mainpass position.

Injection Sequence

Before the start of the injection sequence, and during an analysis, the injection valve is in the mainpass position. In this position, the mobile phase flows through the autosamplers metering device, sample loop, and needle, ensuring all parts in contact with sample are flushed during the run, thus minimizing carry-over.

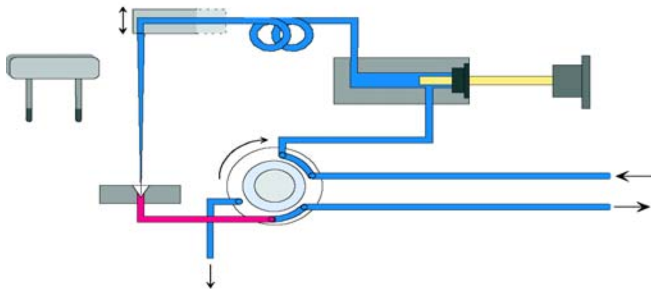


Figure 18 Mainpass Position

When the sample sequence begins, the valve unit switches to the bypass position. Solvent from the pump enters the valve unit at port 1, and flows directly to the column through port 6.

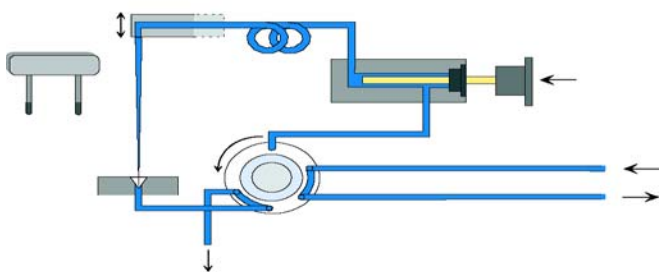


Figure 19 Bypass Position

Next, the needle is raised, and the vial is positioned below the needle. The needle moves down into the vial, and the metering unit draws the sample into the sample loop.

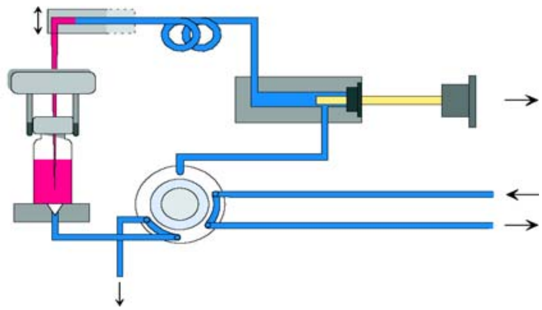


Figure 20 Drawing the Sample

When the metering unit has drawn the required volume of sample into the sample loop, the needle is raised, and the vial is replaced in the sample tray. The needle is lowered into the needle seat, and the injection valve switches back to the mainpass position, flushing the sample onto the column .

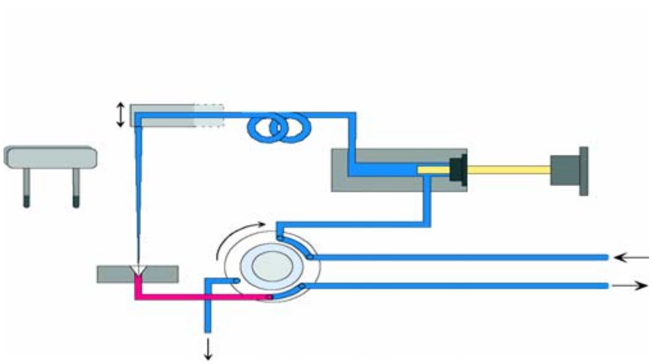


Figure 21 Mainpass Position (Sample Injection)

Sampling Unit

The sampling unit comprises three main assemblies: needle drive, metering device, and injection valve.

NOTE The replacement sampling unit excludes the injection valve and metering head assemblies.

Needle-Drive

The needle movement is driven by a stepper motor connected to the spindle assembly by a toothed belt. The circular motion of the motor is converted to linear motion by the drive nut on the spindle assembly. The upper and lower needle positions are detected by reflection sensors on the sampling unit flex board, while the needle-in-vial position is determined by counting the motor steps from the upper needle-sensor position.

Analytical head

The analytical head is driven by the stepper motor connected to the drive shaft by a toothed belt. The drive nut on the spindle converts the circular movement of the spindle to linear motion. The drive nut pushes the sapphire plunger against the tension of the spring into the analytical head. The base of the plunger sits on the large bearing of the drive nut, which ensures the plunger is always centered. A ceramic ring guides the movement of the plunger in the analytical head. The home position of the plunger is sensed by an infra-red sensor on the sampling unit flex board, while the sample volume is determined by counting the number of steps from the home position. The backward movement of the plunger (driven by the spring) draws sample from the vial.

Table 18 Analytical Head Technical Data

	Standard (100 µl)
Number of steps	15000
Volume resolution	7 nl/motor step
Maximum stroke	100 µl
Pressure limit	400 bar
Plunger material	Sapphire

Injection-Valve

The two-position 6-port injection valve is driven by a stepper motor. Only five of the six ports are used (port 3 is not used). A lever/slider mechanism transfers the movement of the stepper motor to the injection valve. Two microswitches monitor switching of the valve (bypass and mainpass end positions).

No valve adjustments are required after replacing internal components.

Table 19 Injection-Valve Technical Data

	Standard
Motor type	4 V, 1.2 A stepper motor
Seal material	Vespel™ (Tefzel™ available)
Number of ports	6
Switching time	< 150 ms

Transport Assembly

The transport unit comprises an X-axis slide (left-right motion), a Z-axis arm (up-down motion), and a gripper assembly (rotation and vial-gripping).

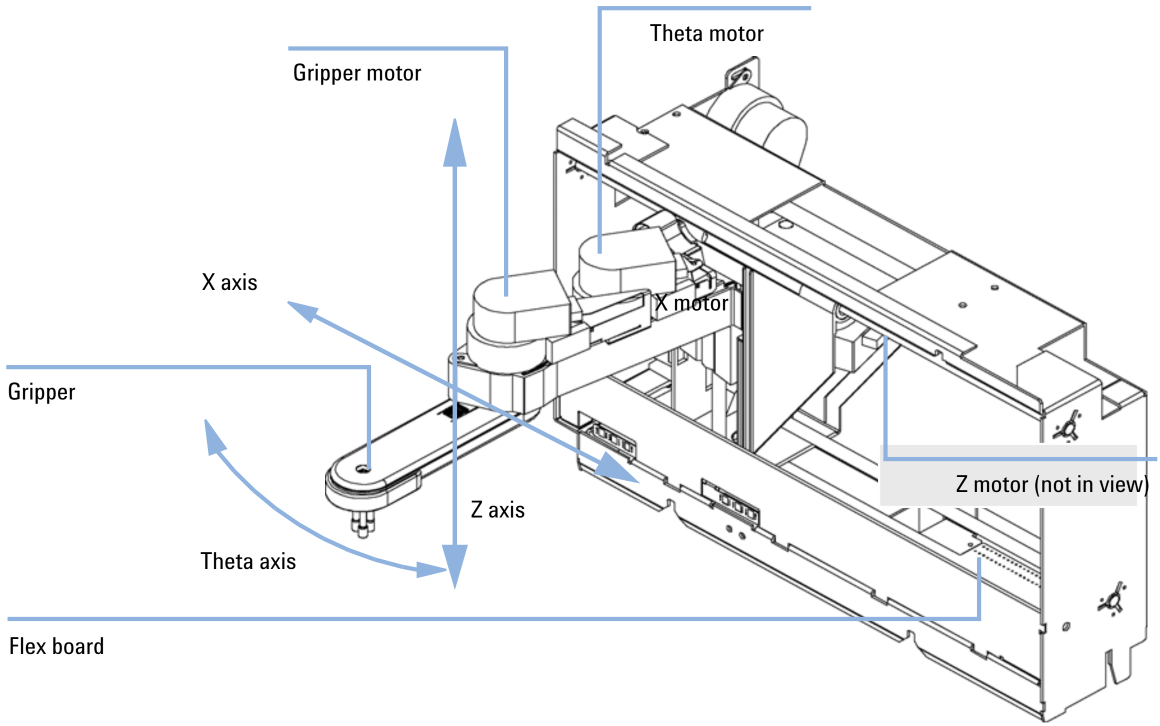


Figure 22 Transport Assembly

The transport assembly uses four stepper motors driven in closed-loop mode for accurate positioning of the gripper assembly for sample-vial transport. The rotational movement of the motors is converted to linear motion (X- and Z-axes) by toothed belts connected to the drive spindles. The rotation (theta axes) of the gripper assembly is transferred from the motor by a toothed belt and series of gears. The opening and closing of the gripper fingers are driven by a stepper motor linked by a toothed belt to the planetary gearing inside the gripper assembly.

The stepper motor positions are determined by the optical encoders mounted onto the stepper-motor housing. The encoders monitor the position of the motors continually, and correct for position errors automatically (e.g. if the gripper is accidentally moved out of position when loading vials into the vial tray). The initialization positions of the moving components are sensed by reflection sensors mounted on the flex board. These positions are used by the processor to calculate the actual motor position. An additional six reflection sensors for tray recognition are mounted on the flex board at the front of the assembly.

Using the Autosampler

Supported trays for the autosampler

Table 20 Supported trays for the Autosampler

Description	Part Number
Tray for 100 x 2 ml vials	G1313-44510
Halftray for 15 x 6 ml vials	G1313-44513
Halftray for 40 x 2 ml vials	G1313-44512

Half-tray combinations

Half-trays can be installed in any combination enabling both 2 ml-and 6 ml-vials to be used simultaneously.

Numbering of vial positions

The standard 100-vial tray has vial positions 1 to 100. However, when using two half-trays, the numbering convention is slightly different. The vial positions of the right-hand half tray begin at position 101 as follows:

Left-hand 40-position tray: 1 - 40

Left-hand 15-position tray: 1–15

Right-hand 40-position tray: 101–140

Right-hand 15-position tray: 101–115

Choice of Vials and Caps

For reliable operation, vials used with the Agilent 1220 Infinity LC autosampler must not have tapered shoulders or caps that are wider than the body of the vial. The vials and caps shown with their part numbers in the tables below have been successfully tested using a minimum of 15,000 injections with the Agilent 1220 Infinity LC autosampler.

Table 21 Crimp Top Vials

Description	Volume (ml)	100/Pack	1000/Pack	100/Pack (silanized)
Clear glass	2	5181-3375	5183-4491	
Clear glass, write-on spot	2	5182-0543	5183-4492	5183-4494
Amber glass, write-on spot	2	5182-3376	5183-4493	5183-4495
Polypropylene, wide opening	1	5182-0567		5183-4496
Polypropylene, wide opening	0.3		9301-0978	

Table 22 Snap Top Vials (continued)

Description	Volume (ml)	100/Pack	1000/Pack	100/Pack (silanized)
Clear glass	2	5182-0544	5183-4504	5183-4507
Clear glass, write-on spot	2	5182-0546	5183-4505	5183-4508
Amber glass, write-on spot	2	5182-0545	5183-4506	5183-4509

Table 23 Screw Top Vials

Description	Volume (ml)	100/Pack	1000/Pack	100/Pack (silanized)
Clear glass	2	5182-0714	5183-2067	5183-2070
Clear glass, write-on spot	2	5182-0715	5183-2068	5183-2071
Amber glass, write-on spot	2	5182-0716	5183-2069	5183-2072

Table 24 Crimp Caps

Description	Septa	100/Pack
Silver aluminum	Clear PTFE/red rubber	5181-1210
Silver aluminum	Clear PTFE/red rubber	5183-4498 (1000/Pack)
Blue aluminum	Clear PTFE/red rubber	5181-1215
Green aluminum	Clear PTFE/red rubber	5181-1216
Red aluminum	Clear PTFE/red rubber	5181-1217

Table 25 Snap Caps

Description	Septa	100/Pack
Clear polypropylene	Clear PTFE/red rubber	5182-0550
Blue polypropylene	Clear PTFE/red rubber	5182-3458
Green polypropylene	Clear PTFE/red rubber	5182-3457
Red polypropylene	Clear PTFE/red rubber	5182-3459

Table 26 Screw Caps

Description	Septa	100/Pack
Blue polypropylene	Clear PTFE/red rubber	5182-0717
Green polypropylene	Clear PTFE/red rubber	5182-0718
Red polypropylene	Clear PTFE/red rubber	5182-0719
Blue polypropylene	Clear PTFE/silicone	5182-0720
Green polypropylene	Clear PTFE/silicone	5182-0721
Red polypropylene	Clear PTFE/silicone	5182-0722

Column Oven

The column oven is based on a resistor heater matt with two thermal sensors to provide constant temperature in the whole column area. A build in over temperature cut off fuse inhibits overheating.

The inner volume of the oven capillary is 6µl.

Maximum column length is 25cm (10 inch).

Operational range is 5 degree above ambient, at least 10 °C up to 60 °C, max specified flow rate is 5ml/min at 60 °C.

NOTE Never operate the column oven with open front cover, to ensure a correct column temperature always operate with closed front cover. The counterpart of the oven isolation is fixed at the inner side of the front cover.

Detector

Detector

The Agilent 1220 Infinity LC variable wavelength detector is designed for highest optical performance, GLP compliance and easy maintenance, with:

- Deuterium lamp for highest intensity and lowest detection limit over a wavelength range of 190 to 600 nm,
- Optional flow-cell cartridges (standard: 10 mm 14 µl, high pressure: 10 mm 14 µl, micro: 3 mm 2 µl, semi-micro: 6 mm 5 µl) are available and can be used depending on the application needs,
- Easy front access to lamp and flow cell for fast replacement, and
- Built-in holmium oxide filter for fast wavelength accuracy verification.

Match the Flow Cell to the Column

Figure 23 on page 62 shows recommendations for flow cells that match the column used. If more than one selection is appropriate, use the larger flow cell to get the best detection limit. Use the smaller flow cell for best peak resolution.

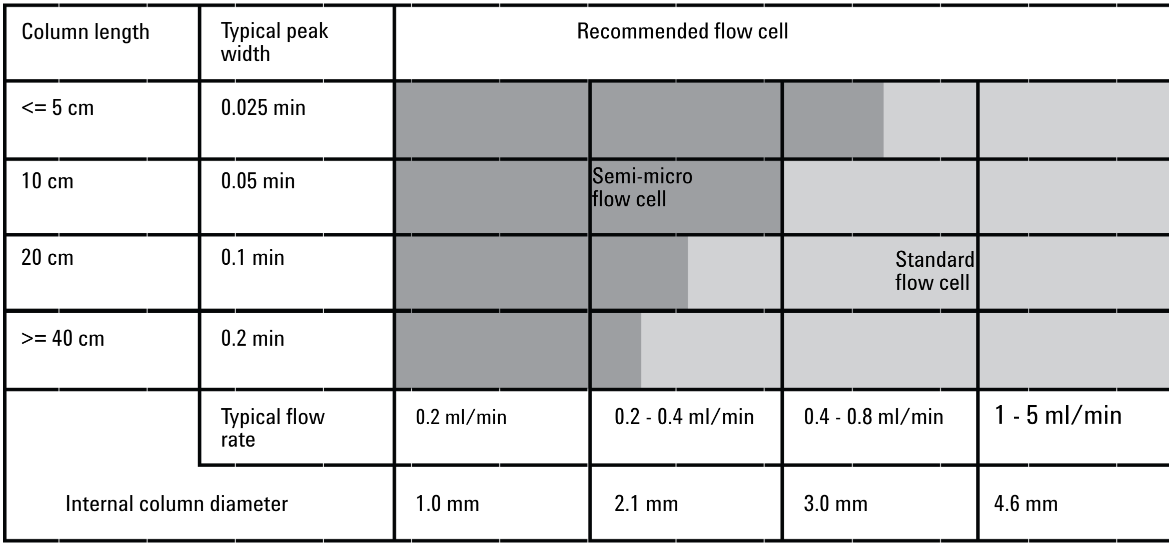


Figure 23 Choosing a Flow Cell

Flow Cell Path Length

Lambert-Beer's law shows a linear relationship between the flow cell path length and absorbance.

$$\text{Absorbance} = -\log T = \log\frac{I_0}{I} = \varepsilon \cdot C \cdot d$$

where

T is the transmission, defined as the quotient of the intensity of the transmitted light I divided by the intensity of the incident light, I_0,

e is the extinction coefficient, which is a characteristic of a given substance under a precisely-defined set of conditions of wavelength, solvent, temperature and other parameters,

C is the concentration of the absorbing species (usually in g/l or mg/l), and

d is the path length of the cell used for the measurement.

Therefore, flow cells with longer path lengths yield higher signals. Although noise usually increases a little with increasing path length, there is a gain in signal-to-noise ratio. For example, the noise increases by less than 10 %, but a 70 % increase in signal intensity is achieved by increasing the path length from 6 mm to 10 mm.

When increasing the path length, the cell volume usually increases — in our example, from 5 to 13 µl. Typically, this causes more peak dispersion. As Figure 24 on page 63 demonstrates, this does not affect the resolution in the gradient separation in our example.

As a rule-of-thumb, the flow cell volume should be about 1/3 of the peak volume at half height. To determine the volume of your peaks, take the peak width as reported in the integration results, multiply it by the flow rate and divide it by 3.

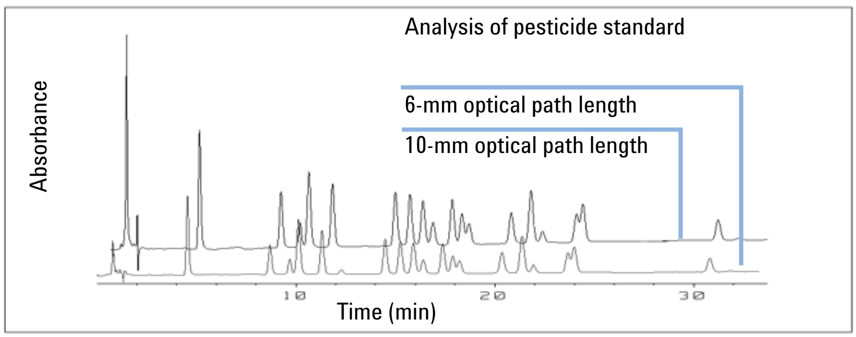


Figure 24 Influence of Cell Path Length on Signal Height

Traditionally, LC analysis with UV detectors is based on comparing measurements with internal or external standards. To check photometric accuracy of the Agilent 1220 Infinity LC VWD, it is necessary to have more precise information on path lengths of the VWD flow cells.

The correct response is:

expected response * correction factor

Details of the Agilent 1220 Infinity LC VWD flow cells are shown in Table 27 on page 64.

Table 27 Correction factors for Agilent VWD flow cells

Flow cell type	Cell volume	Part number	Path length (nominal)	Path length (actual)	Correction factor
Standard flow cell	14 µl	G1314-60086	10 mm	10.15 ± 0.19 mm	10/10.15
Semi-micro flow cell	5 µl	G1314-60083	6 mm	6.10 ± 0.19 mm	6/6.10
Micro flow cell	2 µl	G1314-60087	3 mm	2.80 ± 0.19 mm	3/2.8
High Pressure flow cell	14 µl	G1314-60082	10 mm	10.00 ± 0.19 mm	6/5.75

NOTE Be aware that there are additional tolerance of gasket thickness and its compression ratio, which are considered to be very small in comparison with the machining tolerance.

4
Test Functions and Calibration

This chapter describes the tests, calibrations and tools that are available with the Instrument Utilities software or the Lab Advisor.

Agilent 1220 Infinity LC System

Installation Check

The **Installation Check** switches on all available modules, purges the system for five minutes at 1 mL/min, tests the flow path by applying a pressure up to 200 bar and switches on the oven (if available) and detector.

NOTE The pump and detector are mandatory for this check; the oven and autosampler are optional.

The installation check passes if the following conditions are met:

- All modules switch on successfully within the timeout period (120 seconds).
- The pump achieves 200 bar after 5 minutes.
- The oven reaches 2°K above its actual temperature.
- The detector lamp ignites and the detector reaches a **Ready** state.

Module Info

Module Info Description

The **Module Info** tool collects diagnostic information from a module and writes the resuls to a file. You can view the results in three tabs:

General

The **General** tab shows information about the module's firmware and options in a two-column table.

Tables

The **Tables** tab allows you to display the contents of all available diagnostic tables for the module. You click the *[+]* sign to open a table, or the *[-]* sign to close an open table.

Signals

The **Signals** tab shows the plots of the available diagnostic signals from the module. The signal plots that are available are module-dependent; where available, both short-term and long-term plots are displayed for a signal.

Displaying Module Info

To display the information for a selected module:

1 Select **Tools** from the explorer pane. The **Tools** screen shows all available modules for the current instrument.
2 In the **Tools** screen, select the module for which you want to display information from the **Module Selection** pane.
3 In the **Tools Selection** pane, select **Module Info**.
4 Click **Start**. The module information for the selected module is displayed.

State Info

The **State Info** tool displays the current status of all Agilent 1220 Infinity LC modules; the status is continuously updated. Unless aborted, the tool runs continuously for 60 minutes. You click **Abort** to stop the tool.

Solvent Delivery System

Leak Test

Isocratic Pump Leak Test

Isocratic Pump Leak Test Description

The leak test is a built-in troubleshooting test designed to demonstrate the leak-tightness of the pump. The test involves monitoring the pressure profile as the pump runs through a predefined pumping sequence. The resulting pressure profile provides information about the pressure tightness and operation of the pump components.

Ramp 1:

After initialization, plunger 2 is at the top of its stroke. The test begins with plunger 1 delivering with a stroke length of 100 µl and a flow of 153 µl/min. The plunger sequence during the pressure ramp is 1-2-1-2.

Plateau 1:

Plunger 2 continues to pump with a flow rate of 2 µl/min for approximately one minute.

Ramp 2:

The flow is changed to 153 µl/min, and plunger 2 continues to deliver for the rest of its stroke. Then plunger 1 continues to pump to complete the second half of the ramp.

Plateau 2:

The flow is reduced to 2 µl/min for approximately one minute (plunger 1 still delivering).

Ramp 3:

The flow increases to 220 µl/min and the stroke is changed to 100 µl. Plunger 1 completes its stroke. Next, the flow is changed to 510 µl/min. The ramp reaches 390 bar with the plunger sequence 2-1-2-1.

Plateau 3:

When the system pressure reaches 390 bar, the flow is reduced to zero, and the pressure stabilizes just below 400 bar.

1 min after reaching the maximum pressure, the pressure drop should not exceed 2 bar/min.

Running the Isocratic Pump Leak Test

When If problems with the pump are suspected

Tools required Wrench 1/4 inch

Parts required

#	p/n	Description
1	G1313-87305	Restriction Capillary
1	01080-83202	Blank nut
1		500 ml Isopropanol

Preparations

- Place a bottle of LC-grade isopropyl alcohol in the solvent cabinet and connect its solvent tube to the active inlet valve of the pump.

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

Running the test from the Agilent Lab Advisor

1 Select the leak test from the test selection menu.
2 Start the test and follow the instructions.

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

NOTE Evaluating the Results describes the evaluation and interpretation of the leak test results (“Evaluating the Results” on page 71).

NOTE For detailed instructions refer to the Agilent Lab Advisor tool.

Evaluating the Results

Defective or leaky components in the pump head lead to changes in the leak-test pressure plot. Typical failure modes are described below.

NOTE Please notice the difference between an **error** in the test and a **failure** of the test! An **error** means that during the operation of the test there was an abnormal termination. If a test **failed**, this means that the results of the test were not within the specified limits.

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

Table 28 No Pressure increase at Ramp 1

Potential Cause	*Corrective Action*
Pump not running.	Check the logbook for error messages.
Purge valve open.	Close the purge valve, and restart the test.
Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
Wrong solvent-line connections.	Ensure the solvent lines from the degasser are connected correctly.
Contaminated purge valve.	Open and close purge valve to flush out contamination. Exchange the valve if still leaky.
Large leaks (visible) at the pump seals.	Exchange the pump seals.
Large leaks (visible) at active inlet valve, outlet valve, or purge valve.	Ensure the leaky components are installed tightly. Exchange the component if required.

Table 29 Pressure limit not reached but plateaus horizontal or positive

Potential Cause	*Corrective Action*
Degasser and pump not flushed sufficiently (air in the pump head).	Purge the degasser and pump thoroughly with isopropanol under pressure (use the restriction capillary).
Wrong solvent.	Install isopropanol. Purge the degasser and pump thoroughly.

Table 30 All plateaus negative

Potential Cause	*Corrective Action*
Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
Loose purge valve.	Tighten the purge valve (14mm wrench).
Contaminated purge valve.	Open and close purge valve to flush out contamination. Exchange the valve if still leaky.
Loose pump head screws.	Ensure the pump head screws are tight.
Leaking seals or scratched plungers.	Exchange the pump seals. Check the plungers for scratches. Exchange if scratched.
Leaking outlet valve.	Exchange the outlet valve.
Leaky damper.	Exchange damper.

Table 31 First plateau positive, second and third plateau negative

Potential Cause	*Corrective Action*
Air in pump or new seals not yet seated.	Flush pump thoroughly with isopropanol under pressure (use restriction capillary).
Loose active inlet valve.	Tighten the active inlet valve (14mm wrench). Do not overtighten!
Loose pump head screws.	Ensure the pump head screws are tight.
Loose outlet valve.	Ensure the sieve in the outlet valve is installed correctly. Tighten the outlet valve.

Table 31 First plateau positive, second and third plateau negative

Leaking seal or scratched plunger.	Exchange the pump seals. Check the plungers for scratches. Exchange if scratched.
Defective active inlet valve.	Exchange the active inlet valve.

Table 32 First plateau negative, second plateau positive

Potential Cause	*Corrective Action*
Leaking outlet valve.	Clean the outlet valve. Ensure the sieve in the outlet valves are installed correctly. Tighten the outlet valve.
Loose pump head screws.	Ensure the pump head screws are tight.
Leaking seals or scratched plungers.	Exchange the pump seals. Check the plunger for scratches. Exchange if scratched.

Table 33 Ramp 3 does not reach limit

Potential Cause	*Corrective Action*
Pump stopped due to error.	Check the logbook for error messages.
Large leaks (visible) at the pump seals.	Exchange the pump seals.
Large leaks (visible) at active inlet valve, outlet valve, or purge valve.	Ensure the leaky components are installed tightly. Exchange the component if required.

Table 34 Third plateau negative (pressure drop > 2 bar/min)

Potential Cause	*Corrective Action*
Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
Loose purge valve.	Tighten the purge valve (14mm wrench).
Contaminated purge valve.	Open and close purge valve to flush out contamination. Exchange the valve if still leaky.
Loose pump head screws.	Ensure the pump head screws are tight.

Table 34 Third plateau negative (pressure drop > 2 bar/min)

Leaking seals or scratched plungers.	Exchange the pump seals. Check the plungers for scratches. Exchange if scratched.
Leaking outlet valve.	Exchange the outlet valve.
Leaky damper.	Exchange damper.

Gradient Pump Leak Test

Gradient Pump Leak Test Description

The leak test is a built-in troubleshooting test designed to verify the tightness of pump components. The test should be used when problems with the pump are suspected. The test involves monitoring the pressure increase at very low flow rates while different plungers are delivering solvent. At these very low flow rates, very small leaks can be detected by evaluating the pressure profile as the pump runs through a predefined pumping sequence. The test requires blocking the pump with a blank nut, then running the test with isopropanol (IPA), while monitoring the pressure profile.

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

Ramp 1

After initialization, plunger 2 is at the top of its stroke. The test begins with plunger 1 delivering with a stroke length of 100µl and a flow of 153µl/min. The plunger sequence during the pressure ramp is 1-2-1-2. The pressure increase during this phase should be linear. Pressure disturbances during this phase indicate larger leaks or defective pump components.

Plateau 1

Plunger 2 continues to pump with a flow rate of 2µl/min for approximately one minute. The pressure during the plateau should remain constant or increase slightly. A falling pressure indicates a leak of >2µl/min.

Ramp 2

The flow is changed to 153µl/min, and plunger 2 continues to deliver for the rest of its stroke. Then plunger 1 continues to pump to complete the second half of the ramp.

Plateau 2

The flow is reduced to 2 µl/min for approximately one minute (plunger 1 still delivering). The pressure during the plateau should remain constant or increase slightly. A falling pressure indicates a leak of >2 µl/min.

Ramp 3

The flow increases to 220µl/min and the stroke is changed to 100 µl. Plunger 1 completes its stroke. Next, the flow is changed to 510µl/min. The ramp reaches 390 bar with the plunger sequence 2-1-2-1.

Plateau 3

When the system pressure reaches 390 bar, the flow is reduced to zero, and the pressure stabilizes just below 400 bar.

1 min after reaching the maximum pressure, the pressure drop should not exceed 2 bar/min.

Running the Isocratic Pump Leak Test

When If problems with the pump are suspected

Tools required Wrench 1/4 inch

Parts required

#	p/n	Description
1	G1313-87305	Restriction Capillary
1	01080-83202	Blank nut
1		500 ml Isopropanol

Preparations

- Place a bottle of LC-grade isopropyl alcohol in the solvent cabinet and connect its solvent tube to the active inlet valve of the pump.

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

Running the test from the Agilent Lab Advisor

1 Select the leak test from the test selection menu.

2 Start the test and follow the instructions.

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

NOTE Evaluating the Results describes the evaluation and interpretation of the leak test results (“Evaluating the Results” on page 71).

NOTE For detailed instructions refer to the Agilent Lab Advisor tool.

Evaluating the Results

Defective or leaky components in the pump head lead to changes in the leak-test pressure plot. Typical failure modes are described below.

NOTE Please notice the difference between an **error** in the test and a **failure** of the test! An **error** means that during the operation of the test there was an abnormal termination. If a test **failed**, this means that the results of the test were not within the specified limits.

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

Table 35 No Pressure increase at Ramp 1

Potential Cause	*Corrective Action*
Pump not running.	Check the logbook for error messages.
Purge valve open.	Close the purge valve, and restart the test.
Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
Wrong solvent-line connections.	Ensure the solvent lines from the degasser are connected correctly.

Table 35 No Pressure increase at Ramp 1

Contaminated purge valve.	Open and close purge valve to flush out contamination. Exchange the valve if still leaky.
Large leaks (visible) at the pump seals.	Exchange the pump seals.
Large leaks (visible) at active inlet valve, outlet valve, or purge valve.	Ensure the leaky components are installed tightly. Exchange the component if required.

Table 36 Pressure limit not reached but plateaus horizontal or positive

Potential Cause	*Corrective Action*
Degasser and pump not flushed sufficiently (air in the pump head).	Purge the degasser and pump thoroughly with isopropanol under pressure (use the restriction capillary).
Wrong solvent.	Install isopropanol. Purge the degasser and pump thoroughly.

Table 37 All plateaus negative

Potential Cause	*Corrective Action*
Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
Loose purge valve.	Tighten the purge valve (14mm wrench).
Contaminated purge valve.	Open and close purge valve to flush out contamination. Exchange the valve if still leaky.
Loose pump head screws.	Ensure the pump head screws are tight.
Leaking seals or scratched plungers.	Exchange the pump seals. Check the plungers for scratches. Exchange if scratched.
Leaking outlet valve.	Exchange the outlet valve.
Leaky damper.	Exchange damper.

Table 38 First plateau positive, second and third plateau negative

Potential Cause	*Corrective Action*
Air in pump or new seals not yet seated.	Flush pump thoroughly with isopropanol under pressure (use restriction capillary).
Loose active inlet valve.	Tighten the active inlet valve (14mm wrench). Do not overtighten!
Loose pump head screws.	Ensure the pump head screws are tight.
Loose outlet valve.	Ensure the sieve in the outlet valve is installed correctly. Tighten the outlet valve.
Leaking seal or scratched plunger.	Exchange the pump seals. Check the plungers for scratches. Exchange if scratched.
Defective active inlet valve.	Exchange the active inlet valve.

Table 39 First plateau negative, second plateau positive

Potential Cause	*Corrective Action*
Leaking outlet valve.	Clean the outlet valve. Ensure the sieve in the outlet valves are installed correctly. Tighten the outlet valve.
Loose pump head screws.	Ensure the pump head screws are tight.
Leaking seals or scratched plungers.	Exchange the pump seals. Check the plunger for scratches. Exchange if scratched.

Table 40 Ramp 3 does not reach limit

Potential Cause	*Corrective Action*
Pump stopped due to error.	Check the logbook for error messages.
Large leaks (visible) at the pump seals.	Exchange the pump seals.
Large leaks (visible) at active inlet valve, outlet valve, or purge valve.	Ensure the leaky components are installed tightly. Exchange the component if required.

Table 41 Third plateau negative (pressure drop > 2 bar/min)

Potential Cause	*Corrective Action*
Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
Loose purge valve.	Tighten the purge valve (14mm wrench).
Contaminated purge valve.	Open and close purge valve to flush out contamination. Exchange the valve if still leaky.
Loose pump head screws.	Ensure the pump head screws are tight.
Leaking seals or scratched plungers.	Exchange the pump seals. Check the plungers for scratches. Exchange if scratched.
Leaking outlet valve.	Exchange the outlet valve.
Leaky damper.	Exchange damper.

Pressure Too High Check

Pressure Too High Check Description

This test checks the flow path for a blockage, and tries to identify the module that is causing the blockage. If the blockage is in the autosampler, the test can identify whether the blockage occurs in the needle or needle seat.

The pump and autosampler are necessary to run the Pressure Too High Check.

Pressure Too High Check Evaluation

Start Conditions

The pump and autosampler are brought to the READY state, and an operating pressure of 200 bar is applied to the system.

The pump ripple is measured, and the start of the test is delayed until the ripple is within the defined limits (typically 1% of operating pressure).

Test Part 1

Part 1 of the test tries to determine in which part of the system the pressure problem lies.

After the system has achieved the start conditions, the autosampler valve is switched from mainpass to bypass, and the pressure slice is tested against a limit.

If the limit is exceeded, the pressure problem lies in the autosampler; otherwise, it lies somewhere in the rest of the flow path.

Test Part 2

In Part 2 of the test, an empty vial is driven to the needle, and the valve is switched from bypass to mainpass, so that the pressure should drop dramatically. The pressure drop is checked against a limit.

If the autosampler is identified as the source of the problem, and the limit is not reached, the problem lies in the needle, needle loop or metering drive; otherwise, the problem lise in the needle seat or needle seat capillary.

If the autosampler is not the source of the problem, the problem lies either in the pump (typically the filter or frit), or after the autosampler (heater capillary or column). If the pressure drop limit is not achieved, the problem lies in the pump; otherwise, the problem occurs after the autosampler.

Purge Pump

Purge Pump Description

The **Purge Pump** tool enables you to purge the pump with solvent at a specified flow rate for a specified time. For multi-channel pumps, and pumps with solvent selection valve (SSV), you select the channels to purge; each channel can be purged with different conditions.

You can select a flow rate between 1 and 5 mL/min in steps of 1 mL/min.

You can select a time from 1, 2, 3, 5, 7, 10 and 15 minutes.

NOTE The G1361A Prep Pump has an automatic purge cycle; there are no user-configurable options.

Purging the Pump

To purge the pump

1 Prepare each channel with the appropriate purge solvents.
2 Select **Purge Pump** from the tool selection screen
3 In the **Purge Configuration** dialog box,

   If necessary, select the channel(s) that you want to purge.

   For each selected channel, select a **Flow** and a purge **Time**.

   Click **OK** to close the **Purge Configuration** dialog box.
4 When the request to open the purge valve appears, open the purge valve on the pump, then click **OK** to close the message box.

   During purging, the **General** tab shows the current channel that is being purged, and the remaining purge time. The **Signals** tab shows a plot of pressure against time for the complete purge cycle.
5 When the purge time has elapsed and the request to close the purge valve appears, close the purge valve on the pump, then click **OK** to close the message box.

   The pump purge process is complete.

Autosampler

Maintenance Positions

Change Needle

The **Change Needle** function moves the safety flap out of position, and positions the needle for easy exchange and alignment.

Start	moves the safety flap away from the needle, and positions the needle approximately 15 mm above the needle seat.
Up	moves the needle arm up stepwise.
Down	moves the needle arm down stepwise. The lowest position is used to align the needle at the correct position in the needle arm.
End	repositions the safety flap around the needle.

Change Piston

The **Change Piston** function draws the piston away from the home position, relieving the tension on the spring. In this position, the analytical head assembly can be removed and reinstalled easily after maintenance.

Start	draws the piston away from the home position, relieving the tension on the spring.
End	repositions the plunger at the home position.

Change Gripper

The **Change Gripper** function moves the gripper to the front of the autosampler enabling easy access to the gripper release mechanism.

Start	moves the gripper to the front of the sample-tray area.
End	repositions the gripper at the home position.

Arm Position

Move Arm Home	Moves the gripper arm to its home position for better access and exchange of trays.
Park Arm	Secures the gripper arm to the park position behind the sampling unit. Before parking the gripper arm, ensure there is no vial in the gripper.

Injector Steps

Each movement of the sampling sequence can be done under manual control. This is useful during troubleshooting, where close observation of each of the sampling steps is required to confirm a specific failure mode or verify successful completion of a repair.

Each injector step command actually consists of a series of individual commands that move the autosampler components to predefined positions, enabling the specific step to be done.

Table 42 Injector Step Commands

Step	Action	Comments
Valve Bypass	Switches injection valve to the bypass position.	
Plunger Home	Moves the plunger to the home position.	
Needle Up	Lifts the needle arm to the upper position.	Command also switches the valve to bypass if it is not already in that position.
Vial to Seat	Moves the selected vial to the seat position.	Command also lifts the needle to the upper position.
Needle into Sample	Lowers the needle into the sample.	Command also positions the vial at the seat, and lifts the needle to the upper position.
Draw	Metering device draws the defined injection volume.	Command also positions the vial at the seat, lifts the needle, and lowers the needle into vial. Command can be done more than once (maximum draw volume of 100µl cannot be exceeded). Use **Plunger Home** to reset the metering device.
Needle Up	Lifts the needle out of the vial.	Command also switches the valve to bypass if it is not already in that position.

Table 42 Injector Step Commands

Step	Action	Comments
Vial to Tray	Returns the selected vial to the tray position.	Command also lifts the needle to the upper position.
Needle into Seat	Lowers the needle arm into the seat.	Command also returns the vial to the tray position.
Valve Mainpass	Switches the injection valve to the mainpass position.	
Reset	Resets the injector.	

Alignment Teaching

ALS Alignment Teaching Description

The Alignment Teaching tool is required to compensate for small deviations in positioning of the autosampler gripper that may occur after the module has been disassembled for repair. It requires that a 100-vial tray be inserted into the autosampler.

The alignment procedure uses two tray positions as reference points; because the tray is rectangular, a two-point alignment is sufficient to correct all other vial positions on the tray. When the correction calculation is complete, the values for both X and theta are rounded to one decimal place. On completion of the alignment procedure, the corrected gripper positions are stored in the module's firmware.

NOTE To ensure correct operation of the autosampler, the alignment procedure must be carried out in the correct sequence and in full (that is, without skipping any part).

ALS Alignment Controls

Button	Description	Keyboard Shortcut
▲	Rotate the gripper by increasing theta	Cursor Up
◀	Move the gripper horizontally to the left	Cursor Left
▶	Move the gripper horizontally to the right	Cursor Right
▼	Rotate the gripper by decreasing theta	Cursor Down
Arm Up	Lifts the gripper arm	Page Up
Arm Down	Lowers the gripper arm	Page Down
Open Gripper	Opens the gripper	
Close Gripper	Closes the gripper	
Start >>	Starts the execution of the procedure. Shown only at the start.	Enter
Continue >>	Jumps to the next step of the procedure. Shown only during alignment.	Enter
Restart	Restarts the execution of the step.	

Running the ALS Alignment Teaching

NOTE To ensure correct operation of the autosampler, the alignment procedure must be carried out in the correct sequence and in full (that is, without skipping any part).

To align the ALS:

1 Insert a 100-vial tray into the autosampler.

2 Place capped vials into positions 15 and 95.

3 Press **Start >>**.

The gripper arm moves to a position above vial 15.

4 Answer **Yes**to reset the correction values to their factory defaults, or **No** to leave them as they are.

5 Use **Arm Down** to move the fingers of the gripper as close as possible to the top of the vial without touching.

6 Use &#25B2; and &#25BC; (for rotation), and &#25BA; and &#25C4; (for movement left and right) to adjust the gripper posion in the horizontal plane.

7 Use **Open Gripper** to open the gripper fingers.

8 Use **Arm Down** to move the gripper arm down a further 5 mm until the vial cap and the rubber of the gripper fingers are the same height.

9 Check that the vial is in the center of the gripper fingers and readjust the position if necessary (step 6).

10 When you are satisfied that the gripper position is correct, press **Continue**.

The gripper arm moves to a position above vial 95.

11 Repeat steps 6 to 9 to align the gripper at position 95.

12 Press **Continue**.

On completion of the calculation, the values for both X and theta are rounded to one decimal place. The correction values are stored permanently in the non-volatile memory of the sampler, and the sampler is initialized.

Gripper Verification

ALS Gripper Verification Description

The verification procedure uses several vial positions as reference points to verify the gripper alignment is correct. If verification indicates one or more positions are out of alignment, the alignment procedure should be done.

Verifying the Gripper Positions

Vial positions 1,10,55,81 and 100 can be used for position verification.

1 Insert empty capped vials into the vial tray at the positions to be verified.
2 Select the first vial position in the vial-position menu.
3 Select **Go to selected position**.
4 If the fingers of the gripper arm are aligned centrally above the vial, select the **Pick vial** button to verify the gripper arm lifts the vial out of the tray correctly. If there is a misalignment, the gripper must be realigned.
5 Select the **Put vial** button to verify the gripper replaces the vial correctly. If there is a misalignment, the gripper must be realigned.
6 Repeat the procedure for the next vial position.

Column Oven

Oven Test

Oven Test Description

The Oven Test is used to evaluate the heating performance of the two Peltier elements.

The heating rate over a 10°K interval from the start temperature is determined. The start temperature must be between 30°C and 50°C, and is determined as follows:

- If the current oven temperature is below 30°C, the oven tries to attain a temperature of 30°C. 30°C is used as the start temperature.
- If the current oven temperature is above 30°C but below 50°C, the current oven temperature is used as the start temperature.
- If the current oven temperature is above 50°C, an error message is displayed. The oven must then be allowed to cool to below 50°C before the test can be run.

Oven Test Evaluation

At the end of the Oven Test, the slope of the temperature rise of the left and right channels are evaluated. The test passes if both slopes are >=4°C/min.

Oven Calibration

Oven Calibration Description

The oven calibration procedure enables the oven temperature to be measured against an external, calibrated measuring device.

Normally, temperature calibration is not required during the lifetime of the instrument; however, in order to comply with local regulatory requirements, the 2-point calibration and verification procedure may be performed.

Running the Oven Calibration

NOTE

For the measurement and calibration procedure, we recommend a measuring device that provides the necessary resolution and precision, for example, Hereaus Quat340 quartz surface-temperature measurement sensor. Contact your local Agilent Technologies support representative for ordering information.

1. Install the calibrated temperature measuring device.
2. Select the **Oven Calibration** in the user interface.
3. Wait for the oven to reach the first set point (40°C).
4. Measure the temperature of the heat exchanger and enter the value in the field.
5. Wait for the oven to reach the second set point (50°C).
6. Measure the temperature of the heat exchanger and enter the value in the field.
7. Click **OK** to save the calibration values to the oven, or **Cancel** to abort the calibration process.

Detector

Cell Test

VWD Cell Test Description

The cell test compares the intensity of the deuterium lamp measured by the sample and reference diodes (unfiltered and not logarithmized) when the grating is in the zero-order position. The resulting intensity ratio (sample:reference) is a measure of the amount of light absorbed by the flow cell. The test can be used to check for dirty or contaminated flow cell windows. When the test is started, the gain is set to -1. To eliminate effects due to absorbing solvents, the test should be done with water in the flow cell.

NOTE The test should not be performed using the micro flow cell, since the reduction in light intensity will cause the test to fail.

Evaluating the VWD Cell Test Results

The intensity ratio is dependent on the degree of contamination of the flow cell windows, and on the type of flow cell used. The lower the ratio, the more light is absorbed by the flowcell.

Table 43 Probable causes of excessive flowcell absorbance

Cause	Corrective action
Absorbing solvent or air bubble in flow cell.	Ensure the flow cell is filled with water, and free from air bubbles.
Dirty or contaminated flow cell.	Exchange the flow cell windows.

Dark Current Test

VWD Dark Current Test Description

The dark-current test measures the leakage current from the sample and reference circuits. The test is used to check for defective sample or reference diodes or ADC circuits which may cause non-linearity or excessive baseline noise. During the test, the lamp is switched off. Next, the leakage current from both diodes is measured. The test evaluates the results automatically.

Evaluating the VWD Dark Current Test

Table 44 Limits

Sample circuit	<7900 counts
Reference circuit	<7900 counts

Probable causes of test failure

Table 45 Sample circuit noise exceeds limit:

Cause	Corrective action
Defective sample diode	Exchange the sample diode.
Defective sample ADC board.	Exchange the sample ADC board.

Table 46 Reference circuit noise exceeds limit:

Cause	Corrective action
Defective reference diode.	Exchange the reference diode.
Defective reference ADC board.	Exchange the reference ADC board.

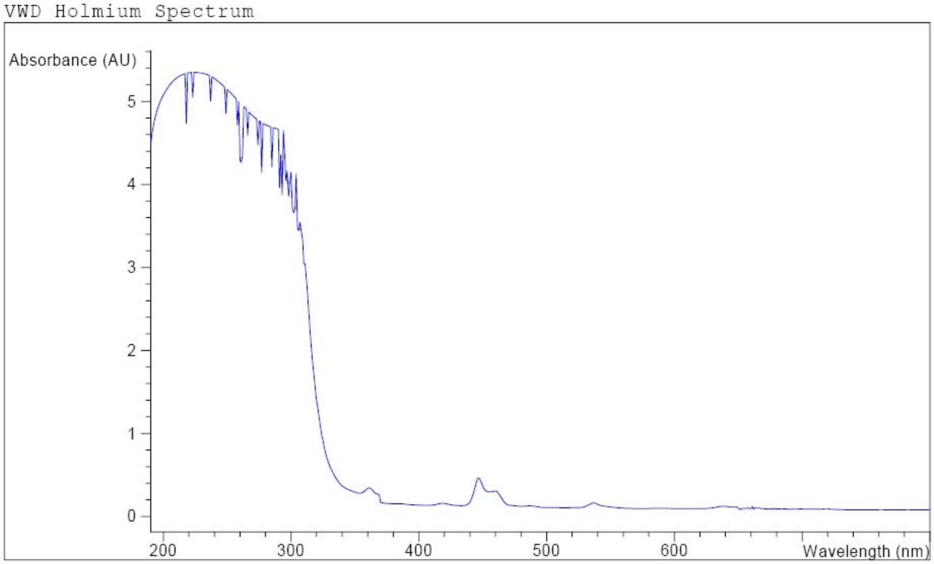
Holmium Oxide Test

VWD Holmium Oxide Test Description

The holmium oxide test uses three characteristic absorbance maxima of the built-in holmium oxide filter to verify wavelength accuracy (see also Wavelength Calibration). The test evaluates the results automatically, and provides a spectrum of the holmium oxide filter. To eliminate effects due to absorbing solvents, the test should be done with water in the flow cell. On completion of the test, the results are displayed automatically.

Holmium Oxide Test Report

VWD Holmium Spectrum



VWD Holmium Test Results

	Specification	Measured	Result
Deviation from wavelength 1: 360.8 nm	-1..1 nm	0.0 nm	Passed
Deviation from wavelength 2: 418.5 nm	-1..1 nm	0.1 nm	Passed
Deviation from wavelength 3: 536.4 nm	-1..1 nm	0.0 nm	Passed

Evaluating the VWD Holmium Oxide Test

The test is evaluated by the instrument, and the measured maxima are displayed automatically. The test fails if one or more of the maxima lies outside the limits.

Table 47 Limits

Absorbance Maxima	Limits
360.8 nm	-1 to +1 nm
418.5 nm	-1 to +1 nm
536.4 nm	-1 to +1 nm

Intensity Test

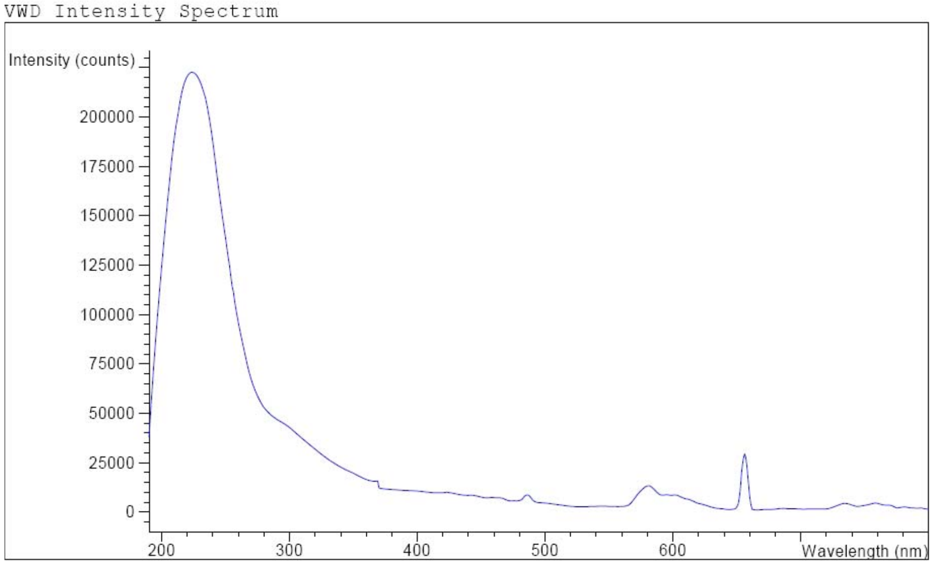
VWD Intensity Test Description

The intensity test measures the intensity of the UV lamp over the full VWD wavelength range (190-800 nm). The test evaluates the results automatically, and provides an intensity spectrum. The test evaluates the highest intensity, average intensity, and lowest intensity across the full wavelength range. The test is used to determine the performance of the lamp and optics (see also cell test). To eliminate effects due to absorbing solvents, the test should be done with water in the flow cell. The shape of the intensity spectrum is primarily dependent on the lamp and grating. Therefore, intensity spectra will differ slightly between instruments. On completion of the test, the intensity spectrum and intensity values are displayed ("VWD Cell Test Description" on page 92).

NOTE The test should not be performed using the micro flow cell, since the reduction in light intensity will cause the test to fail.

Intensity Test Report

VWD Intensity Spectrum




```
VWD Intensity Test Results
                                      Specification       Measured  Result
--------------------------------------------------------------------------
Accumulated lamp on time                                   94.35 h
Highest intensity                     > 320000 cts    7123680 cts  Passed
Average intensity                     > 160000 cts     951488 cts  Passed
Lowest intensity                        > 6400 cts      36384 cts  Passed
```

Evaluating the VWD Intensity Test

Table 48 Limits

Intensity	Limits (counts)
Highest	>320000
Average	>160000
Lowest	>6400

Table 49 Probable causes of test failure

Cause	Corrective action
Lamp off.	Switch on the lamp.
Old lamp.	Exchange the lamp.
Absorbing solvent or air bubble in flow cell.	Ensure the flow cell is filled with water, and free of air bubbles.
Dirty or contaminated flow cell.	Run theCell Test . If the test fails, exchange the flow cell windows (“VWD Cell Test Description” on page 92).

Filter/Grating Motor Test

VWD Filter/Grating Test Description

The actual position of the filter motor and grating motor is defined as the number of steps from the reference (sensor) positions. The filter/grating test counts the number of motor steps required to move the filter motor and grating motor back to the reference (sensor) position. If the number of steps required to reach the reference positions are the same as the expected step number, the test is passed. If a motor fails to move, or loses motor steps, the test fails. The test evaluates the results automatically.

VWD Filter/Grating Test Results

Probable causes of test failure:

Table 50 Filter Motor Test

Cause	Corrective action
Defective filter motor assembly.	Exchange the filter motor assembly.
Defective VWM board.	Exchange the VWM board.

Table 51 Grating Motor Test

Cause	Corrective action
Defective filter motor assembly.	Exchange the filter motor assembly.
Defective VWM board.	Exchange the VWM board.

Detector Calibration

Wavelength Verification/Calibration

Wavelength calibration of the detector is done using the zero-order position and 656 nm (alpha-emission line) and beta-emission line at 486 nm emission-line positions of the deuterium lamp. The calibration procedure involves three steps. First the grating is calibrated on the zero-order position. The stepper-motor step position where the zero-order maximum is detected is stored in the detector. Next, the grating is calibrated against the deuterium emission-line at 656 nm, and the motor position at which the maximum occurs is stored in the detector. Finally, the grating is calibrated against the deuterium emission-line at 486 nm, and the motor position at which the maximum occurs is stored in the detector.

NOTE The wavelength verification/calibration takes about 2.5 minutes and is disabled within the first 10 minutes after ignition of the lamp because initial drift may distort the measurement.

When the lamp is turned ON, the 656 nm emission line position of the deuterium lamp is checked automatically.

When to Calibrate the Detector

The detector is calibrated at the factory, and under normal operating conditions should not require recalibration. However, it is advisable to recalibrate:

- after maintenance (flow cell or lamp),
- after repair of components in the optical unit,

- after exchange of the optical unit or VWM board,
- at a regular interval, at least once per year (for example, prior to an Operational Qualification/Performance Verification procedure), and
- when chromatographic results indicate the detector may require recalibration.

Test Chromatogram

A built-in pre-defined test chromatogram on the VWM board is processed through ADC like normal signals from the diodes and can be used to check the ADC and the data handling system. The signal is available at the analog output and on the GPIB.

NOTE The run time of the chromatogram is depending on the setting for response time (peak width). If no stop time is set the chromatogram will repeat continuously.

Response Time	Stop Time
0.06 sec	0.8 min.
0.12 sec	0.8 min.
0.25 sec	0.8 min.
0.50 sec	0.8 min.
1.00 sec	1.6 min.
2.00 sec	3.2 min. (Default settings)
4.00 sec	6.4 min.
8.00 sec	12.8 min.

The test chromatogram has four main peaks with the following absorbances:

Peak	Absorbance (approx.)
1	38 mAU
2	100 mAU
3	290 mAU
4	20 mAU

Spectral Scan

The Spectral Scan tool is available for diode-array and variable wavelength detectors (DAD/MWD and VWD). It allows you to scan a spectrum over a specified wavelength range and export the data to a csv (comma-separated values) file that can be used in other applications (for example, Microsoft Excel).

Scan Parameters

UV Lamp On	Switches on the UV lamp.
Blank Scan (VWD only)	Scans a blank spectrum (solvent only) over the specified wavelength range at the specified resolution. You specify the wavelength range in the **from** and **to** fields, and the resolution in the **step** field.
Sample Scan	Scans the sample spectrum over the specified wavelength range at the specified resolution. You specify the wavelength range in the **from** and **to** fields, and the resolution in the **step** field.
Export Data	Exports the selected data in csv format. Using the options in the **Export Filter** section, you can select to export only the peak maxima, all peak data (the peak maximum and four adjacent values to left and right) or all data points.

5
Error Information

This chapter provides information on the error messages that might be displayed, and gives the possible causes and suggestions on their solutions.

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.

General Error Messages

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

Compensation Sensor Open

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

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

Probable cause	Suggested actions
1 Defective main board.	Please contact your Agilent service representative.

Compensation Sensor Short

The ambient-compensation sensor (NTC) on the main board in the module has failed (short circuit).

The resistance across the temperature compensation sensor (NTC) on the main 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 main board.	Please contact your Agilent service representative.

Fan Failed

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.

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

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.

Leak Sensor Open

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.

Leak Sensor Short

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 flow sensor.	Please contact your Agilent service representative.
2 Leak sensor incorrectly routed, being pinched by a metal component.	Please contact your Agilent service representative.

Open Cover

The top foam has been removed.

Probable cause	Suggested actions
1 Foam not activating the sensor.	Please contact your Agilent service representative.
2 Dirty or defective sensor.	Please contact your Agilent service representative.

Remote Timeout

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).

Shut-Down

An external instrument has generated a shut-down 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.

Synchronization Lost

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.

Timeout

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.

Pump Error Messages

These errors are specific to the pump.

Encoder Missing

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

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

Probable cause	Suggested actions
1 Defective or disconnected pump encoder connector.	Ensure the connector is clean, and seated correctly.
2 Defective pump drive assembly.	Exchange the pump drive assembly.

Index Adjustment

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

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

Probable cause	Suggested actions
1 Irregular or sticking drive movement.	Remove the pump head, and examine the seals, plungers, and internal components for signs of wear, contamination or damage. Exchange components as required.
2 Defective pump drive assembly.	Exchange the pump drive assembly.

Index Limit

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

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

Probable cause	Suggested actions
1 Irregular or sticking drive movement.	Remove the pump head, and examine the seals, plungers, and internal components for signs of wear, contamination or damage. Exchange components as required.
2 Defective pump drive assembly.	Exchange the pump drive assembly.

Index Missing

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

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

Probable cause	Suggested actions
1 Disconnected or defective encoder cable.	Ensure the encoder cable are not damaged or dirty. Make sure the cables are connected securely to the main board.
2 Defective pump drive assembly.	Exchange the pump drive assembly.

Initialization Failed

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

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

Probable cause	Suggested actions
1 Blocked passive inlet valve.	Exchange the inlet valve.
2 Defective pump drive assembly.	Exchange the pump drive assembly.
3 Defective main board.	Exchange the main board.

Missing Pressure Reading

The pressure readings read by the pump ADC (analog-digital converter) are missing.

The ADC reads the pressure readings from the damper every 1ms. If the readings are missing for longer than 10 seconds, the error message is generated.

Probable cause	Suggested actions
1 Damper disconnected.	Ensure the damper is connected, clean and seated correctly.
2 Defective damper.	Exchange the damper.
3 Defective main board.	Exchange the main board.

Motor-Drive Power

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

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

Probable cause	Suggested actions
1 Flow path blockage in front of the damper.	Ensure the capillaries and frits between the pump head and damper inlet are free from blockage.
2 Blocked outlet ball valve.	Exchange the outlet ball valve.
3 High friction (partial mechanical blockage) in the pump drive assembly.	Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.
4 Defective pump drive assembly.	Exchange the pump drive assembly.
5 Defective main board.	Exchange the main board.

Pressure Above Upper Limit

The system pressure has exceeded the upper pressure limit.

Probable cause	Suggested actions
1 Upper pressure limit set too low.	Ensure the upper pressure limit is set to a value suitable for the analysis.
2 Blockage in the flowpath (after the damper).	Check for blockage in the flowpath. The following components are particularly subject to blockage: purge-valve frit, needle (autosampler), seat capillary (autosampler), sample loop (autosampler), column frits and capillaries with low internal diameters (e.g. 0.12 mm id).
3 Defective damper.	Exchange the damper.
4 Defective main board.	Exchange the main board.

Pressure Below Lower Limit

The system pressure has fallen below the lower pressure limit.

Probable cause	Suggested actions
1 Lower pressure limit set too high.	Ensure the lower pressure limit is set to a value suitable for the analysis.
2 Leak.	• Inspect the pump head, capillaries and fittings for signs of a leak. • Purge the module. Run a pressure test to determine whether the seals or other module components are defective.
3 Defective main board.	Exchange the main board.

Pressure Signal Missing

The pressure signal from the damper is missing.

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

Probable cause	Suggested actions
1 Damper disconnected.	Ensure the damper is connected correctly to the main board.
2 Defective damper.	Exchange the damper.

Pump Configuration

At switch-on, the gradient pump has recognized a new pump configuration.

The gradient pump is assigned its configuration at the factory. If the gradient valve is disconnected, and the gradient pump is rebooted, the error message is generated. However, the pump will function as an isocratic pump in this configuration.The error message reappears after each switch-on.

Probable cause	Suggested actions
1 Gradient valve disconnected.	Reconnect the gradient valve.

Pump Head Missing

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

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

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

Restart Without Cover

The module was restarted with the top cover and foam open.

The sensor on the main board detects when the top foam is in place. If the module is restarted with the foam removed, the module switches off within 30 s, and the error message is generated.

Probable cause	Suggested actions
1 The module started with the top cover and foam removed.	Reinstall the top cover and foam.

Servo Restart Failed

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

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

Probable cause	Suggested actions
1 Disconnected or defective cable.	Ensure the pump-assembly cables are not damaged or dirty. Make sure the cables are connected securely to the main board.
2 Mechanical blockage of the module.	Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.
3 Defective pump drive assembly.	Exchange the pump drive assembly.
4 Defective main board.	Exchange the main board.

Stroke Length

The distance between the lower plunger position and the upper mechanical stop is out of limits (pump).

During initialization, the module monitors the drive current. If the plunger reaches the upper mechanical stop position before expected, the motor current increases as the module attempts to drive the plunger beyond the mechanical stop. This current increase causes the error message to be generated.

Probable cause	Suggested actions
1 Defective pump drive assembly.	Exchange the pump drive assembly.

Temperature Limit Exceeded

The temperature of one of the motor-drive circuits is too high.

The processor continually monitors the temperature of the drive circuits on the main board. If excessive current is being drawn for long periods, the temperature of the circuits increases. If the temperature exceeds the upper limit, the error message is generated.

Probable cause	Suggested actions
1 High friction (partial mechanical blockage) in the pump drive assembly.	Ensure the capillaries and frits between the pump head and damper inlet are free from blockage.
2 Partial blockage of the flowpath in front of the damper.	Ensure the outlet valve is not blocked.
3 Defective pump drive assembly.	• Remove the pump head assembly. Ensure there is no mechanical blockage of the pump head assembly or pump drive assembly. • Exchange the pump drive assembly.
4 Defective main board.	Exchange the main board.

Temperature Out of Range

The temperature sensor readings in the motor-drive circuit are out of range.

The values supplied to the ADC by the hybrid sensors must be between 0.5 V and 4.3 V. If the values are outside this range, the error message is generated.

Probable cause	Suggested actions
1 Defective main board.	Exchange the main board.

Valve Failed

Valve 0 Failed: valve A

Valve 1 Failed: valve B

Valve 2 Failed: valve C

Valve 3 Failed:valve D

One of the valves of the multi-channel gradient valve has failed to switch correctly.

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

Probable cause	Suggested actions
1 Gradient valve disconnected.	Ensure the gradient valve is connected correctly.
2 Connection cable (inside instrument) not connected.	Ensure the connection cable is connected correctly.
3 Connection cable (inside instrument) defective.	Exchange the connection cable.
4 Gradient valve defective.	Exchange the gradient valve.

Valve Fuse

Valve Fuse 0: Channels A and B

Valve Fuse 1: Channels C and D

The gradient valve in the quaternary pump has drawn excessive current causing the electronic fuse to open.

Probable cause	Suggested actions
1 Defective gradient valve.	Restart the quaternary pump. If the error message appears again, exchange the gradient valve.
2 Defective connection cable (front panel to main board).	Exchange the connection cable.
3 Defective main board.	Exchange the LPM board.

Wait Timeout

When running certain tests in the diagnostics mode or other special applications, the pump must wait for the plungers to reach a specific position, or must wait for a certain pressure or flow to be reached. Each action or state must be completed within the timeout period, otherwise the error message is generated.

Possible Reasons for a Wait Timeout:

- Pressure not reached.
- Pump channel A did not reach the delivery phase.
- Pump channel B did not reach the delivery phase.
- Pump channel A did not reach the take-in phase.
- Pump channel B did not reach the take-in phase.
- Solvent volume not delivered within the specified time.

Probable cause	Suggested actions
1 Flow changed after starting test.	Ensure correct operating condition for the special application in use.
2 Defective pump drive assembly.	Exchange the defective pump drive assembly.

Zero Solvent Counter

Pump firmware version A.02.32 and higher allow to set solvent bottle fillings in the data system. If the volume level in the bottle falls below the specified value the error message appears when the feature is configured accordingly.

Probable cause	Suggested actions
1 Volume in bottle below specified volume.	Refill bottles and reset solvent counters.
2 Incorrect setting of limit.	Make sure the limits are set correctly.

Autosampler Error Messages

These errors are specific to the autosampler.

Arm Movement Failed

The transport assembly was unable to complete a movement in one of the axes.

The processor defines a certain time window for the successful completion of a movement in any particular axis. The movement and position of the transport assembly is monitored by the encoders on the stepper motors. If the processor does not receive the correct position information from the encoders within the time window, the error message is generated.

See figure Figure 22 on page 56 for axes identification.

- **Arm Movement 0 Failed**: X-axis.

  Arm Movement 1 Failed: Z-axis.

  Arm Movement 2 Failed: Theta (gripper rotation).

  Arm Movement 3 Failed: Gripper (gripper fingers open/close).

Probable cause	Suggested actions
1 Mechanical obstruction.	Ensure unobstructed movement of the transport assembly.
2 High friction in the transport assembly.	Exchange the sample transport assembly.
3 Defective motor assembly.	Exchange the sample transport assembly.
4 Defective sample transport assembly flex board.	Exchange the sample transport assembly.
5 Defective main board.	Exchange the main board.

Initialization Failed

The autosampler failed to complete initialization correctly.

The autosampler initialization procedure moves the needle arm and transport assembly to their home positions in a predefined sequence. During initialization, the processor monitors the position sensors and motor encoders to check for correct movement. If one or more of the movements is not successful, or is not detected, the error message is generated.

Probable cause	Suggested actions
1 Mechanical obstruction.	Ensure unobstructed movement of the transport assembly.
2 Defective sampling unit flex board.	Exchange the transport assembly.
3 Defective transport assembly flex board.	Exchange the transport assembly.
4 Defective sampling unit motor.	Exchange the defective sampling unit motor.
5 Defective ASM board.	Exchange the ASM board.

Initialization with Vial

The autosampler attempted to initialize with a vial still in the gripper.

During initialization, the autosampler checks correct operation of the gripper by closing and opening the gripper fingers while monitoring the motor encoder. If a vial is still in the gripper when initialization is started, the gripper fingers cannot close causing the error message to be generated.

Probable cause	Suggested actions
1 Vial still in gripper.	Remove the vial using the **Release Vial** function in the user interface. Reinitialize the autosampler.

Invalid Vial Position

The vial position defined in the method or sequence does not exist.

The reflection sensors on the transport assembly flex board are used to check automatically which sample trays are installed (coding on tray). If the vial position does not exist in the current sample tray configuration, the error message is generated.

Probable cause	Suggested actions
1 Incorrect tray or trays installed.	Install the correct trays, or edit the method or sequence accordingly.
2 Incorrect vial positions defined in the method or sequence.	Exchange the transport assembly.
3 Tray recognition defective (dirty sample tray or defective transport assembly flex board).	Ensure the coding surfaces of the sample tray are clean (located at the rear of the sample tray).

Metering Home Failed

The metering plunger has failed to move back to the home position.

The home position sensor on the sampling unit flex board monitors the home position of the plunger. If the plunger fails to move to the home position, or if the sensor fails to recognize the plunger position, the error message is generated.

Probable cause	Suggested actions
1 Dirty or defective sensor.	Exchange the sampling unit flex board.
2 Broken plunger.	Exchange the metering plunger and seal.
3 Defective metering-drive motor.	Exchange the metering-drive motor.
4 Defective ASM board.	Exchange the ASM board.

Missing Vial

No vial was found in the position defined in the method or sequence.

When the gripper arm picks a vial out of the sample tray, the processor monitors the gripper motor encoder. If a vial is present, the closing of the gripper fingers is limited by the vial. However, if no vial is present, the gripper fingers close too far. This is sensed by the processor (encoder position), causing the error message to be generated.

Probable cause	Suggested actions
1 No vial in the position defined in the method or sequence.	Install the sample vial in the correct position, or edit the method or sequence accordingly.
2 Incorrect gripper alignment.	Align gripper.
3 Defective gripper assembly (defective gripper fingers or belt).	Exchange the gripper assembly.
4 Defective transport assembly flex board.	Exchange the transport assembly.

Missing Wash Vial

The wash vial programmed in the method was not found.

When the gripper arm picks a vial out of the sample tray, the processor monitors the gripper motor encoder. If a vial is present, the closing of the gripper fingers is limited by the vial. However, if no vial is present, the gripper fingers close too far. This is sensed by the processor (encoder position), causing the error message to be generated.

Probable cause	Suggested actions
1 No wash vial in the position defined in the method.	Install the wash vial in the correct position, or edit the method accordingly.

Motor Temperature

One of the motors of the transport assembly has drawn excessive current, causing the motor to become too hot. The processor has switched OFF the motor to prevent damage to the motor.

See figure Figure 22 on page 56 for motor identification.

- **Motor 0 temperature**: X-axis motor.

  Motor 1 temperature: Z-axis motor.

  Motor 2 temperature: Theta (gripper rotation) motor.

  Motor 3 temperature: Gripper motor (motor for gripper fingers).

The processor monitors the current drawn by each motor and the time the motor is drawing current. The current drawn by the motors is dependent on the load on each motor (friction, mass of components etc.). If the current drawn is too high, or the time the motor draws current is too long, the error message is generated.

Probable cause	Suggested actions
1 Mechanical obstruction.	Ensure unobstructed movement of the transport assembly.
2 High friction in the transport assembly.	Exchange the transport assembly.
3 Motor belt tension too high.	Switch OFF the autosampler at the power switch. Wait at least 10 minutes before switching on again.
4 Defective motor.	Exchange the transport assembly.
5 Defective transport assembly flex board.	Exchange the transport assembly.

Needle Down Failed

The needle arm failed to move down into the needle seat.

The lower position of the needle arm is monitored by a position sensor on the sampling unit flex board. The sensor detects the successful completion of the needle movement to the needle seat position. If the needle fails to reach the end point, or if the sensor fails to recognize the needle arm movement, the error message is generated.

Probable cause	Suggested actions
1 Needle installed incorrectly, or wrong needle type (too long).	Ensure the correct needle type is used, and installed correctly.
2 Defective or dirty position sensor.	Exchange the sampling unit flex board.
3 Defective motor.	Exchange the needle drive motor.
4 Sticking spindle assembly.	Exchange the spindle assembly or sampling unit assembly.
5 Defective ASM board.	Exchange the ASM board.

Needle Up Failed

The needle arm failed to move successfully from the seat or out of the vial to the upper position.

The upper position of the needle arm is monitored by a position sensor on the sampling unit flex board. The sensor detects the successful completion of the needle movement to the upper position. If the needle fails to reach the end point, or if the sensor fails to recognize the needle arm movement, the error message is generated.

Probable cause	Suggested actions
1 Defective or dirty position sensor.	Exchange the sampling unit flex board.
2 Defective motor.	Exchange the needle drive motor.
3 Sticking spindle assembly.	Exchange the spindle assembly or sampling unit assembly.
4 Defective ASM board.	Exchange ASM board.

Safety Flap Missing

The safety flap was not detected.

Before the needle moves down into the needle seat to inject sample, the safety flap locks into position. Next, and the gripper checks the safety flap by trying to move the safety flap away from the needle. If the gripper is able to move beyond the safety flap position (safety flap not in position), the error message is generated.

Probable cause	Suggested actions
1 Safety flap missing or broken.	Exchange the safety flap.

Valve to Bypass Failed

The injection valve failed to switch to the bypass position.

The switching of the injection valve is monitored by two microswitches on the valve assembly. The switches detect the successful completion of the valve movement. If the valve fails to reach the bypass position, or if the microswitch does not close, the error message is generated.

Probable cause	Suggested actions
1 Defective injection valve.	Exchange the injection valve.
2 Defective ASM board.	Exchange the ASM board.

Valve to Mainpass Failed

The injection valve failed to switch to the mainpass position.

The switching of the injection valve is monitored by two microswitches on the valve assembly. The switches detect the successful completion of the valve movement. If the valve fails to reach the mainpass position, or if the microswitch does not close, the error message is generated.

Probable cause	Suggested actions
1 Defective injection valve.	Exchange the injection valve.
2 Defective ASM board.	Exchange the ASM board.

Vial in Gripper

The gripper arm attempted to move with a vial still in the gripper.

During specific stages of the sampling sequence, no vial should be held by the gripper. The autosampler checks if a sample vial is stuck in the gripper by closing and opening the gripper fingers while monitoring the motor encoder. If the gripper fingers are unable to close, the error message is generated.

Probable cause	Suggested actions
1 Vial still in gripper.	Remove the vial using the **Release Vial** function in the user interface. Reinitialize the autosampler.

Detector Error Messages

These errors are specific to the variable wavelength detector.

ADC Hardware Error

A/D-Converter hardware is defective.

Probable cause	Suggested actions
1 A/D-Converter hardware is defective.	Replace the optical unit.

Calibration Failed

The intensity maximum was not found during wavelength calibration.Calibration 0 Failed: Zero-order calibration failed.Calibration 1 Failed: 656 nm calibration failed. During zero-order and 656 nm calibration, the detector searches for the intensity maximum. If the maximum is not detected within the scan range, the error message is generated.

Probable cause	Suggested actions
1 Lamp is OFF.	Switch on the lamp.
2 Incorrect flow cell installation.	Ensure the flow cell are installed correctly.
3 Flow cell contamination or air bubbles.	Clean/replace flow cell windows or remove air bubbles.
4 Intensity too low.	Replace lamp.
5 Current step value too far from maximum.	Enter a different calibration step value (different scan range). Repeat the calibration.

Probable cause	Suggested actions
6 Misaligned/defective grating assembly.	Run the grating-motor test to determine if the grating assembly is defective. If defective, replace the optical unit.
7 ProbableCause?	Exchange the VWM board.

Filter Check Failed

The automatic filter check after lamp ignition has failed. When the lamp is switched on, the detector moves the cutoff filter into the light path. If the filter is functioning correctly, a decrease in lamp intensity is seen. If the expected intensity decrease is not detected, the error message is generated.

Probable cause	Suggested actions
1 Filter motor defective.	Run the filter motor test to determine if the motor is defective.
2 Defective or missing filter.	Exchange the filter assembly.

Filter Missing

The filter motor is not detected.

Probable cause	Suggested actions
1 Filter motor is not connected.	Re-connect the filter motor on the main board.
2 Cable/connector defective.	Replace the optical unit or main board.

Grating/Filter Motor Test Failed

The motor test has failed.

test

- Test 0 Failed: Filter motor.
- Test 1 Failed: Grating motor.

During the motor tests, the detector moves the motor to the end position while monitoring the end-position sensor. If the end position is not found, the error message is generated.

Probable cause	Suggested actions
1 Defective motor assembly.	Please contact your Agilent service representative.

Grating Missing

The grating motor is not detected.

Probable cause	Suggested actions
1 Grating motor is not connected.	Re-connect the filter motor on the main board.
2 Cable/connector defective.	Replace the optical unit or main board.

Heater Current Missing

The lamp heater current in the detector is missing. During lamp ignition, the processor monitors the heater current. If the current does not rise above the lower limit within one second, the error message is generated.

Probable cause	Suggested actions
1 Lamp disconnected.	Ensure the lamp is connected.
2 Ignition started without the top foam in place.	Replace the top foam, and turn on the lamp.
3 Defective VWM board	Please contact your Agilent service representative.
4 Defective or non-Agilent lamp.	Exchange the lamp.
5 Defective power supply.	Please contact your Agilent service representative.

Heater Failed

Every time the deuterium lamp or the tungsten lamp is switched on or off a heater self-test is performed. If the test fails an error event is created. As a result the temperature control is switched off.

Probable cause	Suggested actions
1 Defective connector or cable.	Please contact your Agilent service representative.
2 Defective heater.	Please contact your Agilent service representative.

Heater Power At Limit

The available power of the heater reached either the upper or lower limit. This event is sent only once per run. The parameter determines which limit has been hit:

0 means upper power limit hit (excessive ambient temperature drop).

1 means lower power limit hit (excessive ambient temperature increase).

Probable cause	Suggested actions
1 Ambient conditions have changed too much during the run, so that optimum results may not be guaranteed.	• Verify that the reproducibility of your results is not affected. • Expose the detector to more stable ambient conditions.

Holmium Oxide Test Failed

The holmium oxide test in the detector has failed. During the holmium test, the detector moves the holmium filter into the light path, and compares the measured absorbance maxima of the holmium oxide filter with expected maxima. If the measured maxima are outside the limits, the error message is generated.

Probable cause	Suggested actions
1 Misaligned/defective grating assembly.	• Ensure the flow cell is inserted correctly, and is free from contamination (cell windows, buffers, and so on). • Run the filter-motor test to determine if the grating motor assembly is defective. Exchange the filter motor assembly. • Run the grating-motor test to determine if the grating assembly is defective. If defective, replace the optical unit.

Illegal Value From Air Inlet Temperature Sensor

This temperature sensor (located on the detector main board) delivered a value outside the allowed range. The parameter of this event equals the measured temperature in 1/100 centigrade. As a result the temperature control is switched off.

Probable cause	Suggested actions
1 The temperature sensor is defect.	Please contact your Agilent service representative.
2 Detector is exposed to illegal ambient conditions.	Verify that the ambient conditions are within the allowed range.

Illegal Value From Temperature Sensor

This temperature sensor delivered a value outside the allowed range. The parameter of this event equals the measured temperature in 1/100 centigrade. As a result the temperature control is switched off.

Probable cause	Suggested actions
1 Dirty or defective sensor.	Please contact your Agilent service representative. Links:
2 Detector is exposed to illegal ambient conditions.	Verify that the ambient conditions are within the allowed range.

Lamp Current Missing

The lamp anode current is missing. The processor continually monitors the anode current drawn by the lamp during operation. If the anode current falls below the lower current limit, the error message is generated.

Probable cause	Suggested actions
1 Lamp disconnected.	Ensure the lamp connector is seated firmly.
2 Top foam removed while lamp is on.	Replace the top foam, and turn ON the lamp.
3 Defective or non-Agilent lamp.	Exchange the lamp.
4 Defective VWM board	Please contact your Agilent service representative.
5 Defective power supply.	Please contact your Agilent service representative.

Lamp Ignition Failed

The lamp failed to ignite. The processor monitors the lamp current during the ignition cycle. If the lamp current does not rise above the lower limit within 2 – 5 seconds, the error message is generated.

Probable cause	Suggested actions
1 Lamp disconnected.	Ensure the lamp is connected.
2 Defective or non-Agilent lamp.	Exchange the lamp.
3 Defective power supply.	Please contact your Agilent service representative.
4 Defective VWM board	Please contact your Agilent service representative.

Lamp Voltage Missing

The lamp anode voltage is missing. The processor continually monitors the anode voltage across the lamp during operation. If the anode voltage falls below the lower limit, the error message is generated.

Probable cause	Suggested actions
1 Defective or non-Agilent lamp.	Exchange the lamp.
2 Defective power supply.	Please contact your Agilent service representative.
3 Defective VWM board	Please contact your Agilent service representative.

Wavelength Check Failed

The automatic wavelength check after lamp ignition has failed. When the lamp is switched on, the detector waits 1 minute to warm-up the lamp. Then a check of the deuterium emission line (656 nm) via the reference diode is performed. If the emission line is more than 3 nm away from 656 nm, the error message is generated.

Probable cause	Suggested actions
1 Calibration incorrect.	Recalibrate the detector.

6
Preventive Maintenance and Repair

Preventive Maintenance (PM) is an Agilent Technologies recommended procedure designed to reduce the likelihood of electro-mechanical failures. Failure to perform preventive maintenance may reduce the long-term reliability of your Agilent 1220 Infinity LC.

PM Scope of Work and Checklist

Preventive Maintenance Scope of Work and Checklist

To perform a preventive maintenance (PM), follow the *PM Scope of Work* and *PM Checklist* step by step. The *PM Scope of Work* and *PM Checklist* documents can be found in the on the DVD for the Lab Advisor Software.

Early Maintenance Feedback

EMF counters for the pump

The user-settable EMF limits for the EMF counters enable the early maintenance feedback to be adapted to specific user requirements. The wear of pump components is dependent on the analytical conditions. Therefore, the definition of the maximum limits needs to be determined based on the specific operating conditions of the instrument.

The Agilent 1220 Infinity LC pump provides a series of EMF counters for the pump head. Each counter increments with pump use, and can be assigned a maximum limit that provides visual feedback in the user interface when the limit is exceeded. Each counter can be reset to zero after maintenance has been done. The pump provides the following EMF counters:

Pump liquimeter

The pump liquimeter displays the total volume of solvent pumped by the pump head since the last reset of the counters. The pump liquimeter can be assigned an EMF (maximum) limit. When the limit is exceeded, the EMF flag in the user interface is displayed.

Seal wear counters

The seal wear counters display a value derived from pressure and flow (both contribute to seal wear). The values increment with pump usage until the counters are reset after seal maintenance. Both seal wear counters can be assigned an EMF (maximum) limit. When the limit is exceeded, the EMF flag in the user interface is displayed.

EMF counters for the autosampler

The user-settable EMF limits for the EMF counters enable the early maintenance feedback to be adapted to specific user requirements. The wear of autosampler components is dependent on the analytical conditions. Therefore, the definition of the maximum limits need to be determined based on the specific operating conditions of the instrument.

The autosampler provides two EMF counters. Each counter increments with autosampler use, and can be assigned a maximum limit which provides visual feedback in the user interface when the limit is exceeded. Each counter can be reset to zero after maintenance has been done. The autosampler provides the following EMF counters:

Injection valve counter

This counter display the total number of switches of the injection valve since the last reset of the counter.

Needle movements counter

This counter displays the total number of movements of the needle into the seat since the last reset of the counter.

EMF counters for the variable wavelength detector

The user-settable EMF limits for the EMF counter enables the early maintenance feedback to be adapted to specific user requirements. The useful lamp burn time is dependent on the requirements for the analysis (high or low sensitivity analysis, wavelength, and so on). Therefore, the definition of the maximum limits need to be determined based on the specific operating conditions of the instrument.

The detector module provides a EMF counter for the lamp. The counter increments with lamp use, and can be assigned a maximum limit which provides visual feedback in the user interface when the limit is exceeded. The counter can be reset to zero after the lamp is exchanged. The detector provides the following EMF counters:

Deuterium lamp on-time

This counter shows the total burn time of the deuterium lamp in hours.

Solvent Delivery System

Introduction

The Agilent 1220 Infinity LC pump is designed for easy repair. The procedures described in this section can be done with the pump in place in the rack.

The most frequent repairs, such as exchanging the plunger seals or purge valve seal, can be done from the front of the pump.

Table 52 Simple repair procedures - overview

Procedure	Typical frequency	Notes
Checking and cleaning the solvent filter	If solvent filter is blocked	Gradient performance problems, intermittent pressure fluctuations
Exchanging the Passive Inlet Valve	If internally leaking	Pressure ripple unstable, run leak test for verification
Exchanging the Outlet Ball Valve	If internally leaking	Pressure ripple unstable, run leak test for verification
Exchanging the Purge Valve Frit or the Purge Valve	If internally leaking	Solvent dripping out of waste outlet when valve closed
Exchanging the Purge Valve Frit or the Purge Valve	If the frit shows indication of contamination or blockage	A pressure drop of > 10 bar across the frit (5 ml/min H_2O with purge open) indicates blockage
Exchanging the Pump Seals	If pump performance indicates seal wear	Leaks at lower pump head side, unstable retention times, pressure ripple unstable — run leak test for verification
Seal Wear-in Procedure	After exchanging the pump seals	

Table 52 Simple repair procedures - overview

Procedure	Typical frequency	Notes
Removing the pump head assembly	Before exchanging the seals, or plungers	
Exchanging the Plungers	If scratched	Seal life time shorter than normally expected — check plungers while changing the seals

WARNING

Instrument is partially energized when switched off.

The power supply still uses some power, even if the switch on the front panel is turned off.

→ To disconnect the Agilent 1220 Infinity LC pump from line, unplug the power cord.

WARNING

Sharp metal edges

Sharp-edged parts of the equipment may cause injuries.

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

WARNING

When opening capillary or tube fittings solvents may leak out.

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

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

CAUTION

Electronic boards and components are sensitive to electrostatic discharge (ESD).

ESD can damage electronic boards and components.

→ In order to prevent damage always use an ESD protection when handling electronic boards and components.

Checking and Cleaning the Solvent Filter

WARNING

Small particles can permanently block the capillaries and valves of the pump.

Damage to the Agilent 1220 Infinity LC pump

→ Always filter solvents.

→ Never use the pump without solvent inlet filter.

NOTE

If the filter is in good condition the solvent will freely drip out of the solvent tube (hydrostatic pressure). If the solvent filter is partly blocked only very little solvent will drip out of the solvent tube.

Cleaning the Solvent Filter

When If solvent filter is blocked

Parts required

#	Description
1	Concentrated nitric acid (35%)
1	Bidistilled water
1	Beaker

Preparations Remove solvent inlet tube from the Inlet Valve.

1. Remove the blocked solvent filter from the bottle-head assembly and place it in a beaker with concentrated nitric acid (65%) for one hour.
2. Thoroughly flush the filter with bidistilled water (remove all nitric acid, some capillary columns can be damaged by nitric acid).
3. Replace the filter.

Exchanging the Passive Inlet Valve

When If leaking internally (backflow)

Tools required

- Wrench 14 mm
- Pair of Tweezers

Parts required

#	Description
G1312-60066	Passive Inlet Valve

Preparations Place the solvent bottles under the pump.

1 Remove the upper front cover.

2 Disconnect the solvent inlet tube from the inlet valve (be aware that solvent may leak out of the tube due to hydrostatic flow).

3 Unscrew the adapter from the inlet valve (optional).

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

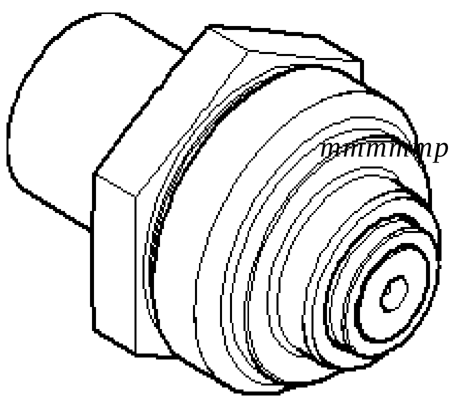


Figure 25 Passive Inlet Valve

	Passive Inlet Valve: part number *G4280-60036*
1	O-Ring: part number *0905-1684*

5 Insert the new valve into the pump head.

6 Using the 14 mm wrench, turn the nut until it is hand-tight.

7 Reconnect the adapter at the inlet valve (optional).

8 Reconnect the solvent inlet tube to the adapter.

9 Reinstall the front cover.

NOTE

After an exchange of the valve it may take several ml of pumping with the solvent used in the current application, before the flow stabilizes at a %-ripple as low as it used to be when the system was still working properly.

Exchanging the Outlet Ball Valve

When If leaking internally

Tools required Wrench 1/4 inch

Parts required

#	Description
G1312-60067	Outlet ball valve

Preparations Switch off pump at the main power switch

Remove the upper front cover

1 Using a 1/4 inch wrench, disconnect the valve capillary from the outlet ball valve.
2 Using the 14 mm wrench, loosen the valve and remove it from the pump body.
3 Check that the new valve is assembled correctly and that the gold seal is present (if the gold seal is deformed, it should be replaced).

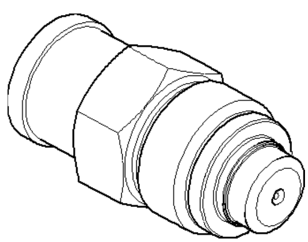
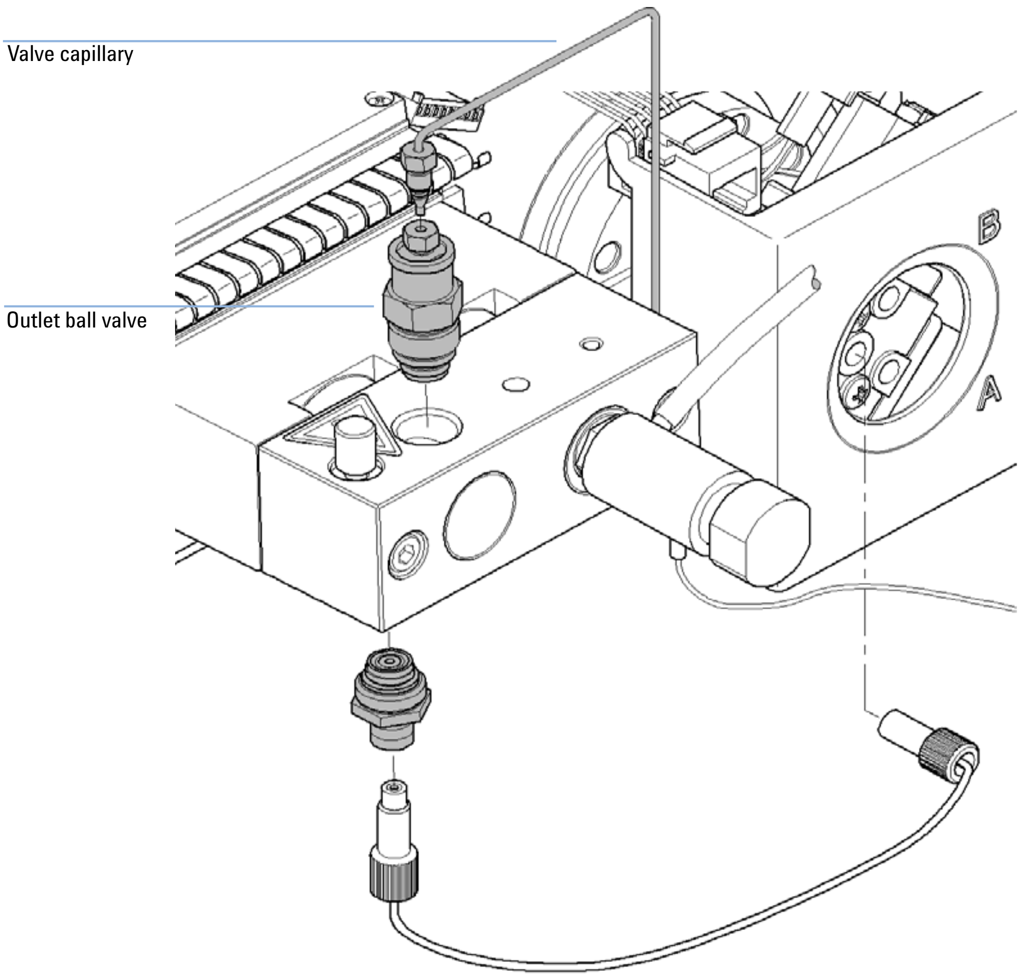


Figure 26 Outlet Ball Valve

1	Outlet ball valve, complete assembly *G1312-60067*

4 Reinstall the outlet ball valve and tighten the valve.
5 Reconnect the valve capillary.


Valve capillary
Outlet ball valve
B
A

Exchanging the Purge Valve Frit or the Purge Valve

When	*Frit:* when plunger seals are exchanged or when contaminated or blocked (pressure drop of > 10 bar across the frit at a flow rate of 5 ml/min of H_20 with purge valve opened) *Purge valve:* if internally leaking
Tools required	• Wrench 1/4 inch • Wrench 14 mm • Pair of tweezers or toothpick

Parts required

#	p/n	Description
5	01018-22707	PTFE frit (pack of 5)
1	G4280-60061	Purge valve

Preparations

Switch off pump at the main power switch

Remove the upper front cover

1 Using a 1/4 inch wrench, disconnect the pump outlet capillary at the purge valve.
2 Disconnect the waste tube. Beware of leaking solvents due to hydrostatic pressure.
3 Using the 14 mm wrench, unscrew the purge valve and remove it.
4 Remove the plastic cap with the gold seal from the purge valve.

5 Using a pair of tweezers or a toothpick, remove the frit.

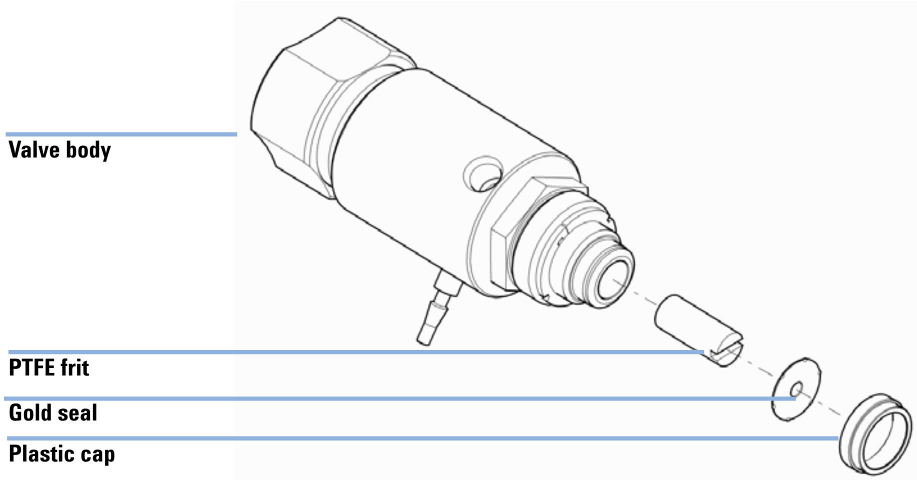


Figure 27 Purge Valve Parts

6 Place a new frit into the purge valve, with the orientation of the frit as shown above.

7 Reinstall the cap with the gold seal.

NOTE If the gold seal is deformed, exchange it before reinstalling.

8 Insert the purge valve into the pump head and locate the pump outlet capillary and the waste tube.

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

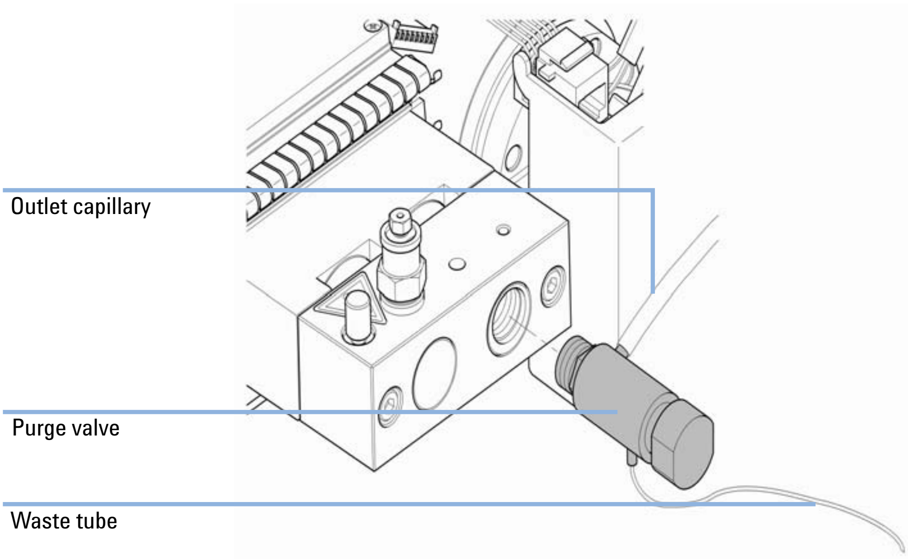


Figure 28 Exchanging the Purge Valve

Removing the Pump Head Assembly

When Before exchanging the seals

Before exchanging the plungers

Tools required

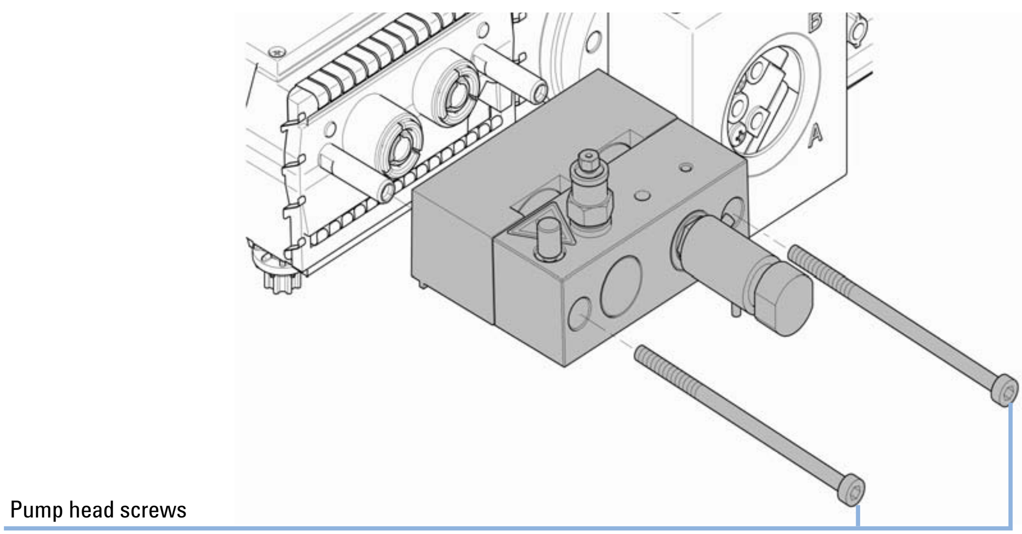
- Wrench 1/4 inch
- 4-mm hexagonal key

Preparations Switch off pump at the main power switch

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

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

1 Remove the upper front cover.
2 Using a 1/4 inch wrench, remove the outlet capillary.
3 Disconnect the capillary from the Outlet Ball Valve.
4 Remove the waste tubing and disconnect the inlet valve tubing.
5 Remove the capillary at the bottom of the Pumphead.
6 Using a 4 mm hexagonal key, loosen the two pumphead screws stepwise and remove the pumphead from the pump drive.



Exchanging the Pump Seals and Seal Wear-in Procedure

Exchanging the Pump Seals

When Seal leaking, if indicated by the results of the leak test.

Tools required

- Wrench 1/4 inch
- 4-mm hexagonal key

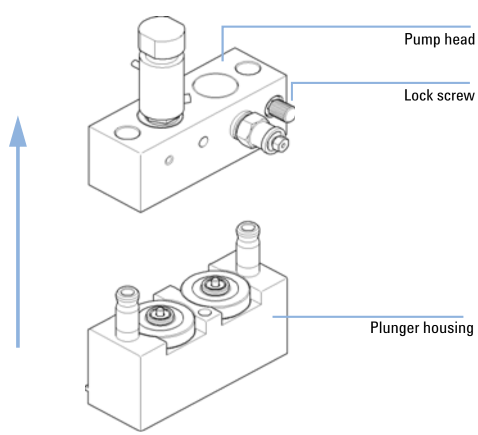
Parts required

#	Description
5063-6589	Metering seal (pack of 2) for 100 µl analytical head
0905-1420	PE seals (pack of 2)
5022-2159	Restriction capillary

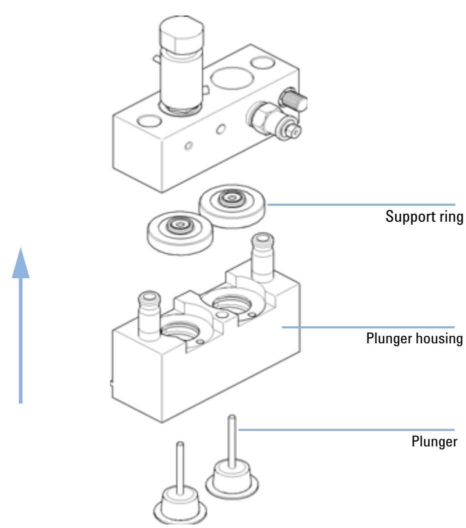
Preparations Switch off the pump at the main power switch.

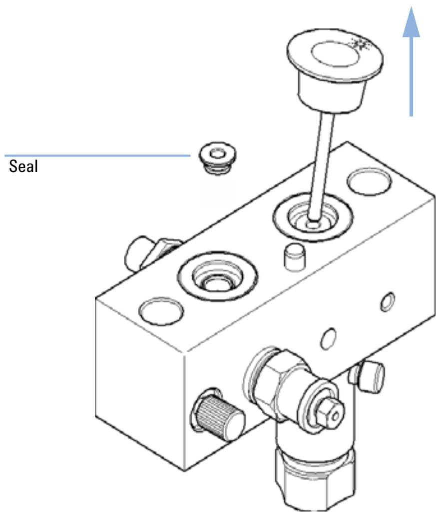
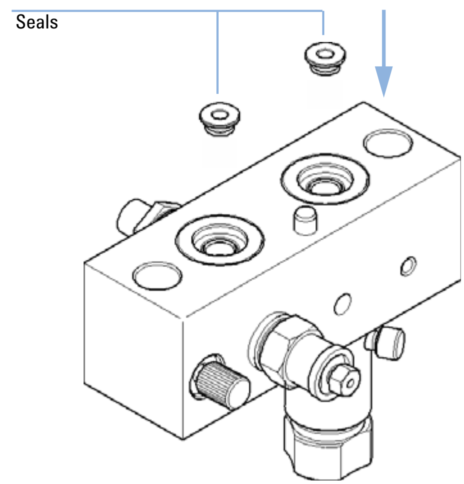
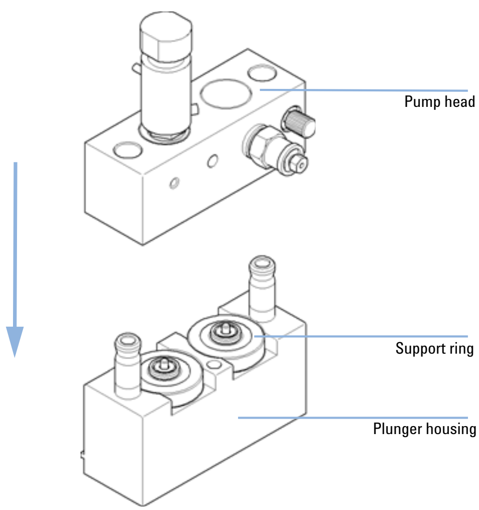
Remove the upper front cover.

1 Place the pump head on a flat surface. Loosen the lock screw (two revolutions) and while holding the lower half of the assembly carefully pull the pump head away from the plunger housing.



2 Remove the support rings from the plunger housing and lift the housing away from the plungers.



3 Using one of the plungers carefully remove the seal from the pump head (be careful not to break the plunger). Remove wear retainers, if still present.  	**4** Insert new seals into the pump head. 
5 Reassemble the pump head assembly.  	

Seal Wear-in Procedure

CAUTION

This procedure is required for standard seals only (5063-6589).

It will damage the normal-phase application seals (0905-1420).

→ Never perform the seal wear-in procedure with normal-phase application seals

1. Place a bottle with 100 ml of Isopropanol in the solvent cabinet and attach a bottle-head assembly (including tubing) to the bottle.
2. Connect the inlet tube from the bottle head directly to the Inlet Valve.
3. Connect one end of the restriction capillary (5022-2159) to the purge valve. Insert the other end into a waste container.
4. Open the purge valve and purge the system for 5 minutes with isopropanol at a flow rate of 2 mL/min.
5. Close the purge valve and set the flow to a rate adequate to achieve a pressure of 350 bar.
6. Pump for 15 minutes at this pressure to wear in the seals
7. Turn off the pump and slowly open the purge valve to release the pressure from the system.
8. Disconnect the restriction capillary and reinstall the bottle containing the solvent for your application.
9. Rinse your system with the solvent used for your application.

Exchanging the Plungers

When When scratched

Tools required

- Wrench 1/4 inch
- 4-mm hexagonal key

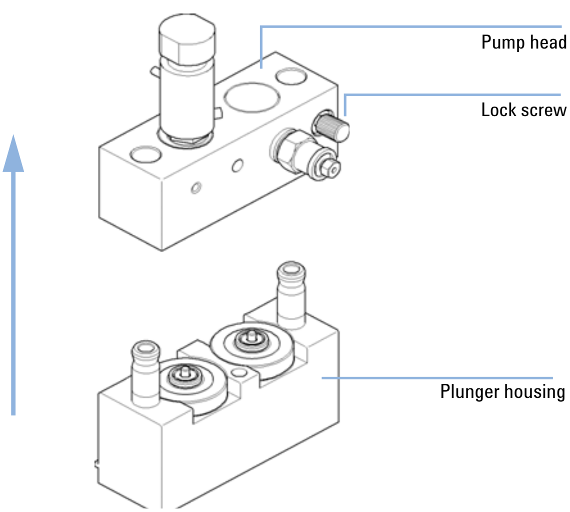
Parts required

#	Description
5067-4695	Plunger

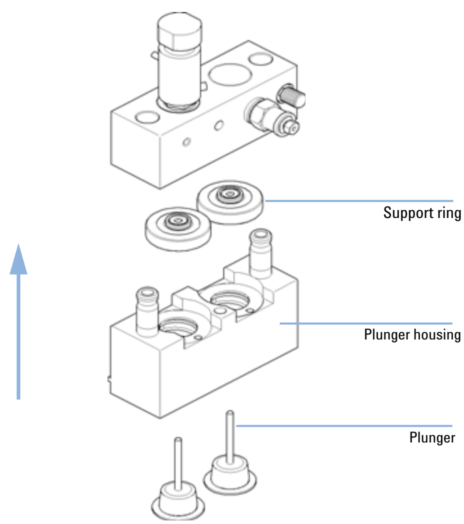
Preparations Switch off the pump at the main power switch.

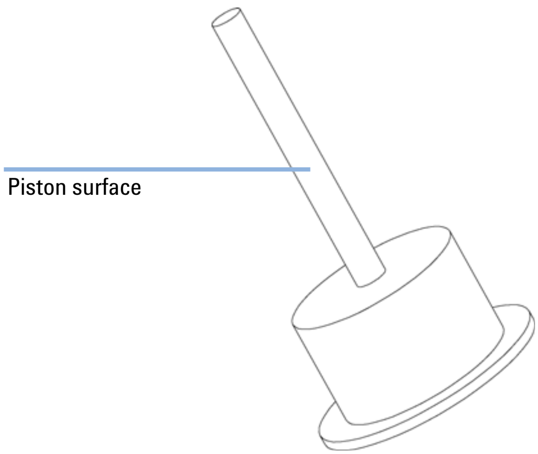
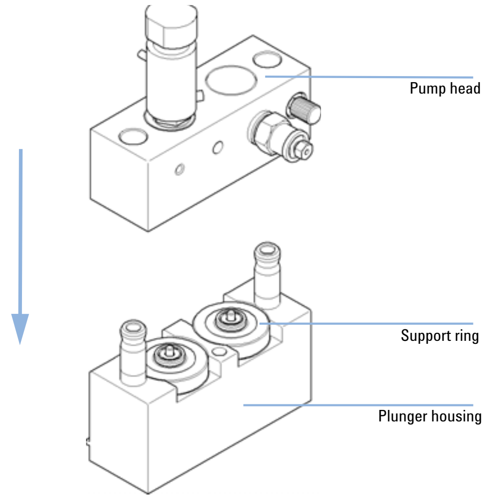
Remove the upper front cover.

1 Place the pump head on a flat surface. Loosen the lock screw (two revolutions) and while holding the lower half of the assembly carefully pull the pump head away from the plunger housing.



2 Remove the support rings from the plunger housing and lift the housing away from the plungers.



3 Check the plunger surface and remove any deposits. The plunger surface can be cleaned with either alcohol or tooth paste. If the plunger is scratched, replace it. 	**4** Reassemble the pump head assembly. 

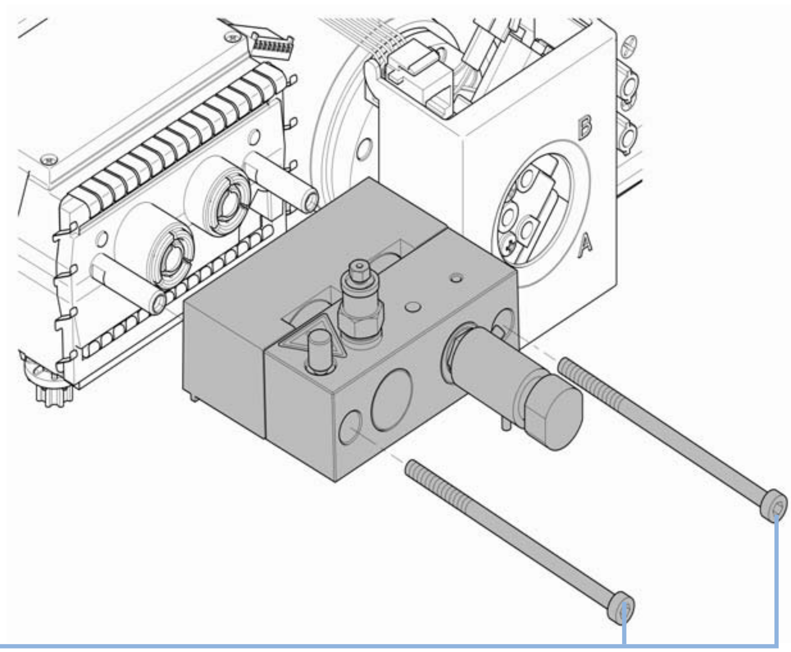
Reinstalling the Pump Head Assembly

When When reassembling the pump

Tools required
- 4-mm hexagonal key

1 Slide the Pumphead Assembly onto the Pumpdrive.

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



Pump head screws

3 Reconnect the capillaries and tubing.

4 Reinstall the front cover.

Exchanging the Dual-Channel Gradient Valve (DCGV)

Tools required Screwdriver Pozidriv #1

Parts required

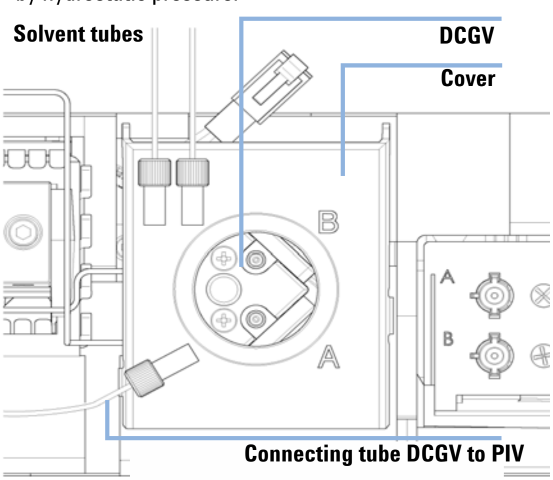
#	p/n	Description
1	G4280-60004	Dual-channel gradient valve

Preparations Switch off the pump at the power switch.

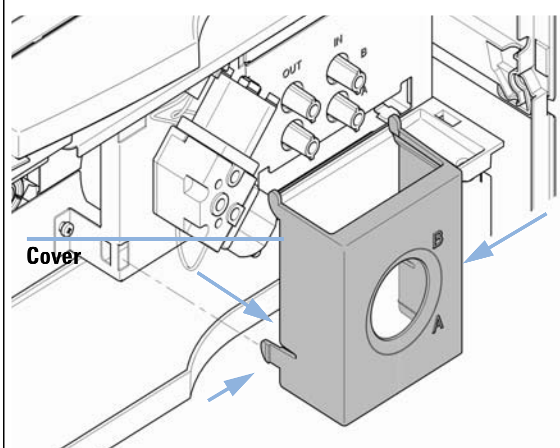
Remove the upper front cover to gain access to the pump mechanics.

NOTE The lifetime of the dual-channel gradient valve can be maintained by regularly flushing the valve, especially when using buffer solutions. If using buffer solutions, flush all channels of the valve with water to prevent precipitation of the buffer. Salt crystals can be forced into an unused channel and form plugs that may lead to leaks of that channel; such leaks will interfere with the general performance of the valve. When using buffer solutions and organic solvents in the Agilent 1220 Infinity LC Pump, it is recommended to connect the buffer solution to the lower port of the gradient valve and the organic solvent to the upper port. It is best to have the organic channel directly above the salt solution channel (A: salt solution, B: organic solvent).

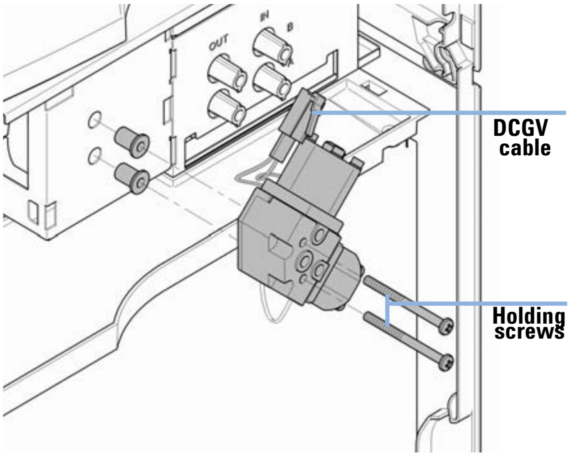
1 Disconnect the connecting tube, waste tube and the solvent tubes from the DCGV, unclip them from the tube clips and place them into the solvent cabinet to avoid flow by hydrostatic pressure.



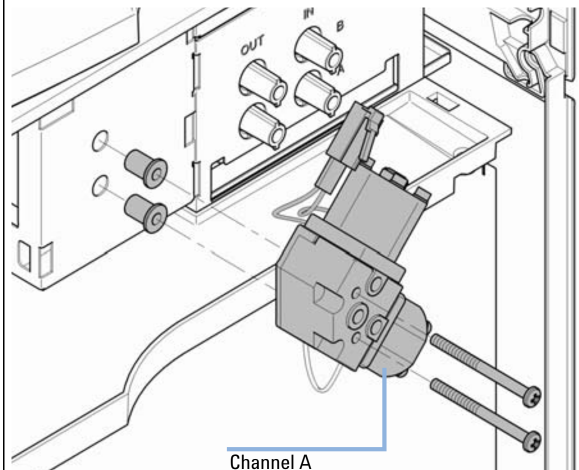
2 Press the lower sides of the cover to unclip it. Remove the cover.



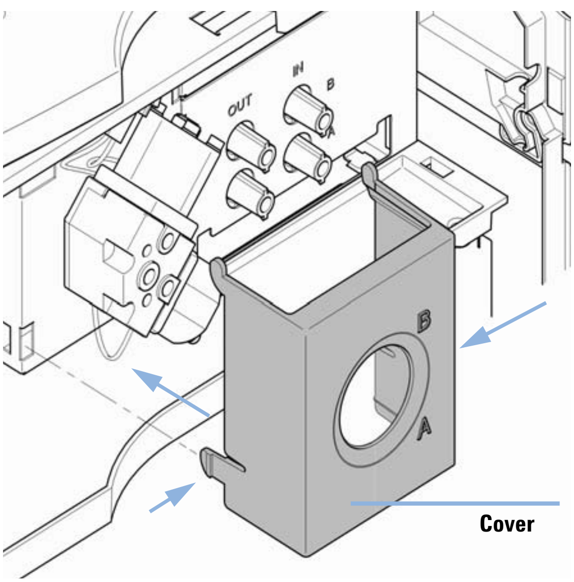
3 Disconnect the DCGV cable, unscrew the two holding screws and remove the valve.



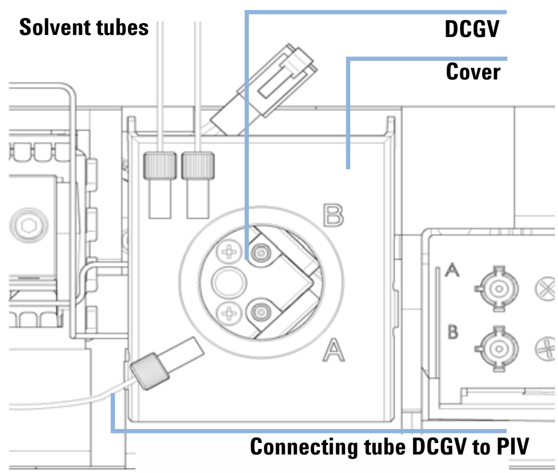
4 Place the new DCGV into position. Make sure that the valve is positioned with the A-channel at the bottom-right position. Tighten the two holding screws and connect the cable to its connector.



5 Replace the DCGV cover. Reconnect the waste funnel with the waste tube holder in the top cover. Insert waste tube in the holder in the waste pan and clip tube to the DCGV cover.



6 Reconnect the tube from the inlet valve to the middle position of the DCGV and then the solvent tubes at channel A and B of the DCGV.



Manual Injector

Overview of Maintenance Procedures

Table 53 Overview of Maintenance Procedures

Procedure	Typical Frequency	Time Required
Flushing the injector	After using aqueous buffers or salt solutions	5 minutes
Exchanging the injection-valve seal	After approximately 10000 to 20000 injections, or when the valve performance shows indication of leakage or wear	10 minutes

Flushing the Manual Injector

CAUTION

The use of aqueous buffers or salt solutions can lead to crystal formation.

Crystal formation may cause scratches on the injection seal.

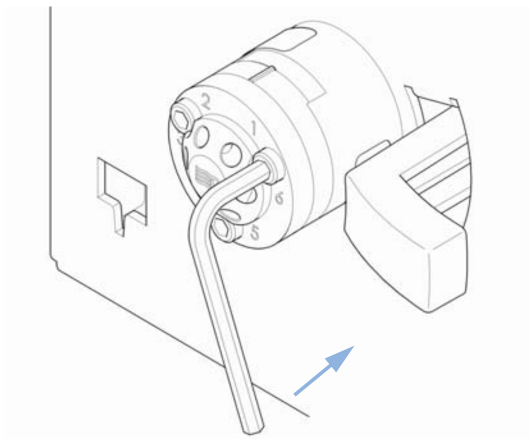
→ Always rinse the valve with water after using aqueous buffers or salt solutions.

1 Switch the valve to the INJECT position.
2 Use the pump to flush the sample loop and seal grooves.
3 Use the needle-port cleaner (supplied with the valve) and syringe to flush the needle port and vent capillary.

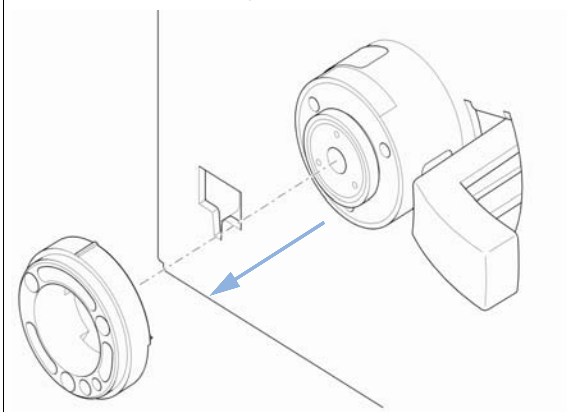
Exchanging the Injection Valve Seal

When	Poor injection-volume reproducibility Leaking injection valve
Tools required	Hex key, 9/64 inch (supplied in the tool kit)
Parts required	**Description** Rotor seal (Vespel™)

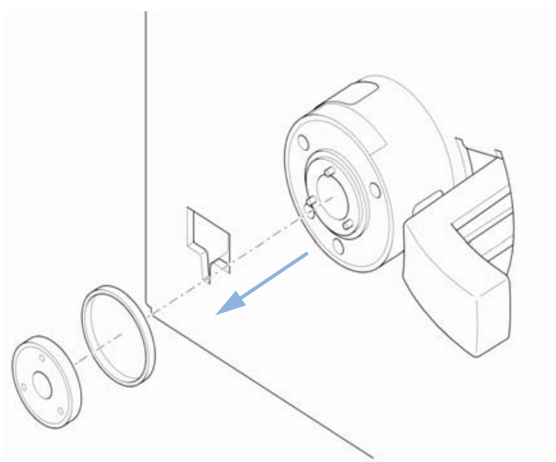
1 Loosen the three stator screws. Remove the stator head.



2 Remove the stator ring.

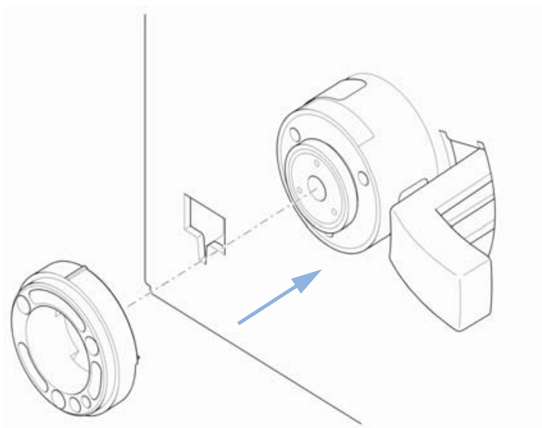


3 Remove the rotor seal.

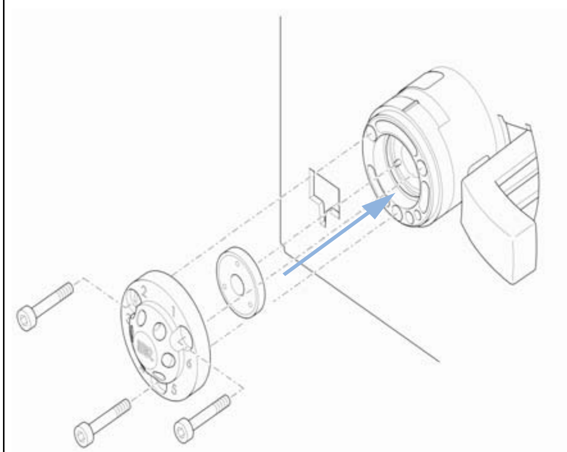


4 Install the new rotor seal.

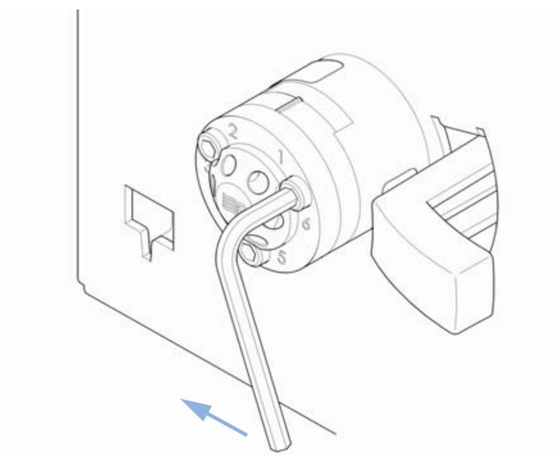
5 Install the stator ring. Ensure the pin in the stator ring is aligned with the hole in the valve body.



6 Install the stator head onto the valve.



7 Secure stator head in place with the stator screws. Tighten each screw alternately ¼-turn until the stator head is secure.



Autosampler

Introduction

The autosampler is designed for easy repair. The most frequent repairs can be done from the front of the instrument with the instrument in place in the Agilent 1220 Infinity LC. These repairs are described in following sections.

Overwiew of procedures

Procedure	Typical Frequency	Time Required
Exchanging the needle assembly	When needle shows indication of damage or blockage	15 minutes
Exchanging the seat assembly	When the seat shows indication of damage or blockage	10 minutes
Exchanging the rotor seal	After approximately 30000 to 40000 injections, or when the valve performance shows indication of leakage or wear	30 minutes
Exchanging the metering seal	When autosampler reproducibility indicates seal wear	30 minutes
Exchanging the gripper arm	When the gripper arm is defective	10 minutes

WARNING **The power supplies still use some power, even if the power switch on the front panel is turned off.**

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

→ Make sure that it is always possible to access the power plug.

→ Remove the power cable from the instrument before opening the cover.

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

Exchanging Internal Parts

Some repairs may require exchange of defective internal parts. Exchange of these parts requires removing the autosampler unit from the Agilent 1220 Infinity LC; these repairs have to be done by trained service personal only.

Safety flap, flex board

It is strongly recommended that the exchange of the safety flap, and flex board is done by Agilent-trained service personnel.

Transport assembly parts

The adjustment of the motors, and the tension on the drive belts are important for correct operation of the transport assembly. It is strongly recommended that exchange of drive belts, and the gripper assembly is done by Agilent-trained service personnel. There are no other field-replaceable parts in the transport assembly. If any other component is defective (flex board, spindles, plastic parts) the complete unit must be exchanged.

Cleaning the autosampler

WARNING **Electrical shock hazard**

Liquid dripping into the autosampler could cause shock hazard and damage to the autosampler.

→ Drain all solvent lines before opening any fittings.

The autosampler covers should be kept clean. Clean with a soft cloth slightly dampened with water or a solution of water and a mild detergent. Do not use an excessively damp cloth that liquid can drip into the autosampler.

Maintenance Functions

Certain maintenance procedures require the needle arm, metering device, and gripper assembly to be moved to specific positions to enable easy access to components. The maintenance functions move these assemblies into the appropriate maintenance position.

Exchanging the Needle Assembly

When	When the needle is visibly damaged When the needle is blocked
Tools required	• ¼ inch wrench (supplied in accessory kit) • 2.5 mm Hex key (supplied in accessory kit) • A pair of pliers

Parts required

#	p/n	Description
1	G1313-87201	Needle assembly for G1313-87101 or G1313-87103 needle-seat

Preparations

Select **Change Needle** in the **Tools** function in the Instrument Utilities or Lab Advisor Software and select **Start**.

When the needle is positioned approximately 15 mm above the needle seat, remove the upper front cover.

WARNING

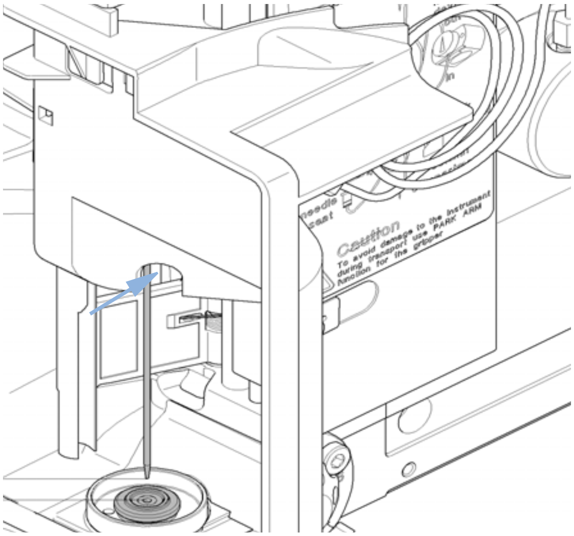
Personal injury

To avoid personal injury, keep fingers away from the needle area during autosampler operation.

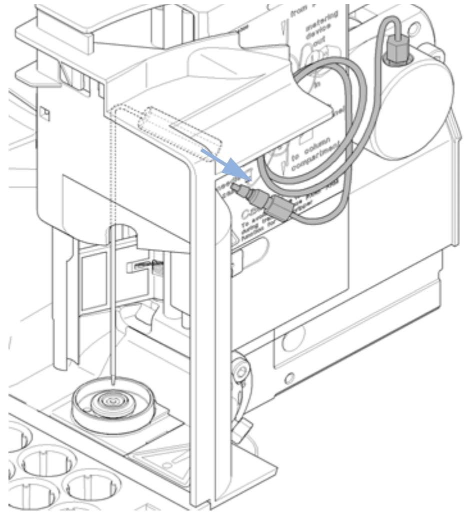
→ Do not bend the safety flap away from its position, or attempt to remove the safety cover.

→ Do not attempt to insert or remove a vial from the gripper when the gripper is positioned below the needle.

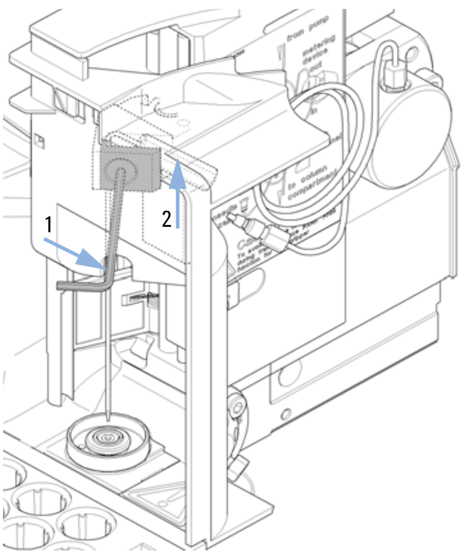
1 Select **Needle Down** until the needle screw is aligned with the hole in the safety cover.



2 Remove the sample-loop fitting from the needle fitting.



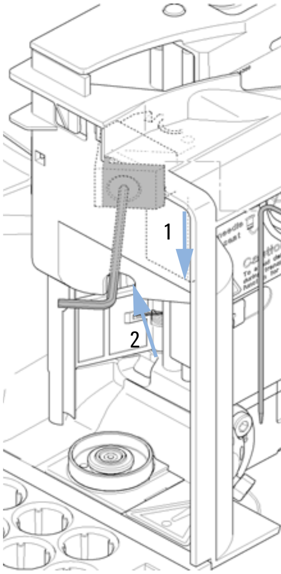
3 Loosen the fixing screw (1), and lift out the needle (2).



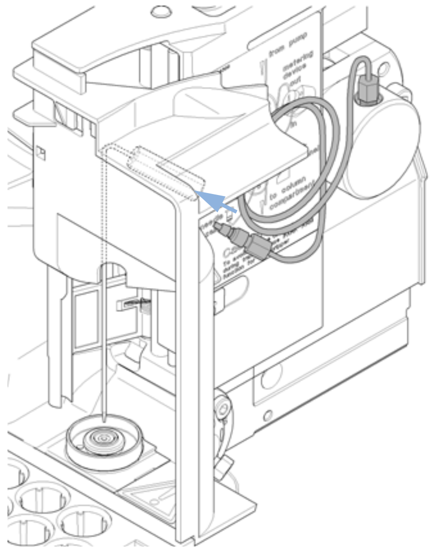
The needle arm must be in its lowest position before installing the new needle, otherwise leaks at the needle seat will occur due to incorrect needle installation.

4 Select **Needle Down** to move the needle arm to its lowest position.

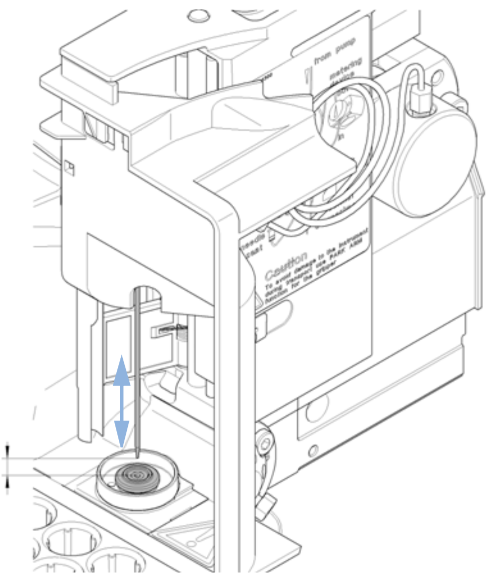
5 Insert the new needle (1). Align the needle in the seat, then tighten the screw firmly (2).



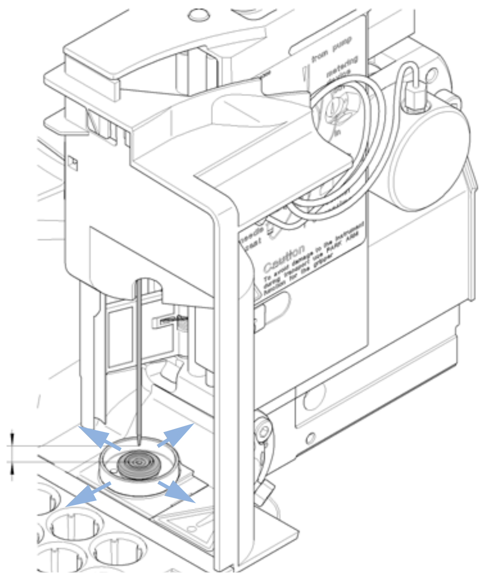
6 Reconnect the sample-loop fitting to the needle fitting.



7 Use **Needle Up** to lift the needle to a position approximately 2mm above the seat.



8 Ensure the needle is aligned with the seat.



Next Steps:

9 On completion of this procedure: Install the front cover.

10 Select “**End**” in the Tools function “**Change Needle**” .

Exchanging the Needle Seat Assembly

When	When the seat is visibly damaged When the seat capillary is blocked
Tools required	• 1/4 inch wrench (supplied in accessory kit). • Flat-head screwdriver.

Parts required

#	p/n	Description
1	G1313-87101	Needle-seat assy (0.17 mm i.d 2.3 µl)

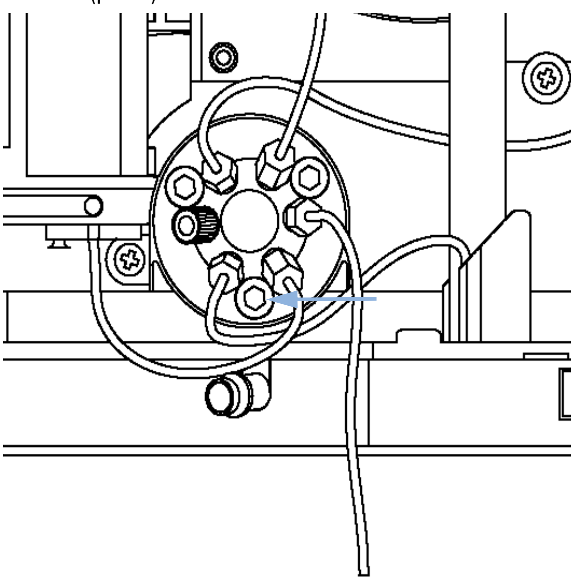
Preparations

Select "Start" in the Tools function in LMD Software "Change Needle"

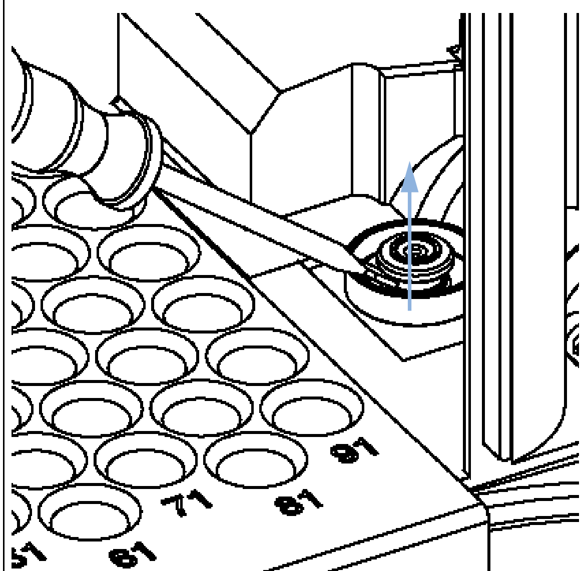
Remove the upper front cover.

Use the “Needle Up” command in the “Change Needle” function to lift the needle an addition 1 cm.

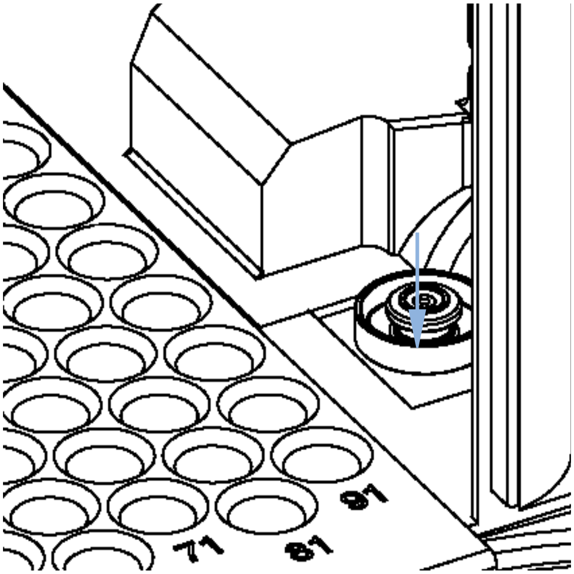
1 Disconnect the seat-capillary fitting from the injection valve (port 5).



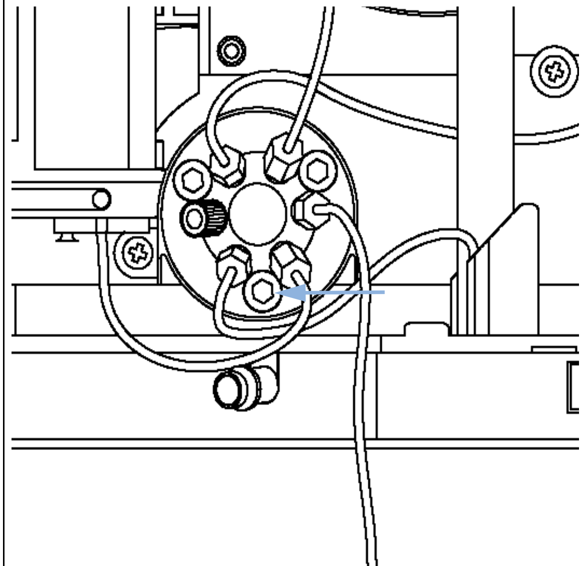
2 Use a small flat-head screwdriver to ease out the needle seat.



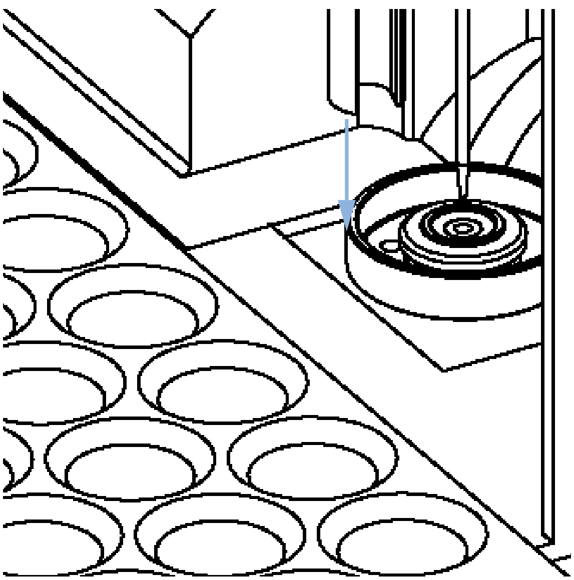
3 Insert the new needle-seat assembly. Press the seat firmly into position.



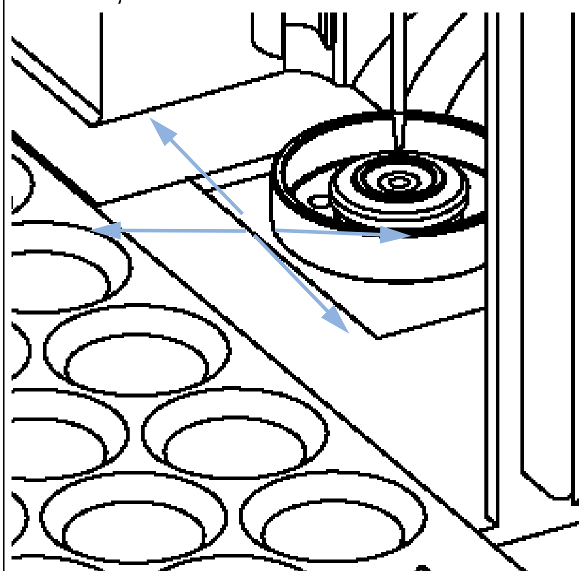
4 Connect the seat-capillary fitting to port 5 of the injection valve.



5 Use “**Down**” to position the needle approximately 2 mm above the seat



6 Ensure the needle is aligned with the seat. If required, bend the needle slightly until the needle is aligned correctly.



Next Steps:

7 On completion of this procedure: Install the front cover.

8 Select “**End**” in the Tools function “**Change Needle**”.

Exchanging the Rotor Seal

When	Poor injection-volume reproducibility Leaking injection valve
Tools required	1/4 inch wrench (supplied in the tool kit) Hex key, 9/16 inch (supplied in the tool kit)

Parts required

#	p/n	Description
1	0100-1853	Rotor seal (Vespel)
1	0100-1849	Rotor seal (Tefzel)
1	0101-1416	Rotor seal (PEEK)

Preparations

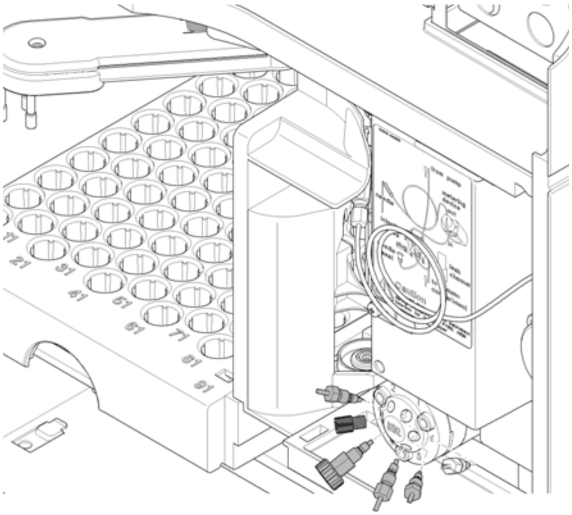
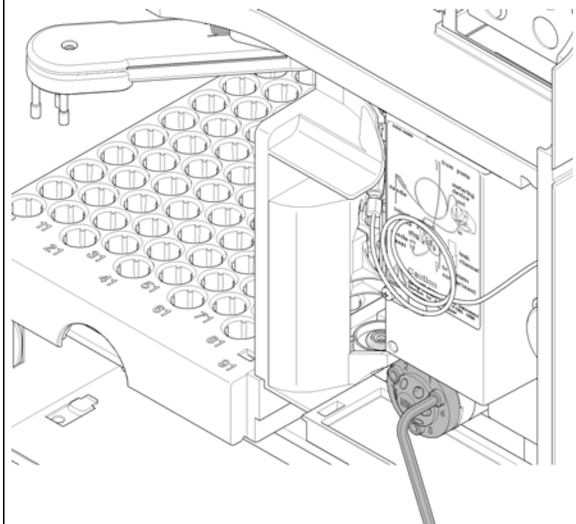
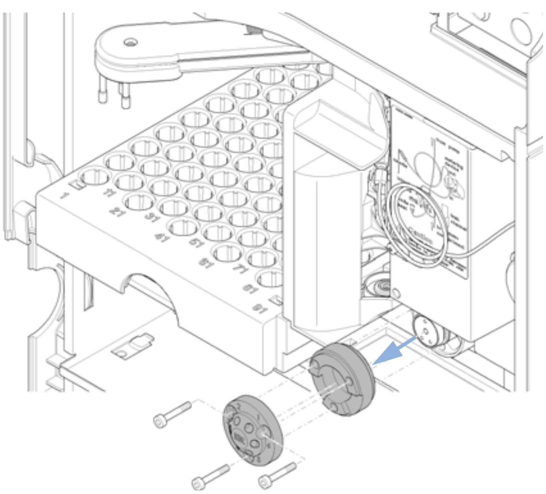
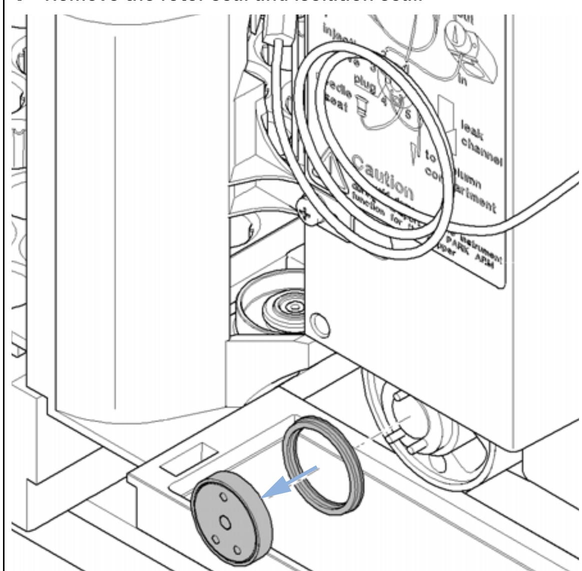
- Remove upper front cover.
- Remove the leak tubing (if necessary).

CAUTION

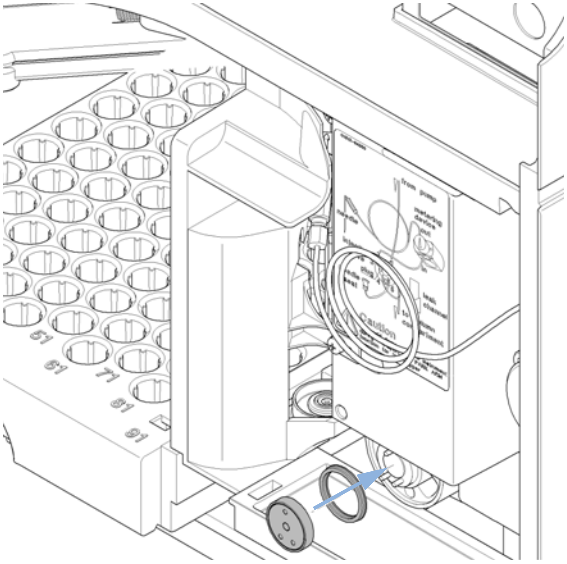
Removing the stator head

The stator face is held in place by the stator head. When you remove the stator head, the stator face can fall out of the valve.

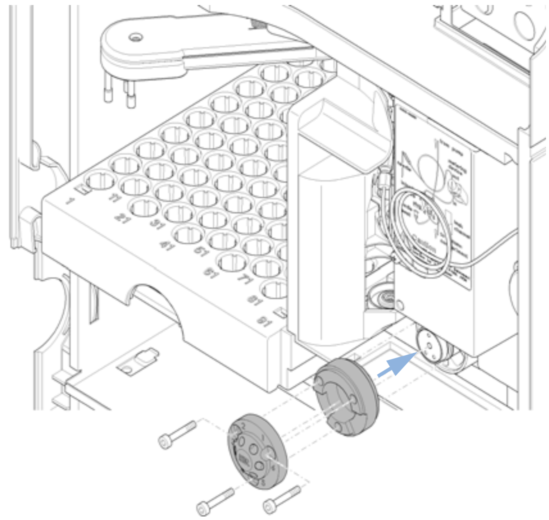
→ Carefully handle the valve to prevent damage to the stator face

1 Remove all capillary fittings from the injection-valve ports . 	**2** Loosen each fixing bolt two turns at a time. Remove the bolts from the head. 
3 Remove the stator head and stator ring. 	**4** Remove the rotor seal and isolation seal. 

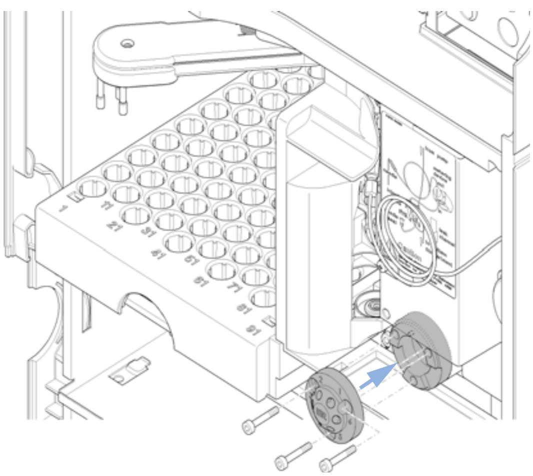
5 Install the new rotor seal and isolation seal. Ensure the metal spring inside the isolation seal faces towards the valve body.



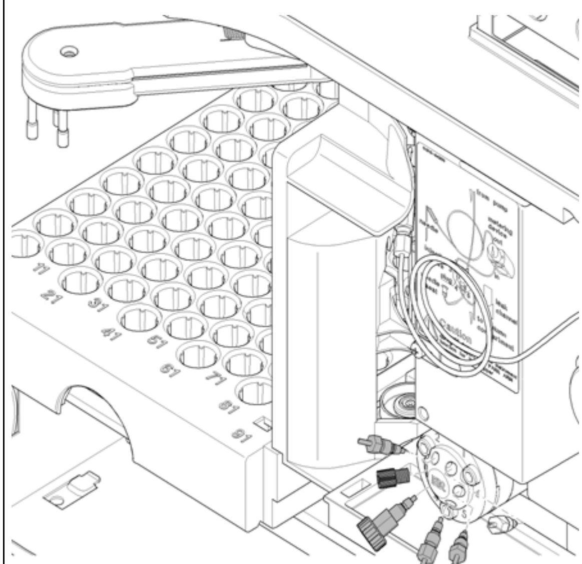
6 Install the stator ring with the short of the two pins facing towards you at the 12 o’clock position. Ensure the ring sits flat on the valve body.



7 Install stator head. Tighten the bolts alternately two turns at a time until the stator head is secure.



8 Reconnect the pump capillaries to the valve ports.



Next Steps:
9 Slide the waste tube into the waste holder in the leak tray.
10 On completion of this procedure: Install the front cover.

Exchanging the Metering Seal

When Poor injection-volume reproducibility
Leaking metering device

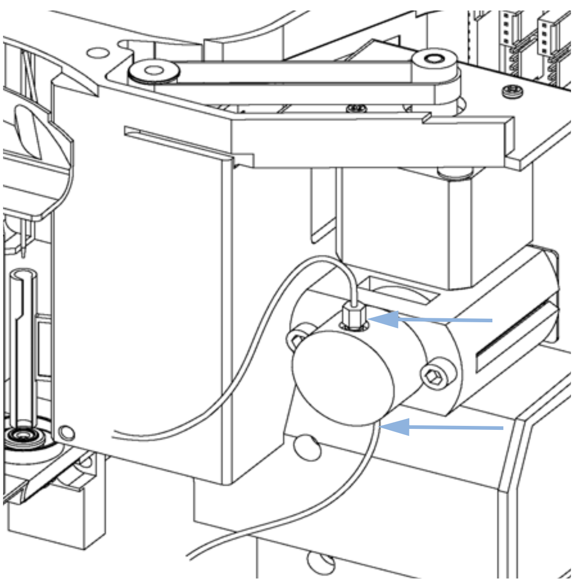
Tools required 1/4 inch wrench (supplied in the tool kit)
4 mm hex key (supplied in the tool kit)
3 mm hex key (supplied in the tool kit)

Parts required

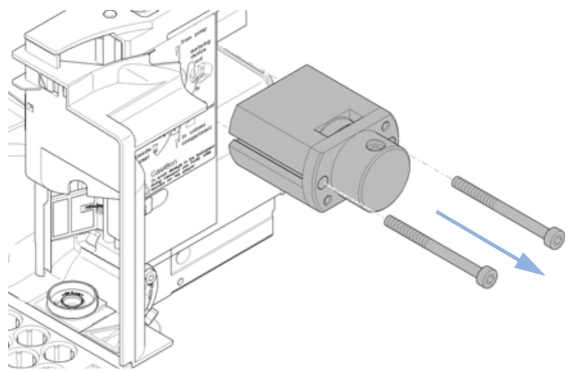
#	p/n	Description
1	5063-6589	Metering seal (pack of 2) for 100 µl analytical head
1	5063-6586	Plunger

Preparations Select **Start** in the Tools function in the LMD Software *Change piston*.
Remove the upper front cover.

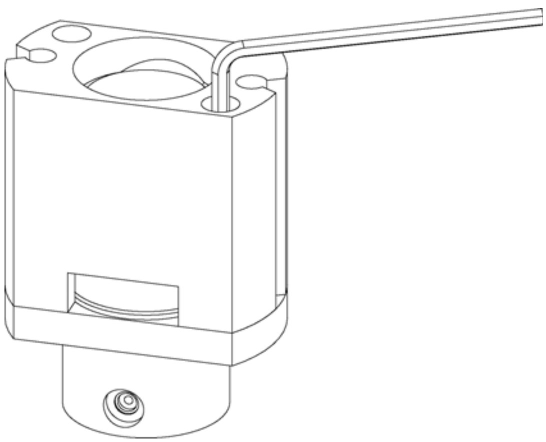
1 Remove the two capillaries from the metering-head assembly.



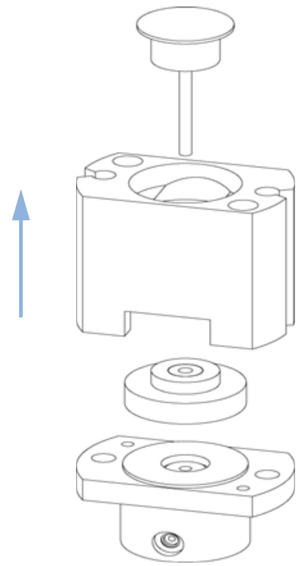
2 Remove the two fixing bolts, and pull the head assembly away from the sampler. Notice that the closed side of the metering head faces upwards.



3 Remove the two fixing bolts from the base of the metering head assembly.

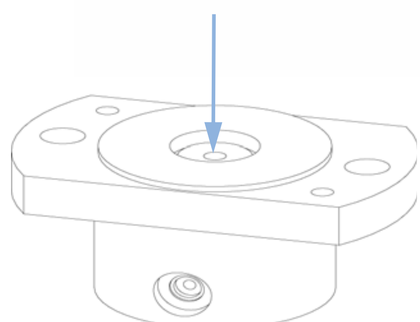


4 Disassemble the metering head assembly.

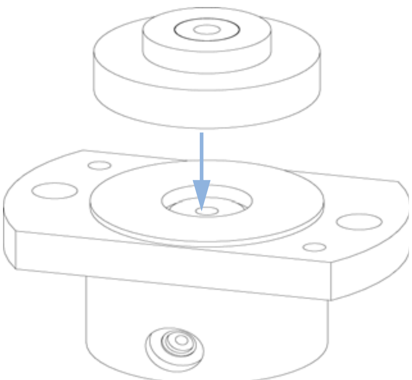


5 Use a small screwdriver to carefully remove the seal. Clean the chamber with lint-free cloth. Ensure all particular matter is removed.

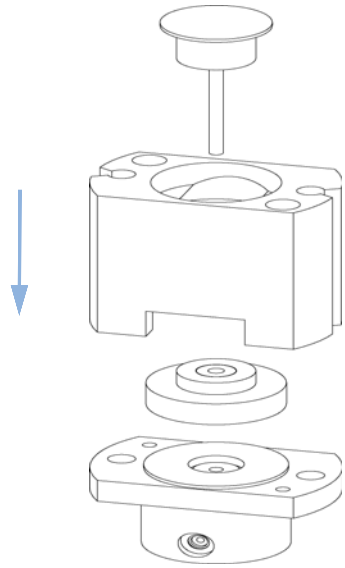
6 Install the new seal. Press the seal firmly into position.



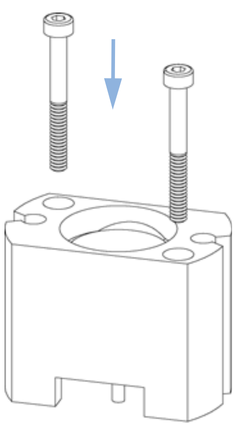
7 Place the piston guide on top of the seal.



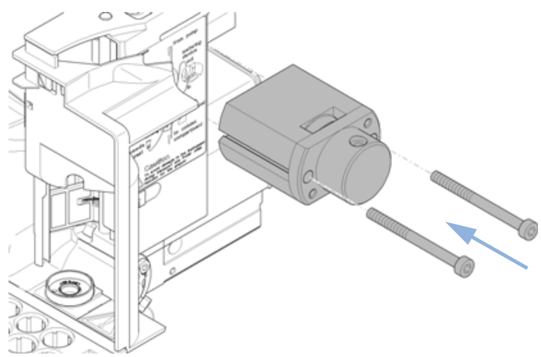
8 Reassemble the metering head assembly. Carefully insert the plunger into the base. The closed side of the metering head must be on the same side as the lower one of the two capillary drillings.

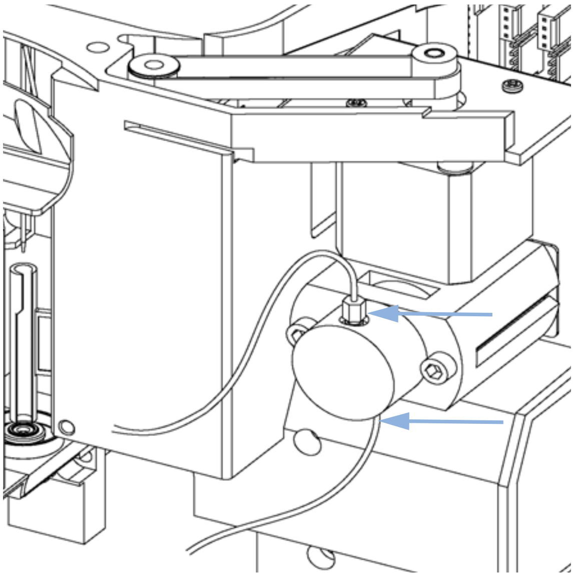


9 Install the fixing bolts. Tighten the bolts securely.



10 Install the metering head assembly in the autosampler. Ensure the large hole in the metering head is facing downwards.

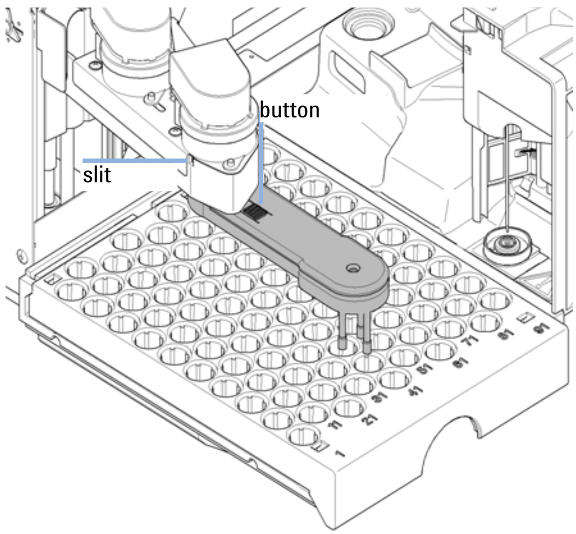


11 Reinstall the capillaries. 	
Next Steps: **12** On completion of this procedure: Install the front cover. **13** Select “**End**” in the Tools function in the LMD Software “**Change piston**” .	

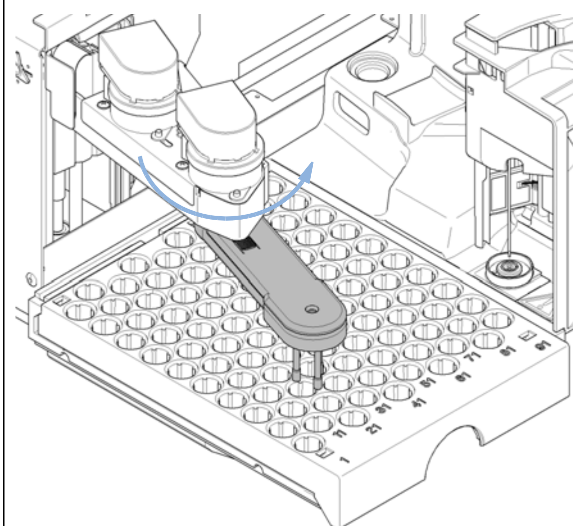
Exchanging the Gripper Arm

When	Defective gripper arm		
Tools required	Straightened paper clip.		
Parts required	**#**	**p/n**	**Description**
	1	G1313-60010	Gripper assembly
Preparations	Select “Start” in the Tools function in the LMD Software “ChangeGripper”. Turn off the power to the Instrument. Remove the upper front cover.		

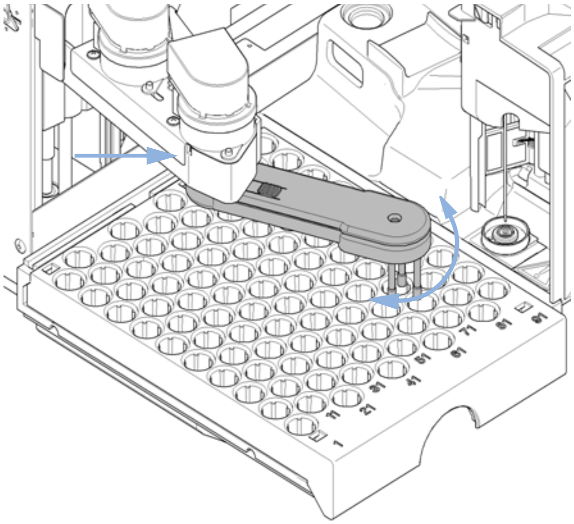
1 Identify the slit below the gripper motor and the gripper arm release button.



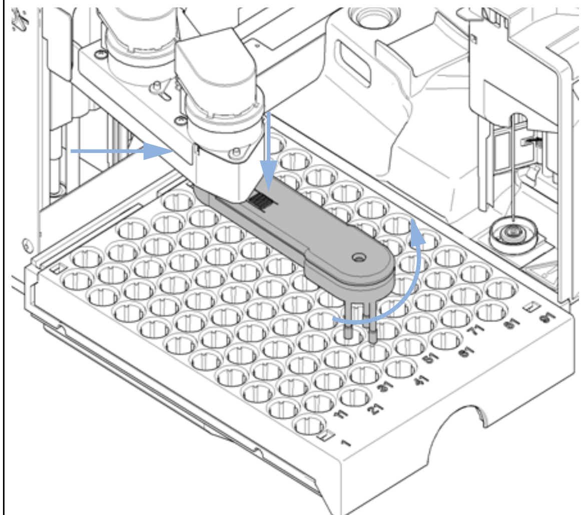
2 Rotate the arm approximately 2.5cm (1 inch) to the left and insert the straightened paper clip into the slit.



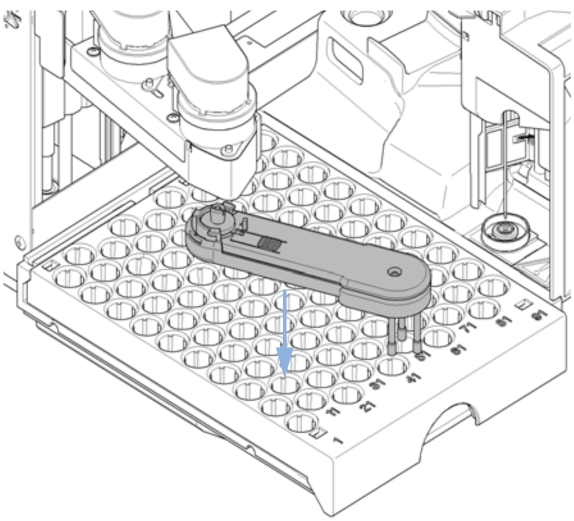
3 Rotate the gripper arm slowly from left to right and apply a gentle pressure to the paper clip. The clip will engage on an internal catch and the rotation of the arm will be blocked.



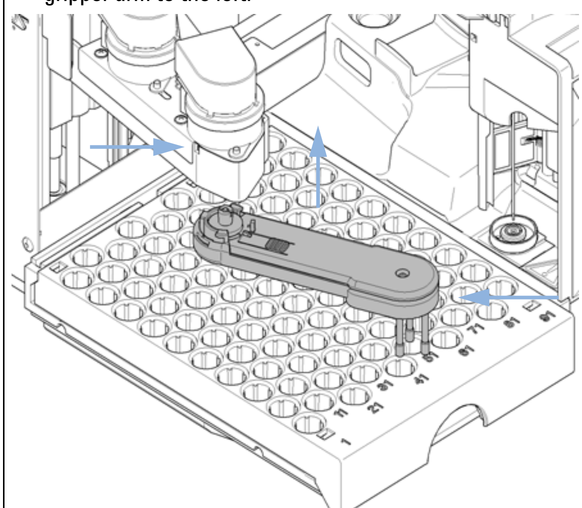
4 Hold the paper clip in place, press the gripper release button and rotate the gripper arm to the right.



5 The gripper arm will come off.



6 Replace the gripper arm by holding the paper clip in place, pushing the gripper arm into the holder and rotating the gripper arm to the left.



Next Steps:
7 On completion of this procedure: Install the front cover.
8 Turn the power to the Instrument ON.

Detector

Introduction

This section describes simple maintenance and repair procedures for the detector that can be carried out without opening the main cover.

Table 54 Detector maintenance and repair

Procedure	Typical Frequency	Notes
Exchanging the deuterium lamp	If noise and/or drift exceeds your application limits or lamp does not ignite.	A VWD test should be performed after replacement.
Exchanging the flow cell	If the application requires a different flow cell type.	A VWD test should be performed after replacement.
Repairing the flow cell	If leaking or if intensity drops due to contaminated flow cell windows.	A pressure tightness test should be done after repair.
Drying the leak sensor	If leak has occurred.	Check for leaks.

Exchanging the Deuterium Lamp

When If noise or drift exceeds application limits or lamp does not ignite.

Tools required Screwdriver POZI 1 PT3

Parts required

#	p/n	Description
1	G1314-60100	Deuterium lamp

Preparations Turn the lamp OFF.

WARNING

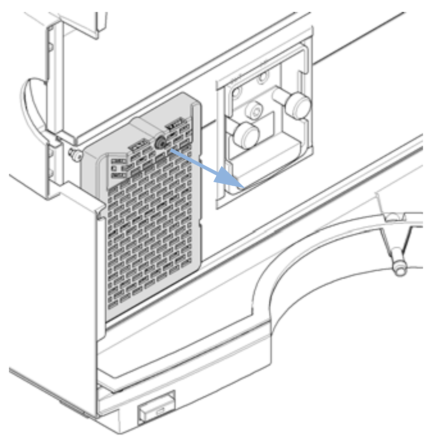
Injury by touching hot lamp

If the detector has been in use, the lamp may be hot.

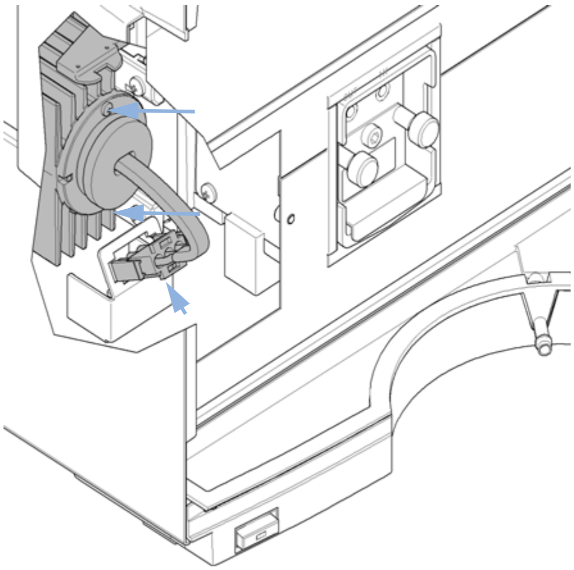
→ If so, wait for lamp to cool down.

1 Press the release buttons and remove the lower front cover to have access to the lamp area.

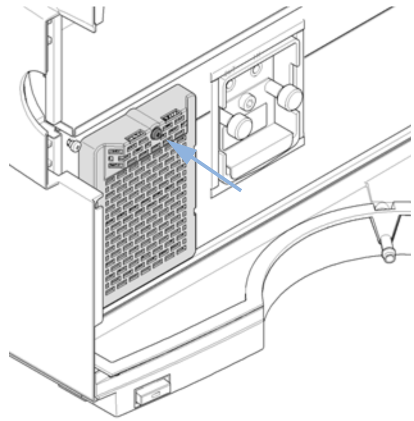
2 Unscrew the heater assembly and remove it.



3 Unscrew, disconnect and replace the lamp. Insert, fix and reconnect the lamp.



4 Replace the heater assembly.



Next Steps:

5 Replace the front cover.

6 Reset the lamp counter as described in the Utilities software documentation.

7 Turn the lamp ON.

8 Give the lamp more than 10 minutes to warm-up.

9 Perform Wavelength Calibration to check the correct positioning of the lamp.

Exchanging a Flow Cell

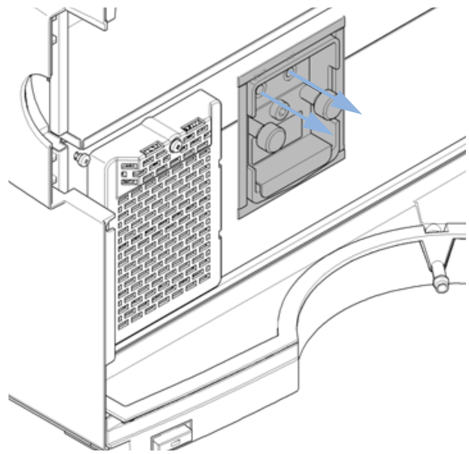
When If the application requires a different type of flow cell, or the flow cell needs maintenance.

Tools required Two 1/4 inch wrenches for capillary connections

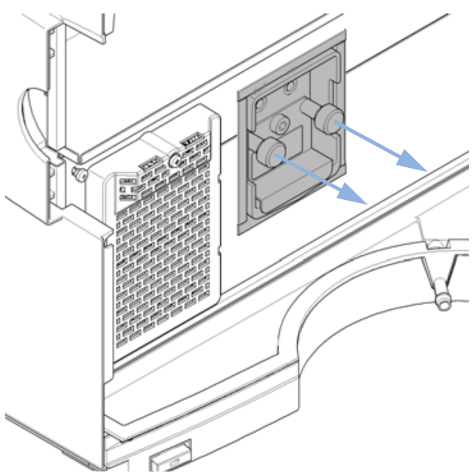
Preparations Turn the lamp OFF.

1 Press the release buttons and remove the lower front cover to gain access to the flow cell area.

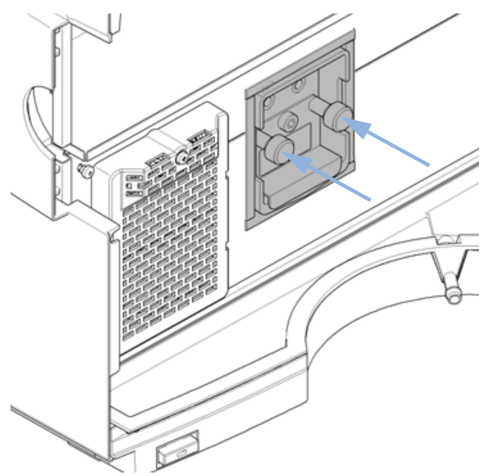
2 Disconnect the inlet and outlet capillaries.

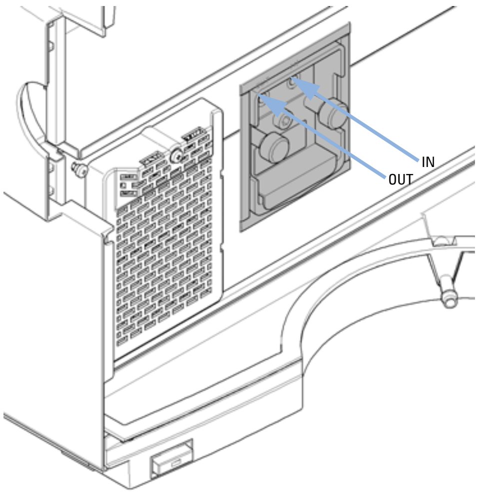


3 Unscrew the thumb screws in parallel and remove the flow cell.



4 Insert the new flow cell and fix the thumb screws.



5 Reconnect the inlet and outlet capillaries to the flow cell. 	
Next Steps:	

6 To check for leaks, establish a flow and observe the flow cell (outside of the cell compartment) and all capillary connections.

7 Replace the front cover.

Repairing the Flow Cell

Parts required	#	Description
	G1314-60086	Standard flow cell, 10 mm, 14 µL, 40 bar
	G1314-65063	Gasket #1 (small hole, i.d. 1 mm, o.d. 7.9 mm), KAPTON

1 - Cell screw
2 - Conical springs
3 - Ring #1 PEEK
4 - Gasket #1 (small hole)
5 - Window Quartz
6 - Gasket #2 (large hole)
7 - Ring #2 PEEK
8 - RFID tag

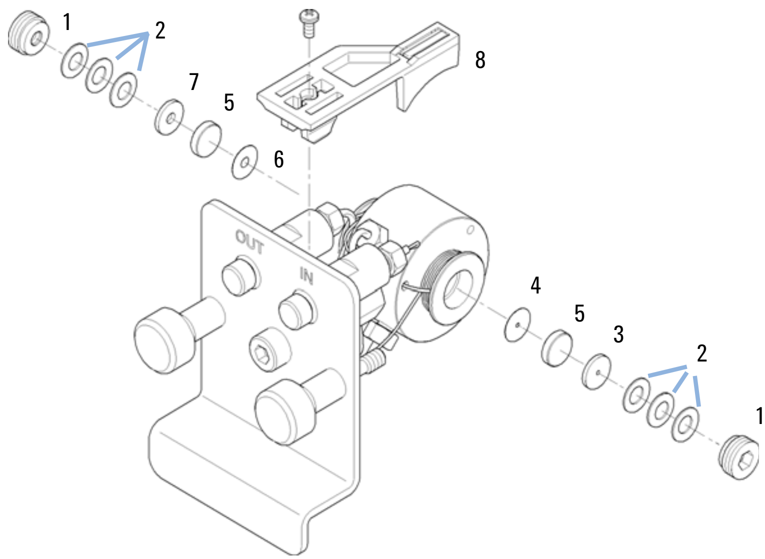


Figure 29 Standard Flow Cell

1. Press the release buttons and remove the lower front cover to gain access to the flow cell area
2. Disconnect the inlet and outlet capillaries.
3. Unscrew the thumb screws in parallel and remove the flow cell.
4. Disassembling the Flow Cell.
   a. Unscrew the cell screw using a 4-mm hexagonal wrench.
   b. Remove the SST rings using a pair of tweezers.

CAUTION

Window surfaces scratched by tweezers

Window surfaces can easily be scratched by using tweezers to remove the windows.

→ Do not use tweezers to remove the windows

c. Use adhesive tape to remove the PEEK ring, the window and the gasket.
d. Repeat step 1 through step 3 for the other window. Keep the parts separate, otherwise they could get mixed up.

5. Cleaning the Flow Cell Parts
   a. Pour isopropanol into the cell hole and wipe clean with a piece of lint-free cloth.
   b. Clean the windows with ethanol or methanol. Dry with a piece of lint-free cloth.
6. Reassembling the Flow Cell
   a. Hold the flow cell cassette horizontal and place the gasket in position. Ensure that both cell holes can be seen through the holes of gasket.

NOTE

Always use new gaskets.

b. Place the the window on gasket.
c. Place the PEEK ring on the window.
d. Insert the conical springs. Make sure that the conical springs point towards the window, otherwise the window might break when the cell screw is tightened.
e. Screw the cell screw into the flow cell and tighten it.

7. Repeat the procedure for the other side of the cell.
8. Reconnect the inlet and outlet capillaries.
9. Test the flow cell for leaks. If there are no leaks, insert the flow cell into the detector.
10. Perform Wavelength Calibration to check the correct positioning of the flow cell ("Wavelength Verification/Calibration" on page 98).

11 Replace the lower front cover.

Using the Cuvette Holder

This cuvette holder can be placed instead of a flow cell in the variable wavelength detector. Standard cuvettes with standards in it, for example, National Institute of Standards & Technology (NIST) holmium oxide solution standard, can be fixed in it.

This can be used for wavelength verifications.

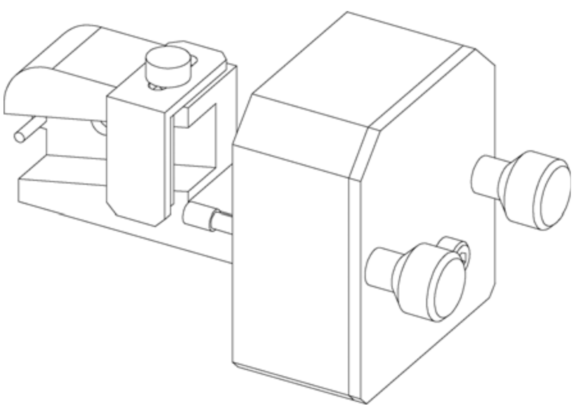
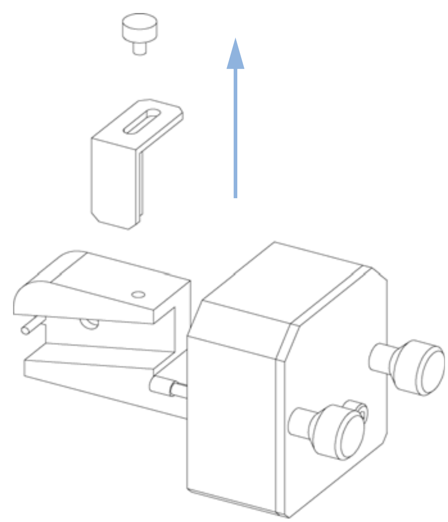
When If your own standard should be used to checkout the instrument.

Tools required None

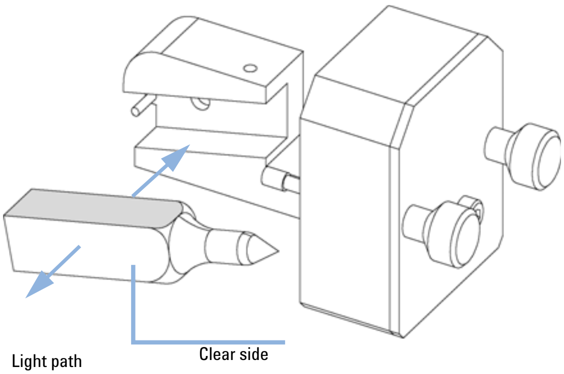
Parts required

#	p/n	Description
1	G1314-60200	Cuvette Holder
1		Cuvette with the “standard”, e.g. NIST certified holmium oxide sample
1	G1313-87201	Needle assembly for G1313-87101 or G1313-87103 needle-seat

Preparations Remove the normal flow cell.
Have cuvette with standard available.

1 Locate the cuvette holder on the desk. 	**2** Unscrew the bracket. 

3 Insert the cuvette with the sample into the holder. The clear side of the cuvette must be visible.



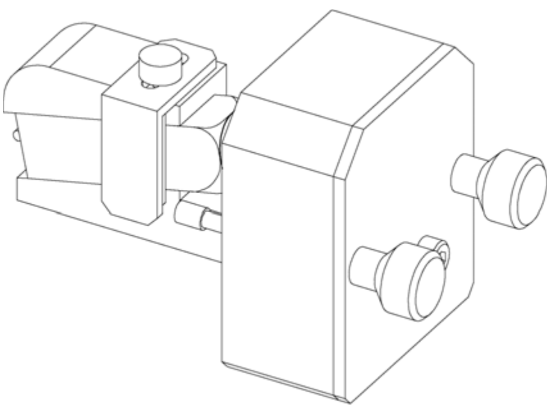
4 Reset the lamp counter as described in the User Interface documentation.

5 Turn the lamp ON.

6 Give the lamp more than 10 minutes to warm-up.

7 Perform Wavelength Verification/Calibration to check the correct positioning of the lamp.

8 Replace the bracket and fix the cuvette.



Next Steps:

9 Install the cuvette holder in the instrument.

10 Perform your verification.

Correcting Leaks

When If a leakage has occurred in the flow cell area or at the capillary connections

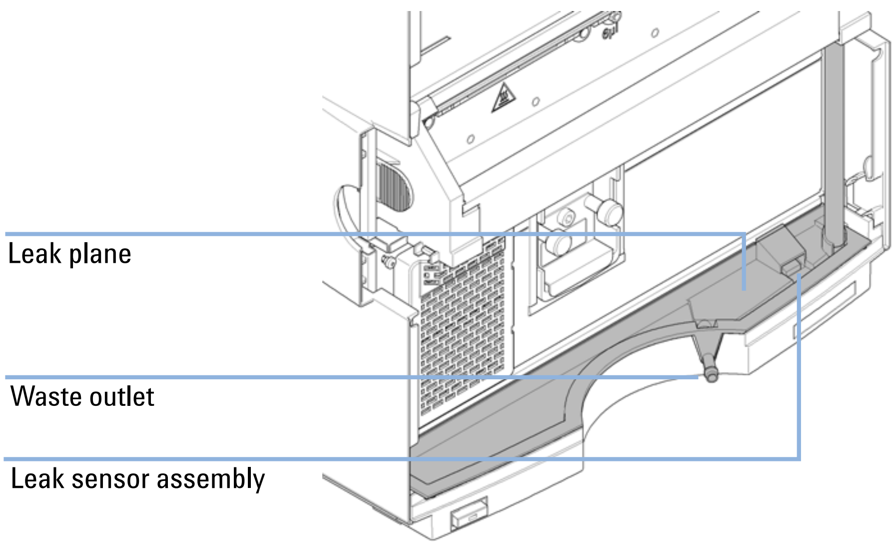
Tools required Tissue

Two 1/4 inch wrenches for capillary connections

Parts required

Description
None

1 Remove the lower front cover.
2 Use tissue to dry the leak sensor area.
3 Observe the capillary connections and the flow cell area for leaks and correct, if required.
4 Replace the front cover.



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 also stimulates their growth. Small algae growth is seen even in distilled water after some time.

Instrumental problems associated with algae

Algae deposit and grow everywhere within the HPLC system causing:

- deposits on ball valves, inlet or outlet, resulting in unstable flow or total failure of the pump.
- small-pore solvent inlet filters to plug, resulting in unstable flow or total failure of the pump.
- small-pore high pressure solvent filters (usually placed before the injector) to plug, resulting in high system pressure.
- column filters to plug, resulting in 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.

Symptoms observed with the Agilent 1220 Infinity LC

In contrast to other HPLC systems, such as HP 1090 and HP 1050 Series, which use helium degassing, algae have a better chance to grow in systems such as the Agilent 1220 Infinity LC, where helium is not used for degassing (most algae need oxygen and light for growth).

The presence of algae in the Agilent 1220 Infinity LC can cause the following to occur:

- Blockage of PTFE frits, part number 01018-22707, (purge valve assembly) and column filter, causing increased system pressure. Algae appear as white or yellowish-white deposits on filters. Typically, black particles from the normal wear of the piston seals do not cause the PTFE frits to block over short-term use.

- Short lifetime of solvent filters (bottle head assembly). A blocked solvent filter in the bottle, especially when only partly blocked, is more difficult to identify and may show up as problems with gradient performance, intermittent pressure fluctuations etc.
- Algae growth may also be the possible source of failures of the ball valves and other components in the flow path.

Preventing and/or reducing the algae problem

- Always use freshly prepared solvents, especially use demineralized water that has been 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 (part number 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.

7
Parts for Maintenance and Repair

Agilent 1220 Infinity LC System

Table 55 System part numbers

Description	Part Number
Power supply	*0950-4997*
Agilent 1220 Infinity LC VL main board	*G4280-65000*
Cabinet kit	*G4280-68713*
Front door, top	*G4280-60102*
Front door, bottom	*G4280-60001*
PSS board (Power switch board)	*G4280-65001*
FSL board (Status LED board)	*G4280-65802*
Connecting tube	*5067-4693*
SSV	*G4280-68708*
Fan, ALS	*G4280-80004*
Power switch cable	*8121-1833*
Cable, status LED	*G4280-81602*
Cable, temp. sensor	*G4280-81620*
Light pipe, status	*G4280-40007*
Power switch coupler	*G4280-40016*
Leak plane, man. inj.	*G4280-44013*
Leak panel, bottom	*G4280-44500*
Leak plane, pump	*G4280-44501*
Leak plane, ALS	*G4280-44502*
Holder, temp. sensor	*G4280-44016*
Leak sensor	*5061-3356*

Table 55 System part numbers

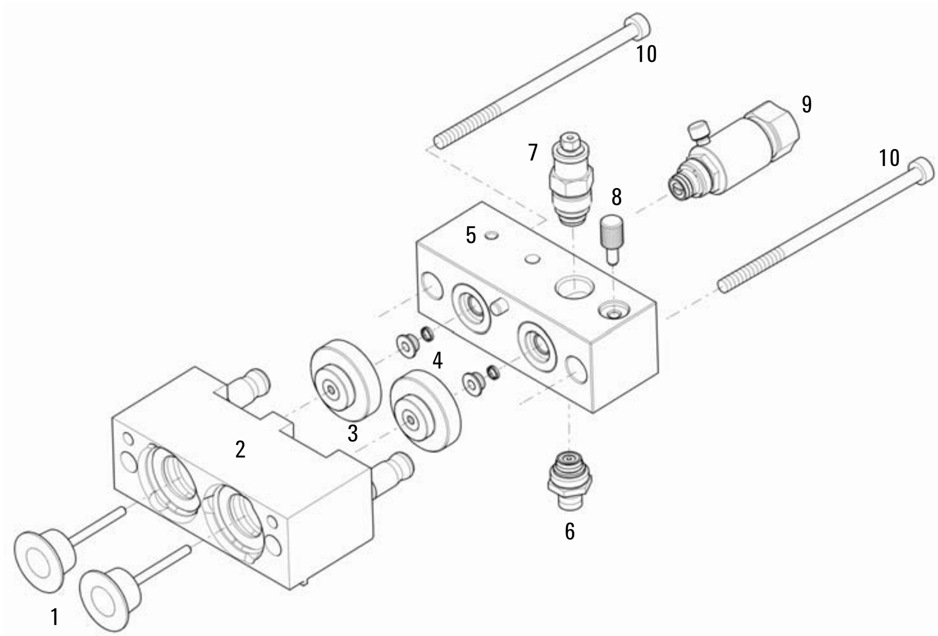
Description	Part Number
Main board fuses, 3.15AT	*2110-1417*
Netfilter fuses 10AT	*2110-1004*

Solvent Delivery System

Pump Head Assembly

Table 56 Pump Head part numbers

Item	Description	Part Number
	Complete pump head assembly, includes items marked with *	*G1312-60064*
1*	Sapphire plunger	*5067-4695*
2*	Plunger housing (including spring)	*G1312-60062*
3*	Support ring	*5001-3739*
	Backup ring	*G4220-24103*
4*	Seal (pack of 2) or Seal (pack of 2) for normal-phase applications	*5063-6589* *0905-1420*
5*	Pump chamber housing	*G1312-25260*
6	Passive inlet valve	*G1312-60066*
7	Outlet ball valve	*G1312-60067*
8*	Screw lock	*5042-1303*
9	Purge valve assembly	*G4280-60061*
10	Screw M5, 60 mm	*0505-2118*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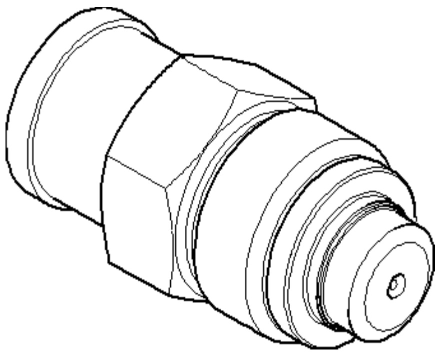
Outlet Ball Valve Assembly

Table 57 Outlet Ball Valve part numbers

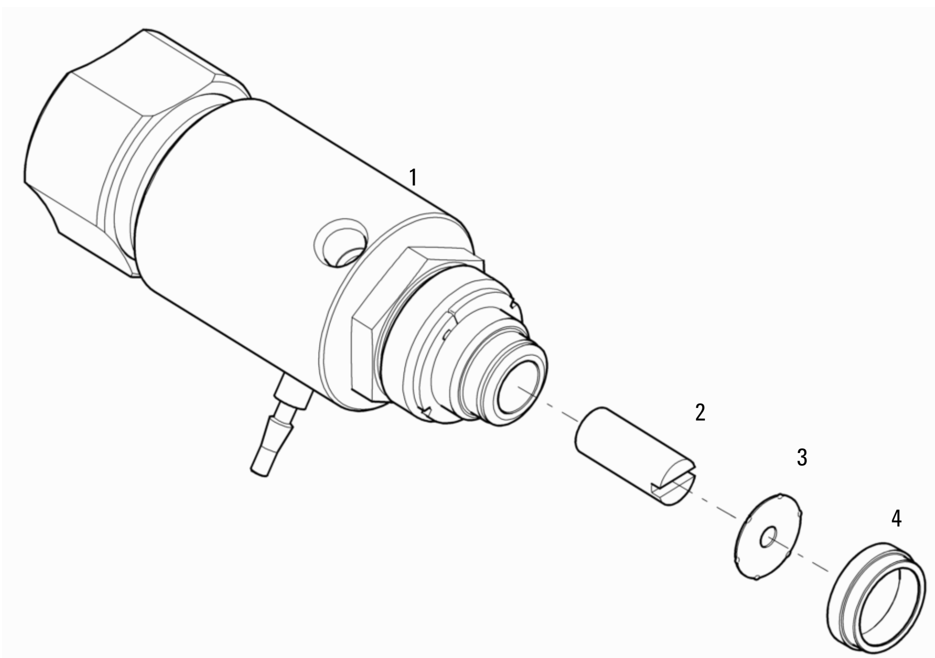
Item	Description	Part Number
	Complete outlet ball valve assembly	*G1312-60067*



Purge Valve Assembly

Table 58 Purge Valve part numbers

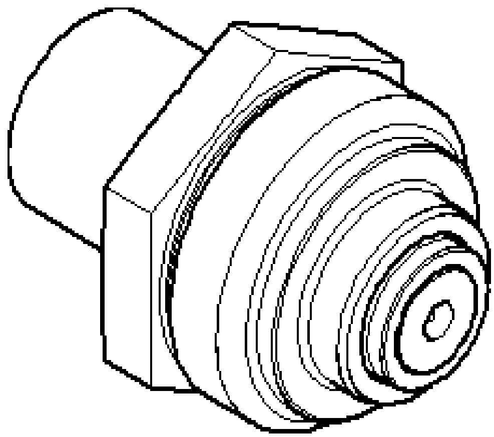
Item	Description	Part Number
	Complete purge valve assembly	*G4280-60061*
1	Valve body	no part number
2	PTFE frit (pack of 5)	*01018-22707*
3	Gold seal	*5001-3707*
4	Cap (pack of 4)	*5062-2485*



Passive Inlet Valve Assembly

Table 59 Passive Inlet Valve part numbers

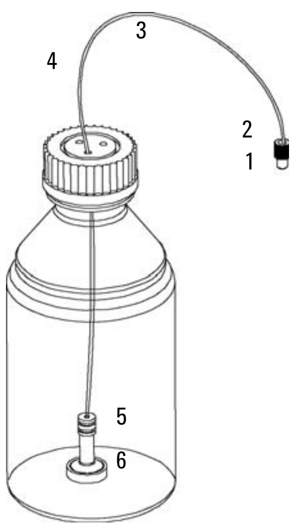
Item	Description	Part Number
	Complete passive inlet valve assembly	*G1312-60066*



Bottle Head Assembly

Table 60 Bottle head part numbers

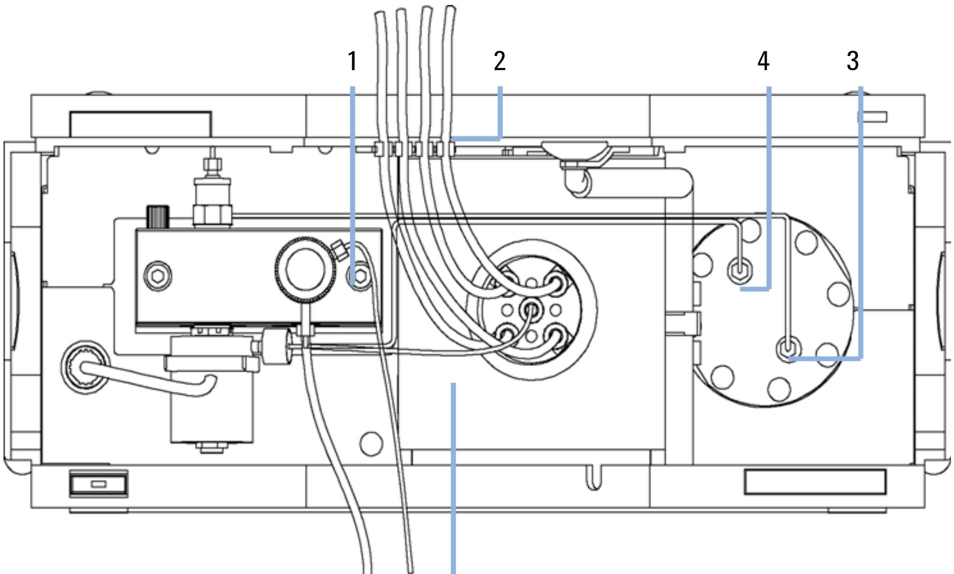
Item	Description	Part Number
	Complete bottle head assembly	*G1311-60003*
1	Ferrules with lock ring (pack of 10)	*5063-6598*
2	Tube screw (pack of 10)	*5063-6599*
3	Wire marker	No part number
4	Solvent tubing, 5 m	*5062-2483*
5	Frit adapter (pack of 4)	*5062-8517*
6	Solvent inlet filter, 20 µm	*5041-2168*



Hydraulic Path

Table 61 Hydraulic path part numbers

Item	Description	Part Number
1	Outlet capillary, pump to injection device	*G1312-67305*
	Bottle head assembly, bottle to passive inlet valve or vacuum degasser	*G1311-60003*
2	Solvent tube, vacuum degasser to DCGV	*G4280-60034*
3	Capillary, plunger 1 to damper	*G4280-81300*
4	Capillary, damper to plunger 2	*G4280-81301*
5	Connecting tube, DCGV to passive inlet valve	*5067-4693*
6	Waste tube, reorder pack, 5 m	*5062-2461*
Not visible	Damper 400 bar	*79335-60005*
Not visible	Pump drive	*G1311-60001*
Not visible	DCGV	*G4280-60004*
Not visible	Fan	*3160-1017*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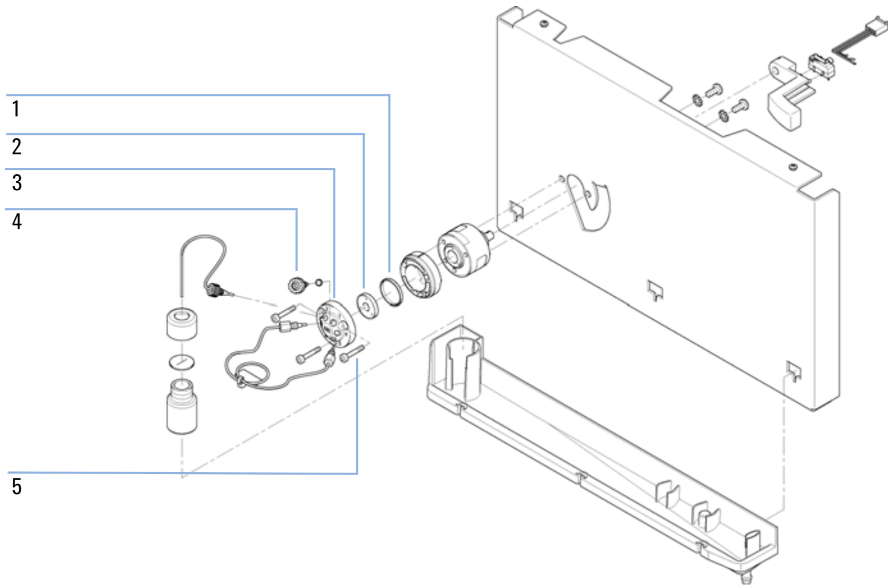
Injection System

Manual Injector

Injection Valve Assembly

Table 62 Manual Injection Valve part numbers

Item	Description	Part Number
	Complete manual injection valve assembly, including 20 µL loop capillary and needle port	*5067-4102*
	Manual injection valve, excluding loop capillary and needle port	*5067-4202*
1	Bearing ring	*1535-4045*
2	Rotor seal (PEEK™)	*0101-1409*
3	Stator head	*0101-1417*
4	Needle port	*5067-1581*
5	Stator screw	*1535-4857*
	Hex key 9/64 inch (for stator screws) — not shown	*8710-0060*



Sample Loops

Table 63 Sample loops for manual injector

Description	Stainless Steel	PEEK™
Sample loop 5 µL	*0101-1248*	*0101-1241*
Sample loop 10 µL	*0100-1923*	*0101-1240*
Sample loop 20 µL	*0100-1922*	*0101-1239*
Sample loop 50 µL	*0100-1924*	*0101-1238*
Sample loop 100 µL	*0100-1921*	*0101-1242*
Sample loop 200 µL	*0101-1247*	*0101-1227*
Sample loop 500 µL	*0101-1246*	*0101-1236*
Sample loop 1 mL	*0101-1245*	*0101-1235*
Sample loop 2 mL	*0101-1244*	*0101-1234*

Autosampler

Autosampler Main Assemblies

Table 64 Autosampler main assembly part numbers

Description	Part Number
Autosampler complete	*G4280-60230*
Transport assembly	*G1329-60009*
Sampling unit assembly (excluding injection valve and analytical head)	*G4280-60027*
Analytical head assembly	*01078-60003*
Injection valve assembly	*0101-1422*
Vial tray	*G1313-44510*
Gripper assembly	*G1313-60010*
Waste capillary	*G4280-87304*
Cable, sampling unit	*G4280-81615*
Cable, sample transport	*G4280-81616*
Needle port	*5067-1581*

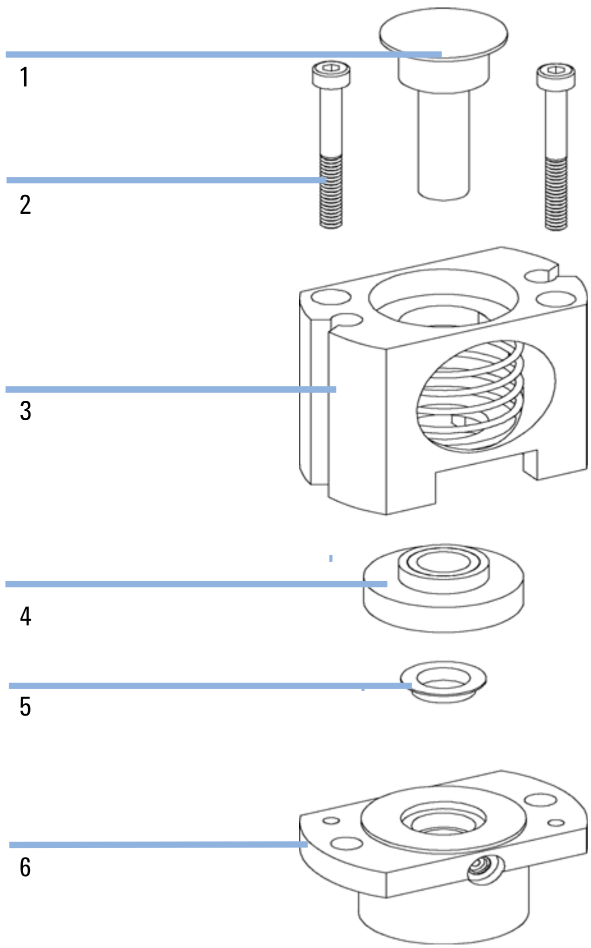
Analytical Head Assembly

Table 65 Analytical head (100 µL) part numbers

Item	Description	Part Number
	Complete analytical head assembly	*01078-60003*
1	Plunger assembly	*5063-6586*
2	Screw, M4, 40 mm long	*0515-0850*
3	Adapter	*01078-23202*
4	Support seal assembly	*5001-3739*
5	Metering seal (pack of 2)	*5063-6589*

Table 65 Analytical head (100 µL) part numbers

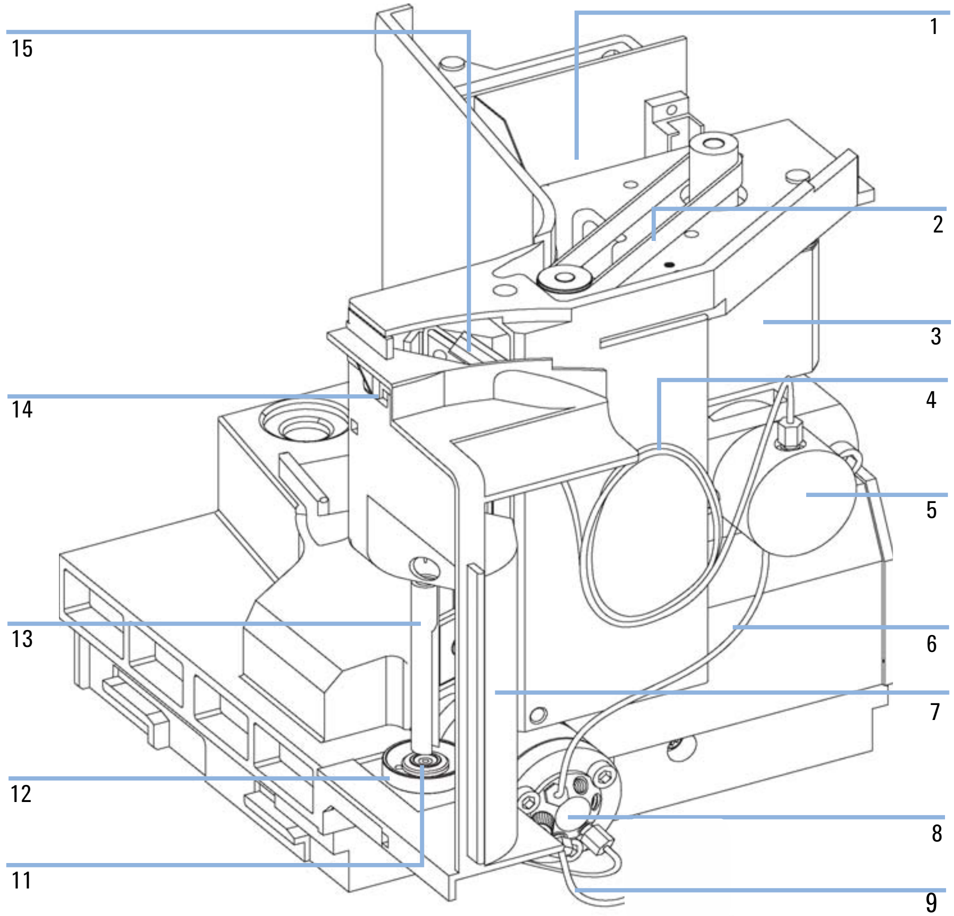
Item	Description	Part Number
6	Head body	*01078-27710*
	Screw M5, 60 mm long, for mounting assembly (not shown)	*0515-2118*



Sampling Unit Assembly

Table 66 Autosampler sampling unit part numbers

Item	Description	Part Number
	Sampling unit assembly (excluding injection valve and analytical head)	*G4280-60027*
1	Sampling unit connector board (SUD)	*G1313-66503*
2	Belt gear for metering unit and needle arm	*1500-0697*
3	Stepper motor for metering unit and needle arm	*5062-8590*
4	Loop capillary (100 µL)	*01078-87302*
5	Analytical head assembly (100 µL)	*01078-60003*
6	Capillary, injection valve to analytical head (160 mm × 0.25 mm)	*G1313-87301*
7	Safety cover	*G1329-44115*
8	Injection valve assembly	*0101-1422*
9	Waste tube, injection valve (120 mm)	*G1313-87300*
11	Needle seat assembly (0.17 mm ID, 2.3 µL)	*G1313-87101*
12	Seat adapter	*G1313-43204*
13	Safety flap	*G1313-44106*
14	Flex board	*G1313-68715*
15	Needle assembly for G-1313-87101 or G1313-87103 needle seat	*G1313-87201*
	Clamp kit (including needle clamp and two clamp screws)	*G1313-68713*


15
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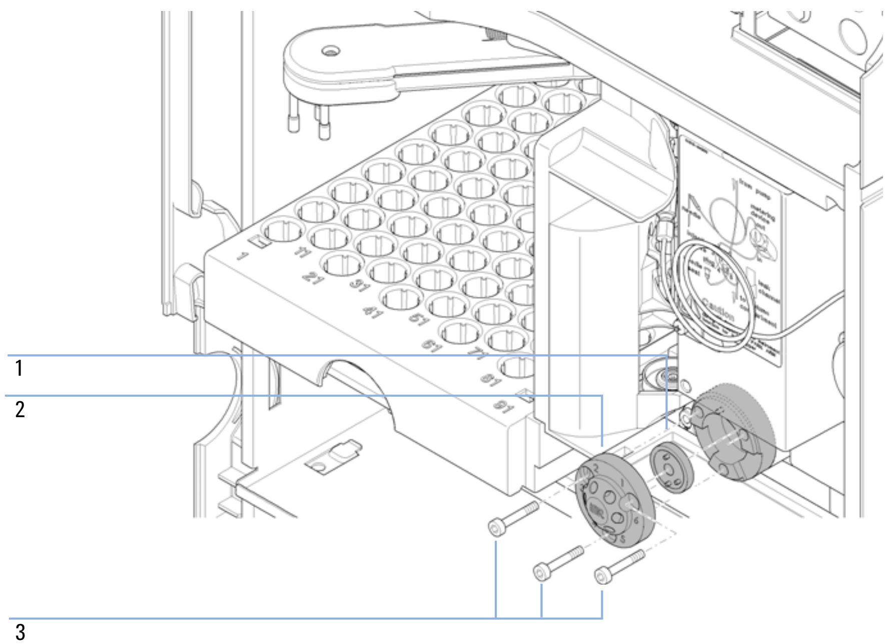
Injection Valve Assembly

Table 67 Injection valve part numbers

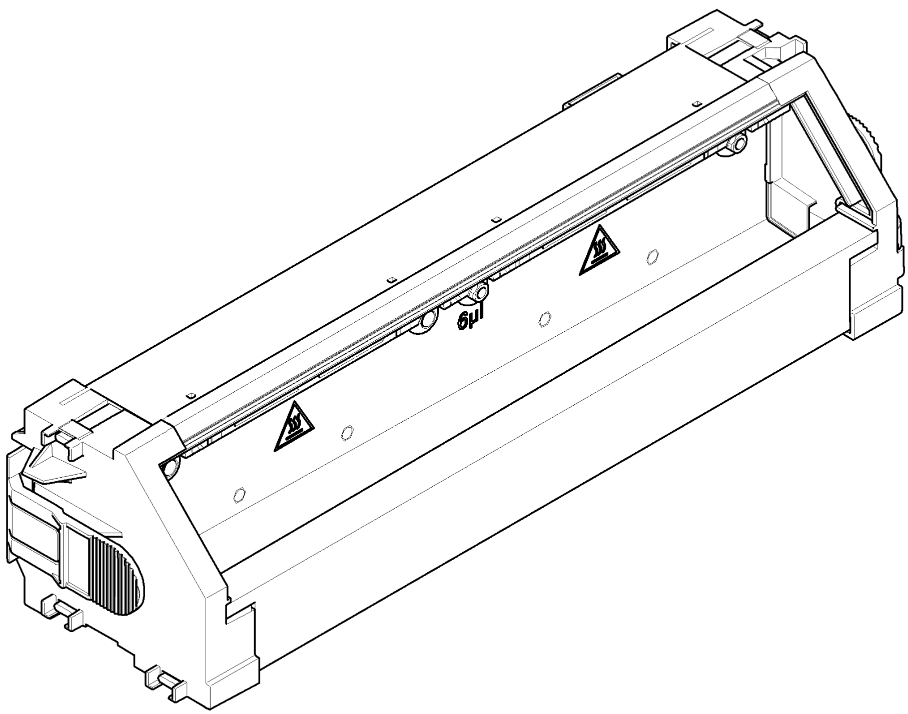
Item	Description	Part Number
	Complete injection valve assembly	*0101-1422*
	Isolation seal	*0100-1852*
1	Rotor seal (PEEK)	*0101-1416*
2	Stator head	*0101-1417*
3	Stator screw	*1535-4857*



Column Oven

Table 68 Column oven part number

Description	Part Number
Complete column oven assembly	*G4280-60040*
Heater door assembly	*G4280-60017*



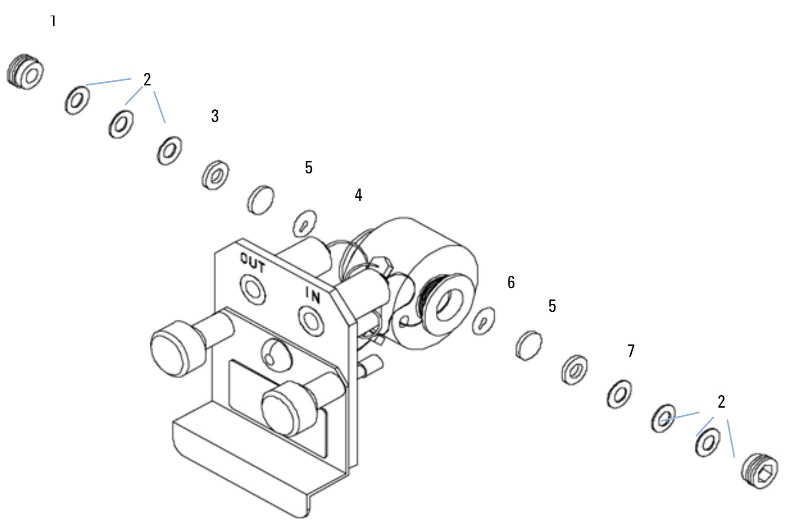
Detector

Standard Flow Cell

Table 69 Standard flow cell part numbers

Item	Description	Part Number
	Standard flow cell, 10mm 14 µL, 40 bar	*G1314-60086*
1	Cell screw kit (quantity = 2)	*G1314-65062*
2	Conical spring kit (quantity = 10)	*79853-29100*
3	Ring #1 PEEK kit (quantity = 2)	*G1314-65065*
4	Gasket #1 (small hole), KAPTON (quantity = 10)	*G1314-65063*
5	Window quartz kit (quantity = 2)	*79853-68742*
6	Gasket #2 (large hole), KAPTON (quantity = 10)	*G1314-65064*
7	Ring #2 PEEK kit (quantity = 2)	*G1314-65066*

1 - Cell screw
2 - Conical springs
3 - Ring #1 PEEK
4 - Gasket #1 (small hole)
5 - Window Quartz
6 - Gasket #2 (large hole)
7 - Ring #2 PEEK



Detector Lamp

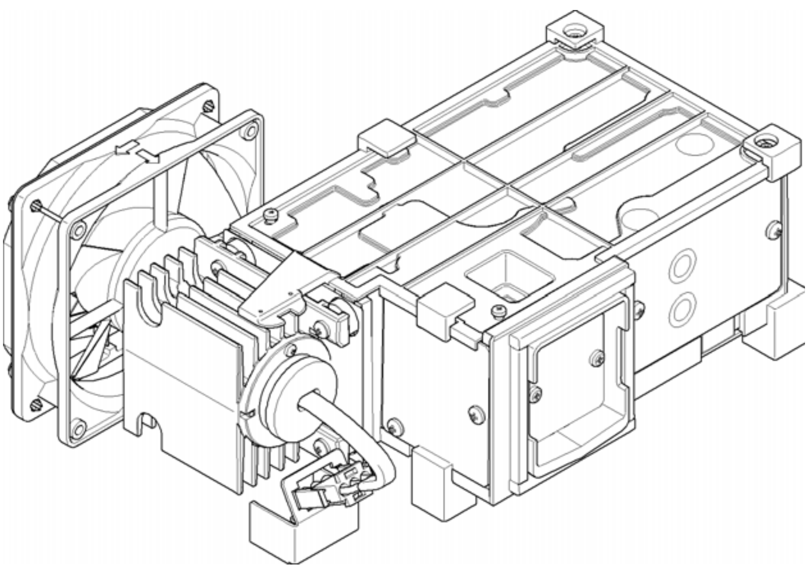
Table 70 Variable Wavelength Detector lamp

Description	Part Number
Deuterium lamp	*G1314-60100*

Optical Unit and Fan Assembly

Table 71 VWD optical unit part number

Description	Part Number
Complete optical unit assembly	*G1314-60061*
Fan	*G4280-80004*
VWD heater	*G1314-60113*
Lamp cable	*G4280-81607*
VWD heater board	*G1314-65826*
VWD temp. sensor board	*G1314-65802*



NOTE Repairs to the optical unit require specialist knowledge.

8
Upgrading the Agilent 1220 Infinity LC

Oven Upgrade

Tools required None

Parts required

Description
Oven upgrade kit

1 Switch off the instrument.
2 Remove the lower front cover.
3 Disconnect the column and remove it.
4 Remove the leak tube.
5 Press the knurled portion at either side of the column tray inwards and remove the column tray.
6 Unpack the oven upgrade kit and separate the two parts.
7 Click the oven into position in place of the column tray.

   The electrical connection to the oven is made automatically.
8 Replace the leak tube.
9 Click the oven insulation into place in the lower front cover, with the cutout in the oven insulation support at the bottom.
10 Replace the column and reconnect the capillaries.
11 Replace the lower front cover.
12 Open the Instrument Utilities software, navigate to the Module Service Center and click **Add new oven**. Follow the instructions to reconfigure your instrument.
13 In the instrument control software, autoconfigure the instrument to register the change to the instrument configuration.

9
Appendix

General Safety Information

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.

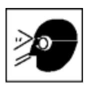
Do not install substitute parts or make any unauthorized modification to the instrument.

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 please observe appropriate safety procedures (e.g. 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.

Safety Symbols

Table 72 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.

Solvent Information

Observe the following recommendations on the use of solvents.

Flow Cell

Avoid the use of alkaline solutions (pH > 9.5) which can attack quartz and thus impair the optical properties of the flow cell.

Prevent any crystallization of buffer solutions. This will lead into a blokkage/damage of the flow cell.

If the flow cell is transported while temperatures are below 5 degree C, it must be assured that the cell is filled with alcohol.

Aqueous solvents in the flow cell can built up algae. Therefore do not leave aqueous solvents sitting in the flow cell. Add small % of organic solvents (e.g. Acetonitrile or Methanol ~5%).

Solvents

Brown glass ware can avoid growth of algae.

Always filter solvents, small particles can permanently block the capillaries. Avoid the use of the following steel-corrosive solvents:

- Solutions of alkali halides and their respective acids (for example, lithium iodide, potassium chloride, and so on).
- High concentrations of inorganic acids like nitric acid, sulfuric acid 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:

  $2CHCl_3 + O_2 \rightarrow 2COCl_2 + 2HCl$

  This reaction, in which stainless steel probably acts as a catalyst, occurs quickly with dried chloroform if the drying process removes the stabilizing alcohol.

- Chromatographic grade ethers, which can contain peroxides (for example, THF, dioxane, 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.

Radio Interference

Cables supplied by Agilent Technologies are screened to provide optimized protection against radio interference. All cables are in compliance with safety or EMC regulations.

Test and Measurement

If test and measurement equipment is operated with unscreened cables, or used for measurements on open set-ups, the user has to assure that under operating conditions the radio interference limits are still met within the premises.

UV Radiation

Emissions of ultraviolet radiation (200-315 nm) from this product is limited such that radiant exposure incident upon the unprotected skin or eye of operator or service personnel is limited to the following TLVs (Threshold Limit Values) according to the American Conference of Governmental Industrial Hygienists:

Table 73 UV-Radiation Limits

Exposure/day	Effective Irradiance
8 hours	0.1 $\mu W/cm^2$
10 minutes	5.0 $\mu W/cm^2$

Typically the radiation values are much smaller than these limits:

Table 74 UV-Radiation Typical Values

Position	Effective Irradiance
Lamp installed, 50-cm distance	average 0.016 $\mu W/cm^2$
Lamp installed, 50-cm distance	maximum 0.14 $\mu W/cm^2$

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

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 starting with 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.

NOTE

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.

Declaration of Conformity for HOX2 Filter

Declaration of Conformity

We herewith inform you that the

Holmium Oxide Glass Filter (Type Hoya HY-1)
(Part No. 79880-22711)

meets the following specification of absorbance maxima positions:

Product Number	Series	Measured Wavelength *	Wavelength Accuracy	Optical Bandwidth
79883A	1090	361.0 nm 418.9 nm 453.7 nm 536.7 nm	+/- 1 nm	2 nm
79854A	1050			
G1306A	1050			
G1315A	1100			
G1315B/C	1100 / 1200			
G1600				
79853C	1050	360.8nm 418.5nm 536.4nm	+/- 2 nm	6 nm
G1314A/B/C	1100 / 1200	360.8nm 418.5nm 536.4nm	+/- 1 nm	6 nm

*) The variation in Measured Wavelength depends on the different Optical Bandwidth.

Agilent Technologies guarantees the traceability of the specified absorbance maxima to a National Institute of Standards & Technology (NIST) Holmium Oxide Solution Standard with a lot-to-lot tolerance of ± 0.3 nm.

The wavelength calibration filter built into the Agilent Technologies UV-VIS detectors is made of this material and meets these specifications. It is, therefore, suitable for wavelength calibration of these detectors within the specified wavelength accuracy of the respective detector over its wavelength range.

January 13, 2006
(Date)

Thomas Jöris
(Engineering Manager)

G. Grotke
(Quality Manager)

P/N 89550-90501

Revision: E
Effective by: Jan 13, 2006

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In This Book

This manual contains information on how to use, maintain, repair and upgrade the Agilent 1220 Compact LC System.

The manual contains the following chapters:

- Introduction
- Installation
- Agilent 1220 Infinity LC Description
- Test Functions and Calibratiojn
- Error Information
- Preventive Maintenance and Repair
- Parts for Maintenance and Repair
- Upgrading the Agilent 1220 Infinity LC
- Appendix

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