

# Agilent 1220 Infinity LC

User Manual



**Agilent Technologies**

# Notices

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### CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

### WARNING

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

# In This Book

This manual covers the Agilent 1220 Infinity LC System configurations:

- G4286B
- G4288B/C
- G4290B/C
- G4294B

## **1 Introduction**

This chapter provides an overview of the Agilent 1220 Infinity LC available configurations.

## **2 Site Requirements and Specifications**

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

## **3 Installation**

This chapter provides an overview on shipment content and installation.

## **4 LAN Configuration**

This chapter provides information on connecting the instrument to the Agilent ChemStation PC.

## **5 Solvent Delivery System Description**

This chapter provides an overview on the operational principles of the solvent delivery system (pump and optional degasser).

## **6 Injection System Description**

This chapter provides an overview of the operational principles of the injection systems: manual injector and autosampler.

## **7 Column Oven Description**

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## **8 Detector Description**

This chapter provides an overview of the operational principles of the detector.

## **9 Test Functions and Calibration**

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

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## **11 Maintenance**

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## **12 Parts for Maintenance**

This chapter provides information on parts for maintenance.

## **13 Upgrading the Agilent 1220 Infinity LC**

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## **14 Identifying Cables**

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## **15 Appendix**

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# 1 Introduction

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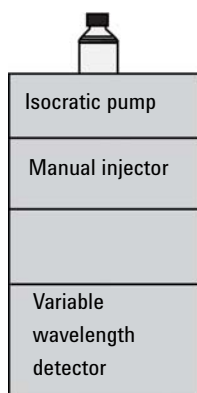
This chapter provides an overview of the Agilent 1220 Infinity LC available configurations.



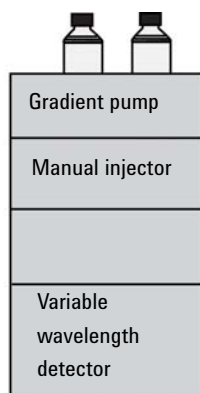
## Agilent 1220 Infinity LC Configurations

### Available configurations of Agilent 1220 Infinity LC

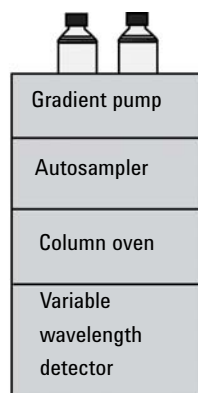
The Agilent 1220 Infinity LC is available in four different configurations. Possible components include isocratic pump, dual-channel gradient pump (with degasser), manual injector, autosampler, column oven and detector. Each configuration comes with at least one pump, one injection system and one detector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



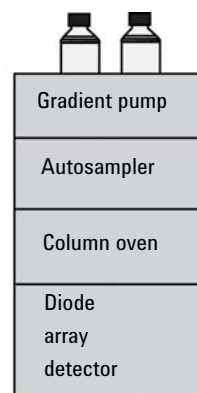
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G4288B



G4290B



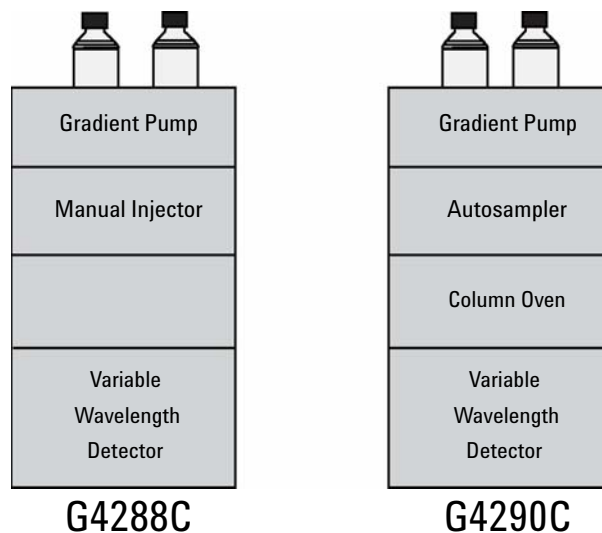
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A Solvent Selection Valve (SSV) Upgrade Kit (G4280-68708) is available.

## 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 isocratic pump, 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.

## 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.

## EMF counters for the diode array detector

### Using the EMF Counters

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

### Setting the EMF Limits

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



## 2 Site Requirements and Specifications

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



## Site Requirements

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

### Power Considerations

The 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 in) of space on either side and approximately 8 cm (3.1 in) 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 can damage the system electronics.

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

## Physical Specifications

**Table 1** Physical Specifications

Type	Specification	Comments
Weight	30 kg (66 lbs) G4294B: 43 kg (94 lbs)	
Dimensions (height × width × depth)	640 × 370 × 420 mm (25.2 × 14.6 × 16.5 inches) G4294B: 640×370×485 mm (25.2×14.6×19.1 inches)	
Line voltage	100 – 240 V~, ± 10 %	Wide-ranging capability
Line frequency	50 or 60 Hz, ± 5 %	
Power consumption	240 VA / 210 W / 717 BTU	Maximum
Ambient operating temperature	4–55 °C (39–131 °F)	
Ambient non-operating temperature	-40 – 70 °C (-40 – 158 °F)	
Humidity	< 95 % r.h. at 40 °C (104 °F)	Non-condensing
Operating altitude	Up to 2000 m (6562 ft)	
Non-operating altitude	Up to 4600 m (15092 ft)	For storing the module
Safety standards: IEC, CSA, UL	Installation category II, Pollution degree 2	For indoor use only.

## Performance Specifications

### 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
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; degassed H <sub>2</sub> O, 80 – 100 bar, 1 mL/min, at constant ambient temperature
Pressure	Operating range 0 – 60 MPa (0 – 600 bar, 0 – 8820 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 < 1.3 %), 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 binary mixing/gradient capability using proprietary high-speed proportioning valve
Delay volume	600 – 900 µL, dependent on back pressure; measured with water at 1 mL/min (water/caffeine tracer)
Composition range	0 – 95 % or 5 – 100, user selectable
Composition precision	< 0.2 % RSD or < 0.4 min SD, whatever is greater, at 1 mL/min; based on retention time at constant room temperature

## Performance Specifications Agilent 1220 Infinity LC Pump VL

**Table 4** Performance Specifications Agilent 1220 Infinity LC Pump VL

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 mL/min
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 5** Performance Specifications Agilent 1220 Infinity LC Autosampler

Type	Specification
Pressure	Operating range 0 – 60 MPa (0 – 600 bar, 0 – 8820 psi)
Injection range	0.1 – 100 $\mu$ L in 0.1 $\mu$ L increments Up to 1500 $\mu$ L with multiple draw (hardware modification required)
Replicate injections	1 – 99 from one vial
Precision	< 0.25 % RSD from 5 – 100 $\mu$ L, < 1 % RSD 1 – 5 $\mu$ L variable volume
Minimum sample volume	1 $\mu$ L from 5 $\mu$ L sample in 100 $\mu$ L microvial, or 1 $\mu$ L from 10 $\mu$ L sample in 300 $\mu$ L microvial
Carryover	Typically < 0.1 %, < 0.05 % with external needle cleaning
Sample viscosity range	0.2 – 50 cp
Sample capacity	100 $\times$ 2 mL vials in 1 tray 40 $\times$ 2 mL vials in ½ tray 15 $\times$ 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 6** Performance Specifications Agilent 1220 Infinity LC Column Oven

Type	Specification
Temperature range	5 °C above ambient to 60 °C 5 °C above ambient to 80 °C (min. FW Rev. B.06.50)
Temperature stability	$\pm$ 0.15 °C, constant Composition and Flow Rate
Temperature accuracy	$\pm$ 0.8 °C
Column capacity	one 25 cm column
Internal volume	6 $\mu$ L

## Performance Specifications Agilent 1220 Infinity LC VWD

**Table 7** Performance Specifications Agilent 1220 Infinity LC VWD

Type	Specification	Comments
Detection type	Double-beam photometer	
Light source	Deuterium lamp	
Wavelength range	190 – 600 nm	
Short term noise (ASTM)	$< \pm 0.25 \cdot 10^{-5}$ AU at 230 nm	See “ <a href="#">Specification Conditions</a> ” on page 27
Drift	$< 1 \cdot 10^{-4}$ AU/h at 230 nm	See “ <a href="#">Specification Conditions</a> ” on page 27
Linearity	$> 2$ AU (5 %) upper limit	See “ <a href="#">Specification Conditions</a> ” on page 27
Wavelength accuracy	$\pm 1$ nm	Self-calibration with deuterium lines, verification with holmium oxide filter
Maximum data rate	80 Hz	
Band width	6.5 nm typical	
Flow cells	Standard: 14 $\mu$ L volume, 10 mm cell path length and 40 bar (580 psi) pressure maximum High pressure: 14 $\mu$ L volume, 10 mm cell path length and 400 bar (5800 psi) pressure maximum Micro: 1 $\mu$ L volume, 5 mm cell path length and 40 bar (580 psi) pressure maximum Semi-micro: 5 $\mu$ L volume, 6 mm cell path length and 40 bar (580 psi) pressure maximum	Can be repaired on component level
Analog outputs	Recorder/integrator: 100 mV or 1 V, output range 0.001 to 2 AU, one output	



**Table 7** Performance Specifications Agilent 1220 Infinity LC VWD

Type	Specification	Comments
Communications	Controller-area network (CAN), RS-232C, APG Remote: ready, start, stop and shut-down signals, LAN (optional)	
Safety and maintenance	Extensive diagnostics, error detection and display (through Agilent ChemStation), leak detection, safe leak handling, leak output signal for shutdown of pumping system. Low voltages in major maintenance areas.	
GLP features	Early maintenance feedback (EMF) for continuous tracking of instrument usage in terms of lamp burn time with user-settable limits and feedback messages. Electronic records of maintenance and errors. Verification of wavelength accuracy with built-in holmium oxide filter.	
Housing	All materials recyclable.	

**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.

## Performance Specifications Agilent 1220 Infinity LC DAD

**Table 8** Performance Specifications

Type	Specification	Comments
Detection type	1024-element diode array	
Light source	Deuterium and tungsten lamps	The UV-lamp is equipped with RFID tag that holds lamp typical information.
Number of signals	8	
Maximum sampling rate	80 Hz	
Short term noise (ASTM) Single and Multi-Wavelength	$< \pm 0.7 \cdot 10^{-5}$ AU at 254/4 nm and 750 nm, TC 2 s	see " <i>Specification Conditions</i> " below
Drift	$< 0.9 \cdot 10^{-3}$ AU/h at 254 nm	see " <i>Specification Conditions</i> " below
Linear absorbance range	$> 2$ AU (5 %) at 265 nm	see " <i>Specification Conditions</i> " below
Wavelength range	190 – 950 nm	
Wavelength accuracy	$\pm 1$ nm	Self-calibration with deuterium lines, verification with holmium oxide filter
Slit width	1, 2, 4, 8, 16 nm	Programmable slit
Diode width	$< 1$ nm	
Flow cell	Standard: 13 $\mu$ L volume, 10 mm cell path length and 120 bar (1740 psi) pressure maximum	The flow cell is equipped with RFID tags that hold cell typical information. pH range 1.0—9.5
Time programmable	Wavelength, polarity, peak width, lamp bandwidth, autobalance, wavelength range, threshold, spectra storage mode	

## Specification Conditions

ASTM: “Standard Practice for Variable Wavelength Photometric Detectors Used in Liquid Chromatography”.

Reference conditions: Standard flow cell, path length 10 nm, flow 1 mL/min LC-grade methanol.

### Noise:

$<\pm 0.5 \cdot 10^{-5}$  AU at 254 nm, TC 2 s, ASTM

RT = 2.2 \* TC

### Linearity:

Linearity is measured with caffeine at 265 nm.

### NOTE

The specifications are based on the standard lamp (G1314-60100) and may be not achieved when other lamp types or aged lamps are used.

ASTM drift tests require a temperature change below 2 °C/hour (3.6 F/hour) 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.

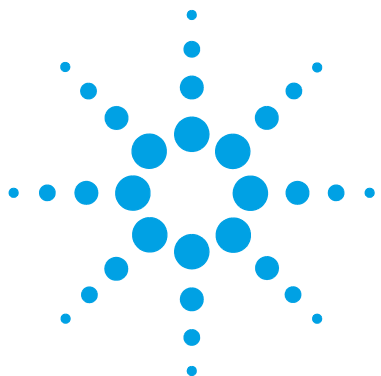
Performance tests should be done with a completely warmed up optical unit (> two hours). ASTM measurements require that the detector should be turned on at least 24 hours before start of testing.

### Time Constant versus Response Time

According to ASTM E1657-98 „Standard Practice of Testing Variable- Wavelength Photometric Detectors Used in Liquid Chromatography” the time constant is converted to response time by multiplying by the factor 2.2.

## **2 Site Requirements and Specifications**

### **Performance Specifications**



## 3 Installation

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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

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

### 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 9** Agilent 1220 Infinity Checklist

Description	Quantity
Agilent 1220 Infinity LC	1
Power cable	1
Flow cell	Installed
User Manual on Documentation CD (part of the shipment - not module specific)	1 per order
Installation guide	1
Accessory kit (see below)	1

## Accessory Kit Contents for G4286B

<b>p/n</b>	<b>Description</b>
G4286-68755	Accessory kit complete
0100-2562	Fitting, onepiece, fingertight
0890-1195	PTFE tubing, 0.052 in i.d.
0890-1711	Flexible tubing (to waste), 3 m
5023-0203	Cross-over network cable, shielded, 3 m (for point to point connection)
5062-8535	Waste accessory kit
5188-2758	PTFE/silicone septa 16mm pre-silt 100/pk (delivered quantity is 0.010)
5190-1501	Syringe, 50.0 $\mu$ L, FN, LC tip
9301-0411	Syringe, Plastic
9301-1337	Syringe adapter
9301-1377	Screw Cap Vial, clear, 6 mL 100/PK (delivered quantity is 0.010)
9301-1379	Screw caps for 6 mL vials 100/PK (delivered quantity is 0.010)
9301-1420	Solvent bottle, transparent
G1311-60003	Bottle-head assembly

### Accessory Kit Contents for G4288B/C

<b>p/n</b>	<b>Description</b>
G4288-68755	Accessory kit complete
0100-2562	Fitting, onepiece, fingertight
0890-1195	PTFE tubing, 0.052 in i.d.
0890-1711	Flexible tubing (to waste), 3 m
5023-0203	Cross-over network cable, shielded, 3 m (for point to point connection)
5062-8535	Waste accessory kit
5188-2758	PTFE/silicone septa 16mm pre-silt 100/pk (delivered quantity is 0.010)
5190-1501	Syringe, 50.0 $\mu$ L, FN, LC tip
9301-0411	Syringe, Plastic
9301-1337	Syringe adapter
9301-1377	Screw Cap Vial, clear, 6 mL 100/PK (delivered quantity is 0.010)
9301-1379	Screw caps for 6 mL vials 100/PK (delivered quantity is 0.010)
9301-1420	Solvent bottle, transparent
9301-1450	Solvent bottle, amber
G1311-60003 (2x)	Bottle-head assembly



### Accessory Kit Contents for G4290B/C, G4294B

<b>p/n</b>	<b>Description</b>
G4290-68755	Accessory kit complete
0100-2562	Fitting, onepiece, fingertight
0890-1195	PTFE tubing, 0.052 in i.d.
0890-1711	Flexible tubing (to waste), 3 m
5023-0203	Cross-over network cable, shielded, 3 m (for point to point connection)
5062-8535	Waste accessory kit
9301-0411	Syringe, Plastic
9301-1337	Syringe adapter
9301-1420	Solvent bottle, transparent
9301-1450	Solvent bottle, amber
G1311-60003	Bottle-head assembly

### Optional Tool Kit for Agilent 1220 Infinity LC

<b>p/n</b>	<b>Description</b>
G4296-68715	Tool kit complete
0100-1710	Mounting Tool for Tubing Connections
8710-0510	Wrench open 1/4 — 5/16 inch
8710-1924	Wrench open 14 mm
8720-0025	Wrench, 1/2 inch & 9/16 inch
01018-23702	Insert tool
8710-2392	Hex key 4 mm 15 cm long T-handle
8710-2394	Hex key 9/64 inch 15 cm long T-handle
8710-2411	Hex key 3 mm 12 cm long
8710-2412	Hex key 2.5 mm, 15 cm long, straight handle
8710-0899	Pozidriv screwdriver

## Installing the Hardware

### Installation Paths

#### Standard Installation Path

(No optional hardware upgrade is added to the module during installation)

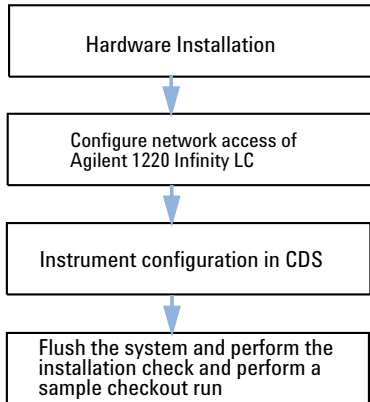
#### Installation Path Including the Installation of Upgrade Kits

(Oven upgrade kit /Manual injector to ALS upgrade kit/  
Isocratic to gradient upgrade kit)

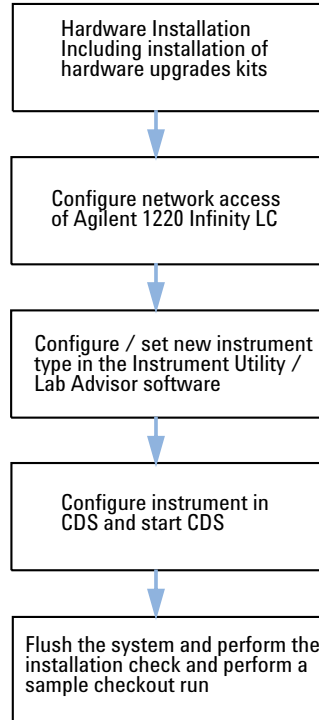
#### NOTE

The Installation of the gradient system upgrade kit and ALS upgrade kit must be done from Agilent-trained service personnel only.

### Standard Installation Path



### Installation Path Including the Installation of Upgrade Kits

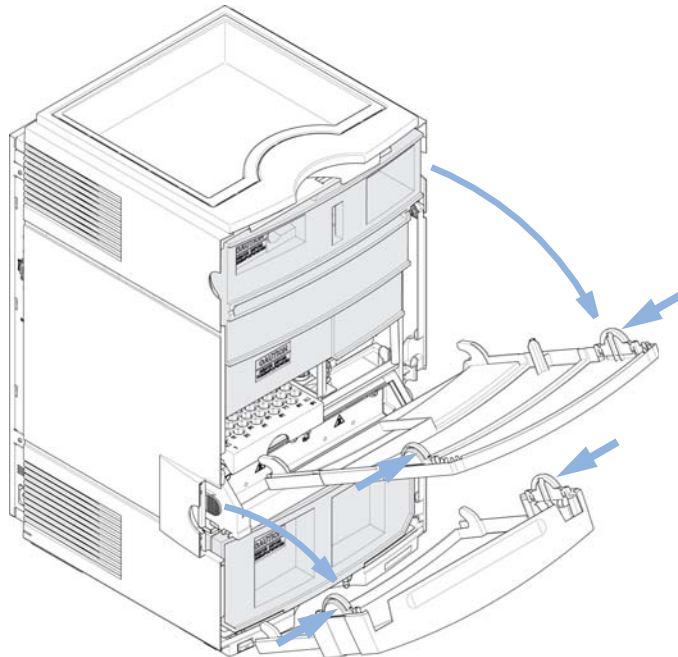


#### NOTE

The installation of a Solvent Selection Valve (SSV) Option does not require the configuration of a new instrument type. The SSV needs to be configured in the CDS only.

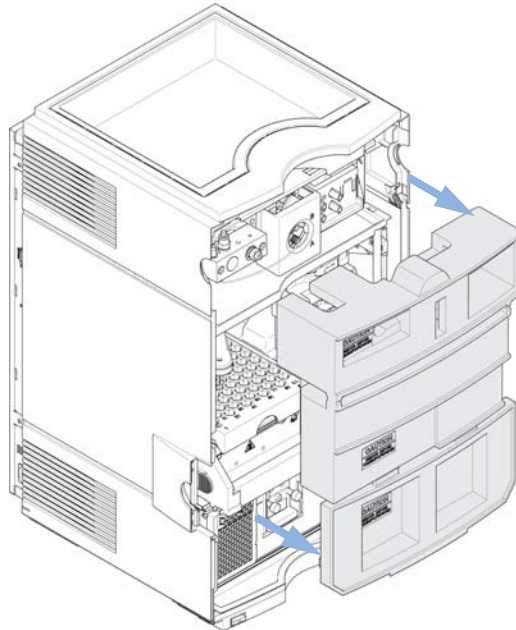
## Installing the Agilent 1220 Infinity LC

- 1 Open the box and compare its content with the delivery checklist for completeness.
- 2 Place the Agilent 1220 Infinity LC on top of the bench.
- 3 Remove both front covers (top and lower) by pressing the release buttons (on both sides).



**Figure 1** Front Cover Mechanism

- 4 Remove the two transport foams.

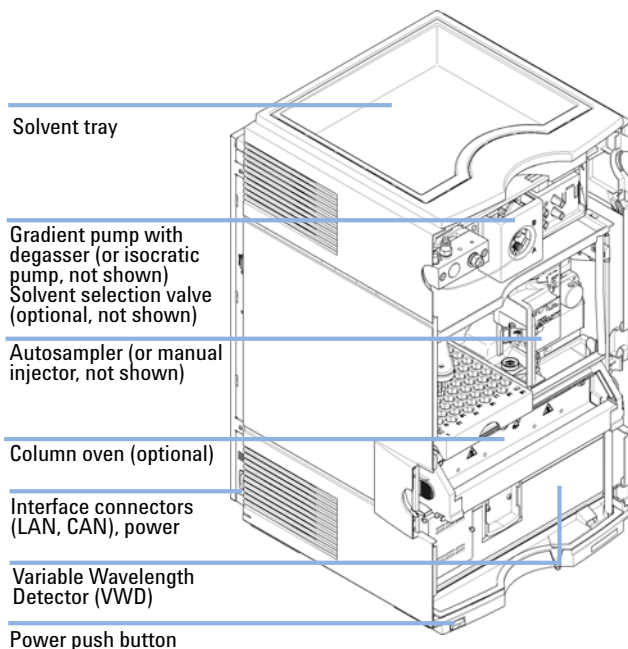


**Figure 2** Remove the Transport Foam

[Figure 3](#) on page 38 shows the content of a fully equipped 1220 Infinity LC system with removed front covers. (Module type shown G4290B)

### 3 Installation

#### Installing the Hardware



**Figure 3** System Overview 1220 Infinity LC

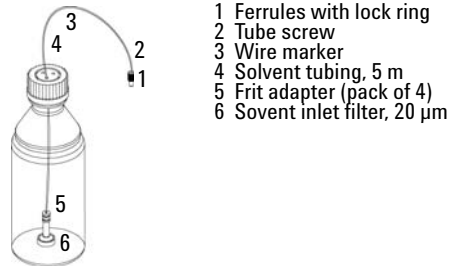
#### NOTE

Additional options or upgrade kits should be installed prior to all solvent path installations. Configuring your Agilent 1220 Infinity LC Module Information can be found in the [“Configuration of the Instrument After an Upgrade Installation”](#) on page 47.

For further information about how to install the options and upgrade kits refer to *Agilent 1220 Infinity LC Module* manual.

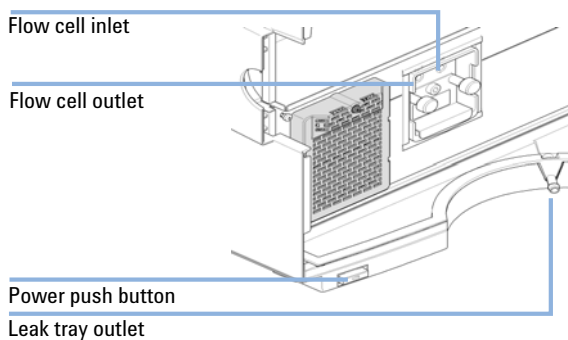
- 5 Place the Solvent Bottle filled with 0.5 L HPLC grade water in the Solvent Tray.

- 6** Place the Solvent Inlet Filter end of the Bottle Head Assembly in the Solvent Bottle (see picture below).



**Figure 4** Bottle Head Assembly and Solvent Bottle

- 7** Prime the tubing using the Syringe (9301-044) and Syringe adapter (9301-1337) (part of the Accessory kit) until the tubing is completely filled with water.
- 8** Connect the Bottle Head Assembly connector (see [Figure 4](#) on page 39 Item 1+2) to:
- the passive inlet valve (isocratic pump) or
  - the degasser inlet Channel A (gradient pump).
- 9** Connect the waste tube with the fitting attached (part of Accessory Kit) to the flow cell outlet and the other end to an appropriate solvent waste container (see [Figure 5](#) on page 39).



**Figure 5** Connections at the VWD Module

### 3 Installation

#### Installing the Hardware

- 10 Attach the corrugated waste tube (part of Accessory Kit) to the VWD leak tray outlet adapter and guide it to a proper waste container (see [Figure 5](#) on page 39).
- 11 Connect the waste tube (part of Accessory Kit) to the purge valve outlet adapter and the other end to the waste container.
- 12 Connect the network connection between the Agilent 1220 Infinity LC and your PC.

#### NOTE

More details about how to establish a network connection to the instrument can be found in [“Connecting the Agilent 1220 Infinity LC to the PC”](#) on page 44 or [“LAN Configuration”](#) on page 51

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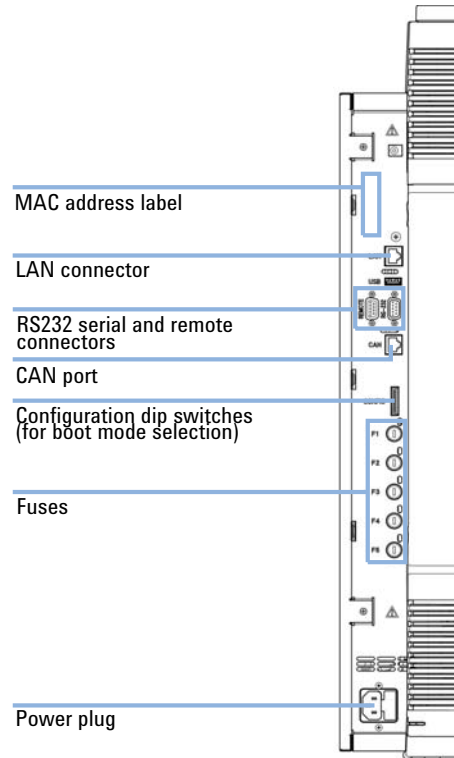
- 13 Verify that the power push button at the front of the module (see [Figure 5](#) on page 39) stands off. Now connect the power cord to the Agilent 1220 Infinity LC and the power line.
- 14 Before switching on the module check that all transport foams have been de-installed (see [Figure 2](#) on page 37). Then switch on the module via the power push button.



## Identifying the connections of the 1220 Infinity LC

### Agilent 1220 Infinity LC with VWD

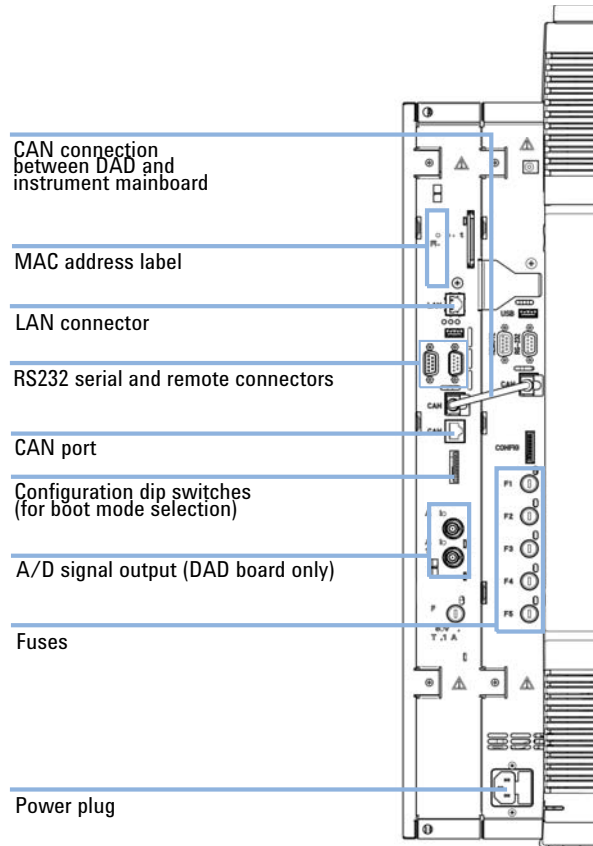
Figure 6 on page 41 shows an overview of the possible connections on the 1220 Infinity LC instrument with VWD.



**Figure 6** Connections of the Agilent 1220 Infinity LC with VWD

## Agilent 1220 Infinity LC with DAD

Figure 7 on page 42 shows an overview of the possible connections on the 1220 Infinity LC instrument with DAD. On the G4294B you must use the configuration dip switches on the DAD mainboard because this will be the communication host in this case. The short CAN cable is the communication connection between the DAD and the other 1220 modules.



**Figure 7** Connections of the Agilent 1220 Infinity LC with DAD

## Connecting and Configuring the Instrument to the Chromatographic Data System

The instrument is compatible to the following software for control and data evaluation:

- Agilent ChemStation for LC
  - EZChrom Software
- 1** Install your Chromatographic Data System (CDS). Please refer to the installation documentation that has been delivered with the CDS.
  - 2** Start your CDS.
  - 3** At the instrument configuration screen enter the Instrument name (free of choice) and the Instrument type (*Agilent Compact LC*).
  - 4** For configuring the module choose **Auto Configuration**.

### 3 Installation

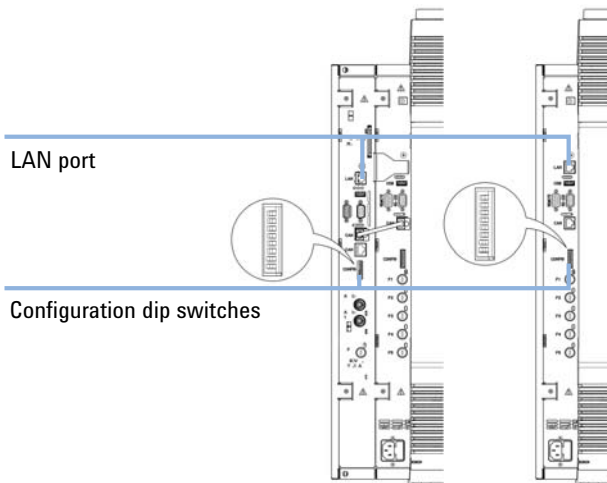
#### Connecting the Agilent 1220 Infinity LC to the PC

## Connecting the Agilent 1220 Infinity LC to the PC

The AGILENT 1220 Infinity LC is delivered from factory with the default network configuration settings. (Configuration dip switches 7 & 8 set to ON). This enables you to quickly connect it via the crossover patch cable (part of the accessory kit) with your PC.

Factory default IP address:

**192.168.254.11**



**Instrument with DAD      Instrument with VWD**

**Figure 8** Location of the Configuration Dip Switches and LAN Port

#### NOTE

On the G4294B use the configuration dip switches of the DAD extension board to configure your LAN connection.

- 1 To connect the instrument with your PC using this default address configure the PC's network settings as followed:

IP: 192.168.254.10

Subnet Mask: 255.255.255.0

Default Gateway: N/A

- 2 Connect the crossover patch cable between the LAN-Port of the Agilent 1220 Infinity LC (Figure 8 on page 44) and the network connector of your PC.

**NOTE**

The crossover cable is only for the direct connection between the module and the PC. If you want to connect your Agilent 1220 Infinity LC via a hub to the network you should contact your local network administrator.

If you want to connect the instrument to a network we strongly recommend consulting your local network administrator to provide you with a valid network address. For further details about LAN configuration of the Agilent 1220 Infinity LC please refer to the *LAN Configuration* section of the *Installation chapter* in the *1220 Infinity LC User Manual*.

Here you find details about:

- TCP/IP parameter configuration
- Configuration Switches
- Using a fixed IP address
- How to configure an individual IP address

## The Instrument Utility / LabAdvisor Software

During the installation process of the Agilent 1220 Infinity LC this software is used for flushing the system and performing the System Installation check (see “[Priming the System and Performing the ‘Installation Check’](#)” on page 48).

- 1 Install the Instrument Utility or Lab Advisor software according to the Installation Procedure on the software CD.
- 2 Setup your Instrument to the software and **Connect** it.

#### NOTE

Whenever a hardware upgrade (Isocratic to Gradient, Column Oven, Autosampler upgrade) has been installed, it is necessary to re-configure your instrument in the Instrument Utility / Lab Advisor software. Therefore please follow the steps that are described in “[Configuration of the Instrument After an Upgrade Installation](#)” on page 47 before you proceed.

---

## Configuration of the Instrument After an Upgrade Installation

This step is only necessary if any of the following hardware upgrade kits has been installed to the instrument.

- G4297A - 1220 Infinity Oven kit
  - G4298A - 1220 Infinity upgrade manual injector to ALS
  - G4299A - 1220 Infinity upgrade isocratic to gradient pump
- 1 Connect the Instrument to the Instrument Utility / Lab Advisor software.
  - 2 Configure your Instrument according to the applied hardware changes:  
Software Revision B.01.04 and below:
    - **Tools > Module Service Center** (any module)Software Revision B.02.01 and higher:
    - **Instrument Control > Controls (any module) > Convert Device Type**(For example if you installed a G4297A - 1220 Infinity Oven kit then press **Add Oven**)
  - 3 Disconnect from the software and re-boot your instrument.
  - 4 Re-connect to the Instrument to the Instrument Utility / Lab Advisor software.
  - 5 Now perform the **Installation Check** as described in [“Priming the System and Performing the ‘Installation Check’”](#) on page 48.
  - 6 When starting the Chromatographic Data System use **Auto Configuration** to have your new hardware configuration configured to the CDS.

## Priming the System and Performing the 'Installation Check'

The steps described below are performed using the Instrument Utility / Lab Advisor software.

- 1 Connect all channels with HPLC grade water and use the **Purge Pump** for flushing the solvent channels.

Software Revision B.01.04 and below:

- **Tools > Pump > Purge Pump**

Software Revision B.02.01 and higher:

- **Service & Diagnostics > Pump (Tools must be checked) > Purge Pump**

- 2 Prime all connected channels sufficiently until all channels are bubble free.

- 3 Use the **Instrument Control** functionality to prime your system with HPLC grade water to remove air out of the system.

Apply the following conditions:

- Purge Valve: closed
- Flow: 2 mL/min
- Time: 5 min/channel
- Set stroke: 100  $\mu$ L

- 4 Perform the **Installation Check** from the **Service and Diagnostics** menu and print out the test result.
- 5 Create and print out a **Status Report**.



## Performing a 'Checkout Run'

- 1 Start the Chromatographic Data System
- 2 Create a checkout method with the following parameters:
  - Flow: 1 mL/min
  - Inj. Volume: 20  $\mu$ L (Autosampler)
  - Oven temp: not controlled
  - VWD Wavelength: 254 nm
  - Runtime: 1 min

This checkout run is done with the factory installed 'restriction capillary' in place.

- 3 Prepare 1ml of a checkout sample (acetone for example) and put it on vial position 1 in the autosampler tray.

For Manual Injector configurations load 20  $\mu$ L of checkout sample in the loop. Overfill the injection loop at least 3 times. (e.g. inject at least 60  $\mu$ L at a 20  $\mu$ L sample loop)

- 4 Start a single run.

As result a single peak should be visible.
- 5 Print out the report.
- 6 Store all created and printed out reports in a binder.

Now you are finished with the installation of the Agilent 1220 Infinity LC.

### **3 Installation**

#### **Performing a 'Checkout Run'**



## 4 LAN Configuration

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This chapter provides information on connecting the instrument to the Agilent ChemStation PC.



## 4 LAN Configuration

### To do first

## To do first

The Agilent 1220 Infinity LC has an on-board LAN communication interface.

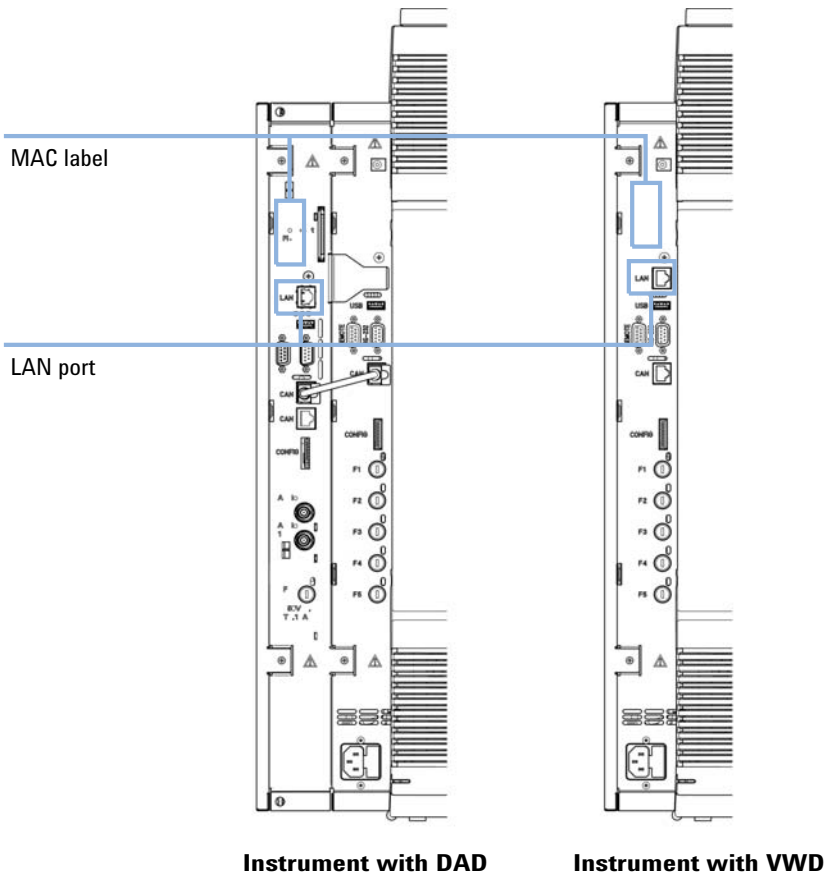
- 1 Note the MAC (Media Access Control) address for further reference. The MAC or hardware address of the LAN interfaces is a world wide unique identifier. No other network device will have the same hardware address. The MAC address can be found on a label at the rear left side of the instrument next to the configuration switch.



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

**Figure 9** MAC label

- 2 Connect the instrument's LAN interface to
- the PC network card using a crossover network cable (point-to-point) or
  - a hub or switch using a standard LAN cable.



**Figure 10** 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 automatically requesting the parameters from a network-based DHCP Server (using the so-called Dynamic Host Configuration Protocol). This mode requires a LAN-onboard Module or a G1369C LAN Interface card, see “[Setup \(DHCP\)](#)” on page 61
- 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, see [Table 11](#) on page 56.

## 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 10** Factory Default Settings

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

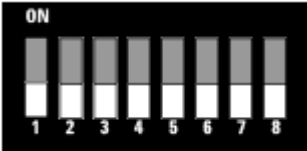
**NOTE**

For the G4294B, the Configuration switches on the DAD main board must be used for configuring the LAN access of the instrument. The switches on the 1220 Infinity LC main board must all be set to off.

## Initialization mode selection

The following initialization (init) modes are selectable:

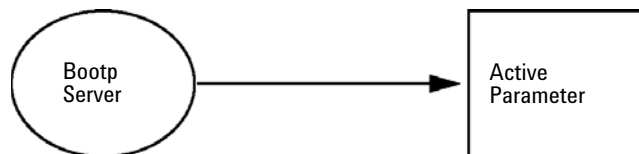
**Table 11** Initialization Mode Switches

	SW 6	SW 7	SW 8	Init Mode
	OFF	OFF	OFF	Bootp
	OFF	OFF	ON	Bootp & Store
	OFF	ON	OFF	Using Stored
	OFF	ON	ON	Using Default
	ON	OFF	OFF	DHCP <sup>1</sup>

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

### Bootp

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



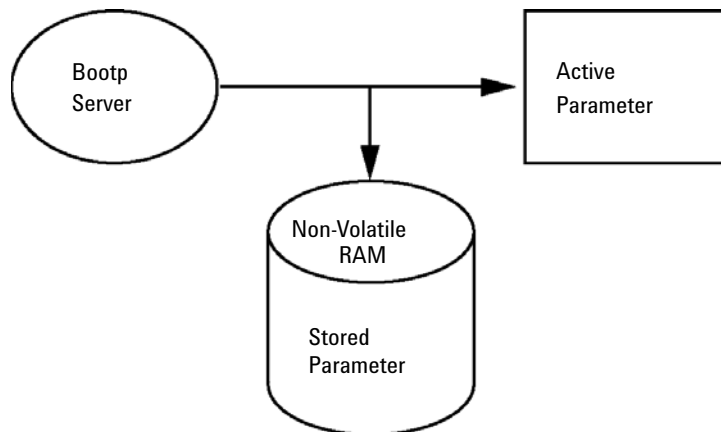
**Figure 11** Bootp (Principle)



## Bootp & Store

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

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



**Figure 12** Bootp & Store (Principle)

### NOTE

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

### Using Stored

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

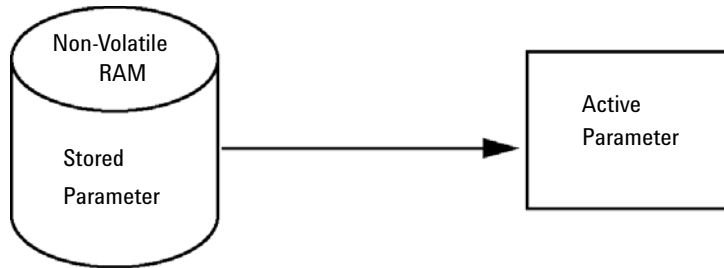


Figure 13 Using Stored (Principle)

### Using Default

When **Using Default** is selected, the factory default parameters are taken instead. These parameters enable a TCP/IP connection to the LAN interface without further configuration, see [Table 12](#) on page 58.

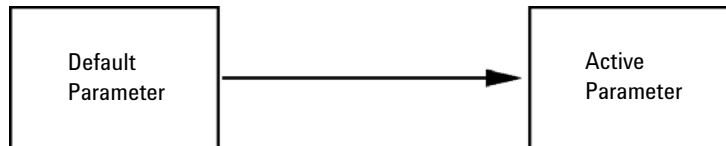


Figure 14 Using Default (Principle)

**NOTE**

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

Table 12 Using Default Parameters

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

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

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

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

**NOTE**

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

---

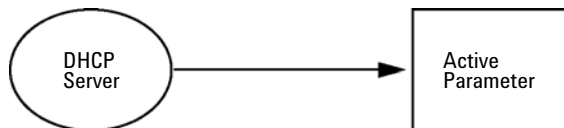
## Dynamic Host Configuration Protocol (DHCP)

### General Information (DHCP)

The Dynamic Host Configuration Protocol (DHCP) is an auto configuration protocol used on IP networks. The DHCP functionality is available on all Agilent HPLC modules with on-board LAN Interface or LAN Interface Card, and “B”-firmware (B.06.40 or above).

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

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



**Figure 15** DHCP (Principle)

#### NOTE

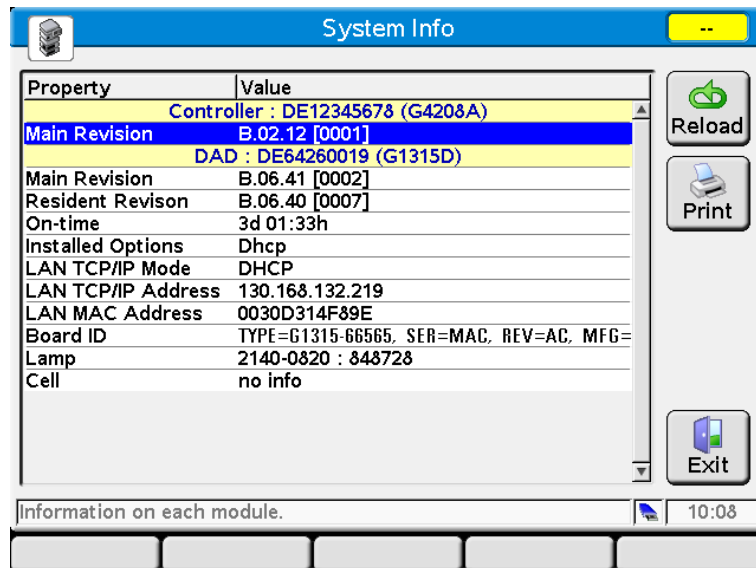
- 1 It may take some time until the DHCP server has updated the DNS server with the hostname information.
- 2 It may be necessary to fully qualify the hostname with the DNS suffix, e.g. *0030d3177321.country.company.com*.
- 3 The DHCP server may reject the hostname proposed by the card and assign a name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

## Setup (DHCP)

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

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

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



**Figure 16** LAN Setting on Instant Pilot

## 4 LAN Configuration

### Dynamic Host Configuration Protocol (DHCP)

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

**Table 13** G1369C LAN Interface Card (configuration switch on the card)

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

**Table 14** LC Modules inclusive 1120/1220 (configuration switch at rear of the instrument)

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

- 3 Turn on the module that hosts the LAN interface.
- 4 Configure your Control Software (e.g. Agilent ChemStation, Lab Advisor, Firmware Update Tool) and use MAC address as host name, e.g. *0030d3177321*.

The LC system should become visible in the control software (see Note in section “[General Information \(DHCP\)](#)” on page 60).

## Link configuration selection


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

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

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

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

**Table 15** Link Configuration Switches

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

## Automatic Configuration with BootP

**NOTE**

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

---

**NOTE**

Assure that the detector configuration switch is set properly. The setting should be either **BootP** or **BootP & Store**, see [Table 11](#) on page 56.

---

**NOTE**

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

---

**NOTE**

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

---

### About Agilent BootP Service

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

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



## How BootP Service Works

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

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

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

## Situation: Cannot Establish LAN Communication

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

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

## Installation of BootP Service

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

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

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

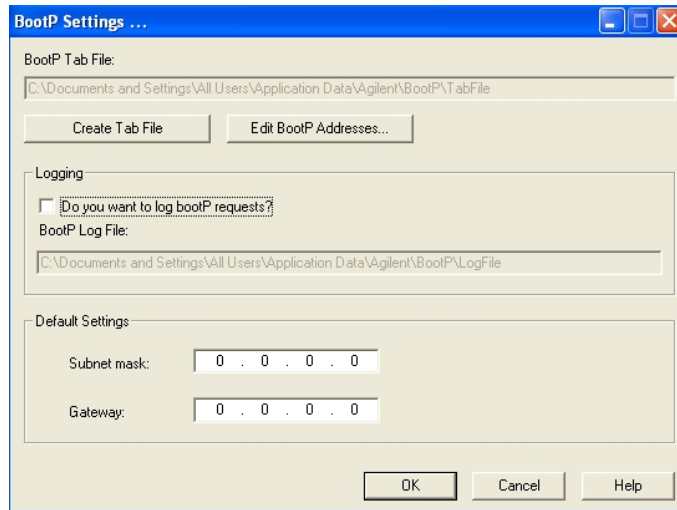


Figure 17 BootP Settings screen

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

Defaults can be used:

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

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

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

15 Remove the DVD from the drive.

This completes installation.

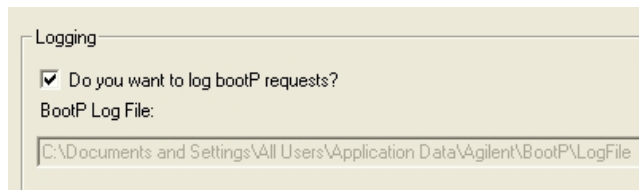
16 Start BootP Service in the Windows® services: On the Windows® desktop click right on **Computer** icon, select **Manage > Services and Applications > Services**. Select the **Agilent BootP Service** and click **Start**.

## Two Methods to Determine the MAC Address

### Enabling logging to discover the MAC address using BootP

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

- 1 Open BootP Settings from **Start > All Programs > Agilent BootP Service > EditBootPSettings**.
- 2 In **BootP Settings...** check **Do you want to log BootP requests?** to enable logging.



**Figure 18** Enable BootP logging

The log file is located in

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

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

- 3 Click **OK** to save the values or **Cancel** to discard them. The editing ends.
- 4 After each modification of the BootP settings (i.e. **EditBootPSettings**) a stop or start of the BootP service is required for the BootP service to accept changes. See “[Stopping the Agilent BootP Service](#)” on page 72 or “[Restarting the Agilent BootP Service](#)” on page 73.
- 5 Uncheck the **Do you want to log BootP requests?** box after configuring instruments; otherwise, the log file will quickly fill up disk space.

### Determining the MAC address directly from the LAN Interface card label

- 1 Turn off the instrument.
- 2 Read the MAC address from the label and record it.

The MAC address is printed on a label on the rear of the module. It is the number below the barcode and after the colon (: ) and usually begins with the letters AD, see [Figure 9](#) on page 52 and [Figure 10](#) on page 53.

- 3 Turn on the instrument.

## Assigning IP Addresses Using the Agilent BootP Service

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

### Determining the MAC address of the instrument using BootP Service

- 1 Power cycle the Instrument.
- 2 After the instrument completes self-test, open the log file of the BootP Service using Notepad.
  - The default location for the logfile is C:\Documents and Settings\All Users\Application Data\Agilent\BootP\LogFile.
  - The logfile will not be updated if it is open.

The contents will be similar to the following:

02/25/10 15:30:49 PM

Status: BootP Request received at outermost layer

Status: BootP Request received from hardware address: 0010835675AC

Error: Hardware address not found in BootPTAB: 0010835675AC

Status: BootP Request finished processing at outermost layer

- 3 Record the hardware (MAC) address (for example, 0010835675AC).
- 4 The Error means the MAC address has not been assigned an IP address and the Tab File does not have this entry. The MAC address is saved to the Tab File when an IP address is assigned.
- 5 Close the log file before turning on another instrument.
- 6 Uncheck the **Do you want to log BootP requests?** box after configuring instruments to avoid having the logfile use up excessive disk space.

### Adding each instrument to the network using BootP

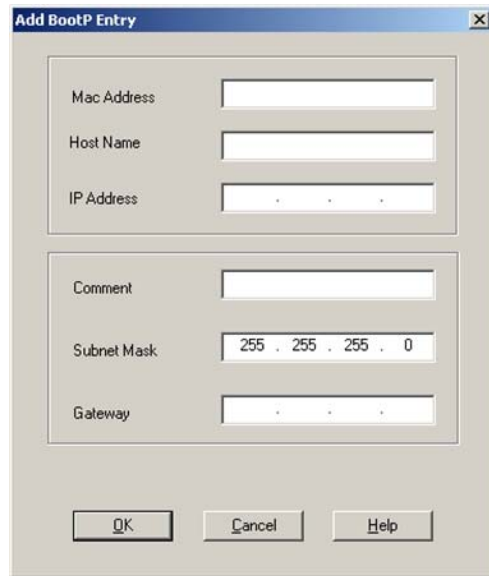
- 1 Follow **Start > All Programs > Agilent BootP Service** and select **Edit BootP Settings**. The BootP Settings screen appears.
- 2 Uncheck the **Do you want to log BootP requests?** once all instruments have been added.

## 4 LAN Configuration

### Automatic Configuration with BootP

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

- 3 Click **Edit BootP Addresses...** The **Edit BootP Addresses** screen appears.
- 4 Click **Add...** The **Add BootP Entry** screen appears.



The screenshot shows a dialog box titled "Add BootP Entry". It contains the following fields and buttons:

- Mac Address: [Empty text box]
- Host Name: [Empty text box]
- IP Address: [Empty text box with dots for separators]
- Comment: [Empty text box]
- Subnet Mask: [Text box containing "255 . 255 . 255 . 0"]
- Gateway: [Empty text box with dots for separators]
- Buttons: OK, Cancel, Help

**Figure 19** Enable BootP logging

- 5 Make these entries for the instrument:
  - MAC address
  - Host name, Enter a Hostname of your choice.  
The Host Name must begin with "alpha" characters (i.e. LC1260)
  - IP address
  - Comment (optional)
  - Subnet mask
  - Gateway address (optional)The configuration information entered is saved in the Tab File.
- 6 Click **OK**.

- 7 Leave **Edit BootP Addresses** by pressing **Close**.
- 8 Exit **BootP Settings** by pressing **OK**.
- 9 After each modification of the BootP settings (i.e. EditBootPSettings) a stop or start of the BootP service is required for the BootP service to accept changes. See [“Stopping the Agilent BootP Service”](#) on page 72 or [“Restarting the Agilent BootP Service”](#) on page 73.
- 10 Power cycle the Instrument.  
OR  
If you changed the IP address, power cycle the instrument for the changes to take effect.
- 11 Use the PING utility to verify connectivity by opening a command window and typing:  
Ping 192.168.254.11 for example.  
The Tab File is located at  
C:\Documents and Settings\All Users\Application Data\Agilent\BootP\TabFile

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

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

### Stopping the Agilent BootP Service

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

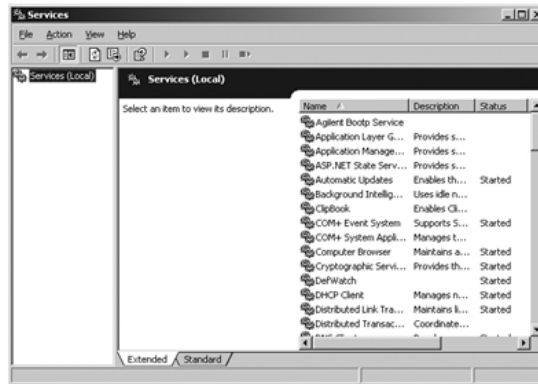


Figure 20 Windows Services screen

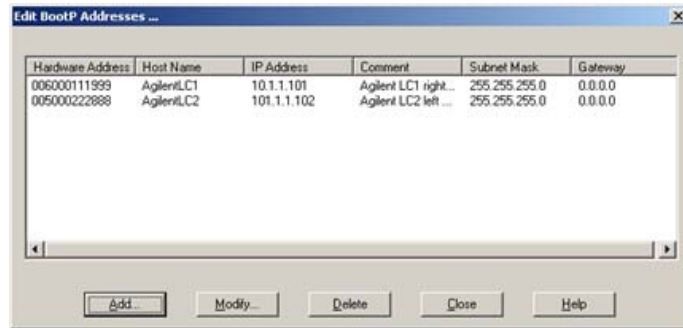
- 2 Right-click **Agilent BootP Service**.
- 3 Select **Stop**.
- 4 Close the **Services and Administrative Tools** screen.

### Editing the IP address and other parameters in EditBootPSettings

- 1 Select **Start > All Programs > Agilent BootP Service** and select **Edit BootP Settings**. The **BootP Settings** screen appears.
- 2 When the **BootP Settings** screen is first opened, it shows the default settings from installation.



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



**Figure 21** Edit BootP Addresses screen

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

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

- 5 Leave **Edit BootP Addresses...** by pressing **Close**.
- 6 Exit BootP Settings by pressing **OK**.

### Restarting the Agilent BootP Service

- 1 In the Windows control panel, select **Administrative Tools > Services**. The **Services** screen appears, see [Figure 20](#) on page 72.
- 2 Right-click **Agilent BootP Service** and select **Start**.
- 3 Close the **Services and Administrative Tools** screens.

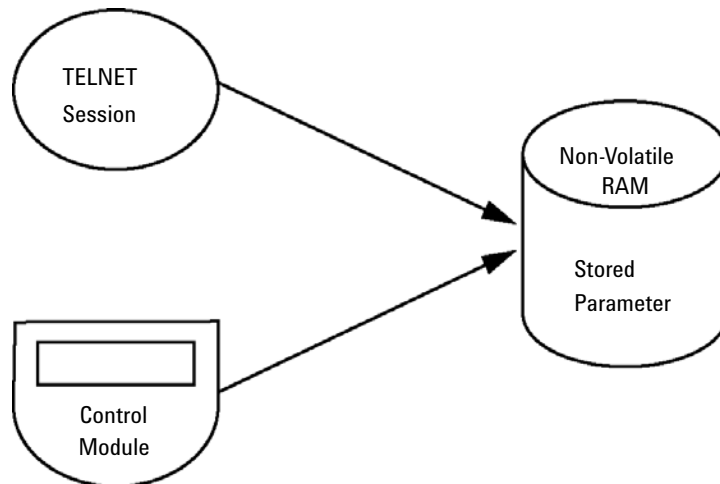
## Storing the settings permanently with Bootp

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

- 1 Turn off the module.
- 2 Change the module's settings of the Configuration Switch to “*Bootp & Store*” mode, see [Table 11](#) on page 56.
- 3 Start the Agilent Bootp Service and open its window.
- 4 If required, modify the parameters for the module according to your needs using the existing configuration.
- 5 Press **OK** to exit the Bootp Manager.
- 6 Now turn on the module 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 module.
- 7 Close the Agilent Bootp Service and turn off the module.
- 8 Change the settings of the module's Configuration Switch to “*Using Stored*” mode, see [Table 11](#) on page 56.
- 9 Power cycle the module. The module can be accessed now via LAN without the Agilent Bootp Service.

## Manual Configuration

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

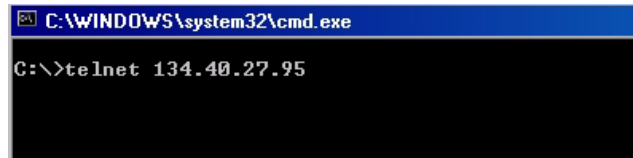


**Figure 22** Manual Configuration (Principle)

## With Telnet

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

- 1 Open the system (DOS) prompt window by clicking on Windows **START** button and select “**Run...**”. Type “cmd” and press OK.
- 2 Type the following at the system (DOS) prompt:
  - `c:\>telnet <IP address>` or
  - `c:\>telnet <host name>`

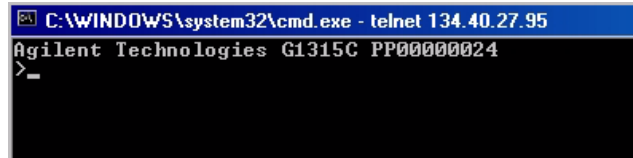


```
C:\WINDOWS\system32\cmd.exe
C:\>telnet 134.40.27.95
```

**Figure 23** Telnet - Starting a session

where <IP address> may be the assigned address from a Bootp cycle, a configuration session with the Handheld Controller, or the default IP address (see “[Configuration Switches](#)” on page 55).

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



```
C:\WINDOWS\system32\cmd.exe - telnet 134.40.27.95
Agilent Technologies G1315C PP00000024
>_
```

**Figure 24** A connection to the module is made

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

```

C:\WINDOWS\system32\cmd.exe - telnet 134.40.27.95
Agilent Technologies G1315C PP00000024
>?
command syntax          description
-----
?                        display help info
/                        display current LAN settings
ip <x.x.x.x>             set IP Address
sm <x.x.x.x>            set Subnet Mask
gw <x.x.x.x>            set Default Gateway
exit                    exit shell
>
  
```

**Figure 25** Telnet Commands

**Table 16** Telnet Commands

Value	Description
<code>?</code>	displays syntax and descriptions of commands
<code>/</code>	displays current LAN settings
<code>ip &lt;x.x.x.x&gt;</code>	sets new ip address
<code>sm &lt;x.x.x.x&gt;</code>	sets new subnet mask
<code>gw &lt;x.x.x.x&gt;</code>	sets new default gateway
<code>exit</code>	exits shell and saves all changes

- 4 To change a parameter follows the style:

- parameter value, for example:  
`ip 134.40.27.230`

Then press [Enter], where parameter refers to the configuration parameter you are defining, and value refers to the definitions you are assigning to that parameter. Each parameter entry is followed by a carriage return.

## 4 LAN Configuration

### Manual Configuration

- 5 Use the “/” and press Enter to list the current settings.

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

information about the LAN interface  
MAC address, initialization mode  
Initialization mode is Using Stored  
active TCP/IP settings  
TCP/IP status - here ready  
connected to PC with controller software (e.g. Agilent  
ChemStation), here not connected

Figure 26 Telnet - Current settings in "Using Stored" mode

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

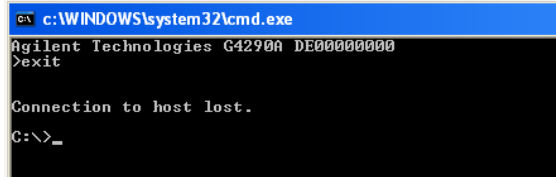
```
C:\WINDOWS\system32\cmd.exe - telnet 134.40.27.95
>ip 134.40.27.99
>/
LAN Status Page
-----
MAC Address   : 0030D30A0838
-----
Init Mode    : Using Stored
-----
TCP/IP Properties
- active -
IP Address   : 134.40.27.95
Subnet Mask  : 255.255.248.0
Def. Gateway : 134.40.24.1
- stored -
IP Address 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

change of IP setting to  
Initialization mode is Using Stored  
active TCP/IP settings  
stored TCP/IP settings in non-volatile memory

connected to PC with controller software (e.g. Agilent  
ChemStation), here not connected

Figure 27 Telnet - Change IP settings

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

A screenshot of a Windows command prompt window. The title bar reads "c:\WINDOWS\system32\cmd.exe". The command prompt shows the output of a Telnet session: "Agilent Technologies G4290A DE00000000", followed by the user typing ">exit". The prompt then displays "Connection to host lost." and returns to the local command prompt "C:\>\_".

```
c:\WINDOWS\system32\cmd.exe
Agilent Technologies G4290A DE00000000
>exit

Connection to host lost.
C:\>_
```

**Figure 28** 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.

---

## **4 LAN Configuration**

### **Manual Configuration**





## 5 Solvent Delivery System Description

Overview	82
Degasser	83
Principles of Operation	84
Compressibility Compensation	88
Variable Stroke Volume	90
Using the Pump	91

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 600 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 isocratic pump of the Agilent 1220 Infinity LC has no 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

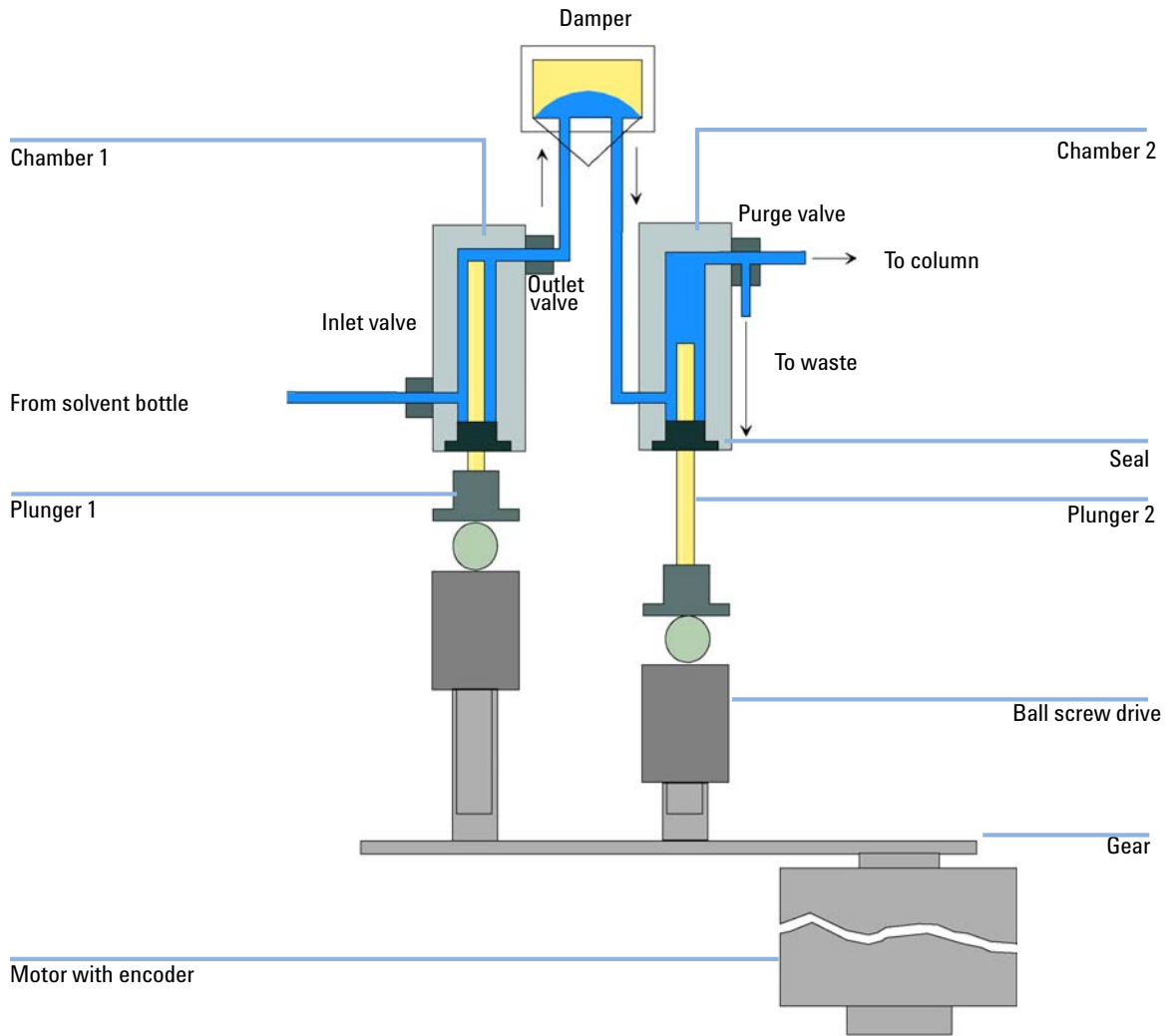
The dual-channel gradient pump comes with a built-in online degasser. The degasser is switched on automatically when the pump is switched on, even if the flow is set to 0 mL/min. A constant vacuum of 75 Torr (100 mbar) is created in the vacuum chamber of the two channels. The solvent flows through a PTFE 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  $\mu\text{L}$  depending on the flow rate. The microprocessor controls all flow rates in a range of 1  $\mu\text{L}/\text{min}$ –10  $\text{mL}/\text{min}$ . 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 29** 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 17** Isocratic pump details

Dead volume	800 – 1100 $\mu$ L, depending on back pressure
Materials in contact with mobile phase	
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
Degasser chamber	TFE/PDD copolymer, FEP, PEEK, PPS

**Table 18** Gradient pump details

Delay volume	800 – 1100 $\mu\text{L}$ , 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  $46 \cdot 10^{-6}$  /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 19** Solvent Compressibility

Solvent (pure)	Compressibility ( $1 \cdot 10^{-6}$ /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 – 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 – 0.001 M sodium azide to the solvent.
- Place a layer of argon on top of your solvent.
- Avoid exposing the solvent bottle to direct sunlight.

### NOTE

Never use the system without a solvent filter installed.

---



## 6 Injection System Description

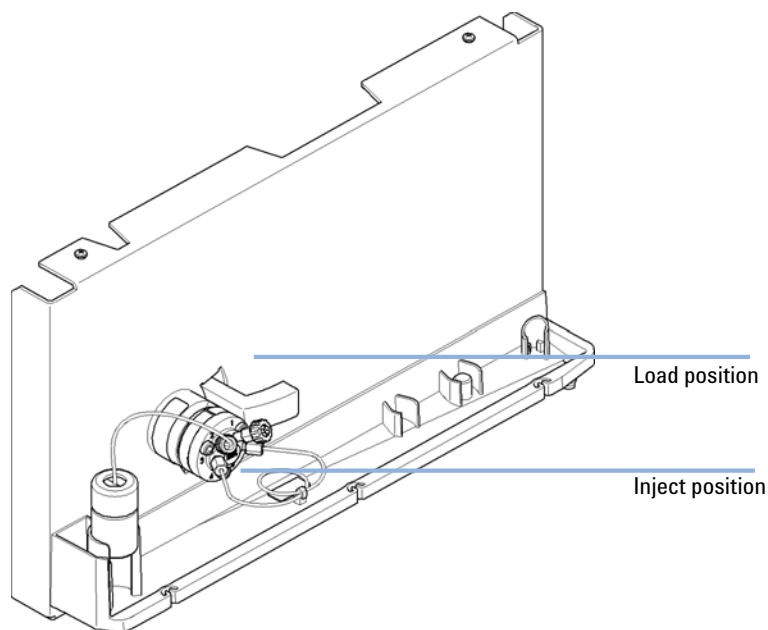
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This chapter provides an overview of the operational principles of the injection systems: manual injector and autosampler.



## Manual Injector

The Agilent 1220 Infinity LC manual injector uses a Rheodyne, 6-port sample injection valve (5067-4202). Sample is loaded into the external 20  $\mu\text{L}$  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 30** Rheodyne 6-port sample injection valve

## The Injection Seal

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

## Injecting Sample

### WARNING

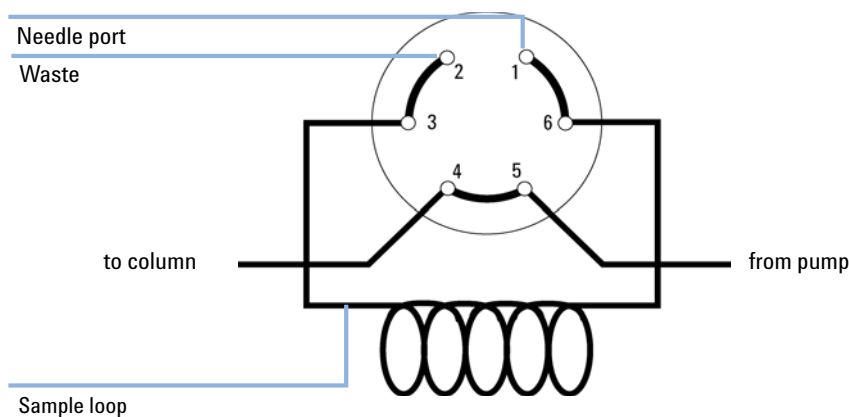
#### Ejection of mobile phase

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

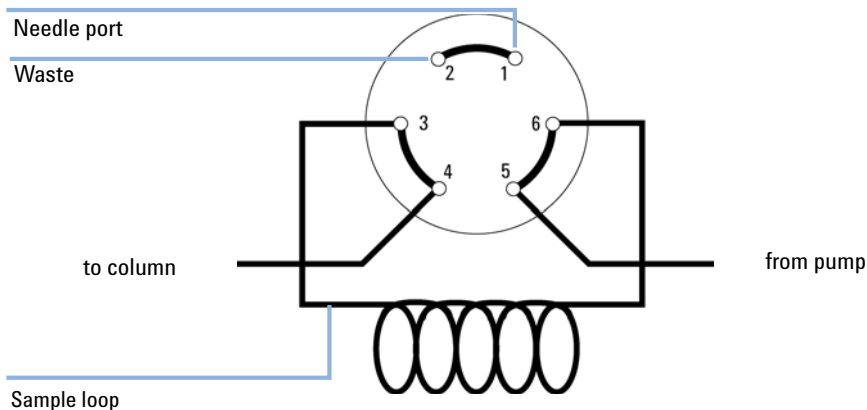
In the LOAD position (see [Figure 31](#) on page 95), the pump is connected directly to the column (ports 4 and 5 connected), and the needle port is connected to the sample loop. At least 2 to 3 sample-loop volumes (more if better precision is required) of sample should be injected through the needle port to provide good precision. The sample fills the loop, and excess sample is expelled through the vent tube connected to port 2.



**Figure 31** LOAD Position

### INJECT Position

In the INJECT position (see [Figure 32](#) on page 96), the pump is connected to the sample loop (ports 5 and 6 connected). All of the sample is washed out of the loop onto the column. The needle port is connected to the vent tube (port 2).



**Figure 32** INJECT Position

## Needles

**CAUTION**

Needle can damage valve

→ Always use the correct needle size.

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

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 and 15 × 6 mL vials respectively. Any two half-size rack trays can be installed in the autosampler simultaneously. The analytical head device provides injection volumes from 0.1 – 100 µL.

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 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 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.

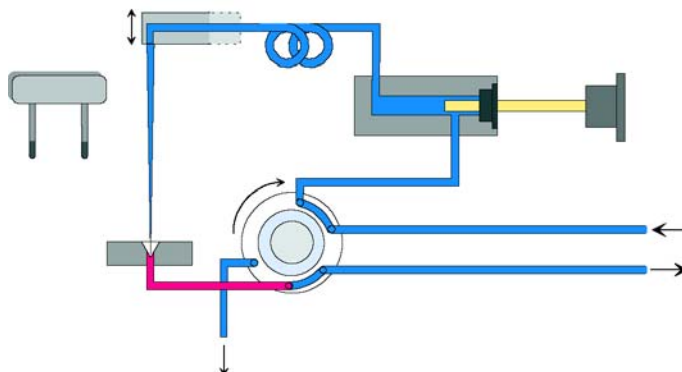
Solvent is bypassed from the autosamplers by the injection valve during the sampling sequence. The sample vial is selected by a gripper arm from a static sample rack. The gripper arm places the sample vial below the injection needle. The required volume of sample is drawn into the sample loop by the 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 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. 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.

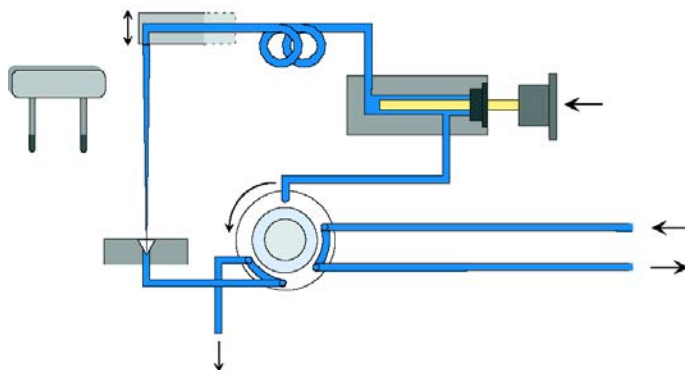


**Figure 33** Mainpass Position

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.

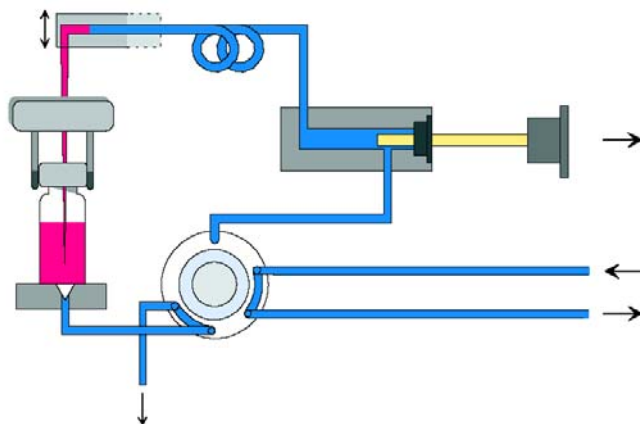
## 6 Injection System Description

### Autosampler



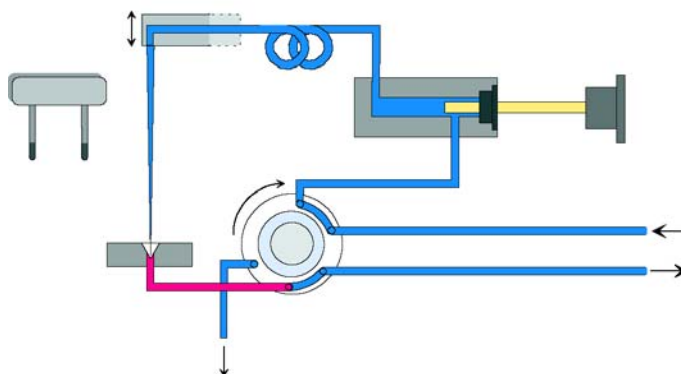
**Figure 34** Bypass Position

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 35** 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 36** 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 20** Analytical head technical data

	Standard (100 $\mu$ L)
Number of steps	15000
Volume resolution	7 nL/motor step
Maximum stroke	100 $\mu$ L
Pressure limit	600 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).

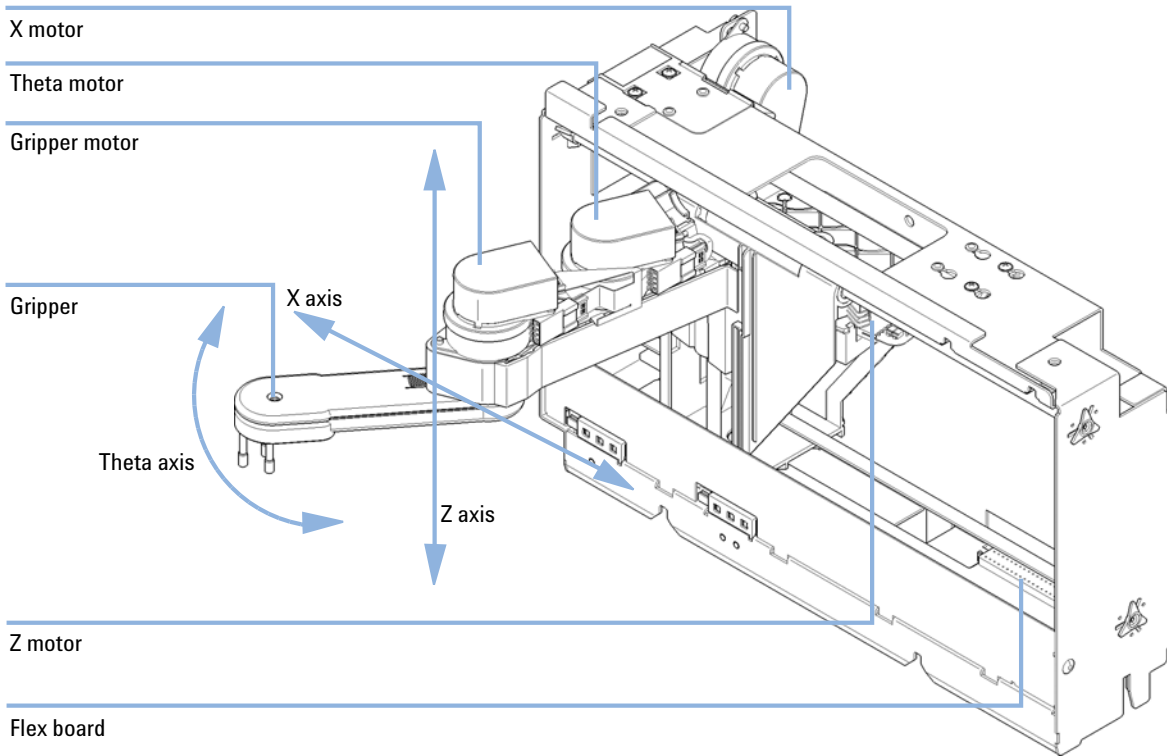
No valve adjustments are required after replacing internal components.

**Table 21** 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 37** 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.

## Supported Trays for the Autosampler

<b>p/n</b>	<b>Description</b>
G1313-44510	Tray for 100 x 2 mL vials
G1313-44513	Halftray for 15 x 6 mL vials
G1313-44512	Halftray for 40 x 2 mL vials

### 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 15000 injections with the Agilent 1220 Infinity LC autosampler.

### Crimp top vials

<b>p/n</b>	<b>Description</b>
5181-3375	Crimp Top Vial, 2 mL, clear glass, 100/Pack
5183-4491	Crimp Top Vial, 2 mL, clear glass, 1000/Pack
5182-0543	Crimp Top Vial, 2 mL, clear glass, write-on spot, 100/Pack
5183-4492	Crimp Top Vial, 2 mL, clear glass, write-on spot, 1000/Pack
5183-4494	Crimp Top Vial, 2 mL, clear glass, write-on spot, 100/Pack (silanized)
5181-3376	Crimp Top Vial, 2 mL, amber glass, write-on spot, 100/Pack
5183-4493	Crimp Top Vial, 2 mL, amber glass, write-on spot, 1000/Pack
5183-4495	Crimp Top Vial, 2 mL, amber glass, write-on spot, 100/Pack (silanized)
5182-0567	Crimp Top Vial, 1 mL, polypropylene, wide opening, 100/Pack
5183-4496	Crimp Top Vial, 1 mL, polypropylene, wide opening, 100/Pack (silanized)
9301-0978	crimp top vial, 0.3 mL, polypropylene, wide opening, 1000/pack

Snap top vials

<b>p/n</b>	<b>Description</b>
5182-0544	Snap Top Vial, 2 mL, clear glass, 100/Pack
5183-4504	Snap Top Vial, 2 mL, clear glass, 1000/Pack
5183-4507	Snap Top Vial, 2 mL, clear glass, 100/Pack (silanized)
5182-0546	Snap Top Vial, 2 mL, clear glass, write-on spot, 100/Pack
5183-4505	Snap Top Vial, 2 mL, clear glass, write-on spot, 1000/Pack
5183-4508	Snap Top Vial, 2 mL, clear glass, write-on spot, 100/Pack (silanized)
5182-0545	Snap Top Vial, 2 mL, amber glass, write-on spot, 100/Pack
5183-4506	Snap Top Vial, 2 mL, amber glass, write-on spot, 1000/Pack
5183-4509	Snap Top Vial, 2 mL, amber glass, write-on spot, 100/Pack (silanized)

Screw top vials

<b>p/n</b>	<b>Description</b>
5182-0714	Screw Cap Vials, 2 mL, clear glass, 100/Pack
5183-2067	Screw Top Vial, 2 mL, clear glass, 1000/Pack
5183-2070	Screw Top Vial, 2 mL, clear glass, 100/Pack (silanized)
5182-0715	Screw Top Vial, 2 mL, clear glass, write-on spot, 100/Pack
5183-2068	Screw Top Vial, 2 mL, clear glass, write-on spot, 1000/Pack
5183-2071	Screw Top Vial, 2 mL, clear glass, write-on spot, 100/Pack (silanized)
5182-0716	Screw Cap Vial, 2 mL, amber glass, write-on spot, 100/pk
5183-2069	Screw Top Vial, 2 mL, amber glass, write-on spot, 1000/Pack
5183-2072	Screw Top Vial, 2 mL, amber glass, write-on spot, 100/Pack (silanized)

## 6 Injection System Description

### Autosampler

#### Crimp caps

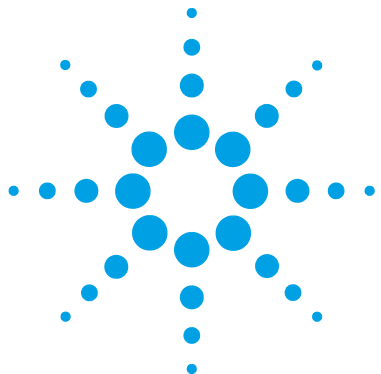
<b>p/n</b>	<b>Description</b>
5181-1210	Crimp Cap, silver aluminum, septum (clear PTFE/red rubber), 100/Pack
5183-4498	Crimp Cap, silver aluminum, septum (clear PTFE/red rubber), 1000/Pack
5181-1215	Crimp Cap, blue aluminum, septum (clear PTFE/red rubber), 100/Pack
5181-1216	Crimp Cap, green aluminum, septum (clear PTFE/red rubber), 100/Pack
5181-1217	Crimp Cap, red aluminum, septum (clear PTFE/red rubber), 100/Pack

#### Snap caps

<b>p/n</b>	<b>Description</b>
5182-0550	Snap Cap, clear polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-3458	Snap Cap, blue polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-3457	Snap Cap, green polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-3459	Snap Cap, red polypropylene, septum (clear PTFE/red rubber), 100/Pack

#### Screw caps

<b>p/n</b>	<b>Description</b>
5182-0717	Screw Cap, blue polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-0718	Screw Cap, green polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-0719	Screw Cap, red polypropylene, septum (clear PTFE/red rubber), 100/Pack
5182-0720	Screw Cap, blue polypropylene, septum (clear PTFE/silicone), 100/Pack
5182-0721	Screw Cap, green polypropylene, septum (clear PTFE/silicone), 100/Pack
5182-0722	Screw Cap, red polypropylene, septum (clear PTFE/silicone), 100/Pack



## 7 Column Oven Description

Column Oven 110

This chapter provides an overview of the operational principles of the column oven.



## 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 built-in over temperature cut off fuse inhibits overheating.

The inner volume of the oven capillary is 6  $\mu$ L.

Maximum column length is 25 cm (10 inch).

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

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## 8 Detector Description

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This chapter provides an overview of the operational principles of the detector.



## Detector Types

There are two different detector types available for the Agilent 1220 Infinity LC System:

- Variable Wavelength Detector (VWD, used in G4286B, G4288B/C, G4290B/C), optical unit of the G1314F VWD
- Diode Array Detector (DAD, used in G4294B), optical unit of the G1315C DAD



# Agilent 1220 Infinity LC Variable Wavelength Detector (VWD)

## 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 – 600 nm,
- Optional flow-cell cartridges (standard: 10 mm<sup>14</sup> μL, high pressure: 10 mm<sup>14</sup> μL, micro: 3 mm<sup>2</sup> μL, semi-micro: 6 mm<sup>5</sup> 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.

# Agilent 1220 Infinity LC Diode Array Detector (DAD)

## Introduction to the Detector

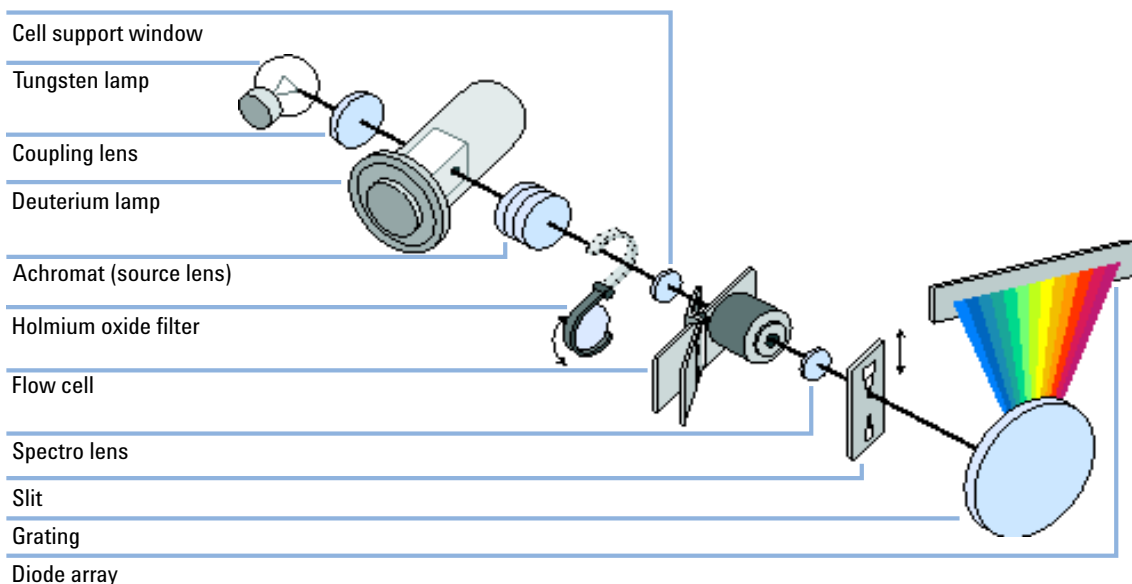
The detector is designed for highest optical performance, GLP compliance and easy maintenance. It includes the following features:

- 80 Hz data acquisition rate for (ultra-) fast LC applications
- RFID tags for all flow cells and UV-lamps provides traceable information about these assemblies
- Long-life deuterium with RFID tag and tungsten lamps for highest intensity and lowest detection limit over a wavelength range of 190 – 950 nm
- No loss in sensitivity for up to eight wavelengths simultaneous
- Programmable slit from 1 – 16 nm for complete optimization of sensitivity, linearity and spectral resolution
- Optional flow-cell cartridges with RFID tag (standard 10 mm<sup>13</sup> μL, semi-micro 6 mm<sup>5</sup> μL, micro 3 mm<sup>2</sup> μL, 80 nL, 500 nL, 10 mm, high pressure 10 mm<sup>1.7</sup> μL and prep-cells) are available and can be used depending on the application needs.
- Easy front access to lamps and flow cell for fast replacement
- Built-in holmium oxide filter for fast wavelength accuracy verification
- Built-in temperature control for improved baseline stability
- Additional diagnostic signals for temperature and lamp voltage monitoring

For specifications, see [“Performance Specifications Agilent 1220 Infinity LC DAD”](#) on page 26.

## Optical System

The optical system of the detector is shown in Figure below. Its illumination source is a combination of a deuterium-arc-discharge lamp for the ultraviolet (UV) wavelength range and a tungsten lamp for the visible (VIS) and short-wave near-infrared (SWNIR) wavelength range. The image of the filament of the tungsten lamp is focused on the discharge aperture of the deuterium lamp by means of a special rear-access lamp design which allows both light sources to be optically combined and share a common axis to the source lens. The achromat (source lens) forms a single, focused beam of light through the flow cell. Each cell room and lamp are separated by a quartz window which can be cleaned or replaced. In the spectrograph, light is being dispersed onto the diode array by a holographic grating. This allows simultaneous access to all wavelength information.



**Figure 38** Optical System of the Detector

**Lamps** The light source for the UV-wavelength range is a deuterium lamp with a shine-through aperture. As a result of plasma discharge in low-pressure deuterium gas, the lamp emits light over the 190 nm to approximately 800 nm wavelength range. The light source for the visible and SWNIR wavelength range is a low noise tungsten lamp. This lamp emits light over the wavelength range 470 – 950 nm.

## 8 Detector Description

### Agilent 1220 Infinity LC Diode Array Detector (DAD)

**Achromat (Source Lens)** The achromat receives the light from both lamps and focuses it so that the beam passes through the flow cell.

**Holmium Oxide Filter** The holmium oxide filter is electromechanically actuated. During the holmium filter test it moves into the light path.

**Cell Support Window** The cell support window assembly separates the holmium filter area from the flow cell area.

**Flow Cell Compartment** The optical unit has a flow cell compartment for easy access to flow cells. A variety of optional flow cells can be inserted using the same quick, simple mounting system. The flow cell can be removed to check the optical and electronic performance of the detector without having influences from the flow cell.

**Spectrograph** The spectrograph material is ceramic to reduce thermal effects to a minimum. The spectrograph consists of the spectrograph lens, the variable entrance slit, the grating and the photodiode array with front-end electronics. The spectrograph lens refocuses the light beam after it has passed through the flow cell. The sampling interval of the diode array is < 1 nm over the wavelength range 190 – 950 nm. Depending on the wavelength this varies from 1.0 to 1.25 diodes per nanometer (for example a diode every 0.8 to 1 nm).

For a small wavelength range, the small non-linearity could be neglected. With the wavelength range from 190 – 950 nm a new approach is required to achieve wavelength accuracy over the full range. Each spectrograph is calibrated individually. The calibration data is stored in the spectrograph on an EEPROM. Based on these data, the built-in processors calculate absorbance data with linear intervals (1.0, 2.0, ...) between data points. This results in an excellent wavelength accuracy and instrument-to-instrument reproducibility.

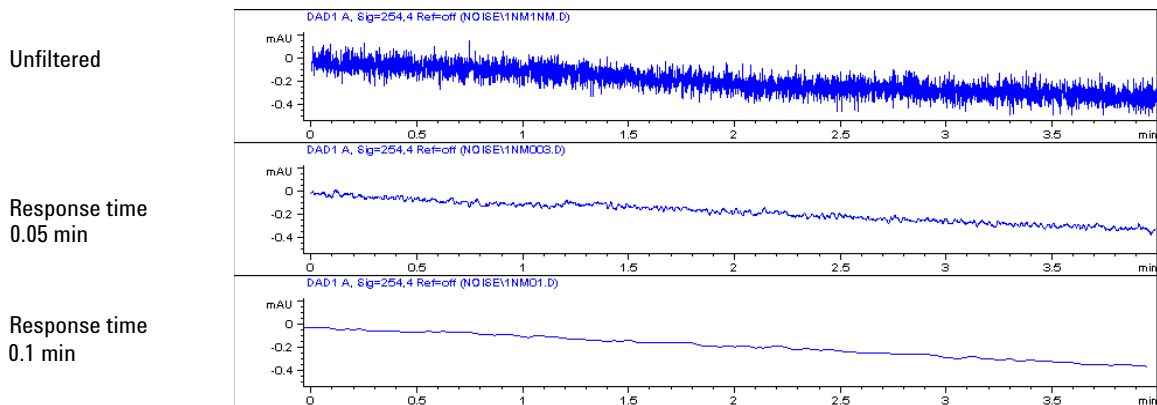
**Variable Entrance Slit System** The micro-slit system makes use of the mechanical properties of silicon combined with the precise structuring capabilities of bulk micro-machining. It combines the required optical functions – slit and shutter – in a simple and compact component. The slit width is directly controlled by the micro-processor of the instrument and can be set as method parameter.

**Grating** The combination of dispersion and spectral imaging is accomplished by using a concave holographic grating. The grating separates the light beam into all its component wavelengths and reflects the light onto the photodiode array.

**Diode Array** The diode array is a series of 1024 individual photodiodes and control circuits located on a ceramic carrier. With a wavelength range from 190 – 950 nm the sampling interval is < 1 nm.

## Peak width (response time)

Response time describes how fast the detector signal follows a sudden change of absorbance in the flow cell. The detector uses digital filters to adapt response time to the width of the peaks in your chromatogram. These filters do not affect peak area nor peak symmetry. When set correctly, such filters reduce baseline noise significantly ( [Figure 39](#) on page 117), but reduce peak height only slightly. In addition, these filters reduce the data rate to allow optimum integration and display of your peaks and to minimize disk space required to store chromatograms and spectra.



**Figure 39** Influence of Response Time on Signal and Noise

[Table 22](#) on page 118 lists the filter choices of the detector. To get optimum results, set peak width as close as possible to a narrow peak of interest in your chromatogram. Response time will be approximately 1/3 of the peak width, resulting in less than 5 % peak-height reduction and less than 5 % additional peak dispersion. Decreasing the peak width setting in the detector will result in less than 5 % gain in peak height but baseline noise will increase by a factor of 1.4 for a factor of 2 response-time reduction. Increasing peak width (response time) by factor of two from the recommended setting (over-filtering) will reduce peak height by about 20 % and reduce baseline noise by a factor of 1.4. This gives you the best possible signal-to-noise ratio, but may affect peak resolution.

## 8 Detector Description

### Agilent 1220 Infinity LC Diode Array Detector (DAD)

**Table 22** Peak Width — Response Time — Data Rate

<b>Peak Width [minutes]</b>	<b>Response Time [seconds]</b>	<b>Data Rate [Hz]</b>
<0.0025	0.025	80
>0.0025	0.05	80
>0.005	0.1	40
>0.01	0.2	20
>0.03	0.5	10
>0.05	1.0	5
>0.10	2.0	2.5
>0.20	4.0	1.25
>0.40	8.0	0.62
>0.85	16.0	0.31

## Sample and Reference Wavelength and Bandwidth

The detector measures absorbance simultaneously at wavelengths from 190 to 950 nm. Two lamps provide good sensitivity over the whole wavelength range. The deuterium discharge lamp provides the energy for the UV range (190 to 400 nm) and the tungsten lamp emits light from 400 to 950 nm for the visible and short wave near infrared.

If you know little about the analytes in your sample, use both lamps and store all spectra over the full wavelength range. This provides full information but fills up your disk space rather quickly. Spectra can be used to check a peak's purity and identity. Spectral information is also useful to optimize wavelength settings for your chromatographic signal.

The detector can compute and store at run time up to 8 signals with these properties:

- sample wavelength, the center of a wavelength band with the width of sample bandwidth (BW), and optionally
- reference wavelength, the center of a wavelength band with the width of reference bandwidth.

The signals comprises a series of data points over time, with the average absorbance in the sample wavelength band minus the average absorbance of the reference wavelength band.

Signal A in the detector default method is set to sample 250,100, reference 360,100, that is, the average absorbance from 200 – 300 nm minus the average absorbance from 300 – 400 nm. As all analytes show higher absorbance at 200 – 300 nm than at 300 – 400 nm, this signal will show you virtually every compound which can be detected by UV absorbance.

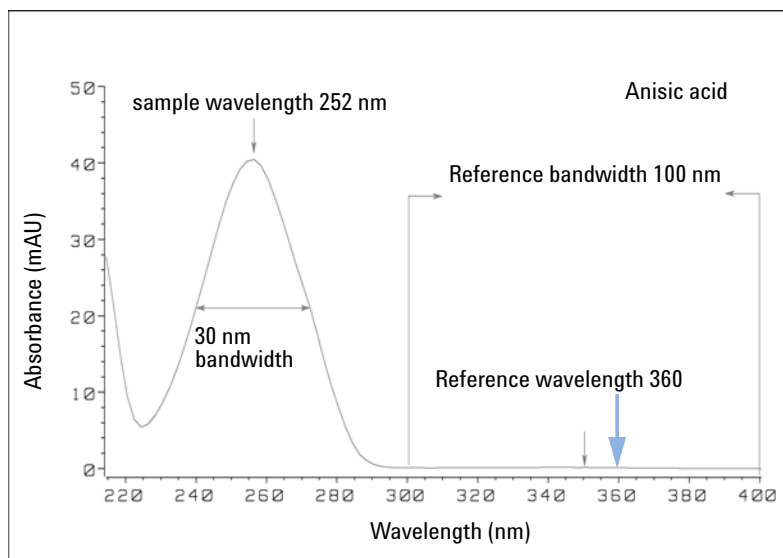
Many compounds show absorbance bands in the spectrum. [Figure 40](#) on page 120 shows the spectrum of anisic acid as an example.

To optimize for lowest possible detectable concentrations of anisic acid, set the sample wavelength to the peak of the absorbance band (that is, 252 nm) and the sample bandwidth to the width of the absorbance band (that is, 30 nm). A reference of 360,100 is adequate. Anisic acid does not absorb in this range.

If you work with high concentrations, you may get better linearity above 1.5 AU by setting the sample wavelength to a valley in the spectrum, like 225 nm for anisic acid.

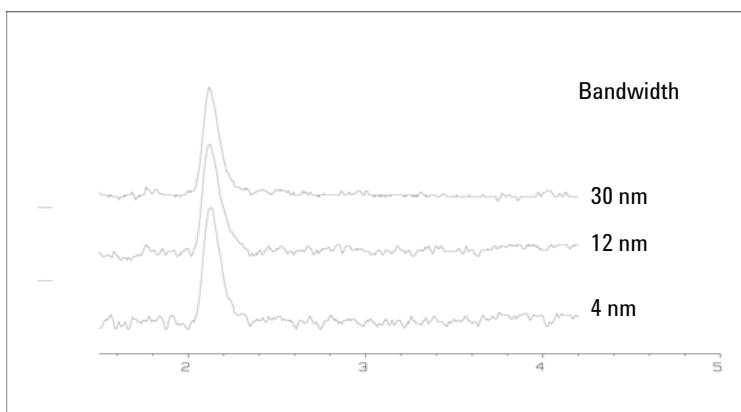
## 8 Detector Description

### Agilent 1220 Infinity LC Diode Array Detector (DAD)



**Figure 40** Optimization of Wavelength Setting

A wide bandwidth has the advantage of reducing noise by averaging over a wavelength range – compared to a 4 nm bandwidth, the baseline noise is reduced by a factor of approximately 2.5, whereas the signal is about 75 % of a 4 nm wide band. The signal-to-noise ratio for a 30 nm bandwidth is twice that for a 4 nm bandwidth in our example.



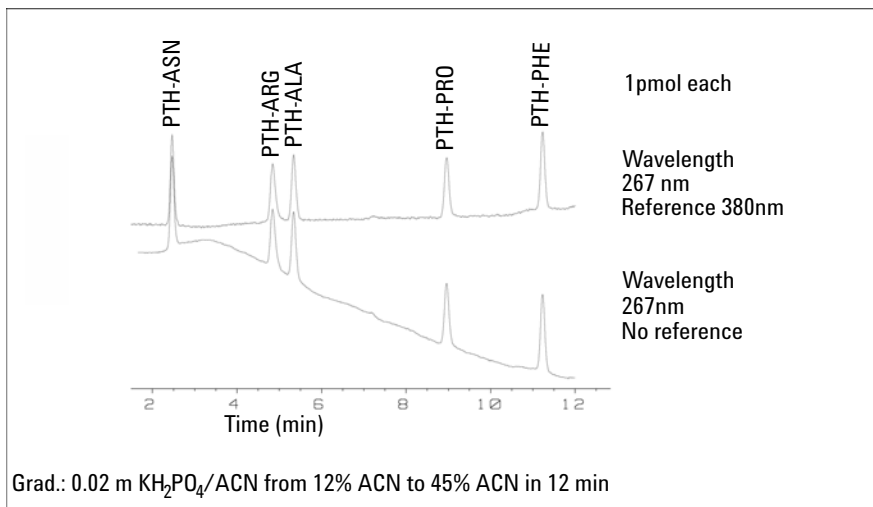
**Figure 41** Influence of Bandwidth on Signal and Noise



Because the detector averages absorbance values that are calculated for each wavelength, using a wide bandwidth does not negatively impact linearity.

The use of a reference wavelength is highly recommended to further reduce baseline drift and wander induced by room temperature fluctuations or refractive index changes during a gradient.

An example of the reduction of baseline drifts is shown in [Figure 42](#) on page 121 for PTH-amino acids. Without a reference wavelength, the chromatogram drifts downwards due to refractive index changes induced by the gradient. This is almost completely eliminated by using a reference wavelength. With this technique, PTH-amino acids can be quantified in the low picomole range even in a gradient analysis.

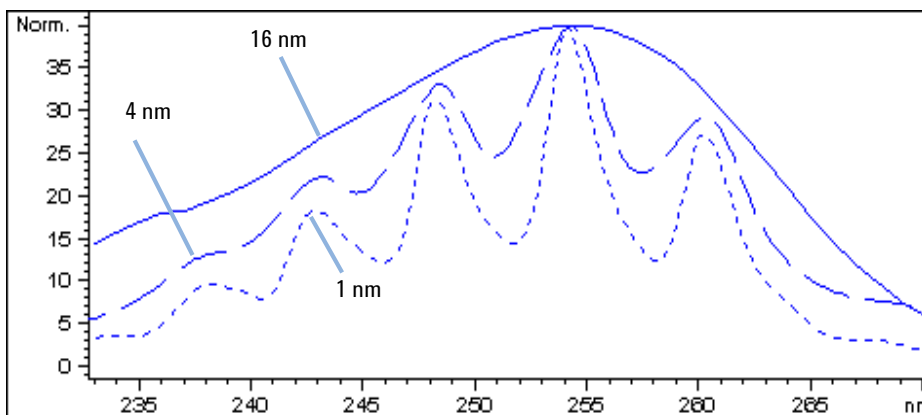


**Figure 42** Gradient Analysis of PTH-Amino Acids (1 pmol each), with and without Reference

## Slit Width

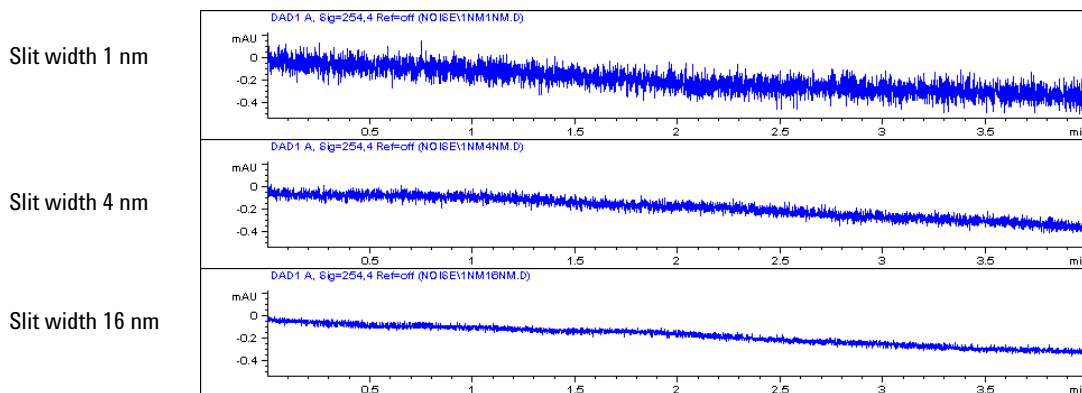
The detector has a variable slit at the entrance of the spectrograph. This is an effective tool to adapt the detector to changing demand of different analytical problems.

A narrow slit provides spectral resolution for analytes with very fine structures in the absorbance spectrum. An example of such a spectrum is benzene. The five main absorbance bands (fingers) are only 2.5 nm wide and just 6 nm apart from each other.



**Figure 43** Benzene at 1, 4 and 16 nm slit width (principle)

A wide slit uses more of the light shining through the flow cell. This gives lower baseline noise as shown in [Figure 44](#) on page 123.



**Figure 44** Influence of the Slit Width on Baseline Noise

However, with a wider slit, the spectrograph's optical resolution (its ability to distinguish between different wavelengths) diminishes. Any photodiode receives light within a range of wavelength determined by the slit width. This explains why the fine spectral structure of benzene disappears when using a 16-nm wide slit.

Furthermore, the absorbance is no longer strictly linear with concentration for wavelengths at a steep slope of a compound's spectrum.

Substances with fine structures and steep slopes like benzene are very rare.

In most cases the width of absorbance bands in the spectrum is more like 30 nm as with anisic acid (Figure 40 on page 120).

In most situations, a slit width of 4 nm will give the best results.

Use a narrow slit (1 or 2 nm) if you want to identify compounds with fine spectral structures or if you need to quantify at high concentrations (> 1000 mAU) with a wavelength at the slope of the spectrum. Signals with a wide bandwidth can be used to reduce baseline noise. Because (digital) bandwidth is computed as average of absorbance, there is no impact on linearity.

Use a wide (8 or 16 nm) slit when your sample contains very small concentrations. Always use signals with bandwidth at least as wide as the slit width.

## Optimizing Spectral Acquisition (DAD only)

Storage of all spectra consumes a lot of disk space. It is very useful to have all spectra available during optimization of a method or when analyzing unique samples. However when running many samples of the same type, the large size of data files with all spectra may become a burden. The detector provides functions to reduce the amount of data, yet retaining the relevant spectral information.

For spectra options see [Table 23](#) on page 129.

### Range

Only the wavelength range where the compounds in your sample absorb contains information that is useful for purity checks and library searches. Reducing the spectrum storage range saves disk space.

### Step

Most substances have broad absorbance bands. Display of spectra, peak purity and library search works best if a spectrum contains 5 to 10 data points per width of the absorbance bands. For anisic acid (the example used before) a step of 4 nm would be sufficient. However a step of 2 nm gives a more optimal display of the spectrum.

### Threshold

Sets the peak detector. Only spectra from peaks higher than threshold will be stored when a peak-controlled storage mode is selected.

## Margin for Negative Absorbance

The detector adjusts its gain during *balance* such that the baseline may drift slightly negative (about -100 mAU). In some special case, for example, when gradient with absorbing solvents are used, the baseline may drift to more negative values.

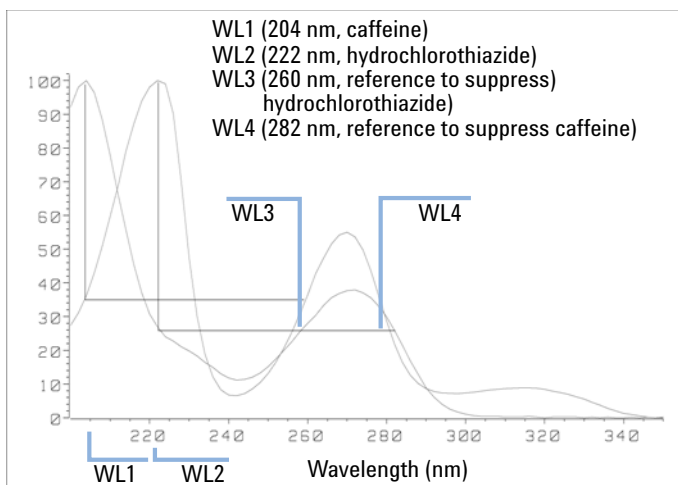
Only for such cases, increase the margin for negative absorbance to avoid overflow of the analog-to-digital converter.

## Optimizing Selectivity

### Quantifying Coeluting Peaks by Peak Suppression

In chromatography, two compounds may often elute together. A conventional dual-signal detector can only detect and quantify both compounds independently from each other if their spectra do not overlap. However, in most cases this is highly unlikely.

With a dual-channel detector based on diode-array technology, quantifying two compounds is possible even when both compounds absorb over the whole wavelength range. The procedure is called peak suppression or signal subtraction. As an example, the analysis of hydrochlorothiazide in the presence of caffeine is described. If hydrochlorothiazide is analyzed in biological samples, there is always a risk that caffeine is present which might interfere chromatographically with hydrochlorothiazide. As the spectra in [Figure 45](#) on page 125 shows, hydrochlorothiazide is best detected at 222 nm, where caffeine also shows significant absorbance. It would therefore be impossible, with a conventional variable wavelength detector, to detect hydrochlorothiazide quantitatively when caffeine is present.



**Figure 45** Wavelength Selection for Peak Suppression

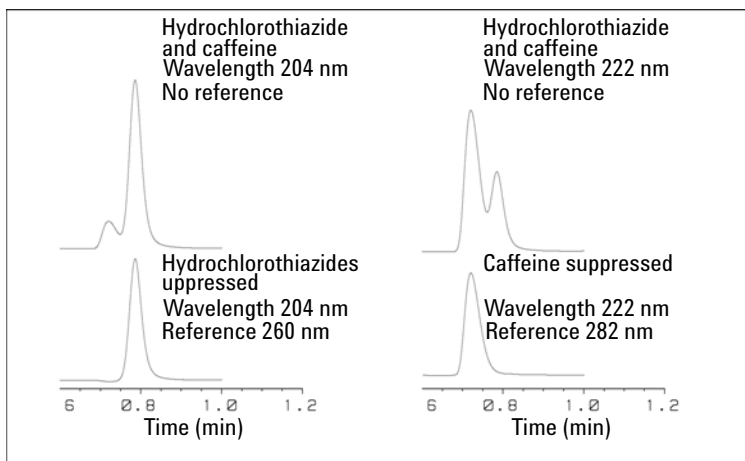
With a UV-visible detector based on a diode array and the correct choice of a reference wavelength setting, quantitative detection is possible. To

## 8 Detector Description

### Agilent 1220 Infinity LC Diode Array Detector (DAD)

suppress caffeine, the reference wavelength must be set to 282 nm. At this wavelength, caffeine shows exactly the same absorbance as at 222 nm. When the absorbance values are subtracted from each other, any indication of the presence of caffeine is eliminated. In the same way, hydrochlorothiazide can be suppressed if caffeine is to be quantified. In this case the wavelength is set to 204 nm and the reference wavelength to 260 nm. [Figure 46](#) on page 126 shows the chromatographic results of the peak suppression technique.

The trade-off for this procedure is a loss in sensitivity. The sample signal decreases by the absorbance at the reference wavelength relative to the signal wavelength. Sensitivity may be decreased by as much as 10–30 %.



**Figure 46** Peak Suppression Using Reference Wavelength

### Ratio Qualifiers for Selective Detection of Compound Classes

Ratio qualifiers can be used where, in a complex sample, only one particular class needs to be analyzed – a parent drug and its metabolites in a biological sample, for example. Another example is the selective analysis of derivatives after pre- or post-column derivatization. Specifying a signal ratio that is typical for the sample class is one way of selectively plotting only those peaks that are of interest. The signal output remains at zero so long as the ratio is out of the user-specified ratio range. When the ratio falls within the range, the signal output corresponds to the normal absorbance, giving single, clear peaks on a flat baseline. An example is shown in [Figure 47](#) on page 127 and [Figure 48](#) on page 127.

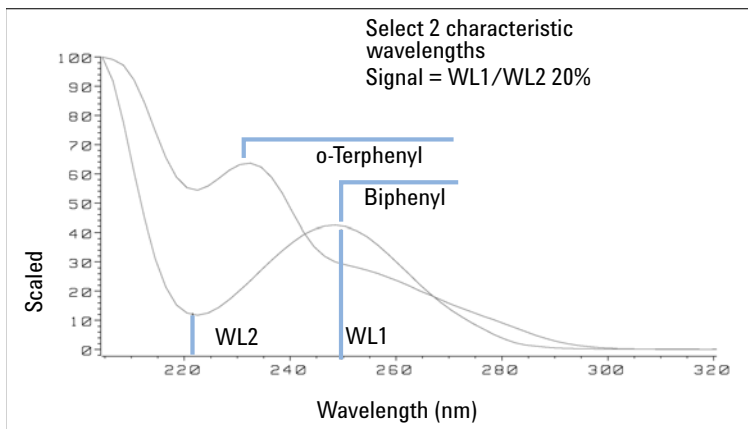


Figure 47 Wavelength Selection for Ratio Qualifiers

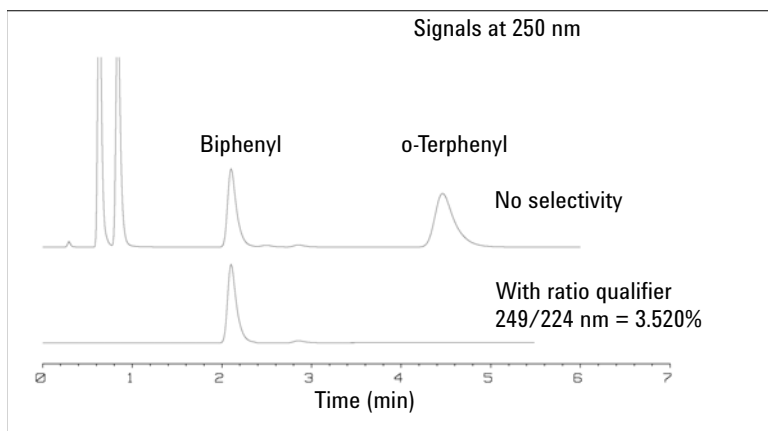


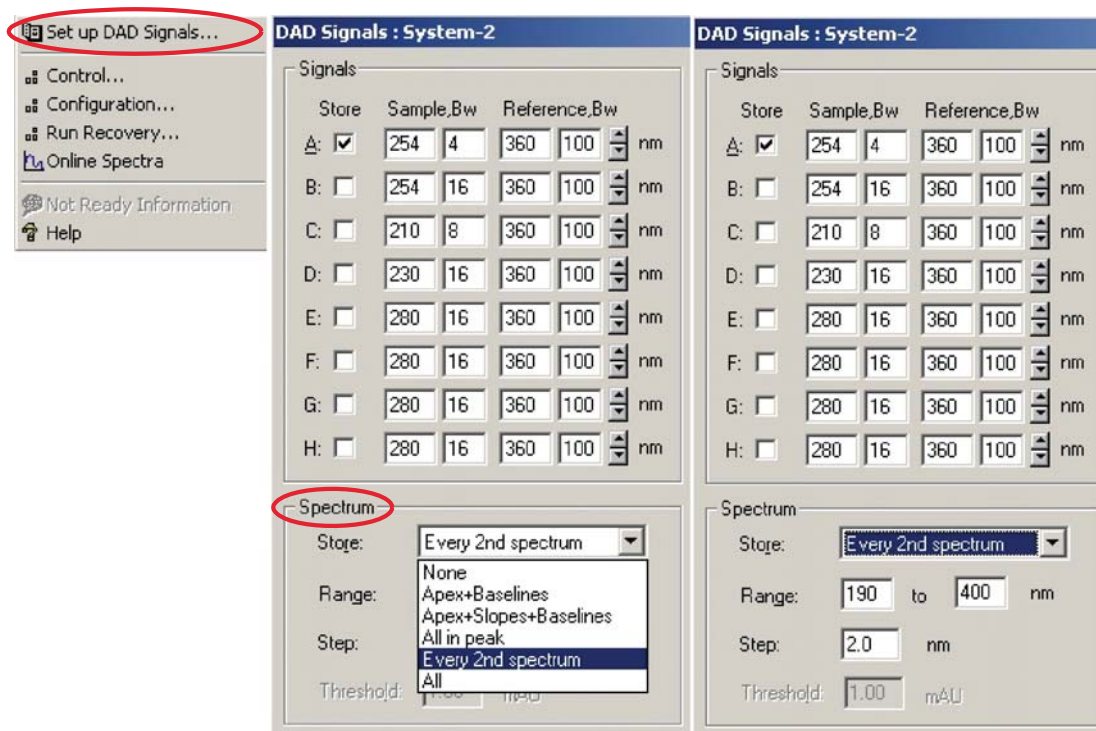
Figure 48 Selectivity by Ratio Qualifiers

In a four-component mixture, only biphenyl was recorded. The other three peaks were suppressed because they did not meet the ratio-qualifier criterion and therefore the output was set to zero. The characteristic wavelengths 249 nm ( $\lambda_1$ ) and 224 nm ( $\lambda_2$ ) were found from the spectra shown in Figure 47 on page 127. The ratio range was set at 2 – 2.4 (2.2  $\pm$ 10%). Only when the ratio between 249 and 224 nm was within this range, is the signal plotted. Of all four peaks, only the third fulfilled the criterion (Figure 48 on page 127). The others were not plotted.

## Spectrum Settings (DAD only)

To change the Spectra settings open.

- 1 To change the Spectra settings select **Setup Detector Signals**.
- 2 In the section Spectrum click on the drop-down list and chose a parameter. [Table 23](#) on page 129 shows the possible parameters.
- 3 Change the Range, Step width and Threshold according to your needs.



**Figure 49** Spectra Settings



**Table 23** Spectrum Settings

Store	Defines at which points on “signal A” spectra will be taken and saved. Signal A is used to control the “peak controlled spectra acquisition”; the other signals have no influence on spectra acquisition.
None	No spectra are taken.
Apex + Baselines	Spectra are taken at the apex and baselines of the peak.
Apex + Slopes + Baselines	Spectra are taken at the apex, baselines, upslope, and downslope of the peak.
All in Peak	All spectra within the peak are taken.
<b>NOTE</b>	The three spectra acquisition types mentioned above are also referred to as peak-controlled spectra acquisition. The peak detection is done by the detector firmware based on the threshold and peakwidth parameters you set for the DAD. If you want to use peak-controlled spectra storage, make sure that you set these parameters to recognize all the peaks of interest. The integration algorithm also includes peak detection based on the threshold and peakwidth parameters set in the integration events.
Every 2nd spectrum	Spectra are taken continuously as for All, but only every second spectrum is stored; other spectra are discarded. This reduces the amount of data storage necessary.
All	Spectra are taken continuously depending on the setting of the Peakwidth. Eight spectra are acquired per Peakwidth. The acquisition time for one spectrum is slightly less than the Peakwidth divided by 8, that is, greater than or equal to 0.01s and less than or equal to 2.55s.
<b>NOTE</b>	If there are no peaks in Signal A, there are no spectra. You cannot process spectra present in other signals.
Range	Range defines the wavelength range for spectral storage. Limits: 190 to 950 nm in steps of 1 nm for both low and high values. The high value must be greater than the low value by at least 2 nm.
Step	Step defines the wavelength resolution for spectral storage. Limits: 0.10 to 100.00 nm in steps of 0.1 nm.
Threshold	The threshold is the height in mAU of the smallest expected peak. The peak detector ignores any peaks which are lower than the threshold value and does not save spectra. Limits: 0.001 to 1000.00 mAU in steps of 0.001 mAU. Usable for modes Apex + Baselines, Apex + Slopes + Baselines and All in Peak

## Match the Flow Cell to the Column

Figure 50 on page 130 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.

### Choosing a Flow Cell for the VWD

Column length	Typical peak width	Recommended flow cell			
<= 5 cm	0.025 min				
10 cm	0.05 min		Semi-micro flow cell		
20 cm	0.1 min			Standard flow cell	
>= 40 cm	0.2 min				
	Typical flow rate	0.2 ml/min	0.2 - 0.4 ml/min	0.4 - 0.8 ml/min	1 - 5 ml/min
	Internal column diameter	1.0 mm	2.1 mm	3.0 mm	4.6 mm

**Figure 50** Choosing a flow cell

### Choosing a Flow Cell for the DAD

Typical column length	Typical peak width	Recommended flow cell				
T ≤ 5 cm	0.025 min	Micro or Semi-nano				
10 cm	0.05 min		Semi-micro flow cell			High pressure flow cell for pressures above 100bar
20 cm	0.1 min			Standard flow cell		
≥ 40 cm	0.2 min					
	Typical flow rate	0.01 ... 0.2 ml/min	0.2 ... 0.4 ml/min	0.4 ... 0.4 ml/min	1 ... 5 ml/min	
	Internal column diameter	0.5 ... 1 mm	2.1 mm	3.0 mm	4.6 mm	

**Figure 51** Choosing a Flow Cell in HPLC

### Flow Cell Path Length

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

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

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*<sub>0</sub>,
- ε** 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.

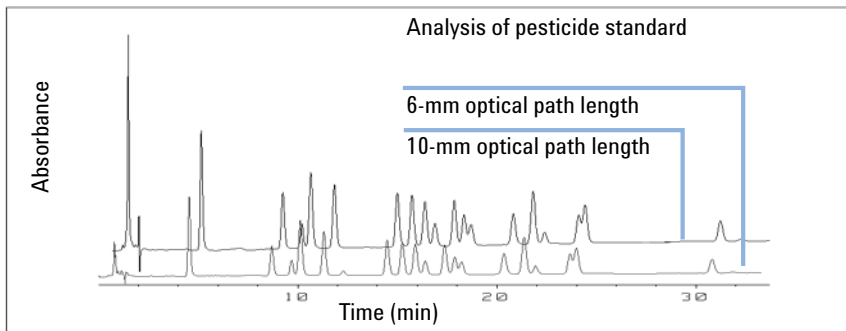
## 8 Detector Description

### Match the Flow Cell to the Column

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  $\mu\text{L}$  to 13  $\mu\text{L}$ . Typically, this causes more peak dispersion. As [Figure 52](#) on page 132 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 52** 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 detector, it is necessary to have more precise information on path lengths of the flow cells.

The correct response is:

expected response \* correction factor

Details of the flow cells are shown in [Table 24](#) on page 133 and [Table 25](#) on page 134.

### Correction factors for VWD flow cells

**Table 24** 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	Standard flow cell, 10 mm, 14 µL, 40 bar (G1314-60086)	10 mm	10.15 ± 0.19 mm	10/10.15
Semi-micro flow cell	5 µL	Semi-micro flow cell, 6 mm, 5 µL, 40 bar (G1314-60083)	6 mm	6.10 ± 0.19 mm	6/6.10
Micro flow cell	2 µL	Micro flow cell, without I.D. tag, 3 mm, 2 µL, 120 bar (G1314-60087)	3 mm	2.80 ± 0.19 mm	3/2.8
High Pressure flow cell	14 µL	High pressure flow cell, 10 mm, 14 µL, 400 bar (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.

## 8 Detector Description

### Match the Flow Cell to the Column

#### Correction factors for DAD flow cells

**Table 25** Correction factors for flow cells

Flow cell	Path length (actual)	Correction factor
Standard flow cell, 10 mm, 13 $\mu$ L, 120 bar ( 12 MPa) (G1315-60022)	9.80 $\pm$ 0.07 mm	10/9.8
Semi-micro flow cell, 6 mm, 5 $\mu$ L, 120 bar ( 12 MPa) (G1315-60025)	5.80 $\pm$ 0.07 mm	6/5.8
Micro flow cell, 3 mm, 2 $\mu$ L, 120 bar ( 12 MPa) (G1315-60024)	3.00+0.05 mm/-0.07 mm	3/3
Semi-nano flow cell kit, 10 mm, 500 nL, 5 MPa (G1315-68724)	10.00 $\pm$ 0.02 mm	10/10
Nano flow cell kit, 6 mm, 80 nL, 5 MPa ( G1315-68716)	6.00 $\pm$ 0.02 mm	6/6
Standard flow cell bio-inert, 10 mm, 13 $\mu$ L, 120 bar ( 12 MPa) for MWD/DAD, includes Capillary Kit Flow Cells BIO (p/n G5615-68755) (G5615-60022)	9.80 $\pm$ 0.07 mm	10/9.8

#### 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.

## 9

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## 9 Test Functions and Calibration

### Match the Flow Cell to the Column

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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 s).
- The pump achieves 200 bar after 5 min.
- The oven reaches 2 K above its actual temperature.
- The detector lamp ignites and the detector reaches a **Ready** state.

## Module Info

The **Module Info** tool collects diagnostic information from a module and writes the results 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.

## 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 min. Click **Stop Test** to stop the tool.

# Solvent Delivery System

## 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 100  $\mu\text{L}$  and a flow of 153  $\mu\text{L}/\text{min}$ . 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 2  $\mu\text{L}/\text{min}$  for approximately one minute. The pressure during the plateau should remain constant or increase slightly. A falling pressure indicates a leak of  $>2 \mu\text{L}/\text{min}$ .

### **Ramp 2**

The flow is changed to 153  $\mu\text{L}/\text{min}$ , 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  $\mu\text{L}/\text{min}$  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  $>2 \mu\text{L}/\text{min}$ .

### **Ramp 3**

The flow increases to 220  $\mu\text{L}/\text{min}$  and the stroke is changed to 100  $\mu\text{L}$ . Plunger 1 completes its stroke. Next, the flow is changed to 510  $\mu\text{L}/\text{min}$ . 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.

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

## Running the Leak Test

**When** If problems with the pump are suspected

**Tools required** **Description**  
Wrench, 1/4 inch (supplied in HPLC Tool-Kit)

<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	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 Leak Test Results"](#) on page 142 describes the evaluation and interpretation of the leak test results.

### NOTE

For detailed instructions refer to the Agilent Lab Advisor tool.

## Evaluating the Leak Test 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 26** No Pressure increase at Ramp 1

<i>Potential Cause</i>	<i>Corrective Action</i>
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 27** Pressure limit not reached but plateaus horizontal or positive

<i>Potential Cause</i>	<i>Corrective Action</i>
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 28** All plateaus negative

<i>Potential Cause</i>	<i>Corrective Action</i>
Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
Loose purge valve.	Tighten the purge valve (14 mm 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 29** First plateau positive, second and third plateau negative

<i>Potential Cause</i>	<i>Corrective Action</i>
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 (14 mm 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 30** First plateau negative, second plateau positive

<i>Potential Cause</i>	<i>Corrective Action</i>
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 31** Ramp 3 does not reach limit

<i>Potential Cause</i>	<i>Corrective Action</i>
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 32** Third plateau negative (pressure drop > 2 bar/min)

<i>Potential Cause</i>	<i>Corrective Action</i>
Loose or leaky fittings.	Ensure all fittings are tight, or exchange capillary.
Loose purge valve.	Tighten the purge valve (14 mm 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

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 lies 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,
  - a If necessary, select the channel(s) that you want to purge.
  - b For each selected channel, select a **Flow** and a purge **Time**.
  - c 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.

## Degasser Exchange

The **Degasser Exchange Tool** allows you to set a new calibration value after exchanging the degasser unit.

When you start the **Degasser Exchange Tool**, a dialog box is displayed asking you to enter the calibration value written on the degasser label. Type the calibration value in the field and click **OK** to upload it to the degasser.

### NOTE

With the introduction of Lab Advisor B.02.04[093], the **Degasser Exchange Tool** function has been moved to **Instrument Control** tab.

To use the tool, do as follows:

- 1 Go to **Instrument Control** tab
  - 2 Select **G4281B** pump module
  - 3 Expand the pump function by clicking the small right arrow
  - 4 In **special commands** you will find the tool
-

# 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.

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

<b>Start</b>	draws the piston away from the home position, relieving the tension on the spring.
<b>End</b>	repositions the piston 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.

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

## Arm Position

<b>Move Arm Home</b>	Moves the gripper arm to its home position for better access and exchange of trays.
<b>Park Arm</b>	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 33** Injector step commands

Step	Action	Comments
<b>Valve Bypass</b>	Switches injection valve to the bypass position.	
<b>Plunger Home</b>	Moves the plunger to the home position.	
<b>Needle Up</b>	Lifts the needle arm to the upper position.	Command also switches the valve to bypass if it is not already in that position.
<b>Vial to Seat</b>	Moves the selected vial to the seat position.	Command also lifts the needle to the upper position.
<b>Needle into Sample</b>	Lowers the needle into the sample.	Command also positions the vial at the seat, and lifts the needle to the upper position.
<b>Draw</b>	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 100 $\mu\text{L}$ cannot be exceeded). Use <b>Plunger Home</b> to reset the metering device.
<b>Needle Up</b>	Lifts the needle out of the vial.	Command also switches the valve to bypass if it is not already in that position.
<b>Vial to Tray</b>	Returns the selected vial to the tray position.	Command also lifts the needle to the upper position.
<b>Needle into Seat</b>	Lowers the needle arm into the seat.	Command also returns the vial to the tray position.
<b>Valve Mainpass</b>	Switches the injection valve to the mainpass position.	
<b>Reset</b>	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
<b>Arm Up</b>	Lifts the gripper arm.	Page Up
<b>Arm Down</b>	Lowers the gripper arm.	Page Down
<b>Open Gripper</b>	Opens the gripper.	
<b>Close Gripper</b>	Closes the gripper.	



Button	Description	Keyboard Shortcut
<b>Start &gt;&gt;</b>	Starts the execution of the procedure. Shown only at the start.	Enter
<b>Continue &gt;&gt;</b>	Jumps to the next step of the procedure. Shown only during alignment.	Enter
<b>Restart</b>	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 Click **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 ▲ and ▼ (for rotation), and ◀ and ▶ (for movement left and right) to adjust the gripper position 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, click **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 Click **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  $\geq 4^{\circ}\text{C}/\text{min}$ .

## 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.

# Variable Wavelength Detector (VWD)

## 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 34** 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 35** Limits

Sample circuit	<7900 counts
Reference circuit	<7900 counts

### Probable causes of test failure

**Table 36** 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 37** Reference circuit noise exceeds limit:

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

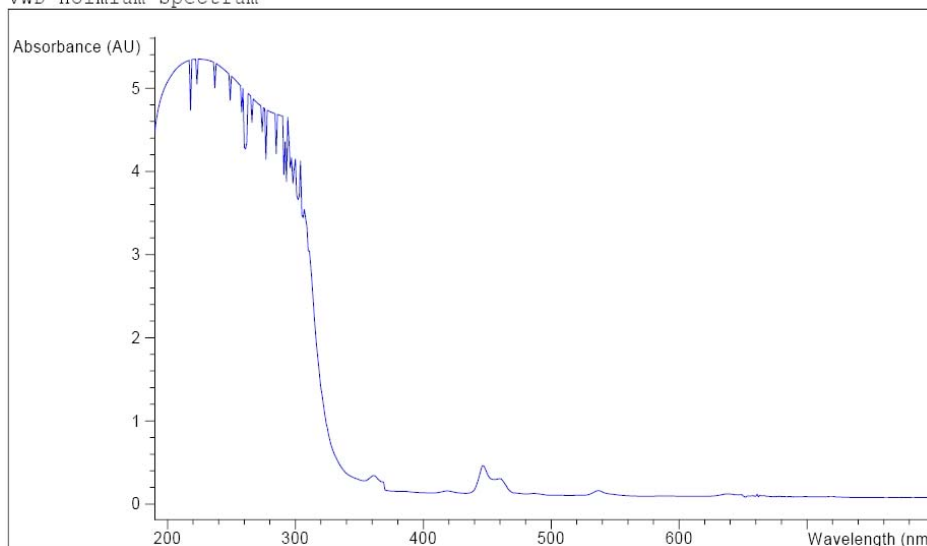
## Holmium Oxide Test

### 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 38** 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 “[VWD Cell Test Description](#)” on page 157). 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.

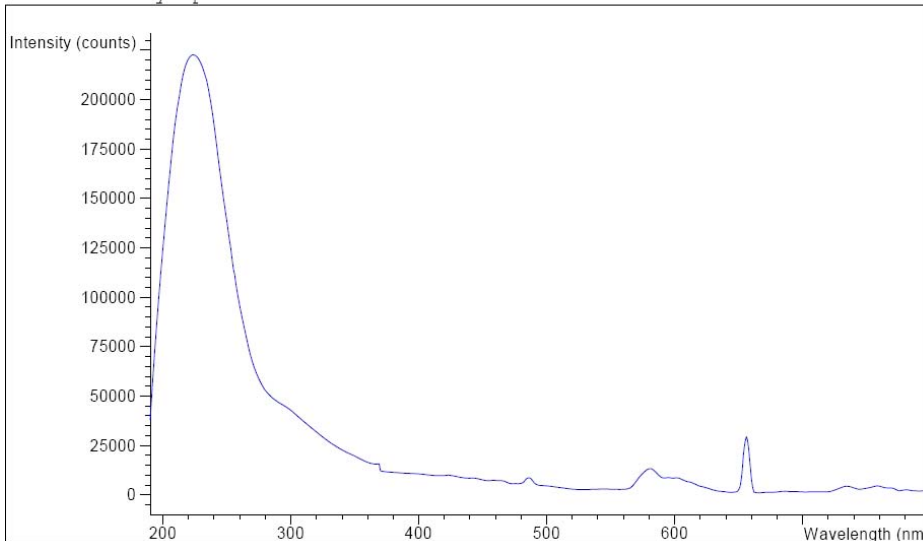
#### NOTE

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 39** Limits

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

**Table 40** 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 from air bubbles.
Dirty or contaminated flow cell.	Run the “ <a href="#">VWD Cell Test Description</a> ” on page 157 . If the test fails, exchange the flow cell windows.

## 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 **VWD 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 41** Filter Motor Test

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

**Table 42** 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 min and is disabled within the first 10 min 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.

<b>Response Time</b>	<b>Stop Time</b>
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:

<b>Peak</b>	<b>Absorbance (approx.)</b>
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

<b>UV Lamp On</b>	Switches on the UV lamp.
<b>Blank Scan</b> (VWD only)	Scans a blank spectrum (solvent only) over the specified wavelength range at the specified resolution. You specify the wavelength range in the <b>from</b> and <b>to</b> fields, and the resolution in the <b>step</b> field.
<b>Sample Scan</b>	Scans the sample spectrum over the specified wavelength range at the specified resolution. You specify the wavelength range in the <b>from</b> and <b>to</b> fields, and the resolution in the <b>step</b> field.
<b>Export Data</b>	Exports the selected data in csv format for use in other applications.

## Diode Array Detector (DAD)

This chapter describes the detector's built in test functions.

### Self-test

The DAD self-test (see [Figure 53](#) on page 168) runs a series of individual tests, and evaluates the results automatically. The following tests are run:

- Filter Test
- Slit Test
- Dark Current Test
- Intensity Test
- Wavelength Calibration Test
- Holmium Test
- Spectral Flatness Test
- ASTM Noise Test (optional)

The self-test can be run once or repetitively. When set up to run repetitively, the tests run in series continually until stopped by the user. Running the test repetitively is useful when troubleshooting problems which occur intermittently.

The ASTM noise test determines the detector baseline noise (254 nm) while pumping water at 1 mL/min. The test requires approximately 20 minutes to run, and can be included or excluded from the self-test sequence as required.

Setup of the self test is done in the Self Test dialog box. Select either Single Test or Repetitive Tests. Check the ASTM Noise Test checkbox to include the noise test in the self test.

## 9 Test Functions and Calibration

### Diode Array Detector (DAD)

Agilent G1315 Self Test Results			
	Limits	Measured	Result
Filter test	0.005..0.5 AU	0.27 AU	Passed
Slit test	0.7..1.3	1.08	Passed
Dark current test	0..12000 cts	7977..8026 cts	Passed
Min. intensity (190nm - 220nm)	> 2000 cts	18042 cts	Passed
Min. intensity (221nm - 350nm)	> 5000 cts	28451 cts	Passed
Min. intensity (351nm - 500nm)	> 2000 cts	16886 cts	Passed
Min. intensity (501nm - 950nm)	> 2000 cts	14683 cts	Passed
Max. intensity (190nm - 350nm)	< 450000 cts	89461 cts	Passed
Max. intensity (700nm - 950nm)	< 300000 cts	63609 cts	Passed
Max. intensity (D2 alpha line)	< 1200000 cts	169947 cts	Passed
Wavelength at 486.0nm	485.5..486.5 nm	486.31 nm	Passed
Wavelength at 656.1nm	655.6..656.6 nm	656.25 nm	Passed
Holmium test	-1..1 nm	0.30 nm	Passed
Spectral flatness	< 0.002 AU	0.0000 AU	Passed
ASTM noise (20 min. at 254nm)	<= 0.02 mAU	0.0096 mAU	Passed

**Figure 53** Self-test Results (report)

For details refer to the individual tests on the following pages.



## Filter Test

The filter test checks the correct operation of the filter assembly. When the test is started, the holmium oxide filter is moved into position. During filter movement, the absorbance signal is monitored. As the edge of the filter passes through the light path, an absorbance maximum is seen. Once the filter is in position, the absorbance maximum (of holmium oxide) is determined. Finally, the filter is moved out of the light path. During movement, an additional absorbance maximum is expected as the edge of the filter passes through the light path. The test passes successfully, if the two maxima resulting from the edge of the filter assembly (during filter movement) are seen, and the absorbance maximum of holmium oxide is within the limits.

```
Instrument:      G1315C
Serial Number:  PP00000024
Operator:       Wolfgang
Date:          25.02.2005
Time:          14:55:42
File:          C:\CHEM32\2\DIAGNOSE\DAD_FILTER3.DGR
```

	Result	Status
-----		
DAD Filter Test		
Date: 25.02.2005; Time: 14:55:42		
Expected total time: approx. 45s.		
Test Procedure:		
1. Measuring and evaluating filter test result	0.16	done

**Figure 54** Filter Test Results (report)

### Filter Test Evaluation

### Filter Test Failed

## 9 Test Functions and Calibration

### Diode Array Detector (DAD)

#### Test Failed

##### Probable cause

- 1 Filter assembly (lever and filter) not installed.
- 2 Defective filter motor.

##### Suggested actions

Install the filter assembly.

Please contact your Agilent service representative.

#### Holmium Oxide Maximum out of Limits

##### Probable cause

- 1 Holmium oxide filter not installed.
- 2 Dirty or contaminated filter.

##### Suggested actions

Install the holmium oxide filter.

Exchange the holmium oxide filter.

## Slit Test

The slit test verifies correct operation of the micromechanical slit. During the test, the slit is moved through all slit positions while the detector monitors the lamp intensity change. When the slit position is changed, the intensity drop (move to smaller slit) or intensity increase (move to larger slit) must be within a defined range. If the intensity changes are outside the expected range, the test fails.

### Slit Test Evaluation

Limit: 0.7 - 1.3

#### Test Failed

##### Probable cause

- 1 Flow cell still installed.
- 2 Old or non-Agilent lamp.
- 3 Defective slit assembly (stray light).
- 4 Defective detector main board.
- 5 Defective PDA/optical unit.

##### Suggested actions

- Remove the flow cell.
- Run the “[Intensity Test](#)” on page 174. Exchange the lamp if old or defective.
- Exchange the slit assembly.
- Exchange the detector main board.
- Exchange the optical unit.

## Dark-Current Test

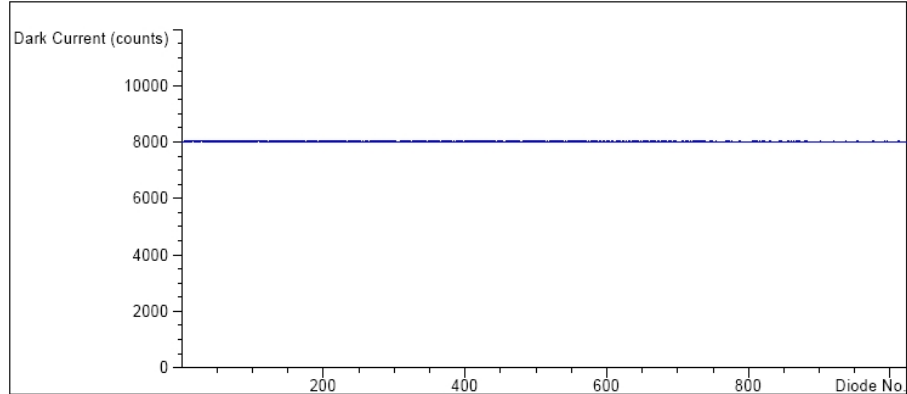
The dark-current test measures the leakage current from each diode. The test is used to check for leaking diodes which may cause non-linearity at specific wavelengths. During the test, the slit assembly moves to the dark position, cutting off all light falling onto the diode array. Next, the leakage current from each diode is measured, and displayed graphically (see [Figure 55](#) on page 172). The leakage current (represented in *counts*) for each diode should fall within the limits (red bands) shown in the plot (see [Figure 55](#) on page 172).

### Dark-Current Test Evaluation

Limit: 0... 12000 counts

```
Instrument:      G1315C
Serial Number:  PP00000024
Operator:       Wolfgang
Date:          25.02.2005
Time:          14:50:12
File:          C:\CHEM32\2\DIAGNOSE\DAD_DARK2.DGR
```

Dark Current Plot



Dark Current Test Results

	Specification	Measured	Result
Dark current maximum value	<= 12000 cts	8056 cts	Passed
Dark current minimum value	> 0 cts	7994 cts	Passed

**Figure 55** Dark-Current Test Results (report)

## Test Failed

### Probable cause

- 1 Defective slit assembly (stray light).
- 2 Defective detector main board.
- 3 Defective PDA/optical unit.

### Suggested actions

Run the “[Slit Test](#)” on page 171 (part of the “[Self-test](#)” on page 167).

Please contact your Agilent service representative.

Please contact your Agilent service representative.

## Intensity Test

### NOTE

The test is for the standard flow cells (10 mm and 6 mm pathlength) only. The nano-flow cells (80 nL and 500 nL) cannot be run with this test due to its low volume.

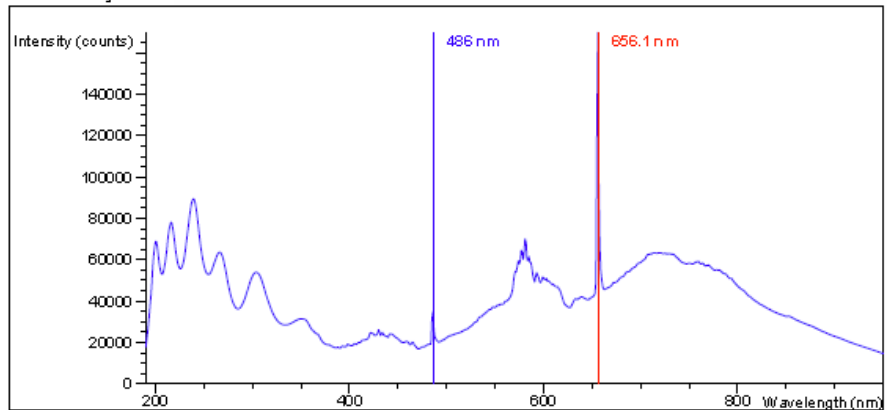
The intensity test measures the intensity of the deuterium and tungsten lamps over the full wavelength range (190 – 950 nm). Four spectral ranges are used to evaluate the intensity spectrum. The test is used to determine the performance of the lamps and optics (see also “Cell Test” on page 181). When the test is started, the 1-nm slit is moved into the light path automatically, and the gain is set to zero. 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, grating, and diode array characteristics. Therefore, intensity spectra will differ slightly between instruments. [Figure 56](#) on page 175 shows a typical intensity test spectrum.

### Intensity Test Evaluation

The Agilent LabAdvisor, ChemStation and Instant Pilot evaluate four spectral ranges automatically, and display the limits for each range, the measured intensity counts, and *passed* or *failed* for each spectral range (see [Figure 56](#) on page 175).

Instrument: G1315C  
 Serial Number: DE60755000  
 Operator:  
 Date: 3/17/2009  
 Time: 1:24:38 PM

Intensity Plot



Intensity Test Results

	Specification	Measured	Result
Accumulated UV lamp on time		68.08 h	
Lowest intensity in range 190nm - 220nm:	> 2000 cts	18069 cts	Passed
Lowest intensity in range 221nm - 350nm:	> 5000 cts	28464 cts	Passed
Lowest intensity in range 351nm - 500nm:	> 2000 cts	16889 cts	Passed
Lowest intensity in range 501nm - 950nm:	> 2000 cts	14665 cts	Passed
Highest intensity in range 190nm - 350nm:	< 450000 cts	89478 cts	Passed
Highest intensity in range 700nm - 950nm:	< 300000 cts	63598 cts	Passed
Highest intensity for the D2 alpha line:	< 1200000 cts	169933 cts	Passed

**Figure 56** Intensity Test Results (report)

In case of low counts in one or more ranges, start the testing with the comparison of values with flow cell vs. flow cell removed.

## 9 Test Functions and Calibration

### Diode Array Detector (DAD)

Contaminations of the cell windows and/or the lenses (there are 3 between vis-lamp and flow cell), will reduce the light throughput.

If the detector fails in the range 501 nm - 950 nm, check

- is the VIS-lamp ON? If not, turn it on.
- is VIS-lamp glass bulb blackened or broken? If yes, replace VIS-lamp.
- does the UV-lamp show a reflective coating towards the VIS-lamp? If yes, replace UV-lamp.

Example (measured without flow cell):

VIS-LAMP OFF or defect:	110 counts
VIS-LAMP ON and OK:	13613 counts

#### Test Failed

Probable cause	Suggested actions
1 Absorbing solvent or air bubble in flow cell.	Ensure the flow cell is filled with water, and free from air bubbles.
2 Dirty or contaminated flow cell.	Run the cell test (see “Cell Test” on page 181). If the test fails, exchange the flow cell windows.
3 Dirty or contaminated optical components (achromat, windows).	Clean optical components with alcohol and lint-free cloth or replace the parts.
4 Old or non-Agilent lamp.	Exchange the lamp.

#### NOTE

If the lamp fails in a single range there might be no reason to change the lamp if the application is not run in that specific range.

Redo the test with removed flow cell. If the counts increase drastically (more than a factor of 2, then flow cell components are contaminated and may require maintenance/service.

If the intervals of lamp replacements are getting shorter, the Agilent service should check the optical unit for contaminated components in the light path (coupling lens, source lens, cell support assembly and flow cell windows).



## Holmium Oxide Test

The holmium oxide test uses three characteristic absorbance maxima of the built-in holmium oxide filter to verify wavelength accuracy (see also “[Wavelength Verification and Recalibration](#)” on page 185). When the test is started, the 1-nm slit is moved into the light path automatically. To eliminate effects due to absorbing solvents, the test should be done with water in the flow cell.

### NOTE

See also “[Declaration of Conformity for HOX2 Filter](#)” on page 371.

### Holmium Oxide Test Evaluation

Limits:

361.0 nm	360.0 - 362.0 nm ( $\pm 1$ nm)
453.7 nm	452.7 - 454.7 nm ( $\pm 1$ nm)
536.7 nm	535.7 - 537.7 nm ( $\pm 1$ nm)

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 of the limits (see [Figure 57](#) on page 178).

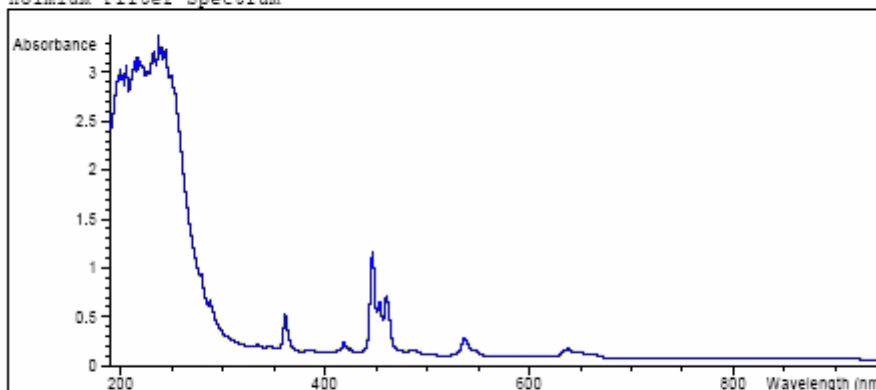
## 9 Test Functions and Calibration

### Diode Array Detector (DAD)

```

Instrument:      G1315C
Serial Number:   FP00000024
Operator:        Wolfgang
Date:           25.02.2005
Time:           14:30:08
File:           C:\CHEM32\2\DIAGNOSE\DAD_FILTER2.DGR
  
```

Holmium Filter Spectrum



Holmium Filter Test Results

	Specification	Measured	Result
Wavelength 1: 361.0 nm	360..362 nm	360.9 nm	Passed
Wavelength 2: 453.7 nm	452.7..454.7 nm	453.4 nm	Passed
Wavelength 3: 536.7 nm	535.7..537.7 nm	536.8 nm	Passed

**Figure 57** Holmium Oxide Test Results (report)

#### Test Failed

##### Probable cause

- 1 Absorbing solvent or air bubble in flow cell.
- 2 Incorrect calibration
- 3 Dirty or contaminated flow cell.
- 4 Dirty or contaminated optical components (achromat, windows).
- 5 Old or non-Agilent lamp.

##### Suggested actions

- Ensure the flow cell is filled with water.
- Recalibrate (see [“Wavelength Verification and Recalibration”](#) on page 185) and repeat the test.
- Run the cell test (see [“Cell Test”](#) on page 181). If the test fails, exchange the flow cell windows.
- Clean optical components with alcohol and lint-free cloth or replace the parts (see [“Intensity Test”](#) on page 174).
- Exchange the UV lamp.

## Spectral flatness test

The spectral flatness test determines the maximum noise (in mAU) on the spectrum. The test is run with the flowcell removed to eliminate effects due to absorbing solvent or a dirty flowcell. First, a detector balance is done. Next, a spectrum (no flowcell) is taken.

Theoretically, the spectrum should be flat, however, in practice, noise is superimposed on the spectrum. The amplitude of the noise is a measure of the optical and electronic performance.

### NOTE

This test is part of the detector self test only, see “Self-test” on page 167.

## Spectral Flatness Evaluation

Limit is < 0.002 AU

### Test Failed

#### Probable cause

- 1 Old or non-Agilent lamp.
- 2 Defective DAM board
- 3 Defective PDA/optical unit.

#### Suggested actions

- Run the Intensity Test.
  - Exchange the lamp if old or defective.
- Exchange the DAM board.
- Exchange the optical unit.

## ASTM Noise Test

The ASTM noise test determines the detector noise over a period of 20 minutes. The test is done with the flowcell removed, so the test results are not influenced by solvent or pump effects. On completion of the test, the noise result is displayed automatically.

### NOTE

This test is part of the detector self test only, see “Self-test” on page 167.

---

### ASTM Noise Test Evaluation

Limit is  $\pm 0.02$  mAU

#### Test Failed

##### Probable cause

- 1 Insufficient lamp warm-up time
- 2 Old or non-Agilent lamp.

##### Suggested actions

- Allow lamp to warm-up for at least 1 hour.
- Exchange the lamp.

## Cell Test

The cell test measures the intensity of the deuterium and tungsten lamps over the full wavelength range (190 – 950 nm), once with the flow cell installed, and once with the flow cell removed. The resulting intensity ratio 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 1-nm slit is moved into the light path automatically, and the gain is set to zero. To eliminate effects due to absorbing solvents, the test should be done with water in the flow cell.

### NOTE

This test should be performed initially with a new detector/flow cell. The values should be kept for later reference/comparison.

### Cell Test Evaluation

The Agilent ChemStation calculates the intensity ratio automatically. The intensity ratio (typically between 0.5 and 0.7 for new standard flow cells and 0.1 to 0.3 for new micro- and high pressure cells) is dependent on the degree of contamination of the flow cell windows, and on the type of flow cell used.

```
Instrument:      G1315C
Serial Number:  PP00000024
Operator:       Wolfgang
Date:          25.02.2005
Time:          14:54:22
File:          C:\CHEM32\2\DIAGNOSE\DAD_CELL2.DGR
```

	Result	Status
-----		
Detector Cell Test		
Date: 25.02.2005; Time: 14:54:22		
Expected total time: approx. 45 s.		
Test Procedure:		
1. If cell not in place, install it		done
2. Measuring intensity with cell	42053	done
3. Remove cell		done
4. Measuring intensity without cell	42034	done
5. Calculating intensity ratio	1.0	done

**Figure 58** Cell Test Results (report) with no flow cell inserted

### NOTE

This test can be used for the standard flow cells only. The nano flow cells will give very low values due to their design.

## 9 Test Functions and Calibration

### Diode Array Detector (DAD)

#### Test Failed (low ratio value)

##### Probable cause

- 1 Absorbing solvent or air bubble in flow cell.
- 2 Dirty or contaminated flow cell.

##### Suggested actions

- Ensure the flow cell is filled with water, and free from air bubbles.
- Exchange the flow cell windows.

## Using the Built-in Test Chromatogram

This function is available from the Agilent ChemStation, Lab Advisor and Instant Pilot.

The built-in Test Chromatogram can be used to check the signal path from the detector to the data system and the data analysis or via the analog output to the integrator or data system. The chromatogram is continuously repeated until a stop is executed either by means of a stop time or manually.

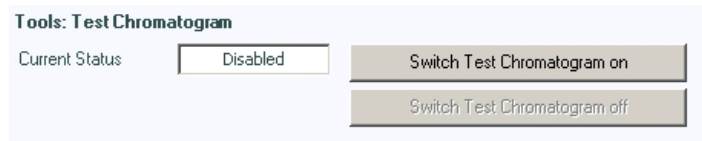
### NOTE

The peak height is always the same but the area and the retention time depend on the set peakwidth, see example below.

### Procedure Using the Agilent LabAdvisor

This procedure works for all Agilent 1200 Infinity detectors (DAD, MWD, VWD, FLD and RID). The example figure is from the RID detector.

- 1 Assure that the default LC method is loaded via the control software.
- 2 Start the Agilent Lab Advisor software (B.01.03 SP4 or later) and open the detector's **Tools** selection.
- 3 Open the test chromatogram screen

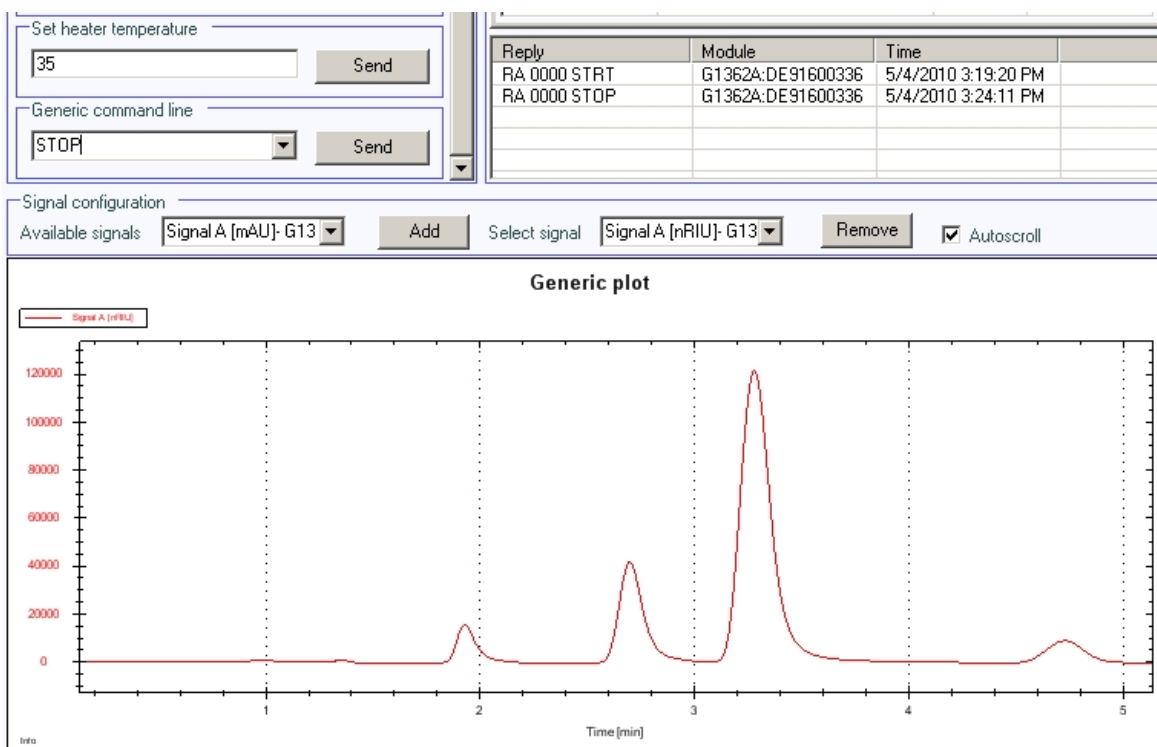


- 4 Turn the **Test Chromatogram** on.
- 5 Change to the detector's **Module Service Center** and add the detector signal to the Signal Plot window.

## 9 Test Functions and Calibration

### Diode Array Detector (DAD)

6 To start a test chromatogram enter in the command line: STRT



**Figure 59** Test Chromatogram with Agilent Lab Advisor

7 To stop the test chromatogram enter in the command line: STOP

#### NOTE

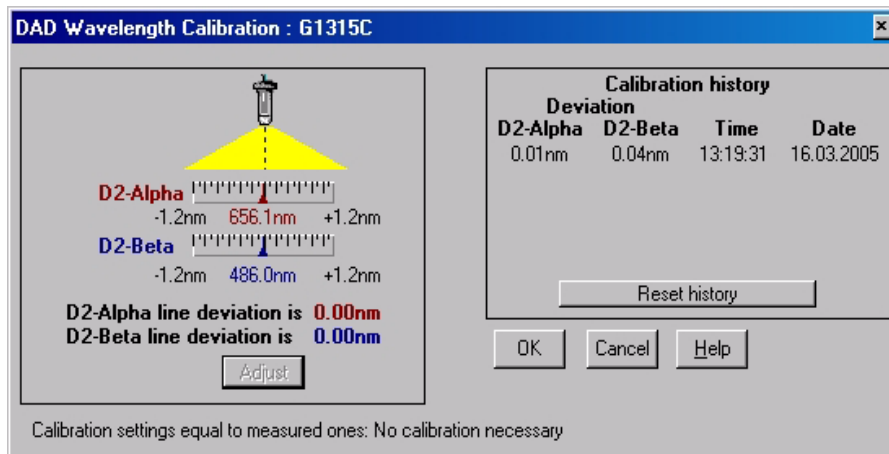
The test chromatogram is switched off automatically at the end of a run.



## Wavelength Verification and Recalibration

The detector uses the alpha (656.1 nm) and beta (486 nm) emission lines of the deuterium lamp for wavelength calibration. The sharp emission lines enable more accurate calibration than is possible with holmium oxide. When verification is started, the 1-nm slit is moved into the light path automatically, and the gain is set to zero. To eliminate effects due to absorbing solvents, the test should be done with bubble free degassed HPLC water in the flow cell.

If a deviation is found and displayed, it can be recalibrated by pressing Adjust. The deviations are tracked in the Calibration History (diagnosis buffer in the detector).



**Figure 60** Wavelength Verification and Recalibration

Wavelength calibration should be done

- after maintenance of the flow cell,
- lamp exchange, or
- after a major repair, like processor board or optical unit exchange, see also “Replacing the Module’s Firmware” on page 318.

After calibration, the holmium oxide test (see [Figure 57](#) on page 178) provides verification of wavelength accuracy at three additional wavelengths.

## Diagnosis Information on Agilent ChemStation

The Agilent ChemStation provides certain information on various assemblies in the detector.

- 1 Open the Diagnosis and change to detailed view.
- 2 Click on the assembly of interest and select “Update Variables Display”. [Figure](#) on page 187 shows an example.

[Table 43](#) on page 186 lists the assemblies which provide detailed information.

**Table 43** Diagnosis - detailed information

Assembly	Details
General	Product number, firmware revision, manufacturing date (of instrument or, if replaced, of main board), serial number, accumulated on-time, spectrometer serial number.
Vis lamp	Accumulated on-time, actual on-time, lamp switch on, accumulated on time switches, switch on voltage/current, lamp current, lamp voltage/current
UV lamp	Accumulated on-time, actual on-time, lamp ignitions, accumulated on time reset, ignition voltage/current, lamp voltage, lamp voltage/current.  Available with ID-tag lamp only. product number, serial number, production date, last intensity test
Holmium Filter	Filter movements, filter moves reset log
Flow Cell	Available with ID-tag flow cells only. Product number, production date, pathlength, max pressure, serial number, volume, last cell test
Micro Slit	Slit movements, filter moves reset log

Details of UV-lamp  
with RFID tag

Diode Array Detector - UV Lamp			
Accum. UV On Time	179.83 h	Accum. On Time Reset	Show
UV Lamp On Time	0.00 h	Ignition Voltage/Current	Show
Number of Ignitions	70	UV Lamp Voltage	Show
Product Number	2140-0820	UV Lamp Volt./Current	Show
Serial Number	213913	Last Intensity Test	02.01.2006
Production Date	08.10.2004		
<input type="button" value="Copy to Memo Pad"/> <input type="button" value="Send Changes"/> <input type="button" value="Cancel Changes"/>			

Details of flow cell  
with RFID tag

Diode Array Detector - Cell			
Product Number	G1315-60022	Serial Number	DE515H0876
Production Date	22.09.2005	Path Length	10 mm
Volume	13000 nl	Max Pressure	120 bar
Last Cell Test	22.09.2005		
<input type="button" value="Copy to Memo Pad"/> <input type="button" value="Send Changes"/> <input type="button" value="Cancel Changes"/>			

**Figure 61** Diagnosis screen in Agilent ChemStation (detailed view)

## D/A Converter (DAC) Test

The detector provides analog output of chromatographic signals for use with integrators, chart recorders or data systems. The analog signal is converted from the digital format by the digital-analog-converter (DAC).

The DAC test is used to verify correct operation of the digital-analog-converter by applying a digital test signal to the DAC.

The DAC outputs an analog signal of approximately 50 mV (if the zero offset of the analog output is set to the default value of 5 %) which can be plotted on an integrator. A continuous square wave with an amplitude of 10  $\mu$ V and a frequency of approximately 1 cycle/24 seconds is applied to the signal.

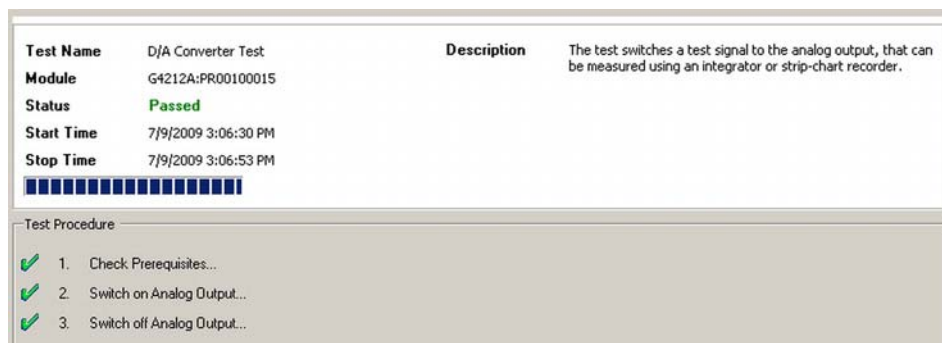
The amplitude of the square wave and the peak-to-peak noise are used to evaluate the DAC test.

**When** If the analog detector signal is noisy or missing.

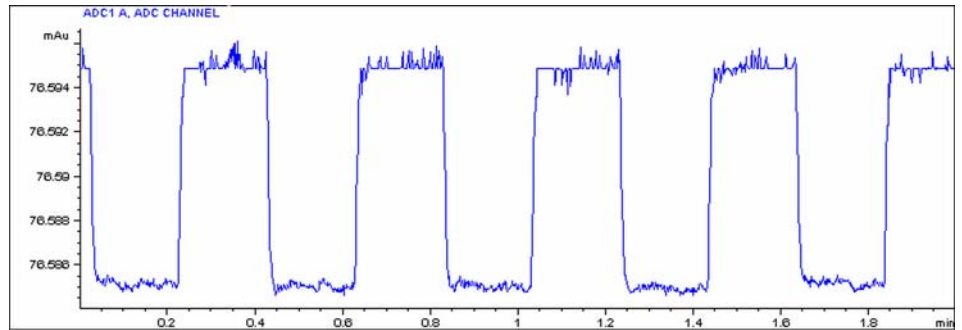
**Preparations** Lamp must be on for at least 10 minutes. Connect integrator, chart recorder or data system to the detector analog output.

### Running the test with Agilent LabAdvisor

- 1 Run the **D/A Converter (DAC) Test** (for further information see Online-Help of user interface).



**Figure 62** D/A Converter (DAC) Test – Results



**Figure 63** D/A Converter (DAC) Test – Example of Integrator Plot

### Running the Test with Instant Pilot

The test can be started via the command line.

- 1 To start the test  
**TEST: DAC 1**  
 Reply: **RA 00000 TEST:DAC 1**
- 2 To stop the test  
**TEST:DAC 0**  
 Reply: **RA 00000 TEST:DAC 0**

### Test Failed

D/A Converter (DAC) Test Evaluation

The noise on the step should be less than 3  $\mu$ V.

Probable cause	Suggested actions
1 Bad cable or grounding problem between detector and external device.	Check or replace the cable.
2 Defective detector main board.	Please contact your Agilent service representative.

## **9 Test Functions and Calibration**

### **Diode Array Detector (DAD)**



## 10 Error Information

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## 10 Error Information

### Diode Array Detector (DAD)

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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.

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

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

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

## General Error Messages

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

### Compensation Sensor Open

**Error ID: 0081**

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

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

**Probable cause**

- 1 Loose connection between the power switch board and the main board
- 2 Defective power switch board
- 3 Defective main board.

**Suggested actions**

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

### Compensation Sensor Short

**Error ID: 0080**

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

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

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

## Fan Failed

### **Error ID: 0068**

The cooling fan in the module has failed.

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

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

<b>Probable cause</b>	<b>Suggested actions</b>
<b>1</b> Fan cable disconnected.	Please contact your Agilent service representative.
<b>2</b> Defective fan.	Please contact your Agilent service representative.
<b>3</b> Defective main board.	Please contact your Agilent service representative.

## Leak

### Error ID: 0064

A leak was detected in the module.

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

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

## Leak Sensor Open

### Error ID: 0083

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

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

<b>Probable cause</b>	<b>Suggested actions</b>
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

### Error ID: 0082

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

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

#### Probable cause

- 1 Defective leak sensor.
- 2 Leak sensor incorrectly routed, being pinched by a metal component.

#### Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Remote Timeout

### Error ID: 0070

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

#### Probable cause

- 1 Not-ready condition in one of the instruments connected to the remote line.
- 2 Defective remote cable.
- 3 Defective components in the instrument showing the not-ready condition.

#### Suggested actions

- Ensure the instrument showing the not-ready condition is installed correctly, and is set up correctly for analysis.
- Exchange the remote cable.
- Check the instrument for defects (refer to the instrument's documentation).

## Shutdown

### **Error ID: 0063**

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

The module continually monitors the remote input connectors for status signals. A LOW signal input on pin 4 of the remote connector generates the error message.

#### **Probable cause**

- 1** Leak detected in another module with a CAN connection to the system.
- 2** Leak detected in an external instrument with a remote connection to the system.
- 3** Shut-down in an external instrument with a remote connection to the system.

#### **Suggested actions**

- Fix the leak in the external instrument before restarting the module.
- Fix the leak in the external instrument before restarting the module.
- Check external instruments for a shut-down condition.

## Lost CAN Partner

### Error ID: 0071

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

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

#### Probable cause

- 1 CAN cable disconnected.
- 2 Defective CAN cable.
- 3 Defective main board in another module.

#### Suggested actions

- Ensure all the CAN cables are connected correctly.
  - Ensure all CAN cables are installed correctly.
- Exchange the CAN cable.
- Switch off the system. Restart the system, and determine which module or modules are not recognized by the system.

## Timeout

### Error ID: 0062

The timeout threshold was exceeded.

#### Probable cause

- 1 The analysis was completed successfully, and the timeout function switched off the module as requested.
- 2 A not-ready condition was present during a sequence or multiple-injection run for a period longer than the timeout threshold.

#### Suggested actions

- Check the logbook for the occurrence and source of a not-ready condition. Restart the analysis where required.
- 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

**Error ID: 2046, 2050, 2510**

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

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

#### Probable cause

- 1 Defective or disconnected pump encoder connector.
- 2 Defective pump drive assembly.

#### Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

### Index Adjustment

**Error ID: 2204, 2214**

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

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

#### Probable cause

- 1 Irregular or sticking drive movement.
- 2 Defective pump drive assembly.

#### Suggested actions

- Remove the pump head, and examine the seals, pistons, and internal components for signs of wear, contamination or damage. Exchange components as required.
- Please contact your Agilent service representative.

## Index Limit

**Error ID: 2203, 2213**

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

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

**Probable cause**

- 1 Irregular or sticking drive movement.
- 2 Defective pump drive assembly.

**Suggested actions**

- Remove the pump head, and examine the seals, pistons, and internal components for signs of wear, contamination or damage. Exchange components as required.
- Please contact your Agilent service representative.

## Index Missing

**Error ID: 2205, 2215, 2505**

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

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

**Probable cause**

- 1 Disconnected or defective encoder cable.
- 2 Defective pump drive assembly.

**Suggested actions**

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Initialization Failed

### Error ID: 2207, 2217

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

- 1 Defective pump drive assembly.
- 2 Defective main board.

#### Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Missing Pressure Reading

### Error ID: 2054

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

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

#### Probable cause

- 1 Damper disconnected.
- 2 Defective damper.
- 3 Defective main board.

#### Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Motor-Drive Power

### **Error ID: 2041, 2042**

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**

- 1** Flow path blockage in front of the damper.
- 2** Blocked outlet valve.
- 3** High friction (partial mechanical blockage) in the pump drive assembly.
- 4** Defective pump drive assembly.
- 5** Defective main board.

#### **Suggested actions**

- Ensure the capillaries and frits between the pump head and damper inlet are free from blockage.
- Exchange the outlet valve.
- Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Pressure Above Upper Limit

**Error ID: 2014, 2500**

The system pressure has exceeded the upper pressure limit.

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

## Pressure Below Lower Limit

**Error ID: 2015, 2501**

The system pressure has fallen below the lower pressure limit.

<b>Probable cause</b>	<b>Suggested actions</b>
<b>1</b> Lower pressure limit set too high.	Ensure the lower pressure limit is set to a value suitable for the analysis.
<b>2</b> Leak.	<ul style="list-style-type: none"> <li>• Inspect the pump head, capillaries and fittings for signs of a leak.</li> <li>• Purge the module. Run a pressure test to determine whether the seals or other module components are defective.</li> </ul>
<b>3</b> Defective main board.	Please contact your Agilent service representative.

## Pressure Signal Missing

### Error ID: 2016

The pressure signal of the damper is missing.

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

#### Probable cause

- 1 Damper disconnected.
- 2 Defective damper.

#### Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Pump Configuration

### Error ID: 2060

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

- 1 Gradient valve disconnected.

#### Suggested actions

- Reconnect the gradient valve.

## Pump Head Missing

**Error ID: 2202, 2212**

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

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

**Probable cause**

- 1 Pump head not installed correctly (screws not secured, or pump head not seated correctly).
- 2 Broken piston.

**Suggested actions**

- Install the pump head correctly. Ensure nothing (e.g. capillary) is trapped between the pump head and body.
- Exchange the piston.

## Restart Without Cover

**Error ID: 2502**

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**

- 1 The module started with the top cover and foam removed.

**Suggested actions**

- Please contact your Agilent service representative.

## Servo Restart Failed

**Error ID: 2201, 2211**

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**

- 1** Disconnected or defective cable.
- 2** Mechanical blockage of the module.
- 3** Defective pump drive assembly.
- 4** Defective main board.

**Suggested actions**

- Please contact your Agilent service representative.
- Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.



## Stroke Length

**Error ID: 2206, 2216**

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

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

**Probable cause**

- 1 Defective pump drive assembly.

**Suggested actions**

Please contact your Agilent service representative.

## Temperature Limit Exceeded

**Error ID: 2517**

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**

- 1 High friction (partial mechanical blockage) in the pump drive assembly.
- 2 Partial blockage of the flowpath in front of the damper.
- 3 Defective pump drive assembly.
- 4 Defective main board.

**Suggested actions**

Remove the pump-head assembly. Ensure there is no mechanical blockage of the pump-head assembly or pump drive assembly.

Ensure the outlet valve is not blocked.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

## Temperature Out of Range

### Error ID: 2517

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

- 1 Defective main board.

#### Suggested actions

Please contact your Agilent service representative.

## Valve Failed (MCGV)

### Error ID: 2040

**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

- 1 Gradient valve disconnected.
- 2 Connection cable (inside instrument) not connected.
- 3 Connection cable (inside instrument) defective.
- 4 Gradient valve defective.

#### Suggested actions

Ensure the gradient valve is connected correctly.

Please contact your Agilent service representative.

Please contact your Agilent service representative.

Exchange the gradient valve.

## MCGV Fuse

**Error ID: 2043**

**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

- 1 Defective gradient valve.
- 2 Defective connection cable (front panel to main board).
- 3 Defective main board.

### Suggested actions

- Restart the quaternary pump. If the error message appears again, exchange the gradient valve.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Wait Timeout

### Error ID: 2053

When running certain tests in the diagnostics mode or other special applications, the pump must wait for the pistons 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

- 1 Flow changed after starting test.
- 2 Defective pump drive assembly.

#### Suggested actions

- Ensure correct operating condition for the special application in use.
- Please contact your Agilent service representative.

## Solvent Zero Counter

### Error ID: 2055, 2524

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

- 1 Volume in bottle below specified volume.
- 2 Incorrect setting.

#### Suggested actions

- Refill bottles and reset solvent counters.
- Make sure the limits are set correctly.

# Autosampler Error Messages

These errors are specific to the autosampler.

## Arm Movement Failed

**Error ID: 4002**

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 37](#) on page 104 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).

<b>Probable cause</b>	<b>Suggested actions</b>
<b>1</b> Mechanical obstruction.	Ensure unobstructed movement of the transport assembly.
<b>2</b> High friction in the transport assembly.	Please contact your Agilent service representative.
<b>3</b> Defective motor assembly.	Please contact your Agilent service representative.
<b>4</b> Defective sample transport assembly flex board.	Please contact your Agilent service representative.
<b>5</b> Defective main board.	Please contact your Agilent service representative.

## Initialization Failed

### Error ID: 4020

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

- 1 Mechanical obstruction.
- 2 Defective sampling unit flex board.
- 3 Defective transport assembly flex board.
- 4 Defective sampling unit motor.
- 5 Defective main board.

#### Suggested actions

- Ensure unobstructed movement of the transport assembly.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Initialization with Vial

### Error ID: 4028

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

- 1 Vial still in gripper.

#### Suggested actions

- Remove the vial using the **Release Vial** function in the user interface. Reinitialize the autosampler.

## Invalid Vial Position

**Error ID: 4042**

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

The reflection sensors on the transport assembly flex board are used to automatically check 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**

- 1 Incorrect tray or trays installed.
- 2 Incorrect vial positions defined in the method or sequence.
- 3 Tray recognition defective (dirty sample tray or defective transport assembly flex board).

**Suggested actions**

- Install the correct trays, or edit the method or sequence accordingly.
- Check method settings vs. installed tray.
- Ensure the coding surfaces of the sample tray are clean (located at the rear of the sample tray). If this does not solve the problem, contact your Agilent service representative.

## Metering Home Failed

**Error ID: 4054, 4704**

The metering piston 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 piston. If the piston fails to move to the home position, or if the sensor fails to recognize the piston position, the error message is generated.

**Probable cause**

- 1 Defective sensor or main board.
- 2 Broken piston.
- 3 Defective metering-drive motor.
- 4 Defective main board.

**Suggested actions**

- Please contact your Agilent service representative.
- Exchange the metering piston and seal.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Missing Vial

**Error ID: 4019, 4034, 4541, 4706**

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.	Please contact your Agilent service representative.

## Missing Wash Vial

**Error ID: 4035, 4542, 4707**

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

**Error ID: 4027, 4040, 4261, 4451**

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 37](#) on page 104 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.

<b>Probable cause</b>	<b>Suggested actions</b>
<b>1</b> Mechanical obstruction.	Ensure unobstructed movement of the transport assembly.
<b>2</b> High friction in the transport assembly.	Please contact your Agilent service representative.
<b>3</b> Motor belt tension too high.	Switch OFF the autosampler at the power switch. Wait at least 10 min before switching on again.
<b>4</b> Defective motor.	Please contact your Agilent service representative.
<b>5</b> Defective transport assembly flex board.	Please contact your Agilent service representative.

## Needle Down Failed

**Error ID: 4018**

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**

- |   |  |
|---|--|
| <b>1</b> Needle installed incorrectly, or wrong needle type (too long). | Ensure the correct needle type is used, and installed correctly. |
| <b>2</b> Defective or dirty position sensor.                            | Please contact your Agilent service representative.              |
| <b>3</b> Defective motor.   | Please contact your Agilent service representative.              |
| <b>4</b> Sticking spindle assembly.                                     | Please contact your Agilent service representative.              |
| <b>5</b> Defective main board.  | Please contact your Agilent service representative.              |

## Needle Up Failed

**Error ID: 4017**

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.

<b>Probable cause</b>	<b>Suggested actions</b>
<b>1</b> Defective or dirty position sensor.	Please contact your Agilent service representative.
<b>2</b> Defective motor.	Please contact your Agilent service representative.
<b>3</b> Sticking spindle assembly.	Please contact your Agilent service representative.
<b>4</b> Defective main board.	Please contact your Agilent service representative.

## Safety Flap Missing

**Error ID: 4032**

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, 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.

<b>Probable cause</b>	<b>Suggested actions</b>
<b>1</b> Safety flap missing or broken.	Please contact your Agilent service representative.

## Valve to Bypass Failed

**Error ID: 4014, 4701**

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**

- 1 Defective injection valve.
- 2 Defective main board.

**Suggested actions**

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Valve to Mainpass Failed

**Error ID: 4015**

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**

- 1 Defective injection valve.
- 2 Defective main board.

**Suggested actions**

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Vial in Gripper

**Error ID: 4033**

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**

- 1 Vial still in gripper.

**Suggested actions**

Remove the vial using the **Release Vial** function in the user interface. Reinitialize the autosampler.

## General Detector Error Messages

These errors are specific to both detector types VWD and DAD.

### Heater at fan assembly failed

**Error ID: 1073**

Every time the deuterium lamp or the tungsten lamp (DAD only) 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**

- 1 Defective connector or cable.
- 2 Defective heater.

**Suggested actions**

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

### Heater Power At Limit

**Error ID: 1074**

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**

- 1 Excessive ambient temperature change.

**Suggested actions**

- Wait until temperature control equilibrates.

## Illegal Temperature Value from Sensor on Main Board

**Error ID: 1071**

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**

- 1 Defective sensor or main board.
- 2 Detector is exposed to illegal ambient conditions.

**Suggested actions**

- Please contact your Agilent service representative.
- Verify that the ambient conditions are within the allowed range.

## Illegal Temperature Value from Sensor at Air Inlet

**Error ID: 1072**

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**

- 1 The temperature sensor is defect.
- 2 Detector is exposed to illegal ambient conditions.

**Suggested actions**

- Replace the cable to the main board.
  - Please contact your Agilent service representative.
- Verify that the ambient conditions are within the allowed range.

## UV Lamp Current

### Error ID: 7450

The UV lamp 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

- 1 Lamp disconnected.
- 2 Defective UV lamp or non-Agilent lamp.
- 3 Defective detector main board.
- 4 Defective power supply.

#### Suggested actions

- Ensure the UV lamp connector is seated firmly.
- Exchange the UV lamp.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## UV Lamp Voltage

### Error ID: 7451

The UV 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

- 1 Defective UV lamp or non-Agilent lamp.
- 2 Defective detector main board.
- 3 Defective power supply.

#### Suggested actions

- Exchange the UV lamp.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.



## VWD Detector Error Messages

These errors are specific to the variable wavelength detector.

### ADC Hardware Error

**Error ID: 7830, 7831**

A/D-Converter hardware is defective.

**Probable cause**

- 1 A/D-Converter hardware is defective.

**Suggested actions**

Please contact your Agilent service representative.

### Wavelength calibration setting failed

**Error ID: 7310**

The intensity maximum was not found during wavelength calibration.

**Calibration 0 Failed:**

Zero-order calibration failed.

**Calibration 1 Failed:**

656 nm calibration failed.

**Probable cause**

- 1 Lamp is OFF.
- 2 Incorrect flow cell installation.
- 3 Flow cell contamination or air bubbles.
- 4 Intensity too low.
- 5 Current step value too far from maximum.
- 6 Misaligned/defective grating assembly.
- 7 Defective main board.

**Suggested actions**

- Switch on the lamp.
- Ensure the flow cell is installed correctly.
- Clean/replace flow cell windows or remove air bubbles.
- Replace lamp.
- Repeat the calibration.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Cutoff filter doesn't decrease the light intensity at 250 nm

### Error ID: 7813

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

- 1 Motor is not connected.
- 2 Defective motor.
- 3 Defective/missing grating or filter.
- 4 Cable/connector defective.

#### Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Filter Missing

### Error ID: 7816

The filter motor is not detected.

#### Probable cause

- 1 Filter motor is not connected.
- 2 Cable/connector defective.

#### Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Grating or Filter Motor Errors

**Error ID: Grating:** 7800, 7801, 7802, 7803, 7804, 7805, 7806, 7808, 7809;  
**Filter:** 7810, 7811, 7812, 7813, 7814, 7815, 7816

The motor test has failed.

<b>Test 0 Failed:</b>	Filter motor.
<b>Test 1 Failed:</b>	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.

<b>Probable cause</b>	<b>Suggested actions</b>
1 Motor is not connected.	Please contact your Agilent service representative.
2 Defective motor.	Please contact your Agilent service representative.
3 Defective/missing grating or filter.	Please contact your Agilent service representative.
4 Cable/connector defective.	Please contact your Agilent service representative.

## Grating Missing

**Error ID: 7819**

The grating motor is not detected.

<b>Probable cause</b>	<b>Suggested actions</b>
1 Grating motor is not connected.	Please contact your Agilent service representative.
2 Cable/connector defective.	Please contact your Agilent service representative.

## No heater current

### Error ID: 7453

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 1, 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.	Please contact your Agilent service representative.
3 Fan not running (permitting lamp on).	Please contact your Agilent service representative.
4 Defective main board.	Please contact your Agilent service representative.
5 Defective or non-Agilent lamp.	Exchange the lamp.
6 Defective power supply.	Please contact your Agilent service representative.

## Wavelength holmium check failed

### Error ID: 7318

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.	<ul style="list-style-type: none"><li>• Ensure the flow cell is inserted correctly, and is free from contamination (cell windows, buffers, and so on).</li><li>• Run the filter-motor test to determine if the filter motor assembly is defective. If defective, please contact your Agilent service representative.</li><li>• Run the grating-motor test to determine if the grating assembly is defective. If defective, please contact your Agilent service representative.</li></ul>

## Ignition Failed

**Error ID: 7452**

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 s, the error message is generated.

**Probable cause**

- 1 Lamp disconnected.
- 2 Defective or non-Agilent lamp.
- 3 Defective power supply.
- 4 Defective main board.

**Suggested actions**

- Ensure the lamp is connected.
- Exchange the lamp.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Wavelength test failed

**Error ID: 7890**

The automatic wavelength check after lamp ignition has failed. When the lamp is switched on, the detector waits 1 min 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**

- 1 Calibration incorrect.

**Suggested actions**

- Recalibrate the detector.

## DAD Detector Error Messages

These errors are specific to the diode array detector.

### Visible Lamp Current

The visible lamp current is missing.

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

**Probable cause**

- 1 Lamp disconnected.
- 2 Defective visible lamp.
- 3 Defective connector or cable.
- 4 Defective power supply.

**Suggested actions**

- Ensure the visible lamp connector is seated firmly.
- Exchange the visible lamp.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

### Visible Lamp Voltage

The visible lamp voltage is missing.

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

**Probable cause**

- 1 Defective connector or cable.
- 2 Defective power supply.

**Suggested actions**

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Diode Current Leakage

### Error ID: 1041

When the detector is switched on, the processor checks the leakage current of each of the optical diodes. If the leakage current exceeds the upper limit, the error message is generated.

#### Probable cause

- 1 Defective PDA/optical unit.
- 2 Defective connector or cable.

#### Suggested actions

- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## UV Ignition Failed

### Error ID: 7452

The UV lamp failed to ignite.

The processor monitors the UV 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

- 1 Lamp too hot. Hot gas discharge lamps may not ignite as easily as cold lamps.
- 2 Lamp disconnected.
- 3 Defective UV lamp or non-Agilent lamp.
- 4 Defective detector main board.
- 5 Defective power supply.

#### Suggested actions

- Switch off the lamp and allow it to cool down for at least 15 minutes.
- Ensure the lamp is connected.
- Exchange the UV lamp.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## UV Heater Current

**Error ID: 7453**

The UV lamp heater current is missing.

During UV 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 UV lamp is connected.
2 Ignition started without the top foam in place.	Please contact your Agilent service representative.
3 Defective UV lamp or non-Agilent lamp.	Exchange the UV lamp.
4 Defective detector main board.	Please contact your Agilent service representative.
5 Defective power supply.	Please contact your Agilent service representative.

## Calibration Values Invalid

**Error ID: 1036**

The calibration values read from the spectrometer ROM are invalid.

After recalibration, the calibration values are stored in ROM. The processor periodically checks if the calibration data are valid. If the data are invalid or cannot be read from the spectrometer ROM, the error message is generated.

Probable cause	Suggested actions
1 Defective connector or cable.	Please contact your Agilent service representative.
2 Defective PDA/optical unit.	Please contact your Agilent service representative.



## Holmium Oxide Test Failed

### Probable cause

- 1 Lamps switched off.
- 2 Defective or dirty flow cell.
- 3 Defective filter assembly.
- 4 Defective achromat assembly.
- 5 Defective PDA/optical unit.

### Suggested actions

- Ensure the lamps are switched on.
- Ensure the flow cell is inserted correctly, and is free from contamination (cell windows, buffers etc.).
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## Wavelength Recalibration Lost

### Error ID: 1037

The calibration information needed for your detector to operate correctly has been lost.

During calibration of the detector the calibration values are stored in ROM. If no data is available in the spectrometer ROM, the error message is generated.

### Probable cause

- 1 The detector is new.
- 2 The detector has been repaired.

### Suggested actions

- Recalibrate the detector.
- Please contact your Agilent service representative.

## DSP Not Running

This error message comes up when the communication between the optical unit and the main board has a problem.

### Probable cause

- 1 Random communication error.
- 2 Defective detector main board.
- 3 Defective PDA/optical unit.

### Suggested actions

- Switch the detector off and on again at the power switch. If the error reoccurs:
  - Please contact your Agilent service representative.
- Please contact your Agilent service representative.
- Please contact your Agilent service representative.

## No Run Data Available In Device

In a very rare case the capacity of the CompactFlash Card is not sufficient. This could happen for example when the interrupt of LAN communication takes longer and the detector uses special settings (e.g full data rate at 80 Hz plus full spectra plus all signals) during data buffering.

### Probable cause

- 1 CompactFlash Card is full.

### Suggested actions

- Correct communication problem.
- Reduce data rate.

## Instrument Logbook

```
Method      Instrument run started          09:44:46 11/20/05
1200 DAD    1 Power on                    10:07:24 11/20/05
1200 DAD    1 UV-lamp on                  10:07:24 11/20/05
1200 DAD    1 Vis-lamp on                 10:07:24 11/20/05
1200 DAD    1 No Run data available in device! 10:07:24 11/20/05
CP Macro    Analyzing rawdata SHORT_02.D  10:07:25 11/20/05
Method      Instrument Error - Method/Sequence stopped 10:07:25 11/20/05
Method      Method aborted                10:09:52 11/20/05
```

**Figure 64** Instrument Logbook

**NOTE**

The logbook does not indicate a communication loss (power fail). It just shows the recovering (Power on, Lamps on).

## **10 Error Information**

### **DAD Detector Error Messages**



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## 11 Maintenance

### DAD Detector Error Messages

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This chapter provides general information on maintenance of the instrument.

## 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.

## Cautions and Warnings

### WARNING

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

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

- Never perform any adjustment, maintenance or repair of the module with the top cover removed and with the power cord plugged in.
  - The security lever at the power input socket prevents that the module cover is taken off when line power is still connected. Never plug the power line back in when cover is removed.
- 

### WARNING

**Sharp metal edges**

**Sharp-edged parts of the equipment may cause injuries.**

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

### WARNING

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

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

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



**CAUTION**

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

- Be sure to hold the board by the edges, and do not touch the electrical components. Always use ESD protection (for example, an ESD wrist strap) when handling electronic boards and components.
- 

**WARNING**

**Eye damage by detector light**

**Eye damage may result from directly viewing the UV-light produced by the lamp of the optical system used in this product.**

- Always turn the lamp of the optical system off before removing it.
- 

**CAUTION**

Safety standards for external equipment

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

## 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 44** 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 <b>Leak Test</b> for verification
Exchanging the Outlet Ball Valve	If internally leaking	Pressure ripple unstable, run <b>Leak Test</b> 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 <sub>2</sub> O 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 <b>Leak Test</b> for verification
Seal Wear-in Procedure	After exchanging the pump seals	
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 carry health risks.**

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

---

**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
Concentrated nitric acid (65 %)
Bidistilled water
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 LC grade water (remove all nitric acid, some columns can be damaged by concentrated nitric acid; check with pH indicator).
- 3 Reinstall the filter.

## Exchanging the Passive Inlet Valve

**When** If leaking internally (backflow)

**Tools required**

Description
Wrench, 14 mm
Pair of tweezers

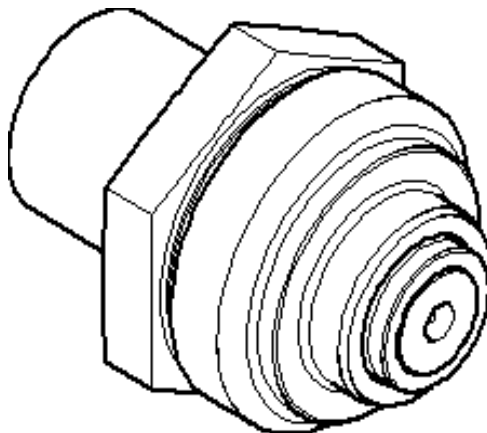
**Parts required**

p/n	Description
G1312-60066	Passive inlet valve 1220/1260

**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 65** Passive inlet valve

- 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.

## Exchanging the Outlet Valve

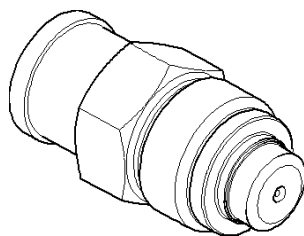
**When** If leaking internally

**Tools required** **Description**  
Wrench, 14 mm

**Parts required** **p/n** **Description**  
G1312-60067 Outlet valve 1220/1260

**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 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).

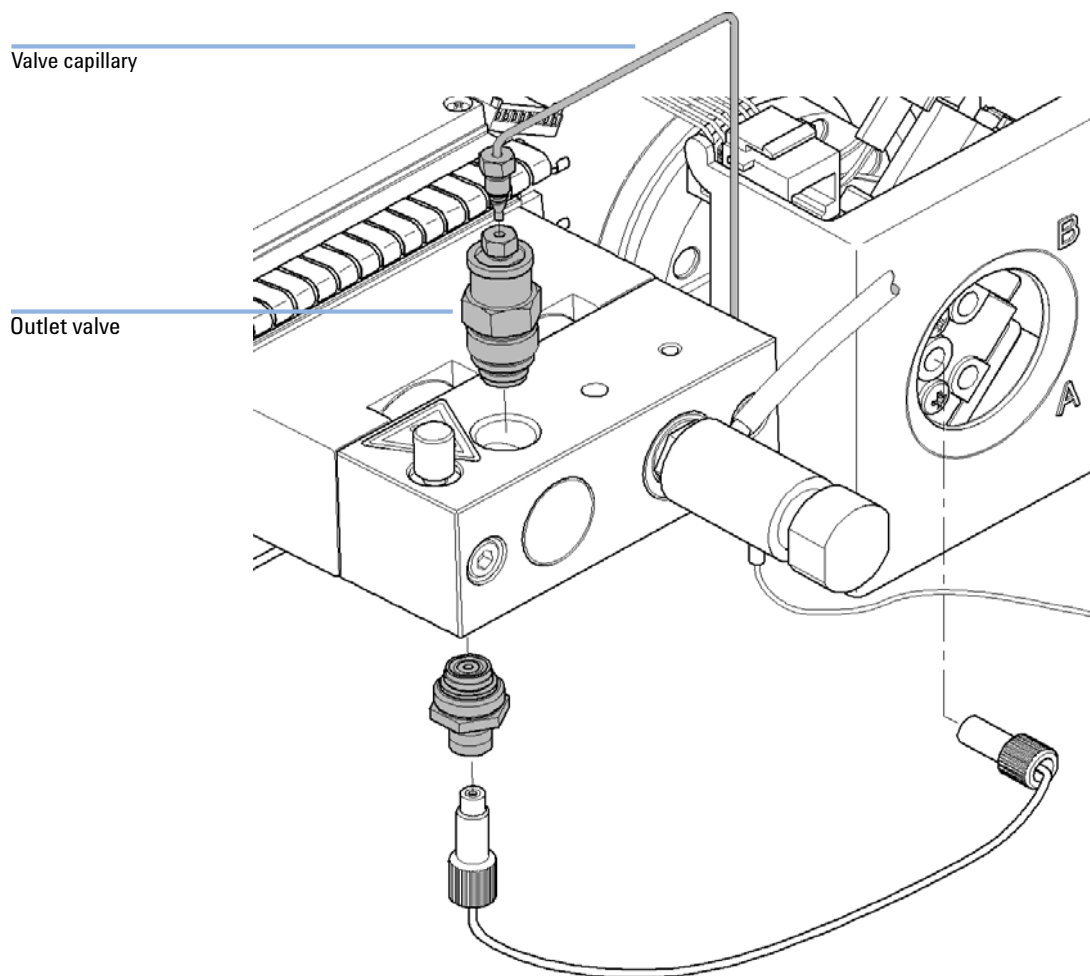


**Figure 66** Outlet ball valve

- 4 Reinstall the outlet valve and tighten the valve.



5 Reconnect the valve capillary.



## 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<sub>2</sub>O with purge valve opened)

*Purge valve:* if internally leaking

**Tools required** **Description**  
Wrench, 1/4 inch  
Wrench, 14 mm  
Pair of tweezers

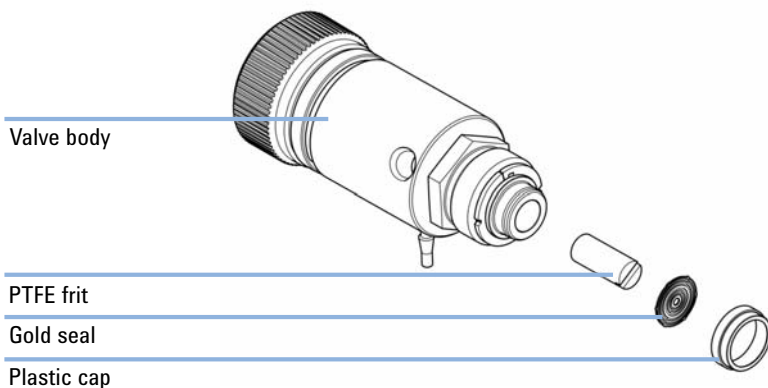
OR  
Toothpick

<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	01018-22707	PTFE frits (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 seal cap from the purge valve.

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



**Figure 67** 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**

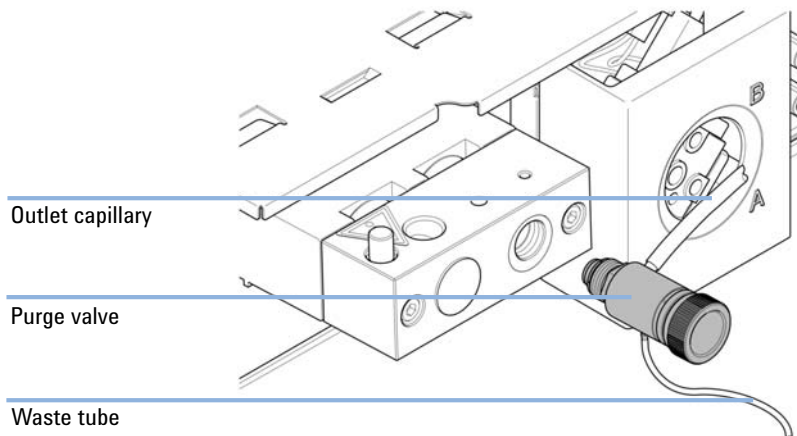
If the gold seal is deformed, exchange it before reinstalling.

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

## 11 Maintenance

### Solvent Delivery System

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



**Figure 68** Exchanging the purge valve

## Removing the Pump Head Assembly

**When** Before exchanging the seals  
Before exchanging the plungers

Tools required	p/n	Description
	8710-0510	Wrench open 1/4 — 5/16 inch
	8710-2392	Hexagonal key, 4.0 mm, 15 cm long, T-handle

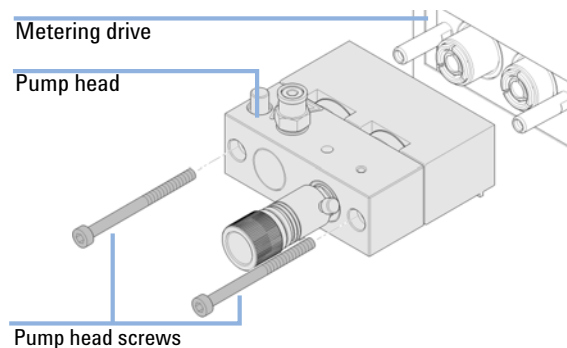
**Preparations** Switch off pump at the main power switch

### 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 valve.
- 4 Remove the waste tubing and disconnect the inlet valve tubing.
- 5 Remove the capillary at the bottom of the pump head.
- 6 Using a 4 mm hexagonal key, loosen the two pump head screws stepwise and remove the pump head from the pump drive.



## Exchanging the Pump Seals and Seal Wear-in Procedure

### Exchanging the Pump Seals

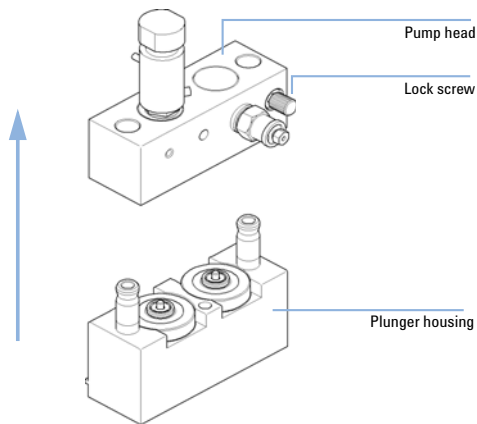
**When** Seal leaking, if indicated by the results of the leak test.

Tools required	p/n	Description
	8710-0510	Wrench open 1/4 — 5/16 inch
	8710-2392	Hexagonal key, 4.0 mm, 15 cm long, T-handle

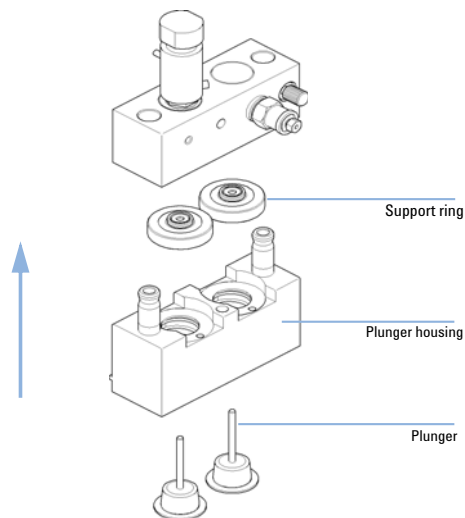
Parts required	p/n	Description
	5063-6589	Piston seal PTFE, carbon filled, black (pack of 2), default
	0905-1420	PE seals (pack of 2)
	5022-2159	Restriction capillary

**Preparations** Switch off the pump at the main power switch.  
Remove the upper front cover.

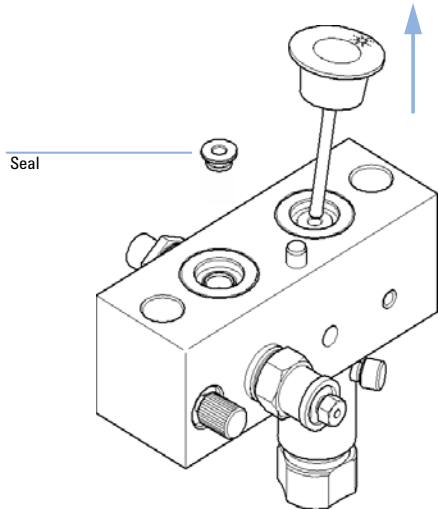
**1** Place the pump head on a flat surface. Loosen the lock screw (two revolutions) and while holding the lower half of the assembly carefully pull the pump head away from the plunger housing.



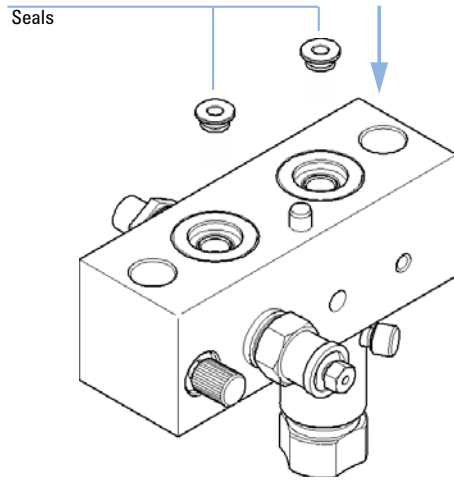
**2** Remove the support rings from the plunger housing and lift the housing away from the plungers.



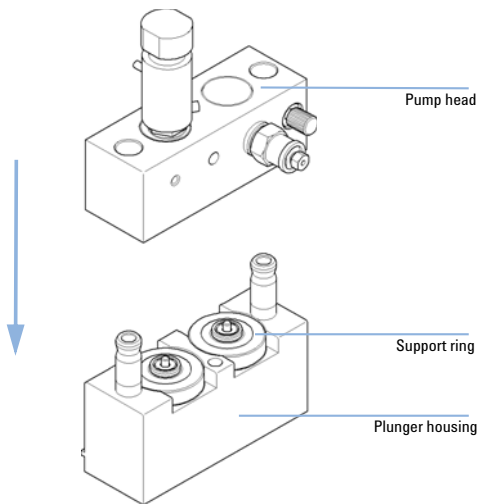
**3** Using one of the plungers carefully remove the seal from the pump head (be careful not to break the plunger). Remove wear retainers, if still present.



**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 (pack of 2) (5063-6589) only. It will damage the PE seals (pack of 2) (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 min 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 min 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.



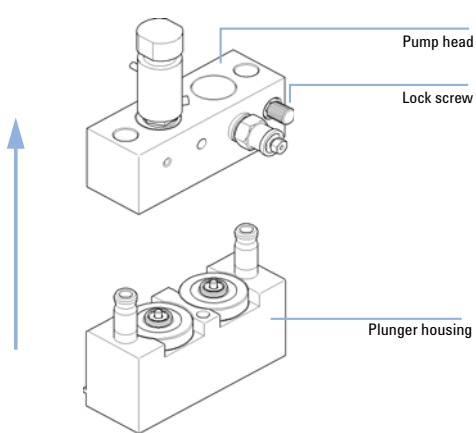
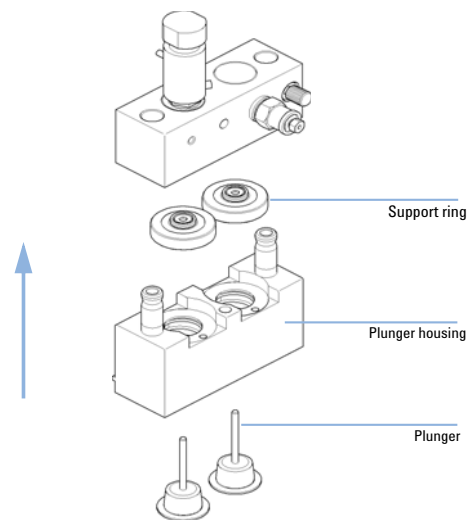
## Exchanging the Plungers

**When** When scratched

<b>Tools required</b>	<b>p/n</b>	<b>Description</b>
	8710-0510	Wrench open 1/4 — 5/16 inch
	8710-2392	Hexagonal key, 4.0 mm, 15 cm long, T-handle

<b>Parts required</b>	<b>p/n</b>	<b>Description</b>
	5067-4695	Sapphire piston

**Preparations** Switch off the pump at the main power switch.  
Remove the upper front cover.

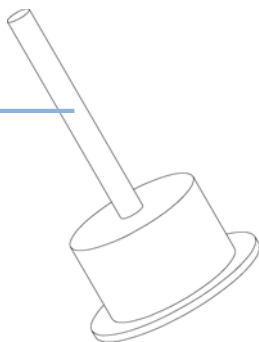
<p><b>1</b> Place the pump head on a flat surface. Loosen the lock screw (two revolutions) and while holding the lower half of the assembly carefully pull the pump head away from the plunger housing.</p> 	<p><b>2</b> Remove the support rings from the plunger housing and lift the housing away from the plungers.</p> 
--	--

## 11 Maintenance

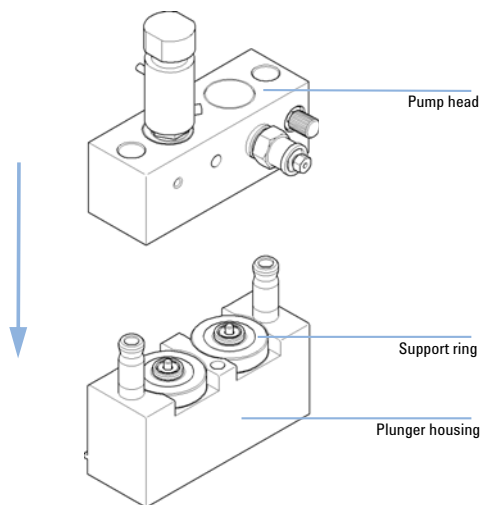
### Solvent Delivery System

- 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.

Piston surface



- 4** Reassemble the pump head assembly.

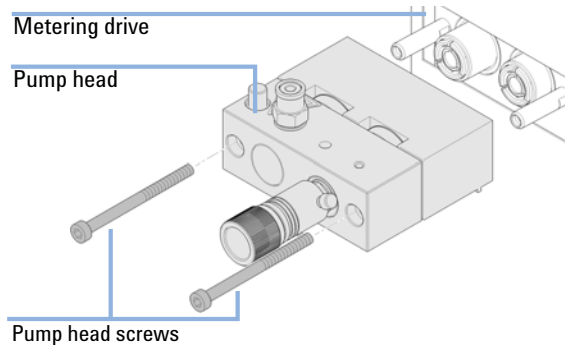


## Reinstalling the Pump Head Assembly

**When** When reassembling the pump

**Tools required** **Description**  
Hexagonal key, 4 mm

- 1 Slide the pump head assembly onto the pump drive and use a 4 mm hexagonal key to tighten the pump head screws stepwise with increasing torque (max. 5 Nm).



- 2 Reconnect the capillaries and tubing.
- 3 Reinstall the front cover.

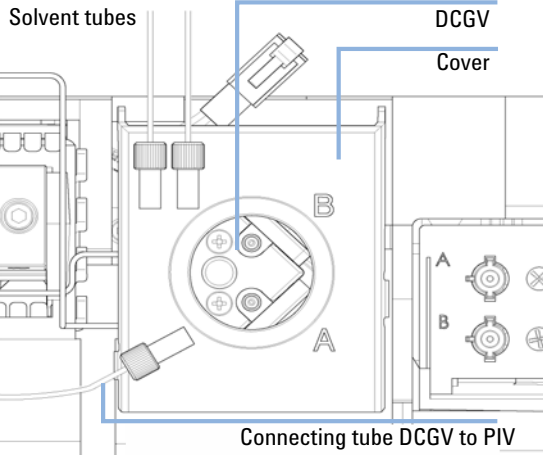
## Exchanging the Dual-Channel Gradient Valve (DCGV)

<b>Tools required</b>	<b>p/n</b>	<b>Description</b>	
	8710-0899	Screwdriver, Pozidriv #1	
<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	G4280-60004	Dual-channel gradient valve
<b>Preparations</b>	Switch off the pump at the power switch. Remove the upper front cover to gain access to the pump mechanics.		

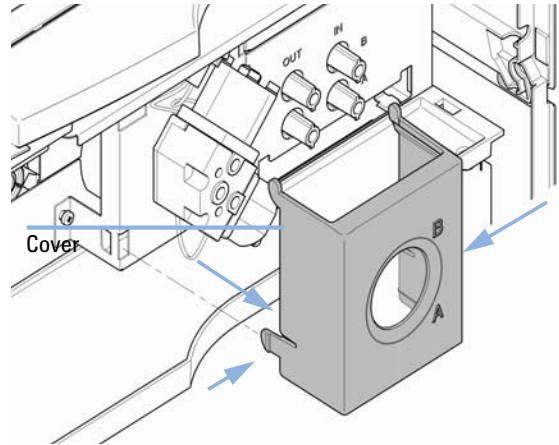
### NOTE

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).

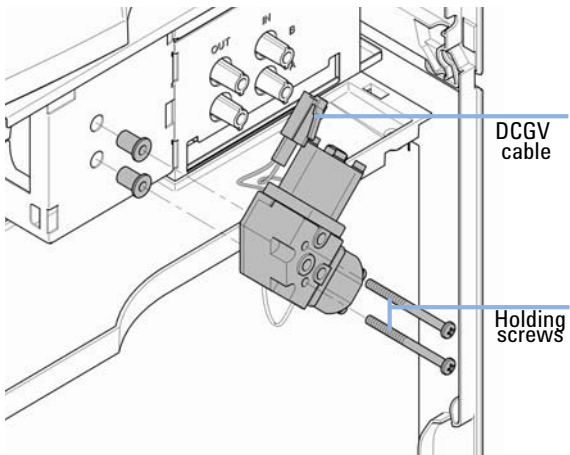
- 1** Disconnect the connecting tube, waste tube and the solvent tubes from the DCGV, unclip them from the tube clips and place them into the solvent cabinet to avoid flow by hydrostatic pressure.



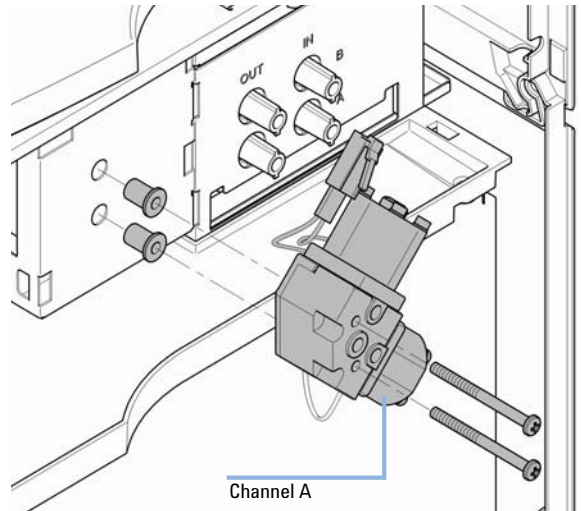
- 2** Press the lower sides of the cover to unclip it. Remove the cover.



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



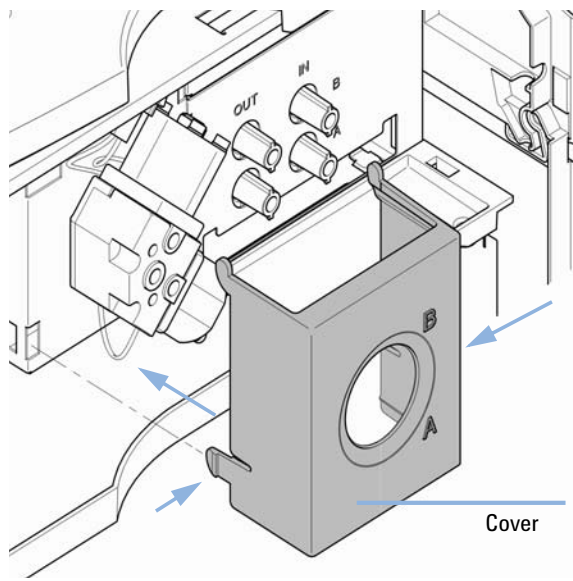
- 4** Place the new DCGV into position. Make sure that the valve is positioned with the A-channel at the bottom-right position. Tighten the two holding screws and connect the cable to its connector.



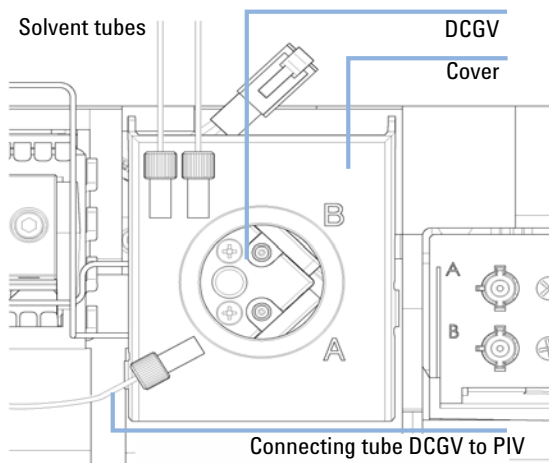
## 11 Maintenance

### Solvent Delivery System

- 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 45** Overview of maintenance procedures

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

## 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.

## 11 Maintenance

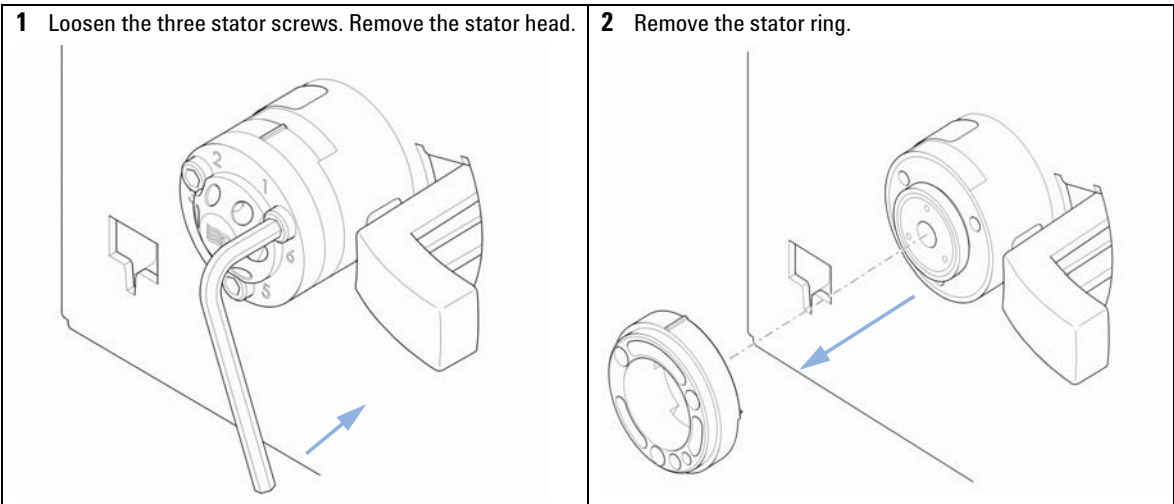
### Manual Injector

# Exchanging the Injection Valve Seal

**When** Poor injection-volume reproducibility  
Leaking injection valve

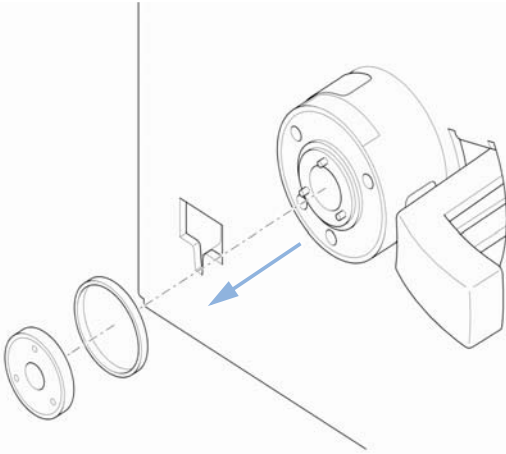
**Tools required** **Description**  
Hex key, 9/64 inch  
(supplied in the tool kit)

**Parts required** **p/n** **Description**  
5068-0082 Rotor seal, PEEK



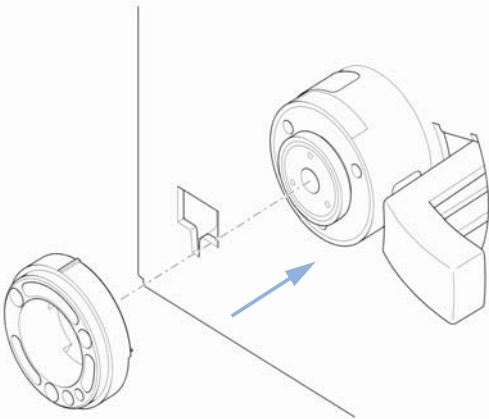


**3** Remove the rotor seal.

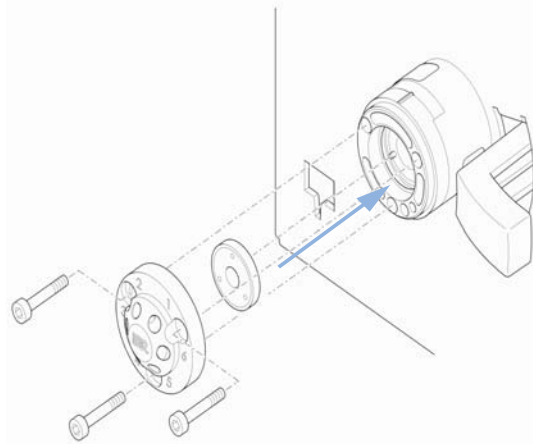


**4** Install the new rotor seal.

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



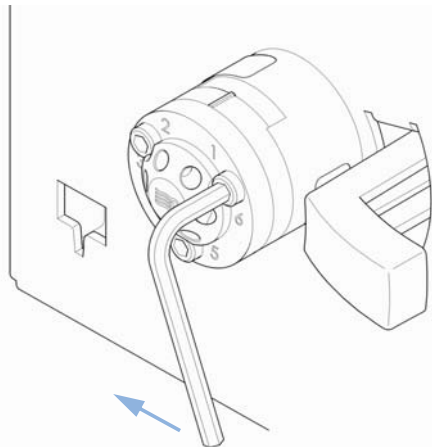
**6** Install the stator head onto the valve.



## 11 Maintenance

### Manual Injector

- 7** Secure stator head in place with the stator screws. Tighten each screw alternately  $\frac{1}{4}$ -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.

### Overview of procedures

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

#### 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 personnel 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** **Description**  
Wrench, 1/4 inch (supplied in HPLC Tool-Kit)  
Hexagonal key, 2.5 mm (supplied in HPLC Tool-Kit)  
Pair of pliers

<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	G1313-87201	Needle assembly

**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

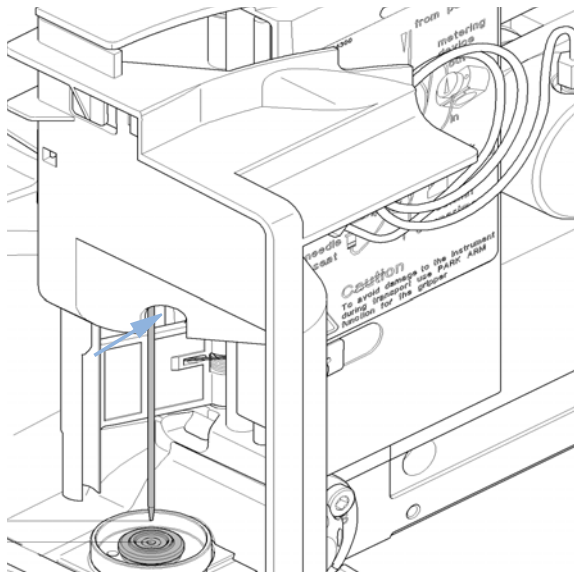
**To avoid personal injury, keep fingers away from the needle area during autosampler operation.**

- 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.
-

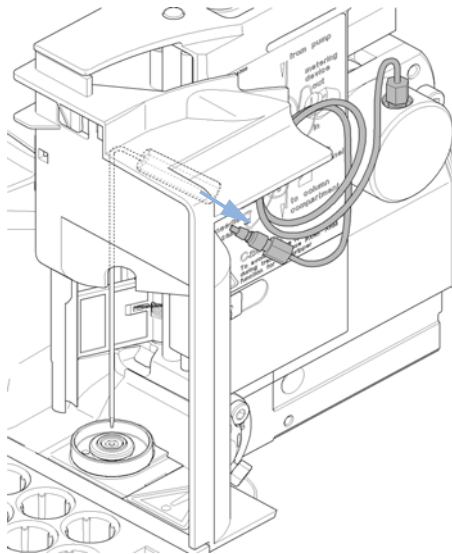
## 11 Maintenance

### Autosampler

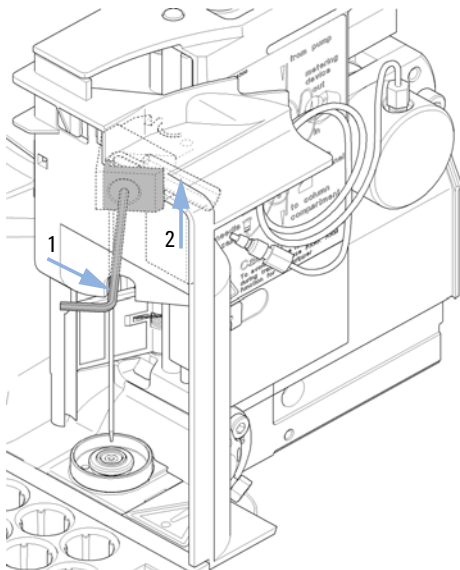
- 1** Select **Needle Down** until the needle screw is aligned with the hole in the safety cover.



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



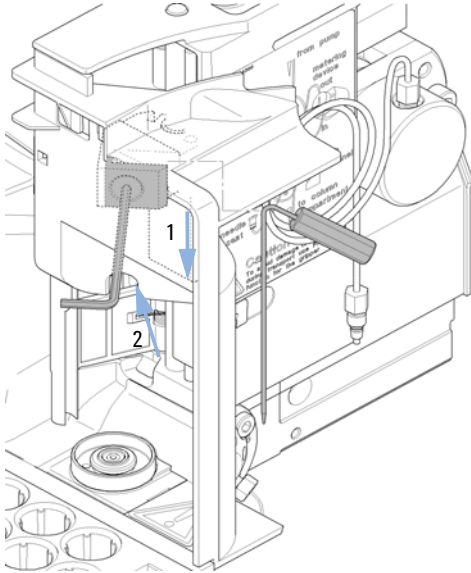
- 3** Loosen the fixing screw (1), and lift out the needle (2).



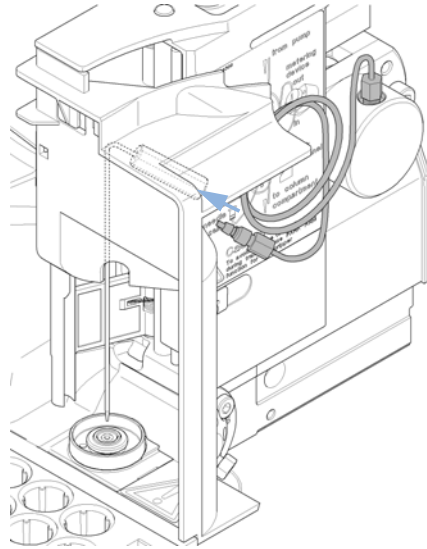
- 4** Select **Needle Down** to move the needle arm to its lowest position.

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.

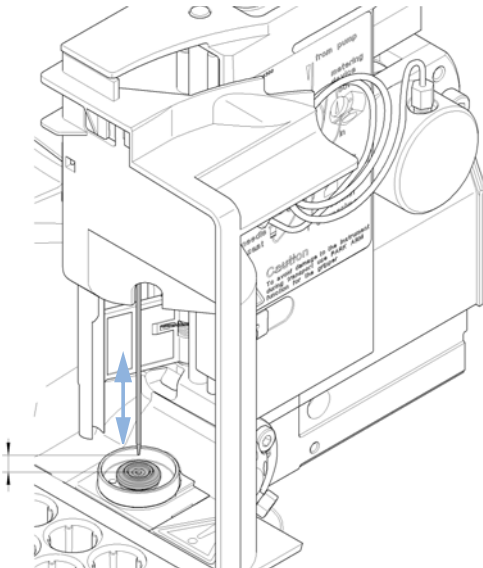
- 5** Insert the new needle (1). Align the needle in the seat, then tighten the screw firmly (2).



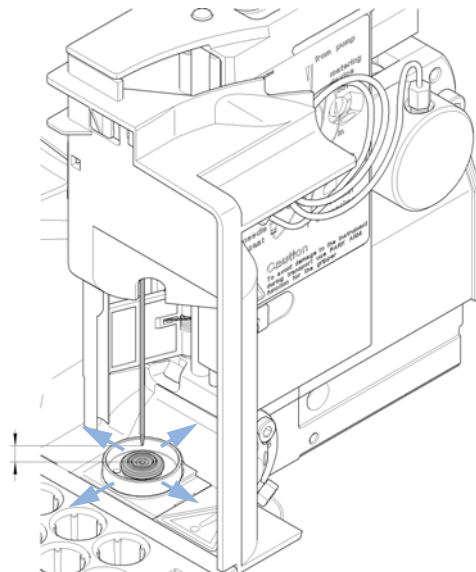
- 6** Reconnect the sample-loop fitting to the needle fitting.



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



- 8** Ensure the needle is aligned with the seat.



## 11 Maintenance

### Autosampler

#### 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

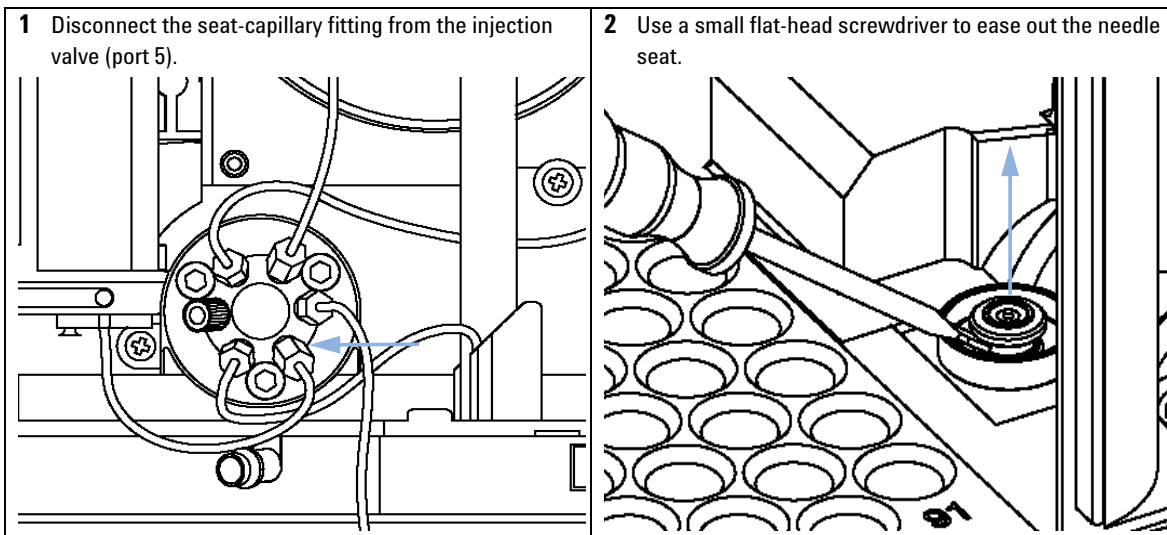
**When** When the seat is visibly damaged  
When the seat capillary is blocked

**Tools required** **Description**  
Wrench, 1/4 inch (supplied in HPLC Tool-Kit)  
Screwdriver, flat-head

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

**Preparations**

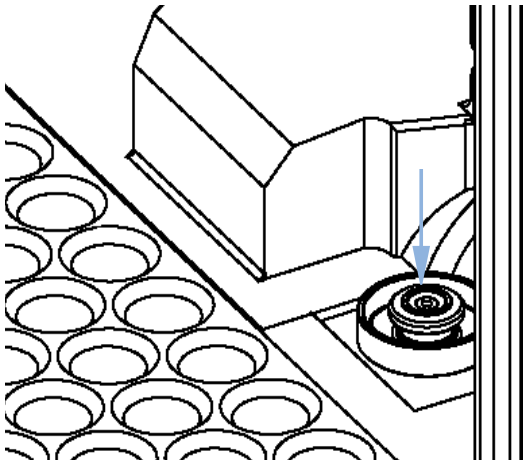
- Select **Start** in the **Tools** function in LMD Software **Change Needle**
- Remove the upper front cover.
- Use the **Needle Up** command in the **Change Needle** function to lift the needle an additional 1 cm.



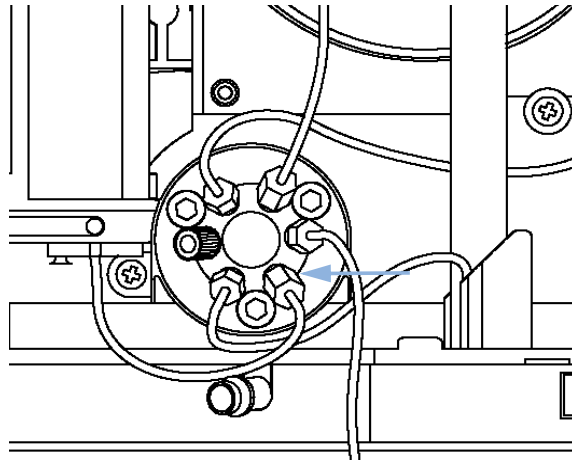
## 11 Maintenance

### Autosampler

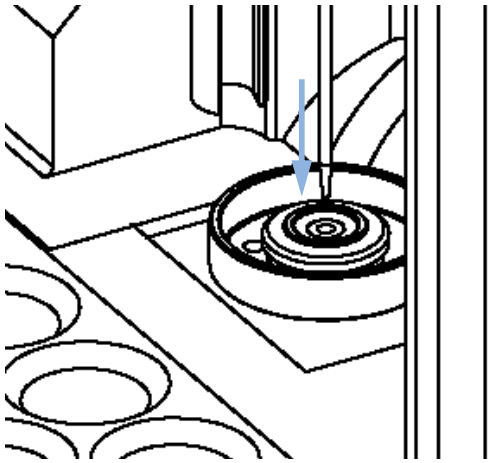
- 3** Insert the new needle-seat assembly. Press the seat firmly into position.



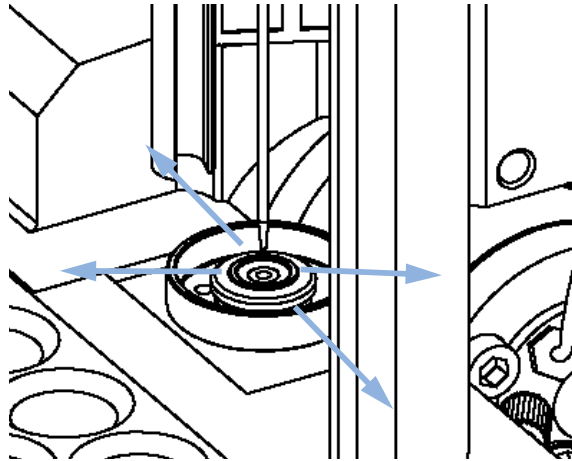
- 4** Connect the seat-capillary fitting to port 5 of the injection valve.



- 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

<b>When</b>	Poor injection-volume reproducibility Leaking injection valve		
<b>Tools required</b>	<b>Description</b> Wrench 1/4 inch Hex key, 9/16 inch (supplied in the tool kit)		
<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	0101-1416	Rotor seal (PEEK)
<b>Preparations</b>	<ul style="list-style-type: none"> <li>• Remove upper front cover.</li> <li>• Remove the leak tubing (if necessary).</li> </ul>		

### CAUTION

Removing the stator head

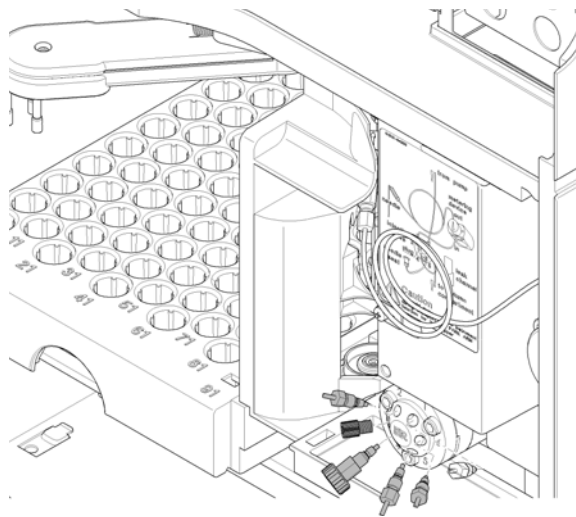
The stator face is held in place by the stator head. When you remove the stator head, the stator face can fall out of the valve.

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

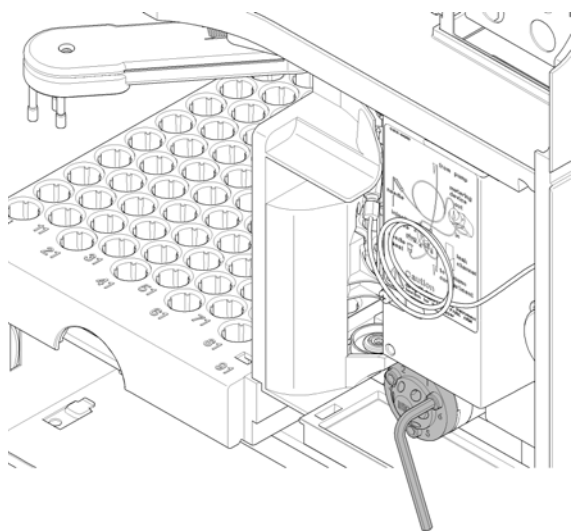
## 11 Maintenance

### Autosampler

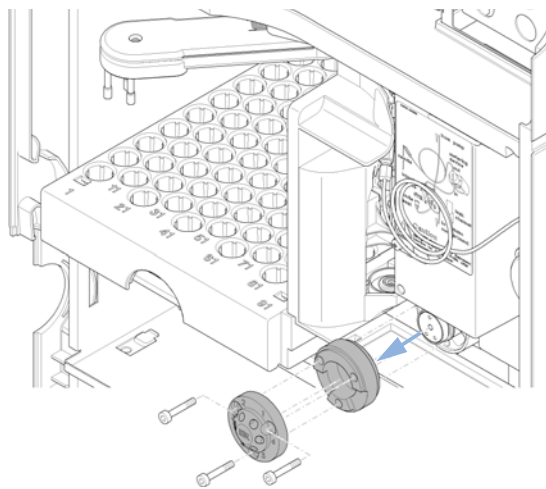
- 1** Remove all capillary fittings from the injection-valve ports.



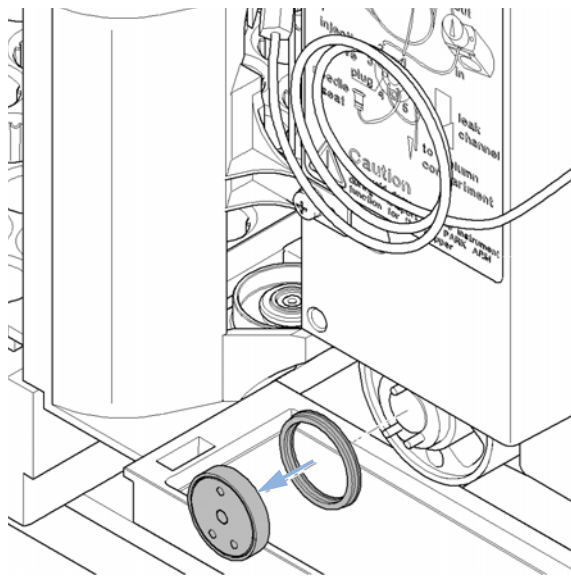
- 2** Loosen each fixing bolt two turns at a time. Remove the bolts from the head.



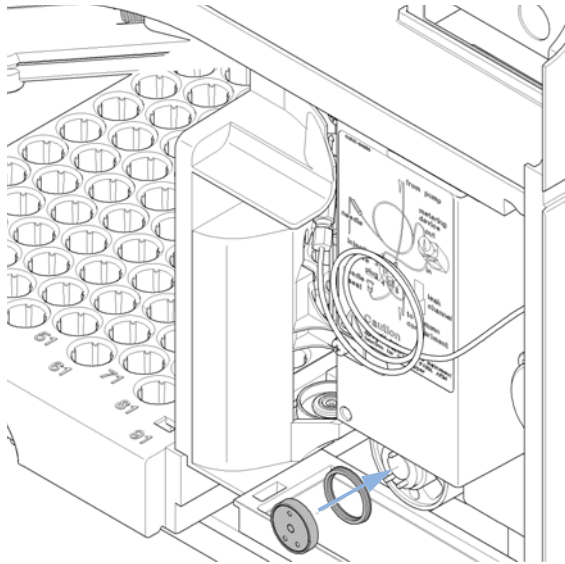
- 3** Remove the stator head and stator ring.



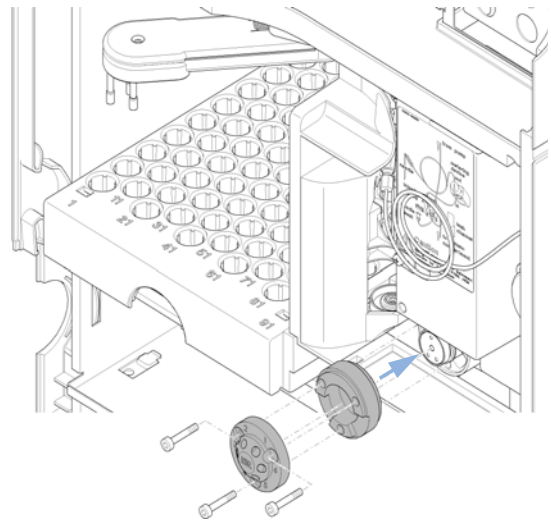
- 4** Remove the rotor seal and isolation seal.



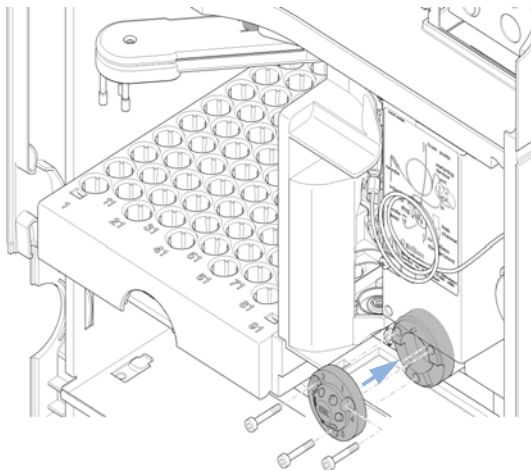
**5** Install the new rotor seal and isolation seal. Ensure the metal spring inside the isolation seal faces towards the valve body.



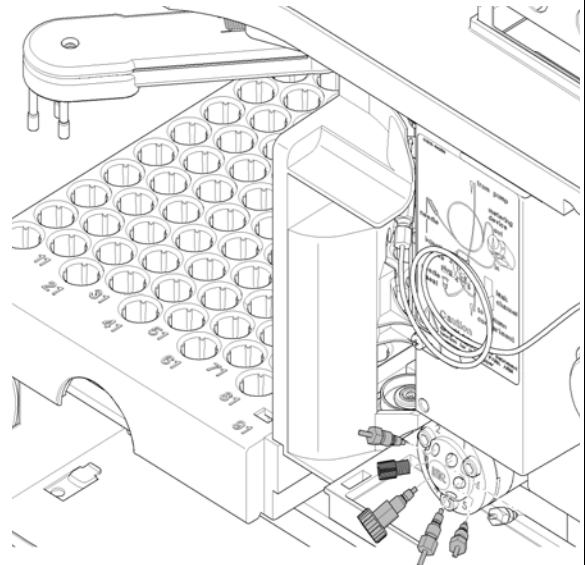
**6** Install the stator ring with the short of the two pins facing towards you at the 12 o'clock position. Ensure the ring sits flat on the valve body.



**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.



## 11 Maintenance

### Autosampler

#### 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

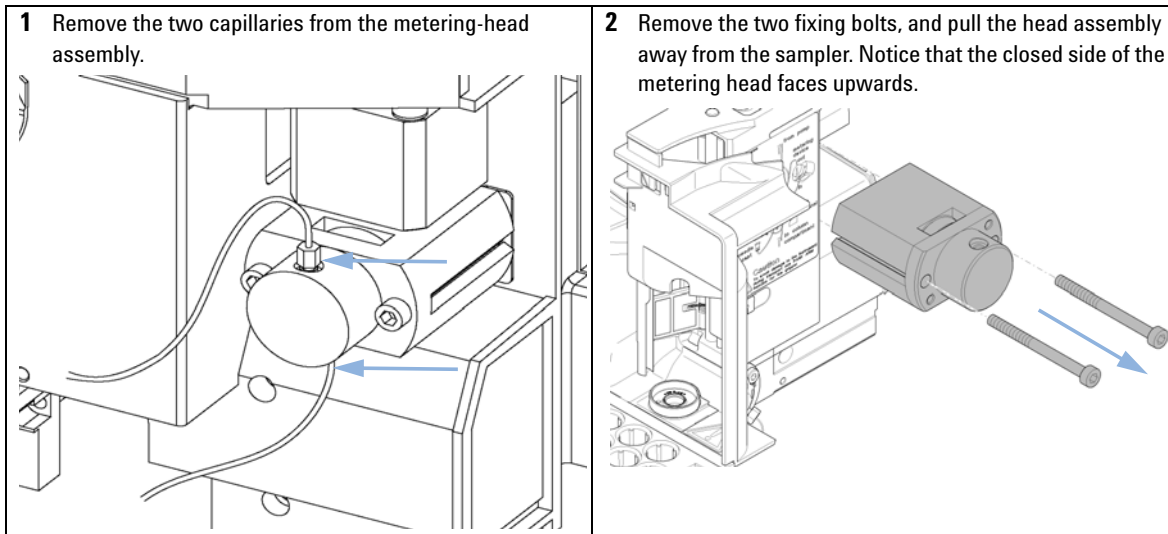
**When** Poor injection-volume reproducibility  
Leaking metering device

<b>Tools required</b>	<b>p/n</b>	<b>Description</b>
		Wrench, 1/4 inch (supplied in HPLC Tool-Kit)
		Hexagonal key, 4 mm (supplied in HPLC Tool-Kit)
	8710-2411	Hexagonal key, 3 mm (supplied in HPLC Tool-Kit)

<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	5063-6589	Metering seal (pack of 2) for 100 $\mu$ L analytical head
	1	5063-6586	Sapphire piston

**Preparations**

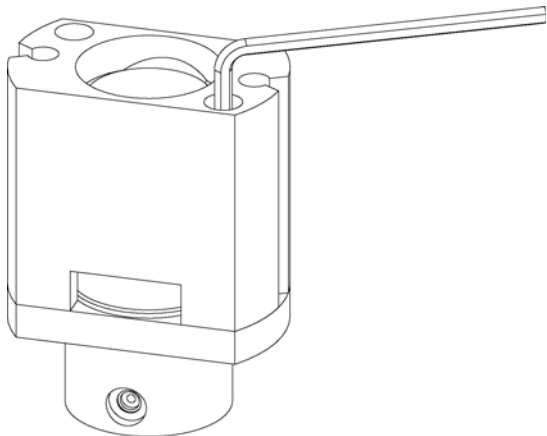
- Select **Start** in the **Tools** function in the LMD software **Change piston**.
- Remove the upper front cover.



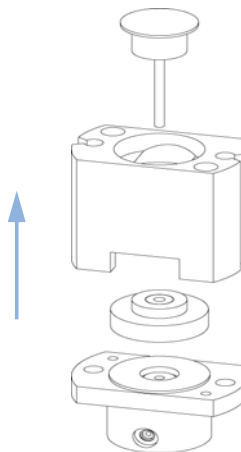
## 11 Maintenance

### Autosampler

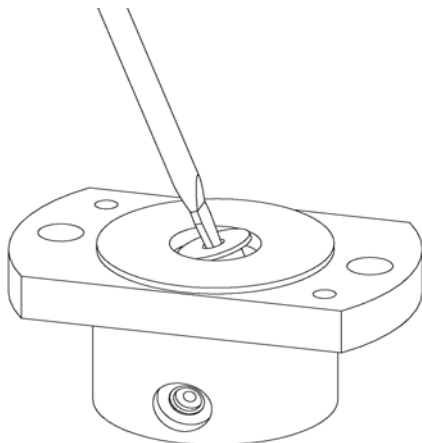
- 3** Remove the two fixing bolts from the base of the metering head assembly.



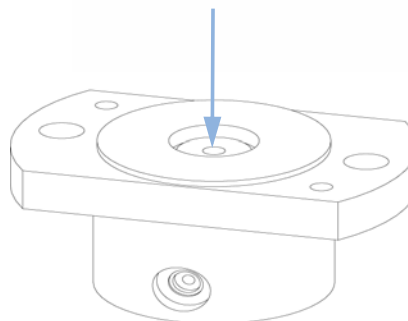
- 4** Disassemble the metering head assembly.



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

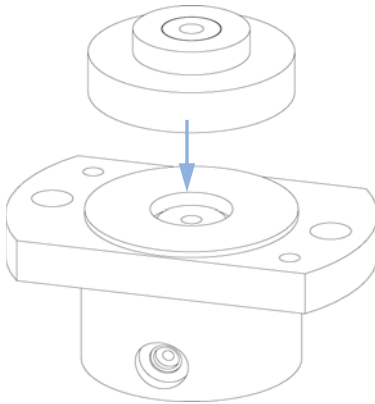


- 6** Install the new seal. Press the seal firmly into position.

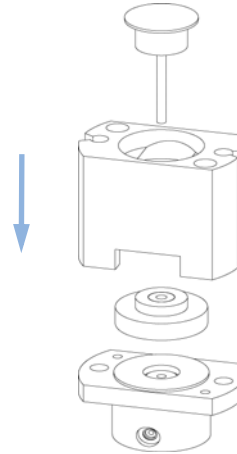




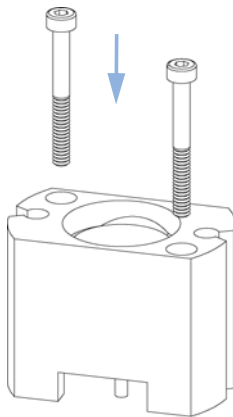
**7** Place the piston guide on top of the seal.



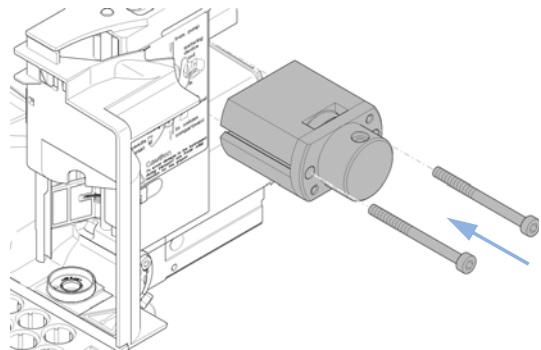
**8** Reassemble the metering head assembly. Carefully insert the plunger into the base. The closed side of the metering head must be on the same side as the lower one of the two capillary drillings.



**9** Install the fixing bolts. Tighten the bolts securely.



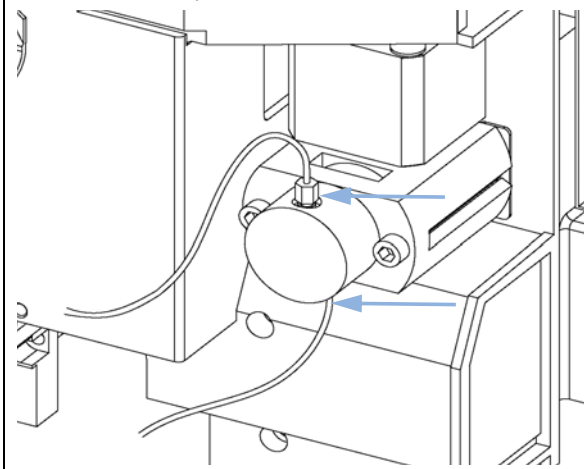
**10** Install the metering head assembly in the autosampler. Ensure the large hole in the metering head is facing downwards.



## 11 Maintenance

### Autosampler

**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

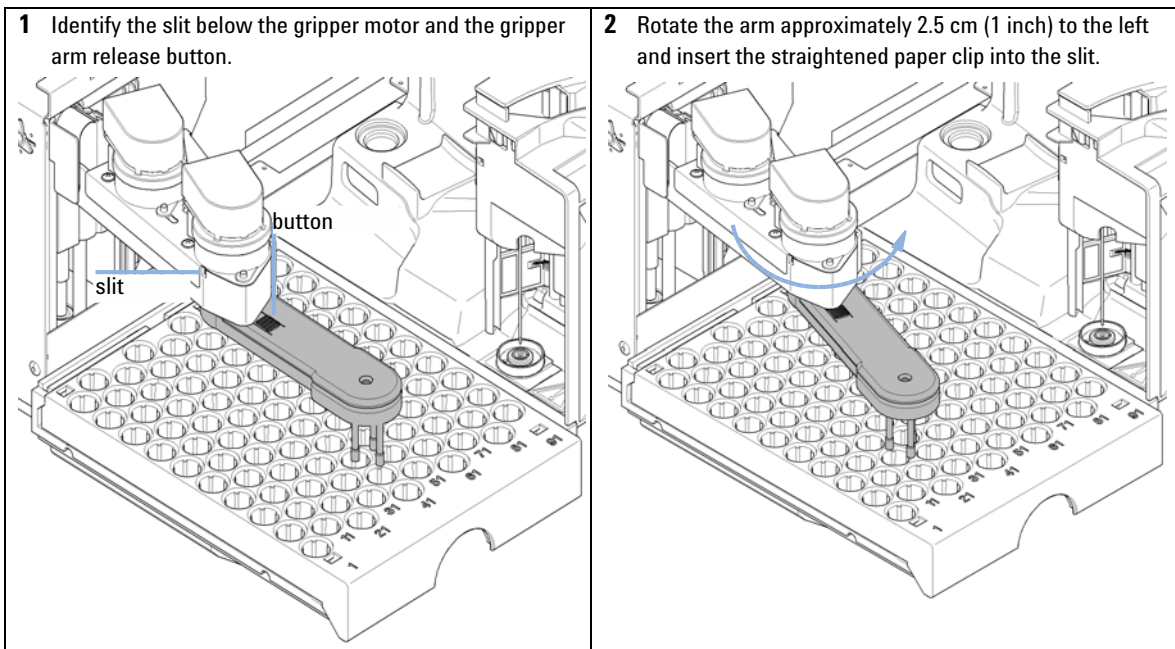
**When** Defective gripper arm

**Tools required** **Description**  
Straightened paper clip.

Parts required	#	p/n	Description
	1	G1313-60010	Gripper assembly

**Preparations**

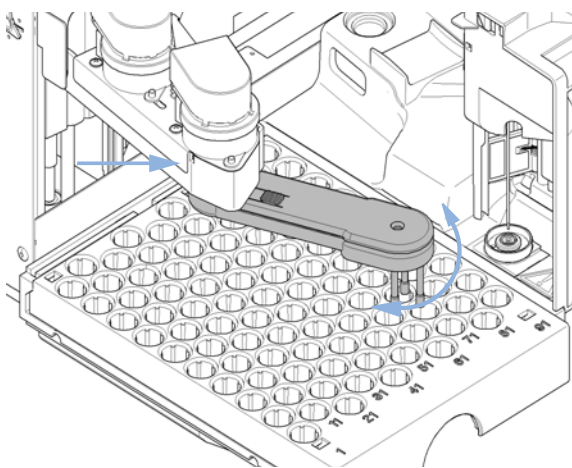
- Select **Start** in the **Tools** function in the LMD software **Change Gripper**.
- Turn off the power to the instrument.
- Remove the upper front cover.



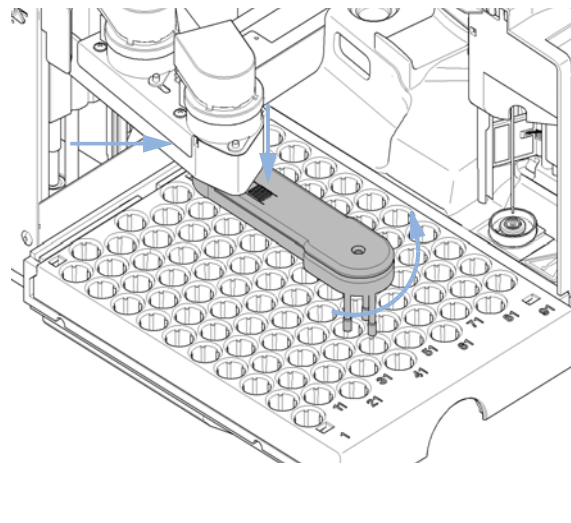
## 11 Maintenance

### Autosampler

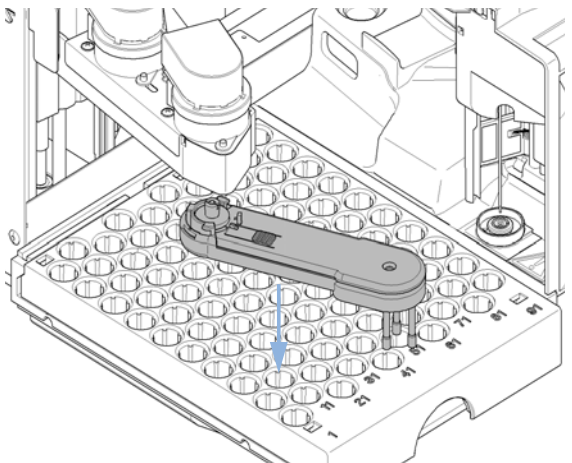
- 3** Rotate the gripper arm slowly from left to right and apply a gentle pressure to the paper clip. The clip will engage on an internal catch and the rotation of the arm will be blocked.



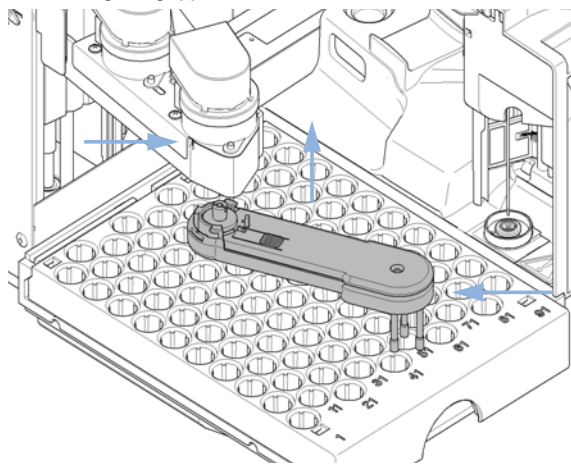
- 4** Hold the paper clip in place, press the gripper release button and rotate the gripper arm to the right.



- 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.

# Variable Wavelength Detector (VWD)

## Introduction

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

**Table 46** 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.

## 11 Maintenance

### Variable Wavelength Detector (VWD)

# Exchanging the Deuterium Lamp

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

**Tools required** **Description**  
Screwdriver, Pozidriv #1 PT3

<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	G1314-60100	Deuterium lamp

**Preparations** Turn the lamp OFF.

### WARNING

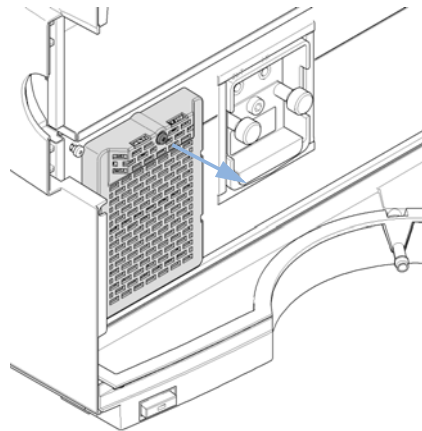
#### Injury by touching hot lamp

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

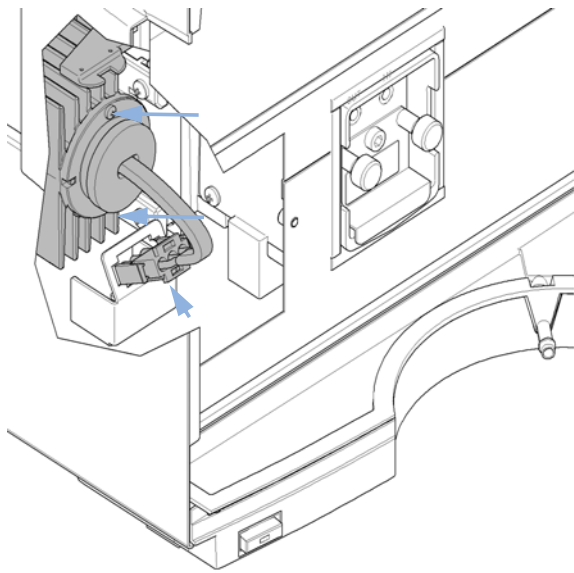
→ If so, wait for lamp to cool down.

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

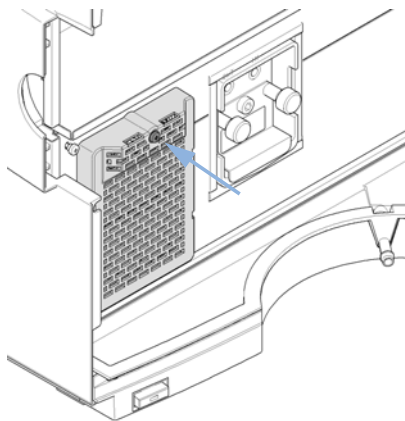
**2** Unscrew the heater assembly and remove it.



**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 min to warm-up.
- 9** Perform Wavelength Calibration to check the correct positioning of the lamp.

## 11 Maintenance

### Variable Wavelength Detector (VWD)

# Exchanging a Flow Cell

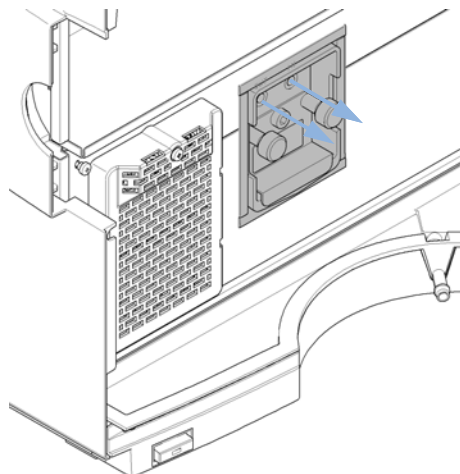
**When** If the application requires a different type of flow cell, or the flow cell needs maintenance.

**Tools required**      **Description**  
Wrench, 1/4 inch  
for capillary connections

**Preparations**      Turn the lamp OFF.

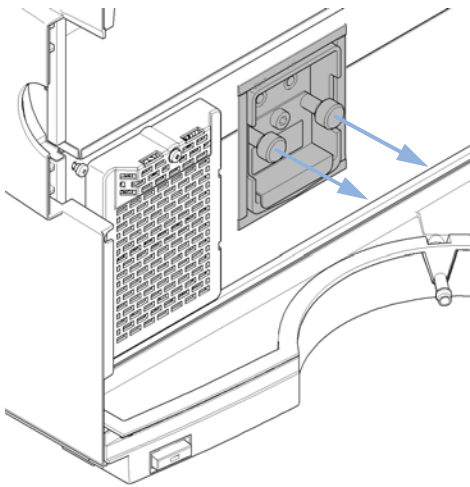
**1** Press the release buttons and remove the lower front cover to gain access to the flow cell area.

**2** Disconnect the inlet and outlet capillaries.

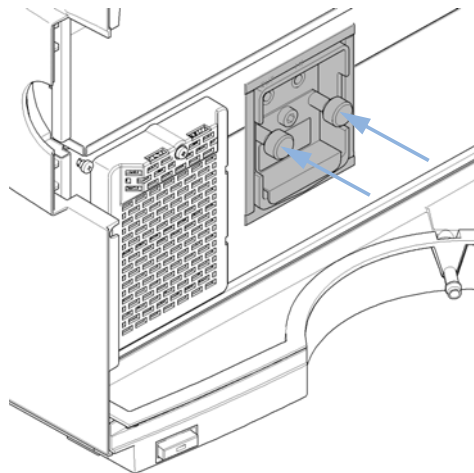




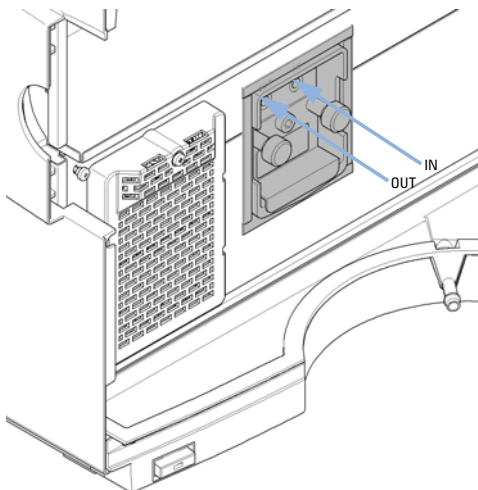
- 3** Unscrew the thumb screws in parallel and remove the flow cell.



- 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	p/n	Description
	G1314-60086	Standard flow cell, 10 mm, 14 $\mu$ L, 40 bar
	G1314-65061	Cell Repair Kit, includes 2x Gasket #1, 2x Gasket #2, 2x Window Quartz

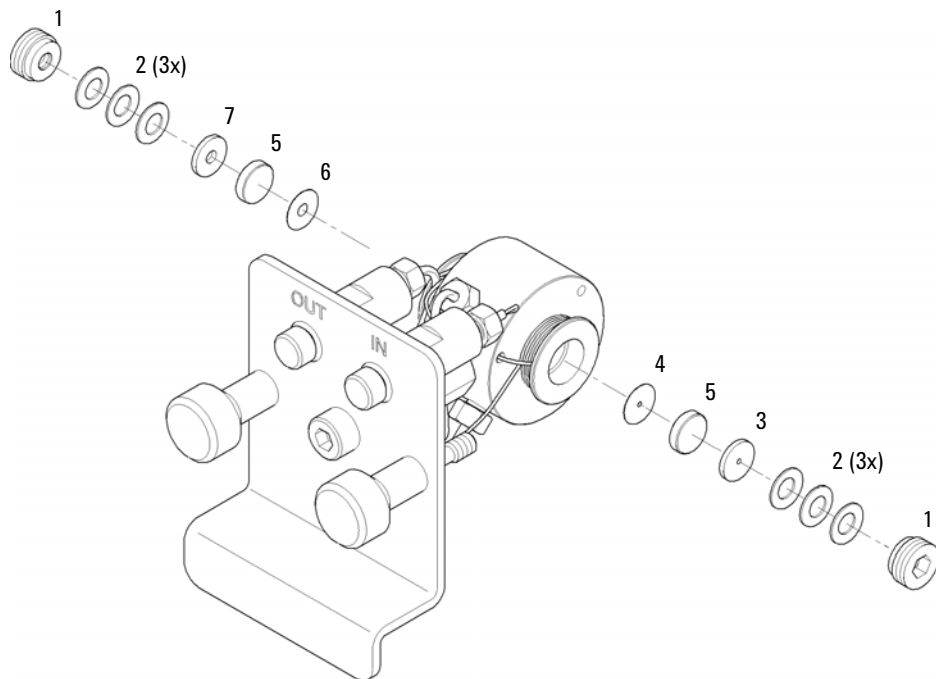
### CAUTION

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

- 1 Cell screw
- 2 Conical springs
- 3 Ring #2 IN
- 4 Gasket #2 IN
- 5 Quartz window
- 6 Gasket #1 OUT
- 7 Ring #1 OUT



**Figure 69** Standard Flow Cell 10 mm / 14  $\mu$ L

- 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.
  - c Use adhesive tape to remove the PEEK ring, the window and the gasket.
  - d Repeat step 1 on page 290 through step 3 on page 291 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 164).
- 11 Replace the lower front cover.

## 11 Maintenance

### Variable Wavelength Detector (VWD)

## 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.

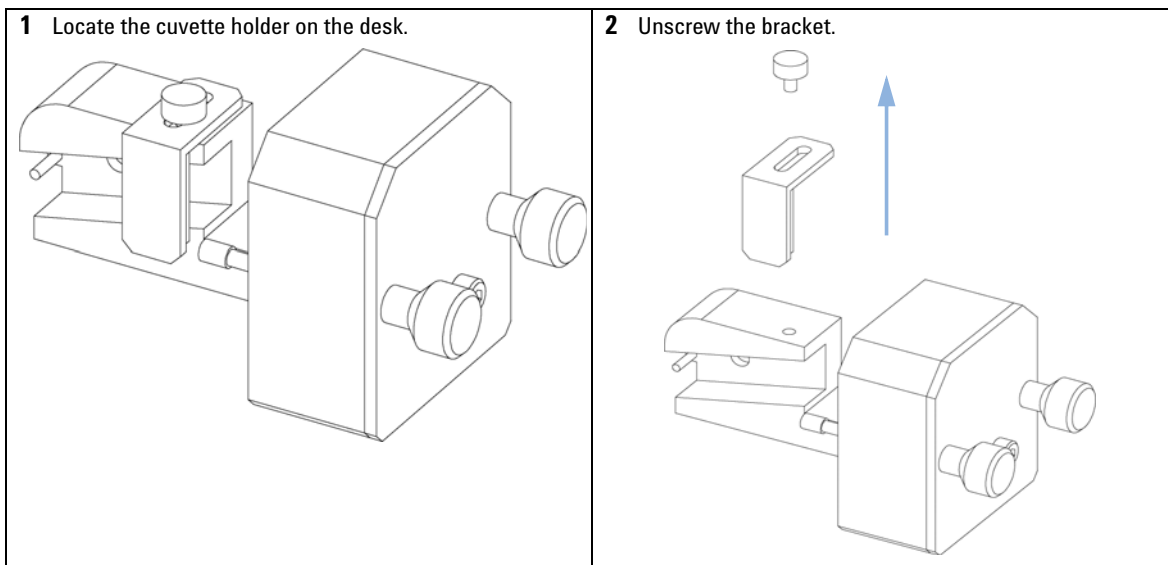
This can be used for wavelength verifications.

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

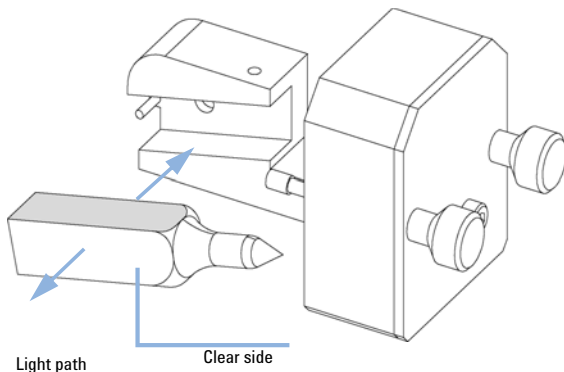
**Tools required** **Description**  
None

<b>Parts required</b>	<b>p/n</b>	<b>Description</b>
	G1314-60200	Cuvette Holder
		Cuvette with the "standard", e.g. NIST certified holmium oxide sample

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

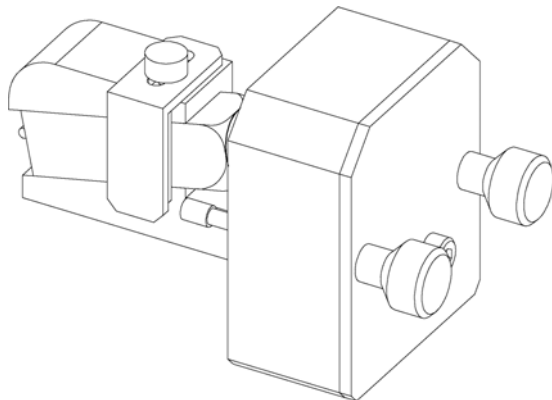


- 3** Insert the cuvette with the sample into the holder. The clear side of the cuvette must be visible.



- 4** Reset the lamp counter as described in the user interface documentation.
- 5** Turn the lamp ON.
- 6** Give the lamp more than 10 min 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.

## 11 Maintenance

### Variable Wavelength Detector (VWD)

## Correcting Leaks

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

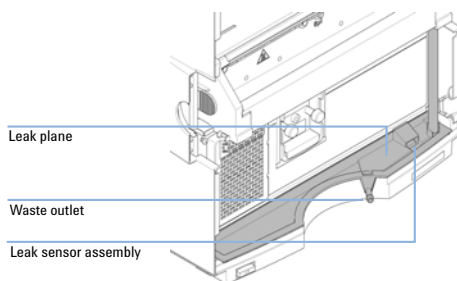
**Tools required**

Tools required	Description
	Tissue
	Wrench, 1/4 inch for capillary connections

**Parts required**

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.



# Diode Array Detector (DAD)

## Overview of Maintenance

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

**Table 47** Overview of Maintenance

Procedure	Typical Frequency	Notes
Cleaning of module	If required.	
Deuterium lamp or tungsten lamp exchange	If noise and/or drift exceeds your application limits or lamp does not ignite.	An intensity test should be performed after replacement.
Flow cell exchange	If application requires a different flow cell type.	A holmium or wavelength calibration test should be performed after replacement.
Flow cell parts Cleaning or exchange	If leaking or if intensity drops due to contaminated flow cell windows.	A pressure tightness test should be done after repair.
Holmium oxide filter Cleaning or exchange	If contaminated.	A holmium or wavelength calibration test should be performed after replacement.
Leak sensor drying	If leak has occurred.	Check for leaks.
Leak handling System replacement	If broken or corroded.	Check for leaks.

## 11 Maintenance

### Diode Array Detector (DAD)

## Cleaning the Module

The module case should be kept clean. Cleaning should be done with a soft cloth slightly dampened with water or a solution of water and mild detergent. Do not use an excessively damp cloth allowing liquid to drip into the module.

### **WARNING**

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

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



## Exchanging a Lamp

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

**Tools required** **Description**  
Screwdriver, Pozidriv #1 PT3

<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	2140-0820	Longlife Deuterium lamp "C" (with black cover and RFID tag)
OR	1	G1103-60001	Tungsten lamp

### WARNING

#### Eye damage by detector light



**Eye damage may result from directly viewing the light produced by the deuterium lamp used in this product.**

→ Always turn the deuterium lamp off before removing it.

### WARNING

#### Injury by touching hot lamp

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

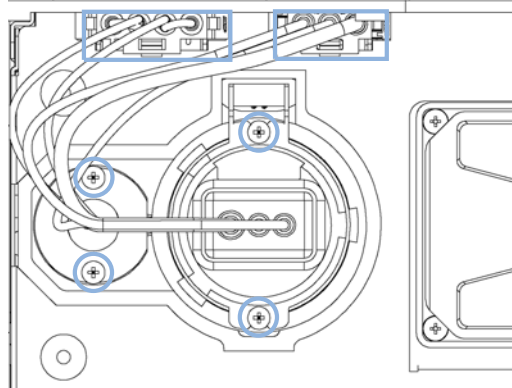
→ If so, wait for lamp to cool down.

## 11 Maintenance

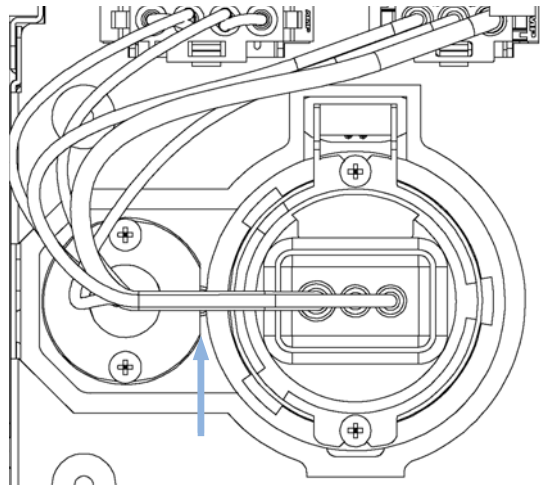
### Diode Array Detector (DAD)

**1** Open the front cover to gain access to the flow cell area.

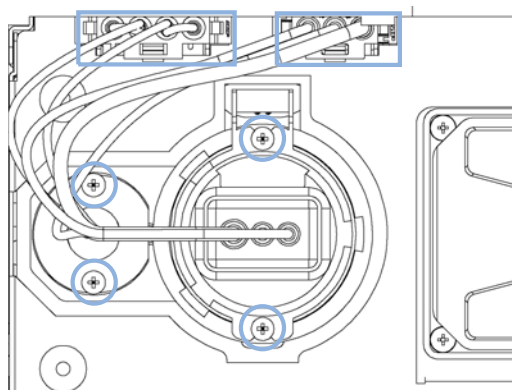
**2** Disconnect lamp from the connector, unscrew the Vis-lamp (left) and/or UV-lamp (right) and remove the lamp. Do not touch the glass bulb with your fingers.



**3** When replacing the Vis-lamp, assure that the Vis-lamp is inserted as shown (flat edge towards the deuterium lamp).



**4** Insert the lamp. Fix the screws and reconnect the lamp to connector.



**Next Steps:**

- 5** Close the front cover.
- 6** Reset the lamp counter as described in the user interface documentation (lamps with I.D. tag cannot be reset).
- 7** Turn the lamp on and give the lamp 10 minutes to warm up.
- 8** Perform a “[Wavelength Verification and Recalibration](#)” on page 185 or a “[Holmium Oxide Test](#)” on page 177 to check the correct positioning of the UV-lamp.
- 9** Perform an “[Intensity Test](#)” on page 174.

## 11 Maintenance

### Diode Array Detector (DAD)

# Exchanging a Flow Cell

**When** If an application needs a different type of flow cell or the flow cell needs repair.

**Tools required** **Description**  
Wrench, 1/4 inch  
for capillary connections

<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	G1315-60022	Standard flow cell, 10 mm, 13 $\mu$ L, 120 bar (12 MPa)
OR	1	G1315-60025	Semi-micro flow cell, 6 mm, 5 $\mu$ L, 120 bar (12 MPa)
OR	1	G1315-60024	Micro flow cell, 3 mm, 2 $\mu$ L, 120 bar (12 MPa)
OR	1	G1315-60015	High pressure flow cell, 6 mm, 1.7 $\mu$ L, 400 bar (40 MPa)
OR	1	G1315-68716	Nano flow cell kit, 6 mm, 80 nL, 5 MPa

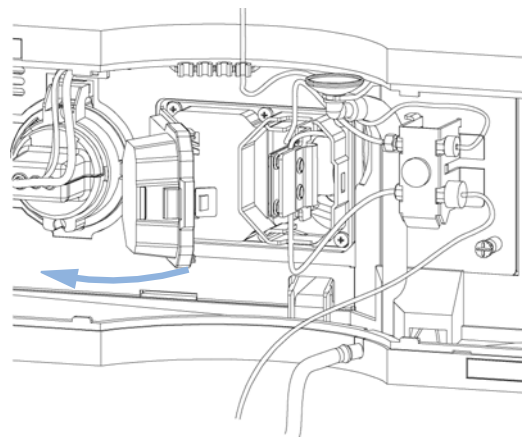
**Preparations** Turn the lamp(s) off.  
Remove the front cover.

**1** Open the front cover to gain access to the flow cell area.

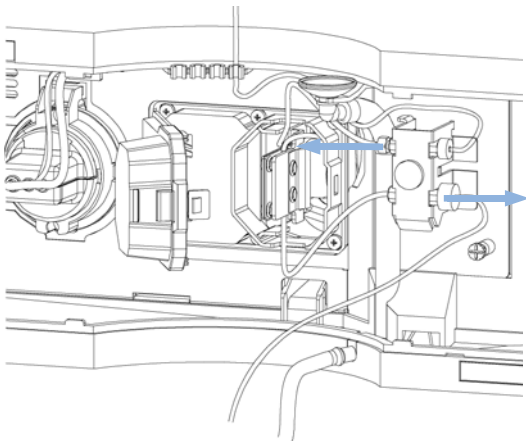
**2** Open the flow cell cover.

### NOTE

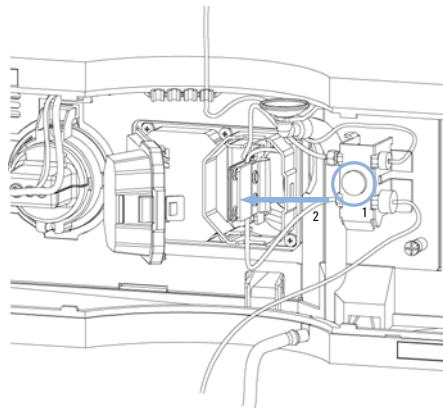
Depending on the system setup, the inlet capillary might be routed directly from the module above or below to the cell and not to the capillary holder.



**3** Disconnect the flow cell inlet capillary (top) and the waste tubing (bottom) from the unions.



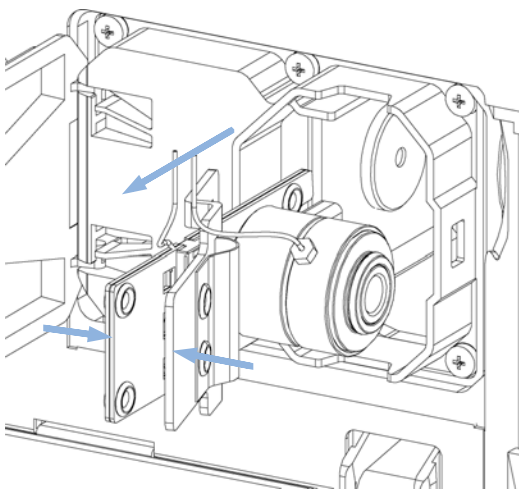
**4** Loosen the thumb screw (1) and remove the flow cell outlet capillary (bottom) with the union (2).



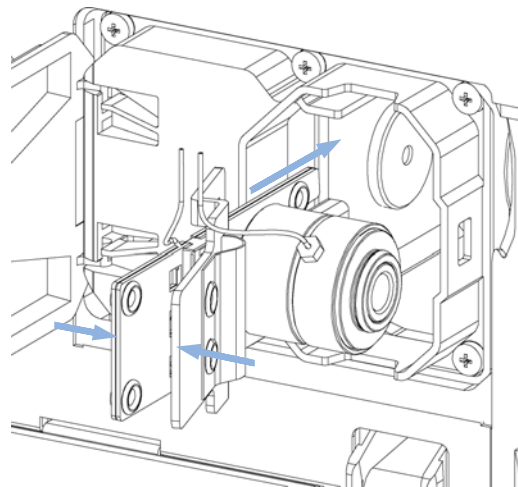
**5** Remove the flow cell while pressing the flow cell holder.

**NOTE**

The label attached to the flow cell provides information on part number, path length, volume and maximum pressure.



**6** Insert the flow cell while pressing the flow cell holder.



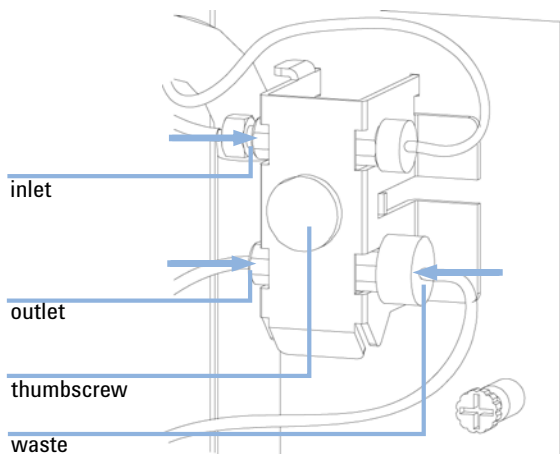
## 11 Maintenance

### Diode Array Detector (DAD)

- 7 Insert the flow cell capillaries into the union holder (top is inlet, bottom is outlet). Tighten the thumb screw and reconnect the waste tubing (bottom) to the union.

#### NOTE

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



#### Next Steps:

- 8 Perform a “[Wavelength Verification and Recalibration](#)” on page 185 or a “[Holmium Oxide Test](#)” on page 177 to check the correct positioning of the flow cell.
- 9 Close the front cover.

## Maintenance of the Flow Cell

**When** If the flow cell needs repair due to leaks or contaminations (reduced light throughput)

**Tools required**

**Description**  
Wrench, 1/4 inch  
for capillary connections  
Hexagonal key, 4 mm  
Toothpick

**Parts required**

**Description**  
For parts, see [“Standard Flow Cell”](#) on page 344.

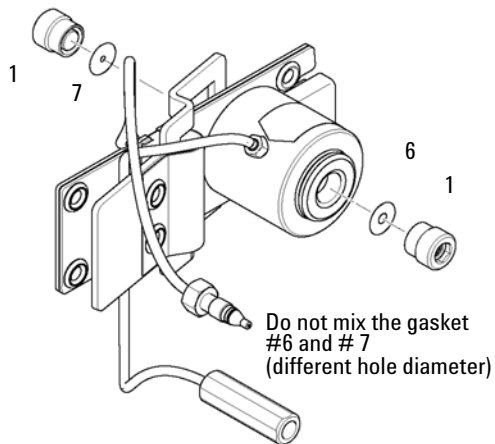
**Preparations**

Turn the flow off.  
Remove the front cover.  
Remove the flow cell, see [“Exchanging a Flow Cell”](#) on page 300.

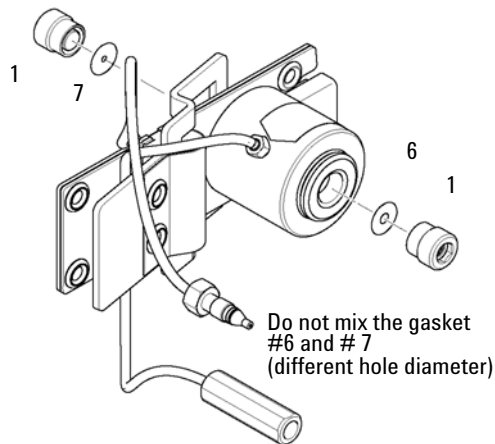
## 11 Maintenance

### Diode Array Detector (DAD)

- 1** Use a 4 mm hex key to unscrew the window assembly [1] and remove the gasket [2] from the cell body.



- 2** Insert the window assembly [1] into the cell body.



#### NOTE

Carefully take one of the gaskets (#6 back or #7 front) and insert it into the cell body.

Do not mix the gasket #6 and #7.

Gasket #7 has the smaller hole and must be on the light entrance side.

Verify that the gasket is positioned flat on the bottom and the light path is not blocked.

If you removed all individual parts from the window assembly refer to the figures in "[Standard Flow Cell](#)" on page 344 for the correct orientation of the parts.



**Next Steps:**

- 3** Using a 4-mm hex key, tighten the window screw hand tight plus a quarter turn.
- 4** Reconnect the capillaries, see [“Exchanging a Flow Cell”](#) on page 300.
- 5** Perform a leak test.
- 6** Insert the flow cell.
- 7** Replace the front cover
- 8** Perform a [“Wavelength Verification and Recalibration”](#) on page 185 or a [“Holmium Oxide Test”](#) on page 177 to check the correct positioning of the flow cell.

## Replacing Capillaries on a Standard Flow Cell

<b>When</b>	If the capillary is blocked
<b>Tools required</b>	<b>Description</b> Wrench, 1/4 inch for capillary connections Wrench, 4 mm (for capillary connections) Screwdriver, Pozidriv #1 PT3
<b>Parts required</b>	<b>Description</b> For parts see <a href="#">“Standard Flow Cell”</a> on page 344.
<b>Preparations</b>	Turn the lamp(s) off. Remove the front cover. Remove the flow cell, see <a href="#">“Exchanging a Flow Cell”</a> on page 300.

### NOTE

All descriptions in this procedure are based on the default orientation of the cell (as it is manufactured). The heat exchanger/capillary and the cell body can be fixed mirror symmetrically to have both capillaries routed to the bottom or to the top (depending on the routing of the capillaries to the column).

---

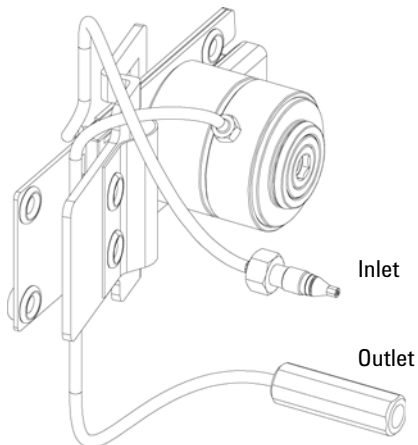
### NOTE

The fittings at the flow cell body are special types for low dead volumes and not compatible with other fittings.

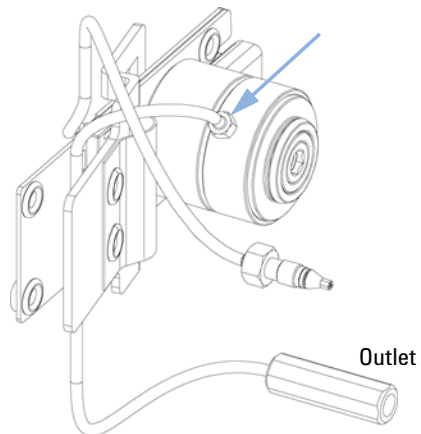
When retightening the fittings, make sure that they are carefully tightened (handtight plus 1/4 turn with a wrench). Otherwise damage of the flow cell body or blockage may result.

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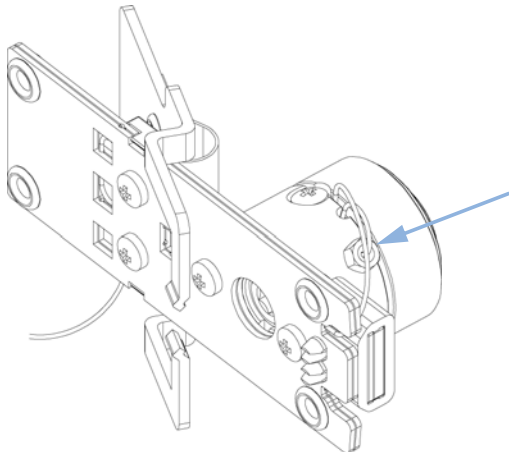
**1** Identify the inlet and outlet capillaries. To replace the inlet capillary, continue with step "To replace the inlet capillary, use a 4-mm wrench for the fitting."



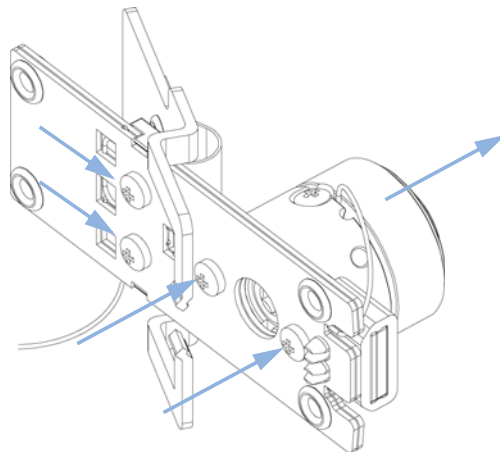
**2** After replacing the outlet capillary, fix it handtight first. Then do a 1/4 turn with a 4-mm wrench.



**3** To replace the inlet capillary, use a 4-mm wrench for the fitting.



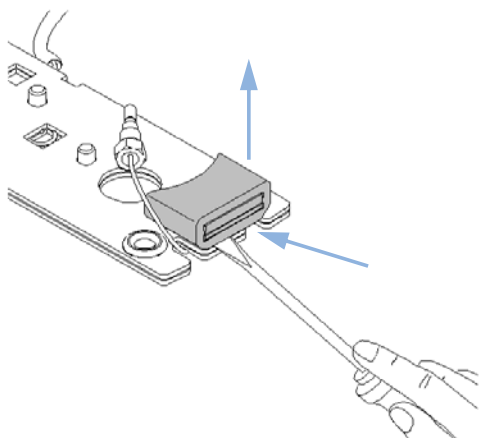
**4** Unscrew the cell body from the heat exchanger and the heat exchanger from the clamp unit.



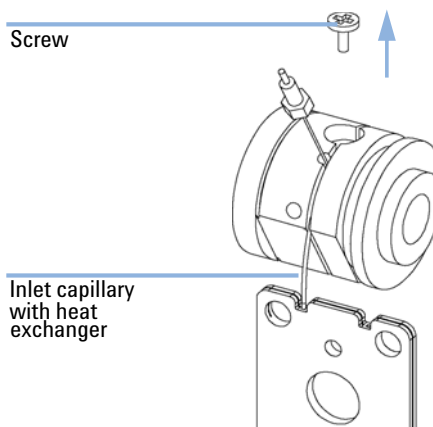
## 11 Maintenance

### Diode Array Detector (DAD)

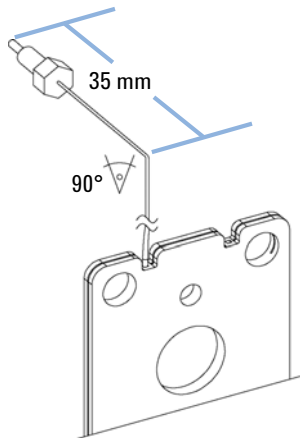
- 5** Use a small flat screw driver to carefully lift off the I.D. tag. Shown is the default orientation. See Note at the beginning of this section.



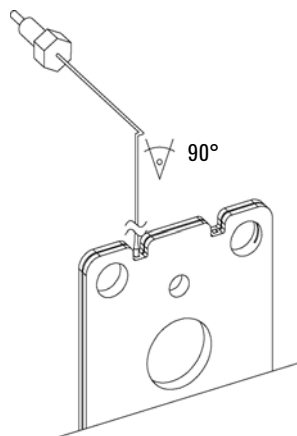
- 6** Unscrew the fixing screw and unwrap the inlet capillary from the groove in the flow cell body.



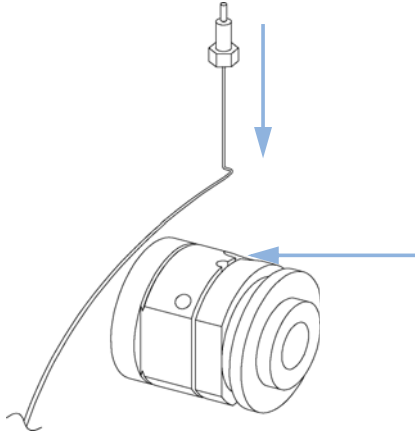
- 7** Take the new inlet capillary and bend it 90° about 35 mm from its end.



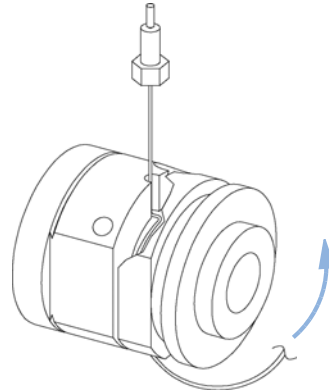
- 8** Bend the capillary again by 90° as shown below.



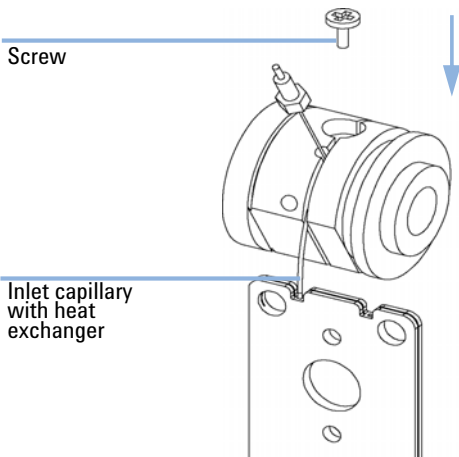
**9** Insert the capillary into the hole between fixing screw and the inlet fitting.



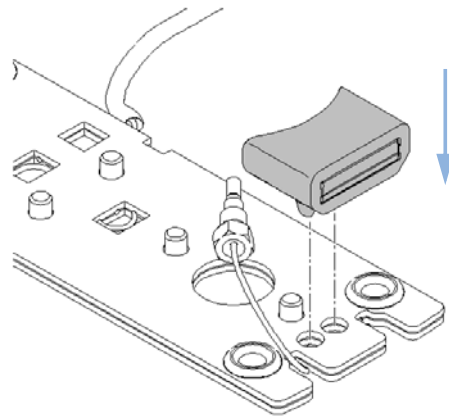
**10** The capillary lays in the groove and should be tied around the body (in the groove) 5 times.



**11** Insert the fixing screw, so that the capillary cannot leave the groove.



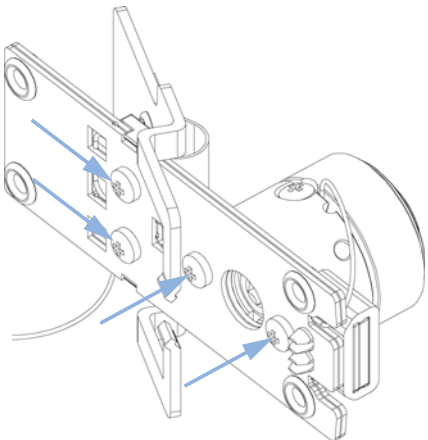
**12** Carefully insert the I.D. tag into the new heat exchanger. Shown is the default orientation. See Note at the beginning of this section.



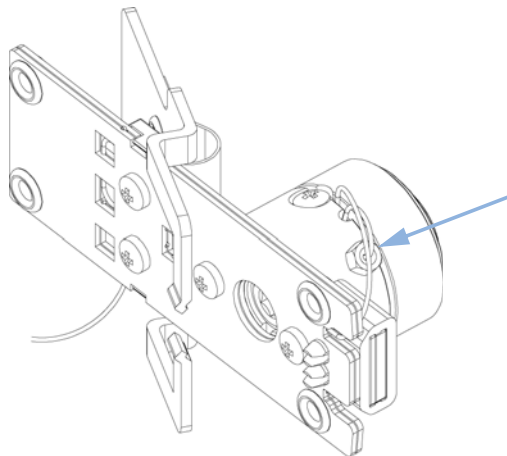
## 11 Maintenance

### Diode Array Detector (DAD)

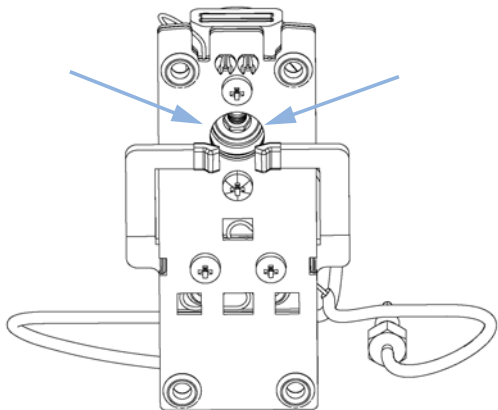
**13** Fix the heat exchanger to the clamp unit and the flow cell body to the heat exchanger.



**14** Fix the inlet capillary to the flow cell body handtight first. Then do a 1/4 turn with a 4-mm wrench.



**15** Check for a centered holder vs. hole. If required adjust with the holder screws.



#### Next Steps:

**16** Reconnect the capillaries, see [“Exchanging a Flow Cell”](#) on page 300.

**17** Perform a leak test.

**18** Insert the flow cell.

**19** Replace the front cover.

**20** Perform a [“Wavelength Verification and Recalibration”](#) on page 185 or a [“Holmium Oxide Test”](#) on page 177 to check the correct positioning of the flow cell.

## Cleaning or Exchanging the Holmium Oxide Filter

**When** If holmium oxide filter is contaminated

**Tools required**

**Description**

Screwdriver, Pozidriv #1 PT3

Screwdriver, flat blade

Wrench, 1/4 inch  
for capillary connections

Pair of tweezers

<b>Parts required</b>	<b>#</b>	<b>p/n</b>	<b>Description</b>
	1	79880-22711	Holmium oxide filter

**Preparations**

Turn the lamp(s) off.

Remove the front cover.

Remove the flow cell, see [“Exchanging a Flow Cell”](#) on page 300.

### NOTE

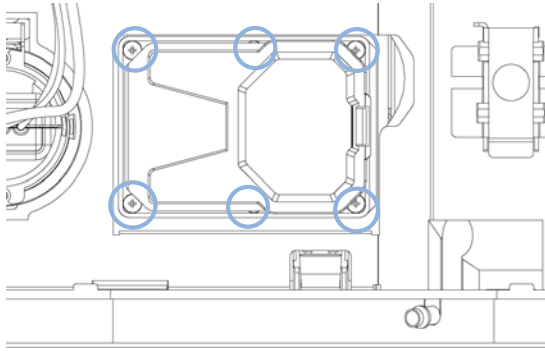
See also [“Declaration of Conformity for HOX2 Filter”](#) on page 371.

The glass tends to build a film on its surface even under normal environmental conditions. This is a phenomenon, which can be found also on the surface of several other glasses and has something to do with the composition of the glass. There is no indication, that the film has an influence on the measurement. Even in the case of a thick film, which scatters the light remarkably, no shift of the peak positions is to be expected. A slight change in the absorbance might be possible. Other components within the light path (lenses, windows, ...) are also changing their behavior over the time.

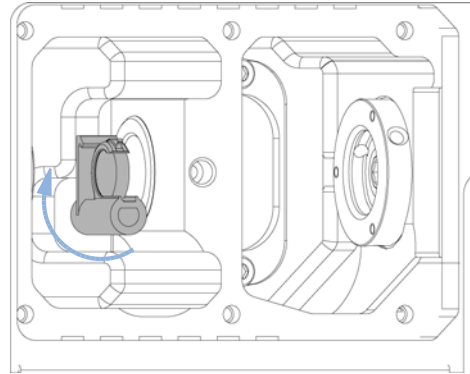
## 11 Maintenance

### Diode Array Detector (DAD)

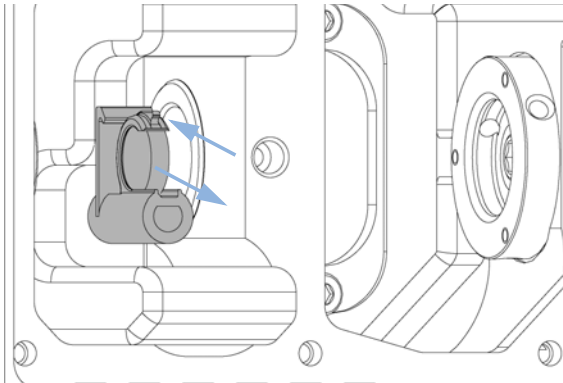
**1** Unscrew the six screws and remove the flow cell cover.



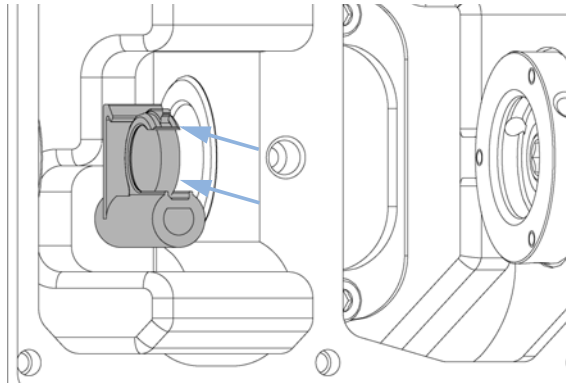
**2** If not already in this position, move the filter up.



**3** While releasing the holder with a screw driver (at the top), carefully remove the holmium oxide filter.



**4** While releasing the holder with a screw driver, carefully insert the holmium oxide filter.



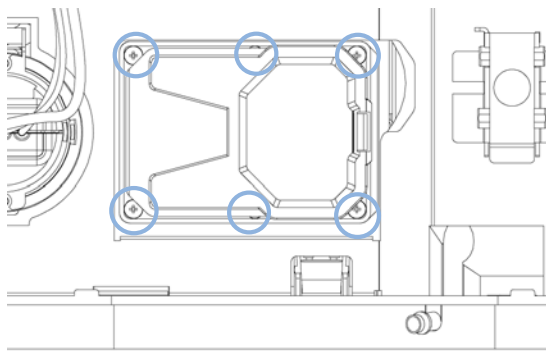
#### NOTE

Do not scratch the holmium oxide filter.

The holmium oxide filter can be cleaned with alcohol and a lint-free cloth.



**5** Replace the flow cell cover and fix the six screws.



**Next Steps:**

- 6** Perform a holmium oxide test, see “[Holmium Oxide Test](#)” on page 177 to check the proper function of the holmium oxide filter.
- 7** Insert the flow cell, see “[Exchanging a Flow Cell](#)” on page 300.
- 8** Replace the front cover.
- 9** Turn on the flow.

## 11 Maintenance

### Diode Array Detector (DAD)

## Correcting Leaks

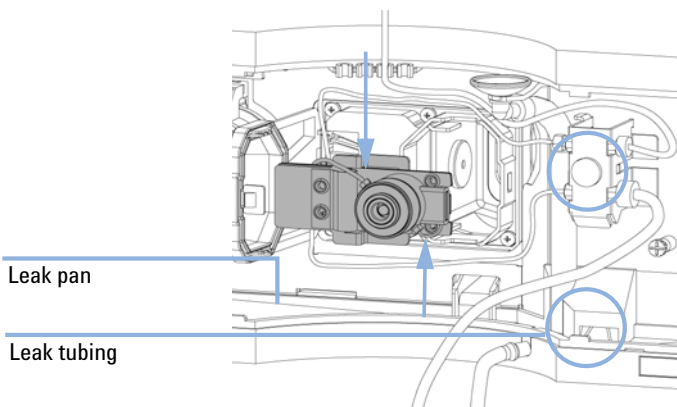
**When** If a leakage has occurred in the flow cell area or at the heat exchanger or at the capillary connections

**Tools required**

Description
Tissue
Wrench, 1/4 inch for capillary connections

**Preparations** Remove the front cover.

- 1 Use tissue to dry the leak sensor area and the leak pan.
- 2 Observe the capillary connections and the flow cell area for leaks and correct, if required.



**Figure 70** Observing for Leaks

- 3 Replace the front cover.

## Replacing Leak Handling System Parts

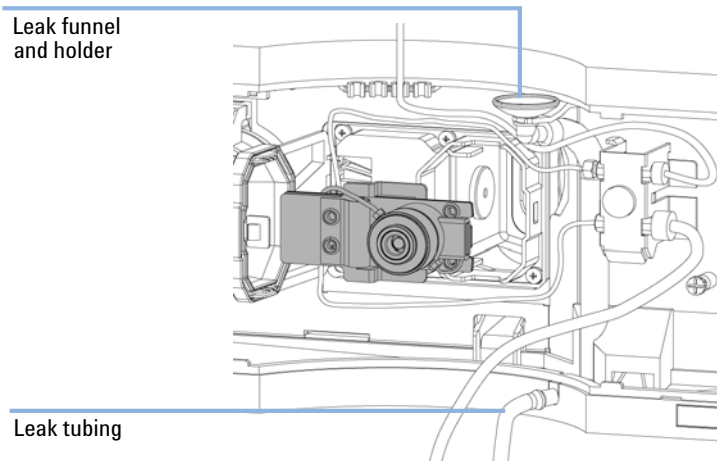
**When** If the parts are corroded or broken

**Tools required** None

Parts required	#	p/n	Description
	1	5041-8388	Leak funnel
	1	5041-8389	Leak funnel holder
	1	5062-2463	Corrugated tubing, PP, 6.5 mm id, 5 m

**Preparations** Remove the front cover.

- 1 Pull the leak funnel out of the leak funnel holder.
- 2 Pull out the leak funnel with the tubing.
- 3 Insert the leak funnel with the tubing in its position.
- 4 Insert the leak funnel into the leak funnel holder.



**Figure 71** Replacing Leak Handling System Parts

- 5 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 (pack of 5) (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  $\mu\text{m}$  filters.
- Never leave mobile phase in the instrument for several days without flow.
- Always discard old mobile phase.
- Use the Solvent bottle, amber (9301-1450) supplied with the instrument for your aqueous mobile phase.
- If possible, add a few mg/l sodium azide or a few percent organic solvent to the aqueous mobile phase.

# Replacing the Module's Firmware

<b>When</b>	<p>The installation of newer firmware might be necessary</p> <ul style="list-style-type: none"><li>• if a newer version solves problems of older versions or</li><li>• to keep all systems on the same (validated) revision.</li></ul> <p>The installation of older firmware might be necessary</p> <ul style="list-style-type: none"><li>• to keep all systems on the same (validated) revision or</li><li>• if a new module with newer firmware is added to a system or</li><li>• if third party control software requires a special version.</li></ul>
-------------	---

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

<b>Parts required</b>	<b>#</b>	<b>Description</b>
	1	Firmware, tools and documentation from Agilent web site

**Preparations** Read update documentation provided with the Firmware Update Tool.

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

- 1 Download the required module firmware, the latest LAN/RS-232 FW Update Tool and the documentation from the Agilent web.
  - [http://www.chem.agilent.com/\\_layouts/agilent/downloadFirmware.aspx?whid=69761](http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?whid=69761)
- 2 For loading the firmware into the module follow the instructions in the documentation.

#### *Module Specific Information*

There is no specific information for this module.



## 12 Parts for Maintenance

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Diode Array Detector (DAD)	344

This chapter provides information on parts for maintenance.



## 1220 Infinity LC System

### System Parts

System part numbers

<b>p/n</b>	<b>Description</b>
0950-4997	Power supply
G4280-65050	Agilent 1220 Infinity LC main board
G4280-68723	Cabinet kit
G4280-60102	Front door, top
G4280-60001	Front door, bottom
G4280-65001	Power switch board
G4280-65802	FSL board (Status LED board)
5067-5378	Connecting tube, DCGV to PIV
G4280-68708	SSV
G4280-80004	Fan
8121-1833	Power Switch Cable
G4280-81602	Cable, status LED
G4280-81620	Temp Sensor Cable
G4280-40007	Light pipe, status
G4280-40016	Power Switch Coupler ZL
G4280-44013	Leak plane, man. inj.
G4280-44500	Leak panel, bottom
G4280-44501	Leak plane, pump
G4280-44502	Leak plane, ALS
G4280-44016	Holder, temp. sensor
5061-3356	Leak sensor



## Fuses

5 mainboard fuses

p/n	Description
2110-1417	Fuse 3.15 A250 V

### NOTE

Next to each fuse is an LED. Red LED indicates the fuse is blown. If one of the fuses is blown, the green LED of the power switch flashes.

- Fuse F1 (degasser, pump, injector motors)
- Fuse F2 (injector sensors, column oven, ext. 24 V connector)
- Fuse F3 (processor core, +5 V, +15 V, -15 V supply on mainboard)
- Fuse F4 (VWD incl. D2-lamp)
- Fuse F5 (VWD heater, fan)

1 fuse netfilter

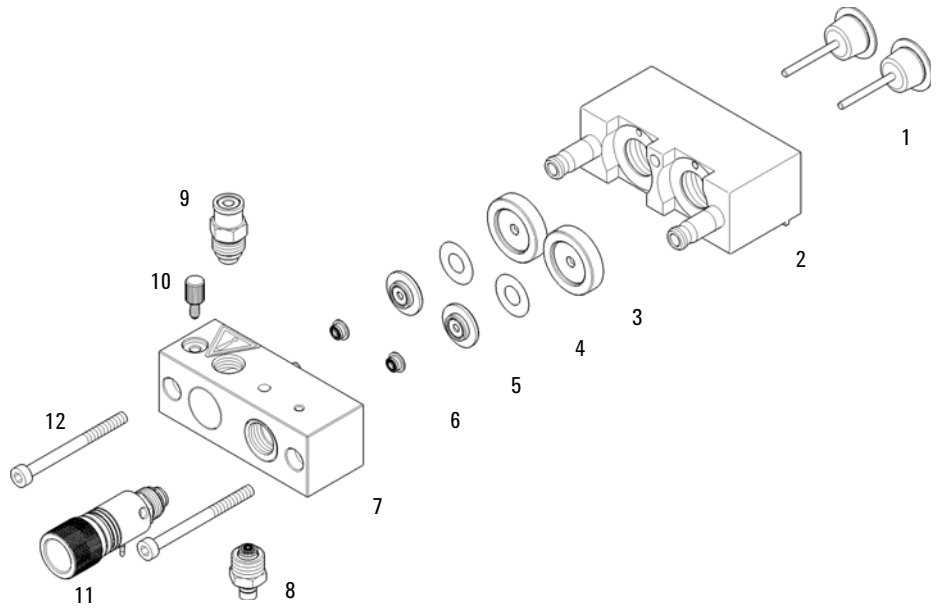
p/n	Description
2110-1004	Fuse 10 A t

## Solvent Delivery System

### Pump Head Assembly Without Seal Wash

<b>Item</b>	<b>p/n</b>	<b>Description</b>
	G1312-60056	Pump Head 1200 SL without Seal Wash
1	5063-6586	Sapphire piston
2	G1311-60002	Piston housing
3	5067-1560	Support Ring SL, no seal wash
4	5062-2484	Gasket, seal wash (pack of 6)
5	5042-8952	Seal holder
6	5063-6589	Piston seal PTFE, carbon filled, black (pack of 2), default
OR	0905-1420	PE seals (pack of 2)
7	G1311-25200	Pump chamber housing
8	G1312-60066	Passive inlet valve 1220/1260
9	G1312-60067	Outlet valve 1220/1260
10	5042-1303	Lock screw
11	G4280-60061	Purge valve
12	0515-2118	Pump head screw (M5, 60 mm)

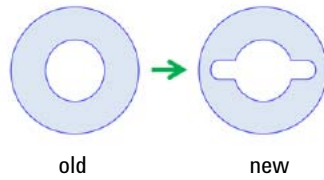
The Pump Head 1200 SL without Seal Wash (G1312-60056) includes items 1-7, 10 and 12.



**Figure 72** Pump head assembly without seal wash option

**NOTE**

The design of the seal wash gasket has changed, see below.



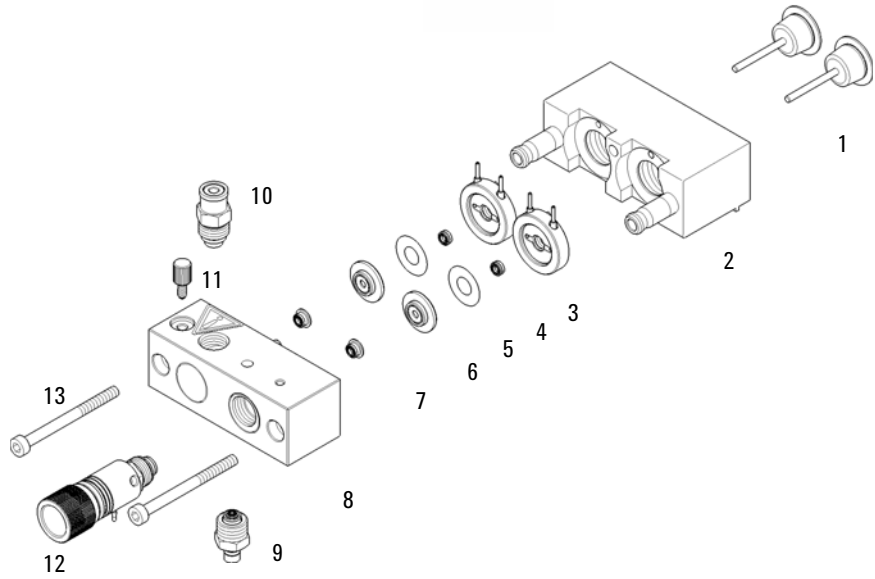
## Pump Head Assembly With Seal Wash Option

Item	p/n	Description
	G1312-60045	Pump head assembly with seal wash
1	5063-6586	Sapphire piston
2	G1311-60002	Piston housing
3	01018-60027	Support ring seal wash
4	0905-1175	Wash seal (PTFE)
OR	0905-1718	Wash Seal PE
	5065-9978	Tubing, 1 mm i.d., 3 mm o.d., silicone, 5 m
5	5062-2484	Gasket, seal wash (pack of 6)
6	5042-8952	Seal holder
7	5063-6589	Piston seal PTFE, carbon filled, black (pack of 2), default
	0905-1420	PE seals (pack of 2)
8	G1311-25200	Pump chamber housing
9	G1312-60066	Passive inlet valve 1220/1260
10	G1312-60067	Outlet valve 1220/1260
11	5042-1303	Lock screw
12	G4280-60061	Purge valve
13	0515-2118	Pump head screw (M5, 60 mm)
	01018-23702	Insert tool

The Pump head assembly with seal wash (G1312-60045) includes items 1-8, 11 and 13.

### NOTE

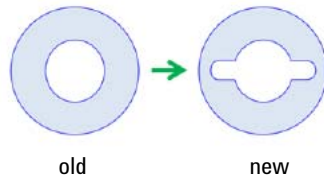
Active seal wash is not supported for the 1220 Infinity LC, only continuous seal wash.



**Figure 73** Pump Head with Seal Wash Option

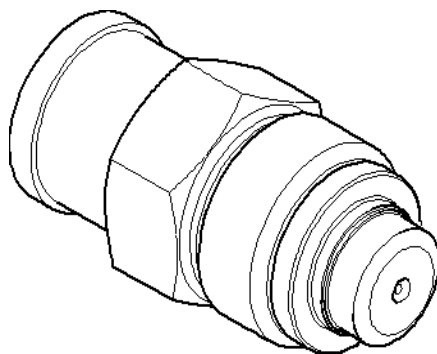
**NOTE**

The design of the seal wash gasket has changed, see below.



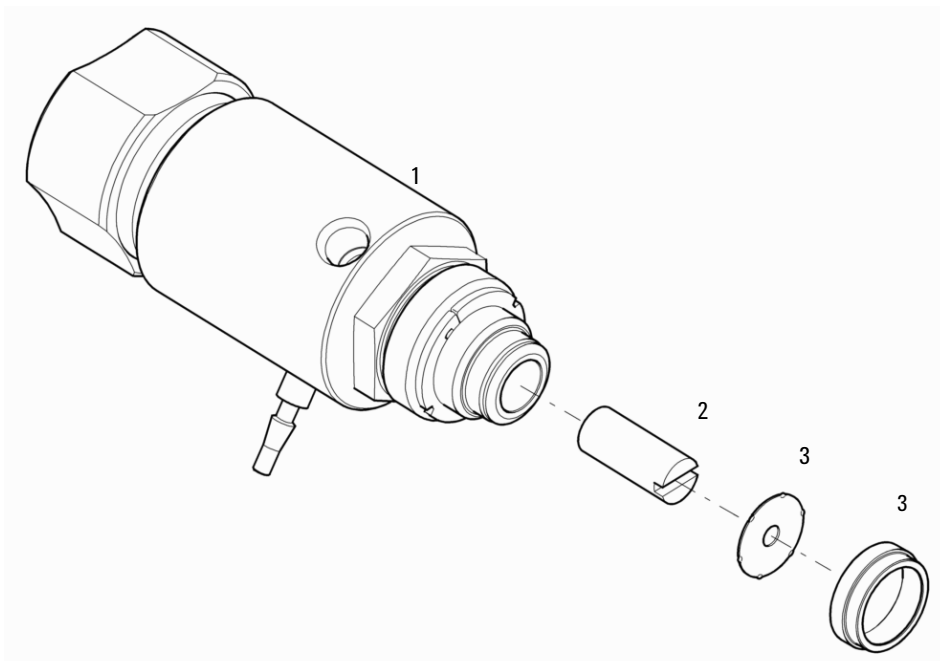
## Outlet Ball Valve Assembly

p/n	Description
G1312-60067	Outlet valve 1220/1260



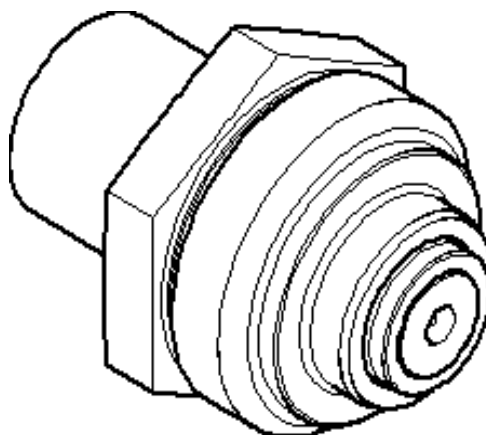
## Purge Valve Assembly

Item	p/n	Description
	G4280-60061	Purge valve
1		Valve body
2	01018-22707	PTFE frits (pack of 5)
3	5067-4728	Seal Cap Assembly



## Passive Inlet Valve Assembly

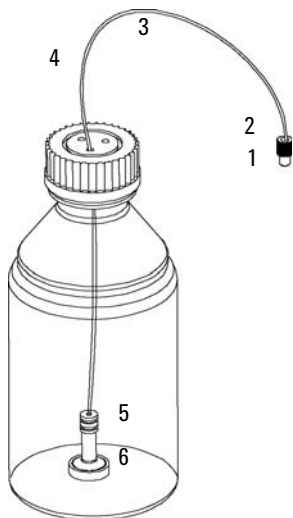
p/n	Description
G1312-60066	Passive inlet valve 1220/1260





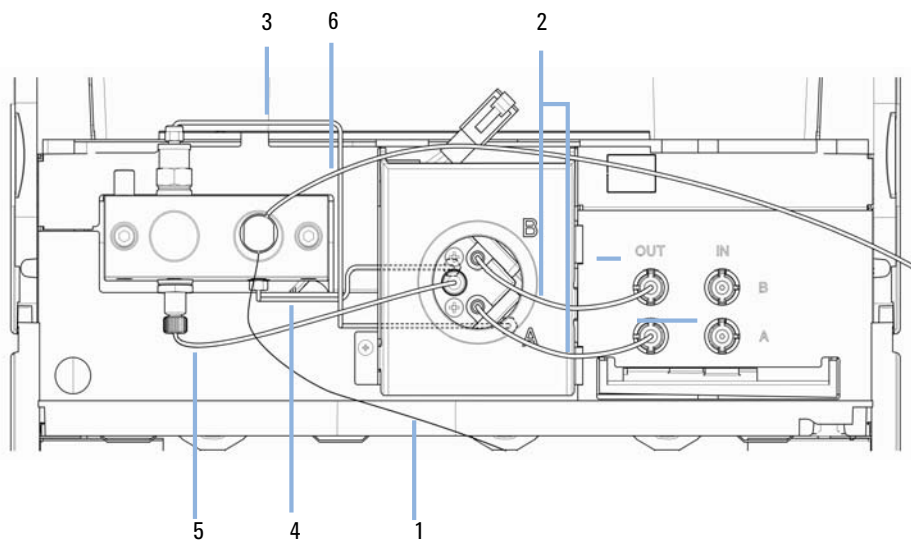
## Bottle Head Assembly

Item	p/n	Description
	G1311-60003	Bottle-head assembly
1	5063-6598	Ferrules with lock ring (10/Pk)
2	5063-6599	Tube screw (10/Pk)
3		Wire marker
4	5062-2483	Tube PTFE 1.5 mm x 5 m, 3 mm od
5	5062-8517	Frit adapter (pack of 4)
6	5041-2168	Solvent inlet filter, 20 µm pore size



## Hydraulic Path

Item	p/n	Description
1	G1312-67305	Outlet capillary, pump to injector
	G1311-60003	Bottle head assembly, bottle to passive inlet valve or vacuum degasser
2	G4280-60034	Solvent tube, vacuum degasser to DCGV
3	G4280-81300	Capillary, plunger 1 to damper
4	G4280-81301	Capillary, damper to plunger 2
5	5067-5378	Connecting tube, DCGV to PIV
6	5062-2461	Waste tube, 5 m (reorder pack)
	G1311-60065	Damper Isocratic/Quaternary Pump 600 bar
	G1311-60001	Pump drive
	G4280-60004	Dual-channel gradient valve
	3160-1017	Fan

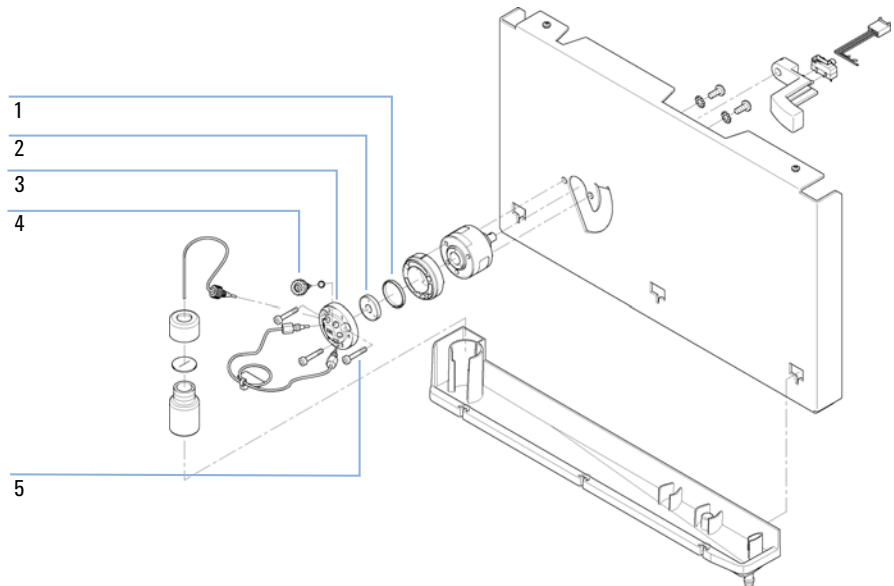


# Injection System

## Manual Injector

### Injection Valve Assembly

Item	p/n	Description
	5067-4202	Manual injection valve 600 bar, complete including loop and needle port
	1535-4045	Isolation seal
2	5068-0082	Rotor seal, PEEK
3	0101-1417	Stator head
4	5067-1581	Needle port
5	5068-0018	Stator screws
	8710-0060	Hex-key wrench, 9/64 inch



### Sample Loops

Sample loops stainless steel

<b>p/n</b>	<b>Description</b>
0101-1248	Sample loop 5 $\mu$ L
0100-1923	Sample loop 10 $\mu$ L
0100-1922	Sample loop 20 $\mu$ L
0100-1924	Sample loop 50 $\mu$ L
0100-1921	Sample loop 100 $\mu$ L
0101-1247	Sample loop 200 $\mu$ L
0101-1246	Sample loop 500 $\mu$ L
0101-1245	Sample loop 1 mL
0101-1244	Sample loop 2 mL

Sample loops PEEK

<b>p/n</b>	<b>Description</b>
0101-1241	Sample loop 5 $\mu$ L
0101-1240	Sample loop 10 $\mu$ L
0101-1239	Sample loop 20 $\mu$ L
0101-1238	Sample loop 50 $\mu$ L
0101-1242	Sample loop 100 $\mu$ L
0101-1227	Sample loop 200 $\mu$ L
0101-1236	Sample loop 500 $\mu$ L
0101-1235	Sample loop 1 mL
0101-1234	Sample loop 2 mL

## Autosampler

### Autosampler Main Assemblies

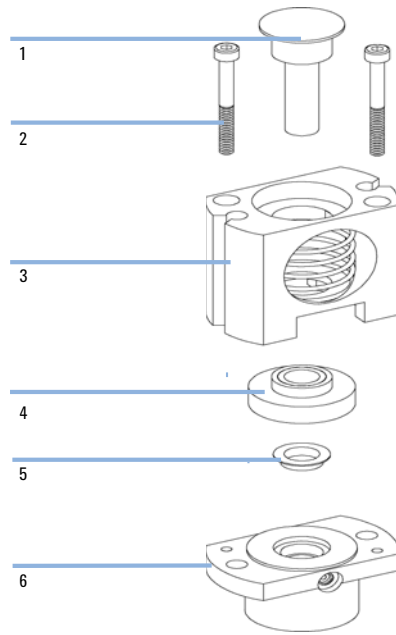
<b>p/n</b>	<b>Description</b>
G4280-60230	Autosampler complete
G1329-60009	Transport assembly
G4280-60027	Sampling unit assembly (excluding injection valve and analytical head)
01078-60003	Analytical head assembly, 100 µL
0101-1422	Injection valve
G1313-44510	Vial tray
G1313-60010	Gripper assembly
G4280-87304	Waste capillary
G4280-81615	Cable, sampling unit
G4280-81616	Cable, sample transport
5067-1581	Needle port

## 12 Parts for Maintenance

### Injection System

#### Analytical Head Assembly

<b>Item</b>	<b>p/n</b>	<b>Description</b>
	01078-60003	Analytical head assembly, 100 $\mu$ L
1	5063-6586	Sapphire piston
2	0515-0850	Screw M4, 40 mm long
3	01078-23202	Adapter
4	5001-3739	Support Seal assembly
5	5063-6589	Metering seal (pack of 2) for 100 $\mu$ L analytical head
6	01078-27710	Head body
	0515-2118	Screw M5, 60 mm long, for mounting assembly



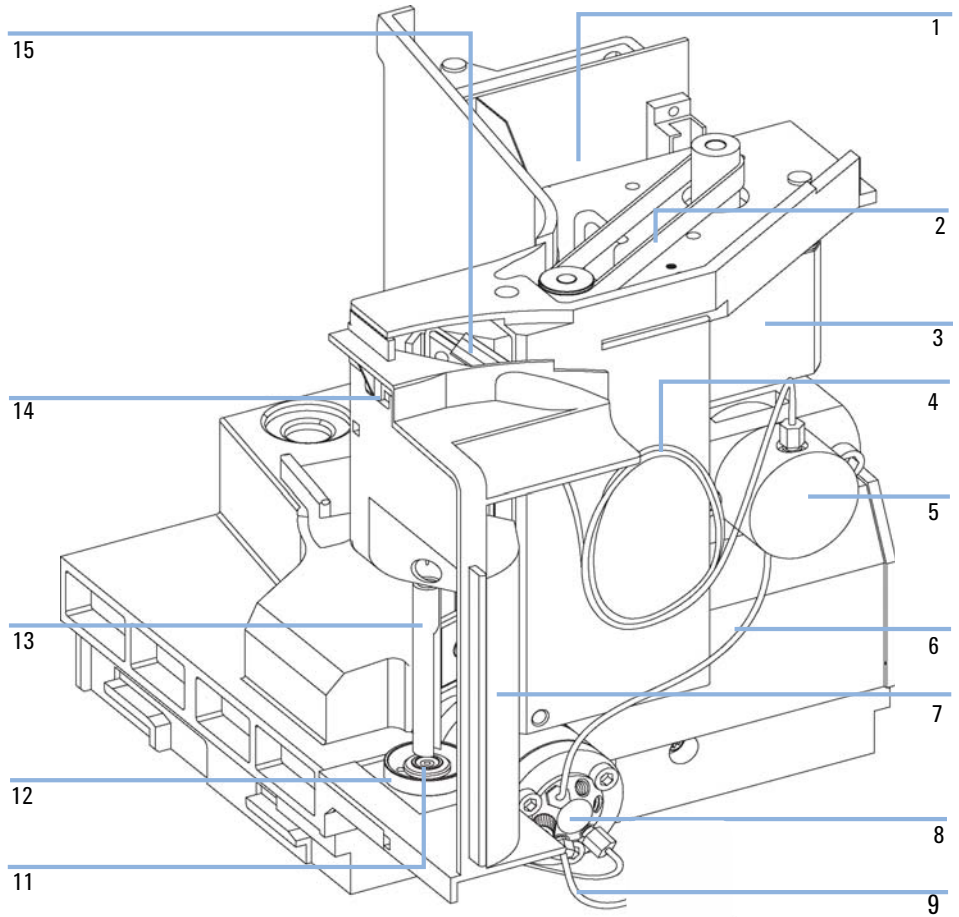
## 12 Parts for Maintenance

### Injection System

#### Sampling Unit Assembly

Item	p/n	Description
	G4280-60027	Sampling unit assembly (excluding injection valve and analytical head)
1	G1313-66503	SUD board
2	1500-0697	Belt gear for metering unit and needle arm
3	5062-8590	Stepper motor for metering unit and needle arm
4	01078-87302	Loop capillary (100 µL)
5	01078-60003	Analytical head assembly, 100 µL
6	G1313-87301	Capillary, injection valve to analytical head (160 mm × 0.25 mm)
7	G1329-44115	Safety cover
8	0101-1422	Injection valve
9	G1313-87300	Waste tube injection valve assy (120 mm)
11	G1313-87101	Needle-seat assy (0.17 mm i.d. 2.3 µL)
12	G1313-43204	Seat adapter
13	G1313-44106	Safety flap
14	G1313-68715	Flex board
15	G1313-87201	Needle assembly
	G1313-68713	Clamp Kit (includes needle clamp and 2 x clamp screw)



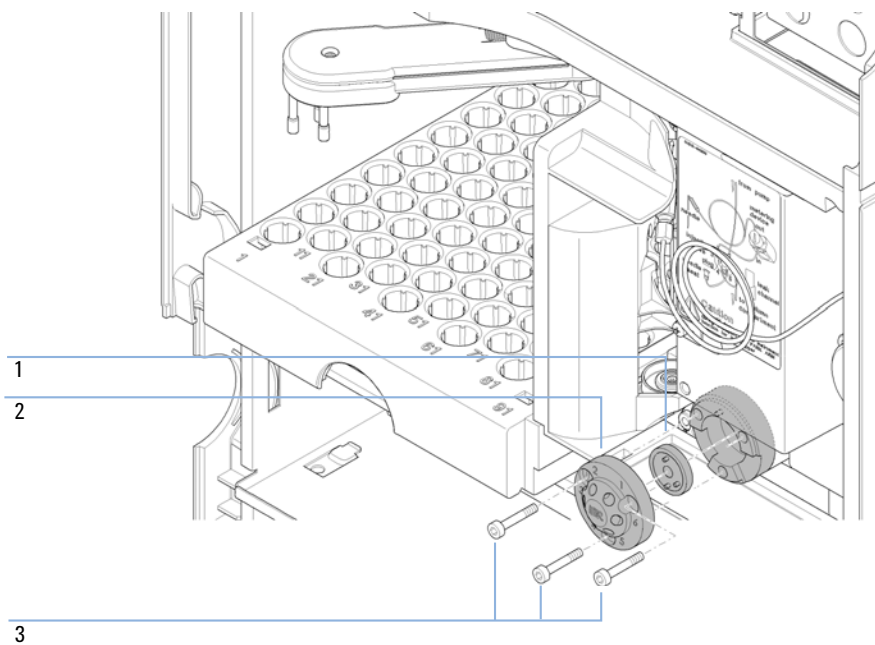


## 12 Parts for Maintenance

### Injection System

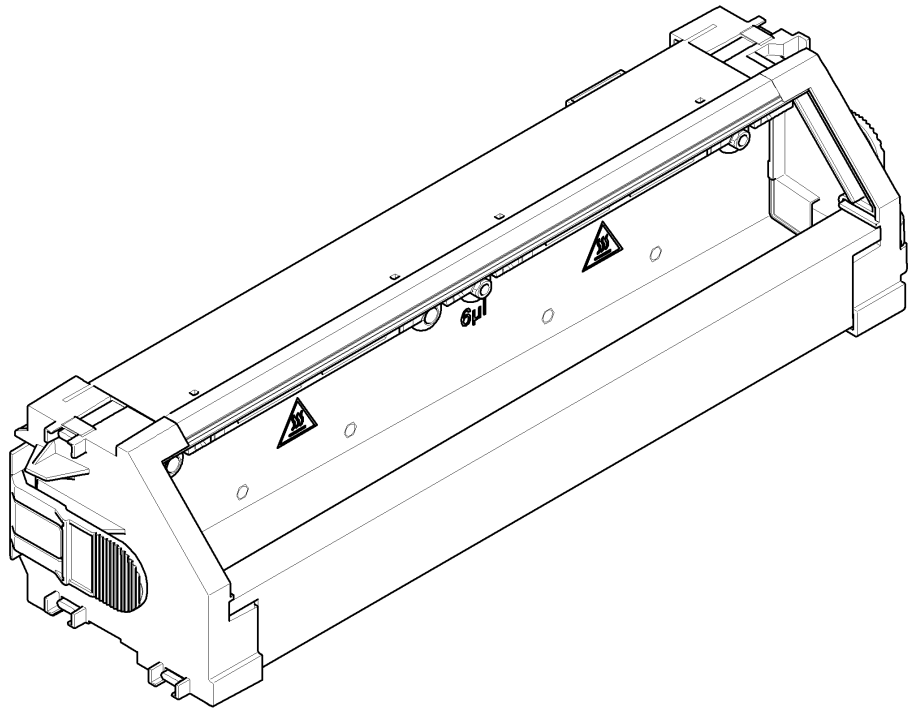
#### Injection Valve Assembly

Item	p/n	Description
	0101-1422	Injection valve
	0100-1852	Isolation seal
1	0101-1416	Rotor seal (PEEK)
2	0101-1417	Stator head
3	1535-4857	Stator screws



## Column Oven

p/n	Description
G4280-60040	Complete column oven assembly
G4280-60017	Heater door assembly



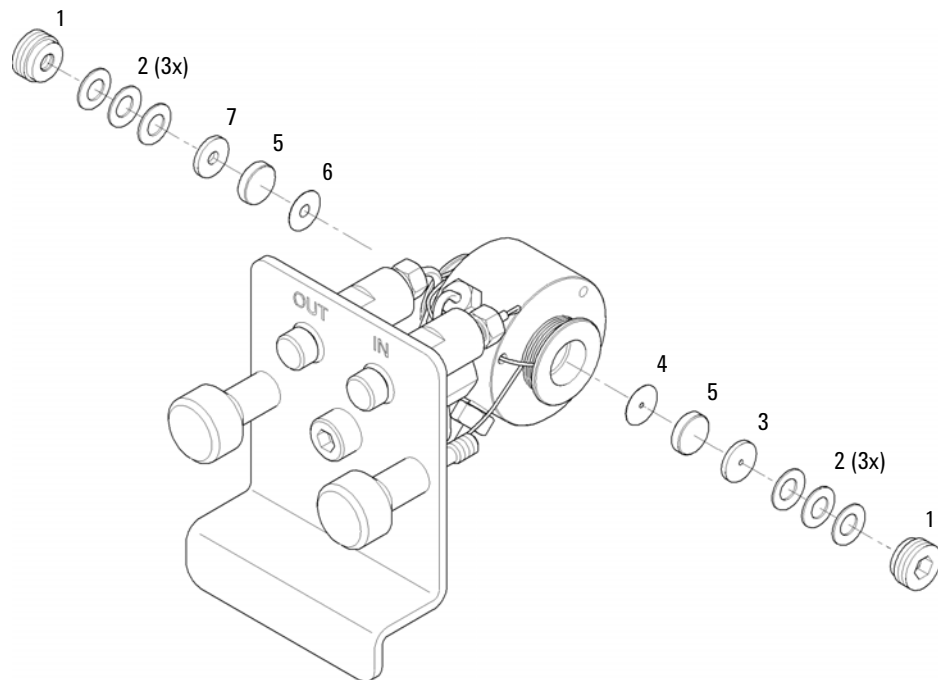
## Detector

### Variable Wavelength Detector (VWD)

#### Standard Flow Cell 10 mm / 14 $\mu$ L

Item	p/n	Description
	G1314-60086	Standard flow cell, 10 mm, 14 $\mu$ L, 40 bar
	5062-8522	Capillary column - detector PEEK 600 mm lg, 0.17 mm i.d., 1/16 inch o.d.
	G1314-65061	Cell Repair Kit, includes 2x Gasket #1, 2x Gasket #2, 2x Window Quartz
1	G1314-65062	Cell screw kit
2	79853-29100	Conical spring kit, 10/pk
3	G1314-65066	Ring #2 kit (IN small hole, i.d. 1 mm) PEEK, 2/pk
4	G1314-65064	Gaskets #2 IN (small hole i.d. 1 mm), KAPTON 10/pk
5	79853-68742	Window quartz kit, 2/pk
6	G1314-65063	Gasket #1 kit (OUT large hole, i.d. 2.4 mm) KAPTON, 2/pk
7	G1314-65065	Ring #1 kit (OUT large hole, i.d. 2.4 mm) PEEK, 2/pk

- 1 Cell screw
- 2 Conical springs
- 3 Ring #2 IN
- 4 Gasket #2 IN
- 5 Quartz window
- 6 Gasket #1 OUT
- 7 Ring #1 OUT



**Figure 74** Standard Flow Cell 10 mm / 14 µL

## 12 Parts for Maintenance

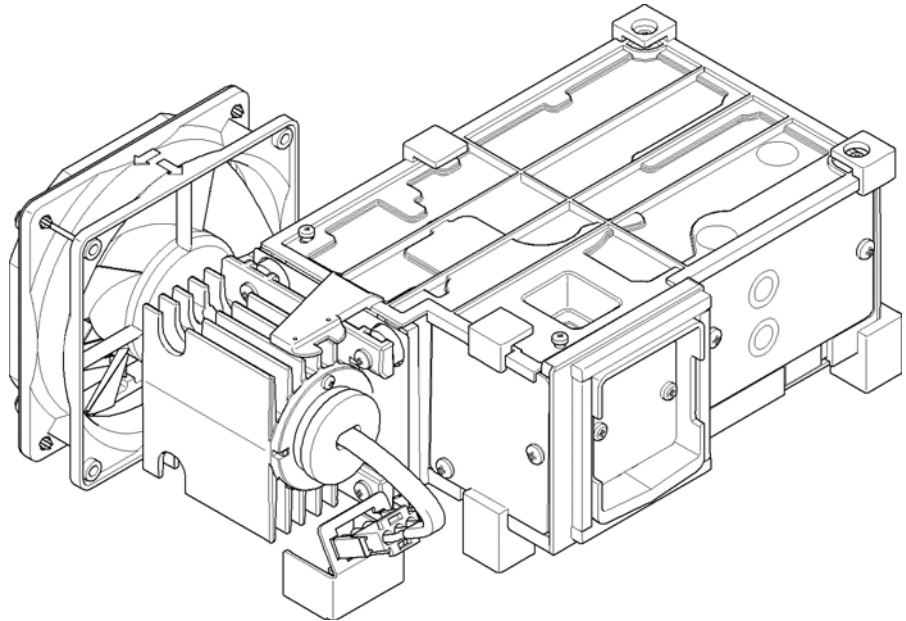
### Detector

#### Detector Lamp

p/n	Description
G1314-60100	Deuterium lamp

## Optical Unit and Fan Assembly

p/n	Description
G1314-60061	Complete optical unit assembly
G4280-80004	Fan
G1314-60113	Heater Assembly
G1314-67000	Heater Interface Board Kit (includes 4 rivets)
G1314-65802	VWD temp. sensor board



### NOTE

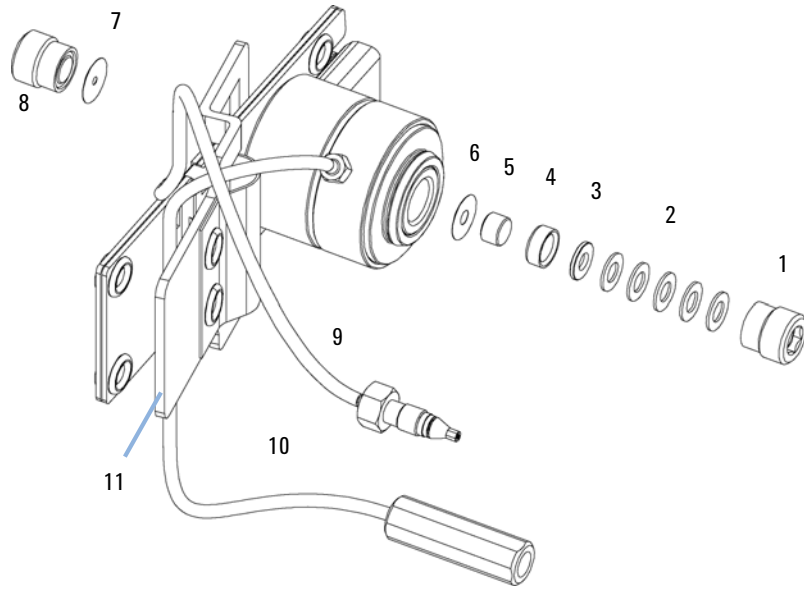
Repairs to the optical unit require specialist knowledge.

## Diode Array Detector (DAD)

### Standard Flow Cell

Item	p/n	Description
	G1315-60022	Standard flow cell, 10 mm, 13 $\mu$ L, 120 bar (12 MPa)
1	79883-22402	Window screw
2	5062-8553	Washer kit (10/pk)
3	79883-28801	Compression washer
4	79883-22301	Window holder
5	1000-0488	Quartz window
6	G1315-68711	Gasket BACK (PTFE), 2.3 mm hole, outlet side (12/pk)
7	G1315-68710	Gasket FRONT (PTFE), 1.3 mm hole, inlet side (12/pk)
8		Window assembly (comprises window screw, spring washers, compression washer, window holder and quartz window)
	G1315-87321	Capillary IN (0.17 mm, 590 mm lg) including heat exchanger
10	G1315-87302	Capillary OUT (0.17 mm, 200 mm lg)
11	G1315-84910	Clamp unit
	0515-1056	Screw M 2.5, 4 mm lg for cell body/clamp
	5022-2184	Union ZDV
	G1315-68712	Cell repair kit STD includes window screw kit, 4 mm hexagonal wrench and seal kit
	79883-68703	Window screw kit, includes 2 quartz windows, 2 compression washers, 2 window holders, 2 window screws and 10 washers



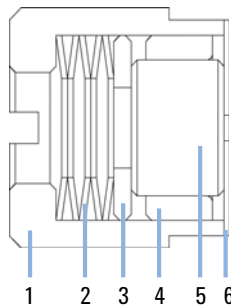


**Figure 75** Standard Flow Cell Parts

**NOTE**

Gaskets # 6 and #7 have different hole diameters.

- 1 - window screw
- 2 - spring washers
- 3 - compression washer
- 4 - window holder
- 5 - quartz window
- 6 - Gasket



**Figure 76** Orientation of Spring Washers

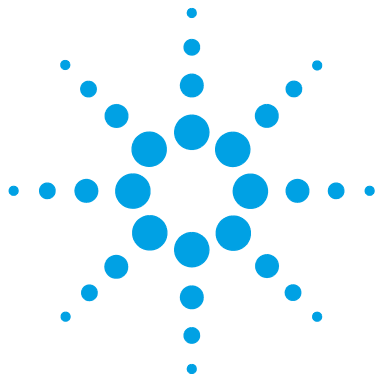
## 12 Parts for Maintenance

### Detector

#### Detector Lamps

<b>p/n</b>	<b>Description</b>
2140-0820	Longlife Deuterium lamp "C" (with black cover and RFID tag)
G1103-60001	Tungsten lamp

1220 Infinity LC



## 13

# Upgrading the Agilent 1220 Infinity LC

Oven Upgrade 348

This chapter provides information for upgrading the LC system.



## Oven Upgrade

Parts required	p/n	Description
	G4297A	1220 Infinity Oven Kit

**Software required** LabAdvisor Software

- 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 Start the **LabAdvisor Software** and connect your Instrument, open **Instrument Controls** and then open **Conversions** on any of the sub-modules and click **Add Oven**. The hardware configuration change will be finalized with the next power-cycle.
- 13 **Power cycle** the instrument and start your **Chromatographic Data System**. Use **Auto configure** and the instrument now should be registered under its new main assembly number.



## 14 Identifying Cables

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Remote Cables	354
BCD Cables	357
CAN/LAN Cables	359
Agilent 1200 module to PC	360

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



## Cable Overview

**NOTE**

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

### Analog cables

p/n	Description
35900-60750	Agilent module to 3394/6 integrators
35900-60750	Agilent 35900A A/D converter
01046-60105	Analog cable (BNC to general purpose, spade lugs)

### Remote cables

p/n	Description
03394-60600	Agilent module to 3396A Series I integrators 3396 Series II / 3395A integrator, see details in section <a href="#">“Remote Cables”</a> on page 354
03396-61010	Agilent module to 3396 Series III / 3395B integrators
5061-3378	Remote Cable
01046-60201	Agilent module to general purpose

### BCD cables

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

### CAN cables

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

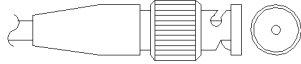
### LAN cables

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

### RS-232 cables

p/n	Description
G1530-60600	RS-232 cable, 2 m
RS232-61601	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9.
5181-1561	RS-232 cable, 8 m

## Analog Cables



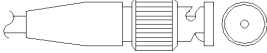
One end of these cables provides a BNC connector to be connected to Agilent modules. The other end depends on the instrument to which connection is being made.

### Agilent Module to 3394/6 Integrators

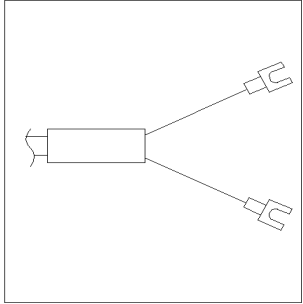
p/n 35900-60750	Pin 3394/6	Pin Agilent module	Signal Name
	1		Not connected
	2	Shield	Analog -
	3	Center	Analog +



### Agilent Module to BNC Connector

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

### Agilent Module to General Purpose

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

## Remote Cables



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

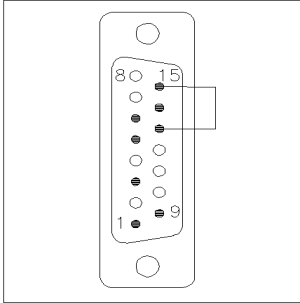
### Agilent Module to 3396A Integrators

p/n 03394-60600	Pin 3396A	Pin Agilent module	Signal Name	Active (TTL)
<p>A diagram of the Agilent module connector, showing a vertical arrangement of pins. Pins 1, 3, 5, 7, 9, 13, and 15 are labeled. Pin 1 is at the bottom, and pin 15 is at the top. There are also unlabeled pins 2, 4, 6, 8, 10, 11, 12, and 14.</p>	9	1 - White	Digital ground	
	NC	2 - Brown	Prepare run	Low
	3	3 - Gray	Start	Low
	NC	4 - Blue	Shut down	Low
	NC	5 - Pink	Not connected	
	NC	6 - Yellow	Power on	High
	5,14	7 - Red	Ready	High
	1	8 - Green	Stop	Low
	NC	9 - Black	Start request	Low
	13, 15		Not connected	

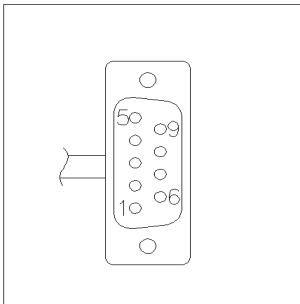
### Agilent Module to 3396 Series II / 3395A Integrators

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

### Agilent Module to 3396 Series III / 3395B Integrators

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

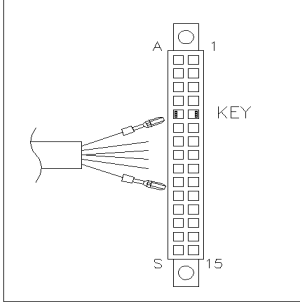
### Agilent Module to Agilent 35900 A/D Converters

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

## 14 Identifying Cables

### Remote Cables

### Agilent Module to General Purpose

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

## BCD Cables



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

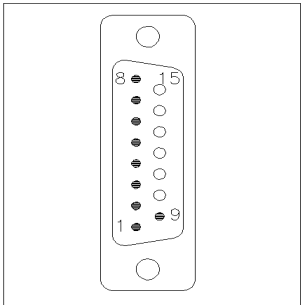
### Agilent Module to General Purpose

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

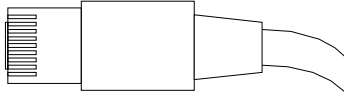
## 14 Identifying Cables

### BCD Cables

#### Agilent Module to 3396 Integrators

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

## CAN/LAN Cables



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

### CAN Cables

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

### LAN Cables

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

## 14 Identifying Cables

Agilent 1200 module to PC

### Agilent 1200 module to PC

<b>p/n</b>	<b>Description</b>
G1530-60600	RS-232 cable, 2 m
RS232-61601	RS-232 cable, 2.5 m Instrument to PC, 9-to-9 pin (female). This cable has special pin-out, and is not compatible with connecting printers and plotters. It's also called "Null Modem Cable" with full handshaking where the wiring is made between pins 1-1, 2-3, 3-2, 4-6, 5-5, 6-4, 7-8, 8-7, 9-9.
5181-1561	RS-232 cable, 8 m





## 15 Appendix

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



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

## Safety Symbols

Table 48 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 blockage/damage of the flow cell.

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

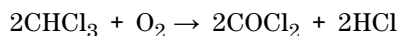
Aqueous solvents in the flow cell can build up algae. Therefore do not leave aqueous solvents sitting in the flow cell. Add small % of organic solvents (for example, acetonitrile or methanol ~5 %).

### 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:



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

## 15 Appendix

### Solvent Information

- 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 49** UV radiation limits

Exposure/day	Effective irradiance
8 h	0.1 $\mu\text{W}/\text{cm}^2$
10 min	5.0 $\mu\text{W}/\text{cm}^2$

Typically the radiation values are much smaller than these limits:

**Table 50** UV radiation typical values

Position	Effective irradiance
Lamp installed, 50 cm distance	average 0.016 $\mu\text{W}/\text{cm}^2$
Lamp installed, 50 cm distance	maximum 0.14 $\mu\text{W}/\text{cm}^2$



## 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)

## 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.

---



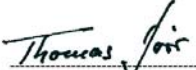



#### NOTE

Do not dispose of in domestic household waste

To return unwanted products, contact your local Agilent office, or see [www.agilent.com](http://www.agilent.com) for more information.

---

# Declaration of Conformity for HOX2 Filter

Declaration of Conformity				
We herewith inform you that the				
<b>Holmium Oxide Glass Filter</b>				
used in Agilent's absorbance detectors listed in the table below meets the requirements of National Institute of Standards and Technology (NIST) to be applied as certified wavelength standard.				
According to the publication of NIST in J. Res. Natl. Inst. Stand. Technol. 112, 303-306 (2007) the holmium oxide glass filters are inherently stable with respect to the wavelength scale and need no recertification. The expanded uncertainty of the certified wavelength values is 0.2 nm.				
Agilent Technologies guarantees, as required by NIST, that the material of the filters is holmium oxide glass representing the inherently existent holmium oxide absorption bands.				
Test wavelengths:				
Where "x" can be any alphanumeric character				
Product Number	Series	Measured Wavelength *	Wavelength Accuracy	Optical Bandwidth
G1315x, G1365x	1100, 1200, 1260	361.0 nm 418.9 nm 453.7 nm 536.7 nm	+/- 1 nm	2 nm
G7115x, G7165x	1260			
G1600x, G7100x	CE			
G1314x	1100, 1200, 1260, 1290	360.8nm 418.5nm 536.4nm	+/- 1 nm	6 nm
G7114x	1260, 1290			
G4286x, ..., 94x	1120, 1220			
*) The variation in Measured Wavelength depends on the different Optical Bandwidth.				
28-Oct-2014				
(Date)				
 (R&D Manager)		 (Quality Manager)		
P/N 89550-90501 	Revision: G Effective by: 28-Oct-2014			

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<http://www.agilent.com>

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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 Calibration
- Error Information
- Maintenance and Repair
- Parts for Maintenance and Repair
- Upgrading the Agilent 1220 Infinity LC
- Appendix

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