GE Healthcare

ÄKTAdesign

Pump P-900

User Manual

ÄKTA™

Important user information

All users must read this entire manual to fully understand the safe use of the component.

WARNING!

The WARNING! sign highlights instructions that must be followed to avoid personal injury. It is important not to proceed until all stated conditions are met and clearly understood.

CAUTION!

The Caution! sign highlights instructions that must be followed to avoid damage to the product or other equipment. It is important not to proceed until all stated conditions are met and clearly understood.

Note

The Note sign is used to indicate information important for trouble-free and optimal use of the product.

CE Certifying

This product meets the requirements of applicable CE-directives. A copy of the corresponding Declaration of Conformity is available on request.

The **CE** symbol and corresponding declaration of conformity, is valid for the instrument when it is:

– used as a stand-alone unit, or

– connected to other CE-marked GE Healthcare instruments, or

– connected to other products recommended or described in this manual, and

– used in the same state as it was delivered from GE Healthcare except for alterations described in this manual.

Recycling

This symobl indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of equipment.

Contents

About this manual

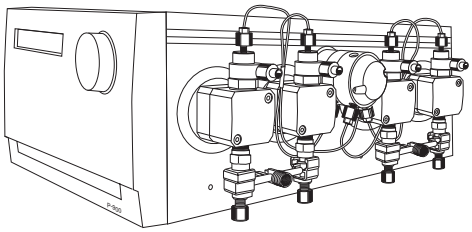
This manual comprises two parts; a practical part (sections 1 – 5) and a reference part (sections A – D). Sections 1 – 5 contain the necessary information for operating the instrument.

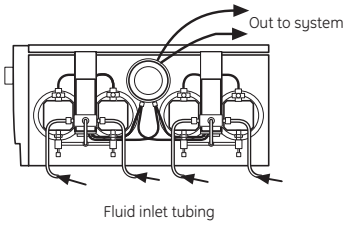
1 Introduction

1.1 General

Pump P-900 is the collective name for a pump family. The family members are:

- P-901 stand-alone or system mounted
  Used as stand-alone, or in ÄKTA™explorer 100. Equipped with four pump heads in two pump modules.
- P-903 stand-alone or system mounted
  Used as stand-alone, or in ÄKTA™purifier 10/10 XT and ÄKTAexplorer 10/10 XT. Equipped with four pump heads in two pump modules.





P-901, P-903

All P-900 models are high performance laboratory pumps for use in liquid chromatography and other applications where accurately controlled liquid flow is required. Double mode can be selected to double the flow rate range.

Pump P-900 features:

- P-901
  - Pressure range 0–10 MPa (100 bar, 1450 psi).
  - Flow rate range 0.01–100 ml/min isocratic and gradient mode.
  - Double mode flow rate range of 0.01–200 ml/min isocratic mode.
- P-903
  - Pressure range 0–25 MPa (250 bar, 3625 psi).
  - Flow rate range 0.001–10 ml/min isocratic and gradient mode.
  - Double mode flow rate range of 0.001–20 ml/min isocratic mode.
- The pumps are equipped with 2 pump modules, A and B, including two pump heads each. This allows for binary gradients with high pressure mixing.
- All pumps have a pressure sensor connected to pump module A.
- Low pulsation.
- Switch-valve control for low pressure gradients and BufferPrep.

All versions are run with the same software. Normal or double mode, as well as the size of the pump heads are stated in a Setup meny, see Reference information B.2.

1.1.1 Accessories

Accessories can be connected to the pumps, and can be controlled from the pumps or from a PC running UNICORN™ version. 2.10 or higher.

These accessories are:

- Mixer M-925.
- 2-way Switching Valve SV-903.

1.2 Safety

IMPORTANT! Pump P-900 is intended for laboratory use only, not for clinical or in vitro use, or for diagnostic purposes.

- The instrument is designed for indoor use only.
- Do not use in a dusty atmosphere or close to spraying water.
- Do not block the air inlet and outlet of the unit.

WARNING! Always disconnect the power supply before attempting to replace any item on the instrument.

WARNING! Incorrectly fitted tubing may loosen, causing a jet of liquid to spray out. This is especially dangerous if hazardous chemicals are in use. Connect the tubing by first inserting the tubing fully, then tightening the connector fingertight. Finally tighten the connector a further 1/4 turn using the key supplied.

WARNING! When using hazardous chemicals, all suitable protective measures, such as protective glasses, must be taken.

WARNING! The instrument must not be opened by the user. It contains high voltage circuits which can give a lethal electric shock.

WARNING! The instrument must be connected to a grounded mains socket.

WARNING! NaOH is injurious to health. Avoid spillage.

WARNING! When using hazardous chemicals, take all suitable protective measures, such as wearing protective glasses and gloves resistant to the chemicals used. Follow local regulations and instructions for safe operation and maintenance of the system.

WARNING! This is a Class A product. In domestic environment this product may cause radio interference in which the user may be required to take adequate measures.

2 Installation

2.1 Unpacking

Unpack the instrument and check the items against the supplied packing list. Inspect the items for obvious damage which may have occurred during transportation.

It is recommended that all packing materials should be retained if onward transport of the instrument is expected.

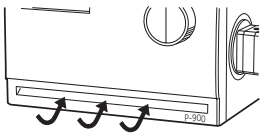
CAUTION! The following information should be read carefully to ensure that the instrument is installed correctly.

2.2 General precautions

The instrument should be installed in a non-corrosive atmosphere.

The instrument should be located in a place of low temperature variations, away from heat sources, draughts and direct sunlight.

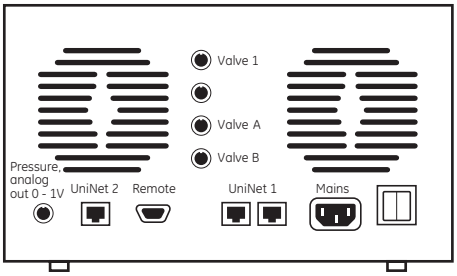
The instrument may be operated at normal ambient temperatures in the range +4 to +40 °C.



The instrument should be installed on a stable laboratory bench, providing a suitable working area or in an ÄKTA system. To ensure correct ventilation a free space of 0.1 m is required behind and in front of the instrument. Do not block the ventilation inlets or aoutlets on the system! Place the instrument directly on the bench. Do not use any soft material under the instrument, to ensure that the ventilation inlet in the front is not blocked.

2.3 Connecting electrical signal cables

The sockets for electrical signals are located on the rear panel.



WARNING! Pump P-900 must be connected to a grounded mains socket to prevent system parts from becoming live.

WARNING! Do not block the rear panel of the system. The mains power switch must always be easy to access.

2.3.1 Connecting to chart recorder (if used)

1 Connect the chart recorder to the Mini-DIN-socket **Pressure** using the cable supplied.

Pin	Signal
1	Signal
2	Signal ground
3–6	Not used (Reserved for factory testing)

Note: *The signal cable is delivered with protective covers on each wire. Do not remove the protective covers from unused connections as a short circuit may disturb the measurements.*

2 Set the recorder to 0–1 V input, full scale.

3 Refer to section B.2.2 for a description of setting the full scale pressure.

2.4 Connecting to communication link

The pumps used in ÄKTAexplorer and ÄKTApurifier, are controlled from a PC running UNICORN version 2.10 or higher, using UniNet cables.

CAUTION! The mains power to ÄKTAexplorer and ÄKTApurifier must be switched OFF before connecting the instrument to the *UniNet 1* link.

1 Connect two *UniNet* cables to the *UniNet 1* connectors. The instrument can be connected in series anywhere in the chain between the PC and the termination plug. The UniNet 1 link connects, in series, the PC with Pump P-900 and other instruments. The termination plug is connected to the last instrument in the chain.

2.5 Connecting to supply voltage

1 Make sure the on/off switch is in the OFF-position O.

2 Connect a mains cable between the instrument and a grounded mains socket. The instrument is delivered with both European and US type mains cables, as standard. Any voltage from 100–240 V AC, 50–60 Hz can be used.

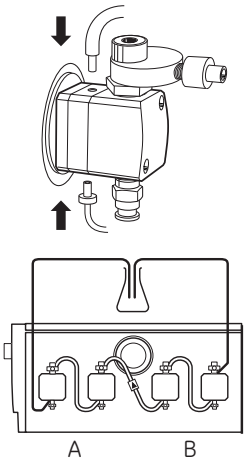
WARNING! The instrument must be connected to a grounded mains socket.

The instrument contains no user replaceable fuse.

WARNING! Only use mains cables delivered or approved by GE Healthcare.

2.6 Installing the piston seal rinsing system

Note: *For the protection of the new pump, do not run the pump until the system has been flushed out and primed with eluent, according to sections 2.8 and 2.9.*



P-901, P-903

The rinsing system for the piston seals must be installed before use. 20% ethanol should be passed around the piston and piston seal on the non–pressure side of the piston seal. This protects the piston seals and pump heads by preventing a build-up of deposits from the solvents.

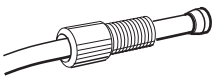
1 Connect the tubing for the piston seal rinsing system. The connections are simple plug-in fittings.

2 The three lengths of wide bore tubing connect the pump heads in series, connecting the top of one pump head to the underside of the next. The wide bore tubing with the check valve should be fitted between the right pump head of pump module A and the left pump head of pump module B. The arrow on the check valve must point towards pump A.

3 Two lengths of narrow bore tubing are also supplied with the pump. Connect the tubing with a Union Luer connector to the underside of the left pump head on pump A. Connect the other to the top of the right pump head of pump module B and immerse the tubing in a flask containing rinsing solution (20% ethanol).

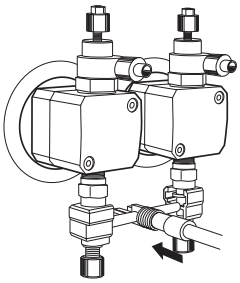
4 Connect a syringe to the rinsing tubing that is connected to the underside of the left pump head on pump A. Slowly suck up rinsing solution to the syringe. When rinsing solution starts to enter the syringe, continue to draw a few millilitres.

5 Loosen the syringe and immerse the tubing in the rinsing solution.



2.7 Connecting the inlet tubing

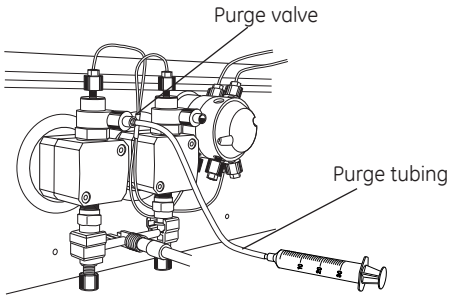
The inlet tubing is connected to the centre port of the inlet manifold of each pump module.

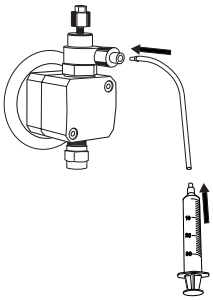


Connect the tubing using male 5/16”-connections.

2.8 Purging the pump

CAUTION! To protect the piston seals, the pump must never be run with air in the inlet tubing. Follow the procedure below to remove the air.



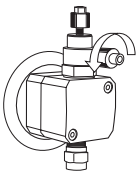


1 Fill a reservoir flask with distilled water. Immerse the inlet tubings of both pump modules, with filters, in the water.

Note: *Never place the reservoir flask below the level of the pump inlet*.

2 Connect a male Luer syringe of about 30 ml to the open end of the purge tubing.

3 Connect the male Luer connector at the other end of the purge tubing to the left purge valve at pump module module A.



4 Turn the purge valve counterclockwise half a turn to open it and slowly draw eluent to the syringe.

5 When fluid starts to enter the syringe continue to draw a few millilitres before closing the purge valve. Check that there is no air left in the inlet tubing.

6 Repeat steps 3 to 5 for pump module B, if fitted.

2.9 Running-in the new pump

2.9.1 General

To be able to follow this section you must know how to operate the pump. Read through section 3 Operation before continuing.

Note: *To ensure trouble-free operation of the pump, it is important hat this running-in procedure is followed.*

The pump heads are filled with 20% ethanol for protection during transportation. This is removed by running-in the pump with a liquid such as distilled water which is miscible with 20% ethanol. After running-in, the pump is primed for the chromatographic run.

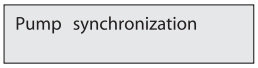
Note: *If, for any reason, the pumpheads are dry, actions according to section 4.5 Running in a new piston seal must be carried out instead!*

2.9.2 Running-in

1 Purge the pump, see section 2.8 *Purging the pump*.

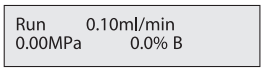
2 Switch the mains power switch on the rear panel to ON.

3 Check that the outlet tubing are not blocked, and press OK in the pump synchronization display.

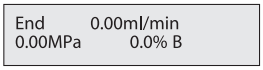


4 Set the flow rate in menu **Set Flow Rate.** Run both pumps at the same time by setting the concentration to 50% in menu **SetConcentrationB** under menu **SetConc./Gradient.** Set the pump in **Run** mode. Run the pump at the flow rates and times specified below.

Pump	Flow rate	Time
P-901	40 ml/min	10 minutes
P-903	4 ml/min	10 minutes

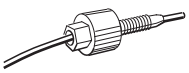


5 Stop the flow by setting the pump in **End** mode.



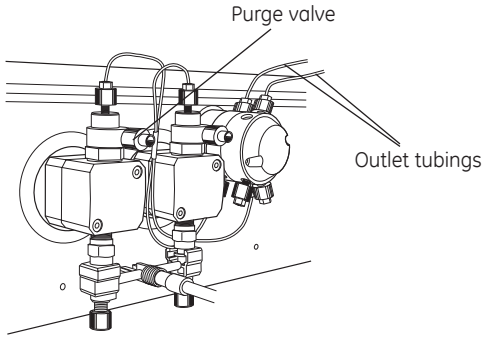
2.10 Connecting the pump outlet tubing

WARNING! Incorrectly fitted tubing may loosen, causing a jet of liquid to spray out. This is especially dangerous if hazardous chemicals are in use. Connect the tubing by first inserting the tubing fully, then tightening the connector fingertight. Finally tighten the connector a further 1/4 turn using the key supplied.



1 Remove the blind plug from the pump head outlet manifold. Connect the outlet tubing using 1/16" Fingertight connectors. Place the end of the tubing in a drain or waste collection vessel.

2 Close the purge valve by turning it clockwise.



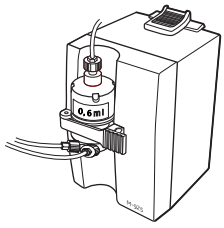
3 Set the flow rate to 10 ml/min for P-901, and to 1 ml/min for P-903.

4 Set the pump in **Run** mode. Allow the pump to run for 1–2 minutes to prime the new outlet tubing.

5 Stop the flow by setting the pump in **End** mode.

2.11 Installation of accessories

Mixer M-925 and up to three 2-way Switching Valves SV-903 can be connected to the pump:



Mixer M-925

Switch Valve SV-903

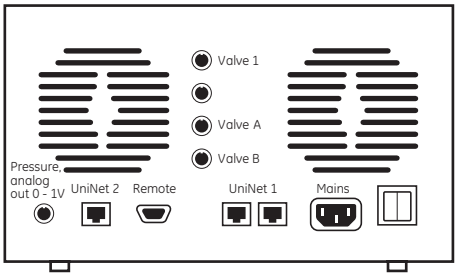
CAUTION! Before connecting any accessories, make sure the power switch is in OFF position.

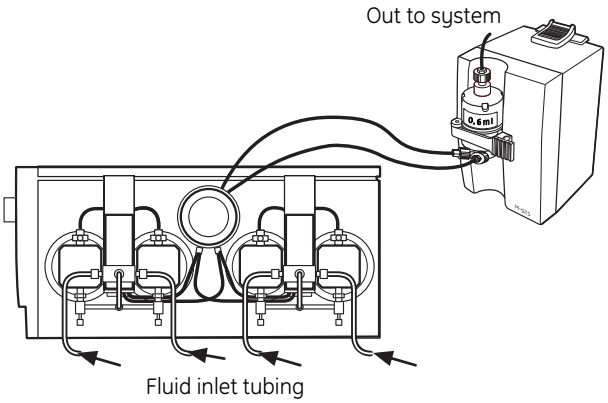
Mixer M-925 is connected to the **UniNet-2** connector.

SV-903 valve for buffer selection is connected to **Valve 1.** The valve is set on/off via the pump sub menu **Set Valve 1** under the **Setup menu**. See *Reference information B.2.8.*

SV-903 valves for BufferPrep are connected to **Valve A** and **Valve B**.

SV-903 for one-pump gradients is connected to **Valve A**.





3 Operation

Selftest

Pump P-900

Pump synchronization

End 0.00ml/min
0.00MPa 0.0% B

3.1 On/off

Switch on the instrument at the mains switch on the rear panel. At switch on the instrument performs a selftest and then asks for synchronization.

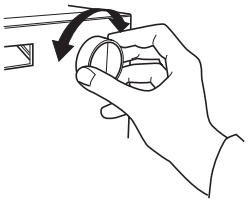
Open the purge valves (see section 2.8) to avoid high pressure during synchronisation which is done at the speed of 0.1 ml/min, and press OK. The display will show **Synchronizing pumps** and after approx. 1 minute the display shows the main operating menu with the pump in **End** mode. Close the purge valves. All parameters are factory set to default values.

3.2 Menu selection and settings

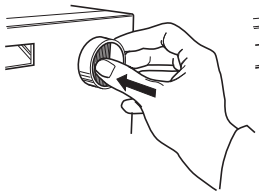
3.2.1 Menu selection

A specific menu is selected by turning the front selection dial clockwise or counterclockwise. When the required menu is visible the menu or selection is accepted by pressing the OK-button.

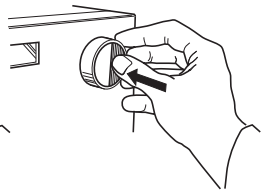
Menu selection



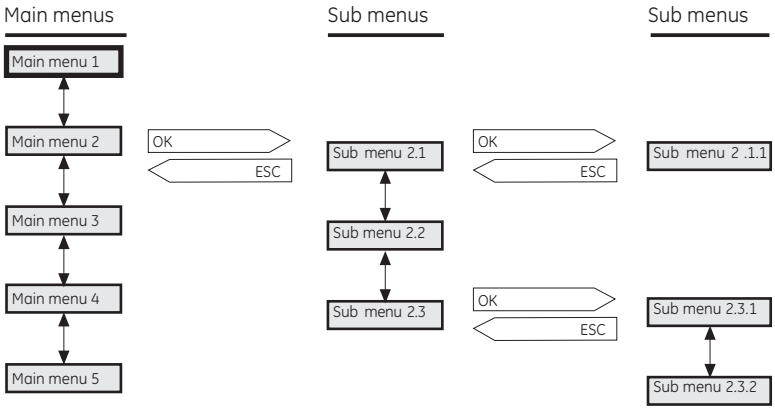
OK-button
Select submenu



ESC-button
Return one menu level



If a menu has sub levels, the sub menu is displayed by pressing the OK-button. Pressing the ESC-button moves back one menu level.

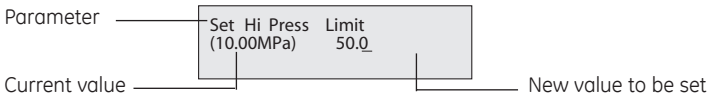


3.2.2 Return to main menu

Pressing **ESC** repeatedly, always returns to the **main menu 2** which is the main operating menu. Press **ESC** once more to return to **main menu 1**, the mode changing menu.

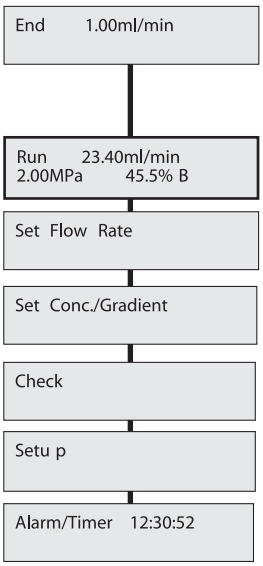
3.2.3 Select value

A cursor below a text or numerical value shows what is affected by the dial. To increase the value turn the dial clockwise. To decrease the value turn the dial counterclockwise. The value can be reset by turning the dial several clicks counterclockwise.



When setting numerical values the cursor moves up to the next digit if the dial is turned quickly in one direction, to simplify entering large values. The cursor moves back one place to the right every two seconds if the dial is not turned. The text or numerical value displayed is accepted by pressing the K-button. To cancel, press the ESC-button.

3.3 Main menu overview



Mode changing menu. This is from where the pump is started and stopped. The menu is accessed from all positions by pressing the ESC-button repeatedly. The appearance of this menu will depent on the current mode.

Main operating menu: The menu is accessed from all positions by pressing the ESC-button repeatedly.

Setting flow rate in ml/min.

Setting concentration and gradient values.

Check internal operating values. *See Reference information section B.1.*

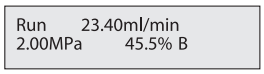
Setup language, pressure limits, etc. *See Reference information section B.2.*

Set different timer options. The pump can be started or stopped at set times. *See Reference information section B.3.*

3.4 *Starting and stopping the pump*

WARNING! Incorrectly fitted tubing may loosen, causing a jet of liquid to spray out. This is especially dangerous if hazardous chemicals are in use. Connect the tubing by first inserting the tubing fully, then tightening the connector fingertight. Finally tighten the connector a further 1/4 turn using the key supplied.

3.4.1 Main operating menu



The main operating menu shows the current flow rate together with a mode indication, pressure and %B, if used. The available modes are:

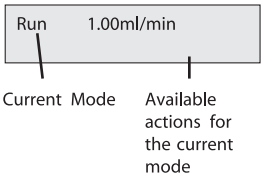
Run The pump is running with set flow rate

End The pump is not running. Flow rate and gradient are reset.

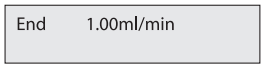
Pause The pump is stopped but the set flow rate value and the gradient are retained.

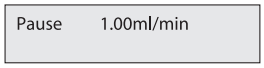
Hold The gradient is held at the value displayed, and the pump continues to run.

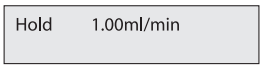
3.4.2 Mode changing menu



Mode changes are made in the mode changing menu above the main operating menu (turn dial counter-clockwise). The current mode is shown in the upper left corner of the display. Available actions are shown at the lower right. There are four different displays for this menu and the menu displayed will depend on the current mode. When a new mode is selected the appearance of the menu will change.







Pressing OK in a mode changing display will select the underlined mode. Different modes can be underlined by turning the dial.

To start the pump: Select **Run** and press OK.
To stop the pump: Select **End** and press OK.

3.4.3 Preparation before starting

CAUTION! Before the start of each run, always ensure that there is an adequate supply of eluent in the reservoirs. Never allow the pump to run dry, since this will affect the lifetime of the piston seals.

1 Check that there is sufficient eluent present for the run, and that the solvent filter is fully immersed. If the eluent is to be changed, see section *3.9 Changing eluent*

Note: *The pump may not work if the buffer vessels are sealed. Do not close the vessels off completely.*

2 If there is air in the tubing or the pump, prime the pump. Refer to section *2.8 Purging the pump*.

3 Check that there is sufficient liquid (20% ethanol) in the rinsing system reservoir.

4 Set the pressure limit. Refer to section B.2.1 in Reference information. If the pressure limit is exceeded, the pump is stopped.

3.4.4 Emergency stop

By pressing **ESC** repeatedly and ending with OK, the pump is set to **Pause** mode.

3.5 Setting the flow rate and starting the pump

Set Flow Rate

1 Select main menu **Set Flow Rate**, press OK.

2 Set the value, press OK.

3 Select the mode menu, select **Run,** press OK. The pump speed gradually increases to deliver the set flow rate.

4 To change the flow rate while the pump is running, perform steps 1 and 2 again.

5 To stop the pump, select the mode menu, select **End**, press OK.

In UNICORN select instruction **Flow** in **System Control:Manual:Pump.** Click on **Execute** and the pump will start.

3.6 Setting concentration B

A percentage of eluent B can be set.

Set Conc./Gradient

1 Select main menu **Set Conc./Gradient,** press OK.

Set Concentration B

2 The display shows **Set Concentration B**, press OK.

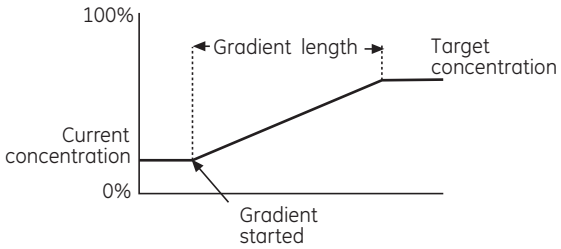
3 Set the %B value, press OK.

In UNICORN, select instruction **Gradient** in **System Control:Manual:Pump**. Set length to zero.

3.7 Running a simple gradient

Gradients can be run in *time* or *volume* base. The default is time base. To change base, see B.2.4 in section *Reference information*.

The gradient is run from current concentration to target concentration, in set length of time or volume. The gradient can be set in any operating mode.



1 Select main menu **Set Conc./Gradient,** press OK.

Set Conc./Gradient

2 The display shows **Set Concentration B**. Turn the dial to select menu **Set Gradient Length,** press OK.

Set Gradient Lengt h

3 Set the value, press OK.

4 Select menu **Set GradientTarget**. Set the gradient target value in %B, press OK. If the pump is in **Run** mode the gradient will start immediately.

Set Gradient Target

5 At the end of the set gradient length time, the pump continues to run at the target concentration.

In UNICORN, select instruction **Gradient** in **System Control:Manual:Pump**.

3.8 Ending the run and storage

The pump can be left filled with a buffer overnight.

Note: *If buffers or water are stored at room temperature, there is a risk that bacterial growth may occur.*

If no further runs are planned, the pump should be flushed immediately with pure eluent. If aqueous buffers have been in use, flushing with pure distilled water is particularly important to prevent salt precipitation.

Overnight storage: The pump can be left filled with a buffer.

Weekend and Long time storage: Flush the pump with water and then fill it with 20% ethanol.

3.9 Changing eluent

CAUTION! To prevent precipitation of crystals when changing from a salt-containing buffer to organic solvent, always flush through the system with water as the intermediate liquid.

When changing from one eluent to another, it is extremely important that the two eluents are totally miscible with one another. If the two eluents are immiscible, the pump should be flushed first with an intermediate liquid, which is miscible with both eluents. Failure to do this will cause a wrong flow of eluent from the pump.

When changing from a salt-containing buffer to an organic solvent, use water as the intermediate liquid to prevent precipitation.

1 Stop the pump by setting it in **Pause** mode.

2 Transfer the inlet tubing into the new eluent or into the intermediate liquid.

3 Run the pump at a flow rate and time as specified in the table in section 2.9.

4 Stop the pump. If an intermediate liquid is being used, transfer the inlet tubing into the final eluent and repeat step 3 with the new eluent.

In UNICORN, select instruction **PumpWash** in **System Control:Manual:Pump**.

3.10 Restart after power failure

If the power supply to the instrument is interrupted, the instrument automatically restarts itself doing selftest and prompting for synchronisation. All values under the **Setup** menu are retained. Other values, e.g. flow rate are reset.

4 Maintenance

Note: *The piston seals have a limited life time depending on the flow rate, pressure and eluents used. The seals are regarded as consumables and are available as a service kit. The wear of the piston seals is not covered by the warranty of the instrument. A typical lifetime is around 1000 run hours*

WARNING! Remove liquid or dirt from the system surface using a cloth and, if necessary, a mild cleaning agent.

WARNING! Always disconnect the power supply before attempting to replace any item on the instrument during maintenance.

CAUTION! Only spare parts approved or supplied by GE Healthcare may be used for maintaining and servicing the instrument.

4.1 Periodic maintenance

Interval	**Action** (see procedures below)
Daily	General care
When required	Removing trapped air bubbles from the pump Fixing leaking connections Replacing the piston seal Replacing a damaged piston Cleaning or replacing the inlet and outlet check valves

4.2 Cleaning-in-place

Pump a cleaning or sanitizing agent through the pump. The standard recommendation is to pump 1 M NaOH for 30 minutes and then wash out with buffer or distilled water.

WARNING! NaOH is injurious to health. Avoid spillage.

WARNING! When using hazardous chemicals, take all suitable protective measures, such as wearing protective glasses and gloves resistant to the chemicals used. Follow local regulations and instructions for safe operation nd maintenance of the system.

WARNING! When using hazardous chemicals, make sure that the entire system has been flushed thoroughly with bacteriostatic solution, e.g. NaOH, and distilled water before service and maintenance.

4.3 General care

Inspect the complete system daily for eluent leaks.

- Wipe the surface regularly with a damp cloth. Do not allow spilt liquid to dry on the instrument.
- Remove dirt from the surface using a cloth and a mild cleaning agent.
- Let the system dry completely before using it.

If, at any time, air is observed in the inlet tubing, purge the pump by opening the appropriate purge valve and running the pump at max. flow rate for about 1 minute. If there is a lot of air in the inlet tubing, stop the pump and perform the procedure in section *2.8 Purging the pump*.

4.3.1 General recommendations for all eluents

It is essential that all liquids passing through the pump are clean and pure. Impure or dirty eluents will not only cause baseline noise and drift, but will cause damage to the pump head assemblies.

4.3.2 Additional recommendations for aqueous eluents

After running with an aqueous eluent the pump should always be thoroughly purged with pure, distilled water to prevent salt precipitation.

4.4 Replacing the piston seal

If there are signs of liquid leaking between the pump head and the housing side panel or the volume of the rinsing solution has increased or decreased, replace the piston seal of the leaking pump head.

CAUTION! Do not disassemble the pump head unless there is good reason to believe that the seal is leaking. Always ensure that sufficient spare components are available before attempting to replace the piston seal. It is not possible to reinstall a used piston seal after removal.

Note: *The power must be switched OFF when removing and refitting the pump heads.*

Note: *Always replace the piston seals on both pump heads at the same time. An even better practice is to replace all four piston seals.*

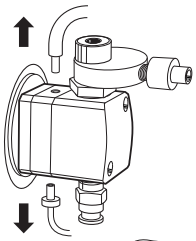
Spare parts and tools required:

Seal kit containing (see Reference information Dfor code no.):
2 or 4 piston seals
2 or 4 rinse membranes
1/4 inch wrench (supplied with the pump)
3 mm allen key (supplied with the pump)
Screwdriver (supplied with the pump)

Note: *After a new seal has been installed, the pump should be run in, see section 4.5 Running-in a new piston seal.*

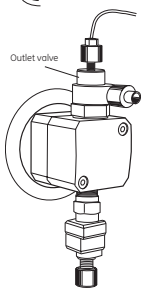
Note: *Before disassembling the pump heads move all input buffers bottles below the level of the pump heads to prevent siphoning.*

CAUTION! Read the following instructions carefully. The individual parts of the pump head can be assembled incorrectly. Take care to ensure that the orientation of each part is correct before continuing with the next instruction.

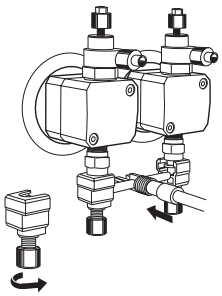


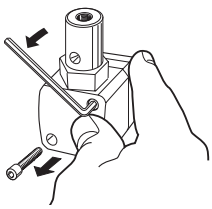
1 Switch off the pump at the mains power switch on the back panel. Remove the piston seal rinsing system. The connectors are simple plug-in fittings.

2 Completely loosen the tubing connector on the outlet valve.



3 If the pump is equipped with Switch Valves SV-903, first remove the switch valves and disconnect the tubing. Unscrew the two white knurled screws under the pump to release the support bracket locking the inlet manifold into the inlet valve. Gently lower and remove the complete manifold.

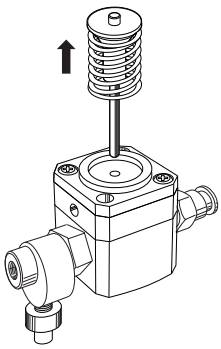




4 Using the Allen key, unscrew and completely remove *one* of the two Allen screws locking the pump head in position.

5 When unscrewing the second locking screw, push firmly on the front face of the pump head to compensate for the pressure of the piston return spring. Hold the pump head firmly to prevent it from twisting. Remove the second screw and, without allowing the pump head to twist sideways, carefully pull it out.

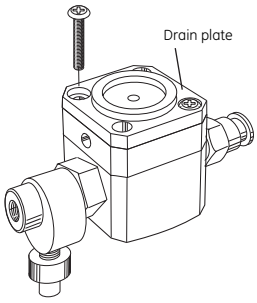
6 Place the pump head face down on the bench. Pull out the piston together with the return spring.

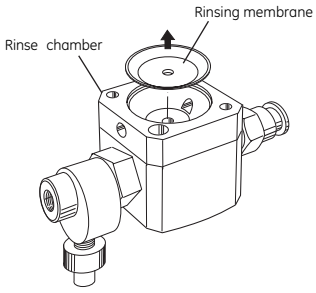


7 Inspect the piston and return spring for sign of damage. If damaged, they should be replaced.

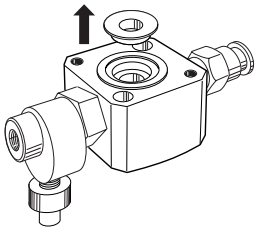
8 Wipe the piston with a clean cloth. If salt solutions have been used the piston may be slightly corroded. This corrosion can be removed with a rubber eraser. If it cannot be wiped or rubbed clean, scrape off any deposits with a scalpel or razor blade. Inspect the piston with a magnifying glass for scratches. Replace with a new piston if any scratches or cracks are found.

9 Remove the two screws securing the drain plate and the rinse chamber. Remove and discard the rinsing membrane. Remove the rinse chamber. For P-903, remove also the support washer.





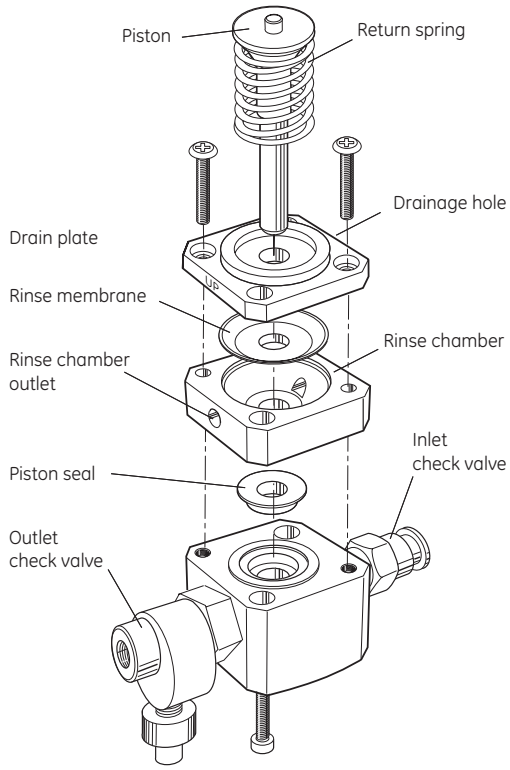
10 Gently withdraw the piston seal. Discard the used seal.



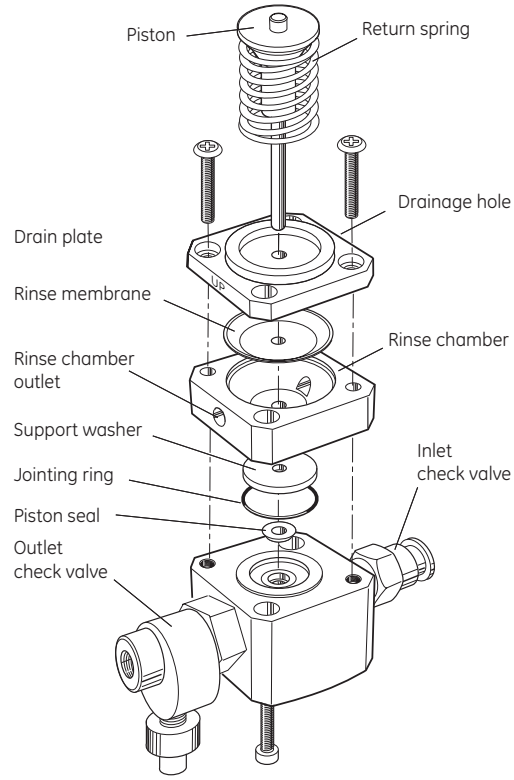
11 The pump head, rinse chamber and drain plate should be carefully rinsed or cleaned in an ultrasonic bath, if available. If dirt can be seen on any surfaces, the inlet and outlet check valves should be removed and cleaned separately *(see section 4.7)*

12 Wet the new seal slightly and place it in the hole on the pump head and press it down into position with a hard flat object For P-903, refit the support washer on top of the new seal.

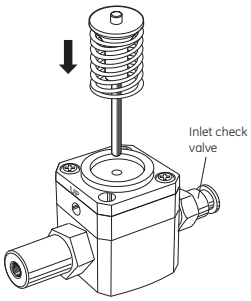
13 With the pump head still facing downwards on the bench, place the rinse chamber onto the head with the rinse ports in line with the inlet and outlet check-valves. The conical depression in the rinse chamber should be facing upwards, ready to accept the new rinsing membrane. Fit the rinsing membrane with the conical face downwards.



P-901



P-903

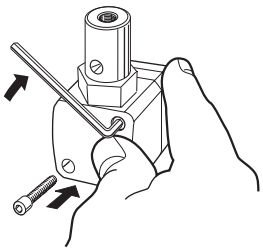


14 Place the drain plate on top of the assembly. Use the two screws to lock the complete assembly together.

Note: *Align the drainage hole in the drainage plate with the inlet check valve (the opposite side of the pump head marked OUT/UP).*

15 Wipe clean the piston and remove all finger prints. Wet the piston and then insert it into the return spring. With the pump head facing downwards on the bench, insert the piston into the pump head by pushing it gently but firmly vertically downwards into the seal.

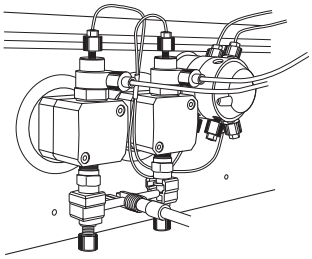
CAUTION! Do not push the piston at an angle to the head and DO NOT twist the piston.



16 Turn the head so that the inlet valve and drainage hole are facing downwards and the text UP/OUT on the pump head is facing upwards. Mount the complete pump head over the locating pins on the front panel. Locate the metal end of the piston and the spring towards the drive cam.

Hold the pump head firmly against the side panel of the housing with one hand. Do not allow the assembly to twist under pressure from the return spring. Using the Allen key, fit and tighten one of the Allen screws. Fit and tighten the remaining Allen screw.

WARNING! Incorrectly fitted tubing may loosen, causing a jet of liquid to spray out. This is especially dangerous if hazardous chemicals are in use. Connect the tubing by first inserting the tubing fully, then tightening the connector fingertight. Finally tighten the connector a further 1/4 turn using the key supplied.



17 Reconnect the outlet tubing to the outlet check valve and the manifold block as described above.

18 Reconnect the inlet manifold and, if used, the switch valves.

19 Refit the tubing of the piston seal rinse system.

20 The pump should now be purged and the new piston seal carefully run-in following the instructions in section 4.5.

4.5 *Running-in a new piston seal*

The piston seal should be run-in using 100% methanol.

CAUTION! To protect the pump seals, always ensure that there is a constant supply of eluent. The pump should never be allowed to run dry.

1 Ensure that the reservoir is filled with sufficient eluent. Immerse the inlet tubing in the eluent. The reservoir should be placed at least 30 cm above the pump inlet.

2 Connect a male Luer syringe of about 30 ml to the open end of the purge tubing.

3 Connect the male Luer connector at the other end of the purge tubing to the left purge valve at pump module module A.

4 Turn the purge valve counterclockwise half a turn to open it and slowly draw eluent to the syringe.

5 When fluid starts to enter the syringe continue to draw a few millilitres before closing the purge valve. Check that there is no air left in the inlet tubing.

6 Repeat steps 3 to 5 for pump module B, if fitted.

7 Check that the outlet tubings are not blocked.

8 Connect a thin capillary or a column that will give sufficient back pressure.

9 Run at the following flow rates for 15 minutes:
P-901 1 ml/min (or 2 ml/min 50%B)
P-903 0.1 ml/min (or 0.2 ml/min 50%B)

10a For P-901, run at 20 ml/min (or 40 ml/min 50%B) at a backpressure of 2–5 MPa for 15 minutes.

10b For P-903, run at 2 ml/min (or 4 ml/min 50%B) at a backpressure of 5–10 MPa for 2 hours, or longer if possible (e.g. overnight).

11 Finally, change the eluent according to the description given in section 3.9.

4.6 Replacing a damaged piston

Typical symptoms of a damaged piston are observed as excessive piston seal wear, unstable pressure, a reduction in the flow or, in some cases, noise as the piston moves. The piston should be removed, examined for damage or salt precipitation and then replaced with a new piston if necessary.

If a damaged piston has been in operation, the piston seal will be destroyed and should also be replaced. To replace the piston and the seal follow the instructions in section 4.4 *Replacing the piston seal*.

In addition to the spare parts listed in section 4.4, the following are required (see *Reference information D* for code no.):

P-901, Piston kit, 100 ml

or:

P-903, Piston kit, 10 ml

4.7 Cleaning the inlet and outlet check valves

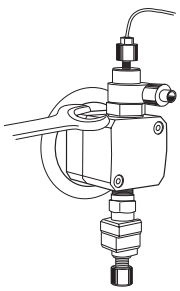
Faulty operation of the check valves is usually indicated by irregular flow, very low flow or unstable pressure traces. Probable causes of this are air or dirt in a check valve preventing it from closing to seal and hold the pressure.

Record the pressure (see section 5.4) and identify the faulty check valve by observing which pump head is delivering the flow (see section B.1.1).

First try to clean the check valves in–place on the pump head by pumping 100% methanol for approximately 10 minutes. If this does not correct the problem, follow the instructions for removing and then cleaning the valves.

Note: *Change solvent to distilled water and flush out all salt before removingthe check valves*.

Tools required: A 13 mm and a 1/4 inch wrench.



4.7.1 Cleaning after removal

Before removing the check valves, move all input buffers bottles below the level of the pump heads, to prevent siphoning.

1 If the condition of the check valve is not improved by in–place cleaning, disconnect and remove the inlet manifold and outlet tubing.

2 Use the 13 mm wrench to remove the valve from the pump head.

CAUTION! Handle the check valves with care when they have been removed from the pump heads to prevent loss of any internal components.

3 Immerse the complete valve in methanol and place in an ultrasonic bath for some minutes.

Then repeat the ultrasonic bath with distilled water.

4 Refit the check valves. The inlet check valve (with a lip for the manifold and a larger diameter opening) is fitted to the side marked IN of the pump head. Tighten the valves until fully finger-tight and then use the 13 mm wrench to tighten a further 1/3rd (110o) of a turn. Do not over-tighten the valves since damage to the internal components can occur.

WARNING! Incorrectly fitted tubing may loosen, causing a jet of liquid to spray out. This is especially dangerous if hazardous chemicals are in use. Connect the tubing by first inserting the tubing fully, then tightening the connector fingertight. Finally tighten the connector a further 1/4 turn using the key supplied.

5 Refit the outlet tubing and the inlet manifold.

6 Purge the pump carefully and check that the pumping action has been corrected. See section 2.8.

Note: *Check valves have precision matched components and should only be disassembled further by a trained service engineer. If the problem cannot be corrected, the valve should be replaced completely.*

5 Trouble shooting

5.1 General

When contacting GE Healthcare for support, state the program version of the instrument, shown for 2 seconds during switch-on.

It is recommended to make a pressure recording since much information can be gained from the pressure trace. see section *5.4 Checking the pump pressure*, for more information.

WARNING! The instrument must not be opened by the user. It contains high voltage circuits which can give a lethal electric shock.

5.2 Faults and actions

If the suggested actions do not correct the fault, call GE Healthcare.

Fault	Action
No text on the front display	1 Check that the mains cable is onnected and the power switch is in ON-position I. 2 Check the mains power supply.
Erratic flow, noisy baseline signal, irregular pressure trace	
Air bubbles passing	1 Check that there is sufficient eluent present in the through or trapped in the pump reservoirs. 2 Check all connections for leaks. 3 Follow the instructions in section *5.5 Removing trapped air* bubbles from the pump.
Inlet or outlet check valves not functioning correctly	1 Follow the instructions in section *4.7 Cleaning the inlet and outlet check valves*. 2 Clean the valves in-place. If improvement is not seen, remove the valves and clean again.
Piston seal leaking	1 Replace the piston seal according to the instructions in section *4.4 Replacing the piston seal*.
Blockage or part blockage	1 Flush through to clear blockage. 2 If necessary, replace tubing. 3 Check inlet tubing filter. It can become clogged if unfiltered buffers or samples are applied. See instructions for flushing through at the end of the run in section *3.8 Ending the run and storage*.
Liquid leaking between the or worn pump head and the side panel	Piston seal or rinsing membrane incorrectly fitted 1 Replace or re-install the seal or membrane. 2 Run-in carefully, see section *4.5 Running-in a new piston seal*.

Fault	Action
Low eluent flow and noise as the pistons move	1 Disassemble pump head and examine the piston spring according to section *4.4 Replacing the piston seal*. Replace if necessary. 2 If spring is corroded, check piston seal and rinse membrane. Ensure that piston rinsing system is always used when working with aqueous buffers with high salt concentration. 3 Check the piston for damage. If damaged, replace the piston according to section *4.6 Replacing a damaged piston*. 4 Remember to replace the piston seal and rinse membrane with new items.
Leaking connection and/or crystalized material around a connector	1 Unscrew the connector and check if it is worn or incorrectly fitted. If so replace the connector. 2 Gently tighten the connector with your fingers.
Error in external chart recorder	1 Check the chart recorder in accordance with its manual.

5.3 Error messages

If the suggested actions do not correct the fault, call GE Healthcare

Message	Action
ERROR No mixer **Check connection!** **ERROR in mixer.** **Check mixer!**	1 Switch off the instrument. 2 Check the connections to the mixer. 3 Switch on the instrument.
ERROR in valve x **Check connections!**	1 Switch off the instrument. 2 Check the connections to the valve(s). 3 Switch on the instrument.
ERROR Pump too warm **Check fans!**	1 Switch off the instrument to let it cool. 2 Clean or clear the front air inlet. 3 Switch on the instrument and check that the fans are running.
ERROR Sync failure **Please restart!**	1 Switch off the instrument. 2 Switch on the instrument. Remember to open the purge valves before synchronization.
ERROR key (OK) **ERROR key (Esc)** **ERROR key (OK+Esc)** **ERROR 100** **ERROR 109-113** **ERROR 120-121**	1 Switch off the instrument. 2 Check all connections. 3 Switch on the instrument.
ERROR 106-108 **ERROR 118**	1 Switch off the instrument. 2 Check all UniNet1 and UniNet 2 connections. 3 Switch on the instrument.

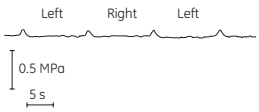
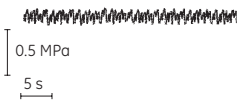
5.4 Checking the pump pressure

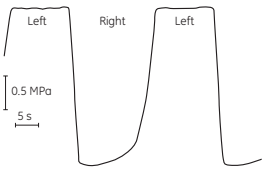
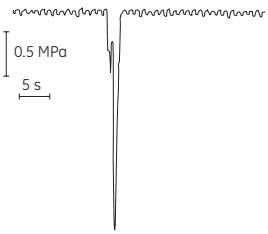
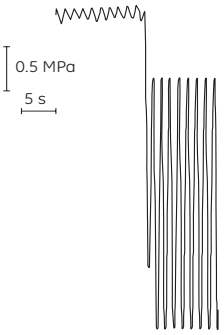
To check the pump function, a recording of the pressure can be made (see section B.2.2), or by checking the pressure in UNICORN. This pressure recording is more sensitive than the reading on the display. By observing the piston stroke indicator in the **Check menu** (see section B.1.1) together with the pressure trace, the pump head which is functioning abnormally can be identified.

There can be several causes of an abnormal pressure recording, for example:

- air trapped in the pump heads
- partially blocked solvent filters
- leaking connections
- piston seal leakage
- check valve malfunction
- piston damaged

Some examples of normal and abnormal pressure traces together with comments are shown in the following table.

Result	Running conditions	Diagnosis
P-901 	Flow rate: 1.00 ml/min Pressure: 2.0 M Recorder 1 V, 1 mm/s Pump setup: Full Scale 10 MPa	Pump performance Pasatisfactory Active head, left and right are shown The small pressure peaks are caused by the pump principle
	Flow rate: 30 ml/min Pressure: 7.5 MPa Recorder 1 V, 1 mm/s Pump setup: Full Scale 10 MPa	Pump performance satisfactory
P-903 	Flow rate: 1.00 ml/min Pressure: 12.0 MPa Recorder 1 V, 2 mm/min Pump setup: Full Scale 25 MPa	Pump performance satisfactory

Result	Running conditions	Diagnosis
P-901 	Flow rate: 1.00 ml/min Pressure: 2.0 MPa Recorder 1 V, 1 mm/s Pump setup: Full Scale 10 MPa	Left pump head OK, right pump head not working Possible causes: • Bad or missing seal • Large leakage in inlet check valve • Inlet opened or blocked
	Flow rate: 20 ml/min Pressure: 4.3 MPa Recorder 1 V, 1 mm/s Pump setup: Full Scale 10 MPa	Air bubbles passing through pump heads, then the trace returns to normal
P-903 	Flow rate: 2 ml/min Pressure: 4.3 MPa Recorder 1 V, 1 mm/s Pump setup: Full Scale 10 MPa	One pump head stops working. Possible causes: • Air bubble stuck in pump head • Large leakage in one pump head • Large leakage in one inlet check valve • Inlet open or blocked

5.5 Removing trapped air bubbles from the pump

During routine operation, the presence of air bubbles in the pump heads is seen as an erratic flow, a noisy detector signal or an irregular pressure recording. With air bubbles trapped in the pump, the pressure reading on the display will fluctuate considerably.

To remove the air from the pump:

1 If the air has accumulated because of a leaking connector, correct the fault.

2 Ensure that the inlet filter is fully immersed in eluent.

3 Purge the pump according to section 2.8 Purging the pump.

If the problem remains, try to remove the air bubbles in accordance with the method described below. Use 100% methanol.

1 Run at 40 ml/min for P-901, or 4 ml/min for P-903.

2 Continue to run for 10 minutes, or until the air bubble is removed.

3 Change the eluent according to the description given in section 3.9.

A Description

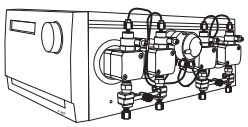
A.1 Instrument

Pump P-900 is a high performance laboratory pump for use in liquid chromatography and other applications where accurately controlled liquid flow is required.

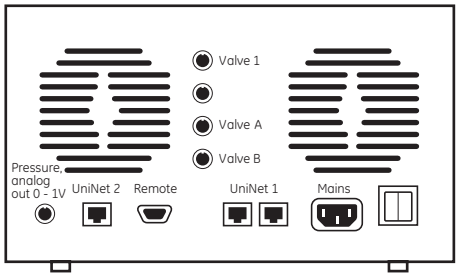
An eluent in an external vessel is drawn into the inlet manifold by the action of the pump. Twin reciprocating pump heads work in unison to deliver a smooth, low-pulsation flow from the pump outlet manifold.

Pump P-900 features:

- P-901
  - Pressure range 0–10 MPa (100 bar, 1450 psi).
  - Flow rate range 0.01–100 ml/min isocratic and gradient mode.
  - Double mode flow rate range of 0.01–200 ml/min isocratic mode.
- P-903
  - Pressure range 0–25 MPa (250 bar, 3625 psi).
  - Flow rate range 0.001–10 ml/min isocratic and gradient mode.
  - Double mode flow rate range of 0.001–20 ml/min isocratic mode.



- The pumps are equipped with 2 pump modules, A and B, including two pump heads each. This allows for binary gradients with high pressure mixing.
- All pumps has a pressure sensor connected to pump module A.
- Low pulsation.
- Switch-valve control for low pressure gradients and BufferPrep.



Connector/switch	Function
Pressure analogue out 0-1V	Pressure signal to chart recorder
UniNet 2	Connection to mixer M-925 and UniNet 2 network
Remote	Input for remote on/off and output for pressure alarm
UniNet 1	Connection UniNet-1 network
Mains	Supply voltage, grounded
0/1	Instrument on/off switch
Valve A, B	Connection to switch valves. A and B used for BufferPrep. When pump used for one pump gradients as stand-alone, valve A should be used.
Valve 1	Connection for an additional switch valve for buffer selection when used as stand–alone

The instrument contains no internal user replaceable items.

Connect any auxiliary equipment to the 9-pole D-SUB female REMOTE connector (5 V TTL signals only).

Pin	Signal	Function Active status = low or closed terminal to pin 5 (0 V)
1	Remote run/pause	active = pause
2–4	–	
5	0V	Signal ground
6	Pressure alarm output	active = alarm
7–9	–	

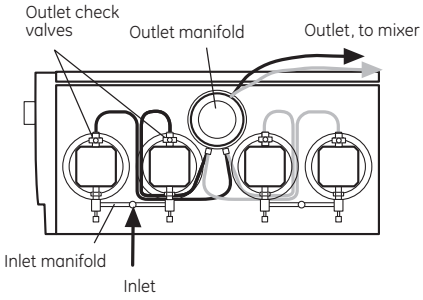
When used in combination with UNICORN and a custom-designed strategy, 4 digital inputs and 4 digital outputs can be handled via the REMOTE connector. Pin 1–4 can then be used as inputs, and pin 6–9 as outputs. All input/output signals are 5 V TTL signals.

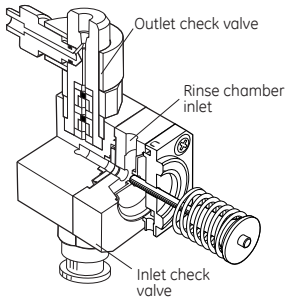
A.2 Pump head

The pump consists of one or two pump modules, A and B. Each pump module consists of two pump heads. The individual heads are identical but are actuated in opposite phase to each other by individual stepper motors controlled by a microprocessor. This gives a continuous, low pulsation, liquid delivery.

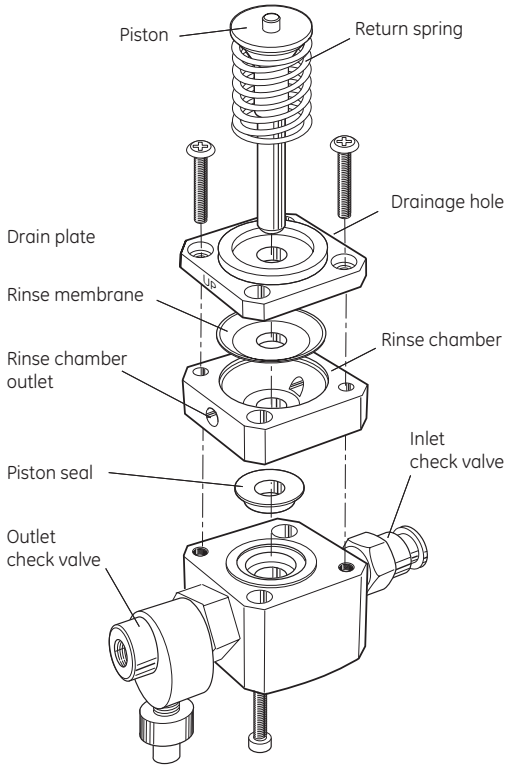
Each outlet check valve houses a purge valve, a fingertight connector. It is used for draining any unwanted eluents or to remove air from the system. The purge valve is opened by turning it counterclockwise half a turn.

The inlet to each pump head is fed from a common manifold. Solvent is drawn up into the pump head through a non-return check valve by the action of the piston being withdrawn from the pump chamber.

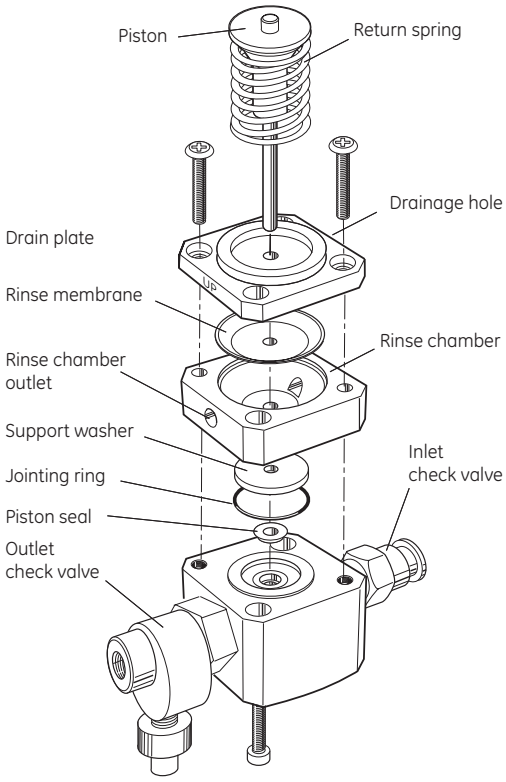




On the delivery stroke of the piston, the inlet valve is sealed by the pressure developed and eluent is forced out through a similar check valve at the outlet.



P-901



P-903

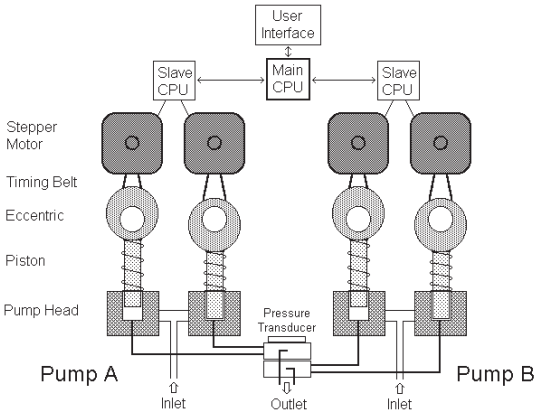
The pistons are actuated by cams (eccentrics) driven by the motors. Force for the retraction of the pistons is provided by coil springs. The length of stroke of the pistons is fixed and changes in the flow rate are made by varying the speed of the drive motor.

Leakage between the pump chamber and the drive mechanism is prevented by a piston seal. The pistons and seals are continuously lubricated by the presence of eluent. To prevent any deposition of salts from aqueous eluents on the piston and to prolong the life of the seals, the low pressure chamber behind the pump head can be flushed continuously with a low flow of distilled water. The flexible rinsing membrane sweeps the piston and seals the rinsing system.

The pump head is manufactured in titanium alloy.

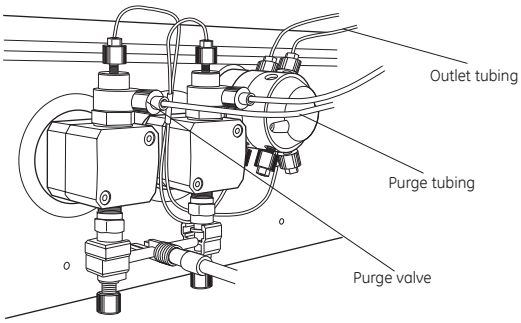
A.3 Pump principle

Each piston is driven by a simple robust cam (eccentric). These cams are driven by stepper motors via timing belts. The motor speed is varied to achieve linear movement and compensation for compressibility. This produces the particular motor sound. This system guarantees an accurate, low pulsation flow over the entire flow rate range, independent of the back pressure. When an increase in flow rate is programmed, the motor speed accelerates gradually, giving a soft start and building up speed to the flow rate required. When a decrease in flow rate is programmed, the motor speed reduces rapidly to the lower flow rate.



A.4 Outlet manifold

The outlet of each pump is connected by tubing to a manifold block where the liquids from both heads are combined to give continuous eluent delivery. The tubing and the manifold block are made in PEEK. The manifold block houses the outlet connections to the mixer.



A.5 Pressure monitoring

The pressure in the system is continuously monitored by the pressure transducer housed in the outlet manifold block of pump module A. In a two-pump module configuration with the pump modules connected to a mixer, the pressure is (almost) the same in pump A and B.

The output pressure is shown in the display together with the flow rate. A continuous recording of the pressure may be made using the analog output. For the protection of the system, a maximum and minimum pressure limit can be set.

A.6 Using an external chart recorder

The facility for recording the actual pressure at the pump outlet can be used for recording the pressure during an overnight run and for checking the pump function for any abnormality.

The external chart recorder output for pressure is 0–1 V. The full scale range is set under sub menu **Set Pr Full Scale** under **Setup**, see *Reference information B.2.2*.

B Menus

B.1 Check menu

B.1.1 Checking piston stroke

To enable trouble shooting it is possible to check which pump module head that delivers flow.

1 Select main menu **Check**, press OK.

Check Heads 2.30MPa

2 The display shows the status of the pistons for both pump modules. A: Left means that the left pump head is delivering flow in the A pump and B:Right the right pump head in the B pump. At the changing point **both** are displayed. The A pump is closest to the front panel.

B.1.2 Check pump operation time

1 Select main menu **Check**, press OK.

Check Total Run Time

2 Select sub menu **Check Total Run Time**. The display shows the accumulated operation time (**Run** and **Hold** mode) for the A and B pumps.

B.1.3 Check number of piston strokes

1 Select main menu **Check**, press OK.

Check Piston Strokes

2 Select sub menu **Check Piston Strokes**. The display shows the accumulated number of piston strokes for the A and B pumps.

B.1.4 Check Service Mode

Check Service Mode

Service information relevant to the instrument can be checked. Information may not be available in all menus.

Telephone Service 012345678901

1 Select main menu **Check**, press OK.

Contract Number 012345678901

2 Select sub menu **Check Service Mode**, press OK.

Serial Number 01234567 YM 012345

3 The service telephone number[1] is displayed, press OK.

Pump P-900 V1.00

4 The service contract number[1] is displayed, press OK.

5 The instrument serial number is displayed, press OK.

Date of Maintenance ?

6 Instrument name and software version are displayed, press OK.

Buzzer Test

7 The date of the last service is displayed, press OK.

8 A test of the instrument buzzer is performed, press OK.

[1] Not always pre-programmed. Depends on customer-specific contract.

B.1.5 Calibrate Pressure Offset

1 Ensure that the pump is at zero pressure.

2 Select main menu **Check**, press OK.

Calib Press Offset

3 Select sub menu **Calib Press Offset**, press OK. "Working, please wait ..." is displayed until the calibration is completed.

B.2 Setup menu

B.2.1 Set pressure limit

Sets high and low pressure limits. When the limit is reached the pump is set in **Pause** mode, a buzzer sounds and an error message **Overpressure** (on ascending pressure) or **Underpressure** (on descending pressure) is shown. The message has to be confirmed by pressing OK.

Setup Hi Press Limit

1 Select sub menu **Setup Hi Press Limit,** press OK.

2 Set the value, press OK.

Setup Lo Press Limit

3 Repeat step 1 and 2 for **Setup Lo Press Limit**.

B.2.2 Set pressure full scale on recorder

Sets the full scale pressure for the chart recorder output. The full scale value will correspond to 1 V output on the analog output.

1 Select sub menu **Setup Pr. Full Scale**, press OK.

Setup Pr. Full Scale

2 Set the value, press OK.

B.2.3 Set pressure unit

Sets the pressure unit used in the display.

1 Select sub menu **Setup Pressure Unit**, press OK.

Setup Pressure Unit

2 Select either **MPa, bar** or **psi**, press OK.

B.2.4 Set gradient base

Sets the base for the gradient to either time or volume.

1 Select sub menu **Setup Gradient Base**, press OK.

Setup Gradient Base

2 Select either **time** or **volume**, press OK.

B.2.5 Set gradient mode

Sets one-pump gradient (1), two-pump gradient (2) or double (D) flow rate mode. The one-pump mode is used for low pressure gradient formation with switch valve SV-903. Two-pump mode is only available with both A and B pumps installed, and varies the speed of each pump for high pressure gradient formation. Double mode allows for double max flow, and is only possible with both A and B pump modules installed. In double mode, the two pump modules are working in parallel with Conc. %B locked to 50%.

Setup Gradient Mode

1 Select sub menu **Setup Gradient Mode**, press OK.

2 Select either **1,2** or **D**, press **OK**.

Note: Selecting one pump gradient mode disables the B pump module. Gradient mixing is not possible in double mode.

B.2.6 Set pump type

Sets the size of pump modules used for pump A and B, either 100 ml/min or 10 ml/min.

Setup Pump-A Type

1 Select sub menu **Setup Pump-A Type**, press OK.

2 Select either **100 ml** or **10 ml,** press OK.

Setup Pump-B Type

3 Select sub menu **Setup Pump-B Type**, press OK.

4 Select either **100 ml** or **10 ml,** press OK.

B.2.7 Set compression compensation

A compensation function can be selecteded, to compensate for flow losses due to compression at high pressure. When the compensation function is selected, the pump takes into consideration the stated compressability for the liquid, at the actual pressure. For methanol at 25 MPa, for example, the loss in flow is reduced from 10% to 1%. However, since this compensation may affect the reproducability, it should only be used when exact flow rate is required. A compressability value between 4.0×10^{-10} Pa^{-1}– 15.0×10^{-10} Pa^{-1} can be stated. Some common values are given below:

Liquid	Value in Pa^{-1}
Water	4.6×10^{-10}
Methanol	12.1×10^{-10}
Most organic solvents (±15%)	~ 11×10^{-10}

Note: The compensation function is only available for P-903 using 10 ml pump heads.

1 Select main menu **Setup**, press OK.

Setup Compr. comp
(off) off on

2 Select sub menu **Setup Compr. comp**, press OK.

3 Select **On** to activate, or **Off** to deactivate compensation. Press OK.

Setup Comp A
(4.0E-10) 4.0

4 Enter a compensation value between 4.0 and 15.0 for pump module A.

Setup Comp B
(4.0E-10) 4.0

5 Enter a compensation value between 4.0 and 15.0 for pump module B.

B.2.8 Set mixer operation

Sets the condition of the mixer connected to the pump.

1 Select sub menu **Setup Mixer**, press OK.

Setup Mixer

2 Select either **auto, off** or **on**, press OK. "Auto" means the mixer is running when the pump is in **Run, Pause** or **Hold** mode.

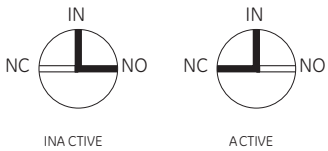
B.2.9 Set valve operation

Sets the condition of any switch valve SV-903 connected to the pump.

1 Select sub menu **Setup Valve 1**, press OK.

Setup Valve 1

2 Select either **off** or **on**, press OK.



B.2.10 Setup language

Sets the language used in the display.

1 Select sub menu **Setup Language** press OK.

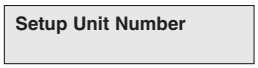
Setup language
(GB) GB D F E I

2 Select the desired language.

GB = British English
D = German
F = French
E = Spanish
I = Italian

B.2.11 Setup unit number

The unit number is the identification the pump has on the UniNetbus. It should correspond to the number set in UNICORN for the pump. The number should be set to 0 if one pump is used. If more than one pump is used they must all have different identification numbers.:



1 Select sub menu **Setup Unit Number**, press OK.

2 Select unit number (0–25), press OK.

B.2.12 Setup display angle

The display angle can be set to compensate for different viewing heights.

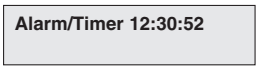
1 Select main menu **Setup**, press OK.

2 Select sub menu **Set Display Angle**, press OK.

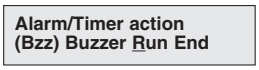
3 Select viewing angle (->\ Up, ->| Mid or ->/ Down), press OK.

B.3 Alarm timer

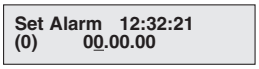
You can set the alarm function to either a fixed alarm time or using a count-down timer. The pump can be started or stopped automatically, or an alarm can sound, at the set time. It is not possible to set both an alarm time and a count-down timer. Current values are shown in parentheses.



1 Select main menu **Alarm/Timer**, press OK.

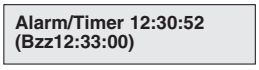


2 Set the action to take place. Press **OK** to select action. **Buzzer** will generate an audible alarm for 15 s and a message. **Run** will start the pump at the set flow rate, **End** will stop the pump, each generating one beep and a message.

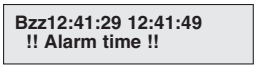


3 Use the sub menu **Set Alarm**, if you want to set an alarm at a fixed time. Press OK to enter the time value in the form **HH.MM.SS**, pressing the OK button after entering each time unit.

4 If you want to set a count-down timer, turn the dial to select sub menu **Set Timer.** Press OK to enter the countdown value in the form **HH.MM.SS**, pressing the OK button after entering each time unit.



5 Press ESC button to return to the **Alarm/Timer** menu which now shows the set alarm time or count-down time as **BzzHH:MM:SS**.



6 When the alarm time is due or the count-down timer reaches 00:00:00, an alert display is shown and the instrument beeps, until the OK button is pressed.

Set Clock **(00:36:53) 00:36:53**

The alarm timer is based on the internal instrument clock which can be set in the **Set Clock** menu placed after the **Alarm/Timer** menu. The clock will be reset when power is turned OFF.

Alarm/Timer off? **(Buzz 05:15:00)**

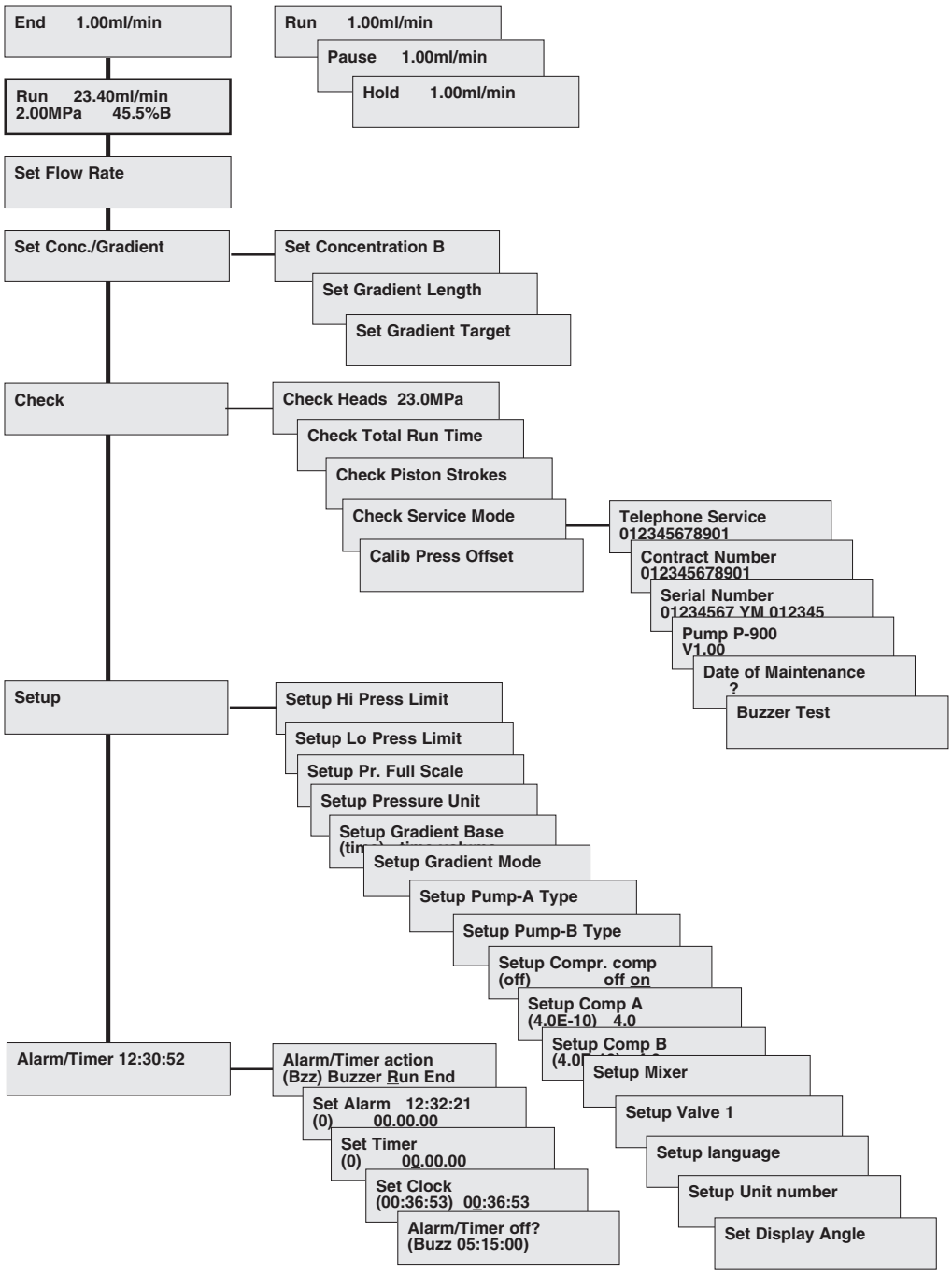
An already set alarm/timer function can be reset by pressing OK in the menu **Alarm/Timer off?**

B. 4 Service displays

Enter Access Code!

The instrument has service displays for use by authorised service personnel. If the service display **Enter Access Code:** is accidentally selected, press the ESC-button to exit to the normal operation display.

B.5 Menu overview



C Technical specifications

C.1 Operating data

The specifications are valid only at pressures higher than 0.2 MPa.

Flow rate range	
P-901;	
isocratic mode	0.01–100 ml/min in steps of 10 µl/min
gradient mode	0.01–100 ml/min in steps of 10 µl/min
double mode;	0.01–200 ml/min in steps of 10 µl/min
P-903;	
isocratic mode	0.001–10 ml/min in steps of 1 µl/min
gradient mode	0.001–10 ml/min in steps of 1 µl/min
double mode;	0.001–20 ml/min in steps of 1 µl/min
Pressure range	
P-901	0–10 MPa (100 bar, 1450 psi)
P-903	0–25 MPa (250 bar, 3625 psi)
pH stability range	1–13, 1–14 (<1 day exposure)
Viscosity	Max. 5 cP
Flow rate accuracy	
P-901;	
0.2–10.0 MPa	±2% or 20 µl/min whichever is greater
P-903;	
0.2–25.0 MPa	±2% or 2 µl/min whichever is greater, with compression compensation activated
Flow rate reproducibility	
P-901;	
Flow rate ≥0.5 ml/min	rsd < 0.5%
P-903;	
Flow rate ≥0.05 ml/min	rsd < 0.5%
Gradient composition	
P-901;	
accuracy	<±1% at 0.5–100 ml/min
reproducibility	rsd <0.25% at 0.5–100 ml/min
P-903;	
accuracy	<±1% at 0.05–10 ml/min
reproducibility	rsd <0.25% at 0.05–10 ml/min
Pressure sensor	
Range	0–27.5 MPa
Offset error	<0.05 MPa
Scale error	<±2%
Environment	+4 to +40 °C 20–95% relative humidity 84–106 kPa (840–1060 mbar)

C.2 Physical data

Delay volumes Total volume between inlet and outlet (per pump module)	
P-901	<800 µl/module
P-903	<600 µl/module
Inlet- and outlet tubing	UNF 10-32 2B "Fingertights" with capillary tubing 1/16" outer diameter
Control	Stand alone or from a PC running UNICORN version 2.20 or higher, through UniNet 1 cable connection.
Degree of protection Housing	IP 20
Wetted materials	
Piston	Aluminium oxide
Pump head	Titanium alloy
Pump seal;	
P-901	PE (polyethylene) and stainless steel (Elgiloy)
P-903	PTFE (polytetrafluoroethylene) and stainless steel (Hastelloy)
Check valve	PTFE (polytetrafluoroethylene), PVDF (polyvinylidene-fluoride), titanium and ruby/sapphire.
Output manifold	PEEK, Kalrez and stainless steel (Hastelloy)
Chemical resistance	The wetted parts are resistant to organic solvents and salt buffers commonly used in chromatography of biomolecules, except 100% Ethylacetate, 100% Hexane, and 100 % Tetrahydrofuran (THF).
Power requirement	100–240 V AC, 50–60 Hz
Power consumption	Up to 400 VA including accessories
Digital input	5 V TTL low or contact closure (see section A.1 for pin significance)
Digital output	TTL, open collectors
Recorder output	0–1 V full scale
Functions	Languages selectable; English, German, Spanish, French, Italian
Display	2 rows with 20 characters each
Dimensions, H x W x D	150 x 260 x 370 mm
Weight	17 kg

Compliance with standards	The declaration of conformity is valid for the instrument only if it is: • used in laboratory locations • used in the same state as it was delivered from GE Healthcare except for alterations described in the User Manual • connected to other CE labelled GE Healthcare modules or other products as recommended.
Safety standards	This product meets the requirement of the Low Voltage Directive (LVD) 73/23/EEC through the following harmonized standards: • EN 61010-1 • IEC 61010-1 • CAN/CSA-C22.2 No. 61010-1 • UL61010-1
EMC standards	This device meets the requirements of the EMC Directive 89/336/EEC through the following harmonized standards: • EN 61326 (emission and immunity) • EN 55011, GR 2, Class A (emission) • This device complies with part 15 of the FCC rules (emission). Operation is subject to the following two conditions: 1 This device may not cause harmful interference. 2 This device must accept any interference received, including interference that may cause undesired operation.

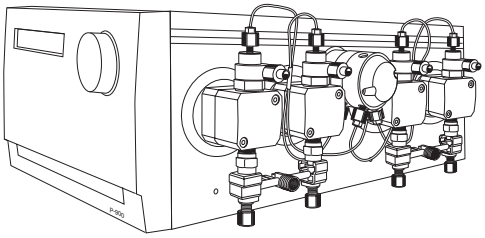
D Accessories and spare parts

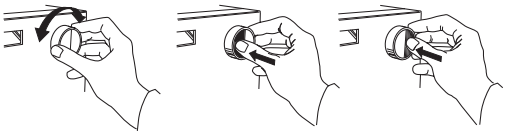
Item	Quantity per pack	Code no.
P-901 Stand-alone	1	18-1114-00
P-901 System mounted	1	18-1108-56
Seal kit in4cluding 4 piston seals and 4 rinse membranes:		
Seal kit, 100 ml:	1	18-1113-12
Piston kit, 100 ml	1	18-1112-13
Pump head capillaries 100 ml	1	18-1117-52
Rinsing/draining housing 100 ml	1	18-1112-03
Pump head, 100 ml complete	1	18-1128-48
Inlet manifold, 100 ml, UNF 5/16”	1	18-1112-25
P-903 Stand-alone	1	18-3000-00
P-903 System mounted	1	18-3100-00
Seal kit including 4 piston seals and 4 rinse membranes:		
Seal kit, 10 ml:	1	18-1120-77
Piston kit, 10 ml	1	18-1120-75
Pump head capillaries 10 ml	1	18-1120-81
Rinsing/draining housing 10 ml	1	18-1120-76
Pump head, 10 ml complete	1	18-1128-47
Inlet manifold, 10 ml, UNF 5/16”	1	18-1120-80
Recorder cable	1	18-1110-64
Check valve kit, including: 1 inlet check valve, 1 outlet check valve	1	18-1128-66
Switch Valve SV-903	1	18-1114-49
Mixer M-925	1	18-1118-89
Mixer chamber 0.6 ml	1	18-1118-90
Mixer chamber 2 ml	1	18-1118-91
Mixer chamber 5 ml	1	18-1118-92
Mixer chamber 12 ml	1	18-1118-93
Purge valve	1	18-1128-87
O-ring for purge valve	10	19-0036-01
Inlet filter set	10	18-1113-16
Inlet tubing kit, i.d. 1/8”, o.d. 3/16”,	1	18-1114-40
Inlet tubing kit, i.d. 1.0 mm , o.d. 1/8”	1	18-1119-26
Tubing kit for rinsing system	1	18-1113-32
Purge kit	1	18-1124-53
Inlet filter assembly	2	18-1113-15

Item	Quantity per pack	Code no.
Teflon tubing, i.d. 1/8", o.d. 3/16"	3 m	18-1112-47
Teflon tubing, i.d. 0.063", o.d. 1/8"	3 m	18-1121-16
Tubing connector for 1/8" o.d. tubing	10	18-1121-17
Tubing connector for 3/16" o.d. tubing	10	18-1112-49
Ferrule for 1/8" o.d. tubing	10	18-1121-18
Ferrule for 3/16" o.d. tubing	10	18-1112-48
Stop plug, 5/16"	5	18-1112-50
Stop plug, 1/16"	5	18-1112-52
Union Luer female/1/16" male	2	18-1112-51
Union 1/16" female/M6 male	6	18-1112-57
Union M6 female/1/16" male	8	18-1112-58
PEEK tubing, i.d. 0.50 mm, o.d. 1/16"	2 m	18-1113-68
PEEK tubing, i.d. 0.75 mm, o.d. 1/16"	2 m	18-1112-53
Teflon tubing, i.d. 0.75 mm, o.d. 1/16"	2 m	18-1112-54
PEEK tubing, i.d. 1.0 mm, o.d. 1/16"	2 m	18-1115-83
Fingertight connector 1/16"	10	18-1112-55

12 Short instructions

The following short instructions are intended as a guide to users who are fully familiar with safety precautions and operating instructions described in this manual. The instructions assumes that the instrument is installed according to the installation instructions.





Selftest

Pump synchronization

End 0.00ml/min
0.00MPa 0.0%B

Set Flow Rate

End 2.50ml/min

Run 2.50ml/min
2.0MPa 0.0%B

Set Gradient Length

Set Gradient Target

Run 2.50ml/min

1 **Switch on the instrument** by means of the mains switch on the rear panel.

2 Press **OK** to start synchronisation.

3 The **main operating menu** is shown.

4 Set the flow rate.

5 Start the pump by setting it in **RUN**-mode.

6 The **main operating menu** is shown.

7 Start a gradient by setting the **Gradient Length** and **Gradient Target**.

8 Stop the pump by setting it in **END**-mode.

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