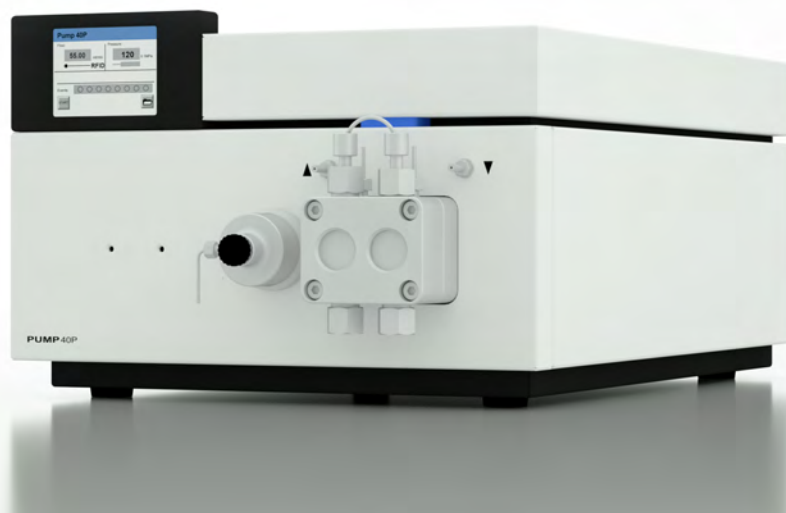


BlueShadow

Pump 40P Instructions



Document no. V7610

HPLC



Note: For your own safety, read the instructions and observe the warnings and safety information on the device and in the instructions. Keep the instructions for future reference.

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1. Product information

1.1 Intended use



Note: Only use the device for applications that fall within the range of the intended use. Otherwise, the protective and safety equipment of the device could fail.

The device or system is suitable for high-pressure liquid chromatography. It is suitable for laboratory use, for analyzing substance mixtures that can be dissolved in a solvent or solvent mixture.

- Operating range**
- Biochemistry analyses
 - Chiral analyses
 - Food analyses
 - Pharmaceutical analyses
 - Environmental analyses

1.2 Views

Front view

Legend

- ① Touchscreen
- ② Pressure sensor
- ③ Ventilation screw
- ④ Tube connections for the piston backflushing
- ⑤ Pump head

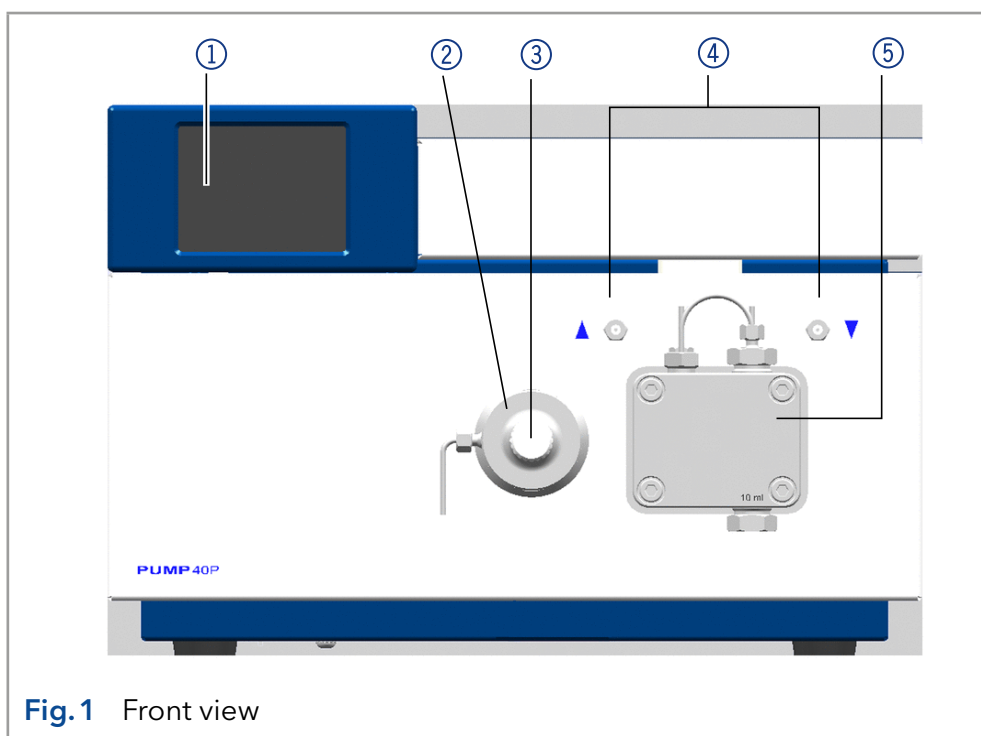


Fig.1 Front view

Rear view

Legend

- ① Serial number
- ② Manager connection
- ③ Terminal strip: Events
- ④ Testing seal
- ⑤ LAN connection
- ⑥ Warning 1
- ⑦ RS-232 port
- ⑧ Fan opening
- ⑨ Terminal strip: Remote
- ⑩ Warning 2
- ⑪ Power switch
- ⑫ Mains power connection
- ⑬ CE mark

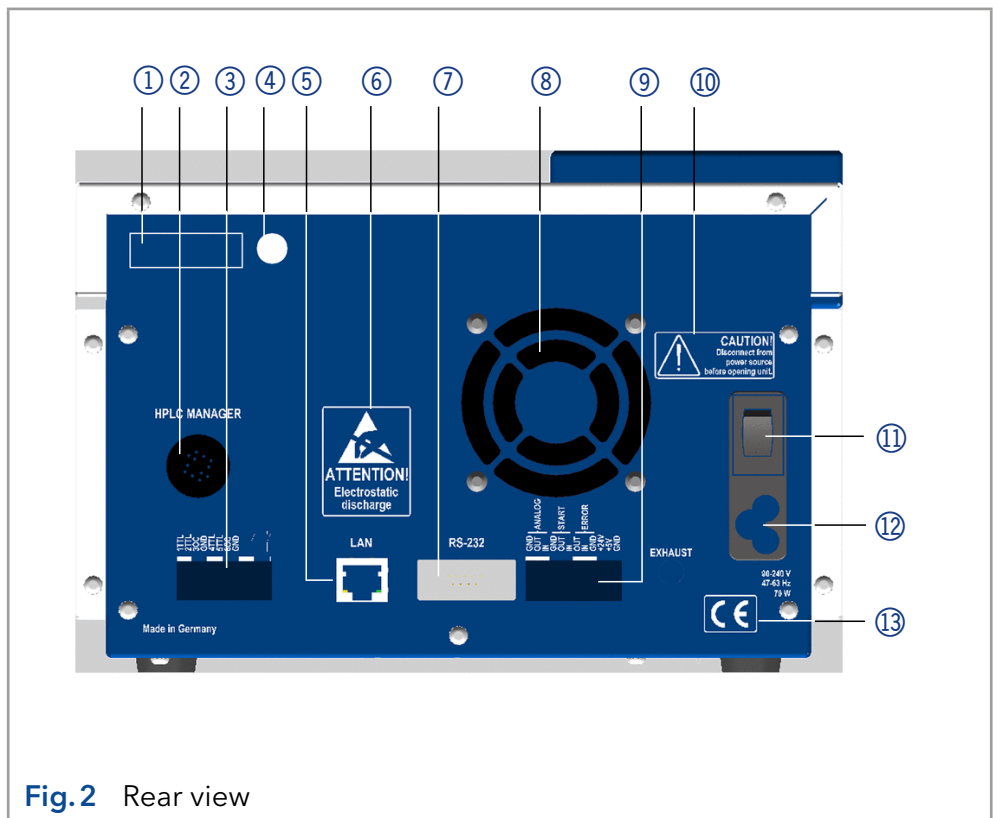


Fig.2 Rear view

1.4 Features

- Dual-piston technology combined with optimized electronic pulsation dampening and compressibility compensation
- Liquid transport with low pulsation, stable flow rate and high flow accuracy
- Pump head made of stainless steel or with titanium inlays
- Automatic piston backflushing
- Ultra-precise gradient mixtures throughout entire flow range
- High physical and chemical stability
- Direct pump control via analog and digital signals
- Control with chromatography software

1.5 Pump heads



Note: Due to the new drive used in the pump, pump heads of older series cannot be used any more.

Available pump head types:

- Pump head 10 ml, for use in analytical applications, standard version made of stainless steel. Ceramic inlays for biocompatible applications.
- Pump head 50 ml, for use in semi-preparative applications, standard version made of stainless steel. Ceramic inlays for biocompatible applications.

Labeling on pump heads

The front of the pump head is labeled with the max. pumping capacity (10 ml or 50 ml). Pump heads with inlays carry additional material labels (SST for stainless steel, C for ceramic).

Automatic pump head recognition

The pump automatically recognizes the pump head by means of an RFID chip.

2. Scope of delivery

Legend

- ① Capacity
- ② Material

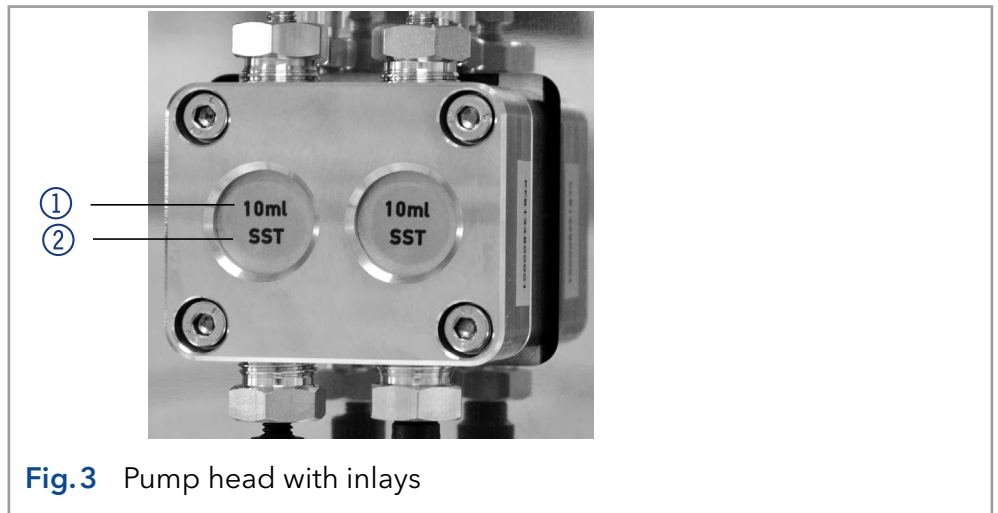


Fig.3 Pump head with inlays



Note: Only use original parts and accessories made by KNAUER or a company authorized by KNAUER.

- Pump with installed pump head
- Cables
 - Power supply cable for Germany
 - Power supply cable for United Kingdom (optional)
 - Power supply cable for USA (optional)
 - Network cable
 - RS-232 port cable
 - 2 x flat ribbon cable, 10-pos.
- Set of connector strips, 12-pos.
- Kit for deaeration of the pump
- Tools
- Silicon tubing
- Single-use syringe 10 ml
- 1 x Screw fitting 1/8"
- 2 x Seal ring 1/8"
- Stainless steel eluent filter

Valid documents:

- Instructions (document no. V7610)
- Declaration of conformity

3. Basic safety instructions

3.1 Target group

This document address persons who are qualified as chemical laboratory technicians or have completed comparable vocational training.

The following knowledge is required:

- Fundamental knowledge of liquid chromatography
- Knowledge regarding substances that are suitable only to a limited extent for use in liquid chromatography
- Knowledge regarding the health risks of chemicals
- Participation during an installation of a device or a training by the company KNAUER or an authorized company.

If you do not belong to this or a comparable professional group, you may not perform the work described in these instructions under any circumstances. In this case, please contact your superior.

3.2 Safety equipment

When working with the device, take measures according to lab regulations and wear protective clothing:

- Safety glasses with side protection
- Protective gloves
- Lab coat

3.3 What must the user take into account?

- All safety instructions in this document
- The environmental, installation, and connection specifications in this document
- National and international regulations pertaining to laboratory work
- Original spare parts, tools, and solvents made or recommended by KNAUER
- Good Laboratory Practice (GLP)
- Accident prevention regulations published by the accident insurance companies for laboratory work
- Filtration of substances under analysis
- Use of inline filters
- Once the capillaries have been used, never re-use them in other areas of the HPLC system.
- Only use a given PEEK fitting for one specific port and never re-use it for other ports. Always install new PEEK fittings on each separate port.
- Follow KNAUER or manufacturer's instructions on caring for the columns.

More safety-relevant information is listed below:

- flammability: Organic solvents are highly flammable. Since capillaries can detach from their screw fittings and allow solvent to escape, it is prohibited to have any open flames near the analytical system.
- solvent tray: Risk of electrical shock or short circuit if liquids get into the device's interior. For this reason, place all bottles in a solvent tray.
- solvent lines: Install capillaries and tubing in such a way that liquids cannot get into the interior in case of a leak.
- leaks: Regularly check if any system components are leaking.
- power cable: Defective power cables are not to be used to connect the device and the power supply system.
- self-ignition point: Only use eluents that have a self-ignition point higher than 150 °C under normal ambient conditions.
- power strip: If several devices are connected to one power strip, always consider the maximum power consumption of each device.
- power supply: Only connect devices to voltage sources, whose voltage equals the device's voltage.
- toxicity: Organic eluents are toxic above a certain concentration. Ensure that work areas are always well-ventilated! Wear protective gloves and safety glasses when working on the device!

Where is use of the device prohibited?

Never use the system in potentially explosive atmospheres without appropriate protective equipment. For further information, contact the Technical Support of KNAUER.

Secure decommissioning





Take the device completely out of operation by disconnecting the power plug from the power supply (wall socket or power strip).

Opening the device

The device may be opened by the KNAUER Technical Support or any company authorized by KNAUER only.

3.4 Warning notifications

Possible dangers related to the device are divided into personal and material damage in these instructions.

Sign	Meaning
	DANGER (red) indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	WARNING (orange) indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION (yellow) indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
	NOTICE (blue) is used to address practices not related to physical injury.

3.5 Decontamination

DANGER

Life-threatening injuries

Health danger if getting in contact with toxic, infectious or radio-active substances.

- Before disposing of the device or sending it away for repair, you are required to decontaminate the device in a technically correct manner.

Contamination of devices with toxic, infectious or radioactive substances poses a hazard for all persons during operation, repair, sale, and disposal of a device.

All contaminated devices must be properly decontaminated by a specialist company or the operating company before they can be recommissioned, repaired, sold, or disposed of. All materials or fluids used for decontamination must be collected separately and disposed of properly.




Decontamination Report

Devices without a completed Decontamination Report will not be repaired. If you would like to return a device to KNAUER, make sure to enclose a completed Decontamination Report with the device:

<http://www.knauer.net/en/knowledge/downloads/service.html>

4. Symbols and signs

The following symbols and signs can be found on the device:

Symbol	Meaning
	Electric shock hazard
	Electrostatic discharge hazard, damages to system, device, or components may occur.
	A device or system marked with CE fulfills the product specific requirements of European directives. This is confirmed in a Declaration of Conformity.

5. Unpacking and setup

Only if the requirements for ambient conditions of the operating environment are met, can the intended use be ensured. Details on the operating conditions can be found in the chapter „Technical Data“.

NOTICE

Device defect

The device overheats at exposure to sunlight and insufficient air circulation. Device failures are very likely.

- Set up the device in such a way that it is protected against exposure to direct sunlight.
- Leave room for air circulation: See paragraph „space requirements“.

5.1 Operating environment

5.1.1 Space requirements

- At least 5 cm space if another device is set up on one side
- At least 10 cm space if further devices are set up on both sides
- At least 15 cm space on the rear panel for the fan.
- Make sure that the power plug on the power supply (wall mounted socket or power strip) is always accessible, so that the device can be disconnected from the power supply.

5.1.2 General requirements

- Position the device on a level and even surface.
- Protect the device against direct exposure to sunlight.
- Set up the device at a location not exposed to air drafts (A/C systems).
- Do not set up the device near other machines that cause floor vibrations.
- Keep the device away from high-frequency sources. High frequencies may compromise measuring values.
- Avoid sources of high frequencies near the device. High-frequency sources may compromise measuring values.

5.2 Unpacking

- Prerequisite**
- Check packaging for damage caused during transportation. If necessary, put forward any claim for damages to the carrier.
- Tool**
- Utility knife

⚠ CAUTION

Bruising danger

Damage to the device by carrying or lifting it on protruding housing parts. The device may fall and thus cause injuries.

- Lift the device only centrally on the side of the housing.

Process

Steps

1. Set up the package in such a way that you can read the label. Using the utility knife, cut the adhesive tape and open the packaging.
2. Remove the foam insert. Take out the accessory kit and the instructions.
3. Open the accessory kits and check the scope of delivery. In case any parts are missing, contact the Technical Support.
4. Clasp the device from below, lift it out of the packaging and place it on its feet. Do not hold onto the front cover.
5. Check the device for signs of damage that occurred during transport. In case you notice any damage, contact the Technical Support.
6. Place the device in its site of operation and remove protective foil.

5.3 Power supply



Note: To disconnect the pump from the power supply, disconnect the power plug on the rear of the device.

Prerequisites

- The electrical power supply at the installation site must be connected directly to the nearest main power line.
- The power must be free from ripple, residual current, voltage peaks and electromagnetic interference.
- The connectors for the mains voltage are grounded accordingly.
- The device receives sufficient power with reserve capacity.

Power cable

- Use only the enclosed power cable to connect the device to the power supply to make sure that the specifications are met which are described in the chapter "Technical Data".
- Beforehand, make sure to use power cables which are admitted for use in your country.
- Replace defective power cables only with accessories from KNAUER.
- Do not replace detachable power cables with different cable types.

NOTICE

Electronic defect

Electronic hazard when using an identically constructed power adapter from another manufacturer.

→ Only use spare parts and accessories from KNAUER or a company authorized by KNAUER.

Power plug

- The device is intended for use with AC power networks of 100-240 V.
- Make sure that the power plug on the power supply (wall mounted socket or power strip) is always accessible, so that the device can be disconnected from the power supply.

5.4 Electric connections

- Use the Events and Remote terminal strip to connect the pump with external devices.
- Use the LAN connection to connect the pump with external devices within a network.
- Alternatively, connect the pump to a computer with the RS-232 port.

NOTICE

Electronic defect

Electrostatic discharge can destroy the electronics.

→ Wear a protective bracelet against electrostatic discharge and ground.

5.4.1 Connecting cables to the terminal strip

To control one device through another, you use the multi-pin connector. To use remote control, you have to connect cables to the terminal strip (both included with delivery). The single ports are used to exchange control signals.

- Prerequisite**
- The device is turned off.
 - The power plug is pulled.

Tools Operating tool

NOTICE

Electronic defect

Connecting cables to the multi-pin connector of a switched on device causes a short circuit.

→ Turn off the device before connecting cables.

→ Pull the power plug.

NOTICE

Electronic defect

Electrostatic discharge can destroy the electronics.

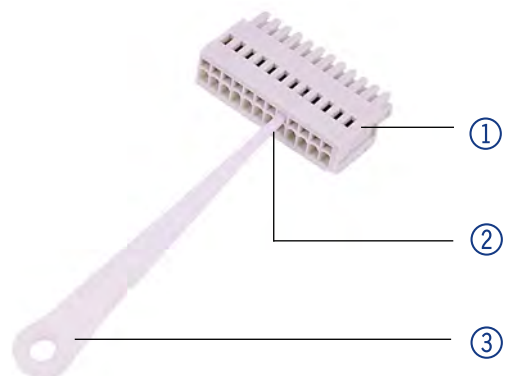
→ Wear a protective bracelet against electrostatic discharge and ground.

Process

Steps

Figure

1. Push the operating tool ③ into an upper small opening on the front of the terminal strip ①.
2. Lead the cable into the opening ② below the inserted operating tool.
3. Remove the operating tool.



Next steps

- Check if the cables are firmly attached.
- Push the terminal strip onto the multi-pin connector.
- Finish the installation.
- Put the device into operation.

5.4.2 Terminal strip: remote

- For receiving start, control and error signals from external devices
- For sending start, control and error signals to external devices

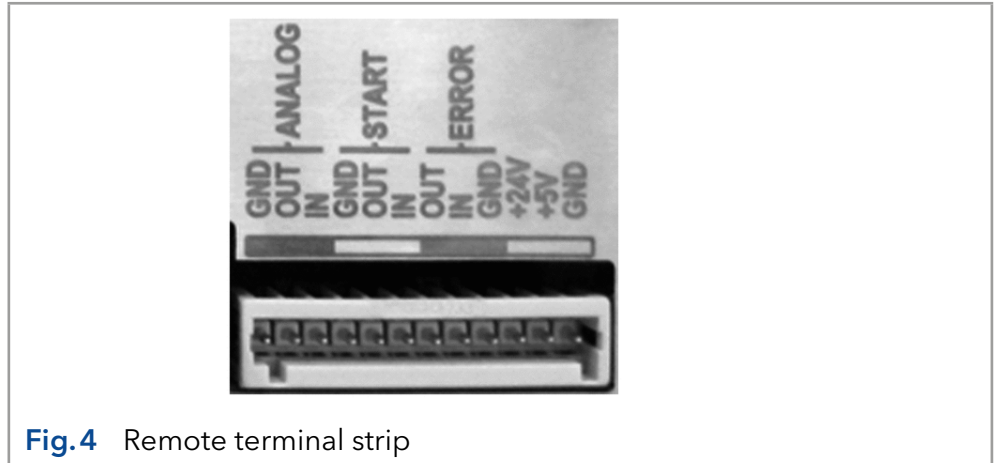


Fig.4 Remote terminal strip

Signal	Explanations
ANALOG: OUT	<ul style="list-style-type: none"> ■ Analog output signal reflecting either the measured system pressure or a control voltage for Pump B. ■ The output range can be set to values of max. 1, 2, 5 and 10 V.
ANALOG: IN	Analog input signal for controlling the flow rate, e.g.: <ul style="list-style-type: none"> ■ 1 V for 1 ml/min in the case of the 10 ml pump head ■ 1 V for 5 ml/min in the case of the 50 ml pump head.
START: OUT	Output is active for 500 ms when the pump starts.
START: IN	Program is activated by a voltage of 0 V against GND.
ERROR: OUT	Output is active until the Error condition has been eliminated.
ERROR: IN	A voltage of 0 V against GND stops the pump.

5.4.3 Terminal strip: Events

- Sending control signals (Events) to external devices
- Opening and closing contacts
- Activating 500 ms pulses

Legend

- ① Status display Events
- ② Terminal strip: Events

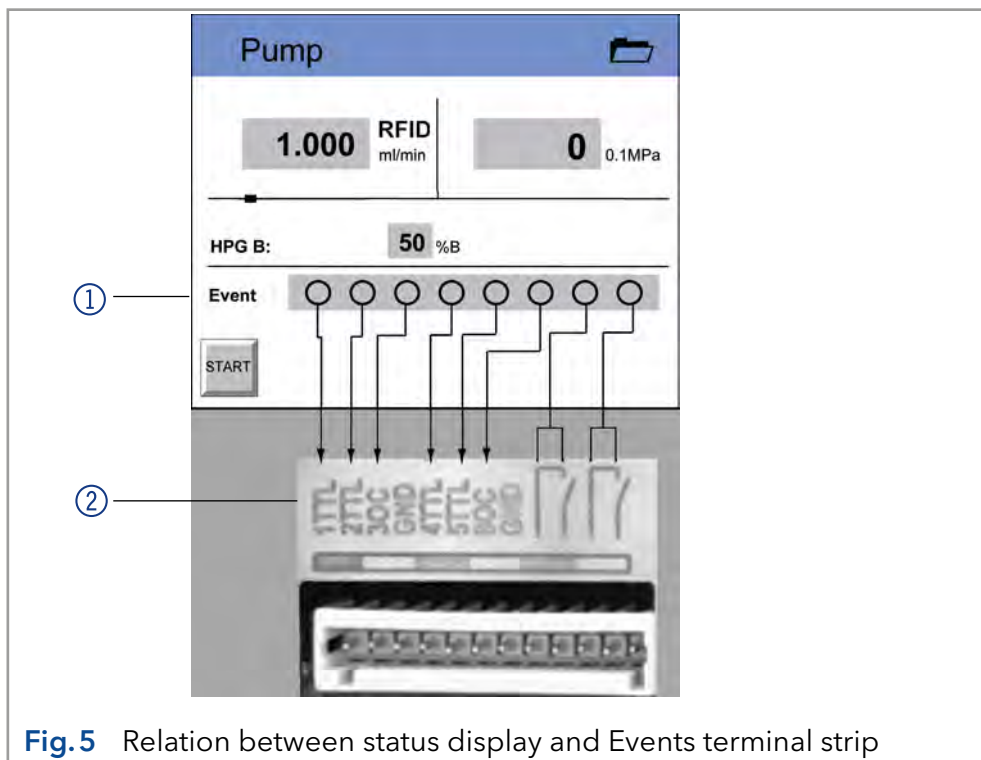


Fig.5 Relation between status display and Events terminal strip

5.5 Connecting device to computer via LAN

5.5.1 Connecting the device to the computer



Note: HPLC devices made by KNAUER work only with IP addresses which are assigned via IPv4. IPv6 is not supported.

This section describes how to set up an HPLC system in a local area network (LAN) and how a network administrator can integrate this LAN into your company network. The description applies to the operating system Windows and all conventional routers.

To set up a LAN, we recommend to use a router. That means the following steps are required:

Process	Steps
	<ol style="list-style-type: none"> 1. On the computer, go to the control panel and check the LAN properties. 2. Hook up the router to the devices and the computer. 3. On the computer, configure the router to set up the network. 4. Install the chromatography software from the data storage device. 5. Switch on the device and run the chromatography software.

5.5.2 Configuring the LAN settings

The LAN uses only one server (which is normally the router) from that the devices automatically receive their IP address.

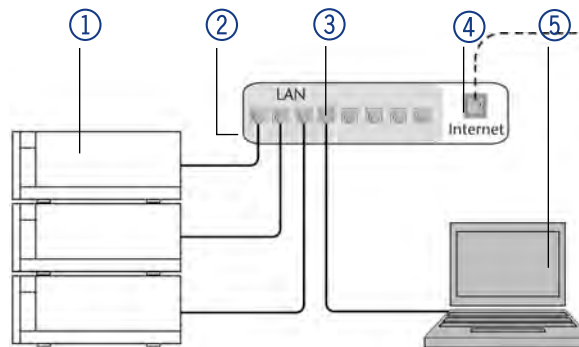
- Prerequisites**
- In Windows, power saving, hibernation, standby, and screen saver must be deactivated.
 - In case you use an USB-to-COM box, the option „Allow the computer to turn off this device to save power“ in the devicemanager must be deactivated for all USB hosts.
 - For all LAN devices: For the network adapter, the following option in the Device Manager must be deactivated: „Allow the computer to turn off this device to save power“.

Process**Steps**

1. In Windows open the Network and Sharing Center.
2. Double-click on LAN Connection.
3. Click on the button Properties.
4. Select Internet Protocol version 4 (TCP/IPv4).
5. Click on the button Properties.
6. Check the settings in the tab General. The correct settings for the DHCP client are:
 - a) Obtain IP address automatically
 - b) Obtain DNS server address automatically
7. Click on the button OK.

5.5.3 Connecting the cables

A router ② has several LAN ports ③ and one WAN port ④ that can be used to integrate the LAN into a wide area network (WAN), e.g. a company network or the Internet. In contrast, the LAN ports serve to set up a network from devices ① and a computer ⑤. To avoid interference, we recommend operating the HPLC system separately from the company network.



You will find a RJ45 patch cable for each device and the router in the accessories kit. To connect the router to a WAN, an additional patch cable is required, which is not supplied within the scope of delivery.

Prerequisites

- The computer is switched off.
- There is a patch cable for each device and the computer.

Process**Steps**

1. Use the patch cable to connect the router and the computer. Repeat this step to connect all devices.
2. Use the power supply to connect the router to the mains power system.

5.5.4 Configuring the router

The router is preset at the factory. You find information about IP address, user name and password in the router instructions:

<https://goo.gl/ahGhmG>

Process**Steps**

1. To open the router configuration, start your Internet browser and enter the IP address (not valid for all routers).
2. Enter user name and password.
3. Configure the router as DHCP server.
4. In the router configuration, check the IP address range and make changes if necessary.



Note: If the IP address range has been changed, it is necessary to note it down.

Result Once the router has assigned IP addresses to all devices, the chromatography software can be used to remotely control the system.

5.5.5 Integrating the LAN into a company network

A network administrator can integrate the LAN into your company network. In this case you use the WAN port of the router.

Prerequisite ■ There is a patch cable.

Process

Steps

1. Check that the IP address range of the router and of the company network do not overlap.
2. In case of an overlap, change the IP address range of the router.
3. Use the patch cable to connect the router WAN port to the company network.
4. Restart all devices, including the computer.

5.5.6 Controlling several systems separately in a LAN

Devices connected to a LAN communicate through ports, which are part of the IP address. If more than one HPLC system is connected to the same LAN and you plan on controlling them separately, you can use different ports to avoid interference. Therefore, the port number for each device must be changed and this same number must be entered into the device configuration of the chromatography software. We recommend to use the same port number for all devices in the same system.



Note: The port is set to 10001 at the factory. You must use the same numbers in the device configuration of the chromatography software as in the device, otherwise the connection fails.

Process

Steps

1. Find out port number and change it on the device.
2. Enter the port number in the chromatography software.

Result The connection is established.

6. Startup

6.1 Running-in procedure



Note: It is mandatory to perform a running-in procedure after a pump head maintenance, or if new pump heads are installed on a pump.



Note: All pump heads are filled with Isopropanol prior to delivery. Please make sure to connect the correct solvent as described in the specification table found in the supplement „[Running-in procedure for pump heads \(V6894\)](#)“.

If a pump was not in operation for a long time, e.g. after shipment, a running-in procedure might be necessary to obtain the best pump performance. The pump head underwent this procedure during the manufacturing process.

NOTICE**Component defect**

Damage to the pump head in case running-in procedure was not performed correctly.

- Set the correct backpressure and flowrate for the running-in procedure of the pump head. Specific running-in parameters and the general procedure can be found in the supplement „[Running-in procedure for pump heads \(V6894\)](#)“.

NOTICE**Device defect**

If the pump is operated only with pure distilled water, significantly higher wear of the piston and the piston seals can be expected.

- If possible, only operate the pump with water together with the added additive or modifier.

6.2 Isocratic operating mode

- Analysis without gradients
- The solvent composition is constant during the analysis.
- The solvent can be recycled.

6.3 Optimizing HPLC separations

To make your HPLC separations as efficient as possible, pay close attention to the following:

Task	Explanation
Avoiding additional dead volumes	<ul style="list-style-type: none"> ▪ Once they have been used, never re-use capillaries in other areas of the HPLC system. ▪ Only use a given PEEK fitting for one specific port and never re-use it for other ports. Always install new PEEK fittings on each separate port.
Using special columns	Use special columns and follow the manufacturer's instructions on caring for the columns.
Checking for clogged capillaries	Regularly check for clogged capillaries - test back pressure without column!
Using filtered solvents	<ul style="list-style-type: none"> ▪ Use ultra-pure, filtered solvents - Gradient grade - for the HPLC. ▪ Filtration of substances to be analyzed. ▪ Use of inline filters.

7. Connecting the pump with other devices

7.1 RFID recognition

The pump head is equipped with an RFID chip. It is used to monitor and save all important parameters and settings of the pump and pump head.

Legend

① RFID designation

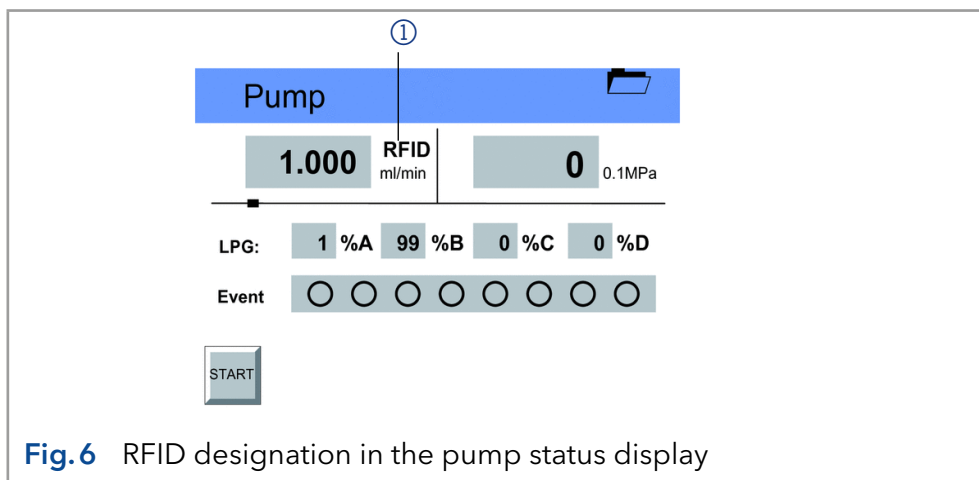


Fig.6 RFID designation in the pump status display

The RFID technology offers the following advantages:

- Automatic detection of all important pump head parameters by means of radio signals (radio frequency identification), by the pump software or the chromatography software:
 - Pump head type
 - Serial number and year of manufacture
 - Number of cycles and operating times
 - Limit values of the pump head parameters
- All measuring data archived in accordance with GLP (good laboratory practice)
- Transfer of all data to the software and pump display

7.2 Solvent line

- Make sure that all connections are tight
- Isocratic system: Connect the solvent reservoir to the pump, either directly or via an external degasser
- HPG system: Connect the respective solvent reservoir with the 2-channel degasser module of the pump or with an external degasser.



Note: The manufacturer recommends always using a degasser module to ensure reliable transport of the solvent as eluent.

7.2.1 Connecting the solvent line to the pump head in an isocratic system

Prerequisites

- The device has been switched off.
- The power plug has been pulled.
- The front cover has been removed.

Material

Flangeless fitting

NOTICE**Device defect**

Damage to pump head, device or system when inlet and outlet of the pump head are blocked.

→ Remove the cap fittings from the inlet and outlet of the pump head prior to use.

Procedure**Process**

1. Slide the flangeless fitting onto the tubing.
2. Insert the tubing into the free inlet ① on the bottom of the pump head.
3. Tighten the fitting by hand.

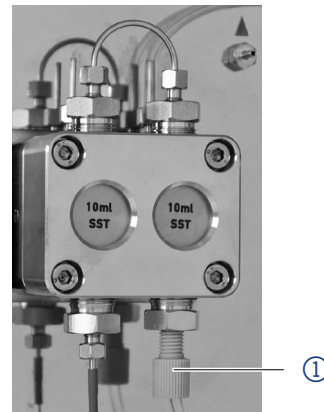
Figure

Fig.7 Solvent line on the pump head

Next steps Integrate the pump into the HPLC flow system.

8. Control



Note: Operator errors and clogged capillaries can cause high pressure spikes.



Note: To avoid damage to the pump head, never allow the pump to run without liquid in the pump head and piston backflushing components.

8.1 Touchscreen

Working without chromatography software

The touchscreen of the pump is suitable for the following tasks:

- Monitoring the device functions
- Using special programs for laboratory work:
 - Flushing program
 - Standby and Wake Up (WU) program
 - Program links (Link menu)
 - Programs for configuring the device (Setup menu)
 - Checking the system status as part of quality assurance measures in accordance with good laboratory practices (GLP menu)

8.1.1 Using the touchscreen

The touchscreen is subdivided into different areas.

Legend

- ① Status line
- ② To main menu
- ③ Parameters or value
- ④ Animated information diagram
- ⑤ Button for starting or stopping the function

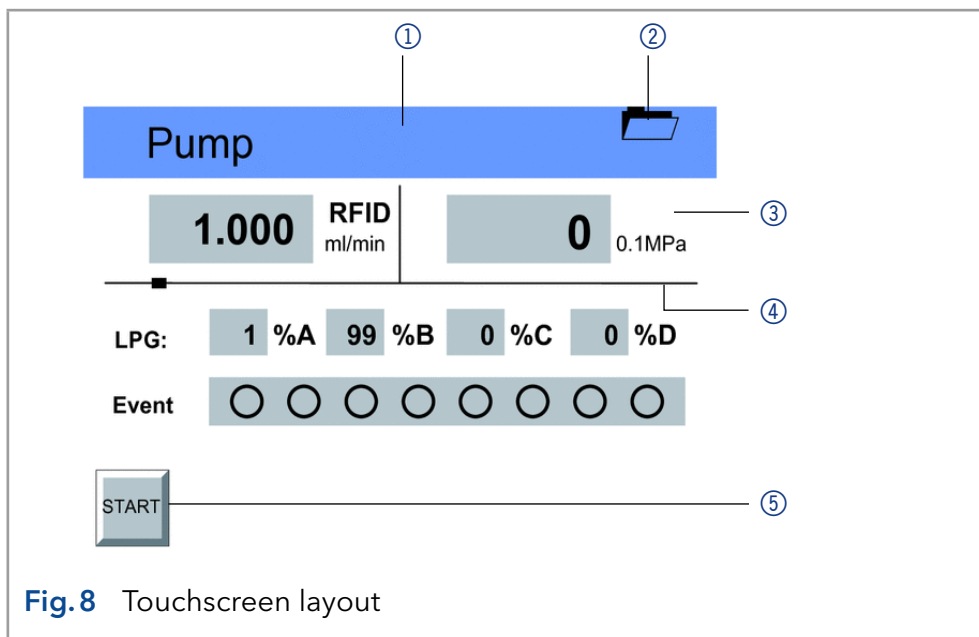


Fig.8 Touchscreen layout








Operating the touchscreen




All fields with a gray background are touch sensitive and can be edited. The buttons for setting or modifying functions are always labeled, e.g., START. The pump starts to work, for example, when you tap the button and the label on the button changes to STOP.



The pumps can be switched off at any time using the [STOP] button on the touchscreen. This function can also be used in remote mode in the chromatography software.

8.1.2 Overview of the touchscreen buttons

Button	Function	Explanation
	Scroll	Scroll through all functions
	One level up	Tap to move up one level
	Go to device status display	Press and hold for two seconds
	To Main menu	Tap to go to the Main menu
	Start device	Starts the device, e.g. a pump begins pumping.
	Emergency stop symbol touchscreen of the pump	This function can also be used in remote mode in the chromatography software.
	Saves the entry	-

Button	Function	Explanation
	Running a program	Starts previously configured program in Program menu
	Interrupt the program	-
	Stop program	-
Restart	Repeat program	-
Finish	Exit loaded program	-
Day	Confirm day	-
Month	Confirm month	-
Year	Confirm year	-
New	Create a new program line with time indication	-
Load	Load program	-
Edit	Edit program	-
Del/Delete	Delete a program	-
Tab	Table	Program line display

8.2 Switch-on and self-test

Process

Steps

1. Switch on the pump.
2. After turning on the device, the touchscreen displays Initialization - the device is running a self-test.
3. Wait until the pump has completed the self-test.
4. After the test has been successfully completed, the most recently active program will be displayed - the pump is now ready for operation.

8.3 Menu structure of the pump GUI

The pumps feature the following uniform structure for their software interface (graphical user interface, GUI):

- Creating programs (program menu)
- Creating program links (link menu)
- Data entry for selected solvent compressibility (solvent menu)
- Pump settings (setup menu)

- Device status displayed according to good laboratory practice (GLP menu)
- Function for switching device into standby-mode

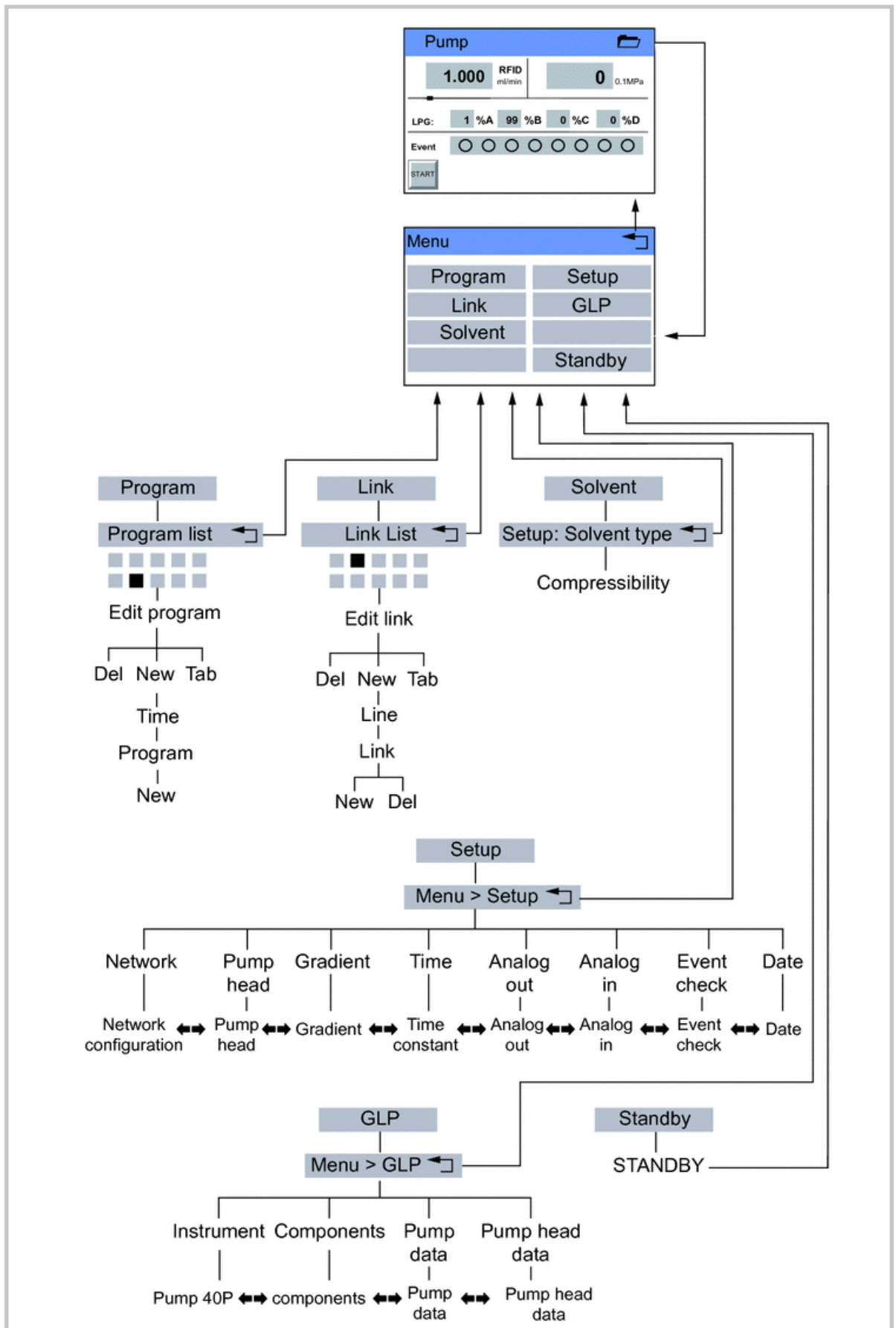


Fig.9 Menu structure pump GUI




8.4 Setting minimum and maximum pump pressure

The pump stops automatically if the pump pressure drops below the min. value or exceeds the max. value.

Min. pump pressure serves to prevent dry running of the pump and enables the pump to stop if there is a leak. If the minimum is set to 0, the minimum pump pressure is not monitored.




Process

Steps

1. In the status display, tap on the field with a gray background next to the pressure display to view the current settings in the Pressure Min/Max menu.
2. Use the numeric fields to enter the correct value for min. pressure.
3. Tap  to save the settings.
4. Use the numeric fields to enter the correct value for max. pressure.
5. Tap  to save the settings.
6. Tap  to move level up.



8.5 Configuring control signals

For test purposes or in some other cases, it can make sense to manually enter these signals.

Symbol	Explanation
	Off
	On
	Pulse

Process

Steps


1. In the status display, tap on the field with a gray background next to Event to view the current settings in the Select: Events menu.
2. Tap on the corresponding symbols to configure the control signals.
3. Tap  to save the settings.
4. Tap  to move level up.

8.6 Main menu

The main menu displays the Program, Link, Solvent, Setup, and GLP menu as well as the Standby Mode function.

Navigating the Main menu

Steps

1. Tap  to go to the Main menu.
2. Tap on desired menu.

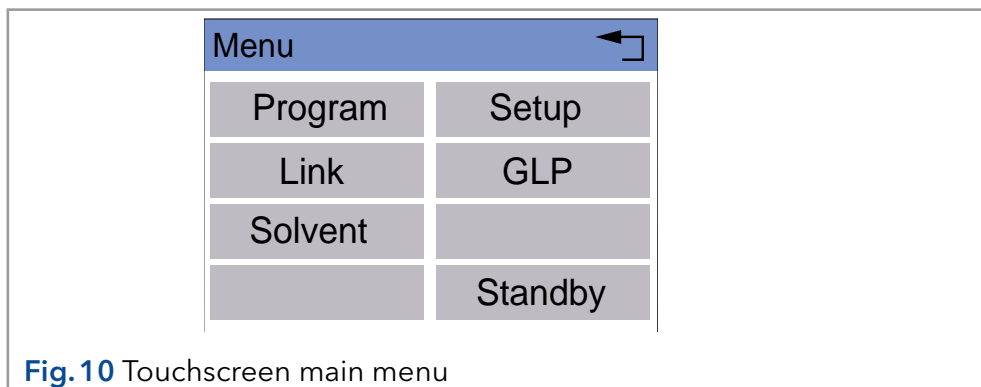




Fig. 10 Touchscreen main menu

8.7 Setup menu

In the Setup menu, fundamental parameters for controlling the pump are specified.

Navigating the Setup menu

Steps

1. Tap the Setup menu to display options.
2. Tap options to display the current pump parameters.
3. Tap the gray highlighted values to display all available parameters.
4. Tap the desired parameters.
5. Tap  to scroll through the other options in the Setup menu.
6. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.

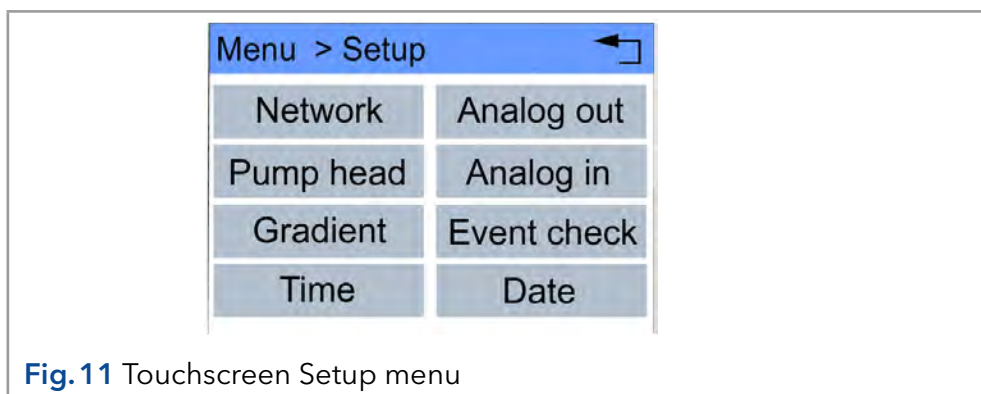



Fig. 11 Touchscreen Setup menu

8.7.1 Setup menu parameters

Value	Meaning
Analog in	<p>Calibration of the analog input of the Remote terminal strip, for remote flow rate control.</p> <p>With Procedure: Set to Zero, an input voltage that is presented can be defined as zero point (i.e. defined as a flow of 0.000 ml/min). If a deviating, positive control voltage is applied, a resulting flow rate is displayed at actual interpreted flow, based on the basic setting: 1 ml corresponds to 1 V for the 10 ml pump head, and 5 ml corresponds 1 V for the 50 ml pump head.</p> <p>That means that the flow rate can be regulated via the input voltage.</p> <p>This flow rate can be altered. Thus a second calibration point is generated, which modifies the scaling.</p>

Value	Meaning
Analog out	<p>Used to output analog pump signals to external devices, by means of the Remote:</p> <p>Setup: Analog out:</p> <ul style="list-style-type: none"> ▪ Data entry Offset for the analog output ▪ Voltage range options Full scale: 1 V, 2 V, 5 V ▪ Signal source: <ul style="list-style-type: none"> - Pressure preset for outputting the currently measured pressure for the purpose of external recordings or control. - Slave B for outputting a signal for controlling a second pump. - HPG A to HPG-D - disabled
Event check	<p>Testing the terminal strip Events:</p> <ul style="list-style-type: none"> ▪ Start-IN and Error-IN: statuses at the digital inputs ▪ Active only: connections Event 1 to Event 8 and 24 V
Gradient	<p>Here the modes of the high-pressure gradient (HPG) and isocratic system can be set:</p> <ul style="list-style-type: none"> ▪ HPG: selection between pump name HPG-A to HPG-D ▪ Isocratic system: none
Network	<p>Setting for external communication connection options of pump:</p> <ul style="list-style-type: none"> ▪ RS232 ▪ LAN-DHCP: Automatic network configuration ▪ LAN manual: Manual network-configuration (Port, IP address, IP mask, Gateway) ▪ Analog
Pump head	<p>Pump head selection:</p> <ul style="list-style-type: none"> ▪ automatic detection ▪ 10 ml ▪ 50 ml <p> Note: Only possible if automatic recognition of the pump head does not function.</p> <p>The selection is used as a basis for calculating the flow rate and determines the max. system pressure. This value applies for all operating modes and cannot be exceeded.</p>


Value	Meaning
Time	<p>Setting the time constant for analog input/output, to be used for signal smoothing.</p> <p>The larger the value of the selected time constant, the stronger the applied signal smoothing. Both an external signal present at the analog input (in) and a signal generated at the analog output (out) can be smoothed.</p> <ul style="list-style-type: none"> ▪ Time constant IN ▪ Time constant OUT

8.8 Solvent menu

In the Solvent menu data for the compressibility of the solvents are entered.

Value	Meaning
Solvent	<p>Data entry for the compressibility of the selected solvent:</p> <ul style="list-style-type: none"> ▪ Water: 0.46 ▪ Benzene: 0.95 ▪ Chloroform: 0.97 ▪ Ethanol: 1.10 ▪ Acetone: 1.23 ▪ Methanol: 1.21 ▪ n-heptane: 1.40 ▪ n-hexane: 1.50 ▪ Diethyl ether: 1.84 ▪ Acetonitrile: 0.99 ▪ Tetrahydrofuran: 0.93 ▪ Water/methanol (10/90): 1.17 ▪ Water/methanol (20/80): 0.86 ▪ Water/methanol (40/60): 0.56 ▪ Water/methanol (50/50): 0.52 ▪ Water/methanol (60/40): 0.46 ▪ Water/methanol (80/20): 0.40 ▪ Water/methanol (90/10): 0.34

Navigating the Solvent menu



- | Steps |
|--|
| <ol style="list-style-type: none"> 1. Tap Solvent menu to display current settings. 2. Tap on value in field with gray background to adjust the value to compressibility. 3. Use the numeric fields to enter the correct value. 4. Tap  to go to a higher level, or hold for two seconds to go to the operating menu. |

8.9 GLP menu

In the GLP menu, statistical data on important parameters of the pump are displayed.

Navigating the GLP menu

Steps

1. Tap the GLP menu to display operating parameters.
2. Tap the gray highlighted values to display all available options.
3. Tap  to scroll through the other options in the GLP menu.
4. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.

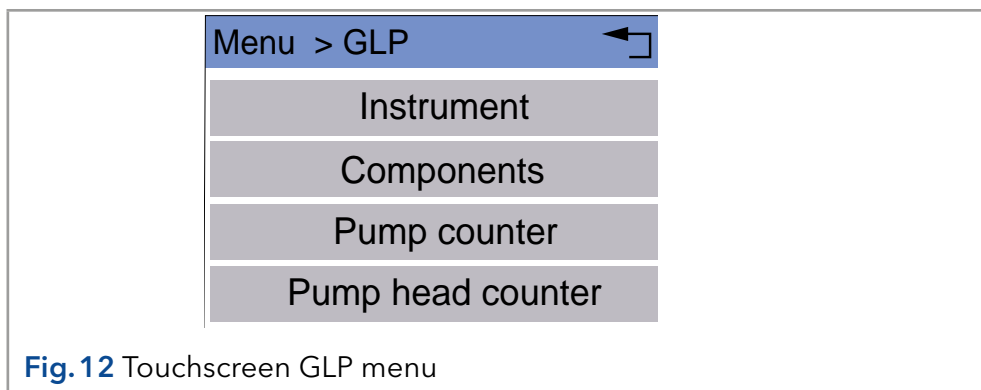


Fig. 12 Touchscreen GLP menu

8.10 Program menu


The Program menu is used to list and create programs. The pump can save up to 20 programs and up to 100 program lines. Max. 10 program links between defined programs can be created and saved.

Programs have the following functions:

- Controlling the flow rate
- Controlling the solvent composition
- Sending control signals (Events)

Navigating the Program menu

Steps

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number to edit, open or delete the program.
3. Tap Load to run a program.
4. Tap Edit to enter the edit mode.
5. Tap Delete to delete a program.
6. Tap Tab to display a program line in a table.
7. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.

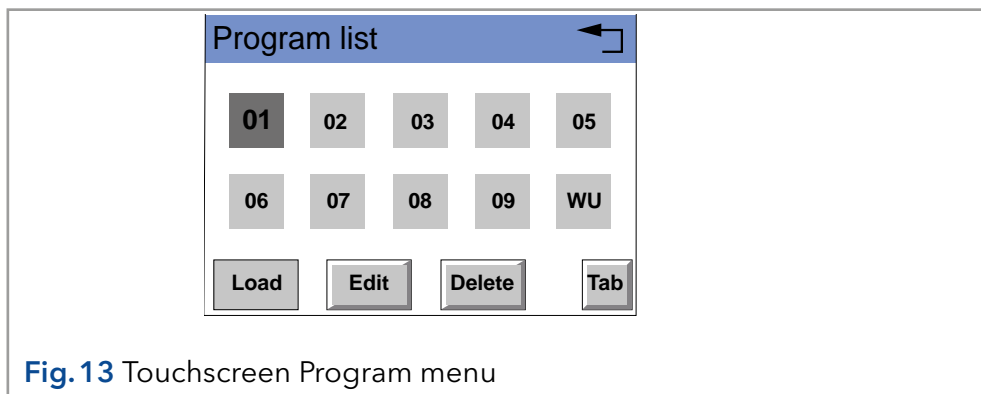


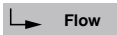


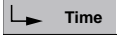


Fig. 13 Touchscreen Program menu

8.10.1 Creating a program

The use of the device is demonstrated using the example of a program to be created: Program 01 is to be used to create a solvent gradient (channels A and B) with constant flow rate of 1 ml/min. The percentage of solvent A is to be continuously decreased from 100 % to 0 % within 0.5 minutes.

Process

Steps

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and edit to edit the program (diagram A).
3. Enter the value for the flow rate: 1.
4. Tap  Flow to save the settings.
5. Enter the value for channel A: 100.
6. Tap  A to save the settings.
7. Tap  to move level up.
8. Tap New to specify the time (diagram B).
9. Enter the time value: 0.5 (diagram C).
10. Tap  Time to save the settings (diagrams C and D).
11. Enter the value for channel A: 0 (diagram E).
12. Tap  A to save the settings.
13. Tap  to go to a higher level (diagram F), or hold for two seconds to go to the operating menu.

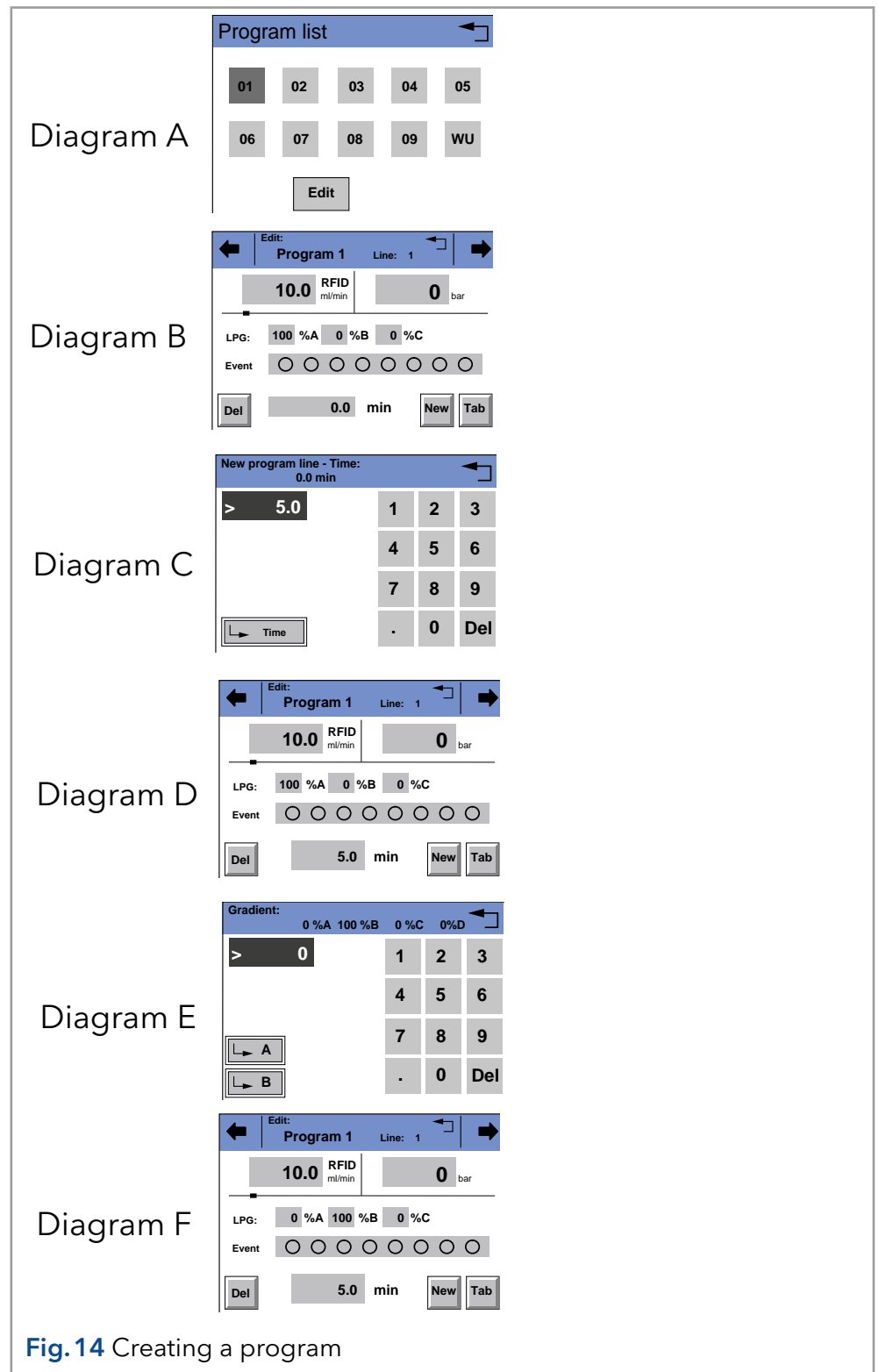


Fig. 14 Creating a program

8.10.2 Creating program lines

New program lines can be created while creating a program.

Process

Steps

1. Tap Tab in the editing window to display the program lines.
2. Tap New to create a new program line.
3. Enter the time value.
4. Save setting.
5. Enter value of desired channel.
6. Save setting.

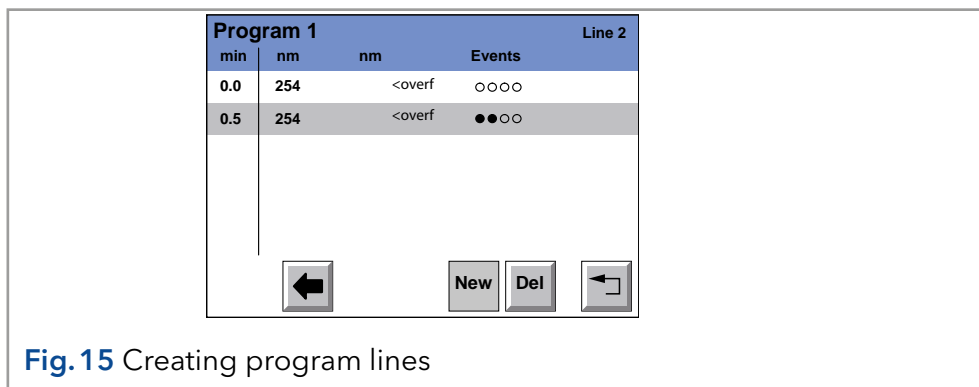


Fig. 15 Creating program lines

8.10.3 Deleting program lines

Program lines can be deleted while creating a program.

Process

Steps

1. Tap Tab in the program's editing window to display the program lines.
2. Tap to mark the desired program line.
3. Tap Del to delete the desired program line.
4. Confirm the query.
5. Tap to go to a higher level, or hold for two seconds to go to the operating menu.

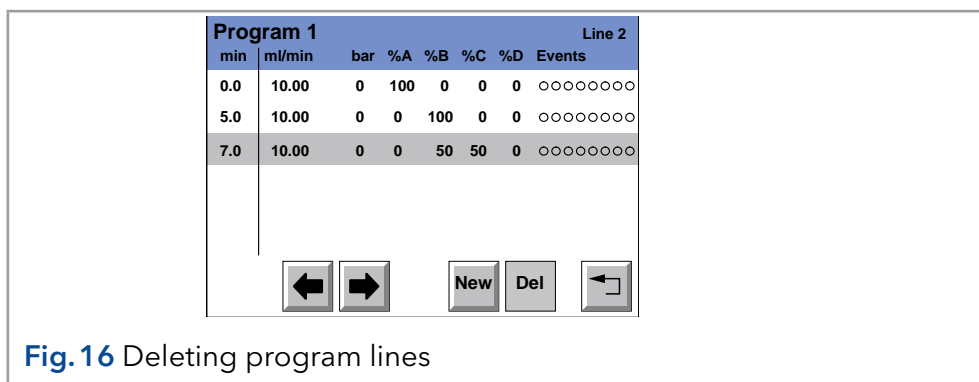


Fig. 16 Deleting program lines

8.10.4 Running a program

During the program sequence, the changes in the solvent composition are displayed in the % A - % D fields.

Process

Steps

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and Load to load the program.
3. Tap to start the program (diagram A).
4. Tap to interrupt the program.
5. Tap to stop the program.
6. Tap to stop the pump.
7. Tap to repeat the program (diagram B).
8. Tap to exit the loaded program.

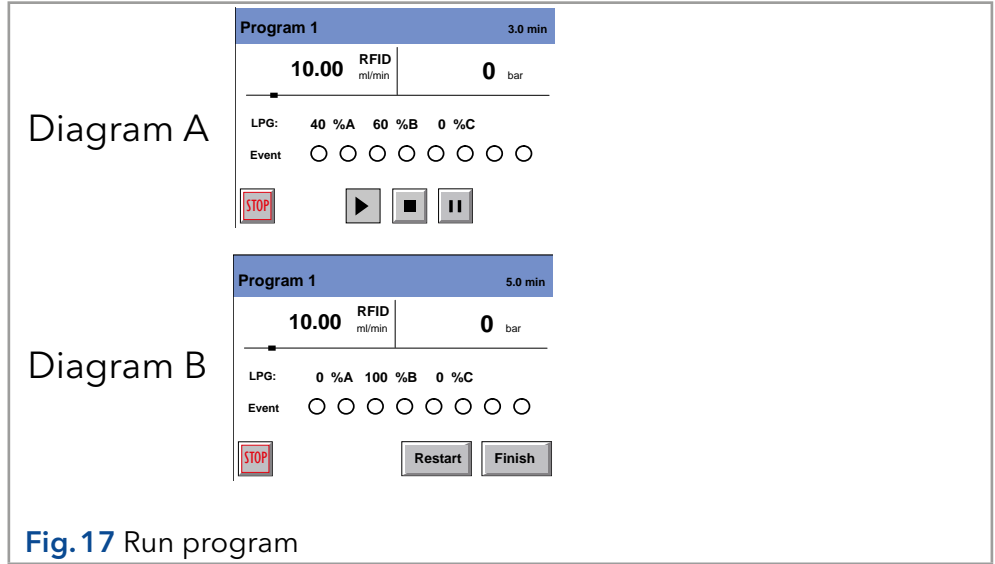


Fig. 17 Run program

8.10.5 Changing a program

Process

Steps

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and Edit to edit the program.
3. Change the desired values.
4. Save setting.
5. Tap to go to a higher level, or hold for two seconds to go to the operating menu.

8.10.6 Displaying the program lines

Process

Steps

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and Tab to reach the program line display.
3. Tap to go to a higher level, or hold for two seconds to go to the operating menu.

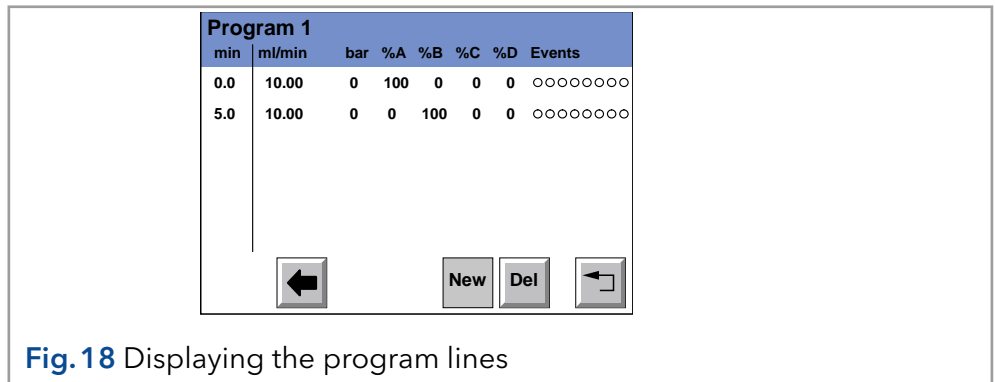



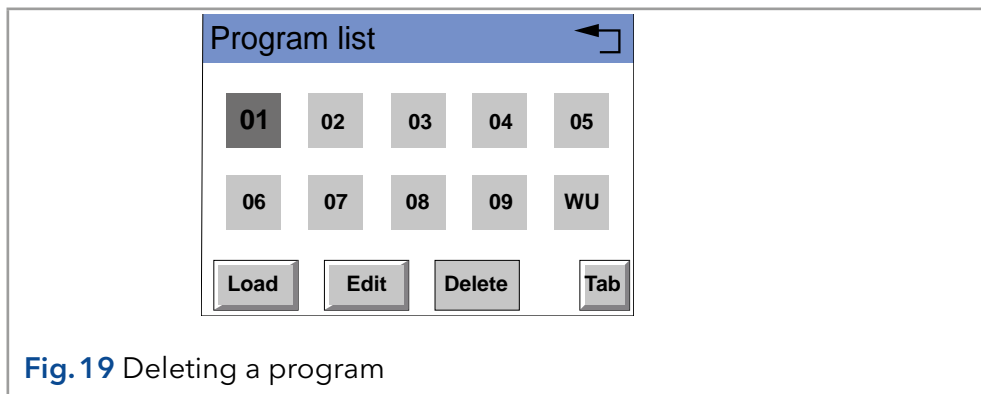
Fig. 18 Displaying the program lines

8.10.7 Deleting a program

Process

Steps

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and Delete to delete the program.
3. Confirm the query.
4. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.



8.10.8 Creating a program with a starting time





The pump can start a program or a program link at a preset time. This program is labeled WU (Program Wake Up) and is located in the program list.

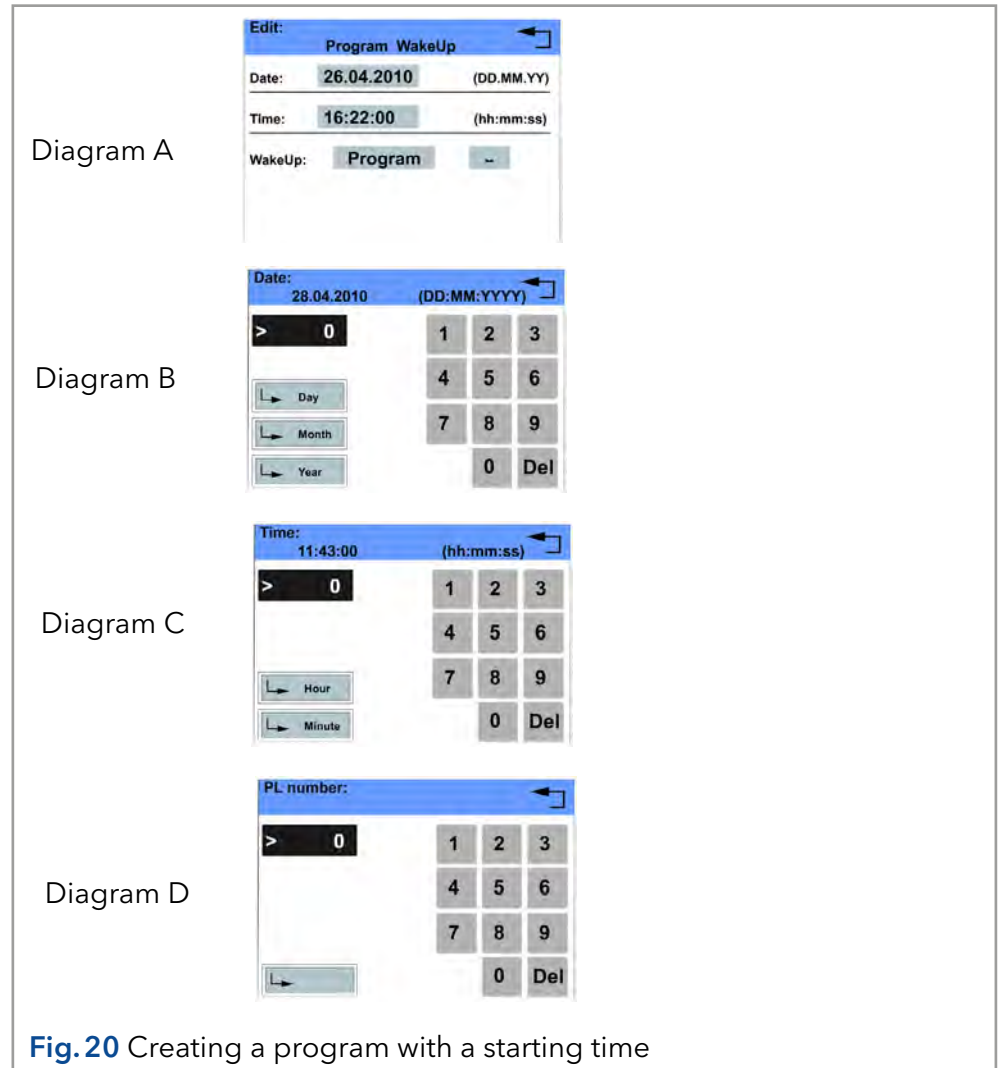


Note: Make sure that the date and time configured in the Setup menu are correct.

Process

Steps


1. Tap the Program menu in order to display the program list.
2. Tap WU and Edit to edit the program.
3. Enter the program start-date (diagrams A and B).
4. Tap  to save the settings.
5. Enter the time for the program start (diagram C).
6. Tap  to save the settings.
7. Choose program or Link (diagram A).
8. Enter program number or Link number (diagram D).
9. Tap  to save the settings.
10. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.



8.11 Link menu

The Link menu displays the status of active links. Max. 10 program links between defined programs can be created and saved.

Navigating the Link menu

- Tap the Link menu to display the link list
- Tap the desired link number to edit, open or delete the link
- Tap Load to run a link
- Tap Edit to enter the edit mode
- Tap Delete to delete a link
- Tap Tab to display the program line
- Tap  to go to a higher level, or hold for two seconds to go to the operating menu.




8.11.1 Creating a link

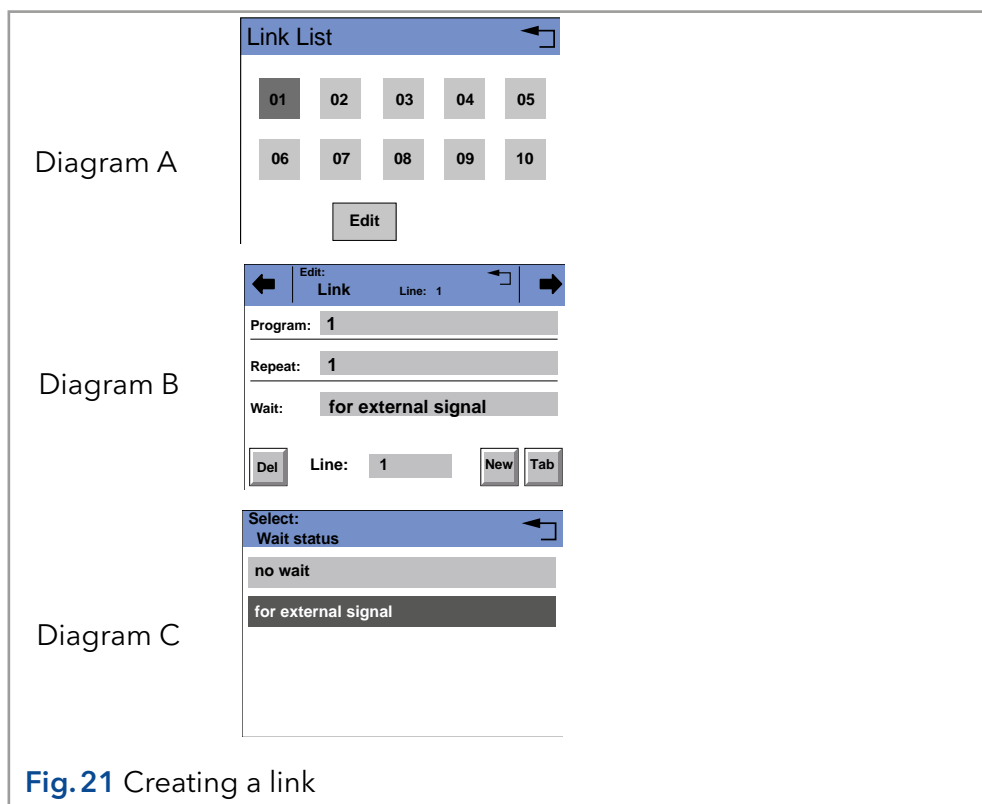


Note: In the setting Wait: for external signal, the pump waits for an external start signal before this program line is run. In the setting Wait: no wait, the link will run without interruption.

Process

Steps

1. Tap the Link menu to display the Link list (diagram A).
2. Tap the desired link number to edit the link.
3. Enter program number (diagram B).
4. Tap  to save the settings.
5. Enter the number of repetitions (repeat) for the previously specified program.
6. Tap  to save the settings.
7. Select the desired option for wait: (diagram C).
8. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.









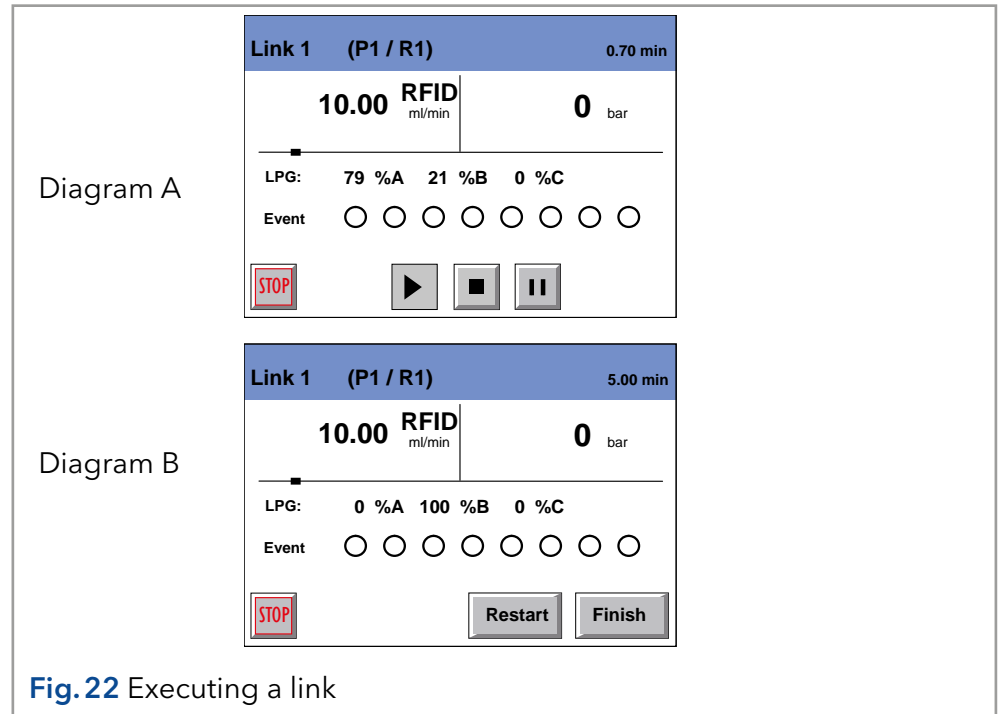
8.11.2 Executing a link

While the link sequence runs, the changes in the solvent composition are displayed in the fields % A - % D.

Process

Steps


1. Tap the Link menu to display the link list.
2. Tap the desired link number and Load to load the link.
3. Tap  to start the link (diagram A).
4. Tap  to interrupt the link.
5. Tap  to stop the link.
6. Tap  to stop the pump.
7. Tap  to re-run the link (diagram B).
8. Tap  to exit the loaded link.

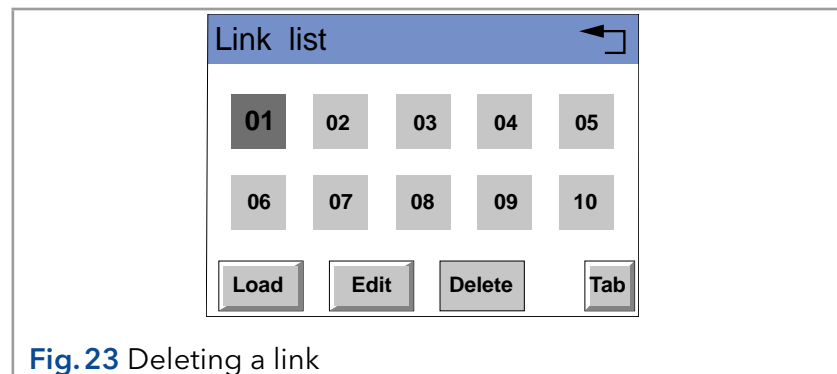


8.11.3 Deleting a link

Process

Steps

1. Tap the Link menu to display the Link list.
2. Tap the desired link number and Delete to delete the link.
3. Confirm the query.
4. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.



9. Purging the pump

9.1 Settings in the Setup menu

Process

Steps

1. In the Gradient directory of the Setup menu, choose Type: HPG A, HPG B, HPG C or HPG D or none (diagram A).
2. Activate desired channels A - D (ON - OFF)

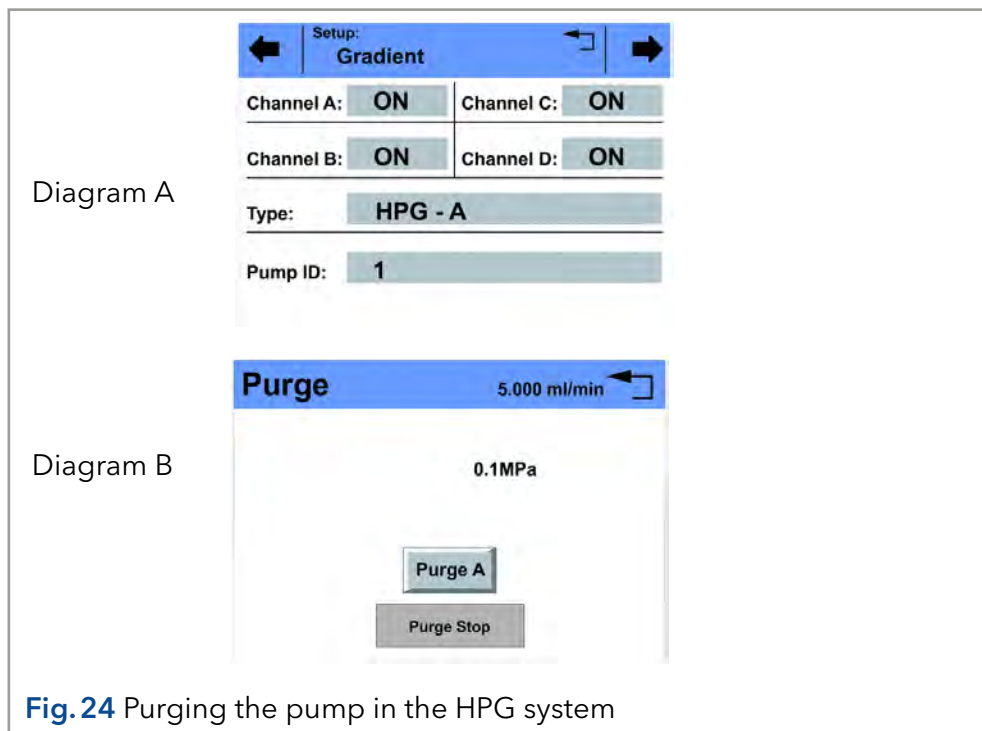
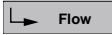




Fig. 24 Purging the pump in the HPG system

9.2 Purging

Process

Steps

1. Open the bleed screw of the pressure sensor.
2. In the status display of the pump, tap on the flow rate field highlighted in gray.
3. Enter the value for the flow rate.
4. Tap  Flow to save the settings.
5. Tap .
6. Suck liquid in via a Luerlock syringe.
7. Choose Purge A, Purge B, Purge C, Purge D or Purge to start the purging process (diagram B).
8. Tap  to stop the purging process.

9.3 Piston backflushing

The pump is equipped with automatic piston backflushing. It increases the service life of the seals and pistons, and removes contaminants from the area behind the seals.

Functional principle

The piston backflushing function automatically flushes the rear piston area of the pump head upon switch-on and in continuous mode.

- Upon switch-on: The rear piston area of the pump head is automatically flushed for 8 seconds
- In continuous mode: The rear piston area of the pump head is flushed automatically every two hours, for 15 seconds

Recommended flushing solution

The rear piston area is flushed with water, with an 80:20 mixture of water and methanol, or with isopropanol, depending on the application.

Legend

- ① Inlet from the solvent bottle to the flush pump
- ② outlet from the pump head to solvent bottle
- ③ Pump head inlet
- ④ Outlet from the flush pump to the pump head

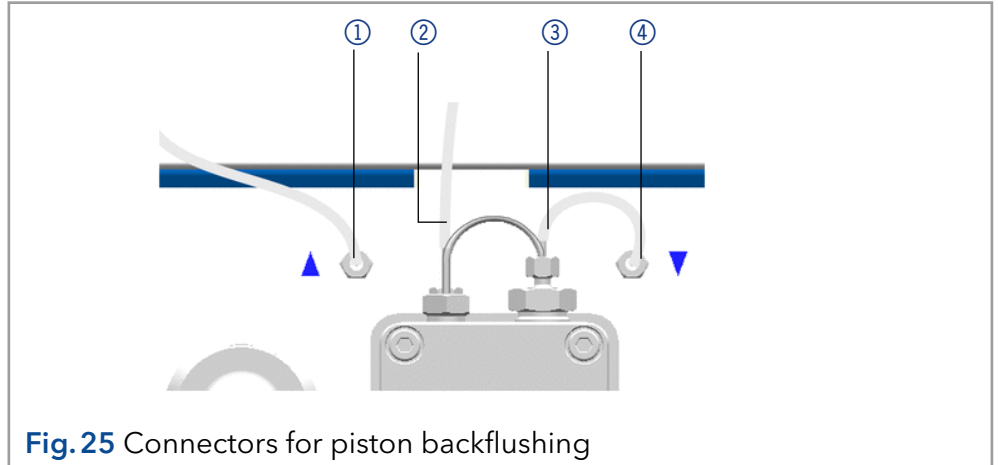


Fig.25 Connectors for piston backflushing

10. Functionality tests (IQ and OQ)



Note: Standard processes in single devices may be handled differently in individual cases.

Installation Qualification (IQ)

The customer may request the Installation Qualification, which is free of charge. In case of a request, the Technical Support of KNAUER or from a provider authorized by KNAUER performs this functionality test during the installation.

The Installation Qualification is a standardized document and includes the following:

- confirmation of flawless condition at delivery
- check if the delivery is complete
- certification on the functionality of the device

Operation Qualification (OQ)

The Operation Qualification includes an extensive functionality test according to KNAUER standard OQ documents. The Operation Qualification is a standardized document and free of charge. It is not part of the delivery, please contact the Technical Support in case of request.

The Operation Qualification includes the following:

- definition of customer requirements and acceptance terms
- documentation on device specifications
- device functionality check at installation site

Test intervals

To make sure that the device operates within the specified range, you should test the device regularly. The test intervals are dependent on the usage of the device.

Execution

The test can be carried out either by the Technical Support of KNAUER or from a provider authorized by KNAUER (for a fee).

11. Maintenance and care

Proper maintenance of your HPLC device will ensure successful analyses and reproducible results.

11.1 Maintenance contract

The following maintenance work on the device may only be performed by the manufacturer or a company authorized by the manufacturer and is covered by a separate maintenance contract:

- Opening the device or removing housing parts

11.2 Which maintenance tasks can users perform on the device?

Users may perform the following maintenance tasks themselves:

- Replacing the pump head
- Exchanging the check valves



Note: The pump has to be switched off for all maintenance tasks.

11.3 Cleaning and caring for the device

All smooth surfaces of the device can be cleaned with a mild, commercially available cleaning solution, or with isopropanol.

NOTICE

Device defect

Intruding liquids can cause damage to the device.

- Place solvent bottles next to the device or in a solvent tray.
- Moisten the cleaning cloth only slightly.

Touchscreen

The touchscreen of the device can be cleaned with isopropanol and wiped dry with a soft, lint-free cloth.

11.4 Screw fittings



Note: If leaks occur on the capillary screw fittings after maintenance and proper assembly, do not tighten them further; instead replace them with new connection capillaries.

11.4.1 Tightening the screw fittings



Note: To pump head AHB40CA (pump APC30EE) apply special torque values. Tighten the fastening screws with a maximum torque of 3 Nm. Exceeding the torque can damage the back plate.

Steps

1. Always tighten the inlet screw 1 ⑤ and the outlet screw 1 ② with a torque wrench and 15 Nm.
2. Always hold the inlet fitting 1 ⑤ with a wrench when the capillary fitting ① is being tightened with a wrench.
3. Using an Allen wrench, screw in the opposite pairs of fastening screws ④ evenly and alternately to prevent the pump pistons on the inside from jamming.

11.4.2 Loosening the screw fittings

Using an Allen wrench, loosen the opposite pairs of fastening screws ④ evenly and alternately to prevent the pump pistons on the inside from jamming.

Legend

- ① Capillary screw fitting
- ② Outlet fitting 1
- ③ Inlet fitting 2
- ④ Fastening screw
- ⑤ Inlet fitting 1
- ⑥ Outlet fitting 2

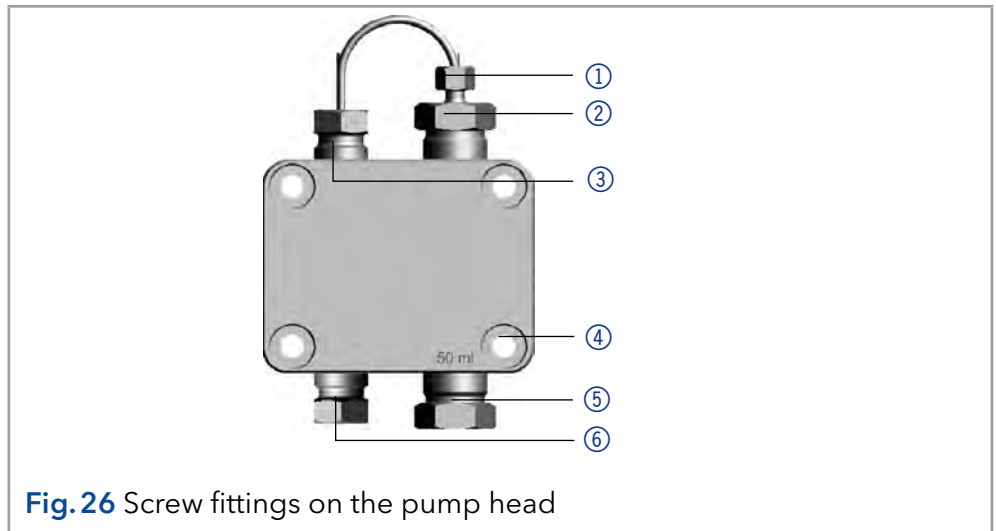


Fig. 26 Screw fittings on the pump head

11.5 Pump head

Depending on the requirements of the user, different pump heads are used.

11.5.1 Removing the pump head

Prerequisites

- The pump head has been purged.
- The tubes at the inlet and outlet have been removed.
- The pump head's inlet and outlet have been sealed with cap fittings.

Tools

- Allen wrench
- Open-end wrench, size 1/4 „
- Open-end wrench, size 13

⚠ WARNING

Chemical burns

Skin damage from aggressive or toxic eluents.

- ➔ Wear protective gloves.
- ➔ Flush the pump head before changing.

NOTICE**Device defect**

Residuals chemicals can damage the pump head if they are not being removed before storage.

- For reuse, flush the pump head and fill it with isopropanol.
- Before storage, seal the inlets and outlets with cap fittings.

NOTICE**Component defect**

Possible damage to the pump piston by tilting the pump head.

- Tighten diagonally opposite fastening screws evenly one turn at a time.
- Also loosen the fastening screws evenly.



Note: The back plate of pump head AHB40CA (pump APC30EE) is made of ceramics and is sensitive to shocks. The back plate is no spare part and excluded from guarantee!

Procedure**Process****Figure**

1. Loosen the capillary connectors ① at the outlet. Remove the capillary.
1. Fixate the outlet fitting ① with an open-end wrench (size 13).
2. Loosen the fitting ② with an open-end wrench (size 1/4").

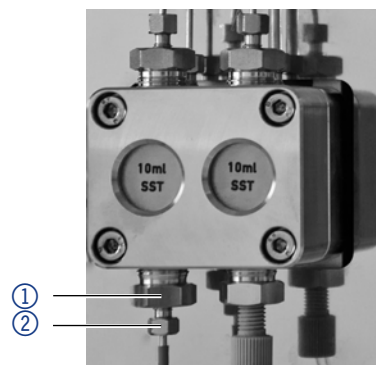


Fig.27 Fitting at the outlet of the pump head

3. Remove the solvent line ② from the solvent inlet.
4. Disconnect the tubes of the piston backflushing ① from the flush pump and the pump head.

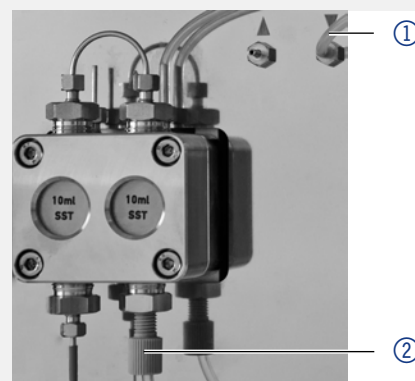


Fig.28 Tubing of the piston backflushing

Procedure

Process

5. Using the Allen wrench, unscrew the 4 screws ① subsequently by one turn.
6. Fixate the pump head with your hand and remove the screws.
7. Lift off the pump head.

Figure

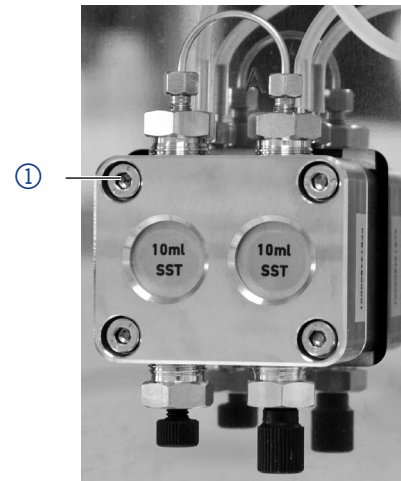


Fig. 29 Screws of the pump head

Next steps

Maintain the check valves or install a new pump head.

11.5.2 Installing the pump head



Note: To pump head AHB40CA (pump APC30EE) apply special torque values. Tighten the fastening screws with a maximum torque of 3 Nm. Exceeding the torque can damage the back plate.

1. Screw in the opposite pairs of fastening screws ② evenly and alternately.
2. Tighten all fastening screws evenly with an Allen key.
3. Screw in the capillary with outlet fitting 2 ⑤ and inlet fitting pressure sensor ⑥ and tighten with a wrench.
4. Check pump head configuration.

11.6 Check valves

Clogged check valves do not open and close properly. They cause pressure fluctuations and irregular flow. If it is impossible to clean the check valves, replace the whole unit.

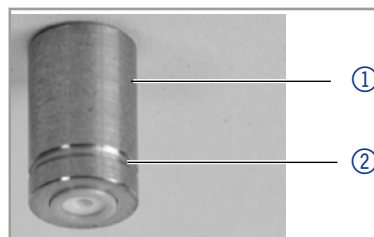


Fig. 30 Check valve

11.6.1 Removing the check valve

The pump head is equipped with two check valves.

Prerequisites

- The pump head has been purged.
- The capillary and tubing have been removed.
- The pump head has been removed.

Tools

- Open-end wrench, size 13

Procedure**Process**

1. Unscrew and remove the capillary connector ①.
1. Loosen the outlet fitting ② with the open-end wrench.
2. Remove the first check valve.
3. Loosen the inlet fitting ③ with the open-end wrench.
4. Remove the second check valve.

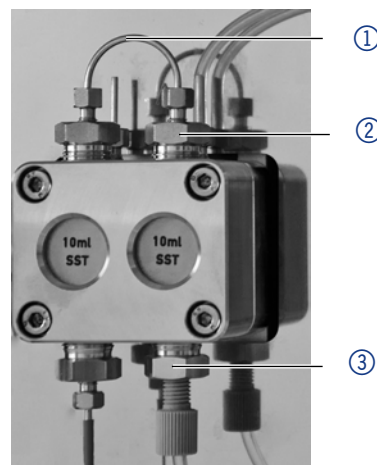
Figure

Fig.31 Check valve in pump head

Next steps Clean the check valves.

11.6.2 Cleaning the check valves

In order to be cleaned, the check valves are not disassembled but are cleaned as a whole.

Prerequisite Both check valves have been removed.

Procedure**Process**

1. Place each check valve into a beaker with solvent, e.g. isopropanol.
2. Put the beaker with the check valve in an ultrasonic bath for at least 10 minutes.
3. Let the check valves dry afterwards.

Next steps Insert both cleaned check valves.

11.6.3 Installing the check valve

Insert the check valves in the direction of the flow. The notch of the check valve points downward.

Normal phase Insert the check valves in the direction of the flow. The arrow on the check valve points upward.

Prerequisite The check valves are dry.

NOTICE

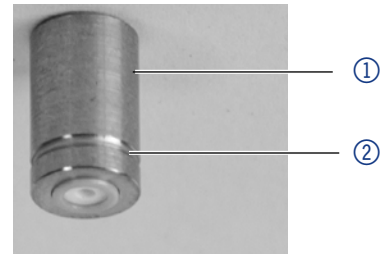
Component defect

Damage to components due to excessive tightening possible.
Observe the torque of the screw connection

- Use 5 Nm torque for stainless steel fittings.
- Use 1 Nm torque for PEEK fittings.

Procedure**Process**

1. Insert the check valves ① in such a way that the notch of the check valve ② points downward.
2. Screw in inlet and outlet fittings and tighten them with a torque wrench and the respective torque.

Figure**Fig.32** Check valve

Next steps Re-install the pump head.

11.7 Transport

Carefully prepare the device for transport. If you want to return your device to KNAUER for repairs, enclose the Service Request Form which can be downloaded from our website.

For a secure transport, note the weight and dimensions of the device (see chapter „Technical data“).

11.8 Storage

Note that prior to storing all tubes and capillary should be emptied or filled with an appropriate flushing solution (e.g. isopropanol). To prevent algae formation, do not use pure water. Seal all inlets and outlets with cap fittings. For ambient conditions, see chapter „Technical Data“.

12. Troubleshooting

12.1 First measures

1. Check all cabling.
2. Check all screw fittings.
3. Check whether air has gotten into the supply lines.
4. Check device for leaks.
5. Pay attention to system messages.

12.2 LAN

Go through the following steps, in case no connection between the computer and the devices can be established. Check after each step if the problem is solved. If the problem cannot be located, contact the Technical Support.

Steps

1. Check the status of the LAN connection in the Windows task bar:



Connected



Not connected

If no connection was established, test the following:

- Is the router switched on?
- Is the patch cable connected correctly to the router and the computer?

2. Check the router settings:

- Is the router set to DHCP server?
- Is the IP address range sufficient for all the connected devices?

3. Check all connections:

- Are the patch cable connected to the LAN ports and not the WAN port?
- Are all cable connections between devices and router correct?
- Are the cables plugged in tightly?

4. If the router is integrated into a company network, pull out the patch cable from the WAN port.

- Can the devices communicate with the computer, even though the router is disconnected from the company network?

5. Restart the system in the following order:

- Turn off all devices, router, and computer.
- Switch on the router and wait until its self-test is finished.
- Switch on the devices and the computer.

6. Replace the patch cable to the device with that no connection could be established.

7. Make sure that the IP port of the device matches the port in the chromatography software.

12.3 Possible problems and solutions

Problem	Solution
Pump will not turn on	<p>The power cable must be connected to the power supply.</p> <p>► Inspect the power cable to ensure that it is plugged into the power supply.</p>
When purging, the pump switches off	<p>The bleed screw on the pressure sensor must be opened.</p> <p>► Check if the bleed screw on the pressure sensor is opened.</p>

Problem	Solution
Pump does not transport solvent	Check the following options: <ul style="list-style-type: none"> ■ Purge the pump head so as to remove the air bubbles ■ Inspect the eluent filter of the HPLC column and change when blocked ■ Exchange the pump head ■ Clean the check valves ■ Exchange the check valves ■ If the pump head seals are defective, solvent enters the piston backflushing; inform the technical support department of the manufacturer
Pressure or flow rate fluctuations	Check the following options: <ul style="list-style-type: none"> ■ Clean the check valves ■ Exchange the check valves ■ Purge the pump head so as to remove the air bubbles ■ Tighten the capillary screw fittings on to the inlet and outlet screw fittings of the pump head with a torque wrench at a tightening torque of 28 Nm
Pump head leaks	Check the following options: <ul style="list-style-type: none"> ■ Inspect and tighten the inlet and outlet screw fittings of the pump head ■ Exchange the pump head ■ If the pump head seals are defective, solvent enters the piston backflushing; inform the technical support department of the manufacturer
Degasser leaks	Should there be a leak in the degasser, solvent can reach the motor and from there reach the exhaust and spill out. In this case, the automatic pump control will switch the device off. Inform the technical support department of the manufacturer.
Flow rate is not correct	Check the following options: <ul style="list-style-type: none"> ■ Check the data for the solvent compressibility ■ Clean the check valves ■ Exchange the check valves

12.4 System messages

Explanation of the touchscreen’s error messages. They are sorted alphabetically.

System message	Solution
Auto pump head type: head data uninitialized!	<ul style="list-style-type: none"> ▪ Switch the device off and on ▪ Check whether a pump head with RFID recognition has been installed ▪ Repeat the automatic configuration step in the chromatography software ▪ Remove pump head, clean it and install it again
Auto pump head type: no head detected!	<ul style="list-style-type: none"> ▪ Switch the device off and on ▪ Repeat automatic configuration in the chromatography software ▪ Remove pump head, clean it and install it again ▪ Check whether a pump head with RFID recognition has been installed
Cannot delete active program/link	Pause active program as well as Link and the delete the link.
Cannot edit program from the running link	First pause the link, then edit the data on the device display or in the chromatography software.
Cannot initialize LAN	Check the cables and connections in the local area network.
Cannot operate with an empty link	The link is empty. First create a link.
Cannot read data from FRAM	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
Cannot read RTC	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
Cannot start time table	Edit the data on the device display or in the chromatography software.
Cannot use non-existing component!	Change the setup settings or change the gradient in the program or in setup.
Cannot write data on FRAM	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
Error input activated	Device error, change device settings.
GUI communication failed (internal)!	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
Insufficient access	Change the entry.

System message	Solution
Invalid command	<ul style="list-style-type: none"> ■ Change the entry ■ Check the cable connections
Invalid parameter(s)	Check the validity of the parameter(s).
Invalid time in time table	Correct the time entry.
Invalid time table index	Change the entry in the program line.
Link is loaded	First unload the link then change the link or delete it.
Link is running	Wait until the link has been completed, then change the link or delete it.
Maximum pressure! System stopped	<ul style="list-style-type: none"> ■ Reduce the pressure or adjust the upper pressure limit ■ Restart the system
Minimum pressure! System stopped	<ul style="list-style-type: none"> ■ Increase the pressure or adjust the lower pressure limit ■ Restart the system
No components are available in isocratic mode	Since the pump can only be operated using a specific valve, the entered data has to be adapted to isocratic mode.
No link available	Create a link and edit it.
No link available Pls edit link first	Create a link and edit it.
No time table to start	Edit the data by means of the chromatography software.
Non-existing component is set to non-0 value	Switch on the channel or edit the data using the chromatography software.
Not enough space to store link	<ul style="list-style-type: none"> ■ Check the pump ■ Check the number of program lines - a maximum of 100 program lines are possible
Not enough space to store program	<ul style="list-style-type: none"> ■ Check the pump ■ Check the number of program lines - a maximum of 100 program lines are possible
Not supported	Change the entry.
Prg not compatible with pump head!	Modify the program or replace the pump head.
Program does not exist	Create and edit a program.
Program is running.	Quit program or wait until program has been completed.
The gradient component is used!	First unload the program. The setup data can only be edited when no program has been loaded or started.
this link is used in WakeUp	First quit or delete wakeup program (WakeUp), then edit or delete link.

System message	Solution
This program is used in a link	First pause or delete link, then edit or delete data by means of the chromatography software.
this program is used in WakeUp	First quit or delete wakeup program (WakeUp), then edit or delete data by means of the chromatography software.
Time already exists	Correct the time entry.
Time table line is empty	Edit the program line.
Too many lines in program	Check the number of program lines - a maximum of 100 program lines are possible.
Unknown pump head type!	<ul style="list-style-type: none"> ▪ Check the pump head ▪ Check whether a pump head with RFID recognition has been installed
used!*/, CRC failed	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
Wrong Line number	Change the line index in the link.
Wrong link	<ul style="list-style-type: none"> ▪ Check Link no. - values from 1-10 are possible. ▪ Correct the entry

13. Technical data

13.1 Solvent delivery

Pump type	Analytical high pressure pump
Delivery system	Dual piston pump with one working piston, one auxiliary
Pulsation compensation	active pressure and pulsation compensation
Flow properties	<ul style="list-style-type: none"> ▪ 10 ml pump head: 0.001-10 ml/min ▪ 50 ml pump head: 0.01-50 ml/min
Flow rate range 10 ml pump head	<ul style="list-style-type: none"> ▪ 0.001 - 10 ml/min ▪ 0.1 - 8 ml/min (recommended) ▪ 0.1 - 4 ml/min (continuous operation)
Maximum pressure	<ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> - 65 MPa up to 5 ml/min - 40 MPa up to 10 ml/min ▪ 50 ml pump head: <ul style="list-style-type: none"> - 3 MPa up to 10 ml/min - 20 MPa up to 50 ml/min
Flow rate accuracy	± 1 %, measured at 5 - 80% of flow range using ethanol

Flow rate precision	< 0.1 % RSD (relative standard deviation) based on retention time at constant room temperature
Residual pulsation	< 2 % amplitude (typically < 1.3 %) or < 0.3 MPa (3 bar), whatever is greater, at 1 mL/min ethanol, at all pressures > 1 MPa (10 bar, 147 psi).
Active piston seal wash	Standard
Gradients	Isocratic HPLC pump
System protection	P_{min} and P_{max} adjustable

13.2 Communication

Analog inputs	Flow (0-10 V)
Analog control input	Flow rate
Control	<ul style="list-style-type: none"> ▪ LAN ▪ RS-232 ▪ remote control connections (Stop, Flow, Pressure, Error) ▪ Touchscreen
Programming	20 programs, 9 program links, WAKE UP program

13.3 Technical parameters

Special features	The system pump head is detected automatically using radio frequency identification (RFID)
GLP	RFID pump head recognition, detailed report
Display	Touchscreen
Ambient conditions	<ul style="list-style-type: none"> ▪ Temperature range: 4-40 °C; 39.2-104 °F ▪ Air humidity: Below 90% humidity (non-condensing)

13.4 General

Supply voltage range	100-240 V
Supply frequency	50-60 Hz
Weight	6.1 kg
Dimensions (L x W x H)	399 x 242 x 165 mm

14. Chemical compatibility of wetted materials



Note: The user is responsible for using fluids and chemicals in an appropriate and safe way. If there is any doubt, please contact the Technical Support.

14.1 General

The device is very resistant against a variety of commonly used eluents. However, make sure that no eluents or water come in contact with the device or enter into the device. Some organic solvents (such as chlorinated hydrocarbons, ether) may cause coating damage or loosen glued components by improper handling. Even small quantities of other substances, such as additives, modifiers, or salts can influence the durability of the materials. Exposure time and concentration have a high impact on the resistance.

The following list contains information about the chemical compatibility of all wetted materials which are used in devices made by KNAUER. The data bases on a literature research on the manufacturer specifications of the materials. The wetted materials of the present device are listed in chapter "Technical data".

All resistances listed here refer to an operation at temperatures up to 40 °C, unless stated otherwise. Note that higher temperatures may have a significant impact on the stability of several materials.

14.2 Plastics

Polyetheretherketone (PEEK)

PEEK is a durable and resistant plastic and, apart from stainless steel, the standard material in HPLC. It can be used at temperatures up to 100 °C and is highly chemical resistant against almost all commonly used solvents in a pH range of 1-12,5. PEEK is potentially moderate resistant against oxidizing and reducing solvents.

Therefore, following solvents should not be used: Concentrated and oxidizing acids (such as nitric acid solution, sulfuric acid), halogenated acids (such as hydrofluoric acid, hydrobromic acid) and gaseous halogens. Hydrochloric acid is approved for most applications.

In addition, following solvents can have a swelling effect and may have an impact on the functionality of the built-in components: Methylene chloride, THF and DMSO in any concentration such as acetonitrile in higher concentrations.

Polyethylene terephthalate (PET, outdated PETP)

PET is a thermoplastic and semi-crystalline material with high wear resistance. It is resistant against diluted acids, aliphatic and aromatic hydrocarbons, oils, fats and alcohols, but not against halogenated hydrocarbons and ketones. Since PET belongs chemically to esters, it is not compatible with inorganic acids, hot water and alkalis. Maximum operating Temperature: up to 120 °C.

Polyimide (Vespel®)

This material is wear-resistant and permanent resilient thermally (up to 200 °C) as well as mechanically. It is chemically broadly inert (pH range 1-10) and is especially resistant against acidic to neutral and organic solvents, but vulnerable to pH strong chemical or oxidizing environments: It is incompatible with concentrated mineral acids (such as sulfuric acid), glacial acetic acid, DMSO and THF. In addition, it will be disintegrated by nucleophilic substances like ammonia (such as ammonium salts under alkaline conditions) or acetate.

Ethylene-tetrafluorethylene copolymer (ETFC, Tefzel®)

This fluorinated polymer is highly resistant against neutral and alkaline solvents. Some chlorinated chemicals in connection with this material should be handled with care. Maximum operating Temperature is 80 °C.

Perfluorethylenpropylene copolymer (FEP), perfluoroalkoxy copolymer (PFA)

These fluorinated polymers hold similar features as PTFE, but with a lower operation temperature (up to 205 °C). PTA is suitable for ultrapure applications, FEP can be used universally. They are resistant against almost all organic and inorganic chemicals, except elemental fluorine under pressure or at high temperatures and fluorine-halogen compounds.

Polyoxymethylene (POM, POM-H-TF)

POM is a semi-crystalline, high-molecular thermoplastic material which stands out due to its high stiffness, low friction value and thermic stability. It can even substitute metal in many cases. POM-H-TF is a combination of PTFE fibers and acetal resin and is softer and has better slip properties as POM. The material is resistant against diluted acids (pH > 4) as well as diluted lyes, aliphatic, aromatic and halogenated hydrocarbons, oils and alcohols. It is not compatible with concentrated acids, hydrofluoric acid and oxidizing agent. Maximum operating temperature is 100 °C.

Polyphenylene sulfide (PPS)

PPS is a soft polymer which is known for its high break resistance and very high chemical compatibility. It can be used with most organic, pH neutral to pH high, and aqueous solvents at room temperature without concerns. However, it is not recommended for using with chlorinated, oxidizing and reducing solvents, inorganic acids or at higher temperatures. Maximum operating temperature: 50 °C.

Polytetrafluorethylene (PTFE, Teflon®)

PTFE is very soft and anti-adhesive. This material is resistant against almost all acids, lyes and solvents, except against fluid sodium and fluoride compounds. In addition, it is temperature-resistant from -200 °C to +260 °C.

System AF™

This amorphous perfluorinated copolymer is inert against all commonly used solvents. However, it is soluble in perfluorinated solvents like Fluorinert® FC-75 and FC-40, and Fomblin perfluor-polyether solvents from Ausimont. In addition, it is affected by Freon® solvents.

Polychlorotrifluorethylene (PCTFE, Kel-F®)

The semi-crystalline thermoplastic material is plasticizer-free and dimensionally stable, even in a wide temperature range (-240 °C to +205 °C). It is moderately resistant against ether, halogenated solvents and toluene. Halogenated solvents over +60 °C and chlorine gas should not be used.

Fluorinated rubber (FKM)

The elastomer consisting of fluorinated hydrocarbon stands out due to a high resistance against mineral oils, synthetic hydraulic fluids, fuels, aromatics, and many organic solvents and chemicals. However, it is not compatible with strong alkaline solvents (pH > 13) like ammonia, and acidic solvents (pH value < 1), pyrrole and THF. Operating temperature: Between -40 °C and +200 °C.

Perfluorinated rubber (FFKM)

This perfluoro elastomer has a higher fluorine content as fluorinated rubber and is therefore chemically more resistant. It can be employed at higher temperatures (up to 275 °C). It is not compatible with Pyrrole.

14.3 Non-metals

Diamond-like carbon (DLC)

This material stands out due to its high hardness, low friction coefficient and thus minimum wear. In addition, it is highly biocompatible. DLC is inert against all acids, alkalis and solvents commonly used in HPLC.

Ceramic

Ceramic is resistant against corrosion and wear and is fully biocompatible. An incompatibility against acids, alkalis and solvents commonly used in HPLC is not known.

Aluminium oxide (Al₂O₃)

Due to their high resistance to wear and corrosion, aluminium oxide ceramics are used as a coating for mechanically stressed surfaces. They are a biocompatible material with low thermal conductivity and low thermal expansion.

Zirconium oxide (ZrO₂)

Zirconium oxide ceramics are characterized by their high mechanical resistance, which makes them particularly resistant to wear and corrosion. They are also biocompatible, have low thermal conductivity and are resistant to high pressures.

Sapphire

Synthetic sapphire is virtually pure monocrystalline aluminium oxide. It is biocompatible and very resistant to corrosion and wear. The material is characterized by a high hardness and a high thermal conductivity.

Ruby

Synthetic ruby is monocrystalline aluminium oxide and has a red coloration by the addition of some chromium oxide. It is biocompatible and very resistant to corrosion and wear. The material is characterized by a high hardness and a high thermal conductivity.

Mineral wool

This insulating material consists of glass or stone wool fibers and isolates in high oxidizing conditions and at high temperatures. Mineral wool is valid as commonly inert against organic solvents and acids.

Glass, glass fiber, quartz, quartz glass

These mineral materials are resistant against corrosion and wear and are mostly chemical inert. They are compatible with oils, fats and solvents and show a high resistance against acids and lyes up to pH values of 3-9. Concentrated acids (especially hydrofluoric acid) may embrittle and corrode the minerals. Lyes may ablate the surfaces slowly.

14.4 Metals

Stainless steel

Stainless steel is, apart from PEEK, the standard material in HPLC. Steels with WNr. 1.4404 (316L) are used, or a mixture with higher compatibility.

They are inert against almost all solvents. Exceptions are biological applications which are metal ion sensible, and applications with extreme corrosive conditions. These steels, in comparison to commonly used steels, are increasingly resistant against hydrochloric acid, cyanides and other halogen acids, chlorides and chlorinated solvents.

The application in ion chromatography is not recommended. In case of electrochemical applications, a passivation must be executed first.

Hastelloy®-C

This nickel-chrome-molybdenum alloy is extremely resistant to corrosion, especially against oxidizing, reducing and mixed solvents, even at high temperatures. This alloy may be used in combination with chlorine, formic acid, acetic acid and saline solutions.

Titanium, titanium alloy (TiA16V4)

Titanium has a low weight and a high hardness and stability. It stands out due to its very high chemical compatibility and biocompatibility. Titan is applied when neither stainless steel nor PEEK are usable.

15. Legal information

15.1 Transport damage

The packaging of our devices provides the best possible protection against transport damage. Check the devices for signs of transport damage. In case you notice damages, contact the Technical Support and the forwarder company within three workdays.

15.2 Warranty conditions

The factory warranty for the device is stipulated by contract. During the warranty period, any components with material or design-related defects will be replaced or repaired by the manufacturer free of charge. Please connect to our website for further information on terms and conditions.

All warranty claims shall expire in the event that any unauthorized changes are made to the device. This warranty also excludes the following:

- accidental or willful damage
- damage or errors caused by third parties that are not contractually related to the manufacturer at the time the damage occurs
- wear parts, fuses, glass parts, columns, light sources, cuvettes and other optical components
- damage caused by negligence or improper operation of the device and damage caused by clogged capillary
- packaging and transport damage

In the event of device malfunctions, directly contact the manufacturer.

KNAUER Wissenschaftliche Geräte GmbH
Hegauer Weg 38
14163 Berlin, Germany

Phone: +49 30 809727-111
Fax: +49 30 8015010
E-mail: support@knauer.net
Internet: www.knauer.net

15.3 Warranty seal

A warranty seal is attached on some devices. The warranty seal is color-coded. A blue seal is used by the assembly or technical support of KNAUER for devices to be sold. After repair, service technicians stick an orange seal in identical position. If unauthorized persons interfere with the device or the seal is damaged, the warranty claim becomes void.



15.4 Declaration of Conformity

The Declaration of Conformity accompanies the product as a separate document and is available online:

<https://www.knauer.net/de/Support/Declarations-of-conformity>

15.5 Disposal

Hand in old devices or disassembled old components at a certified waste facility, where they will be disposed of properly.

AVV marking in Germany According to the German „Abfallverzeichnisverordnung“ (AVV) (January, 2001), old devices manufactured by KNAUER are marked as waste electrical and electronic equipment: 160214.

WEEE registration KNAUER as a company is registered by the WEEE number DE 34642789 in the German „Elektroaltgeräteregister“ (EAR). The number belongs to category 8 and 9, which, among others, comprise laboratory equipment.

All distributors and importers are responsible for the disposal of old devices, as defined by the WEEE directive. End-users can send their old devices manufactured by KNAUER back to the distributor, the importer, or the company free of charge, but would be charged for the disposal.

Solvents and other operating materials All solvents and other operating materials must be collected separately and disposed of properly.

All wetted components of a device, e. g. flow cells of detectors or pump heads and pressure sensors for pumps, have to be flushed first with isopropanol and then with water before being maintained, disassembled or disposed.

16. Glossary

Here you can find information on the abbreviations and terminology used in this device manual for the pump.

Terminology	Explanations
GLP	Good Laboratory Practice - quality assurance for laboratories.
Gradient	Time-dependent composition of solvent (mobile phase) on low-pressure or high-pressure side of system.
HPG	High Pressure Gradient (HPG) Operating mode of an HPLC system. The solvent is mixed on the high-pressure side of the pump.
HPLC	High Pressure Liquid Chromatography (HPLC).
IP address	Unique address of transmitter or receiver in local network or Internet (Internet Protocol).
Link	Combination of multiple chromatography programs in a single HPLC system.
Remote	The chromatography software controls the pump.
Solvent	Mobile phase (eluent) or carrier for liquid chromatography.

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