

Science with Passion



*Azura*

# Pump P 2.1L

## Instructions



Document no. V6840

# 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.



**Note:** In case you require this instruction in another language, please submit your request including the corresponding document number via e-mail or fax to KNAUER.

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**Support in Germany**

(Austria & Switzerland on case-to-case basis):

Phone: +49 30 809727-111 (workdays 9-17h CET)

Fax: +49 30 8015010

E-mail: [support@knauer.net](mailto:support@knauer.net)

**Publisher:** KNAUER Wissenschaftliche Geräte GmbH

Hegauer Weg 38

14163 Berlin

Germany

Phone: +49 30 809727-0

Fax: +49 30 8015010

Internet: [www.knauer.net](http://www.knauer.net)

E-mail: [info@knauer.net](mailto:info@knauer.net)

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# 1. General

## 1.1 About these instructions

These operating instructions enable the safe and efficient operation of the device. The user must have carefully read and understood these operating instructions before starting any work.





The basic prerequisite for safe operation is compliance with all safety instructions (see "2 Basic safety instructions", p. 3). In addition to the safety and warning instructions in these operating instructions, the local accident prevention regulations and the national industrial safety regulations apply.

These operating instructions are an integral part of the device. It has to be kept in the immediate vicinity of the device and accessible to the user at all times.

You can download these and other instructions from the KNAUER website: [www.knauer.net/library](http://www.knauer.net/library)

## 1.2 Signal words

Possible dangers related to the device are distinguished in personal and material damages.

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

## 1.3 Additional typographical conventions

Note: Specific information are prefixed with the word "Note" and an information icon.



**Note:** This is an example.

## 1.4 Legal information

### 1.4.1 Liability limitation

The manufacturer is not liable for the following issues:

- Non-compliance of these instructions
- Non-observance of necessary safety precautions
- Improper use
- Operation of the device by unqualified personnel (see "2.2 User qualification", p. 3)
- Use of non-approved spare parts
- Technical changes by the user such as opening the device and unauthorized modifications
- Violations of General Terms and Conditions (GTC)

### 1.4.2 Transport damage

The packaging of our devices provides the best possible protection against transport damage. However, check the packaging for transport damage. In case you notice any damage, inform the Technical Support and the shipping company within three workdays.

### 1.4.3 Warranty conditions

For information on warranty please refer to our general terms and conditions on the website: [www.knauer.net/terms](http://www.knauer.net/terms)

### 1.4.4 Warranty seal

A blue or orange warranty seal is affixed to some devices.

- A blue seal is used by KNAUER's Manufacturing or Customer Support for devices to be sold.
- After repair, service technicians attach an orange seal onto the identical position.

After repair, the service technician affixes an orange seal in the same place. If unauthorized persons tamper with the device or if the seal is damaged, the warranty will lapse.



### 1.4.5 Declaration of conformity

The declaration of conformity is enclosed as a separate document with the product and can be obtained online:

[www.knauer.net/en/Support/Declarations-of-conformity](http://www.knauer.net/en/Support/Declarations-of-conformity)



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## 2. Basic safety instructions

The device has been developed and constructed in such a way that hazards arising from its intended use are largely excluded. Nevertheless, the following safety instructions have to be observed in order to exclude residual hazards.

### 2.1 Intended use

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.

#### 2.1.1 Operating ranges

The device is intended to be used indoors for chromatographic applications.

#### 2.1.2 Foreseeable misuse

Refrain from the use of the device for the following purposes or conditions:

- Medical purposes. The device is not approved as a medical product.
- Operating outdoors. Otherwise, the manufacturer does not guarantee the functionality and safety of the device.
- Operation in potentially explosive areas without special and additional explosion protection. Contact the KNAUER Customer Support for more information.

### 2.2 User qualification

The users are qualified to handle the device if all of the following points apply:

- They have at least a basic knowledge of liquid chromatography.
- They have knowledge about the properties of the used solvents and their health risks.
- They are trained for the special tasks and activities in the laboratory and know the relevant standards and regulations.
- Due to their technical training and experience, they can understand and carry out all the work described in the operating instructions on the instrument and recognize and avoid possible dangers independently.
- Their ability to react is not impaired by the consumption of drugs, alcohol or medication.
- They have participated in the installation of an instrument or training by KNAUER or an authorized company.

If users do not meet these qualifications, they have to inform their supervisors.

## 2.3 Operator responsibility

The operator is any person who operates the device himself or leaves it to a third party for use. It also bears the legal product responsibility for the protection of the user or third parties during operation.

The obligations of the operator are listed below:

- Know and follow the applicable work safety regulations.
- Identify hazards arising from the working conditions at the place of use in a risk assessment.
- Set up operating instructions for the operation of the device.
- Regularly check whether the operating instructions correspond to the current status of the regulations.
- Clearly regulate and specify responsibilities for installation, operation, troubleshooting, maintenance and cleaning and set clear rules.
- Ensure that all personnel who work with the device have read and understood these operating instructions.
- Train the personnel who work with the device at regular intervals and inform them about the dangers.
- Provide the necessary safety equipment to the employees working with the unit (see section below).

## 2.4 Personal safety equipment

The protective measures required in the laboratory have to be observed and the following protective clothing worn during all work on the device:

- Safety glasses with side protection
- Protective gloves in accordance with the prevailing ambient conditions and used solvents (e.g. heat, cold, protection against chemicals)
- Lab coat
- Personalized protective safety equipment which is specified in the particular laboratory.

## 2.5 Safety features on the device

- Power switch: Devices of the AZURA® L series may be switched off using the power switch (toggle switch on the back side of housing) at any time, this causes no damage to the device. To switch off devices of the AZURA® S series, remove the plug from the power socket or use the toggle switch of the power supply unit.
- Front cover: Devices of the AZURA® L series have a front cover as a splash protection for the user
- Leak tray: Devices of the AZURA® L series have a leak tray on the front side. The leak tray collects leaking solvents and protects components from potential damage caused by discharging liquid.
- Lamp: For the detectors AZURA DAD 2.1L, DAD 6.1L and MWD 2.1L, the lamp switches off automatically when the cover is opened.

## 2.6 Working with solvents

### 2.6.1 General requirements

- The user is trained for handling different solvents.
- Note recommended solvents and concentrations in these instructions in order to avoid personal injury or damage to the device. For example, certain chemicals may cause PEEK capillaries to swell or burst (see "12 Chemical compatibility of wetted materials", p. 58).
- Note that organic solvents are toxic above a certain concentration. For handling hazardous solvents see the following section.
- Mobile phases and samples may contain volatile or combustible solvents. Avoid the accumulation of these substances. Ensure good ventilation of the installation site. Avoid open flames and sparks. Do not operate the instrument in the presence of flammable gases or vapors.
- Only use solvents which do not self-ignite under given conditions. This applies especially to the use of a thermostat where liquids could get onto hot surfaces in the interior.
- Degas solvents before use and observe their purity.

### 2.6.2 Contamination by health-threatening solvents

- Contamination with toxic, infectious or radioactive substances poses a hazard for all persons involved during operation, repair, sale, and disposal of a device.
- All contaminated devices have to be decontaminated properly by a specialist company or the operating company before they can be recommissioned, repaired, sold, or disposed (see "10 Disposal", p. 55).

### 2.6.3 Avoiding leakage

Risk of electrical shock or short circuit if solvents or other liquids leak into the interior of the device. You can avoid a leakage through the following measures:

- Tightness: Visually check the device or system regularly for leaks.
- Solvent tray: The use of a solvent tray prevents liquids get from the bottles into the inside of the device.
- Eluent lines: Install capillaries and hoses in such a way that, in case of a leak, liquids cannot get into the interior of the devices underneath.
- In case of leakage: Switch off the system. Only take the device into operation if the cause of the leak has been resolved (see "8 Maintenance and care", p. 47).

## 2.7 Specific environments

### 2.7.1 Earthquake-endangered areas

In earthquake-endangered areas, do not stack more than 3 devices on top of each other. Otherwise there is risk of injury due to falling devices or loose parts.

### 2.7.2 Explosive environment

Never use the system in potentially explosive atmospheres without appropriate protective equipment. For more information, contact the KNAUER Customer Support.

### 2.7.3 Cooling room

You may operate the device in a cooling room. To prevent condensation, note the following instructions:

- Allow the device to acclimatize for min. 3 hours before taking it into operation.
- After taking into operation, the device should stay switched on.
- Avoid temperature fluctuations.

### 2.7.4 Wet room

The device must not be operated in wet rooms.

## 2.8 Maintenance, care and repair

- Avoiding electric shock: Before performing any maintenance and service work, disconnect the device from the power supply.
- Tools: Use only tools recommended or prescribed by the manufacturer.
- Spare parts and accessories: Only use original parts and accessories made by KNAUER or a company authorized by KNAUER.
- PEEK fittings: Use PEEK fittings only for a single port or brand-new PEEK fittings in order to avoid dead volume or not exactly fitting connections.
- Column care: Follow KNAUER or other manufacturer's instructions on caring for the columns (see [www.knauer.net/columncare](http://www.knauer.net/columncare)).
- Used capillaries: Do not use any used capillaries elsewhere in the system in order to avoid dead volumes, not exactly fitting connections and spreading contamination.
- Safety features: The device may only be opened by the KNAUER Customer Support or any company authorized by KNAUER (see "1.4.1 Liability limitation", p. 2).
- For more information visit the KNAUER website: [www.knauer.net/hplc-troubleshooting](http://www.knauer.net/hplc-troubleshooting)

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## 2.9 Service request form and decontamination report

Devices which are shipped without the completed document "Service request form and decontamination report" will not be repaired. If you would like to return a device to KNAUER, make sure to enclose the completed document: [www.knauer.net/servicerequest](http://www.knauer.net/servicerequest)

## 3. Product information



**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.

### 3.1 Features

The pump transports the fluid. By choosing the pump head accordingly, it is possible to reach the maximum values (see "11.1 Main features", p. 56).

The pump P 2.1L offers the following features:

- Self-priming pump
- Prolonged operating time because of the automatic piston backflushing
- Leak management

**Options** KNAUER offers the following accessories:

- Stainless-steel pump heads
- Titanium pump heads for biocompatible applications
- Display software Mobile Control
- Heating/cooling elements for the pump head
- Valve block for binary or ternary low pressure gradients
- Pump head inlet for one eluent tubing

### 3.2 Scope of delivery



**Note:** Only use original parts and accessories made by the manufacturer or a company authorized by the manufacturer.

- AZURA® Pump P 2.1L
- Power cable
- Instructions DE/EN
- Declarations of conformity
- Accessories kit AZURA®
- Accessories kit pump

### 3.3 Device overview

P 2.1L is a self-priming pump with automatic piston backflushing that is used in preparative HPLC systems.

### Legend

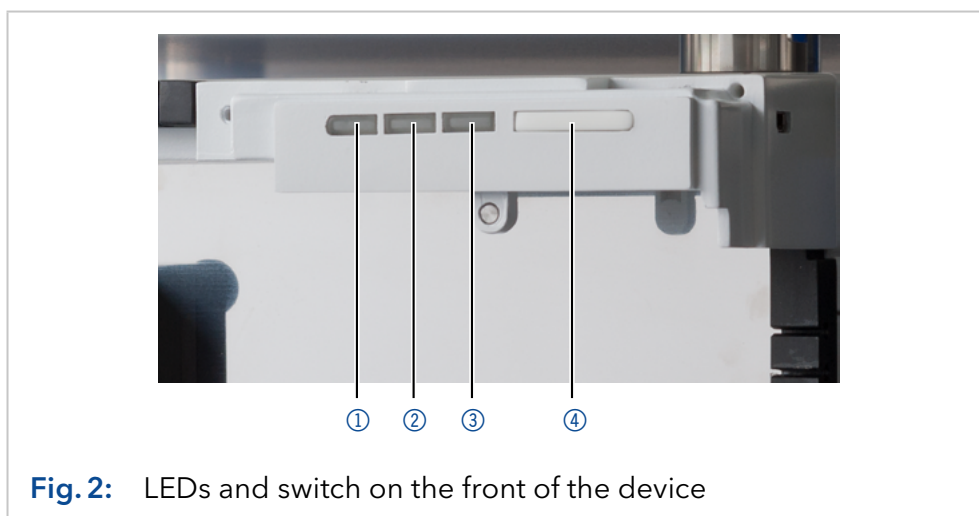
- ① Status LEDs
- ② Pump head
- ③ Pressure sensor



**Fig. 1:** Pump P 2.1L front view

### Legend

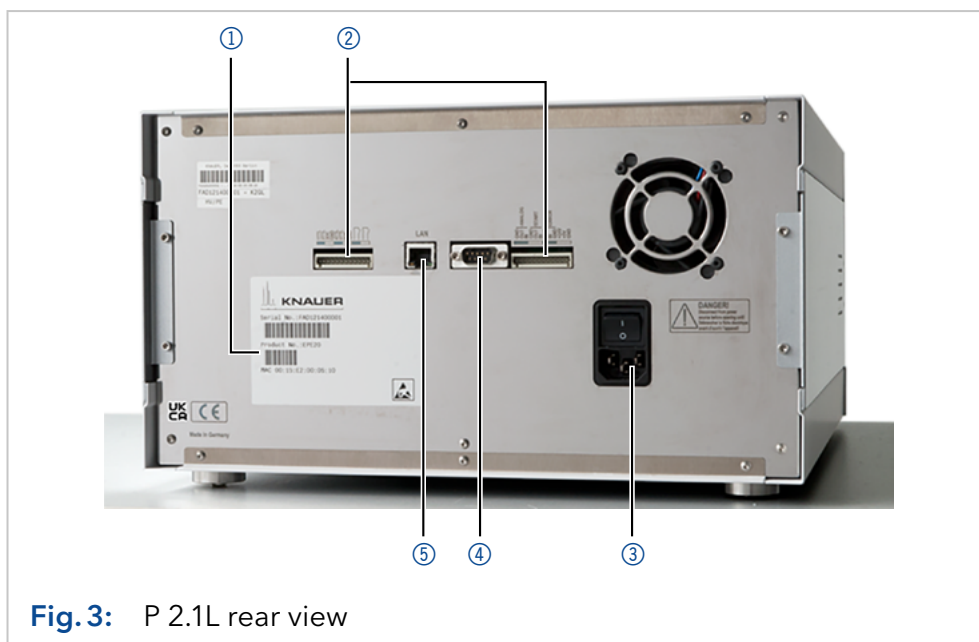
- ① Left LED
- ② Center LED
- ③ Right LED
- ④ Standby switch



**Fig. 2:** LEDs and switch on the front of the device

### Legend

- ① Serial number
- ② Pin header
- ③ Main power connection and power switch
- ④ Interface for the Technical Support
- ⑤ LAN port



**Fig. 3:** P 2.1L rear view

**Operating range** As part of a HPLC system, the pump takes part in separating substance mixtures and in filtering substances. It can alternatively be used as a single module. The pump transports the mobile phase within the chromatography system. For transportation there are two operating modes possible:

- Standard mode: Fluid transportation with a flow rate of up to 1 000 ml/min
- Dosing mode: Fluid transportation with a dose flow

**Location** In laboratories the device can be used in the following areas:

- Separation of chiral substances
- Separation of biomolecules
- Separation of fine chemicals
- Separation of active pharmaceutical ingredients (API)

### 3.4 Pump heads

The pump automatically recognizes the pump head by means of the RFID chips. 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.

Pump head for use in preparative applications:

- Standard model, stainless steel
- Pump heads with titanium or ceramic inlays for biocompatible applications 100 ml, 250 ml, 500 ml, 1 000 ml

### 3.5 Eluents

Even small quantities of other substances, such as additives, modifiers, or salts can influence the durability of the materials.



**Note:** The solvent list contains the solvents KNAUER recommends for use. If there is any doubt, contact the Technical Support of the manufacturer.



### Suitable solvents

- Acetone at 4 - 25 °C (39.2 - 77.0 °F)<sup>1</sup>
- Acetonitrile<sup>2</sup>
- Benzene
- Dilute acetic acid (e.g. 10-50 %) at 25 °C/77.0 °F
- Dilute ammonia solution
- Dilute sodium hydroxide (1 M)
- Ethanol<sup>1</sup>
- Ethyl acetate
- Hexane/heptane at 4 - 25 °C (39.2 - 77.0 °F)<sup>1</sup>
- Isopropanol
- Methanol
- Phosphate buffer solutions (0.5 M)
- Toluol
- Water

1. Valid for the specified temperature range.
2. Not recommended in combination with PEEK small parts and PEEK capillary.

### Less suitable solvents

- Carbon dioxide (liquid 99.999 % CO<sub>2</sub>)
- Dilute phosphoric acid
- Dimethyl sulfoxide (DMSO)
- Methylene chloride<sup>1</sup>
- Slightly volatile solvents
- Tetrahydrofuran (THF)<sup>1</sup>

1. Not recommended in combination with PEEK small parts and PEEK capillary.

### Not suitable solvents

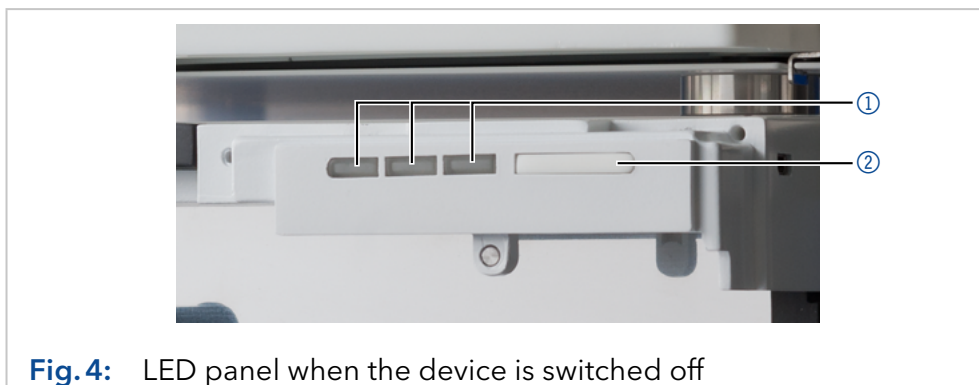
- Chloroform
- Concentrated mineral and organic acids
- Concentrated bases
- Halogenated hydrocarbons, e.g. Freon<sup>®</sup>
- Perfluorinated solvents, e.g. Fluorinert<sup>®</sup> FC-75, FC-40
- Perfluorinated polyether, e.g. Fomblin<sup>®</sup>
- Solvents containing particles

### 3.6 Meaning of the LEDs

There are three LEDs ① and a standby switch ② on the front of the device.

#### Legend

- ① Status LEDs
- ② Standby switch



**Fig. 4:** LED panel when the device is switched off

The LEDs show different colors depending on the operating status.

	Color	Operating condition	Operation
<b>Left LED</b>	Flashes red	Error error	<ul style="list-style-type: none"> <li>■ Check the system.</li> <li>■ Shortly press the switch to deactivate the error message.</li> </ul>
	Red	Serious error	<ul style="list-style-type: none"> <li>■ Restart the device.</li> <li>■ If the operating condition does not change, contact the Technical Support.</li> </ul>
<b>Center LED</b>	Green	Program or sequence is running/was loaded.	-
	Off	Pump is ready and does not convey liquid.	-
<b>Right LED, power status</b>	Flashes green	Equilibration	Wait until the device is ready.
	Green	Pump conveys liquid	-
	Green	Switched on	-
	Blue	Standby	Exit standby by pressing the standby switch.







**Standby** To activate the standby, keep the switch pressed for 5 seconds.



**Note:** Malfunctioning system after repeated standby possible. After repeatedly using the standby, switch off the power switch and back on again, to reset the data storage.

### 3.7 Symbols and signs

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

Symbol	Meaning
	Electric shock hazard. Failure to observe this warning may result in loss of life, serious injury or damage or destruction of the device.
	Electrostatic discharge hazard, damages to system, device, or components can occur.
	The device is covered by the Waste Electrical and Electronic Equipment Directive (WEEE Directive). It may not be disposed of as unsorted municipal waste and has to be collected separately. For more information (see "10.2 WEEE registration number", p. 55).
	Obey maximum load for leak tray during transportation, installation and operation.
	A device marked with CE fulfills the product specific requirements of European directives. This is confirmed in a Declaration of Conformity.
	The device complies with the product-specific requirements of the United Kingdom.

## 4. Installation and initial startup

Before you determine the operation site, read the chapter "11. Technical data" on page 56. There you will find all device-specific information on power supply, ambient conditions and humidity.



**Note:** The intended use be ensured only if the requirements for ambient conditions of the operating environment are met.

### 4.1 Unpacking

#### Process

#### Procedure

1. Place the packaging in such a way that the lettering on the label is in the correct position.
2. Check the packaging, the device and the accessories for transport damage.
3. Check the scope of delivery. In the event of incomplete delivery, contact Technical Support immediately.
4. When lifting, carrying or moving the device, grab the unit only from below on the sides. Do not hold onto front cover or leak tray, as these parts are loosely attached to the device.

#### Next steps

- Keep the included packing list for repeat orders.
- Keep the original packaging for safe storage or transportation.

### 4.2 Ambient conditions

#### 4.2.1 Operation site

Observe the following requirements for the operation site so that the measurement results are not influenced:

- Place on a firm, level and straight surface.
- Protect against direct sunlight.
- Do not expose to air drafts such as air conditioning systems.
- Do not set up next to other machines that cause floor vibrations.
- Keep from high frequency sources.
- Ensure adequate ventilation (see "4.2.3 Space requirements", p. 15).
- Avoid temperature fluctuations (see "4.2.2 Ambient temperature", p. 14).
- Avoid electrostatic discharges at the pump head.

#### 4.2.2 Ambient temperature

If the ambient temperature of the device is abruptly changed (e.g. when it is installed in a cooling chamber), condensation will form inside the device and may cause damage to the device. Allow the device to acclimate for 3 hours, before it is connected to the power supply and taken into operation.

### 4.2.3 Space requirements

- Make sure that the power plug on the power supply (wall socket or power strip) is always accessible, so that the device can be disconnected from the power supply.
- Ensure adequate ventilation around the device, otherwise it may overheat and malfunction:
  - Min. 5 cm distance if another device is set on one side.
  - Min. 10 cm distance if further devices are set on both sides.
  - At least 15 cm to the cooler fan on the rear.
- The mounting of a small device to an AZURA L device with a mounting bracket does not affect the performance of either device. The space requirements specified in both device instructions do not apply in this case.

## 4.3 Power supply

### 4.3.1 Power supply requirements

- Failure-free power supply: For failure-free operation, the electrical voltage has to be free of fluctuations, residual currents, voltage peaks and electromagnetic interference. The device has to receive sufficient voltage and reserve capacity.
- Check voltage: Only connect devices to a power supply whose voltage corresponds to the permissible voltage of the device.
- Power consumption: The nominal power of the connected devices must not exceed 50 % of the highest connected power capacity, since higher currents can flow briefly when the device is switched on.
- Main connection: The electrical power supply at the operation site has to be connected directly to the nearest main power connection.
- Grounding: The connectors for the voltage have to be grounded accordingly.

### 4.3.2 Power supply cables and plugs

- Original parts: For power supply, use the supplied power cable and plug to meet the specifications which are described in the chapter "11. Technical data" on page 56. Detachable power cable cables are not allowed to be replaced with other cable types.
- Country-specific plugs: Before switching on the device, check whether the supplied plug is approved for your country. Overview of the device- and country-specific plug types from KNAUER: [www.knauer.net/plugs](http://www.knauer.net/plugs)
- Power strips: If several devices are connected to one power strip, always consider the maximum power consumption of each device.
- Access to power supply: Make sure that the power plug on the power supply (wall socket or power strip) is always accessible, so that the device can be disconnected easily from the power supply.
- Damaged power supply cables and plugs: For safety reasons, damaged or faulty cables and plugs must not be used to connect the device to the power supply. Replace defective cables and plugs only with KNAUER accessories.

## 4.4 Connecting the piston backflushing

The piston backflushing removes salts and other substances from the area behind the pump head seals.

To do this, connect a bottle with flushing solution to the flush pump and the piston backflushing. The silicone tubing between the piston backflushing and the flush pump are pre-installed.

**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 15 seconds.
- In continuous mode: The rear piston area of the pump head is flushed automatically every 30 minutes, for 15 seconds.

**Designation** Inlet and outlet of the flush pump are located on the front of the device. The flush pump is inside of the device and not visible from the outside.



**Fig. 5:** Inlet symbol



**Fig. 6:** Outlet symbol

**Prerequisite**

- The pump has been set-up at the site of operation.
- The pump has been switched off.

**Material**

- Silicone tube

Process	Figure
<p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Use the first hose to connect the inlet ① of the flush pump to the bottle containing the flushing solution.</li> <li>2. Lead a tube from the flush pump's outlet ③ to the pump head's inlet ④ and fasten it.</li> <li>3. Use the second hose to connect the pump head ② to the bottle containing the flushing solution.</li> </ol>	<p><b>Fig. 7:</b> Connectors of pump head and flush pump</p>

**Flushing solution** These are suitable flushing solutions:

- Mixture of 80 % ethanol and 20 % water or higher ethanol content
- Mixture of 80 % isopropanol and 20 % water or higher isopropanol content



**Note:** KNAUER recommends the use of pure isopropanol as flushing solution for piston backflushing.



**Note:** Never fill the backpiston flushing with normal phase solvents like heptan or hexan.



**Note:** Fluctuations in the level of the back piston cylinder may indicate a problem with the seals or connections of the pump head.

#### NOTICE

##### Component defect

Possible damage to the pump head due to over-tightened capillary fitting.

→ Note the torque of the screw connection.



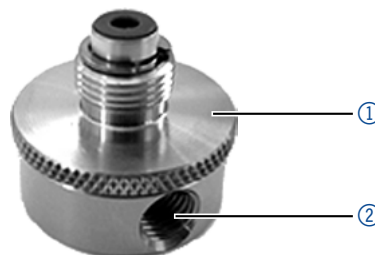
**Note:** PEEK fittings can withstand pressures up to 400 bar for 1/16" and 200 bar for 1/8".

## 4.5 Eluent inlet

The eluent lines are connected by the eluent inlet to the pump head. Before the eluent lines are connected, the eluent inlet has to be attached to the pump head.

### Legend

- ① Knurled-head screw
- ② Eluent inlet
- ③ Olive-type tube fitting

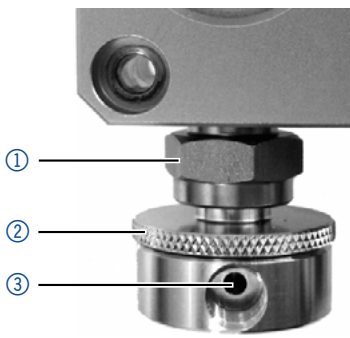


**Fig. 8:** Eluent inlet for 100-500 ml pump heads



**Fig. 9:** Eluent inlet for 1000 ml pump head

## 4.5.1 Connecting the eluent inlet to the pump head

	Process	Figure
<b>Procedure</b>	<ol style="list-style-type: none"> <li>1. With the knurled-head screw ② screw the eluent inlet into the inlet screw fitting ① of the pump head.</li> <li>2. Turn the eluent inlet until the intake manifold input ③ points forward.</li> <li>3. Tighten the knurled-head screw.</li> </ol>	

**Fig. 10:** Eluent inlet

## 4.5.2 Connecting the eluent line



**Note:** If connecting a pump head from 100 – 500 ml, make sure that the tapered side of the cutting ring is pointed towards the fastening screw of the Teflon hose.

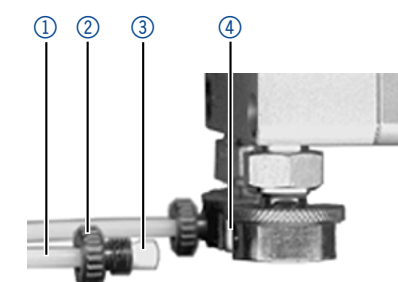
**Prerequisite** The eluent inlet has been connected.

**Preparations**

- Make sure that all connections are tight.
- Make sure that the tapered side of the cutting ring is pointed towards the fastening screw of the Teflon hose.

Pump head:

- 100 ml
- 250 ml
- 500 ml

	Process	Figure
<b>Procedure</b>	<ol style="list-style-type: none"> <li>1. Push the Teflon hose ① through the fastening screw ② and the cutting ring ③.</li> <li>2. Insert the hose end as far as possible into the eluent inlet fitting ④ of the pump head.</li> <li>3. Tighten the fastening screw by hand.</li> </ol>	

**Fig. 11:** Connecting the eluent line to the pump head



Pump head:

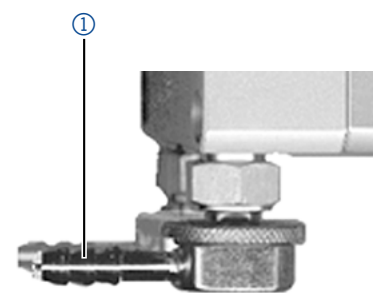
- 1 000 ml

### Procedure

#### Process

1. Push the Teflon hose directly on the olive-type tube fitting ①.
2. Fasten the Teflon hose with a hose clamp.

#### Figure



**Fig. 12:** Eluent line on 1 000 ml pump head

**Next steps** Check whether the connectors and lines are tight.

## 4.6 Changing the setup to LPG

By assembling a valve block, the setup of the system is changed to low pressure gradient (LPG). The valve block is mounted to the front of the pump. There are two types of valve blocks:

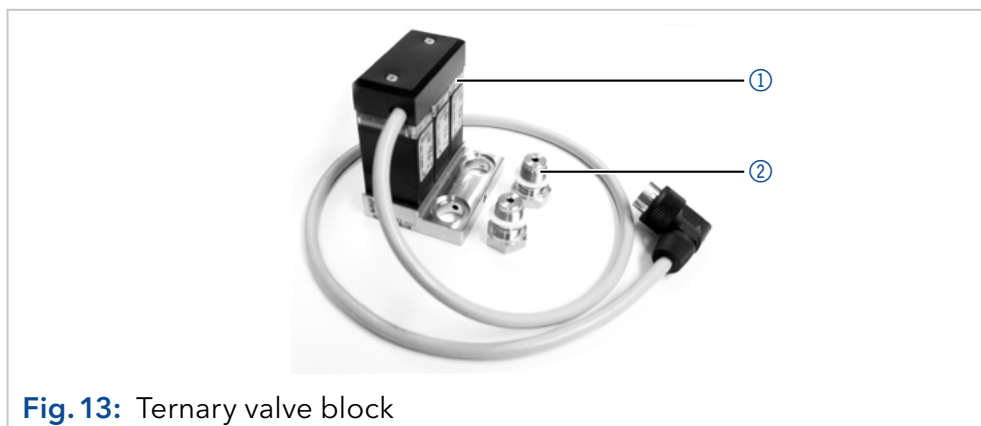
- Types**
- Ternary valve block for flow rates from 10 - 250 ml/min
  - Binary valve block for flow rates from 10 - 800 ml/min



**Note:** The manufacturer recommends to employ the binary LPG valve block for flow rates in the range of 100 - 800 ml/min.

### Legend

- ① Valve block
- ② Screw with seal ring



**Fig. 13:** Ternary valve block



**Note:** The front cover can no longer be used with the LPG valve block installed.

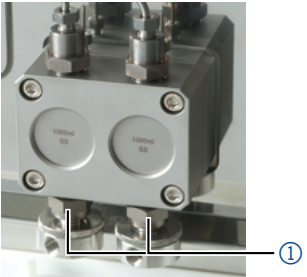
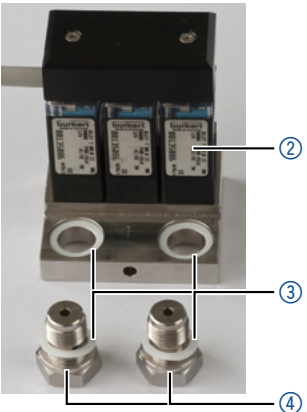
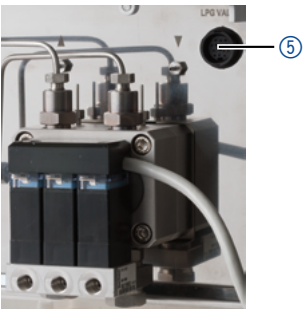
## 4.6.1 Mounting the valve block

- Prerequisite**
- The pump has been switched off.
  - The power plug has been pulled.

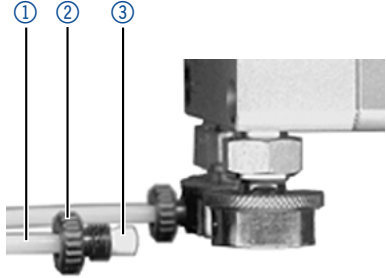

- Tool**
- Open-end wrench, size 17
  - Torque wrench



**Note:** Always place seals in pairs on both fastening screws.

Process	Figure
<p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Unscrew the inlets ① from the pump head.</li> </ol>	 <p><b>Fig. 14:</b> Inlet on the pump head</p>
<ol style="list-style-type: none"> <li>2. Place the seal rings ③ on the screws ④ and valve block ②.</li> <li>3. Using the torque wrench, tighten the screws ④ of the valve block ② with a 7.5 Nm torque.</li> </ol>	 <p><b>Fig. 15:</b> Valve block</p>
<ol style="list-style-type: none"> <li>4. Insert the plug into the female connector ⑤.</li> </ol>	 <p><b>Fig. 16:</b> Socket for the LPG valve block</p>

## 4.6.2 Connecting the eluent line to the pump head

Process	Figure
<p><b>Procedure</b></p> <ol style="list-style-type: none"><li>1. Push the Teflon hose ① through the fastening screw ② and the cutting ring ③.</li></ol>	 <p><b>Fig. 17:</b> Cutting ring with Teflon hose</p>
<ol style="list-style-type: none"><li>2. Insert the hose end as far as possible into the eluent inlet fitting ④ of the valve block.</li><li>3. Tighten the fastening screw by hand.</li><li>4. Plug a cap fitting into the unused inlet.</li></ol>	 <p><b>Fig. 18:</b> Inlets of the valve block</p>
<p><b>Next steps</b> Connect the plug of the valve block.</p>	

## 4.7 Priming the pump

**Prerequisite** The capillaries have been connected.

**Tool** Syringe

### NOTICE

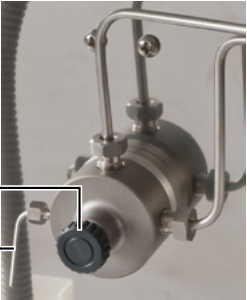
#### Column defect

Damage to the column due to purging.

- Open the venting screw.
- Remove the column.



**Note:** Before the pump can be used, it has to be primed.

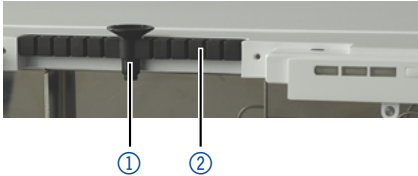
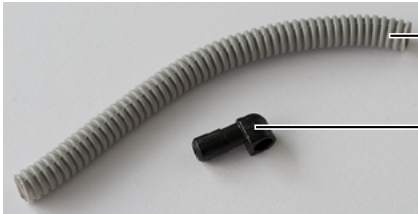


	Process	Figure
<b>Procedure</b>	<ol style="list-style-type: none"> <li>1. Open the venting screw ① of the pressure sensor.</li> <li>2. With the syringe, extract fluid through the priming port ②.</li> <li>3. If the extracted fluid flows continuously, stop suction and close the venting screw.</li> </ol>	 <p><b>Fig. 19:</b> Venting screw of the pressure sensor</p>

**Result** No air bubbles in the pump head and in the capillaries.

## 4.8 Leak management

The leak management consists of the leak sensor and the drainage system (funnels, hoses, nozzles). The drainage system ensures that escaping liquids flow into a waste bottle. When leaks are registered by the leak sensor, the LED flashes red. Both the device and the data acquisition via chromatography software are stopped.

**Prerequisite** ■ The front cover has been removed.

Process	Figure
<p><b>Procedure</b></p> <ol style="list-style-type: none"> <li>1. Carefully push the funnel ① into the center opening of the capillary guide ②.</li> </ol>	 <p><b>Fig. 20:</b> Funnel and capillary guide</p>
<ol style="list-style-type: none"> <li>2. Push the long ending of the first nozzle ④ into the hose ③.</li> </ol>	 <p><b>Fig. 21:</b> Hose and nozzle</p>
<ol style="list-style-type: none"> <li>3. Connect the nozzle and the funnel.</li> <li>4. Push the other end of the hose onto the nozzle ⑤ of the leak tray.</li> </ol>	 <p><b>Fig. 22:</b> Hose connected to the device</p>
<ol style="list-style-type: none"> <li>5. For the bottom device, push the short end of the nozzle ⑥ into the opening in the collection point of the leak tray.</li> <li>6. Connect the hose to the nozzle and lead the second ending to the waste bottle.</li> <li>7. Place the waste bottle below the bottom device.</li> </ol>	 <p><b>Fig. 23:</b> Leak tray with nozzle</p>

**Next step** Attach the front cover.

## 4.9 Control

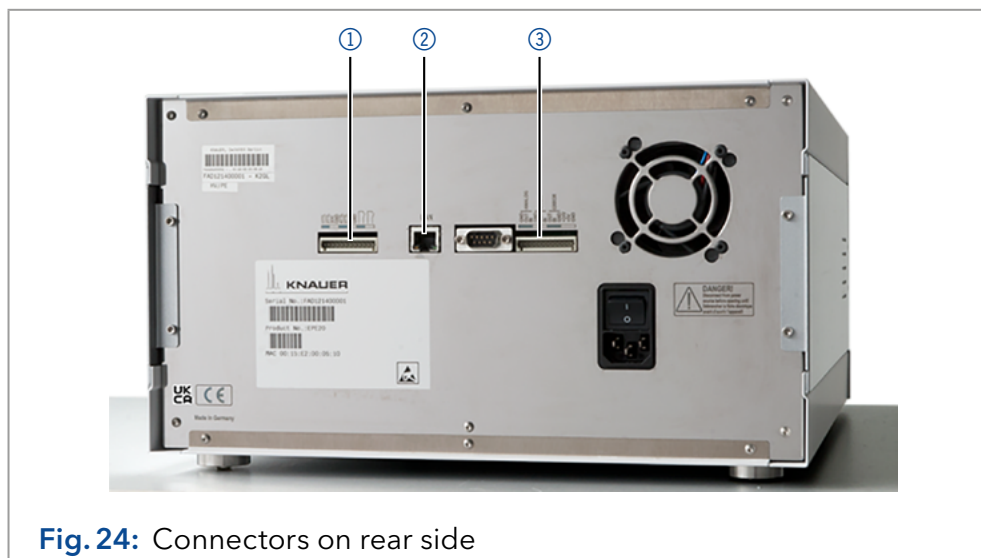
The pump can be operated in two ways:

- Via the pin header (Analog-In connection with WAGO plug)
- As part of a LAN, via the LAN connector of the router

All connectors for external control are located on the rear side of the pump.

### Legend

- ① Events connector
- ② LAN connector
- ③ Remote connector



**Fig. 24:** Connectors on rear side



**Note:** HPLC devices from KNAUER only work with IP addresses, which have been assigned by IPv4. IPv6 is not supported.



**Note:** When using PurityChrom®, static IP addresses are needed (see section “4.10 Setting IP addresses via software” on page 27).

The following chapters describe how to set up a chromatography 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.

### 4.9.1 Setting up LAN

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

#### Process

#### Procedure

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. Set up the router for the computer network.
4. Install the chromatography software.
5. Switch on the device and run the chromatography software.

#### Next steps

Configure LAN properties (see section “4.9.2 Configuring LAN settings” on page 25).

## 4.9.2 Configuring 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 have to 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 Device Manager has to be deactivated for all USB hosts.
  - Applies to all LAN devices: Disable the setting for the network adapter in Device Manager "Allow the computer to turn off this device to save power".

### Process

- Procedure**
1. In Windows, open <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 an IP address automatically
    - b) Obtain DNS server address automatically
  7. Click on the button <OK>.

**Next steps** Connect devices (see section "4.9.3 Connecting devices with LAN" on page 25).

## 4.9.3 Connecting devices with LAN

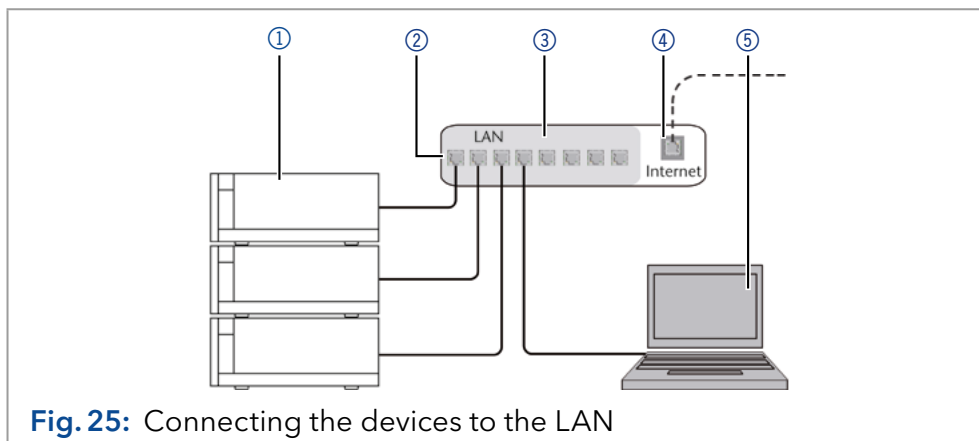
A router ② has several LAN ports ③ and one WAN port ④ that can be used to integrate the LAN into a wide area network (WAN), e.g. a company network or the Internet. In contrast, the LAN ports serve to set up a network from devices ① and a computer ⑤. To avoid interference, we recommend operating the chromatography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



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

## Legend

- ① Devices
- ② Router
- ③ LAN ports
- ④ WAN/Internet connection
- ⑤ Computer



**Fig. 25:** Connecting the devices to the LAN

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

### Process

- Procedure**
1. Use the patch cable to connect the router and the computer. Repeat this step to connect all devices.
  2. With additional patch cables, connect all devices individually with the router.
  3. Use the power supply to connect the router to the mains power system.

**Next steps** Set the router properties (see section “4.9.4 Configuring the router” on page 26).

## 4.9.4 Configuring the router

The router is preset at the factory. Information about address, user name and password is noted in the router manual: [www.knauer.net/en/Support/Library/PC-hardware](http://www.knauer.net/en/Support/Library/PC-hardware).

### Process

- Procedure**
1. To open the router configuration, start your Internet browser and enter the IP address (does not apply 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 essential to note this information on the router.

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

## 4.9.5 Integrating LAN into the company network

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

- Prerequisites**
- There is a patch cable for the connection.



Process	
<b>Procedure</b>	1. Make sure that there is no overlap between the IP addresses of the router and the corporate network.
	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.
<b>Result</b>	The LAN is now integrated into the company network.

#### 4.9.6 Controlling several systems separately in LAN

Devices connected to a LAN communicate through ports, which are part of the IP address. If more than one chromatography 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 has to be changed and this same number has to 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 have to use the same numbers in the device configuration of the chromatography software as in the device, otherwise the connection fails.

Process	
<b>Procedure</b>	1. Find out port number and change it on the device.
	2. Enter the port number in the chromatography software.
<b>Result</b>	The connection is established.

### 4.10 Setting IP addresses via software



**Note:** Check the IT security standards for your lab before intervening in the LAN settings.

**PurityChrom®** Static IP addresses are required to run certain chromatography software, e.g. Purity Chrom®. For a comprehensive overview on how to set static IP addresses for PurityChrom®, refer to the document „PurityChrom® Installation Guide“ on the PurityChrom® installation CD.

For Mobile Control and Firmware Wizard, it is possible to set a fixed (static) or dynamic (DHCP) IP address via software.



#### 4.10.1 Mobile Control: Setting a static IP address



**Note:** The device is preset to a dynamic address (DHCP). To ensure a constant LAN connection between the chromatography software and the instrument, we recommend switching the instrument to a static IP address for certain applications. More information about LAN settings can be found in the [Mobile Control Software Instructions](#) (document no. V6851-2).

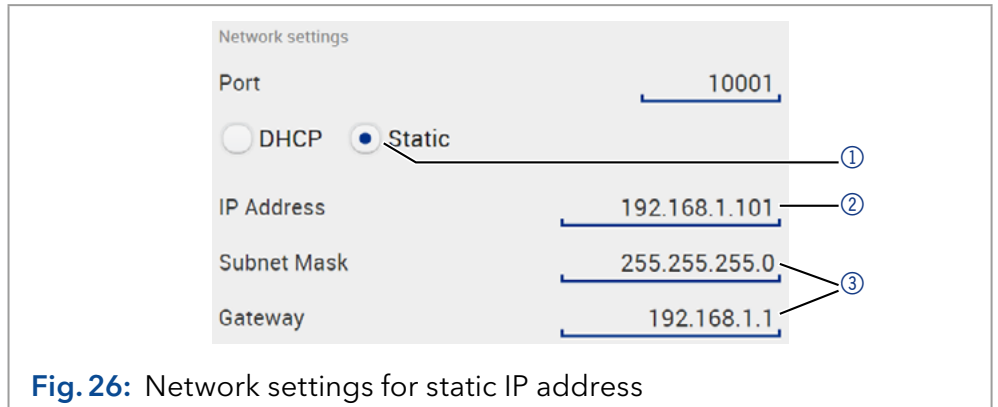
- Prerequisites**
- The device is switched on.
  - Mobile Control is installed and running.
  - The connection between Mobile Control and the device has been established.

**Process**

- Procedure**
1. In Mobile Control, click  <Settings>.
  2. On the <General> tab, choose the device name.
  3. In <Network Settings>, choose the setting <Static> ①.
  4. Enter the IP address into the text box <IP Address> ②.
  5. If necessary, change the subnet mask and the gateway ③.
  6. Click  in the top right corner.
  7. Restart the device (recommended).

**Legend**

- ① IP address mode
- ② Text box for IP address
- ③ Text field for subnet mask/gateway





**Fig. 26:** Network settings for static IP address

**Result** The device is now accessible via the static IP address.

### 4.10.2 Mobile Control: Setting a dynamic IP address via device name

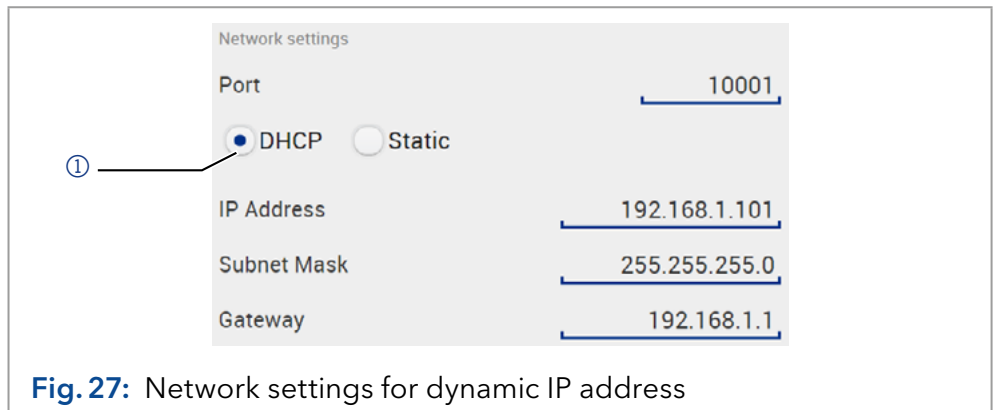
- Prerequisites**
- The device is switched on.
  - Mobile Control is installed and running.
  - The connection between Mobile Control and the device has been established.

**Process**

- Procedure**
1. In Mobile Control, click  <Settings>.
  2. On the <General> tab, choose the device.
  3. In <Network Settings>, choose the setting <DHCP> ①.
  4. Click  in the top right corner.
  5. Restart the device (recommended).

## Legend

- ① IP address mode



**Result** The device is now accessible via a dynamic IP address.

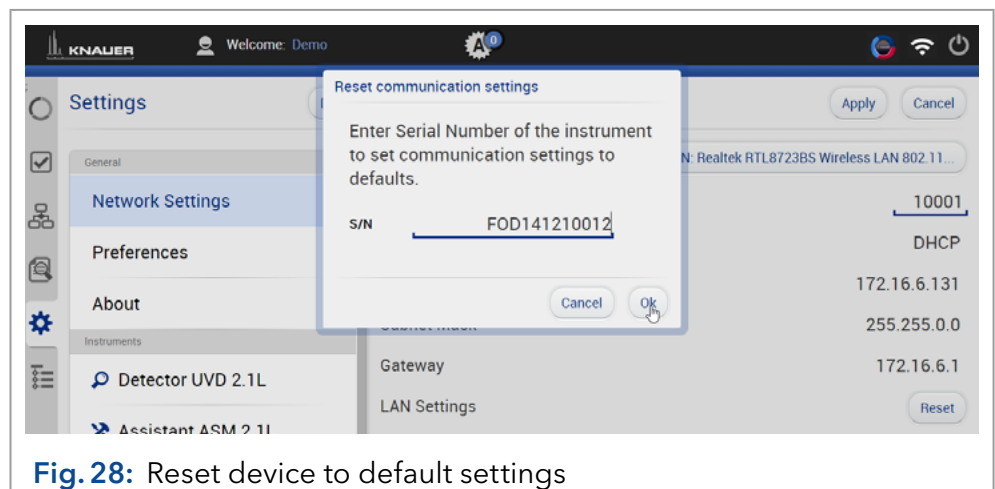
### 4.10.3 Mobile Control: Setting a dynamic IP address via device serial number

- Prerequisites**
- The device is switched on.
  - Mobile Control is installed and running.
  - The connection between Mobile Control and the device has been established.

#### Process

- Procedure**
1. In Mobile Control, click <Settings>.
  2. In <Network Settings>, click <Reset>. The windows <Reset communication settings> opens.
  3. Enter the serial number of the device into the text field.
  4. Click <OK>. The device is now reset to default settings.
  5. Restart the device (recommended).

**Result** The device is now accessible via a dynamic IP address.



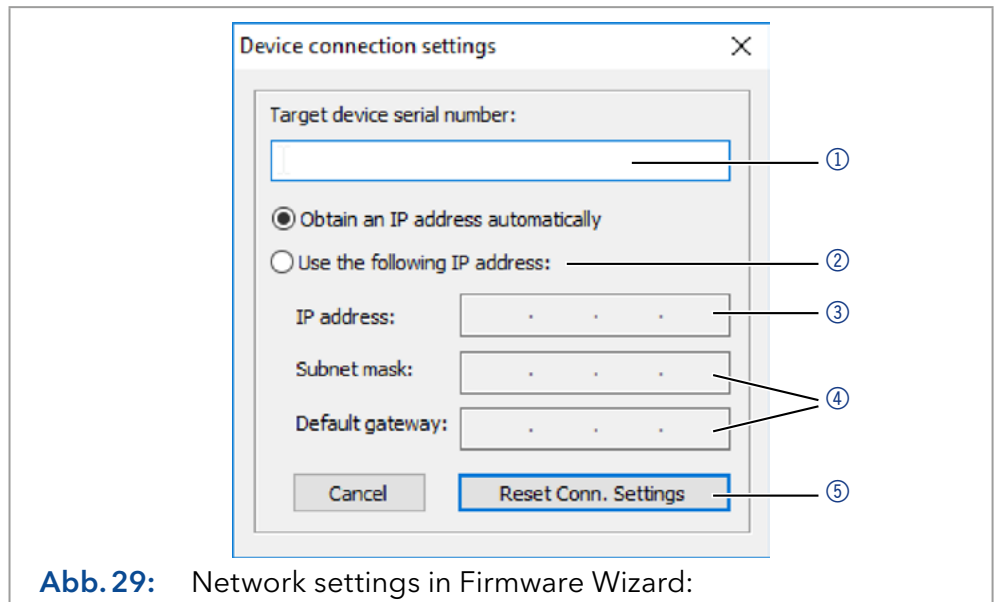
## 4.10.4 Firmware Wizard: Setting a static IP address



**Note:** More information about LAN settings can be found in the Mobile Control Software Instructions in the chapter "Firmware Wizard" (document no. V6851-2).

### Legend

- ① Text box for serial number of the device
- ② Setting IP address manually
- ③ Text box for IP address
- ④ Text box for subnet mask & gateway
- ⑤ Confirm changes



**Abb. 29:** Network settings in Firmware Wizard:

- Prerequisites**
- The device is switched on.
  - Firmware Wizard is installed and running.

### Process

#### Procedure

1. In Firmware Wizard, click <Reset LAN Settings...>.
2. The window <Device connection settings> opens. Enter serial number of the device into the text field <Target device serial number> ①.
3. Select option <Use the following IP address> ②.
4. Enter the IP address into the text field <IP address> ③.
5. Optionally, adjust subnet mask and gateway ④.
6. Click <Reset Conn. Settings> ⑤ to accept changes.
7. Restart the device (recommended).

**Result** The device is now accessible via the static IP address.

## 4.10.5 Firmware Wizard: Setting a dynamic IP address

- Prerequisites**
- The device is switched on.
  - Firmware Wizard is installed and running.

### Process

#### Procedure

1. In Firmware Wizard, click <Reset LAN Settings...>.
2. The window <Device connection settings> opens. Enter serial number of the device into the text field <Target device serial number> ①.
3. Select option <Obtain an IP address automatically> ②.

**Process**

4. Click <Reset Conn. Settings> ⑤ to accept changes.
5. Restart the device (recommended).

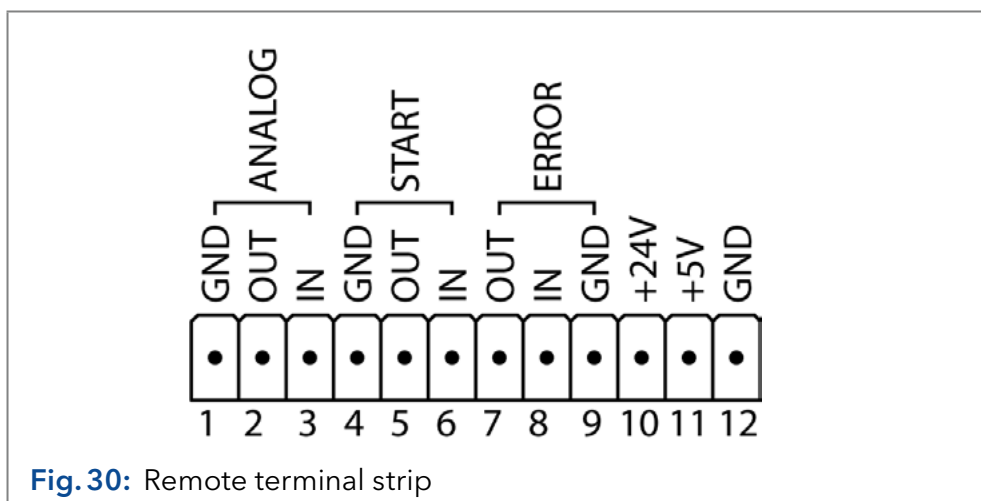
**Result** The device is now accessible via a dynamic IP address.

## 4.11 Remote control

### 4.11.1 Connector assignment

**Remote terminal strip**

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



**Fig. 30:** Remote terminal strip

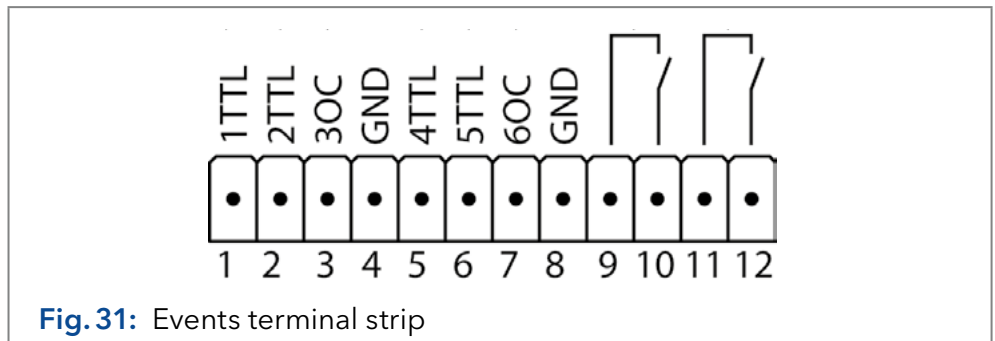
Signal	Explanation
Analog OUT	Analog output signal. Either outputs the measured system pressure or a control voltage for Pump B. The output range can be set to values of max. 1, 2, 5 and 10 V.
Analog IN	Analog input signal for controlling the flow rate, e.g.: <ul style="list-style-type: none"> <li>■ 1 V for 10 ml/min in the case of the 100 ml pump head</li> <li>■ 1 V for 25 ml/min in the case of the 250 ml pump head</li> <li>■ 1 V for 50 ml/min in the case of the 500 ml pump head</li> <li>■ 1 V for 100 ml/min in the case of the 1000 ml pump head</li> </ul>
Start OUT	Output is active for 500 ms when a program starts.
Start IN	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.
+24V	Event-controlled switching of 24 V against GND Protection: 24 V-200 mA

Signal	Explanation
+5V	Provides a voltage of 5 V with respect to GND. This makes it possible to supply a consumer that is switched by an EVENT. Protection: 5 V-50 mA
GND	Reference point of the voltage at the signal inputs.

**Events remote connector**








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





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



**Fig.31:** Events terminal strip

Assignment	Connection	Function
	1TTL	<p><b>TTL-compatible output</b></p> <p>Levels:</p> <ul style="list-style-type: none"> <li>■ passive 0 V <input type="checkbox"/></li> <li>■ active 5 V <input checked="" type="checkbox"/></li> </ul> <p>Pulse:</p> <p>5 V for at least 1 000 ms </p>
	2TTL	<p><b>TTL-compatible output</b></p> <p>Levels:</p> <ul style="list-style-type: none"> <li>■ passive 0 V <input type="checkbox"/></li> <li>■ active 5 V <input checked="" type="checkbox"/></li> </ul> <p>Pulse:</p> <ul style="list-style-type: none"> <li>■ 5 V for at least 1 000 ms </li> </ul>
	3OC	<p><b>TTL output</b></p> <p>Levels:</p> <ul style="list-style-type: none"> <li>■ passive 0 V <input type="checkbox"/></li> <li>■ active 5 V <input checked="" type="checkbox"/></li> </ul> <p>Pulse:</p> <ul style="list-style-type: none"> <li>■ 5 V for at least 1 000 ms </li> </ul>

Assignment	Connection	Function
	GND	Reference point of the voltage at the signal inputs.
	4TTL	<p><b>TTL-compatible output</b></p> <p>Levels:</p> <ul style="list-style-type: none"> <li>passive 0 V <input type="checkbox"/></li> <li>active 5 V <input checked="" type="checkbox"/></li> </ul> <p>Pulse:</p> <ul style="list-style-type: none"> <li>5 V for at least 1 000 ms </li> </ul>
	5TTL	<p><b>TTL-compatible output</b></p> <p>Levels:</p> <ul style="list-style-type: none"> <li>passive 0 V <input type="checkbox"/></li> <li>active 5 V <input checked="" type="checkbox"/></li> </ul> <p>Pulse:</p> <ul style="list-style-type: none"> <li>5 V for at least 1 000 ms </li> </ul>
	6OC	<p><b>TTL output</b></p> <p>Levels:</p> <ul style="list-style-type: none"> <li>passive 0 V <input type="checkbox"/></li> <li>active 5 V <input checked="" type="checkbox"/></li> </ul> <p>Pulse:</p> <ul style="list-style-type: none"> <li>5 V for at least 1 000 ms </li> </ul>
	GND	Reference point of the voltage at the signal inputs.
		<p><b>Relay Contact</b></p> <p>The contact is on a floating basis. Its setting depends on the settings in the software.</p> <p>Steady-rate signal:</p> <ul style="list-style-type: none"> <li>passive = open relay contact <input type="checkbox"/></li> <li>active = closed relay contact <input checked="" type="checkbox"/></li> </ul> <p>Pulse:</p> <ul style="list-style-type: none"> <li>Closed relay contact for at least 1 000 ms</li> </ul> <p>Permissible load of the relay contact: 1 A/ 24 V DC </p>
		<p><b>Relay Contact</b></p> <p>The contact is on a floating basis. Its setting depends on the settings in the software.</p> <p>Steady-rate signal:</p> <ul style="list-style-type: none"> <li>passive = open relay contact <input type="checkbox"/></li> <li>active = closed relay contact <input checked="" type="checkbox"/></li> </ul> <p>Pulse:</p> <ul style="list-style-type: none"> <li>Closed relay contact for at least 1 000 ms</li> </ul> <p>Permissible load of the relay contact: 1 A/ 24 V DC </p>

Assignment	Connection	Function
	Analog GND	Reference point of the voltage at the signal inputs.
	Analog OUT	Voltage range 0 - 5 V, scalable
	Analog IN	Voltage range 0 - 10 V 10 V according to maximum flow rate
	Start GND	Reference point of the voltage at the signal inputs.
	Start OUT	<b>TTL output</b> Levels: <ul style="list-style-type: none"> <li>■ passive 5 V </li> <li>■ active 0 V </li> </ul>
	Start IN	<b>TTL input</b> <ul style="list-style-type: none"> <li>■ Low active</li> </ul> Secure switching threshold at least 10 mA After receiving a signal (short-circuit to ground) from an external device, the device starts. If controlled with software, an electronic trigger is send through the LAN.
	Error OUT	<b>TTL output</b> Levels: <ul style="list-style-type: none"> <li>■ passive 5 V </li> <li>■ active 0 V </li> </ul>
	Error IN	<b>TTL input</b> <ul style="list-style-type: none"> <li>■ Low active</li> </ul> Secure switching threshold at least 10 mA After receiving a signal (short-circuit to ground) from an external device, an error message appears and the device stops.
	Error GND	Reference point of the voltage at the signal inputs.

### 4.11.2 Connecting the pin header

To control one device through another, the pin header is used. To use remote control, you have to connect cables to the pin header. The single ports are used to exchange control signals.

- Prerequisites**
- The device is switched off.
  - The power plug is disconnected from the device.
- Tools**
- Depressor tool



**NOTICE****Electronic defect**

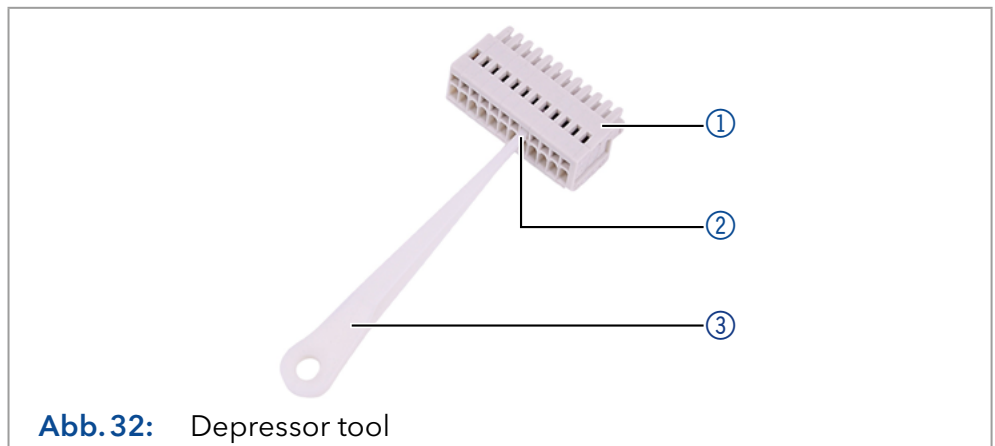
Connecting cables to the multi-pin connector of a switched on device causes a short circuit.

- 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.



**Abb. 32:** Depressor tool

**Process****Procedure**

1. Insert the depressor tool ③ in an upper small opening at the front of the pin header ①.
2. Insert the cable into the opening ② underneath the inserted depressor tool
3. Pull out the depressor tool.

**Next steps**

Check whether the cables are tightly attached. Press the pin header onto the connector. Finish the installation. Bring the device into operation.

## 4.12 Analog control



**Note:** Contact the customer support to change the default settings and to select the analog control.

Analog ports serve for exchanging analog control signals. Reference point for the signals is the connector GND.

OUT: Device sends signal.

IN: Device receives signal.

## 5. Operation

### 5.1 Initial operation

Use this checklist to check if the pump is ready for initial operation:

- Device is positioned in the correct location.
- The power plug has been connected.

If the device is part of an HPLC system, note the following:

- The network connection to the router is established
- The chromatography software has been installed by KNAUER or a company authorized by KNAUER.
- The capillaries have been connected.



**Note:** Before switching on the pump, purge it to remove air from capillaries and tubings (see "5.2 Purging the pump" on p. 37).

#### 5.1.1 Pump head running-in



**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.

All pump heads were filled with isopropanol prior to delivery. 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.

If the pump is performing within specification, or during intensive operation, it is not necessary to perform this procedure.

#### 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.

## 5.2 Purging the pump

Before the pump can be used, it has to be purged to remove excess air in the capillaries.

Purge the pump in the following cases:

### When is flushing required?

- At initial startup to eliminate air bubbles in hoses and capillaries.
- When changing solvents.
- After using buffer solutions to eliminate salt residues.
- Before turning off, if you do not plan to restart the device within shortly.

### Prerequisites

- The installation has been completed.
- The capillaries and hoses have been connected.
- The pump has been switched on and is in "flow mode".

### Tool

- Syringe with Luer lock

Use the purging solvent to be used in the following application.



**Note:** The purging process may take a while during initial operation because the solvent tubes are filled with liquid for the first time.



**Note:** If a buffer solution is used, select a solvent for purging in which the buffer solution is soluble.

### NOTICE

#### Column defect

Damage to the column due to purging.

- Open the venting screw.
  - Remove the column.
-

Procedure	Process	Figure
	<ol style="list-style-type: none"> <li>1. Insert the inlet hoses into the storage containers and start the pump with an intermediate flow rate.</li> <li>2. As the pump is self-priming, the venting screw ① of the pressure sensor can be opened.</li> <li>3. If necessary, draw liquid through the dry feed hoses to the pump head with the provided syringe. If you are working without the pump head inlet, pay attention that both feed hoses are filled with solvent.</li> <li>4. With the syringe, extract fluid through the purge port ②.</li> <li>5. If the extracted fluid flows continuously, stop suction and close the venting screw ①.</li> </ol>	

**Fig. 33:** Venting screw of the pressure sensor

The purging process of the pump is limited to a maximum pressure of 5 MPa. If this value is exceeded during the purging process, the pump switches off automatically. If you are using very small hoses and capillaries, the pressure can be too high.

#### For how long is purging required?

If there are air bubbles in the capillaries, the flow pulsates. As soon as the flow is constant, the pump is purged and the purging process can be stopped. The duration for purging depends on capillary and hose length as well as the flow rate.

## 5.3 Switch-on

#### Prerequisite

- Liquid container is sufficiently filled.
- Piston backflushing is connected.
- Washing container is sufficiently filled.

#### NOTICE

##### Device defect

Changes of the ambient temperature cause condensation inside the device.


- ➔ Allow device to acclimate for 3 h before connecting to power supply and taking into operation.

#### NOTICE

##### Component defect

Possible damage to the pump head due to dry running.

- ➔ Make sure that solvent flows through the pump head and piston backflushing.

	Process	Figure
<b>Procedure</b>	<ol style="list-style-type: none"> <li>1. Switch on the pump at the power switch ① on the rear side.</li> <li>2. Wait until the pump has completed the self-test.</li> <li>3. If the self-test has been successfully completed, the LED on the right lights up green.</li> </ol>	 <p data-bbox="1002 450 1294 483"><b>Fig. 34:</b> Power switch</p>

**Result** The pump is now ready for operation. If the test fails, an error message will be displayed. Contact the Technical Support of the manufacturer if the error occurs several times.

**Next step** Forestall pressure fluctuations by letting the pump run for 1 hour.

## 5.4 Software control

There are several options for controlling the device:

- with chromatography software
- with KNAUER Mobile Control



**Note:** It is not possible to use two control methods simultaneously. If the device is connected to the software, it cannot be controlled via Mobile Control.

### 5.4.1 Controlling with chromatography software

To operate the device with software, you have to establish a connection between the LAN port and a computer. Devices can be controlled with e. g. OpenLAB EZChrom edition version A.04.05 or higher, ChromGate version 3.3.2 or higher and ClarityChrom version 3.0.7 or higher.

You find a detailed description on chromatography software in the corresponding instructions.

### 5.4.2 Controlling with Mobile Control

The Mobile Control is a software which can be installed on your computer or tablet. To control the device using the Mobile Control, connect the computer or tablet with operating system Windows 10 to a wireless LAN router. The firmware version of the pump has to be V01.09 or higher. You find a detailed description in the Mobile Control Instructions (V6851-2).

## 5.5 Switch-off

If you want to switch off the pump for a longer term, purge the pump head with isopropanol.

**Prerequisite** The pump has been purged (see "5.2 Purging the pump" on p. 37). Use isopropanol if you are going to take the device out of operation for a longer period of time or if you want to prepare it for storage.

The device is no longer in operation (only the LED to the right lights green).

**Process**

1. Stop the flow.
2. Set the power switch on the rear side to OFF.

**Result** The LED turns off.

## 6. Functionality tests



**Note:** Standard processes regarding IQ and OQ in single devices may be handled differently in individual cases.

### 6.1 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 a provider authorized by KNAUER performs this functionality test during the installation.

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

- Confirmation of flawless condition at delivery
- Check if the delivery is complete
- Certification on the functionality of the device

You can either use the IQ document attached to this instruction manual or download a digital version from our website:



### 6.2 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 a 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 depend on the usage of the device.

**Execution** The test can be carried out either by the technical support of KNAUER or by a provider authorized by KNAUER (for a fee). For further information visit our website:



## 7. Troubleshooting

First measures:

- Check all cables and fittings.
- Check if air has got into the supply lines.
- Check the device for leakages.

Further measures:

- Compare occurring errors with the list of possible errors (see below).
- Contact the Customer Support.

### 7.1 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, call the Technical Support.

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



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 cables 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. Turn off all devices, router, and computer. First, switch on the router and wait until it has successfully completed its self-test. Then turn on the router, then the devices and finally the computer.
    - Has this been successful?
  6. Replace the patch cable with the device to which a connection could not be established.
    - Has this been successful?
  7. Make sure that the IP port of the device matches the port in the chromatography software.



## 7.2 Possible problems and solutions

Problem	Solution
Device cannot be switched on.	Inspect the power cable to ensure that it is plugged into the power supply.
When purging, the pump switches off.	Check if the venting screw on the pressure sensor is turned up.
Pump does not transport solvent.	<ul style="list-style-type: none"> <li>■ Purge the pump head to remove the air bubbles.</li> <li>■ Clean the check valves.</li> <li>■ Exchange the check valves.</li> <li>■ If the pump head seals are defective, solvent enters the piston backflushing; inform the Technical Support of the manufacturer.</li> <li>■ Exchange the pump head.</li> </ul>
Pressure and flow rate variations	<ul style="list-style-type: none"> <li>■ Purge the pump head to remove the air bubbles.</li> <li>■ Let the pump run for 1 h.</li> <li>■ Always tighten the inlet screw fittings and outlet screw fittings on the pump head with a torque wrench and 15 Nm.</li> <li>■ Clean the check valves.</li> <li>■ Exchange the check valves.</li> <li>■ Exchange the pump head</li> <li>■ Inform the Technical Support of the manufacturer.</li> </ul>
Pump head leaks.	<ul style="list-style-type: none"> <li>■ Inspect the inlet and outlet screw fittings of the pump head.</li> <li>■ If the seals are defective, eluent enters the piston backflushing; inform the Technical Support of the manufacturer.</li> <li>■ Exchange the pump head.</li> </ul>
Flow rate is not correct.	<p>Check the following options:</p> <ul style="list-style-type: none"> <li>■ Check the data for the solvent compressibility</li> <li>■ Cleaning the check valves</li> <li>■ Exchange the check valves</li> </ul>

## 7.3 Error messages

If other error messages are displayed besides those listed below, please restart the device. Inform the Technical Support of the manufacturer in case the error message displays repeatedly.

	Message	Solution
A	Auto pump head type: head data uninitialized!	<ul style="list-style-type: none"> <li>Switch the device off and on.</li> <li>Check whether a pump head with RFID recognition has been installed.</li> <li>Repeat the automatic configuration step in the chromatography software.</li> <li>Remove pump head, clean it and install it again.</li> </ul>
	Auto pump head type: no valid head detected!	<ul style="list-style-type: none"> <li>Switch the device off and on.</li> <li>Check whether a pump head with RFID recognition has been installed.</li> <li>Repeat the automatic configuration step in the chromatography software.</li> <li>Remove pump head, clean it and install it again.</li> </ul>
	Auto pump head type: RFID hardware not present or failed!	Pump head without RFID detection: If necessary, replace pump head.
	Auto pump head type: read failed!	<ul style="list-style-type: none"> <li>Switch the device off and on.</li> <li>Repeat the automatic configuration step in the chromatography software.</li> <li>Remove pump head, clean it and install it again.</li> <li>Inform the Technical Support of the manufacturer in case the system message repeats itself.</li> </ul>
	Auto pump head type: write failed!	<ul style="list-style-type: none"> <li>Switch the device off and on.</li> <li>Repeat the automatic configuration step in the chromatography software.</li> <li>Remove pump head, clean it and install it again.</li> <li>Inform the Technical Support of the manufacturer in case the system message repeats itself.</li> </ul>
C	Cannot edit program from the running link	First stop the link and then edit the data on the device display or with the chromatography software.
	Cannot delete active program/link	First pause link, then delete program.
	Cannot edit program from the running link	First pause link, then edit data using chromatography software.
	Cannot initialize LAN	Check cables and connections in local area network.

	<b>Message</b>	<b>Solution</b>
	Cannot operate with an empty link	Create a link.
	Cannot purge during the run!	End method and start purging.
	Cannot read data from FRAM	Switch the device off and on. Inform the Technical Support of the manufacturer in case the system message repeats itself.
	Cannot read RTC	Switch the device off and on. Inform the Technical Support of the manufacturer in case the system message repeats itself.
	Cannot start time table	Edit the data 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. Inform the Technical Support of the manufacturer in case the system message repeats itself.
	Component settings not compatible with gradient setup!	Change the setup settings or change the gradient in the program or in setup.
<b>E</b>	Error input activated	Device error, change device settings.
<b>G</b>	GUI communication failed	Switch the device off and on. Inform the Technical Support of the manufacturer in case the system message repeats itself.
<b>I</b>	Instrument in standalone mode	<ul style="list-style-type: none"> <li>■ Change the entry in the Setup menu.</li> <li>■ Change the entry in the chromatography software.</li> </ul>
	Instrument remote controlled	This entry is not executable. Quit software.
	Invalid index in time table	Change the entry in the program line.
	Invalid line number	Change the entry in the program line.
	Invalid time in time table	Correct the time entry.
<b>L</b>	Leak sensor not present	<ul style="list-style-type: none"> <li>■ Switch the device off and then on.</li> <li>■ If the leak sensor is still not present, contact the Technical Support of the manufacturer.</li> </ul>
	Leak was detected	Switch off the device. Remove the leak and start the device afterwards.
	Line in time table is empty	Edit 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.
<b>M</b>	Max. flow limit reached	Confirm, pump continues running

	<b>Message</b>	<b>Solution</b>
	Maximum pressure! System stopped	<ul style="list-style-type: none"> <li>■ Reduce the pressure or adjust the upper pressure limit.</li> <li>■ Restart the system.</li> </ul>
	Minimum pressure! System stopped	<ul style="list-style-type: none"> <li>■ Increase the pressure or adjust the lower pressure limit.</li> <li>■ Restart the system.</li> </ul>
	Motor failure: max current	Switch the device off and on. Inform the Technical Support of the manufacturer in case the system message repeats itself.
<b>N</b>	No gradient is available in isocratic mode	Change the setup settings or change the gradient in the program or in setup.
	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.
<b>P</b>	Program does not exist	Create a program.
	Program is running	Quit program or wait until program has been completed.
	Program not compatible with pump head	Modify the program or replace the pump head.
<b>S</b>	Sum of components is not 100	Change the entry.
<b>T</b>	This link is used in WAKEUP	First quit or delete wakeup program (wu = Wake Up), then edit or delete link.
	This program is used in a link	First pause or delete the link, then edit or delete data by means of the chromatography software.
	This program is used in WAKEUP	First quit or delete wakeup program (wu = Wake Up), then edit or delete data by means of the chromatography software.
	Time already exists	Correct the time entry.
	Too many lines in program	Check the number of program lines. A maximum of 100 program lines are possible.
<b>U</b>	Unable to attain min. flow set point	Confirm, pump continues running
	Unknown pump head type!	<ul style="list-style-type: none"> <li>■ Check the pump head.</li> <li>■ Check whether a pump head with RFID recognition has been installed.</li> </ul>
<b>W</b>	Wake up time already passed	Correct the entry for date or otherwise time.

## 8. Maintenance and care

Organic solvents are toxic above a certain concentration. Ensure that work areas are always well-ventilated! When performing maintenance tasks on the device, always wear safety glasses with side protection, protective gloves, and an overall.

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

### NOTICE

#### Electronic defect

Performing maintenance tasks on a switched on device can cause damage to the device.

- Switch off the device.
- Pull the power plug.

### NOTICE

#### Device defect

Device defect due to intruding liquids.

- Use new capillary connections only, if leaks appear at the capillary fittings after maintenance or installation tasks.

Users may perform the following maintenance tasks themselves:

- Replacing the pump head
- Replacing the check valves of the pumps

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

### 8.1 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

### 8.2 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.

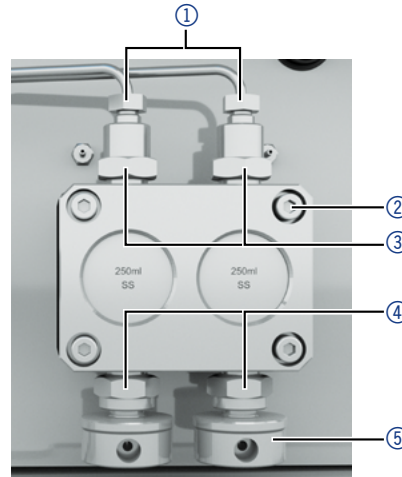
## 8.3 Pump head

Depending on the requirements of the user, different pump heads are used (see "13.2 Pump heads with accessories", p. 63).

### 8.3.1 Screw fittings on the pump head

#### Legend

- ① Capillary fitting
- ② Allen screws
- ③ Outlet fittings
- ④ Inlet fittings
- ⑤ Eluent Inlet



**Fig.35:** Screw fittings on the pump head

### 8.3.2 Dismounting the pump head

- Prerequisite**
- The pump head has been purged.
  - The tubes and hoses have been removed.
- Tools**
- Allen wrench
  - Open-end wrench, sizes 10, 17

#### **⚠ WARNING**

##### **Chemical burns**

Skin damage from aggressive or toxic eluents.

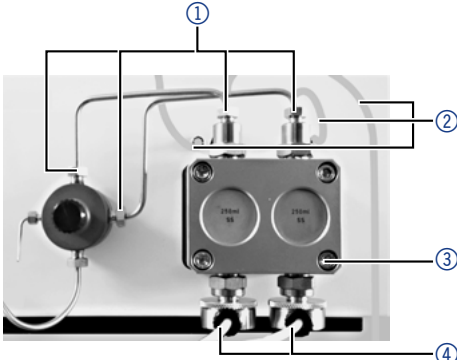
- ➔ Wear protective gloves.
- ➔ Flush the pump head before changing.

#### **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.

	Process	Figure
<b>Procedure</b>	<ol style="list-style-type: none"><li>1. To remove the capillary, loosen the capillary screw fittings ① at the pump head outlet and pressure sensor inlet.</li><li>2. Disconnect the hoses of the piston backflushing ② from the flush pump and the pump head.</li><li>3. Remove the eluent lines ④ from the eluent inlets.</li><li>4. Unscrew the Allen screws ③.</li><li>5. Hold the pump head by hand, and consecutively pull out all Allen screws.</li><li>6. Lift off the pump head.</li></ol>	 <p>The diagram shows a pump head assembly with four numbered callouts: ① points to the capillary screw fittings at the top; ② points to the piston backflushing hoses on the right; ③ points to the Allen screws on the front face; and ④ points to the eluent lines at the bottom.</p>

**Fig. 36:** Removing the pump head

<b>Intermediate result</b>	The pump head is dismantled. To mount the pump head, proceed the steps in reverse order.
<b>Next step</b>	Mounting a pump head.

### 8.3.3 Attaching capillaries to the pump head

#### NOTICE

##### Component defect

Possible damage to the pump head due to over-tightened capillary fitting.

→ Note the torque of the screw connection.

Pay attention to the torques in the chapter "8.4 Check valves" on page 51.

**Prerequisite** The pump head has been removed.

**Tool** Open-end wrench, sizes 10, 17



**Note:** PEEK fittings can withstand pressures up to 400 bar for 1/16" and 200 bar for 1/8".

Process	Figure
<b>Procedure</b>	
<ol style="list-style-type: none"> <li>1. Slide the fitting ① onto the capillary ②.</li> <li>2. Slide the clamping ring ③ onto the capillary, so the capillary comes out.</li> </ol>	<b>Fig.37:</b> Screw fitting
<ol style="list-style-type: none"> <li>3. Using an open-end wrench, hold the inlet fitting ⑤ in place.</li> <li>4. Tighten the fitting ④ at the pump head.</li> <li>5. If the capillary cannot be screwed tight, then use a new clamping ring.</li> </ol>	
	<b>Fig.38:</b> Pump head



## 8.4 Check valves

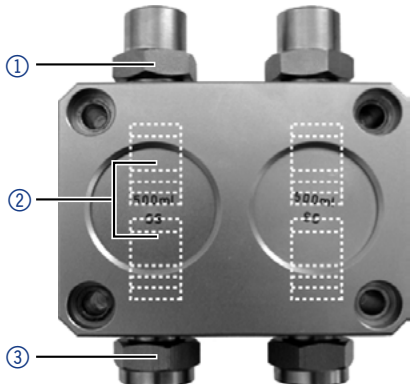
Dirty check valves do not open and close properly. They cause pressure fluctuations and irregular flow. If it is impossible to clean the check valves, replace the whole unit.

	Pump head stainless steel	Torque for inlet and outlet fitting
Torque	100 ml	15 Nm
	250 ml	15 Nm
	500 ml	12 Nm
	1 000 ml	12 Nm

### 8.4.1 Removing the check valves

- Prerequisite**
- The pump head has been purged.
  - The capillaries have been removed.
  - The pump head has been dismantled.

**Tools** Open-end wrench, sizes 10, 17

	Process	Figure
<b>Procedure</b>	<ol style="list-style-type: none"> <li>1. Unscrew the outlet fittings ①.</li> <li>2. Remove the check valve ②.</li> <li>3. Unscrew the inlet fittings ③.</li> <li>4. Remove the check valve.</li> </ol>	

**Fig. 39:** Removing the check valve

**Next steps** You can either replace or clean the check valves.

### 8.4.2 Cleaning the check valve

The check valves are not disassembled for cleaning but they are cleaned as a unit.

- Prerequisite**
- Both check valves have been removed.

**Process**

- Procedure**
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 step** Insert both cleaned check valves.

### 8.4.3 Installing the check valves

**NOTICE****Component defect**

Possible damage to the pump head due to over-tightened capillary fitting.

→ Note the torque of the screw connection.



**Note:** PEEK fittings can withstand pressures up to 400 bar for 1/16" and 200 bar for 1/8".



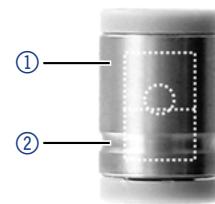
**Note:** The ball and position of the valves have been harmonized to each other. Insert the valves in the direction of flow.

- Prerequisite**
- The pump head has been purged.
  - The capillaries have been removed.
  - The pump head has been dismantled.

**Tools** Open-end wrench, sizes 10, 17

**Process****Figure**

- Procedure**
1. Insert the check valves ① so that the notch of the check valve ② points downward.
  2. Manually screw in inlet and outlet fittings and tighten them with a torque wrench and the respective torque.



**Fig. 40:** Check valve

## 9. Transport and storage

Regarding the following information, carefully prepare the device for transport or storage.

### 9.1 Taking the device out of operation

**Prerequisites** The device is switched off.

#### Process

- Procedure**
1. Disconnect the mains plug from the socket and then remove the power supply cable from the device.
  2. Pack the power cable together with the device.

**Next steps** Disconnect all electrical connections. Remove the accessories and pack the device for transport or storage.

### 9.2 Packing the device

- Original packaging: Ideally use the original transport packaging.
- Lifting: Grab the device around the center of both sides and lift it into the packaging. Do not hold onto front cover or leak tray, as these parts are loosely attached to the device.

### 9.3 Transporting the device

- Documents: If you want to return your device to KNAUER for repairs, enclose the "[Service request form and decontamination report](#)" which can be downloaded from our website.
- Device data: For a secure transport, note the weight and dimensions of the device (see section "11. Technical data" on page 56).

### 9.4 Storing the device

- Flushing solution: Pay attention that all hoses and capillaries have been emptied or filled with flushing solution (e. g. isopropanol) before storage. To prevent algae formation, do not use pure water.
- Seals: Close all inputs and outputs with cap fittings.
- Ambient conditions: The device can be stored under ambient conditions which are listed in the Technical Data (see section "11. Technical data" on page 56).

## 9.4.1 Storing the pump head

### 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.

If you want to store pump heads separately, proceed as follows:

**Prerequisite** The pump head has been dismantled (see chapter "8.3.2 Dismounting the pump head" on page 48).

- Materials**
- Syringe
  - Flushing solution

### Process

- Procedure**
1. Fill the flushing solution into a syringe and inject into the capillary at the pump head inlet. Leave it for 5 minutes.
  2. Flush with suitable flushing solution.
  3. Fill the pump head with isopropanol.
  4. Seal the inlets and outlets with cap fittings.

**Storage conditions** The pump head can be stored under the ambient conditions described in chapter "11. Technical data" on page 56.

## 10. Disposal

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

### 10.1 AVV-Marking Germany

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

### 10.2 WEEE registration number



KNAUER as a company is registered by the WEEE number DE 34642789 in the German "Elektroaltgeräteregister" (EAR). The number classifies to category 8 and 9, which, among others, comprises 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.

### 10.3 Eluents and other operating materials

All eluents and other operating materials have to be collected separately and disposed of properly.

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

# 11. Technical data

## 11.1 Main features

Pump type	Preparative HPLC pump
Delivery system	Dual-piston pump
Flow rate range	<ul style="list-style-type: none"> <li>■ 100 ml pump head:             <ul style="list-style-type: none"> <li>• 0.01 - 100 ml/min</li> <li>• 1 - 80 ml/min (recommended)</li> <li>• 1 - 40 ml/min (continuous working)</li> </ul> </li> <li>■ 250 ml pump head:             <ul style="list-style-type: none"> <li>• 0.01 - 250 ml/min</li> <li>• 2.5 - 200 ml/min (recommended)</li> <li>• 2.5 - 100 ml/min (continuous working)</li> </ul> </li> <li>■ 500 ml pump head:             <ul style="list-style-type: none"> <li>• 0.01 - 500 ml/min</li> <li>• 5 - 400 ml/min (recommended)</li> <li>• 5 - 200 ml/min (continuous working)</li> </ul> </li> <li>■ 1000 ml pump head:             <ul style="list-style-type: none"> <li>• 1 - 1 000 ml/min</li> <li>• 10 - 800 ml/min (recommended)</li> <li>• 10 - 400 ml/min (continuous working)</li> </ul> </li> </ul>
Maximum pressure	<ul style="list-style-type: none"> <li>■ 100 ml pump head:             <ul style="list-style-type: none"> <li>• 400 bar to 100 ml/min</li> </ul> </li> <li>■ 250 ml pump head:             <ul style="list-style-type: none"> <li>• 225 bar to 100 ml/min</li> <li>• Linear reduction: 225 - 200 bar of 100 - 150 ml/min</li> <li>• 200 bar of 150 - 250 ml/min</li> </ul> </li> <li>■ 500 ml pump head:             <ul style="list-style-type: none"> <li>• 100 bar to 500 ml/min</li> </ul> </li> <li>■ 1000 ml pump head:             <ul style="list-style-type: none"> <li>• 75 bar to 350 ml/min</li> <li>• Linear reduction: 75 - 50 bar of 350 - 600 ml/min</li> <li>• 50 bar of 600 - 1 000 ml/min</li> </ul> </li> </ul>
Flow rate accuracy	±2 % at 2 - 50 % of the flow range with ethanol-water mixture (10/90, v/v)
Flow rate precision	< 0.1 % RSD, measured at 5 - 50 % of the flow range with ethanol-water mixture (10/90, v/v)

Gradient support	<ul style="list-style-type: none"> <li>■ Isocratic HPLC pump</li> <li>■ Pump with binary or ternary LPG valve block (low pressure gradient system, LPG)</li> <li>■ Up to 4 pumps in combination (high pressure gradient system, HPG)</li> <li>■ The percent value of the gradient is adjustable in whole numbers</li> </ul>
System protection	$P_{min}$ and $P_{max}$ adjustable

## 11.2 Communication

Control	<ul style="list-style-type: none"> <li>■ LAN</li> <li>■ Pin header connectors (Analog IN, Start IN, Error IN)</li> </ul>
Supply frequency	50 - 60 Hz
Power consumption	<ul style="list-style-type: none"> <li>■ Pump: maximum 320 W</li> <li>■ Binary or ternary valve block: 5 W</li> </ul>
Protection type	IP 20

## 11.3 General

### Permitted operating environment

Power Supply	<ul style="list-style-type: none"> <li>■ Pump: 100 - 240 V, 50 - 60 Hz</li> <li>■ Binary valve block: 24 V</li> <li>■ Ternary valve block: 12 V</li> </ul>
Dimensions	361 mm x 208 mm x 523 mm (width x height x depth)
Weight	19 kg
Leak sensor	Yes
Area of use	For indoor use only
Line voltage fluctuations do not exceed $\pm 10\%$ of normal voltage.	
Overvoltage category II	Energy consumers are supplied by a fixed device.
Permitted pollution degree	2
Height above sea level	Maximum 2000 meters
Temperature range	4 - 40 °C; 39.2 - 104 °F
Air humidity	Below 90 %, non-condensing

## 12. Chemical compatibility of wetted materials



**Note:** The user takes the responsibility for using the fluids and chemicals in an appropriate and safe way. If there is any doubt, contact the Technical Support of the manufacturer.

### 12.1 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 this device are listed in the chapter "Technical data".

All resistances mentioned here are for use at temperatures up to 40 °C, unless stated otherwise. Please note that higher temperatures can significantly affect the stability of different materials.

### 12.2 Plastics

#### **Polyetheretherketone (PEEK)**

PEEK is a durable and resistant plastic and, next to 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-tetrafluoroethylene 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.

**Perfluorethylenpropylen-Copolymer (FEP), Perfluoralkoxy-Polymer (PFA)**

These fluorinated polymers hold similar features as PTFE, but with a lower operation temperature (up to 205 °C). PFA is suitable for ultra-pure 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-HTF)**

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 fibres 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.

**Polytetrafluoroethylene (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.

**Polychlorotrifluoroethylene (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 value > 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.

## 12.3 Non-metals

**Diamond-like carbon (DLC)**

This material is characterized by a high hardness, a low coefficient of friction and thus low 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.

**Alumina (Al<sub>2</sub>O<sub>3</sub>)**

Due to their high resistance to wear and corrosion, alumina ceramic is used as a coating for mechanically stressed surfaces. It is a biocompatible material with low thermal conductivity and low thermal expansion.

**Zirconium oxide (ZrO<sub>2</sub>)**

Zirconia ceramics are characterized by their high mechanical resistance, which makes them particularly resistant to wear and corrosion. It is also biocompatible, has low thermal conductivity and is resistant to high pressures.

**Sapphire**

Synthetic sapphire is virtually pure monocrystalline alumina. 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 alumina and gets its red color 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 fibres and isolates in high oxidizing conditions and at high temperatures. Mineral wool is valid as commonly inert against organic solvents and acids.

**Glass, glass fibre, 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.

## 12.4 Metals

**Stainless steel**

Stainless steel is, apart from PEEK, the standard material in HPLC. Steels with WNr. 1.4404 (316L) are used, or with a mixture of 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 use in ion chromatography is not recommended. In case of electrochemical applications, a passivation has to 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 (TiAl6V4)**

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.

## 13. Repeat orders

This list for reorders is valid for the time the document has been published. Deviations afterwards are possible.

For reorders of spare parts use the enclosed packing list. Contact the Technical Support in case there are any questions on spare parts or accessories.

**Further information** Further information on spare parts and accessories can be found online: [www.knauer.net](http://www.knauer.net).

### 13.1 Device and accessories

Name	Order no.
Pump P 2.1L	APE20
Pump P 2.1L with 100 ml pump head stainless steel	APE20KA
Pump P 2.1L with 100 ml pump head titanium	APE20KB
Pump P 2.1L with 250 ml pump head stainless steel	APE20LA
Pump P 2.1L with 250 ml pump head titanium	APE20LC
Pump P 2.1L with 500 ml pump head stainless steel	APE20MA
Pump P 2.1L with 500 ml pump head titanium	APE20MC
Pump P 2.1L with 1 000 ml pump head stainless steel	APE20NA
Pump P 2.1L with 1 000 ml pump head titanium	APE20NB
Mobile Control license with tablet	A9607
Mobile Control Chrom license with tablet	A9608
Mobile Control license	A9610
Mobile Control Chrom license	A9612
Tablet lock with stand	A9615
Tablet lock	A9616
Flexible tablet mount	A9617
Accessories kit pump	FPE
AZURA accessories kit	FZA02
Patch cable 3 m	A5255
Set WAGO micro connect. strips 12-polar	A1420V12
10-polar flat band cable 1.5 m	A1467
RS-232 cable	A0895

## 13.2 Pump heads with accessories




	Name	Order no.
<b>Pump heads</b>	Pump head, 100 ml, stainless steel	A4029-1
	Pump head, 100 ml, titanium	A4029V2
	Pump head, 250 ml, stainless steel	A4021-1
	Pump head, 250 ml, titanium	A4021V2
	Pump head, 500 ml, stainless steel	A4038-1
	Pump head, 500 ml, titanium	A4038V2
	Pump head, 1 000 ml, stainless steel	A4022-1
	Pump head, 1 000 ml, titanium	A4022V2
<b>Check valves</b>	Check valve unit for 100 ml and 250 ml pump heads	A1122
	Check valve unit for 500 ml and 1000 ml pump heads	A1080
<b>Pump head inlet</b>	1/4" (NPT), stainless steel	A9861
	1/2"-20 UNF, PEEK with CTFE	A9868
<b>Inlet merging</b>	Inlet merging device for peak recycling and SMB applications for 100 ml and 250 ml pump heads	A1121

## 13.3 Documents

Name	Order no.
Instructions	V6840
Installation qualification	VIQ-INST
Operation qualification	VOQ-PUMPS

## **Appendix: Installation Qualification (IQ)**

### Installation Qualification (IQ) for a Device

	Created	Reviewed	Approved
Function	Technical editor	Engineering	Head of Quality
Name	Anna Erben	Paul Pietsch	Kate Monks
Date	23/08/2022	29/08/2022	30/08/2022
Signature	 <small>Digital unterschrieben von Anna Erben Datum: 2022.08.23 14:09:27 +02'00'</small>		

#### 0. Customer approval

Prior to installation at the customer site, the customer has reviewed the OQ document and agrees with the design and scope

Company name:

Name	Function	Reviewed & approved	Date	Signature

## Installation Qualification (IQ) for a Device

### 1. Definition of the Installation Qualification

The qualification document „Installation Qualification (IQ)“ is part of the quality management system at the company KNAUER Wissenschaftliche Geräte GmbH.

### 2. Scope

The customer can request the Installation Qualification. In case of a request, the technical support of KNAUER or a provider authorized by KNAUER performs this functionality test during the installation. The IQ 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

### 3. Instructions

All deviations from the specifications that occurred during installation have to be recorded in this document.

In addition, all measures taken to eliminate the deviations have to be noted down as comments in the list of rectifications (LOR) on page 4.

If certain items in the report are not applicable, this has to be indicated in the table as „N/A“ (not applicable). Major sections that are not used have to be crossed out (diagonal line), marked „N/A“, dated and signed.

All required documents have to be completed by the end of the installation. The document has to be reviewed and approved by an authorized person. The review and approval have to be documented with signature and date (DD/MM/YYYY).

The tests have to be carried out in a suitable environment, as described in the user instruction of the device.

### 4. About this document

The information in this document is subject to change without prior notice. This document may not be used, reproduced or translated without written consent of KNAUER Wissenschaftliche Geräte GmbH. Depending on the customer's quality assurance system, the signed document either has to be filed in the device folder or scanned and stored in an electronic archive.

### 5. Device data

Device name		Product number	
Serial number		Order number	
Firmware version			
Installation location			

### 6. Customer and manufacturer data

	Customer	Manufacturer
Company		KNAUER Wissenschaftliche Geräte GmbH
Customer number		-
Contact person/agent		
Address		Hegauer Weg 38
Postal Code/City		14163 Berlin
Phone		+49 30 80 97 27 111
E-Mail		support@knauer.net



## Installation Qualification (IQ) for a Device

### 7. Installation Qualification Tests

Test	Description	Specification	Passed	Failed	N/A	Comment/LOR No.
1	Identify the device.	The name on the device matches the name on the delivery order.				
2	Check the device for transport damage.	No transport damage is observed.				
3	Check the scope of delivery.	The scope of delivery matches the packing list and/or the delivery order.				
4	Check that the technical documentation provided is correct and complete (material documentation of wetted parts, calibration certificates etc.)	The documentation is correct and complete.				
5	Check that all equipment is properly and correctly labeled according to the delivery order and/or the labeling specifications document, if applicable.	The equipment is labeled correctly.				
6	Connect all loose parts (e.g. capillaries, tubings, measuring head) according to the user instructions.	The device is fully assembled and ready to use.				
7	Ensure that the installation site is suitable according to the user instructions.	The installation site matches the specifications in the user instructions.				
8	Connect the device to the power supply and switch it on.	The device starts (operating noise). The power LED or the display lights up.				



## Installation Qualification (IQ) for a Device

### 9. List of changes to the document

Revision no.	Description of change	Additional information	Date/signature

## Installation Qualification (IQ) for a Device

### 10. Certificate and approval

A KNAUER employee or an employee authorized by KNAUER has checked the device and performed all tests described in the IQ.

The IQ form has to be signed by an authorized person. The scope of the IQ meets the customer’s requirements.

The results of the IQ, any changes made as well as the IQ process have been documented in this form in writing. The users listed below were instructed and are familiar with how to operate the device. Both parties confirm that the IQ has been performed to the customer’s satisfaction by signing it.

#### 10.1 Customer approval

Name	Function	Date	Signature

#### 10.2 KNAUER agent approval

Name	Function	Date	Signature

### 11. Comments / recommendations

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Latest KNAUER instructions online:  
[www.knauer.net/library](http://www.knauer.net/library)

**KNAUER**  
Wissenschaftliche Geräte GmbH  
Hegauer Weg 37-38  
14163 Berlin

Phone: +49 30 809727-0  
Fax: +49 30 8015010  
E-mail: [info@knauer.net](mailto:info@knauer.net)  
Internet: [www.knauer.net](http://www.knauer.net)