KNAUER

Smartline

Pump 1050
Maintenance

V7611A

Table of contents

Note: For your own safety, **read** the manual and **always** observe the warnings and safety information on the device and in the manual!

Intended use

HPLC

High Performance Liquid Chromatography (HPLC) is a method for separating substance mixtures and their determining their qualitative and quantitative makeup.

Smartline Pump 1050

The pump is a conveying system for analytical and semi-preparative applications. Pump head inlays made of different materials cover all needs of the user. Stainless steel is pressure-resistant up to 400 bar. If bio-compatibility is required, titanium inlays can be used. The pump heads can be exchanged easily.

Automatic piston backflushing increases the service life of the seals and pistons. The piston backflushing removes salts and other substances from the area behind the seals.

Note: Due to the new drive used in the Smartline Pump 1050, pump heads of the previous series models cannot be used any more.

Pump type

Not self-priming pump

▶ For initial startup of the pump, pull liquid with syringe and Luer lock at the ventilation part.

Local area network and automatic configuration

The pump is controlled either by means of the input panel on the front of the device, or by means of the chromatography software.

Remote control

Normally, the pump is controlled by means of the chromatography software via a local network (LAN).

Pump head is recognized automatically

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

Automatic configuration

A pump connected to a local area network (LAN) is automatically recognized by the chromatography software.

Device status

When used in a local area network (LAN), the system status of the pump can be verified by means of chromatography software.

LAN setting

Ex works, the pump is set to DHCP (Dynamic Host Configuration Protocol). This means that the pump is automatically assigned an IP address within the local network. In the Setup menu, this setting can be modified manually.

Laboratory use

- Biochemistry analyses
- Chiral analyses
- Food analyses

- Pharmaceutical analyses
- Environmental analyses

DANGER! **Explosion hazard! Never use the device in potentially explosive atmospheres without appropriate protective equipment and approval by a notified body!**
Inform the technical support of KNAUER.

Safety

The installation manual is an addition to the existing system manual that includes all work that requires the installation of certain components or the opening of a device's housing.

Who may perform repairs?

These instructions apply to the following professional groups

Professional group	Authorized
Service technician	▪ Service technicians from manufacturer ▪ Service technicians authorized by the manufacturer
UHPLC experts HPLC experts	▪ Trained (with certificate) by manufacturer to perform maintenance

If you do not belong to one of these professional groups, under no circumstances may you perform the work described in this manual.

What must be taken into account?

Observe the following:

- All safety instructions in the maintenance manual
- All safety instructions in the device manual
- The environmental, installation and connection specifications
- Only use replacement parts, tools and cleaning agents recommended or prescribed by the manufacturer

What is a service technician not allowed to repair

Observe the ROHS conformity for main boards! Never perform maintenance on the main board independently. Always replace the main board and return the defective board to the manufacturer technical support.

Laboratory regulations

Adherence to laboratory regulations

▶ Observe national and international regulations pertaining to laboratory work!

- Good Laboratory Practice (GLP) of the American Food & Drug Administration
- For development of methods and validation of devices: Protocol for the Adoption of Analytical Methods in the Clinical Chemistry Laboratory, American Journal of Medical Technology, 44, 1, pages 30–37 (1978)
- Accident prevention regulations published by the accident insurance companies for laboratory work

Solvent

Caution! **To avoid damage from leaks, do not place the solvent bottle on the device.**

Autozero

▶ Perform an autozero each time you exchange the solvent.

Suitable solvents

Solvents suitable for use in HPLC:

- Acetone
- Acetonitrile
- Ammonia (10–50%)
- Benzene
- Chloroform
- Acetic acid (10–50%), at 25 °C
- Ethyl acetate
- Ethanol
- Hexane/Heptane
- Isopropanol
- Carbon dioxide (liquid 99.999% CO_2)
- Methanol
- Sodium hydroxide (1 M)
- Phosphate buffer solutions (0.5 M)
- Phosphoric acid
- Toluol
- Water

Note

Even small quantities of other substances, such as additives, modifiers, or salts can influence the durability of the materials. The list of selected solvents was compiled based on research in the pertinent literature and is only a recommendation by the manufacturer. If there is any doubt, contact the technical customer service department of the manufacturer.

Solvent only suitable to a limited extent

The following solvents are suitable to only a limited extent for use in the device:

- Methylene chloride
- Tetrahydrofuran (THF)
- Dimethyl sulfoxide (DMSO)
- Slightly volatile solvents

Unsuitable solvents

The following solvents can attack the components of the device and are therefore not suitable:

- Mineral and organic acids (except in buffer solutions)
- Bases (except in buffer solutions)
- Liquids containing particles
- Perfluorinated solvents, e.g. Fluorinert® FC-75, FC-40
- Perfluorinated polyether, e.g. Fomblin®
- Halogenated hydrocarbons, e.g. Freon®

Exhaust

Connect silicone tube (inner diameter: 3.0 mm) with the olive-type tube fitting of the *exhaust* and lead the gases or liquids into a suitable collecting container or to a fume hood.

pH value

The solvents should have a pH value in the range of 1–12.

Ultra-pure solvents

HPLC requires filtered and ultra-pure solvents labeled as ‘gradient grade’ or ‘hypergrade’.

Solvent tray

To avoid damage from leaks, always place solvent bottles in a solvent tray on the device.

Toxicity

Organic solvents are toxic above a certain concentration. Ensure that work areas are always well-ventilated! Wear protective gloves and safety glasses when working on the device!

Flammability

Organic solvents are highly flammable. Since capillaries can detach from their screw fittings and allow solvent to escape, it is prohibited to have any open flames near the device!

Self-ignition point

Only use solvents that have a self-ignition point higher than 150 °C under normal ambient conditions!

Leaks and clogged capillaries

Regularly check for leaks and clogged capillaries – test back pressure without column.

Protective measures

The following applies for all repairs on the device:

Hazard symbol	Warning instructions
	DANGER! Danger of electric shock! Switch off power supply! Pull the power plug!
	DANGER! Danger due to toxic, caustic or radioactive substances due to contamination of the device. The customer must ensure that the device has been thoroughly decontaminated before repairs are performed.

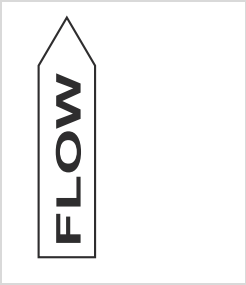
Power supply and mains connection

The modules are equipped with universal AC/DC switching power supplies rated for 100–240 V AC. Ground the power connection according to the pertinent regulations! Use a three-conductor line cord! Switch off the module and pull the power plug to completely isolate it from the supply voltage.

Symbols and labels

Explanations of the symbols and labels

Markings

Symbol	Explanation
	Flow direction symbol for piston backflushing: inlet to flush pump
	Flow direction symbol for piston backflushing: outlet to pump head
	Symbol indicating flow direction through a column
	CE (Conformité Européenne) mark for equipment that complies with the pertinent EU directives and comes with a declaration of conformity from the manufacturer.
	Marking for devices that comply with the Canadian requirements for laboratory equipment: CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version

Hazard symbols

Symbol	Explanation
	For your own safety, read the operating instructions and always observe the warnings and safety information on the device and in the operating instructions!
	Caution! Micro-electronic device components that could be damaged by electro-static discharge (ESD) when touched.
	Danger! Danger of electric shock! Switch off power supply! Pull the power plug!
	Warning! Corrosive chemicals! When working with corrosive chemicals, always take appropriate safety precautions!

Mandatory sign

	Take precautions against electrostatic discharge.
	To disconnect the device from the mains power, disconnect the power plug.
	Wear safety gloves when handling corrosive or toxic chemicals.
	Carefully screw capillaries to avoid leaks.

What is maintained or repaired?

Measures	Hours in operation
▪ Check the torque of the screw fittings ▪ Clean the pistons ▪ Check ball valves	1000
▪ Check the drive ▪ Check the tension of the timing belt ▪ Check motor and axial tolerance ▪ Replace all seals ▪ Clean the ball valves	5000
▪ Clean drive and grease again (if necessary) ▪ Replace timing belt ▪ Overhaul pump head, replace all wear parts ▪ Check motor and axial tolerance ▪ Check the adjustment of all parameters with the service tool ▪ Replace ball valves	10000

Pump head repair

WARNING! **Aggressive or toxic solvent residue can irritate the skin! Wear protective gloves!**

In case of a malfunction or as part of routine maintenance, the pump head can be disassembled into individual parts.

During this procedure, seals, guide discs, springs or pistons can be replaced. It is not necessary to disassemble the pump head to replace the check valves.

Prerequisites

- It is important that the pistons are not pushed in tilted at an angle, as this will reduce the service life of the pump head.
- OQ test has been performed.
- Large, clean work surface.

Special tool

- Torque wrench: X0219
- Set of wrenches: X0221, X0222, X0223
- Hex socket bit 4 mm: X0236
- Adapter: X0234
- KIT sealing tool for 10 ml pump head: W0200
- KIT sealing tool for 50 ml pump head: W0206
- Allen wrench set®: X0217

Duration approx. 30 min.

Level of difficulty Level 7 (1 = very easy to 7 = very difficult)

Removing the pump head

1. Remove the tubes from the inlet and outlet of the piston backflushing (A).
2. Remove all tubes from the solvent bottles.
3. Unscrew the eluent line (D).
4. Unscrew the outlet fitting 2 (E) and the inlet fitting of the pressure sensor (F) to remove the capillary.
5. Loosen the opposite pairs of fastening screws (B) on the pump head evenly and alternately.
6. Hold the pump head by hand, and consecutively pull out all fastening screws.
7. Remove the pump head.

Legend

A Inlet and outlet of the piston backflushing

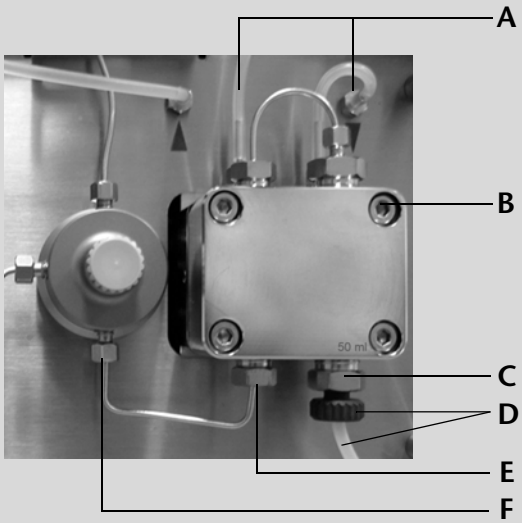
B Fastening screw

C Inlet fitting 1

D Eluent line

E Outlet fitting 2

F Inlet fitting of the pressure sensor



Removal of Pump Head

CAUTION! Avoid breaking the piston rods! Before disassembly, first remove the two piston rods. Deposit the two piston rods in the correct orientation to ensure correct orientation when putting them back in.

Overview of the pump head parts

A Capillary screw fitting
B Seal ring
C Capillary connection kit
D Inlet fitting
E Check valve
F Seal
G Outlet fitting
H Capillary connection kit
I Feed block
J High-pressure seal
K Sapphire ring
L Adaptor ring
M Support ring
N O-ring
O Piston backflushing
P Low-pressure seal
Q Washer
R Compression spring
S Bushing
T Piston guide
U Screw
V Piston rod

Figure

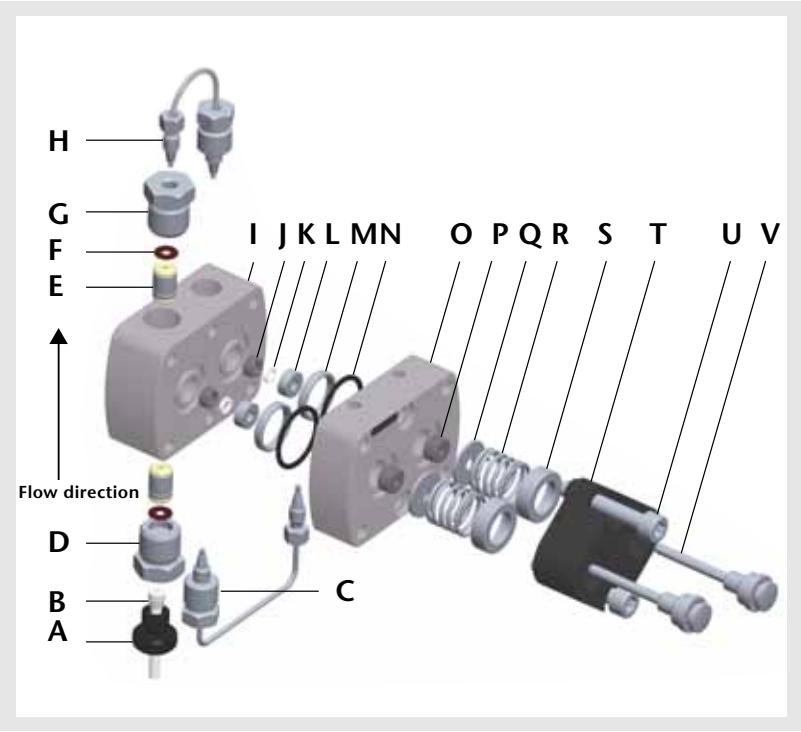


Fig. 1 Rear view of a complete UHPLC pump head

Overview of the pump head parts

No.	Component	Comment
A	Capillary screw fitting	Ø 1/8" (outer)
B	Seal ring	Ø 1/8" (outer) ferrule
C	Capillary connection kit	Ø 0.25 mm (inner)
D	Inlet fitting	Inlet fitting, side of pump head

Overview of the pump head parts

No.	Component	Comment
E	Check valve	Ball valve with flow in one direction; Made of sapphire/ ruby w/direction of flow indicator
F	Seal	Modified Teflon seal
G	Outlet fitting	Outlet fitting, side of pump head
H	Capillary connection kit	Ø 1/16" (outer); Ø 0.5 mm (inner)
I	Feed block	High-pressure plate
J	High-pressure seal	From Bal Seal® with metal wire spring
K	Sapphire ring	Sapphire
L	Adaptor ring	For adjustment of the sapphire rings
M	Support ring	Between feed block and piston backflushing
N	O-ring	Of the piston backflushing
O	Piston backflushing	Low-pressure plate
P	Low-pressure seal	From Bal Seal®
Q	Washer	-
R	Compression spring	-
S	Bushing	For the compression spring
T	Piston guide	With 2 screws for assembly
U	Screw	M5, stainless steel
V	Piston rod	Made of sapphire with stainless steel guide

Complete disassembly of the pump head

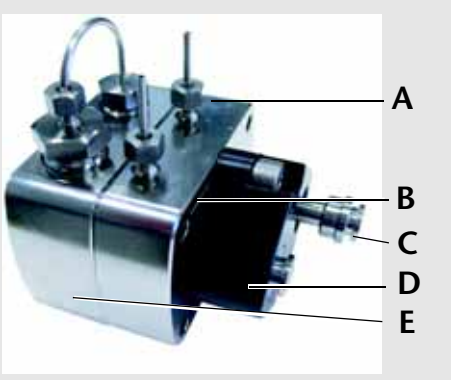
A Piston backflushing

B RFID-Chip

C Piston rod

D Piston guide

E Feed block

Procedure	Figure
1. Flush the pump head with water or isopropanol if the pump head is to be stored. 2. Remove the pump head (see manual). 3. Remove and inspect the piston rods of the removed pump head, e.g. for wear tracks. 4. Unscrew the piston guide. 5. Put the individual parts of the piston guide back onto the piston in the correct orientation to make the subsequent assembly easier. 6. Remove flushing block.	 **Fig. 2 With the pump head removed at the back of the device, the components are now visible**

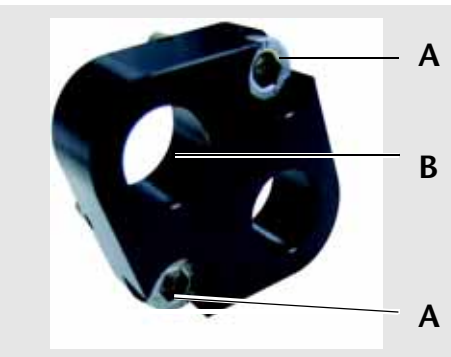
Removing and inspecting the piston

1. Deposit the pump head on a soft surface.
2. Remove the piston rod by hand, making sure it does not tilt and is pulled out straight.
3. Deposit the piston rod in the correct orientation.
4. Check both piston rods for visual wear tracks.

Removing the piston guide

A Screw

B Piston guide

Procedure	Figure
1. Clamp the pump head in a vice if possible. 2. Unfasten screws using Allen wrench “size 4” while pressing down on piston guide to protect against pressure. 3. Remove piston guide from the pump head and lay it to the side.	 **Fig. 3 Piston guide**

Removing the parts of the piston guide

A Low-pressure seal

B Washer

C Compression spring

D Bushing

E Piston guide

F Piston rod

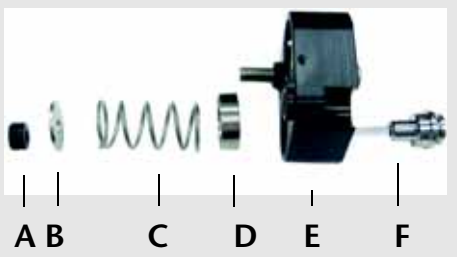
Procedure	Figure
1. Remove the parts and securely deposit them in the proper sequence and in the correct orientation.	

Fig. 4 **Parts of the piston guide**

The principle of the internal piston guide

A High-pressure seal from Bal Seal®

B Sapphire ring

C Sapphire ring for adaptor ring with guide to the outside

D Piston

Principle

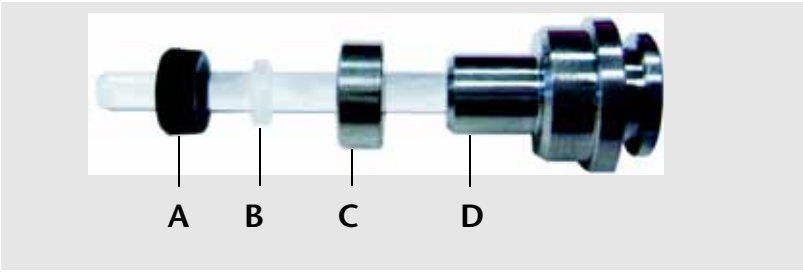
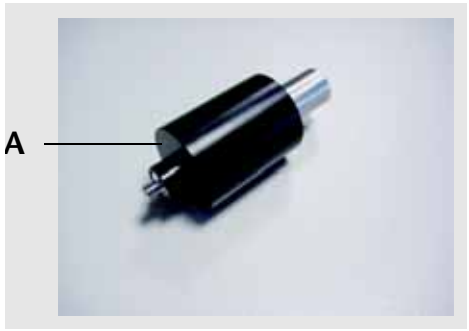
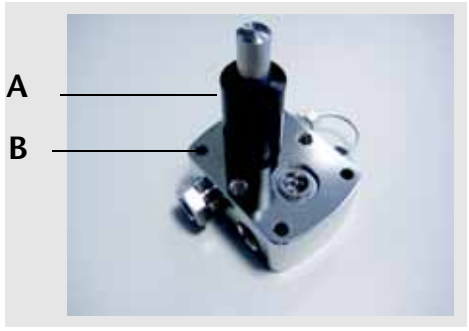


Fig. 5 **The figure shows the principle of the internal structure of the piston guide**

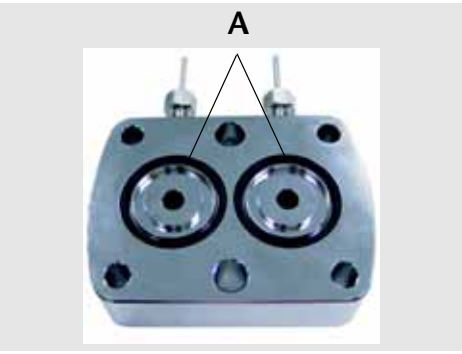
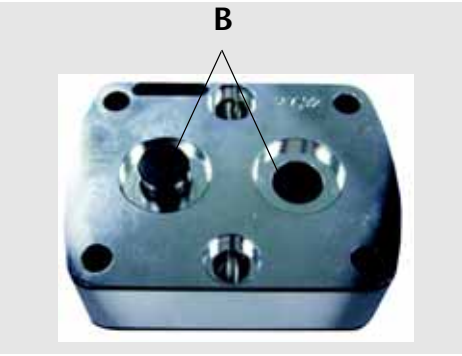
Replacing seals on the inner side of the feed block	Procedure	Figure
A Special tool for removal seal B Feed block	1. Screw the special tool into the Bal Seal® seal and remove from the feed block.	 **Fig. 6 Special tool for Bal Seal® seal**  **Fig. 7 Special tool with feed block**

Practical Tip Use a new seal.

Replacing the seals on the inner side of the piston backflushing

A O-Ringe

B Low-pressure seal

Procedure	Figure
1. Replace O-rings of the piston backflushing. 2. Screw the special tool into the low-pressure seal and remove from the feed block.	 **Fig. 8 O-ring of the piston backflushing**  **Fig. 9 Low-pressure seal of the piston backflushing**

Assembling the pump head

Order of operation for assembly

The pump head is assembled in this sequence:

- The pump head is assembled.
- Peripherals are attached to the pump head.
- Pump head is installed into the pump.

Assembly begins with inserting the new seals on the feed and flushing blocks. The blocks are then laid onto each other in the correct orientation.

Pre-forming the seal from Bal Seal® with the special tool

A Special tool for pressing in the seal

B High-pressure seal

Procedure	Figure
1. Set the high-pressure seal with the metal washer spring pointing out onto the special tool and pre-form the seal.	 **Fig. 10 Special tool for pressing in the high-pressure seal**

Press fit the high-pressure seal using the special tool

A Special tool

Procedure	Figure
1. Press fit high-pressure seal using special tool into the feed block.	 **Fig. 11 Special tool in feed block**  **Fig. 12 Piston backflushing**

Inserting the spacer

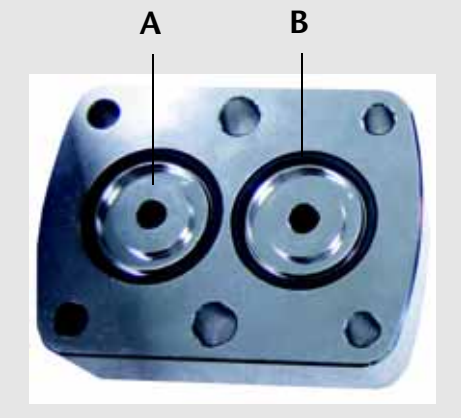
A Adaptor ring

Procedure	Figure
1. Insert sapphire ring into adaptor ring and place on sealing tool. 2. Using the sealing tool, insert the adaptor ring, together with the sapphire ring, into the feed block	 **Fig. 13 Sapphire ring in adaptor ring**

Inserting the guide disc and O-ring into the flushing block

A Guide discs

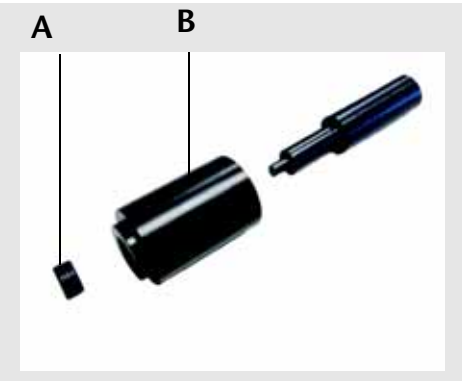
B O-ring

Procedure	Figure
1. Insert the guide discs into the piston backflushing. 2. Insert the O-rings. 3. Put the feed block and piston backflushing together in the correct orientation.	 **Fig. 14 Piston backflushing with O-rings**

Pressing the low-pressure seal from Bal Seal® into the piston backflushing

A Low-pressure seal

B Special tool

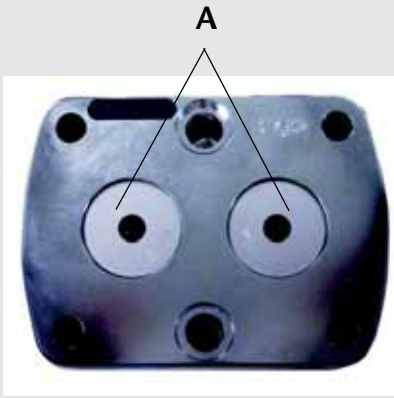
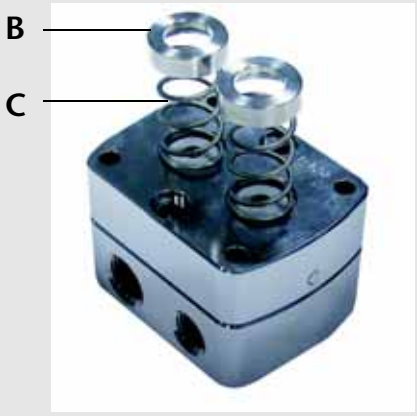
Procedure	Figure
1. Position the low-pressure seal on the special tool. 2. Press fitting seal using special tool.	 **Fig. 15 Special tool and low-pressure seal**  **Fig. 16 Feed block with piston backflushing and low-pressure seal**

Positioning the washers flat and fitting the compression springs and bushings

A Washers

B Bushing

C Compression spring

Procedure	Figure
The springs for the piston guide can be positioned on the feed block and piston backflushing, which have been put together. 1. Position the washers flat. 2. Position compression springs. 3. Position the bushing in the correct orientation.	 **Fig. 17 Piston backflushing with washers**  **Fig. 18 Compression springs with bushing**

ATTENTION! It is important that the washers are position flat, as any tilting will shorten the pump head service life.

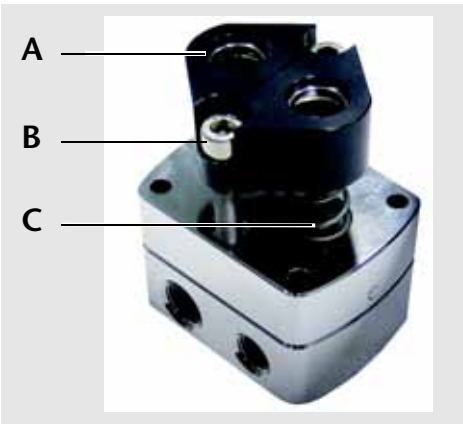
Intermediate result The pump head is ready to be screwed together.

Screwing the pump head together

A Piston guide

B Screw

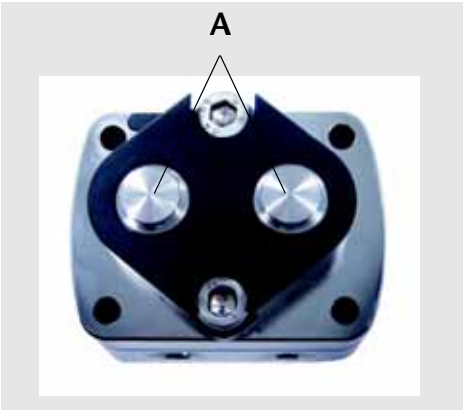
C Compression spring

Procedure	Figure
1. Position piston guide. 2. Insert screws with Allen wrench. 3. Manually press the piston guide down against the compression springs. 4. Alternately screw in the screws with a “size 4” Allen wrench, making sure that no tilting or jamming occurs and tighten the screws with a torque of 3 Nm.	 **Fig. 19 Assembling the piston guide**

ATTENTION! It is important that the pistons are not pushed in tilted at an angle, as this will reduce the service life of the pump head.

Inserting the piston rod

A Piston rods

Procedure	Figure
1. Carefully insert the piston rods individually one after the other by hand.	 **Fig. 20 Assembled pump head without peripherals**

Replacing the check valves

Dirty check valves may not open and close correctly. The entire check valve is replaced. For replacement of the check valves, KNAUER recommends removing the pump head.

Prerequisites
- Pump has been flushed with water and isopropanol.
- Pump has been switched off.

Duration approx. 10 min.

Level of difficulty
- Level 2 (1 = very easy to

Replacing the check valves

A Inlet, outlet
B Feed block
C Capillary connection
D Capillary connection
E Screw fitting at the outlet side
F Seal made out of advanced Teflon®
G Check valve
H Check valve
I Seal made out of advanced Teflon®
J Screw fitting at the inlet side
K Capillary connection

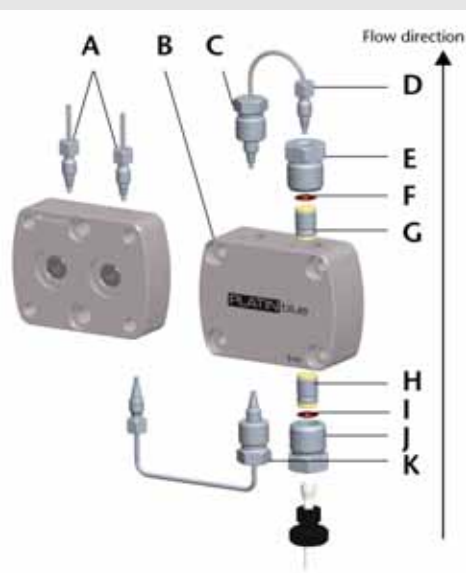
Procedure	Figure
1. Loosen the capillary connections between the two feed chambers of the pump with a wrench, alternating sides every revolution to avoid jamming (due to tilting). 2. Loosen the screw fittings at the outlet and inlet side. 3. Check seals made out of advanced Teflon® and replace if necessary. 4. Replace check valves paying attention to its alignment. Marking ring ' in the check valve indicates the direction of flow (see illustration). The marking on the check valve must be on the bottom, as the flow of eluent will otherwise be blocked.	

Fig. 21 Check valves with marking ring for direction of flow

Torque Values

No.	Torque	Wrench
C, K	7,5 Nm	10 er
D	5 Nm	1/4 "
E, J	15 Nm	13 er

Disassembling the device

- Disassembly of the device hood, suitable for certain maintenance and repair work on the inside of a device.

WARNING! Danger of electric shock!
Switch off the power supply!
Pull the power plug!

Remove the device hood upward

The device hood is secured with a total of 6 cross-head screws, three on each side.

Procedure The following steps are recommended for opening the casing:

1. Switch off the device and pull the power plug.
2. Remove cross-head screws on device hood on the sides
3. Remove the device hood upward

Tools
- Cross-head screwdriver size 1

Duration
- Approx. 10 min.

Level of difficulty
- Level 2 (from 1 to 7, very easy to very difficult)

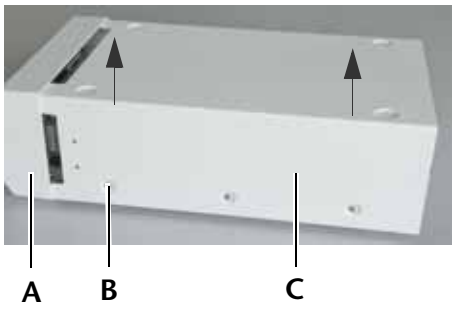
Remove device hood	Process	Figure
A Device door B Cross-head screws C Device hood	1. Open device door 2. Remove 3 cross-head screws on each side of the device 3. Lift the device hood up and out with both hands.	

Fig. 22 Remove device hood

Result The housing has been opened. All necessary maintenance and repair work on the inside of the device can be performed.

Spare parts

Component	Comment	Order number
Device hood		P0199
Device door	Complete	G1616
Cross-head screws	ISO 4762 M 3x6	R0053

Replacing the device door

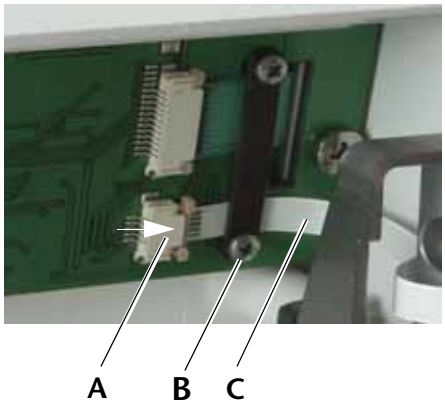
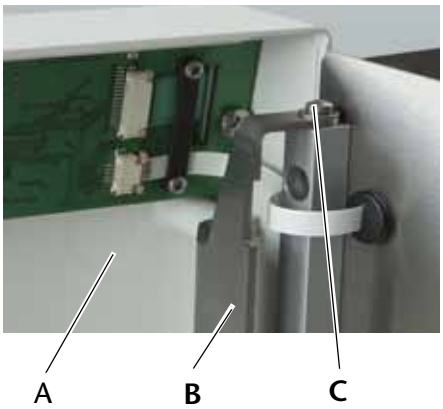
Prerequisite The housing has been opened and the device hood has been removed.

Procedure Always remove the door with on the device.

Tools
- Cross-head screwdriver size 1

Duration
- Approx. 5 min.

Level of difficulty
- Level 2 (from 1 to 7, very easy to very difficult)

Remove device door	**Process**	**Figure**
A Locking device the plug B Strain relief C Flexible flat cable	1. Open the device door. 2. Loosen the 2 cross-head screws of the strain relief and loosen the strain release. Try not to unscrew the screws completely. 3. Prior to pulling out the flexible flat cable, unlock the locking device of the plug (A) with tweezers in the direction of the arrow 4. Pull flat conductor cable out of the plug.	 **Fig. 23 Loosen lower flexible flat cable**
A Device door B Hinges C Cross-head screw	1. Remove cross-head screws of the hinge. Remove the door upward 2. Unscrew hinge from door	 **Fig. 24 Fastening screw on hinge**

Result The door has been removed.

Next steps Mount new door.

Spare parts

Component	Comment	Order number
Device door	complete with control panel, display, magnet lock	G1616

Replacing the fan

Note the following when repairing the fan:

- The fan is fastened on the rear panel of the device with fan mountings made of EPDM rubber
- The fan can be removed from the inside of the device without the use of tools
- To install the new fan, the use of at least a pair of combination pliers and a pair of bent needle-nose pliers is recommended
- Always also order a complete set of four of replacement fan mountings.

WARNING! Danger of electric shock!
Switch off the power supply!
Pull the power plug!

Removing the fan

Prerequisite The device hood has been removed.

Procedure Procedure for removing the fan:

1. Remove the fan power supply cable from the PIN connector of the main board.
2. Remove the fan completely from the inside of the device by hand.
3. When inserting a new fan, pay attention to the arrow on the fan indicating the direction of air flow.
4. Pull the fan mounts through the rear panel of the device using combination pliers
5. Cut off protruding fan mounts with scissors or a knife.
6. Insert the fan power supply cable into the next PIN connector of the main board.

Tools
- Combination pliers or bent needle-nose pliers
- Scissors or knife

Duration
- Approx. 15 min.

Level of difficulty
- Level 2 (from 1 to 7, very easy to very difficult)

Pulling out the fan

1. Remove the fan power cable from the PIN connector (C).
2. By hand, remove the entire fan out of the rear panel of the device in the direction of the arrow. This is possible without the use of additional tools.

Legend

A Power supply

B Fan with the power cable

C PIN connector on the main board

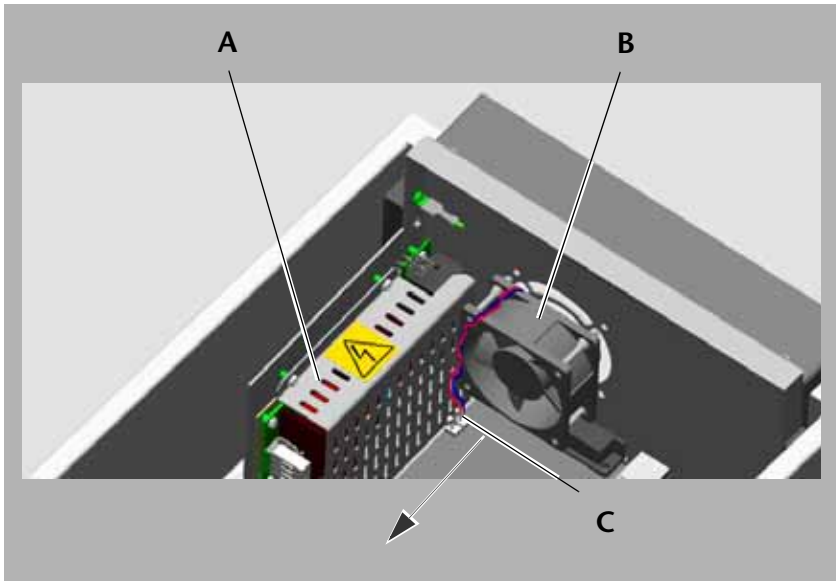


Fig. 25 Pulling out the fan

Inserting the fan mounts

Note: Before installing the fan, first completely insert the fan mounts. Always also order a complete set of fan mounts.

1. Pay attention to the direction of air flow of the fan!
2. Insert the fan mount into the fan by hand so that the shorter side points outward.
3. Using a pair of bent needle-nose pliers, carefully pull all four fan mounts into the provided holes.

Inserting a new fan

Note Pay attention to the direction of the fan printed on the fan. One arrow indicates the direction of rotation of the fan, the other indicates the direction in which the air is pulled.

Legend

A Power supply

B Fan with the power cable

C PIN connector on the main board

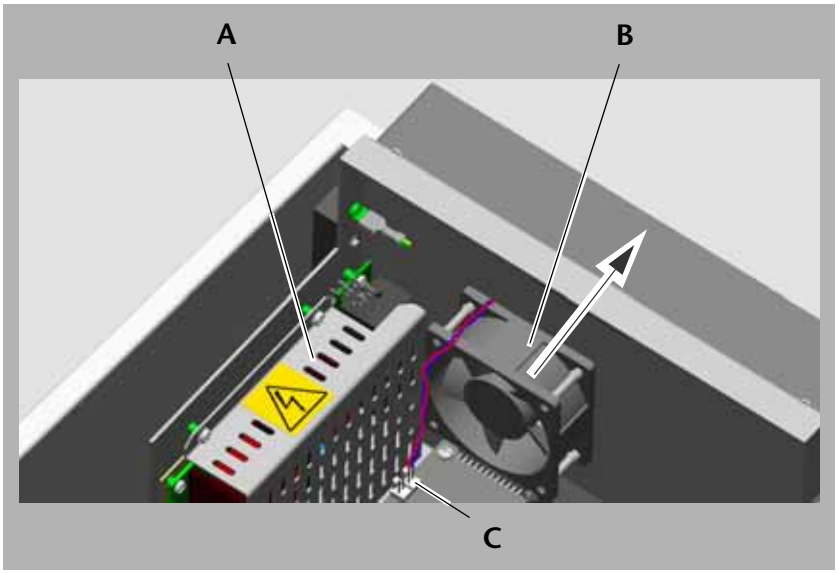


Fig. 26 Inserting a new fan

1. Position the fan on the rear panel of the device so that the arrow indicating the direction of air suction on the fan corresponds with the arrow in the drawing.
2. Push the fan mounts of the new fan through the device rear panel so that they can be gripped from the other side with combination pliers.
3. Using the combination pliers, pull out all four fan mounts so that the fan is positioned flat against the inside of the rear panel of the device.
4. Cut off protruding external fan mounts with scissors or a knife.
5. Connect the fan power cable to the next PIN connector (C).

Note: Both PIN connectors on the main board that can be reached with the fan cable are designed for the fan.

Result A new fan has been inserted and connected to the main board via a PIN connector.

Spare parts

Component	Comment	Order number
Fan	Complete	G5026
Fan mount	Material: EPDM rubber	M0984

Removal of piston backflushing pump

Prerequisite Side parts and cover of the housing have been removed.

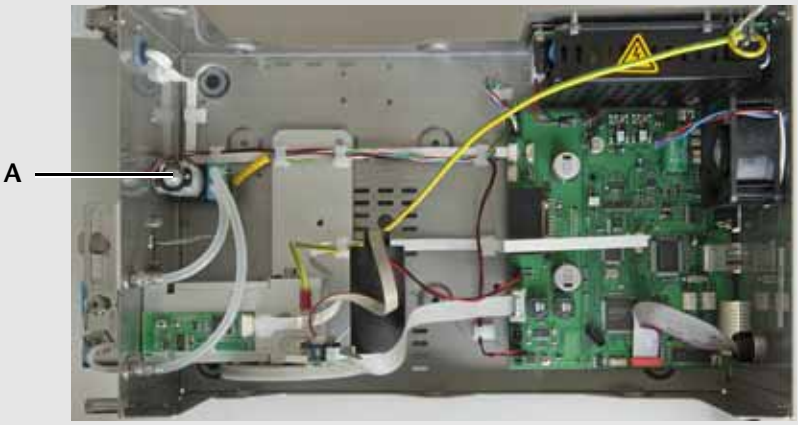
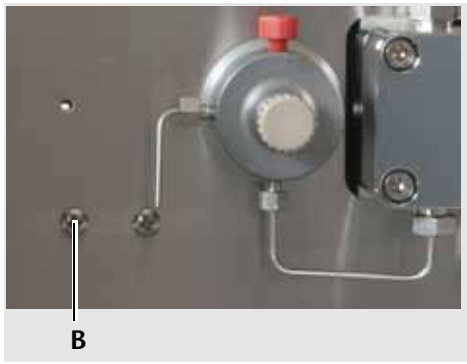


Fig. 27 Overview: Piston backflushing pump (A)

Piston backflushing pump The piston backflush pump (A) is attached to the inside of the front panel.

Procedure

- Loosen the piston backflushing pump.
- With combination pliers, press the holders of the tubs of the piston backflush pump in the interior of the device together so that the tubes can be removed.

Remove piston backflushing pump	Process	Figure
	1. From the front of the device, loosen both screws (B) which hold the piston backflushing with a Phillips-head screwdriver	 **Fig. 28 Piston backflushing pump**

Spare part

Component	Comment	Order number
Piston backflushing pump	-	G1659XA

Replacing the pressure sensor

Prerequisite

Side parts and cover of the housing have been removed.

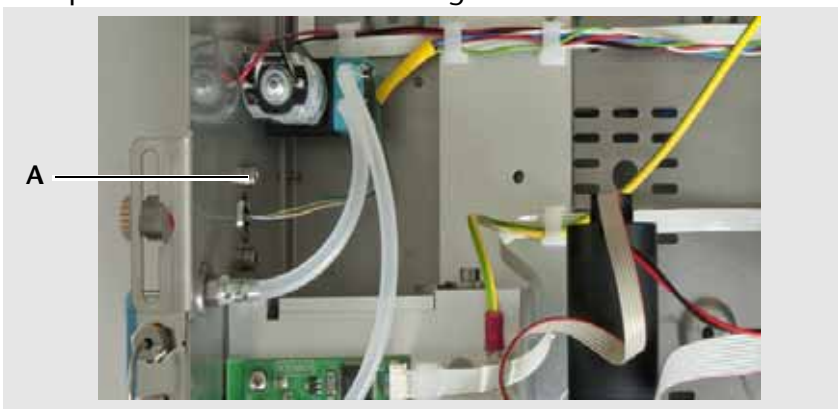


Fig. 29 Pressure sensor holder (A)

Functional principle

The pressure sensor is adjusted to the mechanical and electrical properties of the pump with a calibration procedure.
The calibration requires a test station from KNAUER and the service software. For better results, the calibration is repeated once.

Prerequisite

- The power plug has been pulled.
- The housing has been opened.
- The test station for the pump with pressure sensor is available.
- The service software for the calibration of the pressure sensor is available.

Procedure

- Detach the capillaries.
- Detach the cabling of the pressure sensor on the board.
- Unscrew the screws of the pressure sensor (A) in the interior of the device.
- Insert the new pressure sensor.
- Calibrate the new pressure sensor.

Note: Repair of the pressure sensor requires special tools and knowledge. For this reason the entire pressure sensor is replaced by the technical service department.

Calibrating the pressure sensor

The pressure sensor is calibrated at the following values:

- HPLC pumps
  - at 0 bar (at calibration zero point)
  - in the range of 350–400 bar (end point of the calibration)

Tools

- Allen wrench for hexagon socket screws (Allen screws), 3.0 mm diameter

Duration

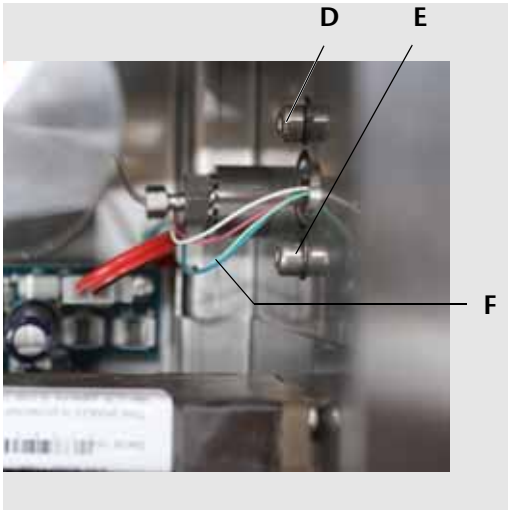
- Approx. 10 min.

Level of difficulty

- Level 4 (from 1 to 7, very easy to very difficult)

Removing the pressure sensor

The pressure sensor is secured with two screws on the inside of the housing of the pump.

Removing the pressure sensor	Process	Figure
	1. Close bleed screw (B) ❷ (order number: P2719XA). 2. Loosen screw fittings of the capillaries (A, C).	Exterior view  **Fig. 30 Capillaries on the front of the device (mixing chamber optional)**
	3. Detach the cable of the pressure sensor (F) from the board. 4. Unscrew both 3 mm Allen screws (D, E) for securing the pressure sensor 5. Hold the pressure sensor and guide it out through the opening together with the cable.	Interior view  **Fig. 31 Screws for securing the pressure sensor in the interior of the device**

Installing a new pressure sensor

1. Guide the cable of the new pressure sensor through the opening and secure the pressure sensor with two 3 mm Allen screws.
2. Connect the cable of the pressure sensor to the board.
3. Calibrate the new pressure sensor on the test station in the service mode of the service software.

Spare parts

Component	Comment	Order number
Pressure sensor	-	G2703V1
Ventilation screw	without O-ring	P2719XA
O-ring	-	M1368

Replacing the motor

Note Replacing the motor of the pump on the inside of the housing is to be performed exclusively by the KNAUER technical service department or a company authorized by KNAUER.

WARNING! Danger of electric shock!
Switch off the power supply!
Pull the power plug!

Prerequisite The housing has been opened.

Procedure Procedure for removing the 24-V motor of the pump:

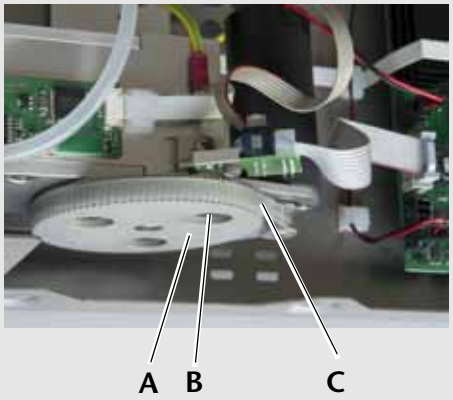
- Disconnect all electrical motor connections.
- Loosen V-belt to be able to remove the motor.
- Remove the motor.
- Install the new motor and the new V-belt.
- Inspect the tension of the V-belt.

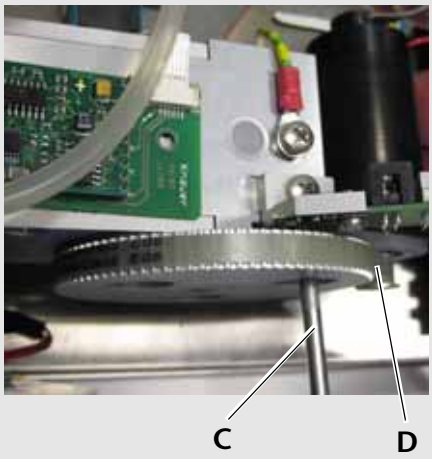
Tools
- Cross-head screwdriver (321/PH 2×100 size)

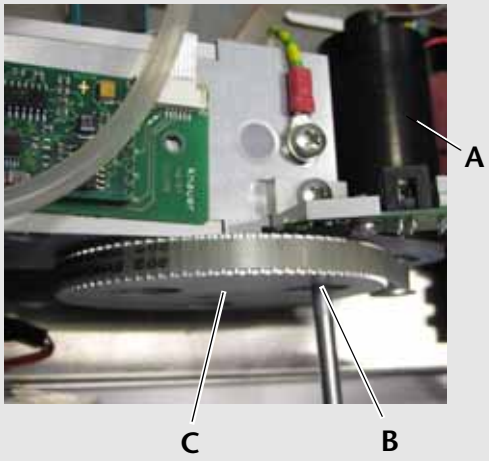
Duration
- Approx. 10 minutes

Level of difficulty
- Level 4 (from 1 to 7, very easy to very difficult)

Removing the motor of the pump

Removal of the motor	Process	Figure
	1. Disconnect all electrical connections of the motor, for instance the control unit for the pulse per revolution (encoder) and the DC power connection. 2. Turn the gear (A) of the drive shaft together with the V-belt (C) to a position where the retaining screws of the motor become visible through one of the openings (B) of the drive shaft.	 **Fig. 32 Drive shaft and openings in the gear**

Removal of the motor	Process	Figure
	3. Only loosen the two screws of the motor mount (C) with a screwdriver (cross-head), do not unscrew them completely. This removes the tension from the V-belt (D). 4. Remove V-belt. 5. Screw out the three Phillips-head flat-head screws (A) around the motor pinion (B) and remove the motor. 6. Insert new motor and screw tight. Ensure that the flat cable of the encoder is vertically pointing upward. 7. Hoist new V-belt	 **Fig. 33 Three Phillips-head flat-head screws (A) fasten the motor of the pump. The V-belt runs openly over the motor pinion (B)**  **Fig. 34 V-belt (C) and position of the drive shaft (D) to remove tension from the V-belt**

Tensioning the V-belt	Process	Figure
	1. Turn the drive shaft (C) together with the V-belt to a position where the upper retaining screw of the motor becomes visible through one of the openings (B) of the drive shaft 2. Lift the motor (A) to tighten the V-belt and tighten the upper screw. 3. Tighten all screws of the motor mount. 4. Reconnect all electrical connections.	 **Fig. 35 Motor (A), drive shaft (C) and openings in the gear (B) of the drive shaft** Note: When the V-belt can be pressed in with a thumb 1–2 mm, the tension of the belt has been set correctly.

Spare parts

Component	Comment	Order number
Complete motor		G2718-2
Motor timing belt		M1840
Phillips-head flat-head screws	M 3×5 mm	R0054

Replacement of the motherboard

Practical tip Not all plug connections on the motherboard are designed confusion-proof. Mark the cable before removing it.

Legend

A Power supply

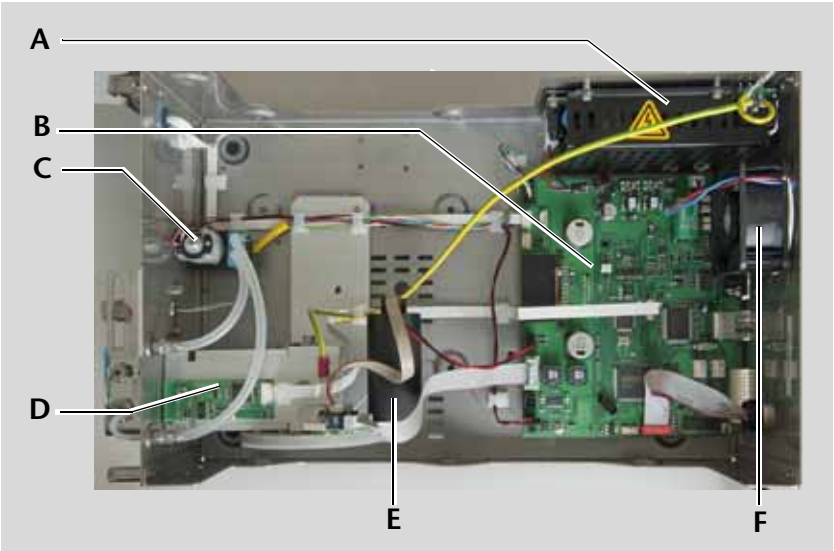
B Motherboard

C Piston backflushing pump

D Pump

E Motor

F Fan



Prerequisites

- Side parts and cover of the housing have been removed.

What can be replaced?

- Motherboard (complete)
- Fuses for the protection of the motherboard (safety fuses) in case of external control via the WAGO remote control board

Note: The battery on the motherboard (service life approx. 10 years) is not replaced. Rather, the motherboard is replaced completely.

Observe following the installation of a new motherboard!

- Transfer the serial number and device settings of the replaced motherboard on the repaired device with the service software
- Transfer current firmware
- Calibrate pump pressure sensor
- Initialize device

Tools

- Allen wrench for hexagon socket screws (Allen screws), 1.5, 2.0 and 2.5 mm diameter in different lengths (recommended)
- Tweezers
- Precision engineering screwdriver

Duration

- approx. 20 min for installation and removal

Level of difficulty

- Level 3 (from 1 to 7, very easy to very difficult)

Replace motherboard

WARNING! **Danger of electric shock!**
Switch off the power supply!
Pull the power plug!

Caution! **Electrostatic discharge can destroy the electronics!**
Wear protective bracelet against electrostatic discharge and ground.

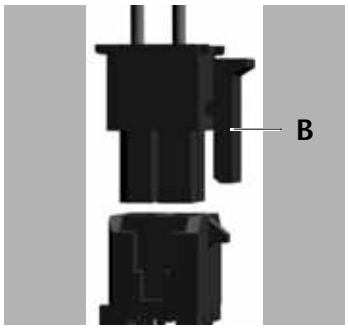


Fig. 36 Edge connector with snap lock

- Disconnect all cable connections on the motherboard
  - Manually press in the snap lock of the plug (B) and of the 24 V power supply unit (A) on the motherboard and pull out the plugs (see figures 36 and 37). The plugs are designed confusion-proof, that is, for the display (five pole) and the 24 V power supply unit (six pole). Pull out further snap locks. Take care of the direction of the snap lock!
  - Plug for the flexible flat cable for the display (E), for the pressure sensor (D) and for the connections of the hall sensor (D) and the flush pump (H, I) with tweezers first unlock and then pull off (see figure 37).
  - Mark position of the cables on the board.
- Loosen the 4 screws for the attachment of the board with a Phillips-head screwdriver and remove from the motherboard with tweezers.
- Remove board as shown in the instructional film.
- Check the 4 space bolts of the motherboard before installing a new motherboard.
- When connecting the flexible flat cable (H, I), lock the plug connections as shown in the instructional film (see figure 37).

Motherboard types and configuration of the plug connectors

Pump

A Rear wall of device

B Fan, possibly doubled

C Power supply

D Pressure sensor

E Display

F RFID

G Motor DC connection

H Hall sensor

I Flush pump

J Manager connection

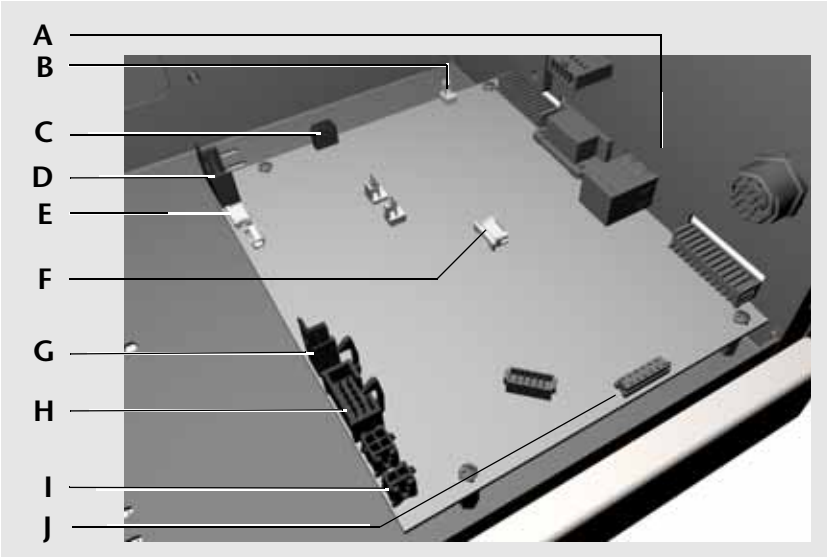
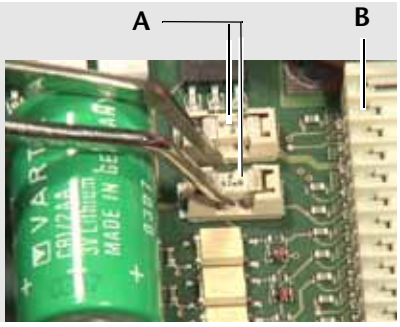


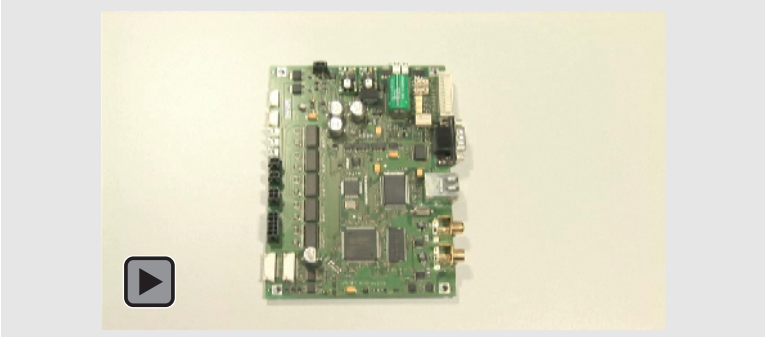
Fig. 37 Motherboard

Replace fuses on the motherboard

Process	Figure
1. Loosen and pull out safety fuses on the motherboard with tweezers 2. When inserting a new safety fuse, ensure that the label with specification of the voltage is pointing upwards	 **Fig. 38 Safety fuses (A) protect the motherboard**

Loosen and pull out fuses on the motherboard with tweezers

Instructional film: Click on the play symbol in the PDF file (Adobe Reader from version 9)



Spare parts

Component	Comment	Order number
Fuses	1 A	M2099
	62 mA	M0734
	250 mA	M0731
S1050 motherboard		G1156XB

Removing the power plug

Prerequisite The housing has been opened.

Procedure Procedure for removing the power supply:

- Disconnect all electrical power supply connections
- Remove cover of the power supply
- Remove printed circuit board of the power supply

Tools
- Size M 2.5 Allen wrench
  Size 1 Cross-head screwdriver

Duration
- Approx. 20 minutes

Level of difficulty
- Level 2 (from 1 to 7, very easy to very difficult)

Removing the power plug

A Allen screws

B Cover of the power supply

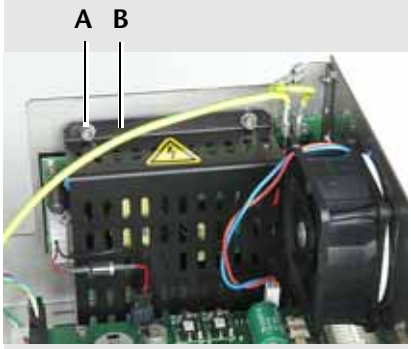
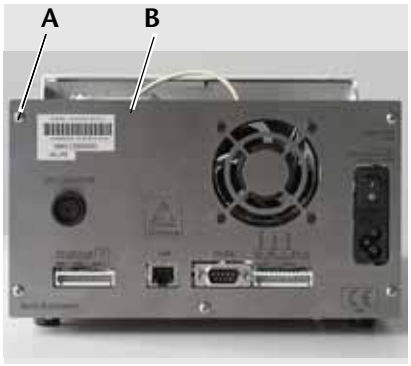
Process	Figure
1. Remove the 2 Allen screws. 2. Remove cover of the power supply upward.	

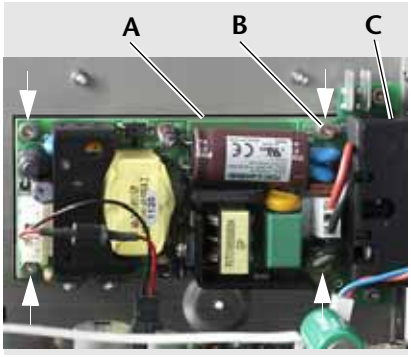
Fig. 39 Power supply with cover

Removing the power plug

Process	Figure
1. Remove the 5 cross-head screws (A) on the back of the device. 2. Fold down the back of the device (B).	 **Fig. 40 Rear view of the device**

A Cross-head screws

B Rear view of the device

1. Loosen all cable connections at the power supply. 2. Remove 4 Allen screws (B). 3. Remove power supply (A).	 **Fig. 41 Power supply without cover**

A Power supply

B Allen screws

C Power input

Result The power supply has been removed.

Next steps A new power supply can be installed or the power input can be replaced.

Spare parts

Component	Comment	Order number
Power supply ZPSA-60-24, 24 V/60 W		K0790
Power input		G1591

Tightening torque for screws

Practical tip The use of a dynamometric screwdriver for the tightening torques is highly recommended.

Screws in materials made of metal

The following materials are considered metal:

- Aluminum
- Steel, stainless and other
- Brass
- Titanium

The specifications are maximum recommended tightening torques of the screws in the materials used by the manufacturer. With respect to the material stainless steel (A2/A4):

Size	Tightening torque (in Nm)*	Tightening torque (in Nm)**
M2	0.4	0.65
M3	1.0	2.2
M4	2.0	4.9
M5	3.0	10.0
M6	4.5	17.0
M8	8.5	41.0
M10	13.0	83.0

*valid for screw strength (8.8) in stainless steel (A2/A4)
*valid for screw strength (12.9) in stainless steel (A2/A4)

Screws in materials made of plastic

The following materials are considered plastic:

- PEEK
- PETP
- POM
- PMMA
- PTFE

Size	Tightening torque (in Nm)
M2	0.2
M3	0.5
M4	1.0
M5	1.5
M6	2.5
M8	4.5
M10	7.5

Troubleshooting

Error list

In the following list, the error numbers with the associated indexes are listed that appear on the display if an error occurs.

Error number	Index
Error_1	System error
Error_2	System error
Error_3	System error
Error_10	Leakage error
Error_15	System error
Error_16	Invalid command
Error_17	Invalid parameter
Error_18	CRC failed
Error_19	access denied
Error_20	Instrument in standalone mode
Error_21	Cannot initialize LAN

Error number	Index
Error_22	12C Init failed
Error_23	Cannot read RTC
Error_24	12C operation failed
Error_25	Cannot write data on FRAM
Error_26	Cannot read data from FRAM
Error_27	Instrument remote controlled
Error_28	Error input activated
Error_29	Time already exists
Error_30	Too many lines in program
Error_31	Invalid line number
Error_32	Invalid link
Error_33	Not enough space to store link
Error_34	Program does not exist
Error_35	Program is running.
Error_36	Link is loaded
Error_37	Link is running
Error_38	Not enough space to store link
Error_39	Cannot operate with an empty link
Error_40	Cannot delete active program/link
Error_41	This program is used in a link
Error_42	This program is used in WAKEUP
Error_43	This link is used in WAKEUP
Error_44	Cannot edit program from the running link
Error_45	No link available. Pls edit link first
Error_46	No link available
Error_47	Wake up time already passed!
Error_48	Not supported
Error_49	Line in time table is empty
Error_50	Invalid index in time table
Error_51	Invalid time in time table
Error_52	No time table to start

Error number	Index
Error_53	Cannot start time table
Error_54	Time table is not active
Error_55	Time table is not loaded
Error_56	No gradient is available in isocratic mode
Error_57	Non-existing component is set to non-0 value
Error_58	Sum of components is not 100.
Error_59	Maximum pressure! System stopped
Error_60	Minimum pressure! System stopped
Error_61	Cannot use non-existing component!
Error_62	Program not compatible with pump head
Error_63	Component settings not compatible with gradient setup!
Error_64	Unknown pump head type!
Error_65	Auto pump head type: no valid head detected!
Error_66	Auto pump head type: head data uninitialized!
Error_67	Auto pump head type: RFID hardware not present or failed!
Error_68	Auto pump head type: read failed!
Error_69	Auto pump head type: write failed!
Error_70	Motor failure
Error_71	Motor failure: max current
Error_72	Motor failure: position error
Error_99	I2C failed for panel
Error_122	GUI internal error!
Error_123	GUI communication failed (internal)
Error_124	GUI communication failed (external)

Possible problems and rectifications

In the following table, approximately 90% of the problems that occur in practical use are listed with possible solutions.

Problem	Cause	Solution
Instable pressure, instable flow	▪ Malfunction of ball valve	▪ Clean the ball valves ▪ Replace ball valve
Instable pressure, instable flow	▪ Seals worn	▪ Replace seal ▪ Inspect piston and replace if necessary
Pulse station too high	▪ System did not recognize the pump head	▪ Check automatic recognition of the pump head
Pulse station too high	▪ RFID detection is not switched on ▪ RFID defective	▪ Switch on RFID detection ▪ Check RFID printed circuit board ▪ Replace RFID printed circuit board ▪ Check RFID tag in pump head ▪ Replace RFID tag
Pulse station too high	▪ Zero point of camshaft not recognized	▪ Replace hall sensor printed circuit board
When switching on the pump, the display remains dark and no motor sounds can be heard.	▪ Defective main power supply ▪ Short circuit in the motherboard or in other electronic components	▪ Replace power supply ▪ Replace motherboard on pump
Pump can be controlled using the device control panel but not by the connected computer	▪ Interface incorrectly configured or defective	▪ Set compatible interface parameters of pump computer ▪ Replace motherboard

Problem	Cause	Solution
Pump can only be controlled using the computer, not from the device control panel	▪ Keyboard, display or touchscreen	▪ Replace door with control panel
Managers cannot be controlled even though the gradient valves in the manager are working properly	▪ The supply voltage with 24 V is not passed on to the manager ▪ Defective fuses on the mainboard of the pump	▪ Replace connection cable of manager pump ▪ Defect in manager ▪ Replace defective fuses on the mainboard of the pump
One or more gradient valves in the manager does not work properly	▪ Defective connection cable of manager pump ▪ Defective motherboard on pump	▪ Replace connection cable of manager pump ▪ Replace motherboard on pump
Motor error is displayed in the display	▪ Defective motor or encoder	▪ Replace motor
Pressure display shows incorrect value	▪ Motherboard not calibrated ▪ Pressure sensor defective	▪ Calibrate motherboard of pump ▪ Replace pressure sensor
No external 24V or 5V power supply at the WAGO terminal strip	▪ Defective fuse on the mainboard	▪ Replace fuse
Loud running noise from pump	▪ Timing belt worn	▪ Replace timing belt and adjust belt tension

Table of figures

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