942 Extension Module Vario

942 Extension Module Vario ONE/Deg

Manual

8.942.8006EN / v6 / 2023-12-31

Metrohm

Metrohm AG
CH-9100 Herisau
Switzerland
+41 71 353 85 85
info@metrohm.com
www.metrohm.com

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2.942.1060

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Technical Communication
Metrohm AG
CH-9100 Herisau

This documentation has been prepared with great care. However, errors can never be entirely ruled out. Please send comments regarding possible errors to the address above.

Disclaimer

Deficiencies arising from circumstances that are not the responsibility of Metrohm, such as improper storage or improper use, etc., are expressly excluded from the warranty. Unauthorized modifications to the product (e.g. conversions or attachments) exclude any liability on the part of the manufacturer for resulting damage and its consequences. Instructions and notes in the Metrohm product documentation must be strictly followed. Otherwise, Metrohm's liability is excluded.

Table of contents

Table of figures

1 Introduction

1.1 Instrument description

942 Extension Module Vario are extension modules used to expand existing 940 Professional IC Vario devices with additional functions. Each 940 Professional IC Vario device can be expanded with up to 3 942 Extension Module Vario devices.

The **942 Extension Module Vario ONE/Deg** enables an additional analysis channel to be installed into a Professional IC system.

With the 942 Extension Module Vario ONE/Deg, a one-channel low-pressure gradient instrument can thus be expanded to a two-channel AnCat instrument with low-pressure gradient. All instruments with sample preparation can be expanded to two-channel systems as well.

Use in a system with photometric detection is also possible, with the 942 Extension Module Vario ONE/Deg serving to convey reagents, a 943 Professional Thermostat/Reactor Vario as column holder and column thermostat and a 944 Professional UV/VIS Detector Vario.

The 942 Extension Module Vario is operated using **MagIC Net** software, just like the IC device. If a 942 Extension Module Vario is connected to a 940 Professional IC Vario device, MagIC Net automatically detects the 942 Extension Module Vario and checks its functional capability. It controls and monitors the entire IC system including all connected devices; it evaluates the measured data and manages it in a database.

The 942 Extension Module Vario ONE/Deg consists of the following components:

Eluent degasser

The eluent degasser removes gas bubbles and dissolved gases from the eluent.

High-pressure pump

The intelligent and low-pulsation high-pressure pump pumps the eluent through the IC system. It is equipped with a chip where its technical specifications and "life history" (operating hours, service data, etc.) are stored.

Inline filter

Inline filters protect the separation column reliably from potential contamination from the eluent. The filter pads with 2 µm pore size can be replaced quickly and easily. They remove particles from the solutions, such as bacteria and algae.

Pulsation absorber

The pulsation absorber protects the separation column from damage caused by pressure fluctuations, e.g. when the injection valve is switched, and reduces interfering pulsations during highly sensitive measurements.

Injection valve

The injection valve connects the eluent path to the sample path. By a quick and precise switching of the valve, a quantity of sample solution defined by the size of the sample loop is injected and flushed to the separation column with the eluent.

1.2 Intended use

The 942 Extension Module Vario ONE/Deg expands an IC system by an additional analysis channel.

This device is suitable for processing chemicals and flammable samples. Usage of the 942 Extension Module Vario ONE/Deg therefore requires the user to have basic knowledge and experience in handling toxic and caustic substances. Knowledge regarding the application of fire prevention measures prescribed for laboratories is also mandatory.

1.3 About the documentation

CAUTION

Read through this documentation carefully before putting the device into operation. The documentation contains information and warnings which the user must follow in order to ensure safe operation of the device.

1.3.1 Content and scope

This document describes the **942 Extension Module Vario ONE/Deg** (2.942.1060), its assembly and connection to the IC device, as well as the installation, operation and maintenance of individual components. Technical specifications, troubleshooting and information concerning scope of delivery and optional accessories make up the rest of the manual.

However, this document does not describe the functions of a unit combining a 940 Professional IC Vario and 942 Extension Module Vario ONE/Deg, nor does it describe the capillary connections that go beyond the 942 Extension Module Vario ONE/Deg. Refer to the manual for the 940 Professional IC Vario and Sample Processor in this regard.

Additional information concerning the configuration of MagIC Net can be found in the online help for MagIC Net.

1.3.2 Symbols and conventions

The following symbols and formatting may appear in this documentation:

*(5-**12**)*	**Cross-reference to figure legend** The first number refers to the figure number, the second to the instrument part in the figure.
1	**Instruction step** Perform the steps one after the other.
Method	**Dialog text**, **parameter** in the software
File ▶ New	Menu or menu item
[Continue]	**Button** or **key**
	**WARNING** This symbol draws attention to a possible life-threatening hazard or risk of injury.
	**WARNING** This symbol draws attention to a possible hazard due to electrical current.
	**WARNING** This symbol draws attention to a possible hazard due to heat or hot instrument parts.
	**WARNING** This symbol draws attention to a possible biological hazard.
	**WARNING** Warning of optical radiation
	**CAUTION** This symbol draws attention to possible damage to instruments or instrument parts.
	**NOTICE** This symbol highlights additional information and tips.

1.4 Safety instructions

1.4.1 General notes on safety

WARNING

Operate this instrument only according to the information contained in this documentation.

This instrument left the factory in a flawless state in terms of technical safety. To maintain this state and ensure non-hazardous operation of the instrument, the following instructions must be observed carefully.

1.4.2 Electrical safety

The electrical safety when working with the instrument is ensured as part of the international standard IEC 61010.

WARNING

Only personnel qualified by Metrohm are authorized to carry out service work on electronic components.

WARNING

Never open the housing of the instrument. The instrument could be damaged by this. There is also a risk of serious injury if live components are touched.

There are no parts inside the housing which can be serviced or replaced by the user.

Supply voltage

WARNING

An incorrect supply voltage can damage the instrument.

Only operate this instrument with a supply voltage specified for it (see rear panel of the instrument).

Protection against electrostatic charges

WARNING

Electronic components are sensitive to electrostatic charges and can be destroyed by discharges.

Do not fail to pull the power cord out of the power socket before you set up or disconnect electrical plug connections at the rear of the instrument.

1.4.3 Tubing and capillary connections

CAUTION

Leaks in tubing and capillary connections are a safety risk. Tighten all connections well by hand. Avoid applying excessive force to tubing connections. Damaged tubing ends lead to leakage. Appropriate tools can be used to loosen connections.

Check the connections regularly for leakage. If the instrument is used mainly in unattended operation, then weekly inspections are mandatory.

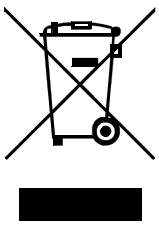
1.4.4 Flammable solvents and chemicals

WARNING

All relevant safety measures are to be observed when working with flammable solvents and chemicals.

- Set up the instrument in a well-ventilated location (e.g. fume cupboard).
- Keep all sources of flame far from the workplace.
- Clean up spilled liquids and solids immediately.
- Follow the safety instructions of the chemical manufacturer.

1.4.5 Recycling and disposal



Properly dispose of chemicals and of the product to reduce negative effects on the environment and public health. Local authorities, waste disposal companies or dealers provide more detailed information on disposal. Observe the WEEE EU directive (WEEE = Waste Electrical and Electronic Equipment) for the proper disposal of waste electronic equipment within the European Union.

2 Overview of the device

2.1 Front

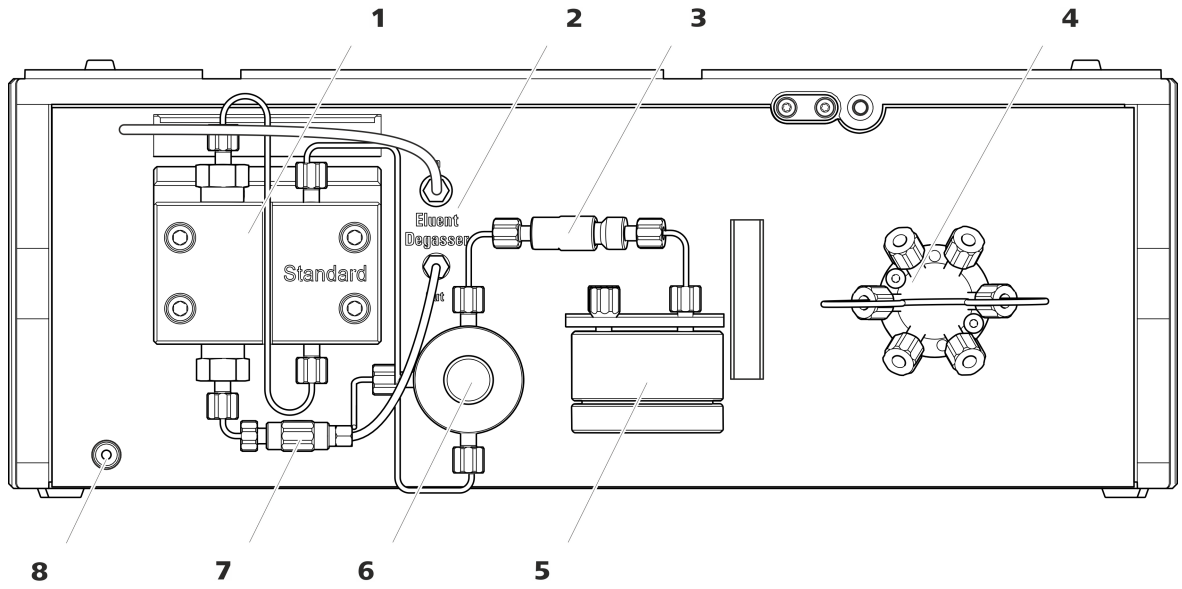


Figure 1 Front

1 **High-pressure pump** *See Chapter 3.6.*	**2** **Eluent degasser** *See Chapter 3.5.*
3 **Inline filter** *See Chapter 3.7.*	**4** **Injection valve** *See Chapter 3.9.*
5 **Pulsation absorber** *See Chapter 3.8.*	**6** **Purge valve** *See Chapter 3.6.*
7 **Coupling (6.2744.230)** For connecting the eluent aspiration tubing.	**8** **Standby indicator**

2.2 Rear

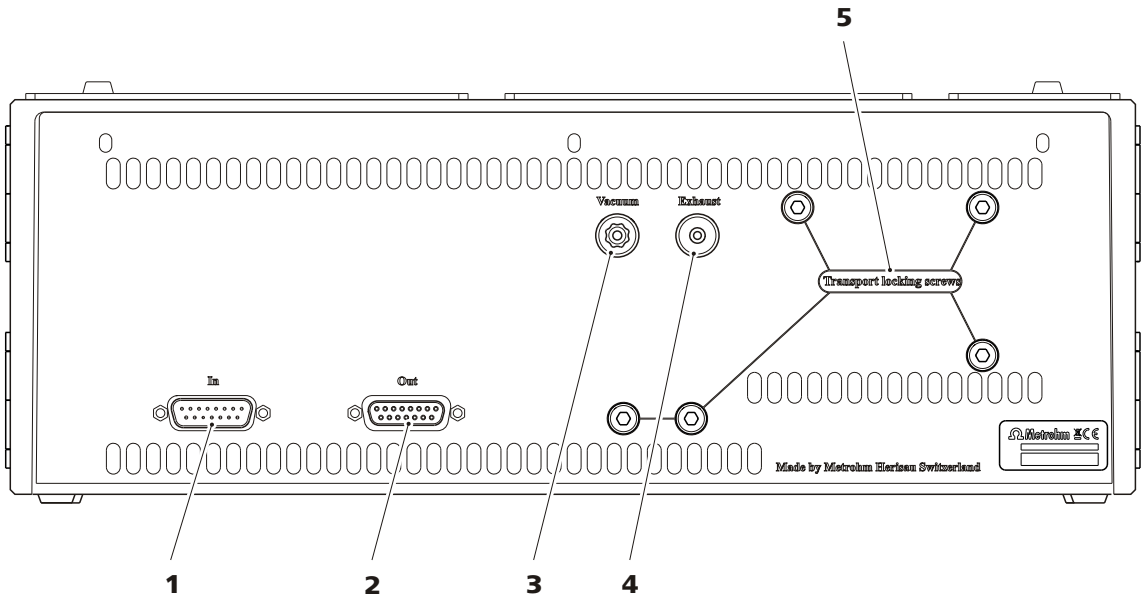


Figure 2 Rear

1	**"In" connection** For connecting the Extension Module to the IC instrument or to a previous Extension Module.
2	**"Out" connection** For connecting an additional Extension Module.
3	**"Vacuum" connection** For connecting additional degassing chambers in extension modules.
4	**Exhaust opening** For extracting the air from the vacuum chamber. Labeled *Exhaust*.
5	**Transport locking screws** For securing the high-pressure pump and the vacuum pump when transporting the instrument.

2.3 Extension Module and 940 Professional IC Vario

The 942 Extension Module Vario units are fitted directly to the 940 Professional IC Vario and connected to it via the connection cable provided. Extension modules have no power supply of their own, but rather draw the electricity they require from the instrument to which they are connected.

Extension modules can be placed in 3 different ways:

- Installed between the instrument and bottle holder *(3-**A**)*.
- Installed between the instrument and base tray *(3-**B**)*.
- Stacked next to the instrument *(3-**C**)*. In this case, we recommend ordering a separate base tray (6.2061.110) and a separate bottle holder (6.2061.100) for the stack.

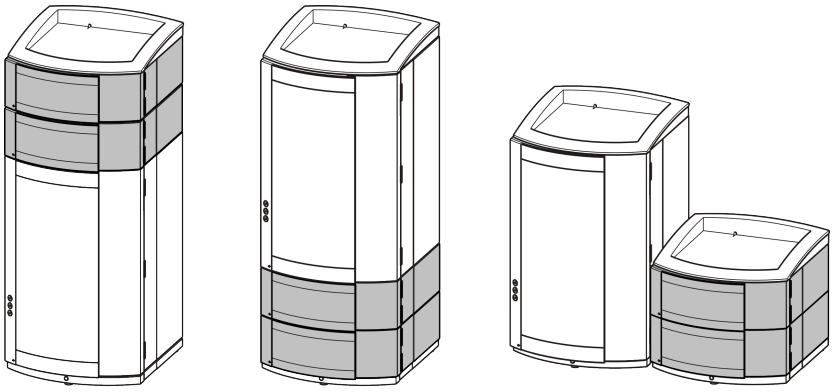


Figure 3 Proposed setup

A	**Extension module on top** Between the 940 Professional IC Vario and the bottle holder.
B	**Extension module below** Between the base plate and the 940 Professional IC Vario.
C	**Extension module separately** Next to the 940 Professional IC Vario with its own base plate and bottle holder.

Up to three extension modules can be connected to an 940 Professional IC Vario. The following restrictions are to be taken into account:

Restrictions

Together, the 940 Professional IC Vario and its extension modules must not contain more than 4 identical components, this means that:

- A maximum of 4 high-pressure pumps,
- A maximum of 4 peristaltic pumps,
- A maximum of 4 injection valves,
- A maximum of 4 suppressors (MSM, incl. SPM),
  BUT

- Only a maximum of 3 degassers
- And a maximum of 3 CO_2 suppressors (MCS)

NOTE

If all four high-pressure pumps are being used simultaneously, then all of them must not be operating with their maximum flow for long periods.

Position the Extension Module in such a way that the capillary connections can be kept as short as possible. If several extension modules are being used, they should all be installed at the same location above or below each other. If this is not possible, extension modules that are farther apart have to be connected together using a longer connecting cable (6.2156.070).

3 Installation

3.1 Setting up the instrument

3.1.1 Packaging

The instrument is supplied in protective packaging together with the separately packed accessories. Keep this packaging, as only this ensures safe transportation of the instrument.

3.1.2 Checks

Immediately after receipt, check whether the shipment has arrived complete and without damage by comparing it with the delivery note.

3.1.3 Location

The instrument has been developed for operation indoors and may not be used in explosive environments.

Place the instrument in a location of the laboratory which is suitable for operation and free of vibrations and which provides protection against corrosive atmosphere and contamination by chemicals.

The instrument should be protected against excessive temperature fluctuations and direct sunlight.

3.2 Transport locking screws

To avoid damage to the drives for the high-pressure pump and the vacuum pump during transport, the pumps are secured with transport locking screws. These are located at the rear of the instrument and labeled with **Transport security screws**.

Remove these transport locking screws before the initial start-up.

Accessories

For this step you need:

- 4 mm hex key (6.2621.030)

Removing the transport locking screws

1 Remove all of the transport locking screws with the hex key.

Store the transport locking screws in a safe place. Reinsert the transport locking screws each time you transport the instrument a significant distance.

CAUTION

The pumps may be damaged if you transport the instrument without inserting the transport locking screws.

3.3 Base tray and bottle holder

3.3.1 Basic information on base tray and bottle holder

The base tray (6.2061.110) and bottle holder (6.2061.100) protect IC instruments from dust, dirt and leaking fluids. The supply bottles for eluent and auxiliary solutions can be positioned neatly on the bottle holder.

In a complex IC system, several different instruments may be used, such as an analyzer, an extension module and a detector. These instruments can be set up in one or more stacks. We recommend that a base tray and bottle holder be mounted for each stack of IC instruments.

The bottle holder and base tray must be removed or set up if one of the following instruments is to be mounted on or under a 940 Professional IC Vario:

- One or more 942 Extension Module Vario
- Or another instrument with the same-sized footprint

3.3.2 Mounting base tray and bottle holder (optional)

The base tray and bottle holder come fully assembled on a new ion chromatograph. To install an Extension Module on the ion chromatograph, remove the bottle holder and put it back on top of the topmost instrument. To install an Extension Module under the ion chromatograph, remove the base tray and set it under the lowest instrument.

3.3.2.1 Removing/mounting the base tray

Remove the base tray to install another instrument under the IC instrument.

CAUTION

Do not pinch capillaries or leak sensor cables

Capillaries are fed through the guide ducts between the base tray and the instrument. Pinches in the leak sensor cable or the capillaries may lead to malfunctions.

- Unplug the leak sensor cable before you remove the base tray.
- Remove all the capillaries from the capillary ducts before you remove the base tray.

Removing the base tray

Prerequisites

- The instrument is switched off.
- The bottle holder is cleared.
- All of the cable connections on the rear have been disconnected.
- The capillaries are removed from the guide ducts between the instrument and the base tray.
- There are no loose parts in the instrument.

Accessories

- 3 mm hex key (6.2621.100)

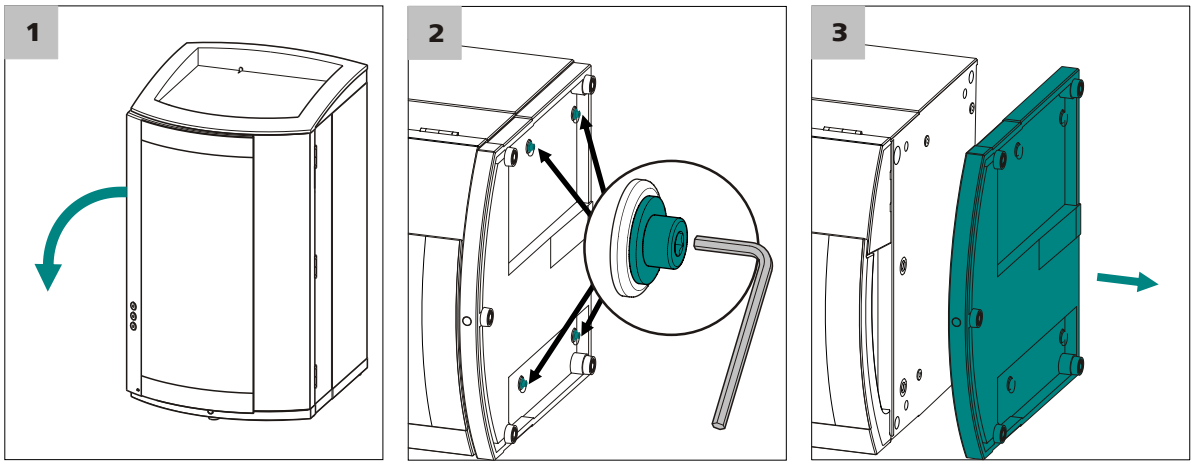


Figure 4 Removing the base tray

1 Tilt the instrument sideways and lay it down flat.

2 Loosen the 4 cylinder screws with the 3 mm hex key. Remove the cylinder screws and their washers.

3 Remove the base tray.

Always mount the base tray under the lowermost instrument of the stack.

Mounting the base tray

Prerequisites

- The instrument is switched off.
- The bottle holder is cleared.
- All of the cable connections on the rear have been disconnected.
- There are no loose parts in the instrument.
- The instrument is lying on its side, and the bottom surface is visible.

Accessories

- 3 mm hex key (6.2621.100)

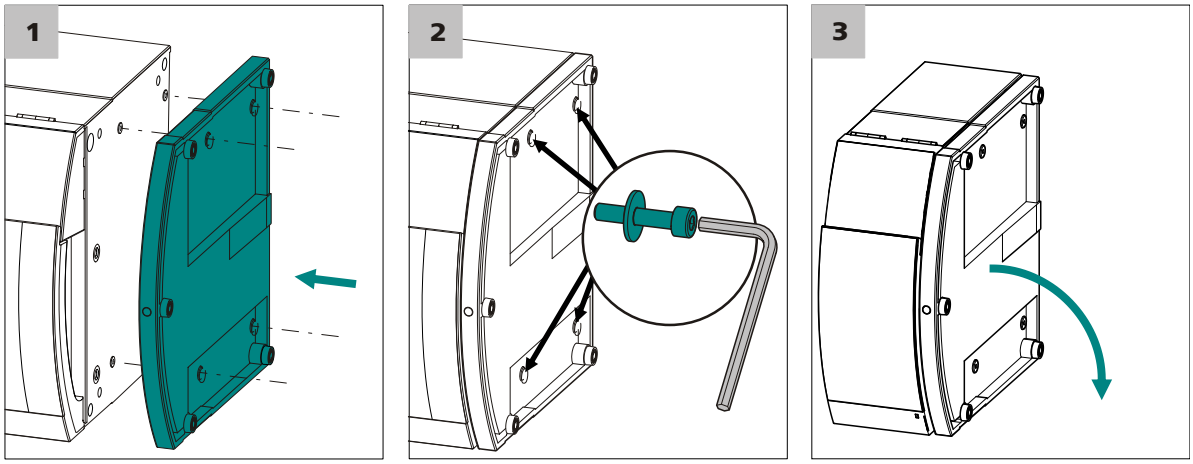


Figure 5 Mounting the base tray

1 Mount the base tray in such a way that the openings in the base tray match exactly the screw threads in the bottom of the instrument.

2 Slide the washers onto the cylinder screws. Insert the cylinder screws with the washers and tighten them with the 3 mm hex key.

3 Set the instrument back up on the base tray.

Stack other instruments in the required order. Mount the bottle holder (6.2061.100) onto the topmost instrument on the stack *(see "Mounting the bottle holder", page 14)*.

3.3.2.2 Removing/mounting the bottle holder

Remove the bottle holder if you want to install another instrument onto the IC instrument.

Removing the bottle holder

Prerequisites

- The instrument is switched off.
- The bottle holder is cleared.
- Drainage tubing is disconnected from the drainage tubing connection of the bottle holder.
- The capillaries are removed from the guide ducts between the instrument and the bottle holder.

Accessories

- 3 mm hex key (6.2621.100)

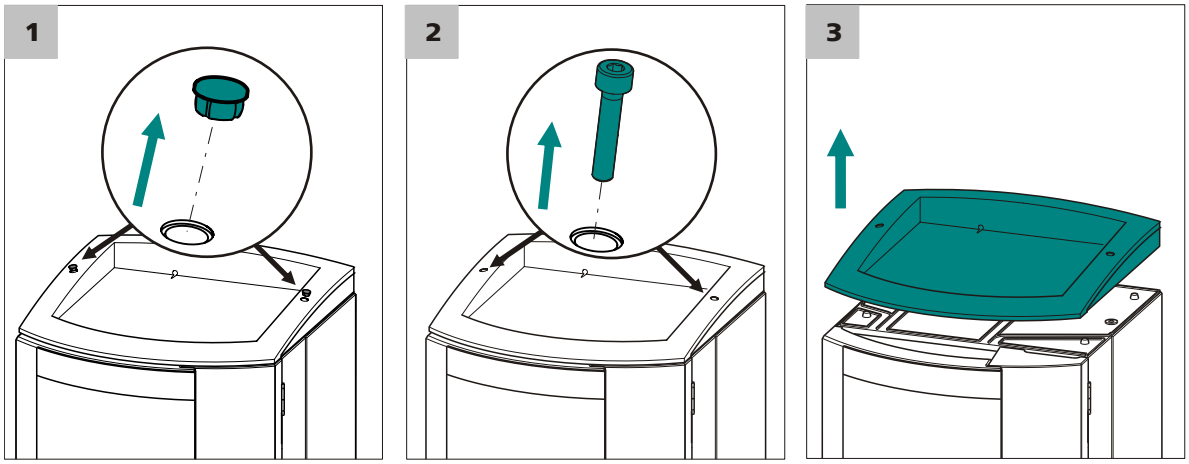


Figure 6 Removing the bottle holder

1 Remove the 2 covering stoppers.

2 Loosen the 2 cylinder screws with the 3 mm hex key and remove them.

3 Remove the bottle holder.

Stack other instruments in the required order. Mount the bottle holder (6.2061.100) onto the topmost instrument on the stack.

Mounting the bottle holder

Prerequisite

- The instrument is switched off.

Accessories

- 3 mm hex key (6.2621.100)

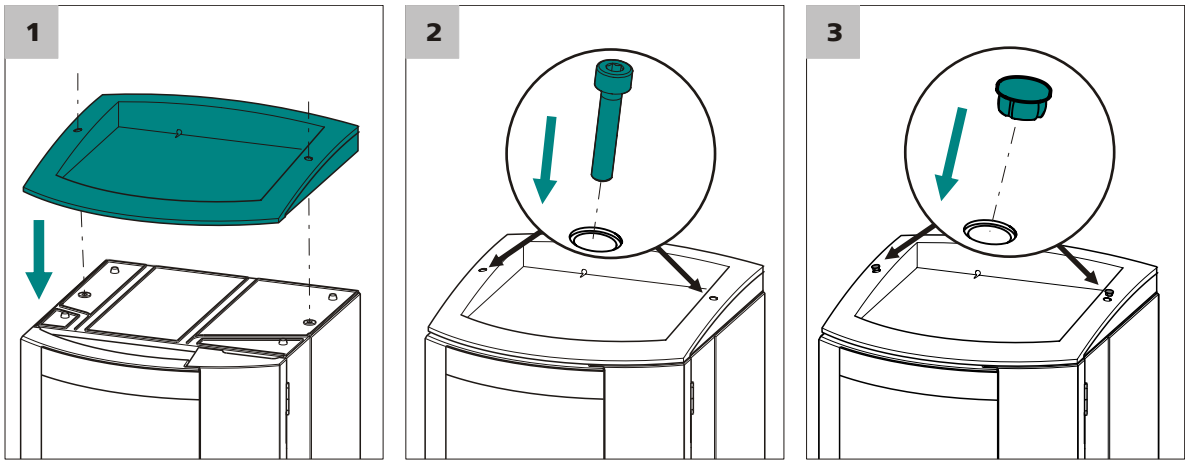


Figure 7 Mounting the bottle holder

1 Mount the bottle holder onto the topmost instrument in such a way that the openings in the bottle holder exactly match the screw threads on the top surface of the instrument.

2 Insert the 2 cylinder screws and tighten them with the 3 mm hex key.

3 Insert both covering stoppers.

After attaching the bottle holder, restore all connections that were loosened at the beginning of the process.

Restoring the loosened connections

1 Plug in all necessary USB cables.

2 Plug in all necessary MSB cables.

3 Plug in the power cord.

4 Mount the drainage tubing again *(see manual of the IC instrument)*.

A longer section of silicone tubing (6.1816.020) may have to be cut to size and mounted *(see also the manual for the IC instrument)*.

5 If one of the instruments in the stack is equipped with a leak sensor connection socket, connect the leak sensor *(see manual of the IC instrument)*.

6 Restore any capillary connections that may have been removed.

3.4 Connecting the eluent bottle

Accessories

For this step, you need the following accessories:

- Eluent bottle (6.1608.070)
- The *eluent bottle cap GL 45* accessory set (6.1602.160)
  This accessory set contains the bottle cap, an M6 tubing nipple, an M8 tubing nipple, two O-rings and an M6 and M8 threaded stopper.
- The *tubing adapter for aspiration filter* accessory set (6.2744.210)
  This accessory set contains a filter holder, a clamping screw and tubing weighting.
- An aspiration filter (6.2821.090)
- The adsorber tube (6.1609.000)
- The SGJ clip (6.2023.020)

Connecting the eluent aspiration tubing

1 Installing the eluent bottle cap (6.1602.160)

- Start by pushing the M8 tubing nipple onto the loose end of the eluent aspiration tubing, followed by the O-ring.
- Push the loose end of the eluent aspiration tubing through the M8 opening of the bottle cap and screw it on for the time being.

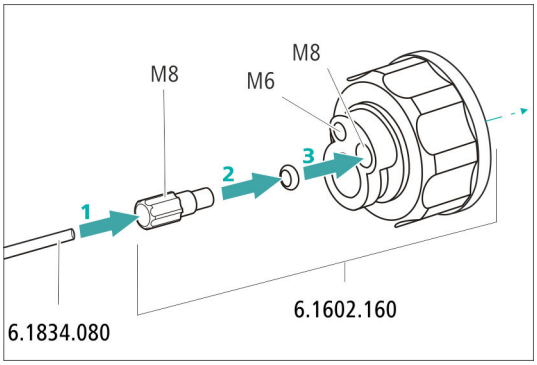


Figure 8 Installing the eluent bottle cap

2 Mounting the tubing adapter

Install the parts of the *tubing adapter for aspiration filter* (6.2744.210) accessory set:

- Start by pushing the tubing weighting onto the loose end of the eluent aspiration tubing.
- Then push the clamping screw onto the loose end of the eluent aspiration tubing.

- Lastly, push the filter holder onto the loose end of the eluent aspiration tubing and screw it onto the tubing nipple.
  The end of the tubing should extend approximately 1 cm.

3 Pre-rinsing the aspiration filter

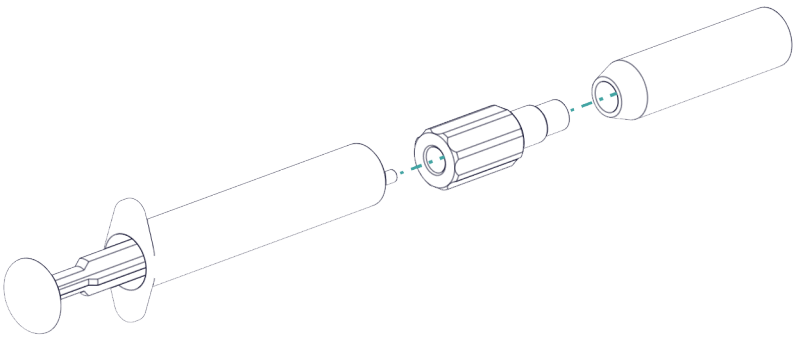
NOTE

Always wear gloves when handling the aspiration filter.

In order to avoid air bubbles after the installation of the aspiration filter, we recommend pre-rinsing the aspiration filter with ultrapure water or eluent.

For pre-rinsing, you will need the adapter Luer inner, M6 outer (6.02744.050), a syringe and a vessel with ultrapure water or eluent.

- Screw the adapter to the aspiration filter.
- Insert the syringe into the adapter.



- Immerse the aspiration filter tin a vessel with ultrapure water or eluent.
- Fill the syringe completely with ultrapure water or eluent 3 times and then empty it again each time.

4 Mounting the aspiration filter

NOTE

Always wear gloves when handling the aspiration filter.

- Place the loose end of the eluent aspiration tubing into the aspiration filter.
  The end of the tubing should reach approximately to the center of the aspiration filter.

- Tighten the aspiration filter to the filter holder.

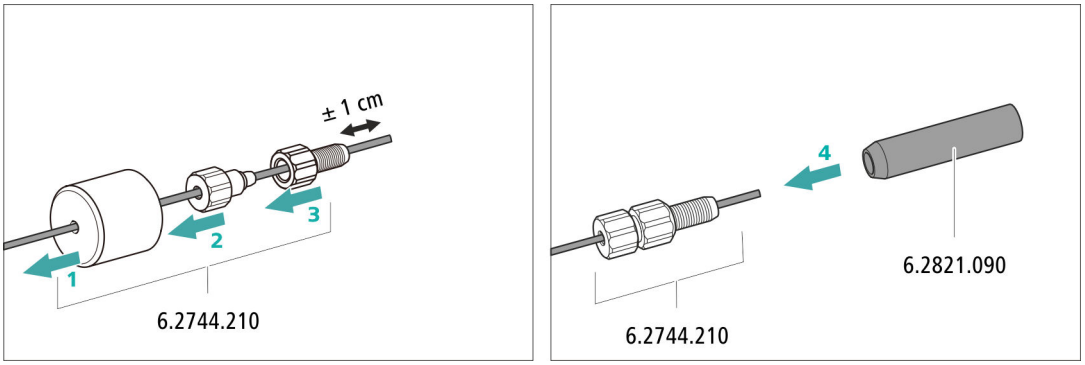
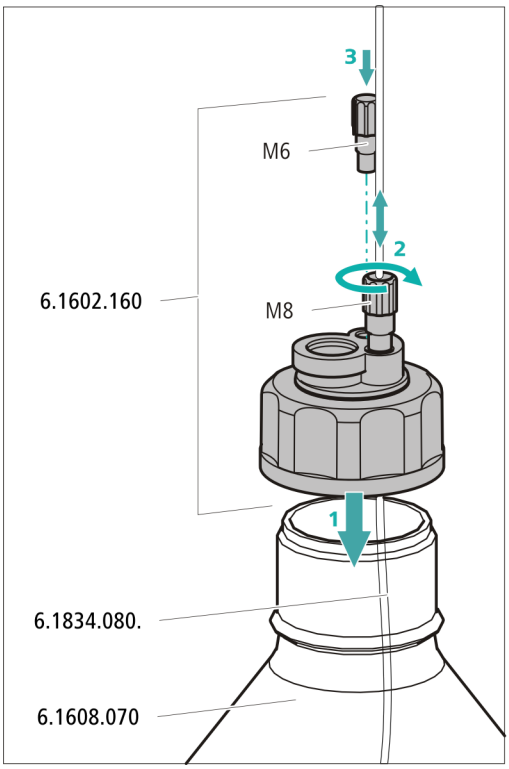


Figure 9 Installing the tubing weighting and aspiration filter

5 Installing the eluent bottle cap on the eluent bottle

- Insert the eluent aspiration tubing into the eluent bottle (6.1608.070).
- Tighten the bottle cap on the eluent bottle.
- Adjust the length of the eluent aspiration tubing so that the aspiration filter is at the bottom of the eluent bottle. Then fix it in place using the M8 tubing nipple.
- Seal the M6 opening on the bottle cap with the M6 threaded stopper from the accessory set.



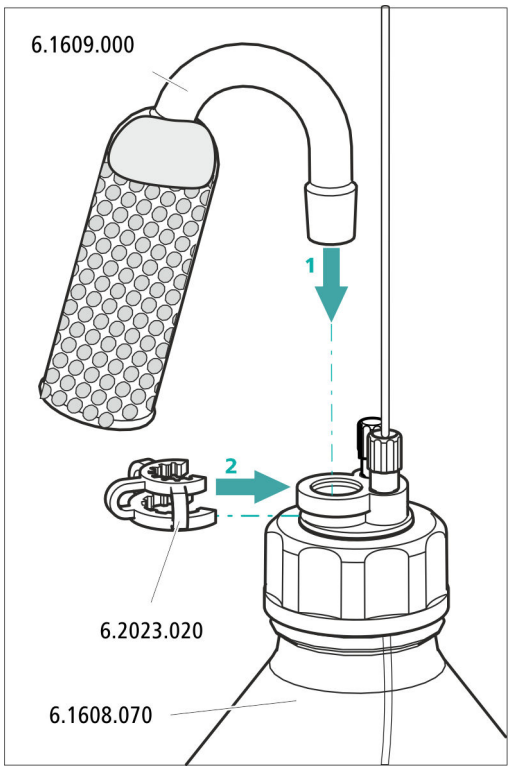
6 Mounting the adsorber tube

NOTE

Depending on the eluent used, the adsorber tube (6.1609.000) must be filled differently:

- For alkaline eluents or eluents with a low buffer capacity: first a little cotton, then with CO_2 adsorber material.
- For all other eluents: only with cotton.

- Remove the plastic cover from the large opening of the adsorber tube. Fill the adsorber tube and close it again using the plastic cover.
- Insert the adsorber tube into the bottle cap's large opening. Fasten it to the bottle cap using the ground-joint clip (6.2023.020).



3.5 Connecting the eluent degasser

The high-pressure pump cannot generate uniform flow if the eluent contains small gas bubbles or dissolved gas. As a result, the baseline cannot be stabilized correctly. In order to achieve good measurement results, the eluent has to be degassed before it goes into the high-pressure pump.

The eluent degasser is completely connected. No installation work is required.

3.5.1 Connecting the vacuum pump(s)

Optional: Connecting a second Extension Module to the pump

Accessories

For this step, you need the following accessories:

- IC tubing set for second Extension Module (6.5332.000), consisting of two pieces of M6 FEP tubing (6.1805.050) and one M6 T connector (6.1808.060)
  This tubing set is available as part of the optional accessories.
- FEP tubing (6.1805.060)

Optional: Connecting a second Extension Module to the vacuum pump

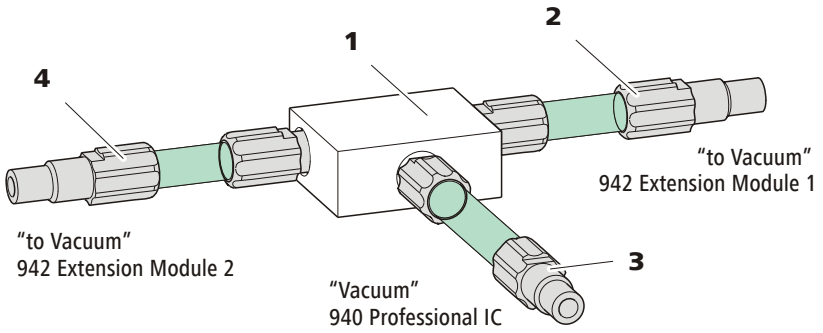


Figure 10 Connecting the vacuum pump

1 T connector (6.1808.060) For connecting several pieces of FEP tubing.	**2 FEP tubing (6.1805.050)** Connect to the *to Vacuum* connector on the first 942 Extension Module Vario.
3 FEP tubing (6.1805.060) Connect to the *Vacuum* connector on the 940 Professional IC Vario.	**4 FEP tubing (6.1805.050)** Connect to the *to Vacuum* connector on the second 942 Extension Module Vario.

1 Connect one end of the FEP tubing (6.1805.050) *(10-**2**)* to the **to Vacuum** connector of the 942 Extension Module Vario.

Connect the other end of the FEP tubing to the T connector (6.1808.060) *(10-**1**)*.

2 Connect one end of the second piece of FEP tubing (6.1805.050) *(10-**4**)* to the **to Vacuum** connector of the second 942 Extension Module Vario.

Also connect the other end of the FEP tubing to the T connector (6.1808.060) *(10-**1**)*.

3 Connect one end of the FEP tubing (6.1805.060) *(10-**3**)* to the third output of the T connector (6.1808.060).

Connect the other end of the FEP tubing to the IC instrument's **Vacuum** connector.

3.6 Installing the high-pressure pump

The intelligent and low-pulsation high-pressure pump pumps the eluent through the system. It is equipped with a chip where its technical specifications and "life history" (operating hours, service data, etc.) are stored.

The high-pressure pump consists of:

- The pump head, which pumps the eluent through the system.
- The purge valve used for bleeding the pump head.

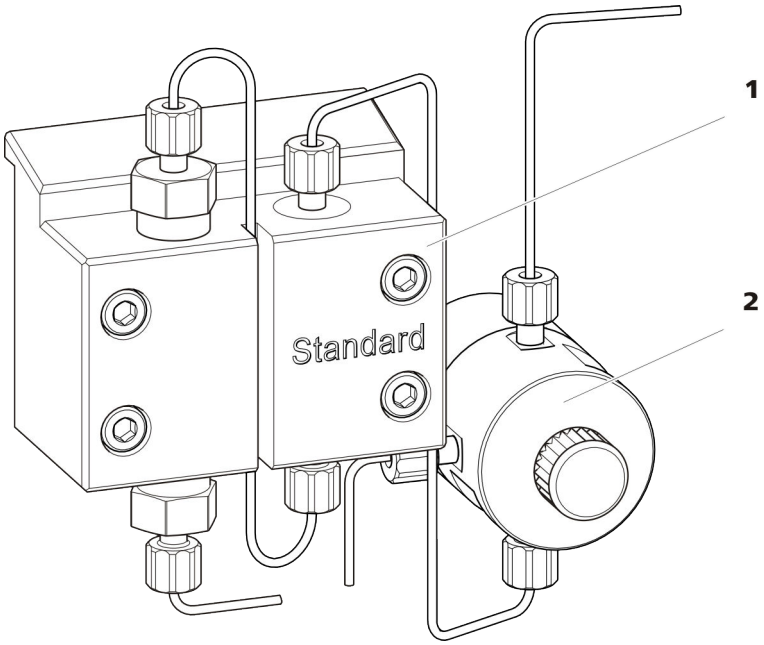


Figure 11 High-pressure pump with purge valve

1 Pump head	**2 Purge valve**

The high-pressure pump is completely connected. No installation work is required.

3.7 Installing an inline filter

Inline filters protect the separation column reliably from potential contamination from the eluent. The small filter pads with 2 µm pore size can be replaced quickly and easily. They remove particles from the solutions.

The inline filter is completely connected. No installation work is required.

3.8 Installing the pulsation absorber

The pulsation absorber is installed between the high-pressure pump and the injection valve. It protects the separation column from damage caused by pressure fluctuations, e.g. when the injection valve is switched, and reduces interfering pulsations during highly sensitive measurements.

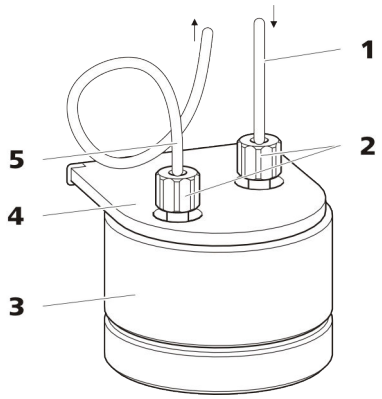
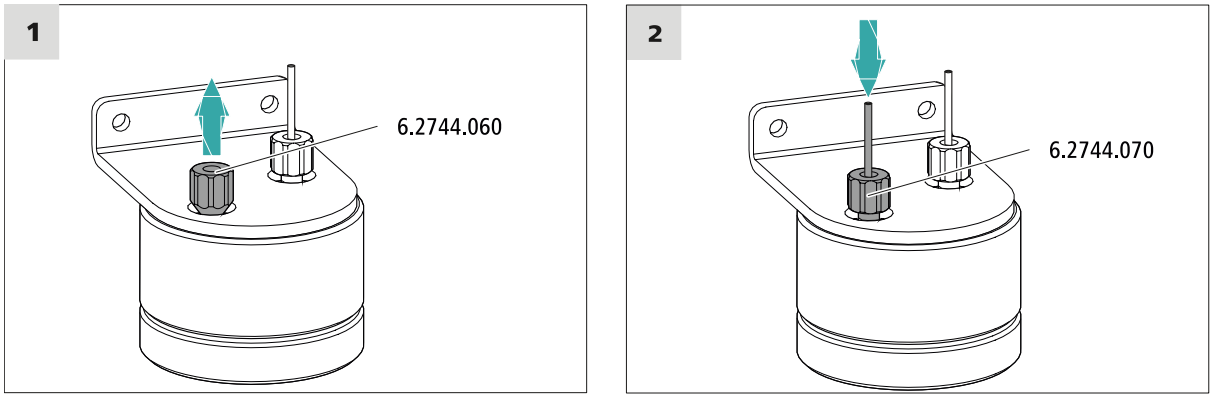


Figure 12 Pulsation absorber

1 **Connection capillary** Connection to inline filter.	**2** **PEEK pressure screws, short (6.2744.070)**
3 **Pulsation absorber (6.2620.150)**	**4** **Holder for pulsation absorber**
5 **Connection capillary** Connection to injection valve.	

Connecting the pulsation absorber



1 Unscrew the threaded stopper from the outlet of the pulsation absorber.

2 Screw one end of the capillary (6.1831.010) to the outlet of the pulsation absorber using a short pressure screw (6.2744.070).

Screw the other end of the capillary to the injection valve of the IC instrument using a pressure screw (6.2744.010).

3.9 Injection valve

The injection valve connects the eluent path to the sample path. By a quick and precise switching of the valve a defined quantity of sample solution is injected and flushed to the separation column with the eluent.

The quantity of sample solution injected is determined by:

- the volume of the sample loop or

The choice of sample loop depends on the application. The following sample loops are normally used:

Table 1 Which sample loop do I need?

Application	Sample loop
Cation determination	20 µL
Anion determination with suppression	20 µL
Anion determination without suppression	100 µL
MiPT, MiPuT	250 µL
MiPCT, MiPCT-ME	Preconcentration column

The injection valve is completely connected. No installation work is required.

Optional: Exchanging the sample loop

NOTE

Only use PEEK pressure screws (6.2744.010) to connect capillaries and the sample loop to the injection valve.

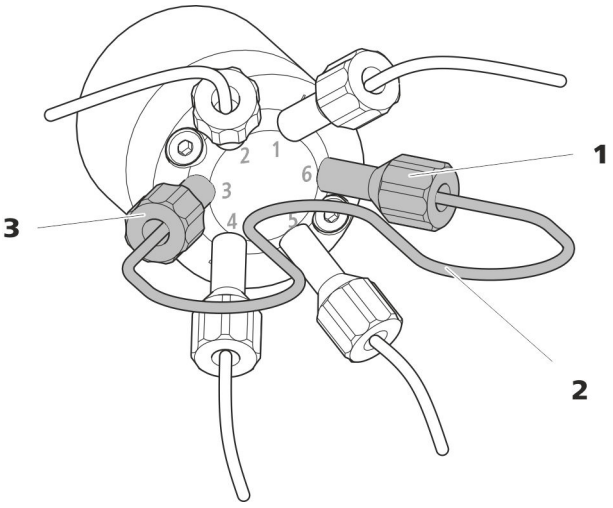


Figure 13 Exchanging the sample loop

1 **Pressure screw** Fastened to Port 6.	**2** **Sample loop**
3 **Pressure screw** Fastened to Port 3.	

Exchanging the sample loop

NOTE

Observe a dead-volume-free installation of the sample loop .

1 Removing the existing sample loop

- Loosen the pressure screws (6.2744.010) at Port 3 and Port 6.
- Remove the sample loop.

2 **Installing a new sample loop**

- Fasten one end of the sample loop to Port 3 using a PEEK pressure screw (6.2744.010).
- Use the second PEEK pressure screw (6.2744.010) to fasten the other end of the sample loop to Port 6.

3.10 Connecting an Extension Module

CAUTION

The 940 Professional IC Vario **has to be switched off** when connecting the Extension Module!

Accessories

For this step you need the following accessories:

- 6.2156.060 cable Extension Module - Professional IC, 40 cm
  or
- 6.2456.070 cable Extension Module - Professional IC, 1 m (optional accessory)

The connection sockets are located on the rear of the instrument.

Connecting the Extension Module to the IC instrument

1 Plug the connecting cable (6.2156.060) into the **In** connection socket on the Extension Module and tighten it in place.

2 Plug the other end of the connecting cable into the **Extension Module** connection socket on the IC instrument and tighten it in place.

Only one Extension Module can be connected directly to the IC instrument. The second Extension Module has to be connected to the first and the third to the second.

Connecting an Extension Module to another Extension Module

1 Plug the connecting cable (6.2156.060) or the longer connecting cable (6.2156.070) into the **In** connection socket on the second Extension Module and tighten it in place.

2 Plug the other end of the connecting cable into the **Out** connection socket on the first Extension Module and tighten it in place.

4 Start-up

The 942 Extension Module Vario ONE/Deg is put into operation together with the IC device.

The following preconditions must be met before initial start-up:

- The eluent bottle is filled and connected.
- The 942 Extension Module Vario ONE/Deg is connected to the 940 Professional IC Vario.

The high-pressure pump has to be deaerated during start-up.

You can find additional information on carrying out initial start-up in the *Start-up* chapter in the manual for the IC device and the MagIC Net online help.

5 Operation and maintenance

5.1 Servicing the door

CAUTION

The door is made of PMMA (poly(methyl methacrylate)). It must never be cleaned with abrasive media or solvents.

CAUTION

Never hold the instrument by the door when lifting it. Only hold the instrument by the housing.

5.2 Handling the eluent

Careful handling of the eluent ensures stable analysis results. Keep the following general measures in mind when handling the eluent:

- The supply bottle with the eluent must be connected as indicated in *chapter 3.4, page 16*. This is particularly important for eluents with volatile solvents (e.g. acetone).
- Avoid condensation in the eluent bottle. Drop formation can change the concentration ratio in the eluent.
- In the case of very sensitive measurements, we recommend that the eluent be stirred constantly with a magnetic stirrer (e. g. the 2.801.0010 with 6.2070.000).
- To protect the IC system from foreign particles, we recommend aspirating the eluent via an aspiration filter *(see chapter 3.4, page 16)* (6.2821.090). This aspiration filter must be replaced as soon as it turns yellow but at least every 3 months.

5.2.1 Manufacturing eluent

Chemicals used for manufacturing eluents must have a purity grade of at least "p.a.". They may be diluted only by using ultrapure water (resistance > 18.2 MΩ*cm). (These specifications apply generally for all reagents used in ion chromatography.)

Newly manufactured eluents always need to be microfiltered (0.45 µm filter).

The composition of the eluent plays a critical role in chromatographic analysis:

Concentration	An increase in the concentration generally leads to shorter retention times and faster separation, but also to a higher background conductivity signal.
pH	pH changes lead to shifts in dissociation equilibria and thus to changes in retention times.
Organic solvents	Adding organic solvents (e.g. methanol, acetone or acetonitrile) to a watery eluent generally speeds up lipophilic ions.

5.2.2 Changing the eluent

Ensure that no precipitates can form when changing the eluent. Immediately successive solutions must be miscible. If the system must be rinsed with organic solvents, several solvents with rising or falling lipophilicity must be used.

NOTE

To change the eluent, remove the guard column and the separation column. Connect the capillaries using a coupling (6.2744.040) and two pressure screws (6.2744.070).

5.3 Eluent degasser maintenance

The pieces of connection tubing are connected to the eluent degasser with clamping screws.

Proceed as follows if you have to loosen and reconnect the connection tubing at the eluent degasser:

Accessories

For this step, you need the following accessories:

- Wrench (6.2621.050)

Loosening the connecting tubing

1
- Loosen the clamping screws with the wrench.
- Unscrew the clamping screws by hand and pull them out of the connector.

Connecting the connecting tubing

1
- Insert the clamping screws on the connector and screw them in by hand.
- Tighten the clamping screws with the wrench.

5.4 Notes on operating the high-pressure pump

CAUTION

The pump head is filled ex works with methanol/ultrapure water. Ensure that the eluent used is miscible with this solvent.

Keep the following recommendations in mind in order to protect the high-pressure pump from damage as much as possible during operation:

- To protect the high-pressure pump from **foreign particles**, we recommend filtering the eluent through a filter with a pore size of 0.45 µm and aspirating it via an aspiration filter (6.2821.090).
- Ensure that no precipitates can form when changing the eluent. Salt crystals between the piston and seal cause abrasive particles that can find their way into the eluent. These particles lead to contaminated valves, an increase in pressure and, in extreme cases, scratched pistons and thus to leakages in the high-pressure pump.
  Immediately successive solutions must always be miscible. If the system must be rinsed with organic solvents, use several solvents with rising or falling lipophilicity.
- In order to protect the pump seals, ensure that the pump is never operated dry. Therefore ensure that the eluent supply is correctly connected and that there is enough eluent in the eluent bottle each time before turning on the pump.

5.5 Servicing the high-pressure pump

NOTE

You can find a video sequence for this task in the *Multimedia Guide IC Maintenance* or on the Internet at *http://ic-help.metrohm.com/*.

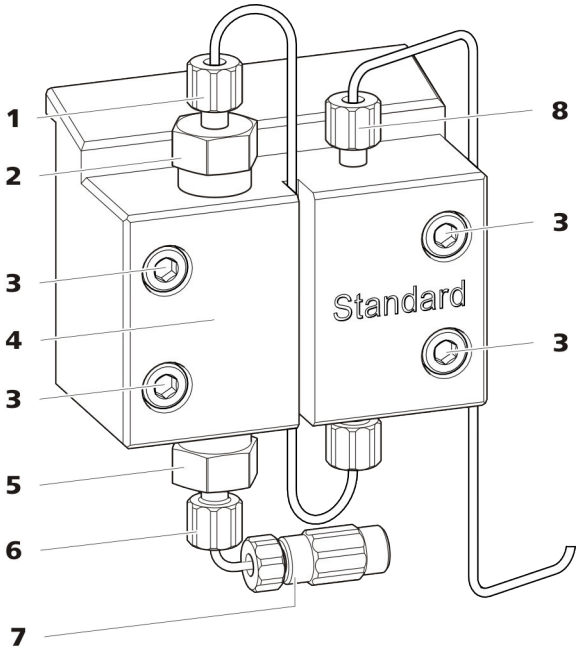


Figure 14 High-pressure pump – Parts

1	**Pressure screw, short (6.2744.070)** Fastened to the outlet valve holder.	**2**	**Outlet valve holder**
3	**Fastening screw**	**4**	**Pump head**
5	**Inlet valve holder**	**6**	**Pressure screw, short (6.2744.070)** Fastened to the inlet valve holder.
7	**Eluent aspiration tubing connector** Consists of a coupling with a pressure screw.	**8**	**Pressure screw, short (6.2744.070)** Fastened to the pump output.

Maintenance interval

The following parts of the high-pressure pump must be serviced at least once per year:

- Inlet valve (6.2824.170)
- Outlet valve (6.2824.160)
- Piston seal (6.2741.020)
- Zirconium oxide piston (6.2824.070)

Maintenance tasks can also be carried out if the following problems occur:

- Unstable baseline (pulsations, flow fluctuations)

CAUTION

Maintenance work on the high-pressure pump may not be carried out unless the **instrument is switched off**.

Recommended procedure

We recommend the following procedure for the maintenance of the pump head:

1. Service the inlet valve and the outlet valve.
2. Remove the pump head.
3. Service both pistons, one after the other.
    a. Remove piston.
    b. Dismantle the piston.
    c. Replace the piston seal.
    d. Replace the zirconium oxide piston.
    e. Assemble the piston.
    f. Insert the piston.
4. Reinstall the pump head.

You can find brief video sequences on the following maintenance steps on the Internet at *http://ic-help.metrohm.com/*.

Servicing the outlet valve and inlet valve

Accessories

For this step, you need the following accessories:

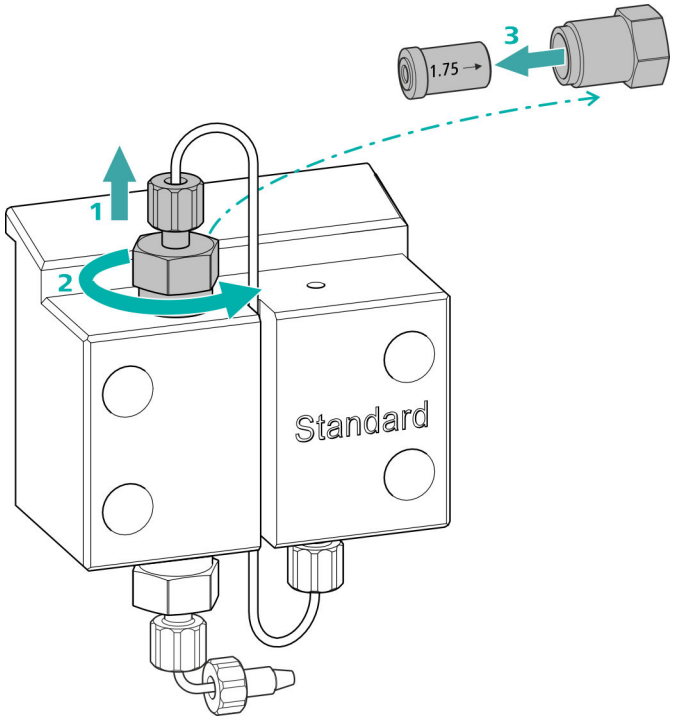
- Adjustable wrench (6.2621.000)

Cleaning the outlet valve

Spare parts

If the outlet valve cannot be cleaned, you will need a new outlet valve (6.2824.160) for this step.

1 Removing the outlet valve



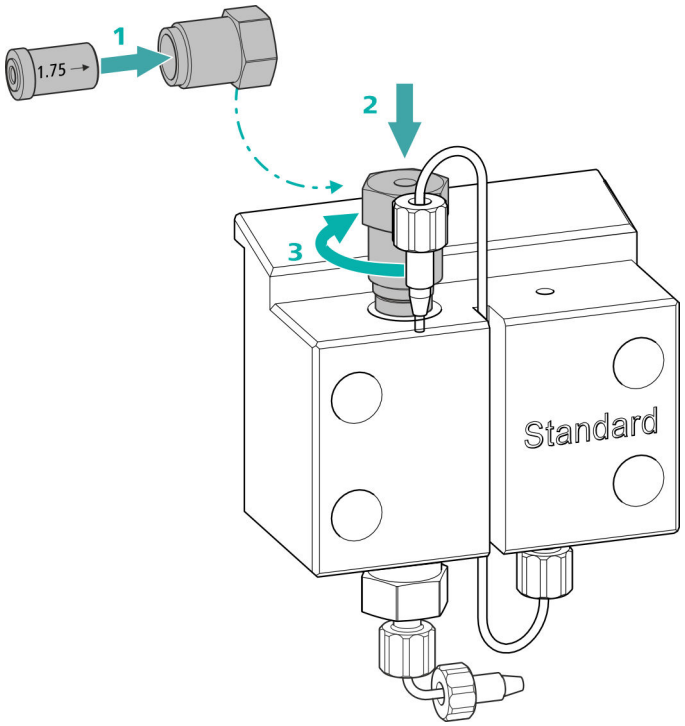
- Unscrew the connection capillary to the auxiliary piston from the outlet valve holder *(14-**2**)* (**1**).
- Start by loosening the outlet valve holder with the adjustable wrench and then unscrew it by hand (**2**) and remove it.
- Remove the outlet valve from the outlet valve holder (**3**).

2 Cleaning the outlet valve

- Start by rinsing the outlet valve in the direction of eluent flow using a wash bottle filled with ultrapure water, RBS™ solution or acetone. (The direction of eluent flow is marked on the valve by an arrow.)
  The rinsing solution must come out at the valve exit.
  If no more solution comes out, then the valve is blocked.
- Rinse the outlet valve in the direction opposite the eluent flow using a wash bottle filled with ultrapure water, RBS™ solution or acetone.
  The rinsing solution may only come out at the valve exit.

The outlet valve must be replaced if it is still clogged after cleaning.

3 Reinserting the outlet valve into the pump head



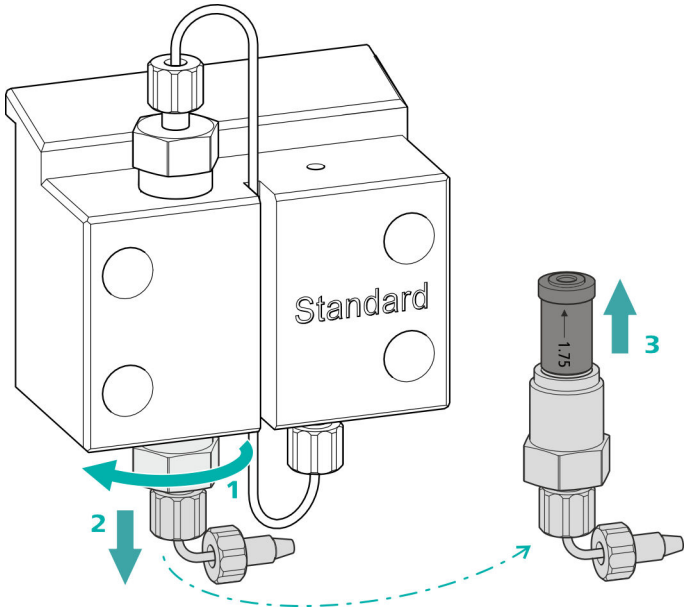
- Insert the outlet valve into the outlet valve holder (the seal must be visible) (**1**).
- Screw the outlet valve holder up into the pump head (**2**) and tighten it firmly by hand and then retighten it one additional ¾ turn using the adjustable wrench (**3**).
- Tighten the connection capillary to the auxiliary piston back onto the outlet valve holder.

Cleaning the inlet valve

Spare parts

If the inlet valve cannot be cleaned, you will need a new inlet valve (6.2824.170) for this step.

1 Removing the inlet valve



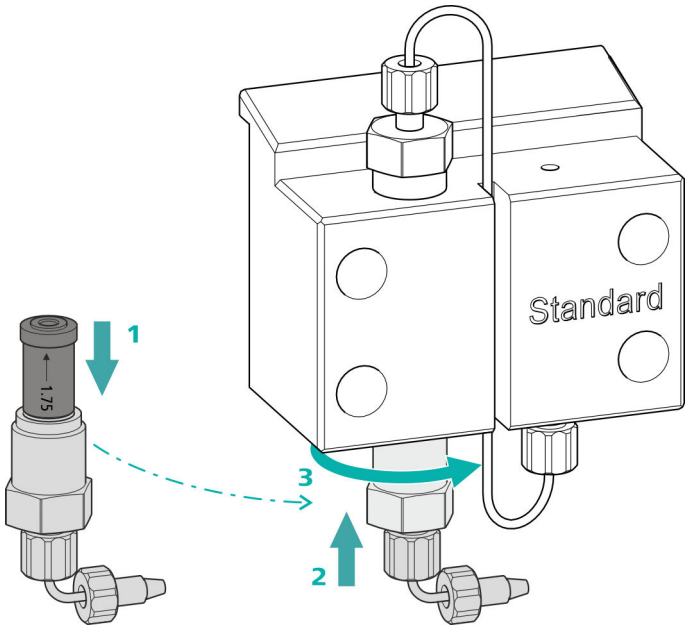
- Unscrew the connection capillary to the connection of the eluent aspiration tubing *(14-**7**)*.
- Start by loosening the inlet valve holder with the adjustable wrench (**1**) and then unscrew it by hand (**2**) and remove it.
- Remove the inlet valve from the inlet valve holder (**3**).

2 Cleaning the inlet valve

- Start by rinsing the inlet valve in the direction of eluent flow using a wash bottle filled with ultrapure water, RBS™ solution or acetone. (The direction of eluent flow is marked on the valve by an arrow.)
  The rinsing solution must come out at the valve exit.
  If no more solution comes out, then the valve is blocked.
- Rinse the inlet valve in the direction opposite the eluent flow using a wash bottle filled with ultrapure water, RBS™ solution or acetone.
  The rinsing solution may only come out at the valve exit.

The inlet valve must be replaced if it is still clogged after cleaning.

3 Reinserting the inlet valve into the pump head



- Insert the inlet valve into the inlet valve holder (the seal must be visible) (**1**).
- Screw the inlet valve holder up into the pump head (**2**) and tighten it firmly by hand and then retighten it one additional ¾ turn using the adjustable wrench (**3**).
- Refasten the connection capillary to the connection of the eluent aspiration tubing *(14-**7**)*.

Removing the pump head

Accessories

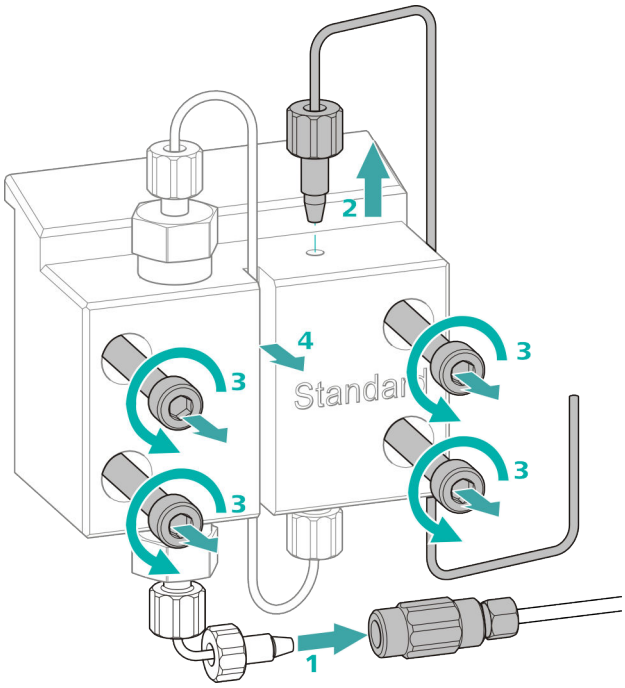
For this step, you need the following accessories:

- 4 mm hex key (6.2621.030)

Removing the pump head

Prerequisites:

- Is the high-pressure pump switched off?
- Has the pressure been released?
- Is the instrument switched off?



1 Release the coupling from the pressure screw and seal it with a stopper.

2 Unscrew and remove the pressure screw on the pump head's outlet *(14-**8**)*.

3 Loosen and remove the four fastening screws *(14-**3**)* using the hex key.

4 Remove the pump head *(14-**4**)*.

Servicing the piston

Carry out the following work on both pistons in turn.

Servicing a piston consists of the following tasks:

1. Replace the piston seal.
2. Clean or replace the zirconium oxide piston.
3. Reinstall the piston.

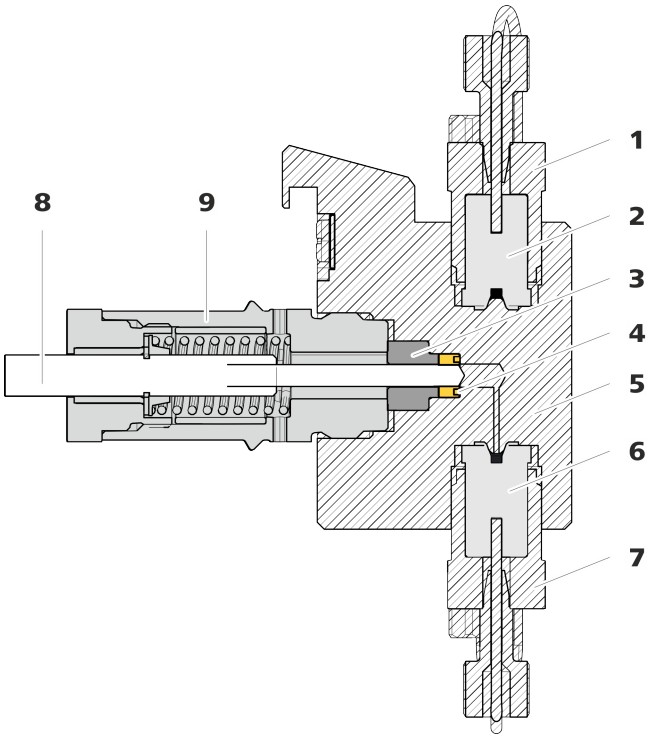


Figure 15 High-pressure pump – Cross-section

1	**Outlet valve holder**	**2**	**Outlet valve (6.2824.160)**
3	**Backup ring**	**4**	**Piston seal (6.2741.020)**
5	**Pump head**	**6**	**Inlet valve (6.2824.170)**
7	**Inlet valve holder**	**8**	**Zirconium oxide piston (6.2824.070)**
9	**Piston cartridge**		

Accessories

For this step, you need the following accessories:

- Adjustable wrench (6.2621.000)
- Tool for piston seals (6.2617.010) consisting of a tip *(16-**1**)* for removing the old piston seal and a sleeve *(16-**2**)* for inserting the new piston seal.

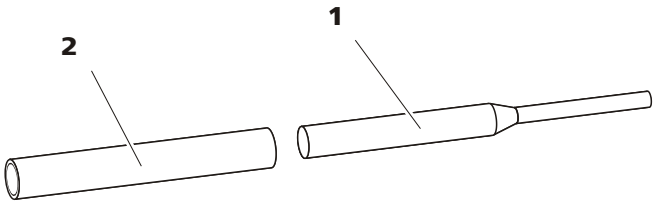


Figure 16 Tool for piston seal (6.2617.010)

1	**Tip**	**2**	**Sleeve**

Spare part

For this step, you need a new piston seal (6.2741.020).

Replacing the piston seal

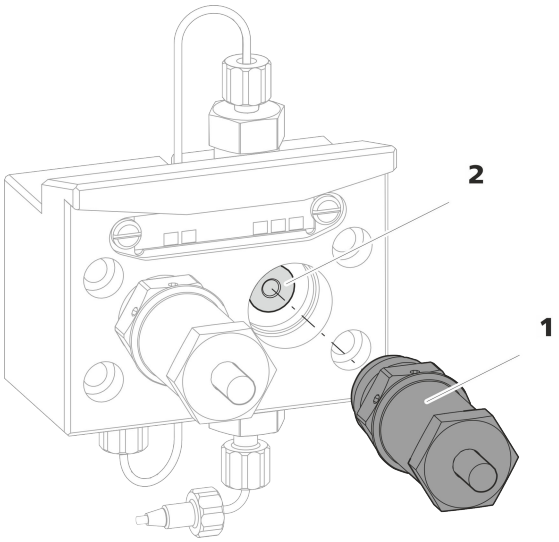


Figure 17 Removing the piston cartridge from the pump head

1 Piston cartridge	**2 Backup ring**

1 Removing the piston cartridge

Loosen the piston cartridge *(17-**1**)* using the adjustable wrench and then unscrew it from the pump head by hand. Set it aside.

2 Removing the backup ring

Shake the backup ring *(17-**2**)* out of the piston opening. Set it aside.

3 Removing the old piston seal

CAUTION

Screwing the (6.2617.010) special tool for the piston seal into the piston seal destroys this completely!

CAUTION

Avoid touching the sealing surface in the pump head with the tool!

Only screw the tip *(16-**1**)* of the tool for the piston seal far enough into the piston seal that the seal can be pulled out.

4 Inserting the new piston seal into the tool

Insert the new piston seal into the recess of the sleeve *(18-**1**)* of the tool for piston seal. The sealing spring must be visible from the outside.

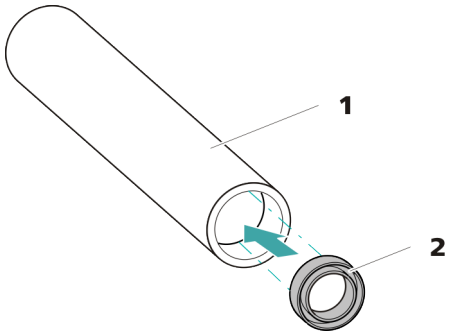


Figure 18 Inserting the piston seal into the tool

1 Tool for piston seal (6.2617.010)
Sleeve for inserting the new piston seal.

2 Piston seal (6.2741.020)

5 Inserting the new piston seal into the pump head

Guide the sleeve *(16-**2**)* of the tool for the piston seal with inserted piston seal into the pump head. Press the seal into the pump head recess using the wide end of the tip *(16-**1**)* of the tool.

Cleaning or replacing the zirconium oxide piston

Prerequisites:

- The pump head has been removed *(see "Removing the pump head", page 37)*.
- The piston cartridge is removed *(see "Replacing the piston seal", page 40)*.

For this task, you need the following accessories:

- Zirconium oxide piston (6.2824.070)

- Adjustable wrench (6.2621.000) from the accessory kit: *Vario/Flex Basic* (6.5000.000).

1 Breaking down the piston cartridge

CAUTION

Inside the piston cartridge there is a taut spring that can launch out of the piston cartridge if the tension is released suddenly.

When opening the piston cartridge, counteract the pressure from the spring and carefully unscrew the cartridge.

- Loosen the piston cartridge's screw with an adjustable wrench and carefully unscrew the screw by hand while counteracting the pressure from the taut spring.
- Remove the zirconium oxide piston and place it on a paper towel.
- Remove the spring retainer, the spring and the inner plastic sleeve from the piston cartridge and lay them next to the piston.
- Place the backup ring you put aside with the remaining parts.

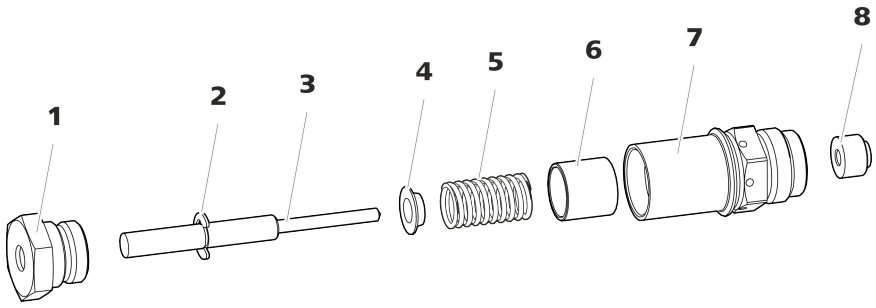


Figure 19 Parts of the piston cartridge

1	**Piston cartridge screw**	**2**	**Retaining washer**
3	**Zirconium oxide piston (6.2824.070)**	**4**	**Spring retainer**
5	**Spring (6.2824.060)**	**6**	**Inner plastic sleeve** Protects from metallic abrasion.
7	**Piston cartridge**	**8**	**Backup ring**

2 Cleaning the parts of the piston cartridge

- If the zirconium oxide piston has become contaminated due to abrasion or deposits, then clean it using a fine abrasive cleaning powder, rinse it using ultrapure water until it is free of particles and dry it.
  The zirconium oxide piston must be replaced if it is heavily contaminated or scratched.

- Rinse the other parts of the piston with ultrapure water and dry with a lint-free cloth.

3 Replacing the zirconium oxide piston

- Remove the retaining washer *(19-**2**)* from the old piston. If the retaining washer sits too tightly, use a pointed object to loosen the retaining washer.
- Assemble the retaining washer at the same point on the new piston.

4 Putting the piston cartridge together

- Insert the inner plastic sleeve, the spring and the spring retainer into the piston cartridge.
- Slide the zirconium oxide piston carefully into the piston cartridge until its tip emerges from the small opening of the piston cartridge.
- Attach the screw and tighten it by hand.

Mounting the piston

1 Reinserting the backup ring

Clean the backup ring *(15-**3**)* wit ultrapure water and reinsert it.

2 Reinserting the piston cartridge

Screw the assembled piston cartridge back into the pump head and tighten, first by hand, then also using an adjustable wrench by approx. 15°.

Clean the second piston cartridge in the same way.

Mounting the pump head

Accessories

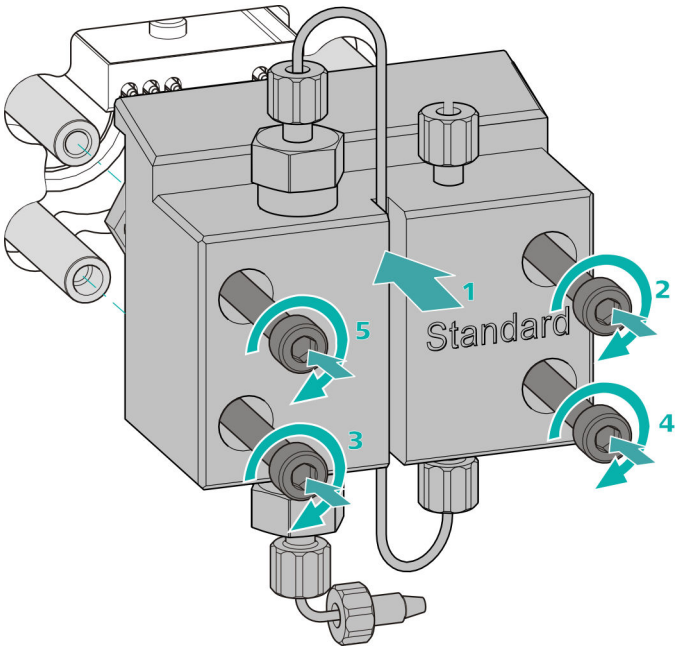
For this step, you need the following accessories:

- 4 mm hex key (6.2621.030)

Mounting the pump head

NOTE

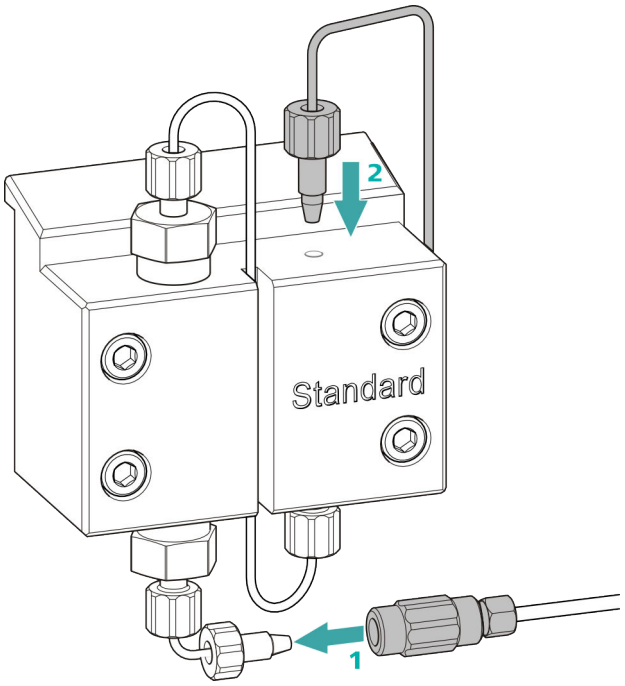
The pump head cannot be mounted the wrong way, as it has fastening bolts with different bore hole depths, i.e., one fastening bolt is longer than all others. The bore hole with the greatest depth must therefore be aligned with the longest bolt.



1

- Push the pump head onto the four fastening bolts (**1**).
- Tighten the four fastening screws using the hex key (6.2621.030) alternating crosswise.

Connecting the entry and exit for the high-pressure pump



1
- Remove the stopper from the coupling. Tighten the coupling to the pressure screw located on the pump head inlet capillary (**1**).
- Reconnect the pump head outlet capillary to the pump head outlet (**2**).

5.6 Servicing the inline filter

NOTE

You can find a video sequence for this task in the *Multimedia Guide IC Maintenance* or on the Internet at *http://ic-help.metrohm.com/*.

Maintenance interval

The filter must be replaced at least every 3 months; it may need to be replaced more frequently, depending on the application.

Accessories

For this task, you need the following accessories:

- Two adjustable wrenches (6.2621.000) from the accessory kit: Vario/Flex Basic (6.5000.000)
- Tweezers
- A new filter from the packaging (6.2821.130)

Removing the filter

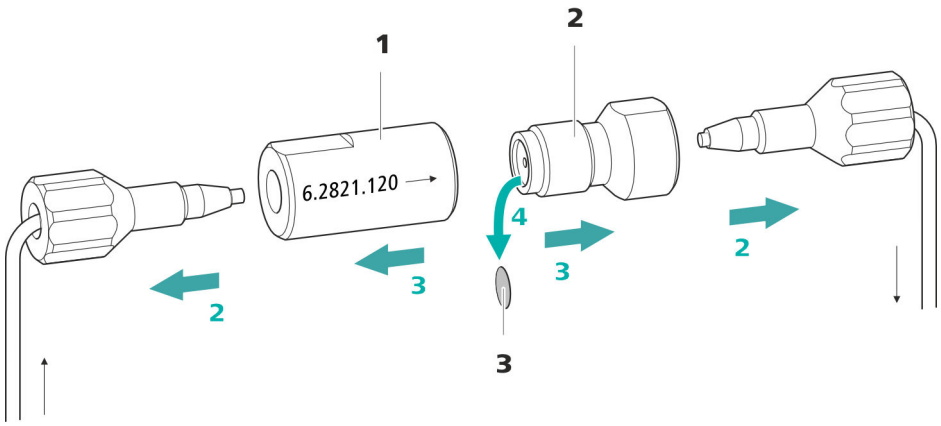


Figure 20 Inline filter – Removing the filter

1	**Filter housing** Inline filter housing. Part of the accessories (6.2821.120).
2	**Filter screw** Screw for the inline filter. Part of the accessories (6.2821.120).
3	**Filter (6.2821.130)** Pack contains 10 pieces.

1 Shutting off the flow

Switch off the high-pressure pump in the software.

2 Removing the inline filter

Unscrew both pressure screws from the inline filter.

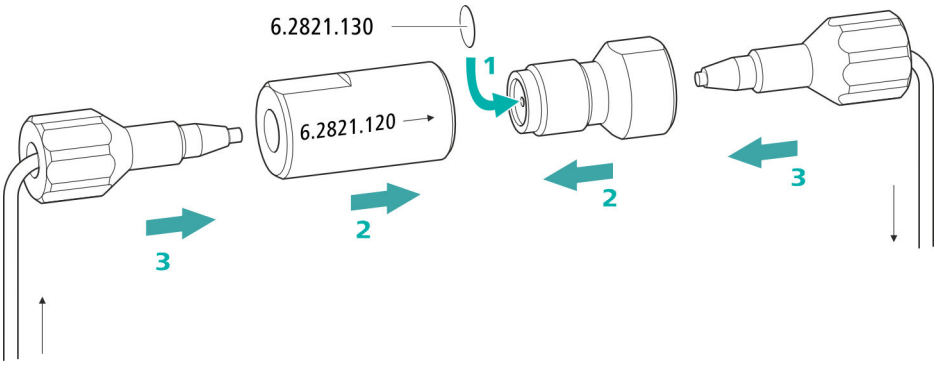
3 Unscrewing the filter screw

Use two adjustable wrenches (6.2621.000) to loosen the filter screw *(20-**2**)* from the filter housing *(20-**1**)* and unscrew it by hand.

4 Removing the filter

Remove the old filter *(20-**3**)* using tweezers.

Inserting a new filter



1 Inserting a new filter

- Use tweezers to carefully place a new filter into the filter screw *(20-**2**)* so that it is flat and press it firmly into place with the rear of the tweezers.

2 Installing the filter screw

- Screw the filter screw *(20-**2**)* back into the filter housing *(20-**1**)* and tighten by hand. Then use two adjustable wrenches (6.2621.000) to tighten it slightly.

3 Remounting the inline filter

- Screw pressure screws back onto the inline filter.
  Take care to ensure that the flow direction matches that inscribed on the inline filter.

4 Rinsing the inline filter

- Dismantle the guard column (if present) and the separation column and replace with a coupling (6.2744.040).
- Rinse the instrument with eluent.
- Reinsert the columns after 10 minutes.

5.7 Servicing the pulsation absorber

CAUTION

The pulsation absorber is maintenance-free and must not be opened.

5.8 Inline sample preparation

In order to protect the separation column from foreign particles that might compromise the separating efficiency, we recommend microfiltrating (filter 0.45 µm) all samples. The ultrafiltration cell may be used for **filtration** (see manual of the *IC Equipment for Ultrafiltration*).

Matrix-loaded samples (e.g. blood, oil) should be prepared for the measurement by means of dialysis (see manual on the *IC Equipment for Dialysis*).

If the concentration of the sample is too high, the sample should be **diluted** before feeding (see manual on the *IC Equipment for Sample Dilution*).

For an overview of all Metrohm inline sample preparation methods go to the following website: *http://misp.metrohm.com*.

5.9 Rinsing the sample path

Before a new sample can be measured, the sample path must be rinsed with it so that the measuring result is not falsified by the previous sample (**sample carry-over**).

In the case of automatic sample injection, the rinsing time should be at least three times the **transfer time**.

The transfer time is the time the sample needs to flow from the sample vessel to the end of the sample loop. It depends on the pump capacity of the peristaltic pump or the Dosino and the total capillary volume.

Determining the transfer time

To ascertain the transfer time, proceed as follows:

1 Emptying the sample path

Pump air through the sample path (pump tubing, tubing connections, sample loop) for several minutes until all liquid is displaced by the air.

2 Aspirating the sample and measuring the time

Aspirate a sample typical for the later application and use a stopwatch to measure the time the sample needs to go from the sample vessel to the end of the sample loop.

The time upon stopping the watch corresponds to the "transfer time". The rinsing time should be at least three times the transfer time.

Checking the rinsing time

You can also determine if the applied rinsing time is sufficient by measuring the sample carry-over directly. Proceed as follows to do this:

1 Preparing two samples

- **Sample A**: A typical sample for the application.
- **Sample B**: Ultrapure water.

2 Determining "Sample A"

Allow "Sample A" to run through the sample path for the duration of the rinsing time; inject and then measure it.

3 Determining "Sample B"

Allow "Sample B" to run through the sample path for the duration of the rinsing time; inject and then measure it.

4 Calculating the sample carry-over

The extent of sample carry-over corresponds to the ratio of the peak areas of the measurement from Sample B to the measurement from Sample A. This ratio can be modified by varying the rinsing time, allowing you to determine the rinsing time required for the application.

5.10 Injection valve

Maintenance on the injection valve is best performed by specialist personnel from Metrohm during annual service.

6 Troubleshooting

6.1 Problems and their solutions

Problem	Cause	Remedy
The baseline has a large amount of noise.	*The eluent is not sufficiently degassed.*	Ensure that the connectors for the eluent degasser are firmly connected *(see chapter 5.3, page 30)*.
	The eluent path has a leak.	Check the eluent path and fix the leak. If necessary, tighten the pressure screws using a wrench (6.2739.000).
	High-pressure pump – Contaminated pump valves.	Clean the pump valves *(see chapter 5.5, page 32)*.
	The eluent path is blocked.	Check the eluent path and eliminate the blockage.
	Contaminations in the eluent	Check the quality of the chemicals and the water.
	High-pressure pump – Defective piston seals.	Replace the piston seals *(see chapter 5.5, page 32)*.
	The pulsation absorber is not connected or is defective.	Connect *(see chapter 3.8, page 23)* or replace the pulsation absorber.
The baseline is drifting.	*The organic solvent in the eluent is evaporating.*	▪ Check the eluent bottle cap *(see chapter 3.4, page 16)*. ▪ Constantly stir the eluent.
The pressure in the system markedly increases.	*The inline filter (6.2821.120) is blocked.*	Replace the filter (6.2821.130) .
	Injection valve – blocked.	Have the valve cleaned (by a Metrohm service engineer).
The retention times in the chromatogram have changed unexpectedly.	*The eluent contains gas bubbles.*	▪ Purge the high-pressure pump .
	High-pressure pump – Defective.	Request Metrohm Service.

Problem	Cause	Remedy
Peak areas are lower than expected.	*Sample - Leak in the sample path.*	Check the sample path.
	Sample - Blockage in the sample path.	Check the sample path.
	Sample - Sample loop not (entirely) filled.	Prolong the sample transfer time.
Individual peaks are greater than expected.	*Sample – Sample carry-over from the previous measurement.*	Rinse the system for a longer period between two samples.
The background conductivity is too high.	*The incorrect eluent is being used.*	Change the eluent *(see chapter 5.2.2, page 30)*.
The retention times are poorly reproducible.	*The eluent path has a leak.*	Check all of the connections along the eluent path and fix the leak.
	The eluent path is blocked.	Check the eluent path and eliminate the blockage.
	The eluent contains gas bubbles.	▪ Deaerate the high-pressure pump .
Precision problems - the measured values are highly scattered.	*Injection valve – Sample loop.*	Check the installation of the sample loop *(see "Optional: Exchanging the sample loop", page 25)*.
	Sample - Rinsing volume too small.	Increase the rinsing time *(see chapter 5.9, page 48)*.
	Injection valve – Defective.	Request Metrohm Service.
Vacuum is not being built	*Eluent degasser – Vacuum connection on the rear of the instrument is not (tightly) sealed.*	▪ Seal the **Vacuum** connector tightly with a threaded stopper (6.1446.040).

7 Technical specifications

7.1 Reference conditions

The technical specifications listed in this chapter refer to the following reference conditions:

Ambient temperature	+25 °C (±3 °C)
Device status	> 40 minutes in operation

7.2 Ambient conditions

Operation

Nominal function range	+5 to +45 °C at max. 80% relative humidity, non-condensing
Storage	+5 to +45 °C at max. 80% relative humidity, non-condensing

7.3 Housing

Dimensions

Width	365 mm
Height	131 mm
Depth	380 mm
Base tray, housing and bottle holder material	Polyurethane hard foam (PUR) with flame retardation for fire class UL 94 V-0, CFC-free, coated
IP degree of protection	IP 20

7.4 Weight

2.942.1060	7.7 kg (without accessories)

7.5 Eluent degasser

Material	Fluoropolymer
Resistance to solvents	No restriction (except PFC)
Time to establish vacuum	< 60 s

7.6 Injection valve

Actuator switching time	typ. 100 ms
Maximum operating pressure	35 MPa (350 bar)
Material	PEEK

7.7 Interfaces

In	1 15-pin D-sub plug (male) Connection to the ion chromatograph or to another Extension Module.
Out	1 15-pin D-sub plug (female) Connection to another Extension Module or to an 891 Professional Analog Out (optional).

8 Displaying accessories

Up-to-date information on the scope of delivery and on optional accessories can be found on the Metrohm website.

1 Searching for a product on the website

- Go to *https://www.metrohm.com*.
- Click on 🔍.
- Enter the article number of the product (e.g. **2.1001.0010**) into the search field and press **[Enter]**.

The search result is displayed.

2 Displaying product information

- To display the products matching the search term, click on **Product models**.
- Click on the desired product.

Detailed information regarding the product is displayed.

3 Displaying accessories and downloading the accessories list

- To display the accessories, scroll down to **Accessories and more**.
  - The **scope of delivery** is displayed.
  - Click on **[Optional parts]** for the optional accessories.
- To download the accessories list, click on **[Download accessories PDF]** under **Accessories and more**.

NOTE

Metrohm recommends keeping the accessories list for reference purposes.

Index