Science Together

KNAUER

AZURA

Detector DAD 6.1L/DAD 2.1L/MWD 2.1L

Instructions

Document No. V6700

HPLC

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

Manuel en français: Si jamais vous préfériez un manuel en français pour ce produit, veuillez vous contacter le support technique (Technical Support) par email ou par fax avec le no. de série. Merci beaucoup.

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The information in this document is subject to change without prior notice.
For latest version of the instructions, check our website:
www.knauer.net/knowledge

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Product information

Intended use

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

The AZURA® detector DAD 6.1L/DAD 2.1L/MWD 2.1L (further on referred to as "detector" in general, or "DAD 6.1L","DAD 2.1L", and "MWD 2.1L") can be used for analytical, semi-preparative and preparative applications.

Operating ranges

The detector can be used in the following areas:

- biochemical analysis
- chemical analysis
- food analysis
- pharmaceutical analysis
- environmental analysis

Views

Front view

On the front of the detector, there are the flow cell and the removable lamp cover for lamp replacement.

Legend

① leak tray
② capillary guide
③ lamp cover
④ serial number
⑤ switch/standby key
⑥ status LED
⑦ flow cell

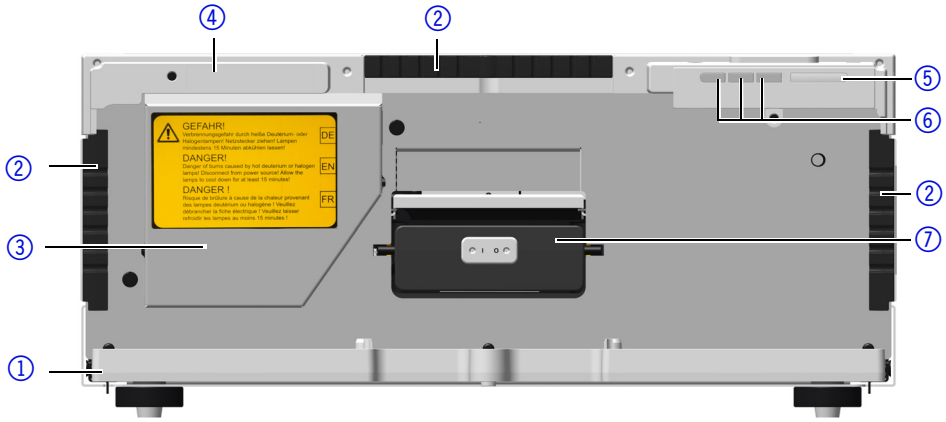


Fig. 1 front view (example DAD 6.1L)

Back view

On the back of the detector, the connectors for LAN and power plug are located, as well as the serial number of the device and the power switch (on/off).

RS-232, service interface

Please note that the service interface is solely used for repair and maintenance tasks performed by service technicians. 3D data acquisition is not fully supported via this interface.

Legend

① integrator outputs
② LAN connector
③ service interface
④ multi-pin connector
⑤ fan
⑥ power connection and power switch

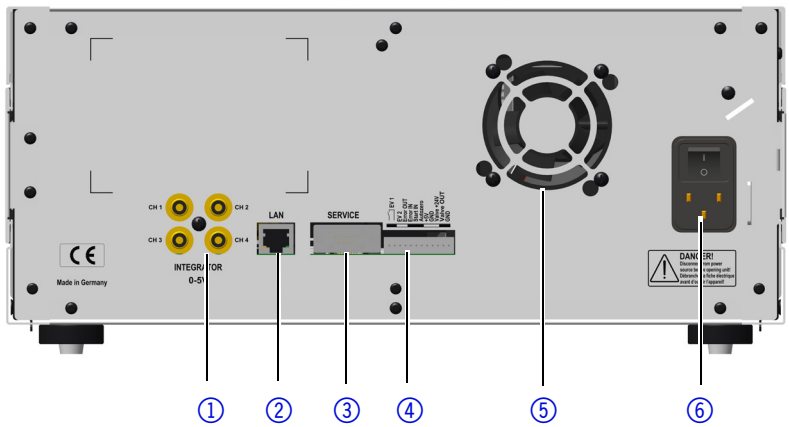


Fig. 2 back view (example AZURA® detector DAD 6.1L)

Features

In an HPLC system, the detector serves to detect substances in liquids and determine their concentration. The sensitivity of the detector depends on the used flow cell.

Optical module

The detectors measure the light absorption of the sample in the ultraviolet and visual spectra. The entire spectrum permeates the sample and afterwards is split up by a grate. The split light falls onto a geometric array of 1024 (DAD 6.1L) or 256 (DAD 2.1L, MWD 2.1L) separate photodiodes – the photodiode array.

The optical system of the DAD 6.1L is depicted in figure 3. An active temperature control with 0.5 °C sensitivity ensures baseline stability for minimal baseline drift.

Legend

① deuterium lamp
② halogen lamp
③ flow cell
④ diode array sensor
⑤ diffraction grating
⑥ mirror

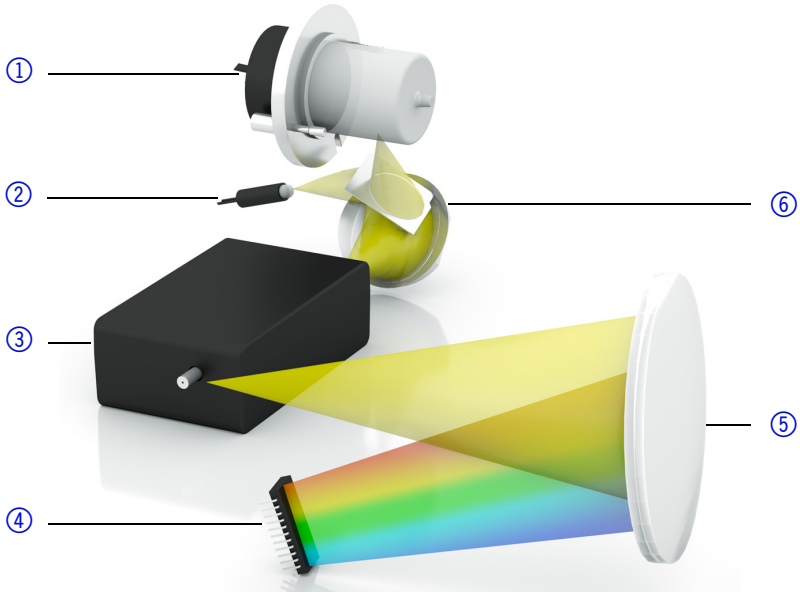


Fig. 3 optical system DAD 6.1L

Lamps

You can exchange the lamps quickly and easily without the need of a service technician (see page 37).

- DAD 6.1L: Two light sources, a deuterium lamp and a halogen lamp, cover the entire UV-Vis wavelength range from 190 to 1000 nm.
- DAD 2.1L, MWD 2.1L: One deuterium lamp covers the UV wavelength range from 190 to 700 nm.

Mirror DAD 6.1L Maximum light intensity over the entire UV-VIS range is provided by effectively mixing the light sources from the deuterium and halogen lamps with a mirror using Polka Dot technology.

Flow cell Various types of flow cells allow a wide range of applications. Flow cell cartridges with KNAUER PressureProof and KNAUER LightGuide technology as well as KNAUER Fiber Optics Technology are available (see page 44).

- KNAUER LightGuide Flow Cell Cartridges combine a maximum light transmission (using total reflection) with a minimum cell volume to offer an ideal signal-to-noise ratio.
- KNAUER PressureProof Flow Cell Cartridges are optimized for conventional and high flow HPLC and FPLC applications. These flow cells feature an increased pressure stability (up to 300 bar) and extended flow rate range (up to 20 ml/min).
- KNAUER Fiber Optics Technology: Adapters for fiber optics are optionally available. Fiber optics allow separating the flow cell from the detector. This way, working with dangerous, explosive, or toxic materials becomes safer. Remote flow cells are recommended for preparative applications (high flow rates), in order to protect sensitive optical components from potential leakages.

Data rate The detector measures with a maximum data rate of 100 Hz. During the measurement, approx. 100 spectra per second are recorded.

Leak management Integrated leak management drains liquids from leaks.

GLP data You can use the Mobile Control and the different software products (ClarityChrom®, OpenLAB®, or Chromeleon™) to display or read GLP data like operating hours, lamp operating hours, number of lamp ignitions, etc.

You find a detailed description on how to display or read out GLP data in the respective instructions.

Upgrade MWD 2.1L The multiwavelength detector can be upgraded to a diode array detector.

Scope of delivery

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

- Detector with test cell
- Power cable
- Accessories Kit AZURA® Detector DAD 6.1L/DAD 2.1L/MWD 2.1L
- Accessories Kit AZURA®

Valid documents:

- Instructions (German/English)
- Installation Qualification document (“IQ“, English)
- Declaration of Conformity

General safety instructions

Target group

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

The following knowledge is required:

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

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

Safety equipment

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

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

What must the user take into account?

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

More safety-relevant information is listed below:

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

Where is use of the device prohibited?

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

Secure decommissioning

Take the device completely out of operation by either switching off the power switch or by pulling the power plug.

Opening the device

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

Signal words

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

⚠ DANGER DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE NOTICE is used to address practices not related to physical injury.

Decontamination

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

⚠ DANGER

Life-threatening injuries

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

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

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

Decontamination Report

Devices without a completed Decontamination Report will not be repaired. If you would like to return a device to KNAUER, make sure to enclose a completed Decontamination Report with the device: http://www.knauer.net/en/knowledge/downloads/service.html

Symbols and signs

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

Symbol	Meaning
	Electric shock hazard
	Electrostatic discharge hazard, damages to system, device, or components can occur.
	Obey maximum load for leak tray during transportation, installation and operation.

Symbol	Meaning
CE	A device or system marked with CE fulfills the product specific requirements of European directives. This is confirmed in a Declaration of Conformity.
TÜVRheinland c US	Testing seals in Canada and the USA at nationally recognized testing centers (NRTL). The certified device or system has successfully passed the quality and security tests.
i	Hints provide useful tips or information worth knowing.

Unpacking and setup

Operating environment

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

NOTICE

Device defect

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

→ Set up the device in such a way that it is protected against exposure to direct sunlight.

→ Keep at least 15 cm clear at the rear and 5–10 cm at each side for air circulation.

Space requirements

- At least 5 cm if another device is set up on one side
- At least 10 cm if further devices are set up on both sides
- At least 15 cm on the rear panel for the fan.
- Leave the power plug on the rear of the device accessible to be able to disconnect the device from the mains.

General requirements

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

Earthquake areas

If you are located in an earthquake area, use the bore holes ① in the side panels to secure the device. The bore holes are located on either right or left side panel.

Fig. 4 bore holes of device

Unpacking

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

Tools Utility knife

⚠ CAUTION

Bruising danger

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

➜ Lift the device on the side of the housing only.

Process

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

Next steps Store packaging and keep the included packing list for repeat orders.

Inserting the flow cell

Before taking a flow cell filled with solvent into operation, please make certain that the used eluent is miscible with that one used previously. Otherwise purge the flow cell with a medium miscible with both the eluents.

Prerequisites

- No flow cell or test cell is installed.
- The device is switched off.

Note: Pay attention to the compatibility of the flow cells.

Practical Tip: Unscrew the capillary for easier handling.

⚠ WARNING

Eye injury

Irritation of retina through UV light. High-energy UV light can leak out from the flow cell or the fiber optic connectors.

➜ Switch off the detector or the lamps.

NOTICE

Performance decrease

Any components in the light path like fiber optic ends become contaminated, when touched with the fingers.

➜ Avoid touching the ends without gloves.

➜ Use alcohol and a cotton bud for cleaning.

Process	Figure
Place the flow cell into the opening and slide to the back until it clicks into place inside the device.	 Fig. 5 flow cell

Next steps Connect the capillaries.

Inserting the flow cell with fiber optics

KNAUER fiber optic cables are extremely robust. Nevertheless fiber optic cables are sensitive to bending. The minimum bending radius is 100 mm (short term: 70 mm).

Observe the following regarding the use of fiber optics:

- UV light will cause the fiber optic to become blind with time (solarization), making them no longer suitable for use.
- Do not touch the ends of the fiber optic with your fingers, as this could falsify the measurement.
- Handle the fiber optic with care, avoid impacts or hard actions.
- Move the fiber optic carefully without using pressure or bending it.

The flow cells with fiber optics are connected via an adapter.

Prerequisites No flow cell or test cell is installed.

Auxiliary material Screw-type cap fittings for the fiber optics

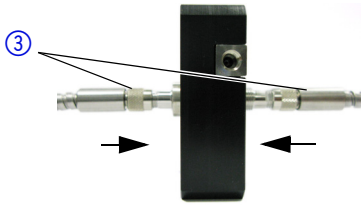
⚠ WARNING

Eye injury

Irritation of retina through UV light. High-energy UV light can leak out from the flow cell or the fiber optic connectors.

➜ Switch off the detector or the lamps.

Note: Fiber optical connectors, like all other optical parts, should never be touched without wearing gloves because otherwise contaminations may reduce light intensity. Contaminated parts may be cleaned with a soft cloth and isopropanol.

Process	Figure
1. Remove the cap fittings ① from the adapter. 2. Place the adapter into the opening and slide to the back until it clicks into place inside the device.	 Fig. 6 fiber optics adapter
3. Remove the screw-type cap fittings ② from the fiber optics. 4. Manually, screw the fiber optics to the adapter.	 Fig. 7 cap fitting on the fiber optics
5. Remove the cap fittings from the flow cell. 6. Manually, screw the fiber optics ③ to the flow cell.	 Fig. 8 fitting of the fiber optics on the flow cell

Next steps Connect the capillaries.

Connecting the capillaries

Capillaries connect the detector with the column and waste or more subsequent operating detectors. For the LightGuide flow cell connectors, we recommend PEEK capillaries and PEEK fittings.

Prerequisites

- The flow cell was inserted.
- Screw-type cap fittings and cap fittings were removed.

Note: The KNAUER LightGuide flow cell cartridges have unisex input and output connections.

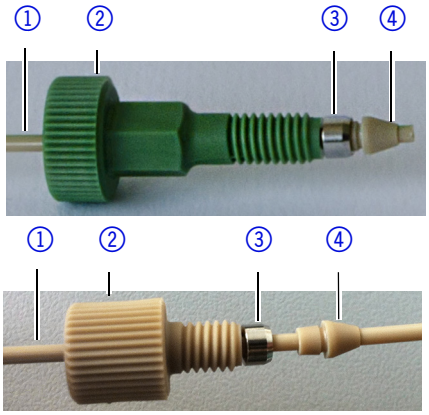
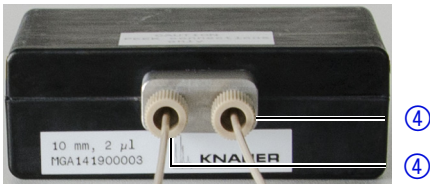
NOTICE

Component defect

Damage to the ports caused by strongly tightened fittings.

➜ Use 5 Nm torque for stainless steel fittings.

➜ Use 0.5 Nm torque for PEEK fittings.

Process	Figure
1. Push the capillary ① through the fitting ② . 2. Slide the lock ring ③ over the tubing. Note that the tapered end of the lock ring has to point to the seal ring ④ . 3. Attach the seal ring ④ .	 Fig. 9 capillary fittings
4. Fasten the capillary at the flow cell ④ fingertight.	 Fig. 10 flow cell with capillary

Next Steps Bring the device into operation.

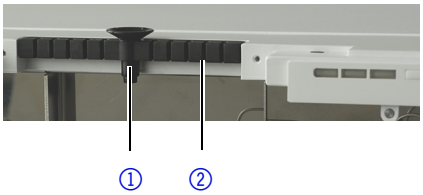
Using the PEEK fittings

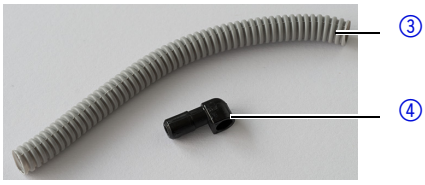
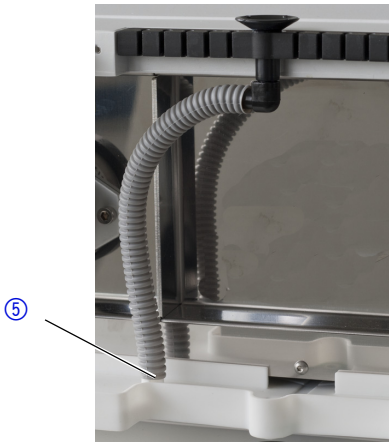
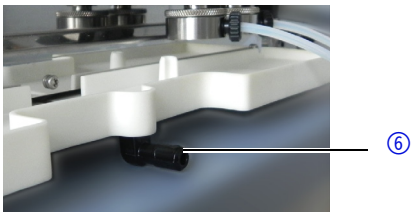
PEEK fittings withstand a maximum pressure of 400 bar. Note the torque of 0.5 Nm.

Connecting the leak management

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

Prerequisite The front cover has been removed.

Process	Figure
1. Carefully push the funnel ① into the center opening of the capillary guide ② .	 Fig. 11 Funnel and capillary guide

Process	Figure
2. Push the long ending of the first nozzle ④ into the hose ③ .	 Fig. 12 Hose and nozzle
3. Connect the nozzle and the funnel. 4. Push the other end of the hose onto the nozzle ⑤ of the leak tray.	 Fig. 13 Hose connected to device
5. For the bottom device, push the short end of the nozzle ⑥ into the opening in the collection point of the leak tray. 6. Connect the hose to the nozzle and lead the second ending to the waste bottle. 7. Place the waste bottle below the bottom device.	 Fig. 14 Leak tray with nozzle

Next steps Attach the front cover.

Control

The detector can be operated in two ways:

- via remote connector
- as part of a LAN, via the LAN connector of the router

All connectors for external control are located on the back side of the detector (see figure 2).

The detector can also be controlled via Mobile Control.

Connecting the device to the computer

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

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

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

Process

1. On the computer, go to the control panel and check the LAN properties.
2. Hook up the router to the devices and the computer.
3. On the computer, configure the router to set up the network.

4. Install the chromatography software from the data storage device.
5. Switch on the device and run the chromatography software.

Configuring the LAN settings

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

Prerequisite

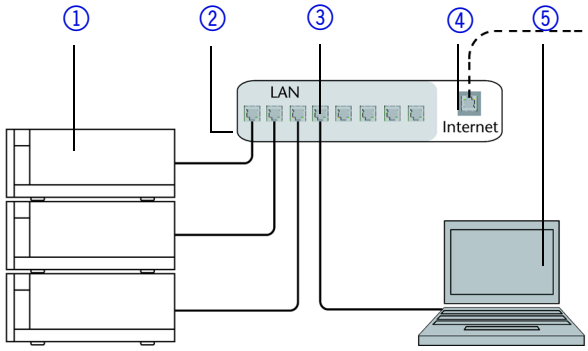
- In Windows, power saving, hibernation, standby, and screen saver must be deactived.
- In case you use an USB-to-COM box, the option "Allow the computer to turn off ths device to save power" in the devicemanager must be deactivated for all USB hosts.
- For all LAN devices: For the network adapter, the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

Process

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

Connecting the cables

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



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

Prerequisite

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

Process

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

Configuring the router

The router is preset at the factory. The login information is mentioned on the router case (IP address, user name, and password), which is needed for router configuration.

Process

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

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

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

Integrating the LAN into a company network

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

Prerequisite There is a patch cable for the connection.

Process

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

Controlling several systems separately in a LAN

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

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

Process

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

Result The connection is established.

Setting a static IP address

A static IP address can be set via the Mobile Control.

Note: Before changing the LAN settings, inform yourself about the IT safety standards valid for your laboratory.

The device is factory set to a dynamic IP address (DHCP). To ensure a permanent LAN connection between the chromatography software and the device, we recommend to set a static IP address for certain applications.

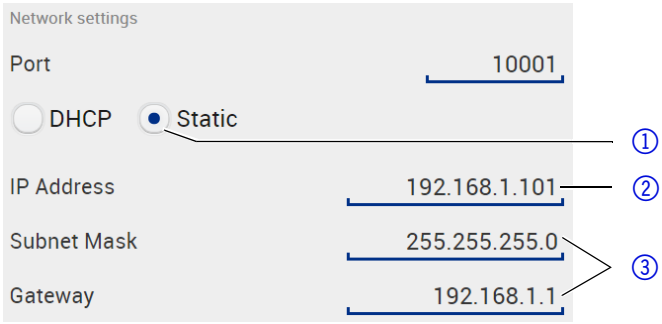
Prerequisites

- The device has been switched on.
- Mobile Control has been installed and started.
- The connection between the Mobile Control and the device has been established.

Note: You find further information on LAN settings in the chapter Device Settings of the Mobile Control User Manual.

Procedure

1. In the Mobile Control, choose Settings .
2. On the General tab, choose the device name.
3. Under Network Settings, choose the setting Static ① .



4. Enter the IP address into the text box IP Address ② .
5. If necessary, change the subnet mask and the gateway ③ .
6. Click Apply in the top right corner.
7. Restart the device.

Next steps

In case necessary, go back to the original setting with the [Reset] button that can be found under Settings > General > Network Settings > LAN Settings.

Using remote control

On the rear panel of the detectors an electrical connector socket is located which serves to send or receive signals from other instruments. For example start signals from an injection valve or an autosampler can be put to the START input. All voltages have to be mounted between GROUND and the corresponding event.

NOTICE

Electronic defect

Electrostatic discharge can destroy the electronics.

➔ Wear a protective bracelet against electrostatic discharge and ground.

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

- sending control signals (Events) to external devices
- opening and closing contacts
- activating 500 ms pulses

The following remote signals can be received and sent:

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

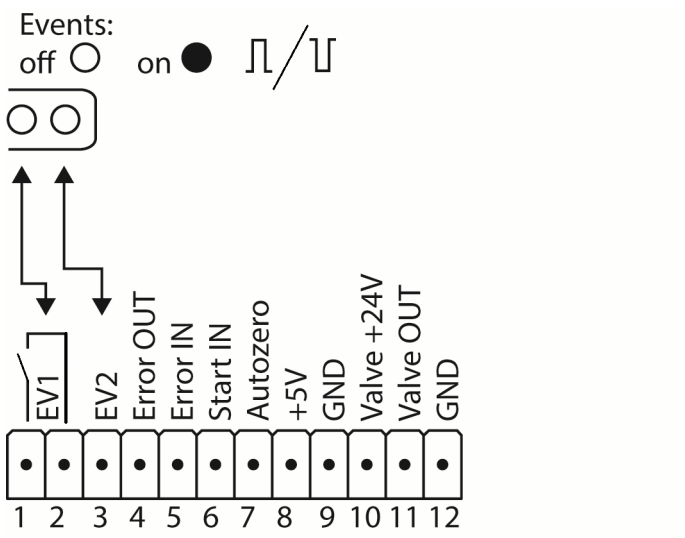


Fig. 15 relation between display and terminal strip

Connections to the terminal strip

Connection	Function
EV 1 (Event 1)	Relay Contact The contact is on a floating basis. Its setting depends on the settings in Mobile Control or software. Steady-rate signal: ▪ passive = open relay contact ▪ active = closed relay contact Pulse: ▪Closed relay contact for at least 1000 ms Permissible load of the relay contact: 1 A/ 24 V DC
EV 2 (Event 2)	TTL compatible Output Levels: ▪ passive 5 V ▪ active 0 V Pulse: ▪ 0 V for at least 1000 ms
Error OUT	OC Output, with external pull-up up to 5V (20mA) Levels: ▪ passive 5 V ▪ active 0 V Output is active until the Error condition has been eliminated.
Error IN	TTL Input ▪ Low active Secure switching threshold at least 10 mA After receiving a signal (short-circuit to ground) from an external device, an error message appe-ars and the device stops.

Connection	Function
Start IN	TTL Input ▪ Low active Secure switching threshold at least 10 mA After receiving a signal (short-circuit to ground) from an external device, the device starts. If controlled with software, an electronic trigger is send through the LAN.
Autozero	TTL Input ▪ Low active Secure switching threshold at least 10 mA A signal (short-circuit to ground) sets the measuring signal to zero.
+5 V	Provides a voltage of 5 V with respect to GND. This makes it possible to supply a load that is switched by an EVENT. Protection: 5 V–50 mA
GND	Reference point of the voltage at the signal inputs.
+24 V Valve	Event-controlled switching of 24 V against GND Protection: 24 V–200 mA
Valve OUT	Output is active until the valve condition has been eliminated.
GND	Reference point of the voltage at the signal inputs.

Connecting cables to the terminal strip

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

Prerequisite
- The device has been turned off.
- The power plug has been pulled.

Tools Operating tool

NOTICE

Electronic defect

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

➜ Turn off the device before connecting cables.

➜ Pull the power plug.

NOTICE

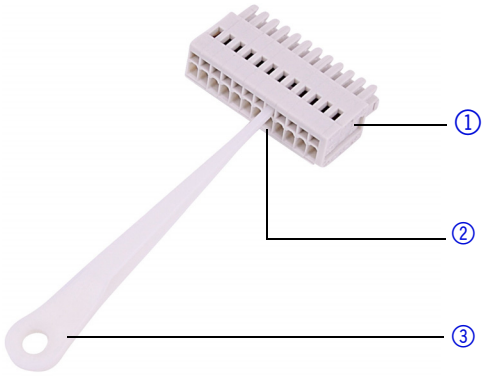
Electronic defect

Electrostatic discharge can destroy the electronics.

➜ Wear a protective bracelet against electrostatic discharge and ground.

Process

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



Next steps

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

Integrator connector

The integrator output supplies the current signal value as an analog voltage (max. 5 V). The integrator output is connected to other instruments with the analog connection cable or other special connection cables.

For details on the integrator connector, see the list below:

- non-bipolar
- 4 channel
- 0 to 5 V
- DAC 16 bit
- scalable
- Adjustable to offset

Power connection

Use only the enclosed power cable to connect the device to the power supply to make sure that the specifications stated in Technical Data are met. But check beforehand to use power cables which are admitted for use in your country. Replace defective power cables only with accessories from KNAUER. Do not replace detachable power cables with different cable types.

NOTICE

Electronic defect

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

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

Prerequisites

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

Power plug

- The device is intended for use with AC power networks of 100–240 V.
- Make sure that the power plug on the rear of the device is always accessible, so that the device can be disconnected from the power supply.

Integrating the detector into the system

To integrate the detector into a system, note the ambient conditions found in the section Technical Data as well as the ambient conditions of other devices to be integrated into that system.

The detector is integrated into the HPLC flow system by connecting the capillary to the flow cell and the HPLC system.

Torque Stainless steel fittings are tightened with 5 Nm, PEEK fittings are tightened with 0.5 Nm.

Capillary layout

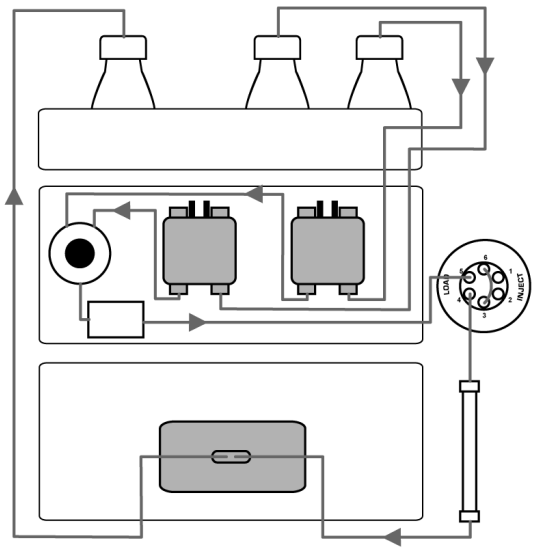


Fig. 16 installation for detector

Pre-Installed capillaries

Pre-installed stainless steel and PEEK capillaries are color-coded according to their inner diameter.

Color	Material	Inner diameter
red marker	stainless steel	0.1 mm
yellow marker	stainless steel	0.18 mm
blue marker	stainless steel	0.25 mm
black marker	stainless steel	0.4 mm
red marker	PEEK	0.1 mm
yellow marker	PEEK	0.18 mm
blue marker	PEEK	0.25 mm
orange marker	PEEK	0.5 mm

Note: PEEK capillaries are not suitable for use with pure acetonitrile. Acetonitrile can cause capillaries to crack or rupture.

Operation

In this chapter, you find the information relevant for operating the detector.

Initial startup

Use this checklist to determine whether the detector is ready for initial startup:

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

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

- The network connection to the router is established

- The chromatography software has been installed by KNAUER or a company authorized by KNAUER.
- A flow cell was inserted.
- The capillaries have been connected.

Switch on

Prerequisites

- Installation has been completed.
- A clean flow cell was inserted.

NOTICE

Device defect

Changes of the environmental temperature cause condensation inside the device.

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

Process	Figure
1. On the rear of the device, plug the power cable into the power connector ② . 2. Plug in the power supply. 3. On the rear of the device, switch on the detector using the power switch ① .	 Fig. 17 power switch with female connector at the rear panel

Result The detector starts its self-validation. If the self-validation has been successfully completed, the LEDs on the right and in the center light up green.

Next steps Bring the detector into service.

Operation

There are several options for controlling the device:

- with chromatography software
- with Mobile Control

Note: It is not possible to use 2 control methods simultaneously. If the device is connected to the software, it cannot be controlled via Mobile Control. The device status can however be monitored.

Note: No 3D data acquisition via RS-232 possible.

Operating with chromatography software

To control the device with software, you have to establish a connection between the LAN port and a computer.

Software versions Devices can be controlled with

- Mobile Control Chrom version 3.0.1 or higher
- OpenLAB EZChrom edition version A.01.05/A.04.05 or higher
- ClarityChrom version 5.0.3 or higher (DAD 6.1L) or version 5.0.5 or higher (DAD 2.1L, MWD 2.1L).
- PurityChrom version 93 or higher
- Chromeleon versions 6.8 SR13 and 7.2

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

Operating with Mobile Control

The Mobile Control is a device control software which can be installed on your computer or tablet. To control the device using the Mobile Control, connect the computer or tablet with a Windows operating system to a wireless LAN router. The firmware version of your DAD 6.1L must be 01.21

or higher, and 01.01 or higher for the DAD 2.1L or MWD 2.1L. Data transfer between device and Mobile Control is actualized through wireless LAN. You find a detailed description on the Mobile Control in its accompanying instructions.

Meaning of the LEDs

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

Legend

① Left LED
② Center LED
③ Right LED
④ Switch/Standby button

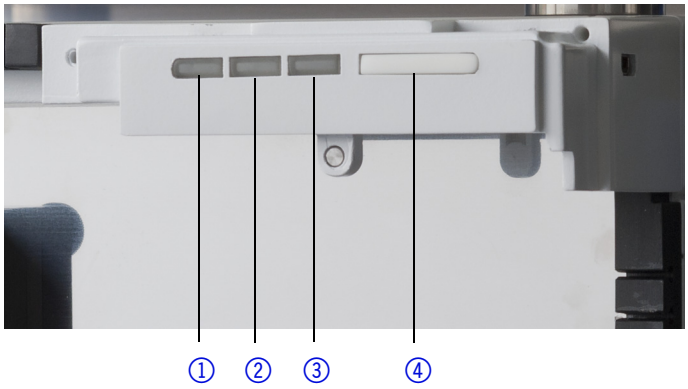


Fig. 18 LEDs and switch/standby button on the front of the device

The LEDs can have different colors depending on the operating conditions.

Standby

To start the standby, keep the standby button pressed for 5 seconds.

Note: Malfunctioning system after repeated standby possible. After repeatedly using standby, restart the device using the power switch to reset the device's data storage.

	Color	Status	Operation
Left LED	red	Error	▪ Check the system. ▪ Shortly press the switch to deactivate the error message.
	green	3D data are acquired.	
Center LED	does not light	The lamp has been switched off.	
	flashes green	The lamp/lamps are initializing or the validation is progressing.	▪ Wait until the lamp is running or the validation is finished.
	green	The deuterium lamp is active.	
Right LED	green	The device has been switched on.	
	flashes green	The device not ready for operation.	▪ Wait until the device is ready for operation.
	blue	The device is in standby	▪ Press the standby button to end the standby.

Default settings

Using the Mobile Control, you can reset the detector to its default settings.

Parameter	Setting
Network	LAN DHCP, port 10001
Lamps	Deuterium ON, Halogen OFF (DAD 6.1L only)
Time constant	2 s
Channels	Channel 1: WL = 254 nm, BW = 8 nm
Reference correction	Reference channel enabled for channel 2, WL = 360 nm, BW = 30 nm
Extended linear range	OFF
Analog out	Offset 1 = 0.00 mV, Scale 1 = 1 AU/V
Flow cell	Test cell
Event check	All events deactivated (o)
Date/Time	Current date/time
Wake-up	Current date/time
Leak sensor	ON, Sensitivity = low

GLP

The following GLP data for the instruments can be found in your software:

	GLP Data	Units	Explanation
Device information	Serial number		FOJYYWWXXXXX (DAD 6.1L) FOUYYWWXXXXX (DAD 2.1L) FOGYYWWXXXXX (MWD 2.1L)
	Firmware version		Current device firmware version
	Operating time	h	Running hours from manufacture
	Installation date		Manufacture date
	Last service date		
Optical properties	Optical bandwidth at 656 nm [FWHM]	nm	
	Optical bandwidth at 253 nm [FWHM]	nm	
	Stray light	AU	
	Lower spectral limit	nm	
	Upper spectral limit	nm	
	Number of shutter switches		
	Integration time	ms	

	GLP Data	Units	Explanation
Wavelength accuracy	Holmium line at 360.9 nm	nm	
	Holmium line at 446.2 nm	nm	
	Deuterium beta line at 486.0 nm	nm	
	Deuterium alpha line at 656.6 nm	nm	
Lamps - power supply	Serial number		
	Operating time		
	Firmware version		
	Supply number		Indicates how often the lamp power supply has been changed since manufacture.
Lamps - deuterium lamp	Serial number		
	Operating time	h	
	Starts		
	Lamp number		Indicates how often the lamp has been changed since manufacture.
	Installation date		
Lamps - halogen lamp (only DAD 6.1L)	Serial number		
	Operating time	h	
	Starts		
	Lamp number		Indicates how often the lamp has been changed since manufacture.
Leak sensor	Serial number		Leak sensor serial number
	Firmware version		Current leak sensor firmware version

Optimizing the detector

In this chapter, you find information on how to optimize your detector.

Location

In order to ensure thermo stability and to prevent drift effects, note the following aspects:

- Protect the detector against strong ventilation.
- Protect the detector against direct sunlight.
- Note the space requirements.
- Avoid vibrations.

Warmup time

The recommended warmup time for the detectors is 30 minutes. This recommendation is applicable after turning the detector on as well as and after turning the lamp/s on.

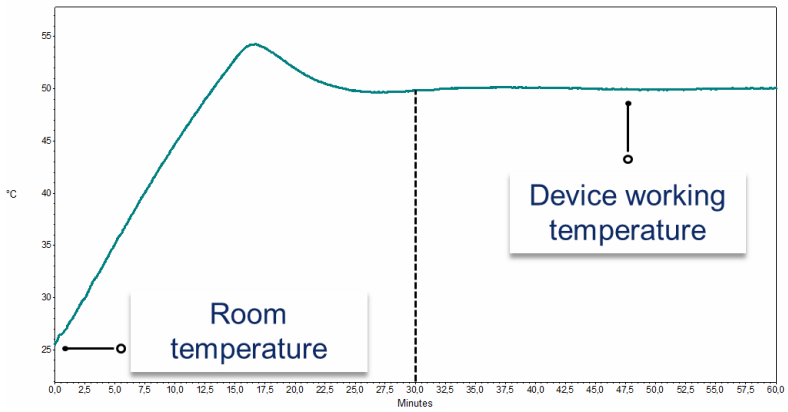


Fig. 19 cold start temperature profile

Selecting the flow cell

Several different flow cells are available for the detector (“Flow cells” auf Seite 44). Note that the detector is shipped with a test cell. A flow cell must be ordered separately.

Signal sensitivity, peak broadening and response can all be affected by the choice of flow cell. Volume, path length as well as wetted parts, required pressure range, flow cell connection, and remote operation are further factors that need considering when selecting a flow cell.

Flow cell volume

Depending on your instrument setup, column and sample(s), one flow cell volume may be more appropriate that another. If the volume is too large, two adjacent peaks may get mixed in the cell. If the volume is too small, the noise may be higher and the signal may be too small due to less light reaching the photodiodes.

Ideal flow cell volume therefore is a compromise between peak broadening and sensitivity (see figure 20).

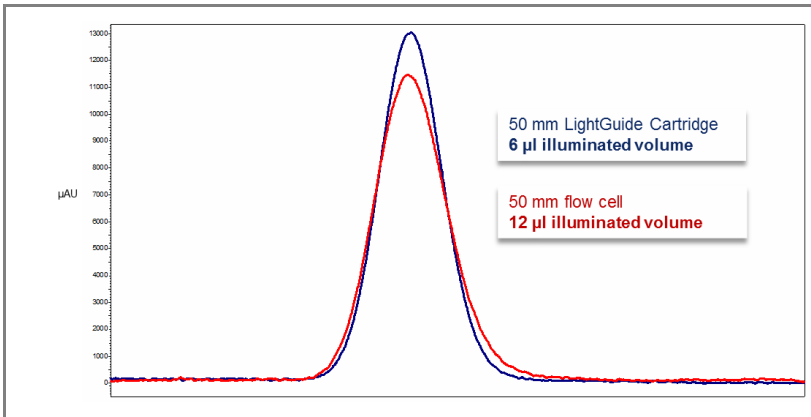


Fig. 20 volume comparison

A good rule of thumb is that the flow cell volume should not be more than 1/3 of the peak volume of your separated sample. To determine the volume of your peaks, take the peak width as reported in the integration results, multiply it by the flow rate and divide it by 3.

Cartridge flow cells with volumes of 2 µl, 6 µl and 10 µl are available for the detectors. Narrow-bore columns (~ 2,1 mm ID) are suitable for flow cells with smaller volumes. Columns with with a larger inner diameter (≥ 3,0 mm ID) are less affected by the volume of the flow cell.

The flow rate should also be taken into consideration. A lower flow rate increases the axial and longitudinal diffusion and adds to a broadened flow profile which may lead to a peak broadening.

Path length

As described by the Beer-Lambert law, the path length of a flow cell affects the light intensity that is detected.

$$A = -\log T = \log\left(\frac{I}{I_o}\right) = \varepsilon \times d \times c$$

A:	measured absorption at a given wavelength
T:	transmittance, defined as the quotient of the light intensity (I) after passing through the sample and the initial light intensity (I_0) before passing through the sample
ε:	molar absorptivity coefficient (wavelength and temperature dependent)
b:	path length
c:	analyte concentration (temperature-dependent)

For the same concentration, the peak height will be higher if the path length is longer. Path lengths of 3 mm, 10 mm, and 50 mm are available for the detectors. A longer path length, therefore, increases the sensitivity of a method (see figure 21). The limit of detection is inversely proportional to the path length.

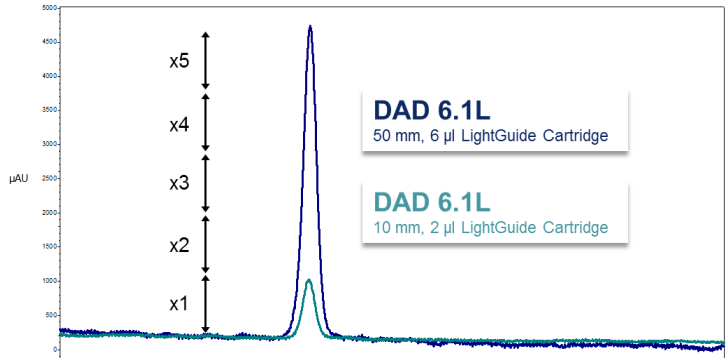


Fig. 21 path length comparison

Wetted parts

The wetted parts of the flow cell must be chemically compatible with the solvents and sample you are working with (see “Chemical compatibility of wetted parts” on page 46). Biocompatible flow cells (with titanium/metal-free) are available (see “Reorders” on page 43).

Pressure stability

The different flow cells can withstand various maximum pressures. The upper pressure limits of the flow cells are 30 bar, 50 bar, or 300 bar. The flow cell should not be subjected to the maximum pressure for a long period of time.

Connection

Undesired effects, like the loss of resolution in the chromatogram, may be prevented by ensuring a correct connection to the flow cell and the removal of any dead volume.

Remote operation (fiber optics)

If the flow cell must be positioned outside of the detector (e.g. in an explosion-proof room, at higher temperatures such as in an oven, or in an environment with radioactive substances), the devices can be optionally equipped with fiber optic connectors. Remote flow cells are recommended for preparative applications (high flow rates), in order to protect sensitive optical components from potential leakages.

For detectors with fiber optic cables the light intensity does not depend just on the lamp and the cell but also on the quality / condition of the fiber optic cables, the quality of the connections, the length of the fiber optic cables, the number of bends and the bending radius.

Sensitivity is typically reduced to half that of an equivalent standard cell when working with standard length fiber optic cables (750 mm). Overall, sensitivity is inversely proportional to the length of the fiber optic cables.

Temperature changes around the cables may cause additional drift.

Selecting the wavelength

Signal wavelength

Wavelength selection can influence the sensitivity, selectivity and linearity of a measurement. The measurement wavelength can be selected within the range from 190–1000 nm for the DAD 6.1L or 190–700 nm for the DAD 2.1L and MWD 2.1L in 1 nm steps. The best wavelength for a given measurement (signal wavelength) is that which fives the maximum absorption above the UV cutoff of the mobile phase. In cases where there are multiple components with different absorbance maxima, a compromise wavelength must be chosen where all components absorb.

Baseline correction / reference wavelength

In order to minimize baseline drift due to refractive index effects, a reference wavelength can be set in order to correct the baseline (see figure 22). The reference should be set in the same spectral region as the signal wavelength (UV or Vis) but at a wavelength at which the analyte has no absorbance.

Default reference wavelength

By default, the reference wavelength 360 nm is activated (for channel 2). This is a suitable value for most applications.

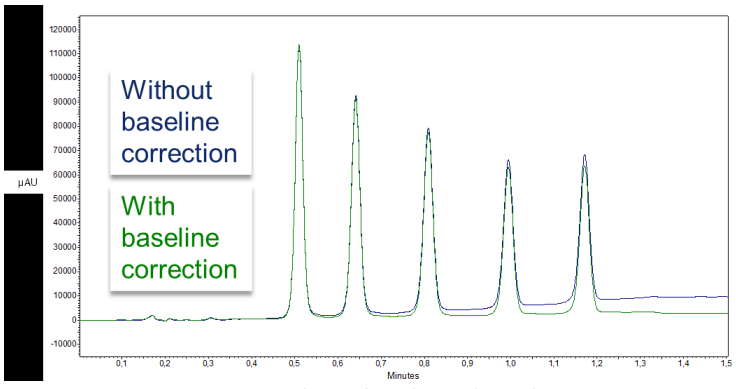


Fig. 22 comparison with and without baseline correction

When selecting the signal and reference wavelengths, the respective bandwidths must also be selected (see the following section).

Bandwidth

The bandwidth defines the total number of wavelengths actually registered by the photodiode when a specific wavelength is set. For example, a wavelength set at 254 nm width a bandwidth of 4 nm results in average absorption of 252–256 nm.

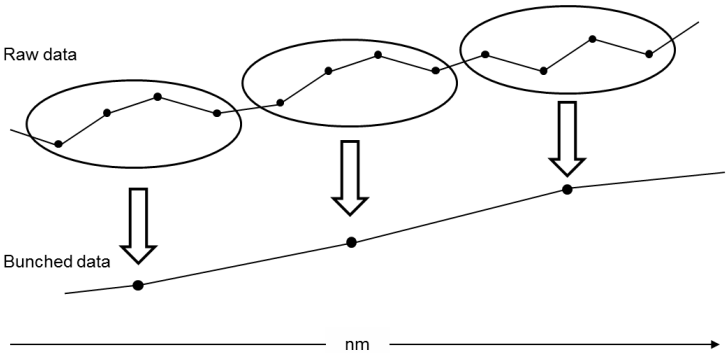


Fig. 23 bandwidth

The selection of bandwidth is a balance between sensitivity and selectivity. Narrow bandwidths increase selectivity, whereas broad bandwidths increase sensitivity.

Default bandwidth

By default (“Default settings” on page 20), the bandwidth for the signal wavelength is set to 8 nm and for the reference wavelength the bandwidth is set to 30 nm.

Spectral range

When measuring with chromatography software, the spectral range selected for a given measurement influences the required disc space. The disc space is necessary to save generated data.

A narrow spectral range reduces disk space. The range, however, should be wide enough to ensure the detection of all components. Also, the spectral range always must include the signal wavelength and the reference wavelength (when applicable).

Time constant & data rate

Response time

The time constant influences the response time of the detector. The response time determines how quickly the detector responds to a change in signal. A good rule of thumb for selection of the time constant is that it should be no larger than $^{1}/_{10}$ of the baseline peak width of the first peak of interest (in seconds). Increasing the time constant allows more averaging of the signal (also known as digital filtering) and results in less baseline noise. However, increasing the time constant too much may result in broad peaks, reduced peak heights and asymmetric peak shapes. Therefore, a compromise has to be found.

Time constant

Using the time constant a signal smoothing can be achieved. The larger this value is set, the more the signal will be smoothed. In general, the best time constant is the reciprocal of the data rate (see table below). If increased sensitivity is desired, or if the baseline noise is interfering with integration, the time constant should be increased. If resolution is compromised, it should be decreased.

It is recommended to set the time constant and data rate in relation to peak width.

Peak width [min]	**Time constant** [s]	**Data rate** [Hz]
<0.003	0.01	100
>0.007	0.02	50
>0.017	0.05	20
>0.033	0.1	10
>0.067	0.2	5
>0.167	0.5	2
>0.333	1	1

Data rate

The data rate (or sampling rate) is the number of data points per second (Hz) at which the detector transmits data to the computer.

Default data rate

The default data rate setting for the detectors is 1 Hz (“Default settings” on page 20). The maximum data rate (digital signal) is 100 Hz. Lower data rates store average data points. A 50 Hz data rate averages 2 points. A 10 Hz data rate averages 10 points. The analog data rate is fixed at 12.5 Hz.

Optimizing the data rate

The optimal data rate depend on your application. Too few points across a peak (short data rate) decrease detail and compromise reproducibility. Too many points (high data rate) introduce noise into the system and the resulting files can become very large. Some general considerations are listed below:

- Each peak should be defined by 20–30 data points. For chromatograms with co-eluting peaks or low signal-to-noise ratios, 40–50 data points per peak are recommended.
- If all peaks are relatively wide, select a slower data rate.
- If any peaks of interest are less than a few seconds, select a faster data rate.
- If the data rate is too slow, the start and end points of the peaks are not accurately determined. If the data rate is too fast, data files may occupy excessive disk space and post-run analyses may require more processing time.

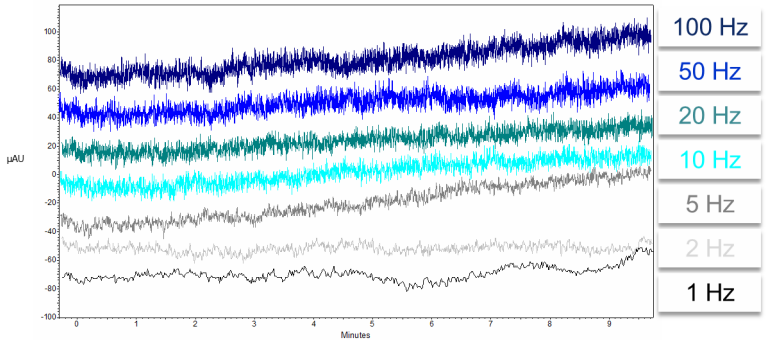


Fig. 24 noise with different data rates

Integration time

Signal level

The integration time influences the intensity of the signal and therefore the sensitivity of the measurement. The larger the integration time, the higher the intensity of the signal until the maximum sensor counts are reached. The integration time is automatically calculated by the software before the start of a measurement. The calculations are in relation to the special range (see “Spectral range” on page 25).

When a narrower spectral range is selected, the signal intensity will be increased. This increase is limited, however, by the data rate.

Subtraction of the baseline chromatogram

The baseline subtraction can eliminate the effects of drift that result from solvent, gradient, or flow programming. The baseline profile is subtracted from the measured chromatogram. This results in a mathematically reprocessed chromatogram with an ideally flat baseline.

Extended linear range

Upon activating the extended linear range option it is possible to broaden the linear range of the AZURA detector, through internal stray light correction. This option can be activated in the used software under advanced settings. You find further information in the respective software instructions.

The Extended Linear Range option is available for devices with firmware versions 01.23 (DAD 6.1L) and 01.10 (DAD 2.1L, MWD 2.1L) or higher.

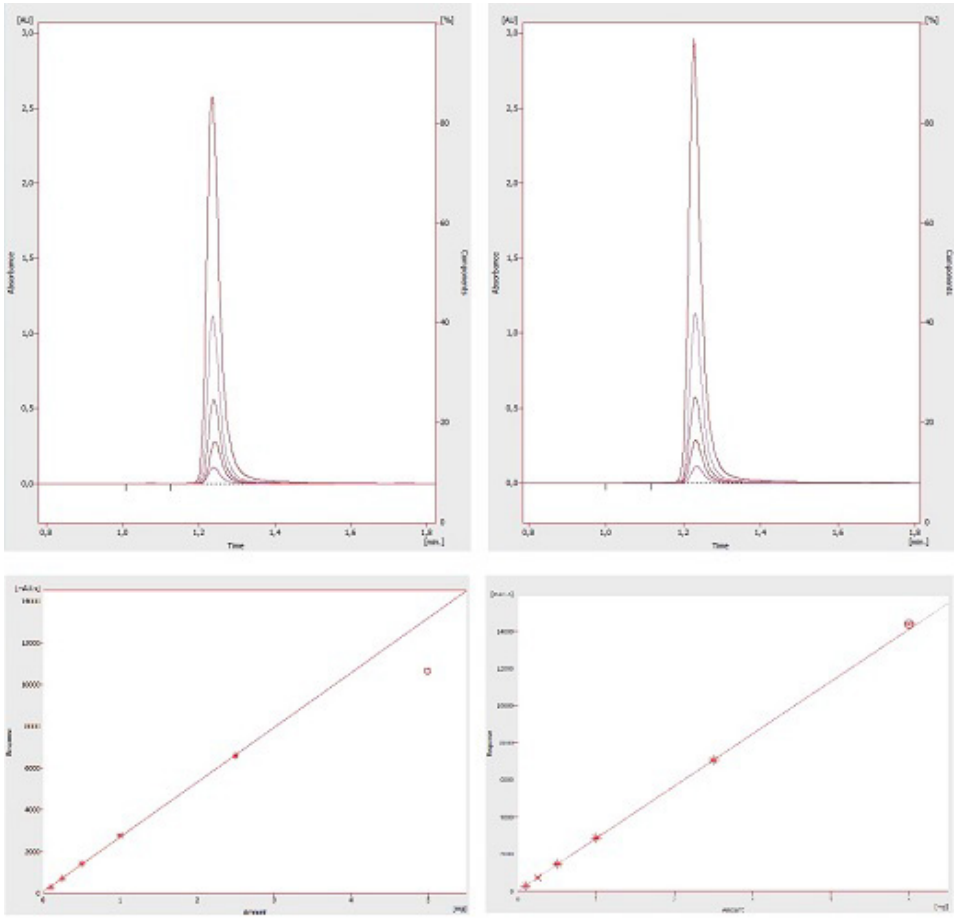


Fig. 25 Range without (left) and with (right) extended linear range

General

- The performance of the detector is largely dependent on the performance of the HPLC system.
- Noise can be related to pump stability, the flow cell cleanliness, lamp quality, mobile phase composition and other factors.
- Drift is usually related to long-term changes in the environment, such as detector warm-up or fluctuations in temperature and mobile phase composition.

Functionality tests

Installation Qualification (IQ)

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

The Installation Qualification is a standardized document that comes as part of the delivery and includes the following:

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

Operation Qualification (OQ)

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

The Operation Qualification includes the following:

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

Test intervals

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

Execution

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

Troubleshooting

First measures

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

LAN

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

1. Check the status of the LAN connection in the Windows task bar:
   -  Connected
   -  Connection not established

   If no connection was established, test the following:
   - Is the router switched on?
   - Is the patch cable connected correctly to the router and the computer?
2. Check the router settings:
   - Is the router set to DCHP server?
   - Is the IP address range sufficient for all the connected devices?
3. Check all connections:
   - Are the patch cable connected to the LAN ports and not the WAN port?
   - Are all cable connections between devices and router correct?

- Are the cables plugged in tightly?

4. If the router is integrated into a company network, pull out the patch cable from the WAN port.
   - Can the devices communicate with the computer, even though the router is disconnected from the company network?
5. Turn off all devices, router, and computer. Firstly, switch on the router and wait until its self-test is finished. Secondly, switch on the devices and the computer.
   - Has this been successful?
6. Replace the patch cable to the device with that no connection could be established.
   - Has this been successful?
7. Make sure that the IP port of the device matches the port in the chromatography software.

Possible problems and solutions

Problem	Solution
Baseline drift	Maintain constant temperature conditions during the measurement.
Device cannot be switched on	Inspect the power cable to ensure that it is plugged into the power supply.
Device cannot be calibrated	1. Insert the test cell. 2. Inspect the calibration with a weak absorbing eluent.
Baseline noise	1. Inspect the flow-cell assembly. 2. Exchange the defective flow cell. 3. Inspect the service life of the lamp on the display. 4. Reduce the air in the flow cell by using a degasser.
The relationship of the signal to the light path reference is very low	1. Flush the flow cell. 2. Replace the lamps
Low UV light	Clean fiber optic ends with alcohol and cotton bud.

Further measures

- Install the maintenance software (service tool).
- Save device information and send to manufacturer.
- Inform the Technical Support of KNAUER.

System messages

If other system messages are displayed besides those listed below, please turn the device off and then on. Inform the Technical Support of the manufacturer in case the system message repeats itself.

The system messages are in alphabetical order:

System message	Problem and solution
"Cannot initialize LAN"	Check cables and connections in local area network.
"Cannot proceed: D2 lamp heating"	Manual validation is not possible while lamp is heating up. Wait until deuterium lamp has initialized and continue afterwards.
"Cannot proceed: D2 lamp off"	Manual validation is not possible while lamp is switched off. Switch the lamp on. In case the error shows again, restart the device. In case no improvement shows, replace the lamp.

	System message	Problem and solution
	"Cannot proceed: Low light"	Validation failed because of exceeded integration time. The operating time of the lamp has been exceeded. Replace the deuterium lamp. Flow cell is dirty. Clean the flow cell. Error state of the optical system. Inform the Technical Support of KNAUER.
	"Communication timeout"	Timeout: Connecting error RS-232 (5 s), leak sensor (0,5 s) or any hardware component (lamp power connection, EPROM, I2C with GUI).
D	"D2 lamp failed"	Manual validation is not possible without deuterium lamp.
	"D2 lamp operation failed"	Restart the device. If the error occurs again, replace the lamp.
	"D2 lamp does not start"	Switch off lamp and turn on again. In case the system message repeats itself, inform the Technical Support of KNAUER . The lamp unit has to be replaced. No lamp ignition when starting the device or the manual validation.
	"Data acquisition active"	No entries are possible. First stop acquiring measurement data, afterwards you can make a new entry.
E	"Error input activated"	External error, outside the device: Check the external devices and cable connections. Check the system to locate and remove the error.
H	"HAL lamp does not start" (DAD 6.1L)	Switch the lamp on. In case the error shows again, restart the device. In case no improvement shows, replace the lamp.
I	"Instrument busy"	3D data is being collected while scanning, leak sensor or cover are processing earlier inputs. Wait until the device has completed the process.
	"Instrument in standalone mode"	Command can not be executed in local operation (only in remote operation)
	"Instrument in standby mode"	Command not allowed during standby mode.
	"Instrument not validated"	Data acquisition or simple scans can not be executed, if the system has not been validated.
	"Instrument remote controlled"	This entry is not executable. Quit software.
L	"Lamp cover open"	The lamp cover was mounted incorrectly or the micro switch is malfunctioning. Mount the lamp cover. In case the system message repeats itself, inform the Technical Support of KNAUER.

	System message	Problem and solution
	"Lamp not installed"	GLP data can not be read and lamp operation can not be executed, as the lamp (D2 or halogen) has not been installed.
	"Lamps off"	Command can not be executed, as the lamps are being switched off.
	"Lamp supply is not available"	Power supply of lamp has not been installed or does not react.
	"Lamp supply temperature limit exceeded"	The upper temperature limit for power supply of lamp was exceeded.
	"Lamp unit temperature limit exceeded"	The upper temperature limit for lamp unit was exceeded.
	"Lamp unit temperature sensor failed"	Temperature sensor of lamp unit was not found or does not react.
	"Leak sensor failed"	Switch the device off and then on. If the leak sensor is still not present, contact the Technical Support of the manufacturer. Leak sensor was not found or does not react.
	"Leak was detected"	Switch off the device. Remove the leak and start the device afterwards.
N	"No D2 lamp detected"	Check if the deuterium lamp was installed correctly.
R	"Recommended D2 lamp life exceeded"	The recommended operating time of the deuterium lamp of 2000 hours was exceeded. Replace the lamp.
	"Recommended HAL lamp life exceeded"	The recommended operating time of the halogen lamp of 1000 hours was exceeded. Replace the lamp.
S	"Shutter position failed"	Malfunction of cover motor
	"Spectrum buffer overflow"	The internal 3D data buffer was used up because of a LAN connection error.
	"Spectrum output busy or not ready"	3D data acquisition can not be started. Wait until data transfer is finished and continue afterwards.
T	"Temperature control failed"	The upper temperature limit of the lamp unit was exceeded.
W	"WL/BW out of spectral range"	Selected path length and bandwidth exceed the spectral range. Expand the selected spectral range or the selected path length/bandwidth.
	"WL validation failed"	Wavelength accuracy test failed. Restart the validation. Holmium oxide and/or Hα, Hβ lines do not meet the specifications. In case the system message repeats itself, inform the Technical Support of KNAUER.

Maintenance and care

In this chapter, you find the information relevant for maintenance, care and storage. Additionally, you find instructions for maintenance tasks that may be performed by the customer. In case there are any maintenance tasks on that you do not find instructions here, contact your supplier or the Technical Support.

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

All wetted components of a device, e. g. flow cells of detectors, have to be flushed with isopropanol first and water second before being maintained, disassembled or disposed.

Opening the module

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

⚠ DANGER

Electric shock

Danger of electric shock from voltage-carrying parts inside the device. The housing serves as a protective cover against voltages inside the device.

➜ Switch the device off before opening the device.

➜ Pull the power plug.

⚠ WARNING

Eye injury

Irritation of retina through UV light. High-energy UV light can leak out from the flow cell or the fiber optic connectors.

➜ Switch off the detector or the lamps.

NOTICE

Electronic defect

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

➜ Switch off the device

➜ Pull the power plug.

Users may perform the following maintenance tasks themselves:

- Regularly check the operating hours of the lamp.
- Inspect the installation of the flow cell.
- Replace the flow cell.
- Replace the lamp.

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

You find the order numbers for the desired spare parts at the end of these instructions (“Reorders” on page 43).

Maintenance contract

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

- Opening the device or removing housing parts.

Maintenance intervals

Operating Hours

Using Mobile Control or software, you can read out the operating hours of the detector. You find a detailed description on how to read out GLP data in chapter “GLP” (see page 20).

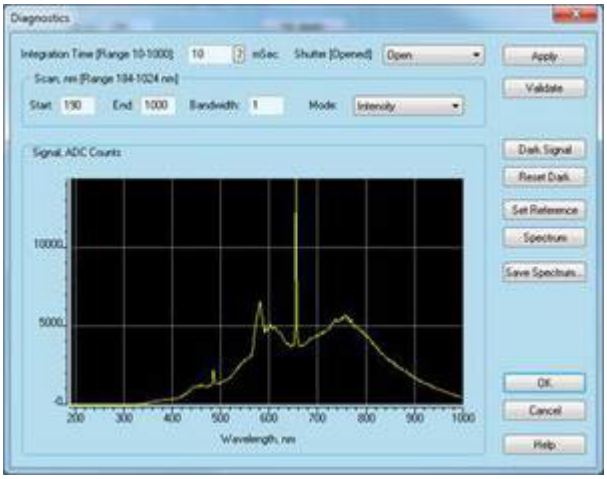
Operating Hours	Measures
1000	▪ Replace halogen lamp (DAD 6.1L).
2000	▪ Replace deuterium lamp.
6000	▪ Replace flow cell. ▪ Replace fiber optic cables.

Cleaning and caring for the device

Flow cell cartridge

An important aspect in handling your flow cell cartridge, is that you should not touch the fiber optic ends with your fingers. Your finger may leave a thin fat layer on the fiber optic ends, which drastically impairs the flow cell's and detector's performance ("Possible problems and solutions" on page 29).

To diagnose this issue, we recommend generating an intensity spectrum (via your chromatographiy software under Diagnostics). Dirty fiber optic ends result in little or no UV light (see below).



Surfaces

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

NOTICE

Device defect

Intruding liquids can cause damage to the device.

➜ Place solvent bottles next to the device or in a solvent tray.

➜ Moisten the cleaning cloth only slightly.

Storage

Pay attention that all tubes and capillaries have been emptied or filled with flushing solution (e. g. isopropanol) before storage. To prevent algae formation, do not use pure water. Close all inputs and outputs with cap fittings.

Device data

Pay attention to the ambient conditions for storage (see chapter Technical Data).

Disconnecting the power supply

Prerequisites

The device has been switched off.

Process
1. Pull the power plug out of the socket and afterwards out of the device. 2. Pack the power cable together with the device.

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

Transport

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

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

⚠ CAUTION

Bruising danger

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

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

Checking the fittings

Check if all fittings are tight. In case you find fittings that are not tight, tighten them up.

Capillary Screw Fittings	Torque
Stainless-steel fittings	5 Nm
PEEK fittings	0.5 Nm

Decommissioning

The detector is designed for the use of different solvents. In case the detector has not been used for several weeks, solvent residues may cause damage. We, therefore, recommend to:

- Flush the flow cell and the capillaries.
- Completely remove used solvents.
- Fill the flow cell and the capillaries with isopropanol.

Before storage, close the open connectors of the flow cell with hole plugs.

Prerequisites The detector has been flushed.

Auxiliary material Hole plugs and/or cap fittings

Process
1. Unscrew the eluent supply lines and close the open connectors with hole plugs. 2. Disconnect the detector from the system and close the open connector of the flow cell with a hole plug.

Next steps Select a storage location according to the requirements, which are listed in the according chapter of these instructions.

Cleaning the flow cell

Increased noise of the baseline and reduced sensitivity can be a Increased noise of the baseline and reduced sensitivity can be a result of a dirty flow cell. Often it is sufficient to rinse the flow cell to restore optimal sensitivity.

Basic cleaning

The following solvents are recommended for rinsing:

- dilute HCl (1 mol/L)
- 1 mol/L NaOH aq.
- Ethanol

- Acetone

Tools Syringe

NOTICE

Performance decrease

Oil drops can contaminate the flow cell.

➜ Do not use compressed air for drying.

Process

1. Fill the syringe with eluent.
2. Inject it into the inlet of the flow cell and allow it to act for 5 minutes.
3. Repeatedly flush with syringe and water.
4. Remove the flow cell from the detector and use a nitrogen stream to dry it.

Next steps Check if the baseline noise has disappeared.

Advanced cleaning

This section describes a cleaning procedure for aggressive cleaning of LightGuide flow cells.

Preparation of chemicals All chemical reagents should be of at least ACS-Grade, preferably HPLC-Grade. This procedure involves the use of caustic and flammable reagents (“General safety instructions” auf Seite 3).

Cleaning solutions #1: 0.5 M Potassium Hydroxide in 100% Ethanol (briefly, 7.013g KOH in 250mL EtOH). After thorough mixing, the solution should be filtered through a 20µm pore size filter.

#2: 100% Methanol

#3: Ultrapure water, Type I per ASTM D1193-99 or equivalent.

Note: Grade 1 ultrapure water per ISO 3696 differs significantly from the above classification.

Prerequisite

- The cleaning solutions #1, #2 and #3 are readily prepared.
- The flow cell is installed in a detector.

Tools 2 syringes with appropriate volumes (about 10 ml) or a peristaltic pump

Note: It is imperative that Solution #2 immediately follow Solution #1 to remove residue remaining on the optical components. Failure to do so will result in poor flow cell performance.

Note: It is recommended the peristaltic pump is configured to “pull” through the cell to avoid possible contamination from degraded peristaltic pump tubing. To lessen the time required for this cleaning method, large bubbles of air can be introduced into the flow cell alternately with the cleaning solutions. This method uses a laminar flow profile and radial diffusion to effectively “scrub” the inside of the flow cell.

Practical Tip: Observe the extent of performance improvement in the Diagnostics window throughout the entire process.

Process with pump

Process 1
1. Flow each cleaning solution through the flow cell in numerical order. 2. Cycle each solution for approximately 3–4 minutes, with a bolus of air introduced between each solution. The flow direction can be reversed between cycles to ensure thorough cleaning. 3. Repeat the procedure until there is no noticeable improvement in sample cell performance. 4. Continue with the “Final Rinsing Process” below.

Process with syringes

Process 2
1. Disconnect the capillaries. 2. Connect the syringes to the liquid ports of the flow cell. 3. Introduce each cleaning solution into the flow cell. 4. Flush each cleaning solution back and forth between the syringes 10–12 times. 5. Repeat the procedure until there is no noticeable improvement in flow cell performance. 6. Continue with the "Final Rinsing Process" below.

Final rinsing process

1. Identify the point where subsequent cleaning cycles no longer improve the performance of the flow cell.
2. Flush the unit with ultrapure water for a period of at least 15 minutes to ensure all cleaning solutions have been completely removed and there are no persistent residues that might affect flow cell performance or stability.

Result The flow cell performance and stability improve noticeably.

Next steps Flush the flow cell with the solution that is going to be used in your next application. Afterwards you can start your application.

Replacing the flow cell

UV light will cause the flow cells to become blind with time (solarization), making them no longer suitable for use. The manufacturer recommends replacing the flow cell after about 6000 operating hours.

Prerequisites

- The capillaries are disconnected.
- The device is switched off.

⚠ WARNING

Eye injury

Irritation of retina through UV light. High-energy UV light can leak out from the flow cell or the fiber optic connectors.

➜ Switch off the detector or the lamps.

NOTICE

Performance decrease

Any components in the light path like fiber optic ends become contaminated, when touched with the fingers.

➜ Avoid touching the ends without gloves.

➜ Use alcohol and a cotton bud for cleaning.

Steps	Figure
1. Press the release lever ① down. 2. The flow cell is being released and can be pulled out. 3. Push in the new flow cell until it locks into place.	 Fig. 26 releasing the flow cell

Next steps Connect the capillaries.

Replacing the lamps

Replace the lamp if it malfunctions or its intensity is low.

Note: After installing a new deuterium lamp into the detector, ensure to allow the lamp a running-in time of approximately 24 hours.

DAD 6.1L, DAD 2.1L, MWD 2.1L
- The recommended operating time of the deuterium lamp is 2000 hours.

DAD 6.1L
- The recommended operating time of the halogen lamp is 1000 hours.

Legend
① deuterium lamp connector
② halogen lamp connector (DAD 6.1L)
③ halogen lamp (DAD 6.1L).
④ deuterium lamp

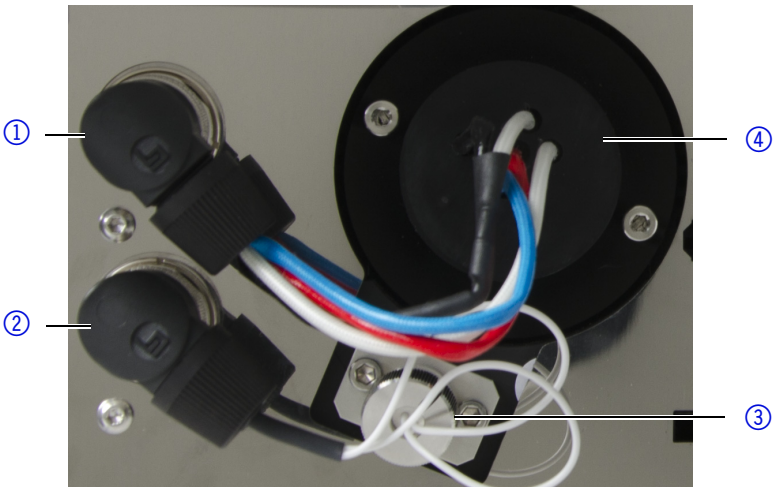


Fig. 27 overview deuterium lamp and halogen lamp

Removing the deuterium or halogen lamp

Prerequisites
- The device is switched off.
- The lamp has cooled down.

Tools Allen screwdriver, 2.5 mm

Note: If the device is still in operation, the integrated security switch turns off the lamp automatically on opening the lamp cover. An error message is displayed. Additionally, the red LED lights up and the center LED does not light.

DANGER

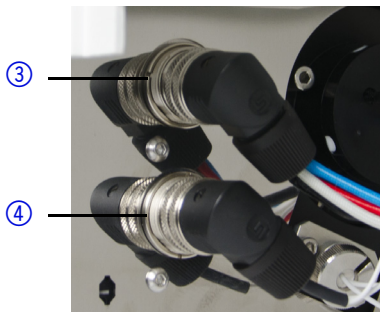
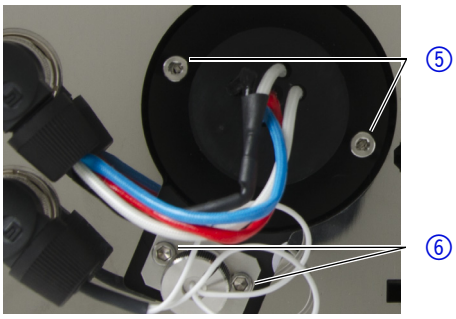
Electric shock
High voltages inside the detector pose a life threatening risk.
➜ Disconnect the power supply before change the lamps.
➜ Check the status of the lamps in the software and on the LEDs.

WARNING

Burns
Burn hazard from hot lamp. The lamp needs to cool down before removal or cleaning.
➜ Switch off the lamp meanwhile the device remains switched on for further 15 minutes, otherwise the lamp can not cool down.
➜ Afterward cool down, switch off the device and pull the power plug.

Deuterium lamp

Process	Figure
1. Loosen the screws ① and ② of the lamp cover. 2. Remove the lamp cover.	 Fig. 28 lamp cover

Process	Figure
3. Loosen the lock ring ③ or ④ of the lamp plug and pull out the plug.	 Fig. 29 lock ring of lamp plug
4. Using the screwdriver, loosen the two screws ⑤ or ⑥ . 5. Remove the lamp.	 Fig. 30 screws on the lamp socket

Next steps Insert a new lamp.

Installing the deuterium or halogen lamp

Removing the lamp cover switches off the device.

Prerequisites
- The device is switched off.
- The lamp cover has been removed.
- The old lamp has been removed.

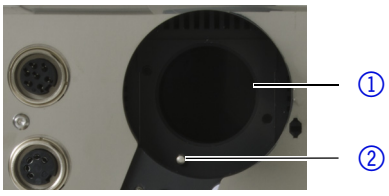
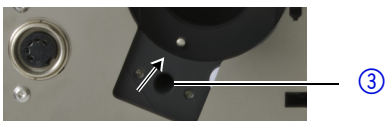
Tools Allen screwdriver, 2.5 mm

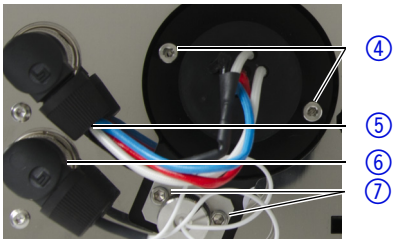
NOTICE

Performance decrease

Damage to the lamp and inaccurate measuring results due to residue possible.

➜ Do not touch the glass body with your hands.
➜ Wear gloves.
➜ Use a clean, soft cloth for cleaning.

Process	Figure
1. Hold the lamp at the lamp socket and guide the glass body into the lamp pod ① . 2. The bolt ② of the deuterium lamp sits in a notch in the lamp socket. 3. Insert the halogen lamp ③ into the lamp pod at a slight angle.	 Fig. 31 lamp pod deuterium lamp  Fig. 32 lamp pod halogen lamp

Process	Figure
4. Using the screwdriver, tighte the two screws ④ or ⑦ on the lamp socket. 5. Connect the plug ⑤ or ⑥ and tighten the lock ring.	 Fig. 33 installing the deuterium lamp
6. Attach the lamp cover and fix it with the screws ⑧ and ⑨ .	 Fig. 34 lamp cover

Next steps Bring the device into operation.

Note: You can clean the lamp thoroughly with a lint free cloth and isopropanol.

Removing a leak

Prerequisites If the leak tray is filled with liquid, the leak has to be removed.

Auxiliary material Cloth for drying the leak sensor

Process
1. Remove the leak. 2. Dry the leak tray. 3. Acknowledge the error message via Mobile Control, the software or the standby switch (without software control).

Next steps Bring the device into operation.

Technical data

DAD 6.1L

Detection	
detector type	diode array detector
number of diodes	1024
pixel pitch	0.8 nm/diode
detection channels	8 (digital), 4 (analog)
light source	high brightness deuterium (D_2) lamp and halogen lamp with integrated GLP chip
wavelength range	190–1000 nm

spectral bandwidth	< 3.5 nm at H_α line (FWHM) Note: digital bandwidth 1–32 nm
wavelength verification	internal holmium filter and deuterium lines
wavelength accuracy	± 1 nm
wavelength precision	≤ 0.5 nm
noise	± 3.5 µAU at 254 nm
drift	300 µAU/h at 254 nm
linearity	> 2.0 AU (typically > 2.5 AU) at 274 nm
time constants	0.00 / 0.01 / 0.02 / 0.05 / 0.1 / 0.2 / 0.5 / 1.0 / 2.0 / 5.0 / 10.0 s
integration time	automatic (5–1000 ms)

Communication	
max. data rate	100 Hz (LAN), 12.5 Hz (analog)
interfaces	LAN (RJ-45), RS-232 (service only), multi-pin connector, 4 x analog (RCA cinch connector)
control	Mobile Control, software, event control, analog, terminal protocol
inputs	Error (IN), Start (IN), Autozero, Output Event 1–2 (Output TTL, OC, Relay)
outputs	Error (OUT), +5 V, Valve +24 V, Valve (OUT)
analog output	4 x 0–5 V scalable, 16 bit

Technical Parameters	
GLP	detailed report including lamp recognition, operating hours, lamp operating hours, number of lamp ignitions
display	Mobile Control (optional)
ambient conditions	temperature range 4–40 °C, 39.2–104 °F humidity: below 90 %, non-condensing

General	
power supply	100–240 V, 50–60 Hz, 75 W
dimensions	361 x 158 x 523 mm (H x W x D)
weight	13.8 kg
leak sensor	yes

DAD 2.1L

Detection	
detector type	diode array detector
number of diodes	256
pixel pitch	2 nm/diode
detection channels	8 (digital), 4 (analog)
light source	deuterium (D_2) lamp with integrated GLP chip
wavelength range	190–700 nm
spectral bandwidth	< 8 nm at Hα line (FWHM) Note: digital bandwidth 1–32 nm
wavelength accuracy	± 1 nm
wavelength precision	± 0.1 nm
wavelength verification	internal holmium filter and deuterium lines
noise	± 5 µAU at 254 nm
drift	400 µAU/h at 254 nm
linearity	> 1.6 AU at 274 nm, typically 2.0 AU
time constants	0.0 / 0.1 / 0.2 / 0.5 / 1.0 / 2.0 / 5.0 / 10.0 s
integration time	automatic (5–1000 ms)

Communication	
interfaces	LAN (RJ-45), RS-232 (SUB-D 9), multi-pin connector, analog (RCA cinch connector)
control	front panel, Mobile Control, software, event control, analog, terminal protocol
inputs	Error (IN), Start (IN), Autozero, Event 1–2 (TTL, OC, Relay)
outputs	Error (OUT), +5 V, Valve +24 V, Valve (OUT), Start (OUT)
analog input	wavelength 0–10 V, flow rate 0–10 V
analog output	1 x 0–5 V scalable, 20 bit, offset adjustable

Technical Parameters	
GLP	detailed report including lamp recognition, operating hours, lamp operating hours, number of lamp ignitions
display	Mobile Control (optional)

ambient conditions	temperature range 4–40 °C, 39.2–104 °F humidity: below 90 %, non-condensing

General	
power supply	100–240 V, 50–60 Hz, 75 W
dimensions	361 x 158 x 523 mm (H x W x D)
weight	12.2 kg
leak sensor	yes

MWD 2.1L

Detection	
detector type	multiwavelength detector
detection channels	8 (digital), 4 (analog)
light source	deuterium (D_2) lamp with integrated GLP chip
wavelength range	190–700 nm
spectral bandwidth	< 8 nm at Hα line (FWHM) Note: digital bandwidth 1–32 nm
wavelength accuracy	± 1 nm
wavelength precision	0.1 nm
wavelength verification	internal holmium filter and deuterium lines
noise	± 5 µAU at 254 nm
drift	400 µAU/h at 254 nm
linearity	> 1.6 AU at 274 nm, typically 2.5 AU
time constants	0.0 / 0.1 / 0.2 / 0.5 / 1.0 / 2.0 / 5.0 / 10.0 s
integration time	automatic (5–1000 ms)

Communication	
interfaces	LAN (RJ-45), RS-232 (SUB-D 9), multi-pin connector, analog (RCA cinch connector)
control	front panel, Mobile Control, software, event control, analog, terminal protocol
inputs	Error (IN), Start (IN), Autozero, Event 1–2
outputs	Error (OUT), +5 V, Valve +24 V, Valve (OUT), Start (OUT)
analog output	1 x 0–5 V scalable, 20 bit, offset adjustable

Technical Parameters	
GLP	detailed report including lamp recognition, operating hours, lamp operating hours, number of lamp ignitions
display	Mobile Control (optional)
ambient conditions	temperature range 4–40 °C, 39.2–104 °F humidity: below 90 %, non-condensing

General	
power supply	100–240 V, 50–60 Hz, 65 W
dimensions	361 x 158 x 523 mm (H x W x D)
weight	12.2 kg
leak sensor	yes

Conditions for specification

Technical data has been determined in accordance with the ASTM standard E1657-98: "Standard Practice for Variable-Wavelength Photometric Detectors Used in Liquid Chromatography".

Reference conditions: test cell at wavelength 254 nm/8 nm with reference wavelength 360 nm/30 nm, time constant 2 s, data rate 1 Hz.

Linearity (5%): Linearity is measured with caffeine at 274 nm/8 nm and time constant 2 s with a flow cell path length 10 mm.

Performance tests should be done with a completely warmed up optical unit (> 2 hours). ASTM measurements require that the detector and/or lamp should be turned on at least 24 h before start of testing. ASTM drift tests require a temperature change below 2 °C/hour over a one hour period.

Reorders

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

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

Further information Further information on spare parts and accessories can be found online: www.knauer.net

Devices and accessories

	Name	Order No.
DAD 6.1L	diode array detector DAD 6.1L with test cell	ADC11
DAD 2.1L	diode array detector DAD 2.1L with test cell	ADC01
MWD 2.1L	multi wavelength detector MWD 2.1L with test cell	ADB01
	upgrade MWD 2.1L to DAD 2.1L	ADB01UMBAU
Instructions	instructions English/German	V6700

	Name	Order No.
Installation Qualification	DAD 6.1L, DAD 2.1L, MWD 2.1L	VIQ_INST
Operation Qualification	DAD 6.1L, DAD 2.1L, MWD 2.1L	VOQ_DAD
Lamps	high intensity deuterium lamp (for DAD 6.1L)	AZL01
	halogen lamp (for DAD 6.1L)	AZL02
	standard deuterium lamp (for DAD 2.1L and MWD 2.1L)	A5193
Drainage system	corrugated hose, 16 cm, PE grey	A9846-1
	funnel	P6431
	exhaust	P6432
	capillary guide top	P6424
	capillary guide side	P6425
Waste tubing kit	kit LightGuide flow cells 1/16"	A9842
	kit UV flow cells 1/16"	A9843
	kit UV flow cells 1/8"	A9844
Mounting bracket	mounting bracket for flow cells	A9853-5
Mobile control	Mobile Control license with 10" touchscreen	A9607
	Mobile Control Chrom license with 10" touch-screen	A9608
	Mobile Control license	A9610
	Mobile Control Chrom license	A9612
Accessories kit	AZURA accessories kit	FZA02
	DAD 6.1L, DAD 2.1L, MWD 2.1L accessories kit	FDC
Tools	AZURA tool kit	A1033
	Luer-lock glass syringe, 10 ml	A0574

Flow cells

	Technical data		Order No.
Standard KNAUER LightGuide Flow Cell Cartridge	path length connection volume wetted parts max. flow rate max. pressure	10 mm 1/16" 2 µl (0.8 µl dispersion vol.) PEEK, quartz, Teflon, titanium, SSt 5 ml/min 50 bar	AMC19XA

	Technical data		Order No.
High Sensitivity KNAUER LightGuide Flow Cell Cartridge	path length connection volume wetted parts max. flow rate max. pressure	50 mm 1/16“ 6 µl (2 µl dispersion vol.) PEEK, quartz, Teflon, SSt 5 ml/min 50 bar	AMD59XA
Analytical KNAUER Pressure-Proof Flow Cell Cartridge (biocompatible)	path length connection volume wetted parts max. flow rate max. pressure	10 mm 1/16" 10 µl titanium, quartz, PEEK 20 ml/min 300 bar	AMC38
Semi-Preparative KNAUER Pressure-Proof Flow Cell Cartridge (biocompatible)	path length connection volume wetted parts max. flow rate max. pressure	3 mm 1/16" 2 µl titanium, quartz, PEEK 100 ml/min 300 bar	AMB18

Flow cells with fiber optics

Technical data		Order No.
path length connection volume wetted parts max. flow rate max. pressure	10 mm 1/16“ 10 µl SSt, quartz, PFA 20 ml/min 300 bar	A4074
path length connection volume wetted parts max. flow rate max. pressure max. temperature	3 mm 1/16“ 2 µl SSt, quartz, PTFE 50 ml/min 300 bar 85°C (only valid for high temperature version)	A4044 A4044HT (high temperature version)
path length connection volume wetted parts max. flow rate max. pressure	3 mm 1/16“ 2 µl PEEK, quartz, PTFE 50 ml/min 30 bar	A4047
path length connection volume wetted parts max. flow rate max. pressure	0.5 mm 1/16“ 3 µl SSt, quartz, PTFE 250 ml/min 200 bar	A4089

Technical data		Order No.
path length connection volume wetted parts max. flow rate max. pressure	0.5 mm 1/16“ 3 µl PEEK, quartz, PTFE 250 ml/min 100 bar	A4096
path length connection volume wetted parts max. flow rate max. pressure	0.5 /1.25 /2 mm 1/8“ 1.7/4.3/6.8 µl SSt, quartz, PTFE 1000 ml/min 200 bar	A4078
path length connection volume wetted parts max. flow rate max. pressure	0.5 /1.25 /2 mm 1/8“ 1.7/4.3/6.8 µl PEEK, quartz, PTFE 1000 ml/min 100 bar	A4079
path length connection volume wetted parts max. flow rate max. pressure	0.5 /1.25 /2 mm 1/4“ 1.7/4.3/6 µl SSt, quartz, PTFE 10000 ml/min 200 bar	A4081
Fiber optics adapter kit	including fiber optics adapter, fiber optic cables and mounting bracket Ideal for semi-preparative and preparative remote flow cells	AMKX8KIT

Fiber optic cables

Name	Order Number
2 x fiber optics, 750 mm	A0740
2 x fiber optics, 750 mm, high temperature up to 85°C	A0740HT
2 x fiber optics, custom made	A0743

Chemical compatibility of wetted parts

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

General

The device is very resistant against a variety of commonly used eluents. However, make sure that no eluents or water come in contact with the device or enter into the device. Some organic solvents (such as chlorinated hydrocarbons, ether) may cause coating damage or loosen glued components by improper handling. Even small quantities of other substances,

such as additives, modifiers, or salts can influence the durability of the materials. Exposure time and concentration have a high impact on the resistance.

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

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

Plastics

Polyetheretherketone (PEEK)

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

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

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

Polyethylene terephthalate (PET, outdated PETP)

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

Polyimide (Vespel®)

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

Ethylene-tetrafluorethylene copolymer (ETFC, Tefzel®)

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

Perfluorethylenpropylene copolymer (FEP), perfluoroalkoxy copolymer (PFA)

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

Polyoxymethylene (POM, POM-H-TF)

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

Polyphenylene sulfide (PPS)

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

Polytetrafluorethylene (PTFE, Teflon®)

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

Systec AF™

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

Polychlortrifluorethylene (PCTFE, Kel-F®)

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

Fluorinated rubber (FKM)

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

Perfluorinated rubber (FFKM)

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

Non-metals

Diamond-like carbon (DLC)

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

Ceramic

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

Mineral wool

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

Glass, glass fibre, quartz, quartz glass

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

Metals

Stainless steel

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

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

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

Hastelloy®-C

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

Titanium, titanium alloy (TiA16V4)

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

Legal information

Transport damage

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

Warranty conditions

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

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

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

- packaging and transport damage

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

KNAUER Wissenschaftliche Geräte GmbH
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e-mail: support@knauer.net
Internet: www.knauer.net

Warranty seal

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

Declaration of conformity

The Declaration of Conformity accompanies the product as a separate document.

Disposal

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

AVV marking in Germany

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

WEEE registration

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

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

Solvents and other operating materials

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

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

HPLC glossary

In the following chapter you find abbreviations and terminology that is used in HPLC.

Term	Definition
absorption	The process of retention in which the solute partitions into a liquid-like coating.
adsorption	A process of retention in which the interactions between the solute an dthe surface of an adsorbent dominate.
analytical	Qualitative analysis of samples in HPLC
backflushing	Useful in chromatography to remove compounds that are held strongly at the head of a column.
calibration	A process for correcting measuring values by the value that a measuring device deviates from the standard.
capillary	Tubing to connect various parts of the chromatograph in order to direct flow to the proper place.
carrier	Refers to the support that is used to attach the active ligand, usually by a covalent bond.
chromatogram	A plot of detector signal output versus time or elution volume during the chromatographic process.
column	The tube and stationary phase through which mobile phase flows resulting in a chromatographic separation.
correction factor	factor that arithmetically corrects device-related deviations from measuring values
dead volume	Dead volume is extra volume experienced by solutes as they pass through a chromatographic system, in particular any unswept volume exposed to the mobile phase flow.
degassing	The process of removing dissolved gas from the mobile phase prior or during use.
detector	device measuring the composition or the quantity of a substance
gradient	A process to change solvent strength as a function of time (normally solvent strength increases) thereby eluting progressively more highly retained analytes.
isocratic	mode of sample separation where the composition of a solvent remains constant
Luer-Lock	a standardized connector between syringes and cannulas
mobile phase	The fluid that moves solutes through the column.
packing	The adsorbent, gel, or solid support used in the chromatography column.
preparative	Isolating the maximum amount of a substance in a short amount of time in a required purity
response time	Time for a detector to respond to ~90 % of the incoming solute amount. The response time is generally taken as 2–4 times the time constant.

Term	Definition
retention time	The time required from an injection of a substance until the maximum concentration of a substance becomes visible.
sample	A mixture of different components which are to be separated via chromatography. The components are moved by the mobile phase and dissolved from the column.
sample loop	A loop which is separate from a chromatographic system and which the sample is injected to. After a switch is actuated, the solvent flow passes the loop and the sample is flushed onto the column.
solute	The dissolved component of a mixture that is to be separated in the chromatographic column.
solvent	The liquid used to dissolve a sample for the injection into a chromatography column or CE capillary.
stationary phase	The immobile phase involved in the chromatographic process. It is the liquid or the liquid film on the surface of the packing material.

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