IC equipment

Dialysis 6.5330.100 | Dialysis Low Volume 6.5330.200

Manual

8.110.8028EN / 2020-10-30

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

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1 Introduction

1.1 Description of IC equipment: Dialysis | Dialysis Low Volume

The IC equipment: Dialysis 6.5330.100 | Dialysis Low Volume 6.5330.200 contains all accessory parts required for Inline Dialysis of matrix-contaminated samples (e.g. emulsions, samples containing fat and protein, body fluids or waste waters with high pollution loads) directly before injection.

The main component of the IC equipment is the high-performance dialysis cell. The ions travel through the semipermeable membrane, diffusing out of the flowing sample and into the stationary acceptor solution, where they are preconcentrated. The ion-preconcentrated acceptor solution is then subsequently injected directly into the IC system.

To operate the dialysis cell, you need an IC system with a peristaltic pump and a cell holder as well as a Sample Processor with a peristaltic pump.

1.2 Product versions

The IC equipment: Dialysis | Dialysis Low Volume is available in the following versions.

Table 1 Product versions

Art. no.	Designation	Version feature	Volume dialysis cell
6.5330.100	IC equipment: Dialysis	Dialysis cell (6.2729.100)	240 µL
6.5330.200	IC equipment: Dialysis Low Volume	Low Volume dialysis cell (6.2729.200)	60 µL

The Low Volume dialysis cell (6.2729.200) requires a lower sample volume than the dialysis cell (6.2729.100). The lower sample volume means that transfer time, dialysis time, and the total analysis time are shorter.

1.3 About the documentation

This manual describes the correct assembly and maintenance of the IC equipment, as well as the installation of the capillary connections to and from the dialysis cell. In addition, it describes how the dialysis works and provides information on applying and optimizing the dialysis.

The installation of the peristaltic pump is not described in this manual. This description can be found in the respective manuals for the ion chromatograph or respectively the Sample Processor.

CAUTION

Please read through this documentation carefully before putting the IC equipment: Dialysis | Dialysis Low Volume into operation. The documentation contains information and warnings which the user must follow in order to ensure safe operation of the IC equipment: Dialysis | Dialysis Low Volume.

1.4 Symbols and conventions

The following symbols and formatting may appear in this documentation:

*(5-**12**)*	**Cross-reference to figure legend** The first number refers to the figure number, the second to the instrument part in the figure.
1	**Instruction step** Carry out these steps in the sequence shown.
Method	**Dialog text**, **parameter** in the software
File ► New	Menu or menu item
[Next]	**Button** or **key**
	**WARNING** This symbol draws attention to a possible life-threatening hazard or risk of injury.
	**WARNING** This symbol draws attention to a possible hazard due to electrical current.

	**WARNING** This symbol draws attention to a possible hazard due to heat or hot instrument parts.
	**WARNING** This symbol draws attention to a possible biological hazard.
	**CAUTION** This symbol draws attention to possible damage to instruments or instrument parts.
	**NOTE** This symbol highlights additional information and tips.

2 Overview

2.1 Parts of the IC equipment: Dialysis | Dialysis Low Volume

Figure 1 IC equipment: Dialysis | Dialysis Low Volume – Parts

* Parts of IC equipment: Dialysis	** Parts of the IC equipment: Dialysis Low Volume

2.2 Parts of the dialysis cell

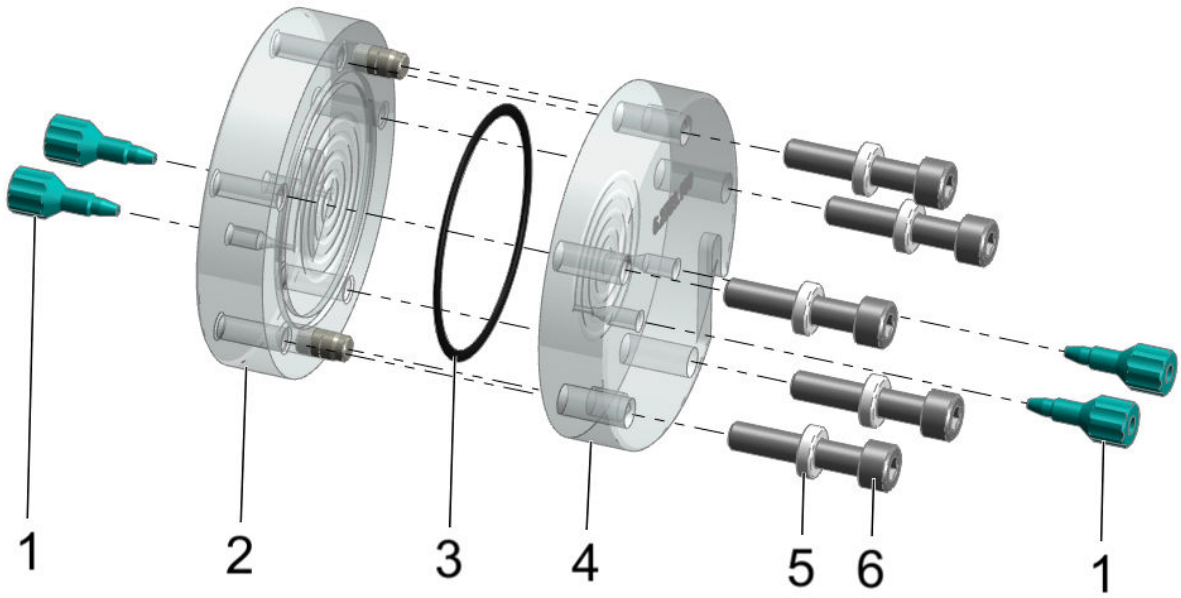


Figure 2 Dialysis cell – Parts

1	**Stopper**	**2**	**Donor chamber**
3	**Sealing ring**	**4**	**Acceptor chamber**
5	**Washers**	**6**	**Screws** For joining the acceptor and the donor chamber.

2.3 Dialysis cell connectors

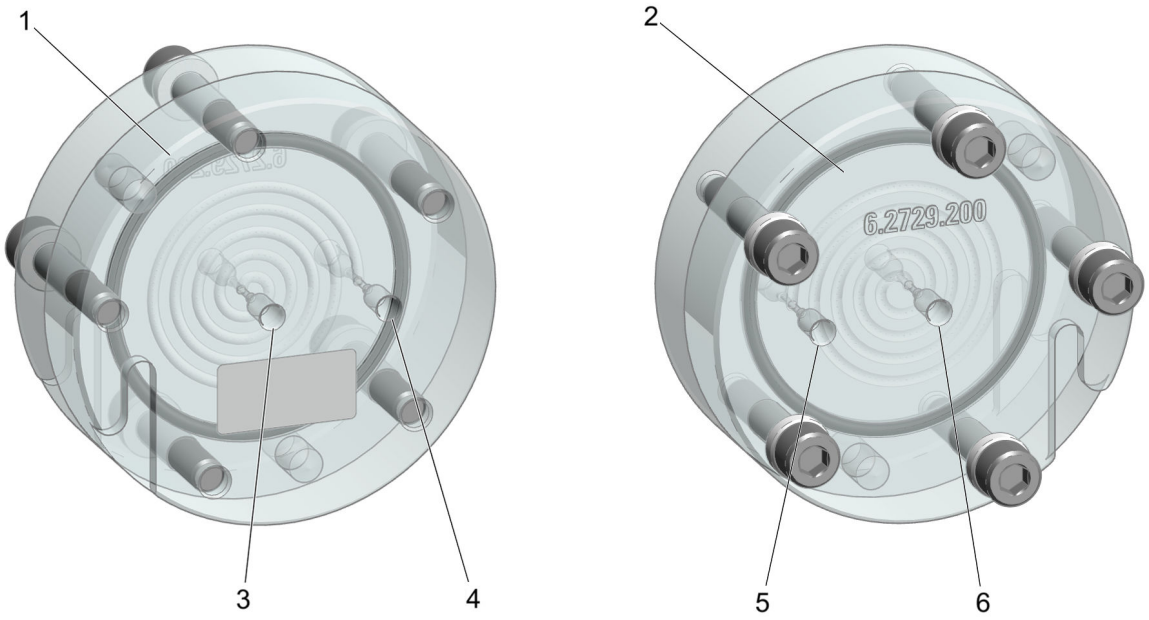


Figure 3 Dialysis cell – Connectors

1	**Donor chamber**	**2**	**Acceptor chamber**
3	**Outlet – Sample**	**4**	**Inlet – Sample**
5	**Inlet – Acceptor solution**	**6**	**Outlet – Acceptor solution**

NOTICE

The product number (6.2729.200) is only engraved in the Low Volume dialysis cell.

2.4 Mode of operation for dialysis

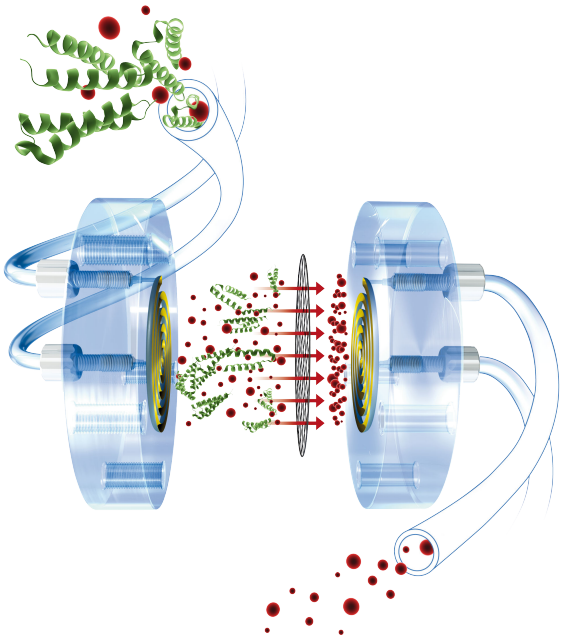


Figure 4 Stopped-flow dialysis

Sample is delivered continuously on the sample side of the dialysis cell. After a rinsing phase, the acceptor flow is stopped. Because of the concentration gradient, the ions pass through the membrane. The acceptor flow remains stationary until a concentration equilibrium is achieved between the two cell halves. The concentration in the acceptor solution thus matches the concentration of the original sample. Afterwards, the acceptor solution is injected directly into the ion chromatograph.

3 Installation

This chapter describes the assembly and connection of the dialysis cell and the conditioning of the dialysis system.

Depending on the ion chromatograph, the dialysis cell may be placed at different locations. Please observe the following recommendations:

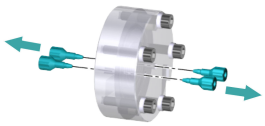
- If you are working with an ion chromatograph that has a peristaltic pump and a cell holder, then place the dialysis cell in the cell holder.
- If you are working with an ion chromatograph that has a peristaltic pump but no cell holder, then place the dialysis cell holder (6.2057.130) in the detector chamber of your ion chromatograph.

3.1 Preparing the dialysis cell

Required tools

- Dialysis cell
  - Dialysis cell (6.2729.100)*
  - Low Volume dialysis cell (6.2729.200)**
- Dialysis membrane (6.2714.010)
- Hex key (6.2621.070)
- Tweezers (6.2831.010)

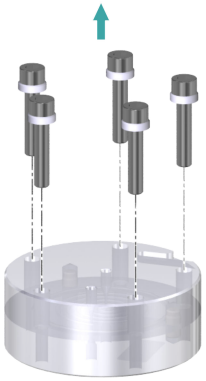
1 Removing the stoppers



- Remove the four green stoppers.
- Turn the dialysis cell around and place it on a table.

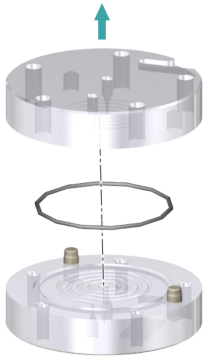
The screws face upwards.

2 Removing the screws



- Loosen the screws with the hex key.
- Remove the screws with the washers and put them aside.

3 Disassembling the dialysis cell



- Remove the upper part of the dialysis cell.
- Remove the sealing ring.

4 Cleaning the dialysis cell

CAUTION

Damage to the dialysis cell

Organic solvents (e.g. acetone) corrode and damage the dialysis cell material (PMMA).

- Use only ultrapure water or a water-ethanol mixture (70:30) for cleaning the dialysis cell.
- For samples that contain organic components (e.g. solvents), use the PEEK dialysis cell (6.2729.120). This cell has an excellent chemical resistance to organic chemicals.

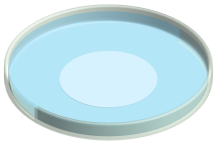
- Thoroughly rinse off the sealing ring *(2-**3**)*, the donor chamber *(2-**2**)* and the acceptor chamber *(2-**4**)* of the dialysis cell with ultrapure water.
- Dry all parts with a lint-free cloth.

5 Wetting the dialysis membrane

NOTICE

In the package containing the dialysis membranes, you will find sheets of different thicknesses and colors:

- The firm white cardboard is a cover protecting the filtration membranes. Do not place it in the dialysis cell.
- The thin light-blue sheets are separation sheets placed between two filtration membranes. Do not place them in the dialysis cell.
- The thin white sheets are the dialysis membranes. Use only these for dialysis.

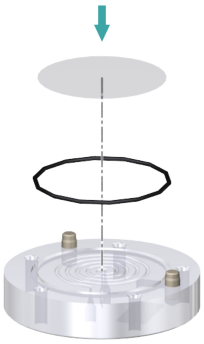


- Using the tweezers, take a new dialysis membrane out of the package.
- Place the dialysis membrane in a petri dish filled with ultrapure water and allow to hydrate for approx. two minutes.

6 Inserting the dialysis membrane

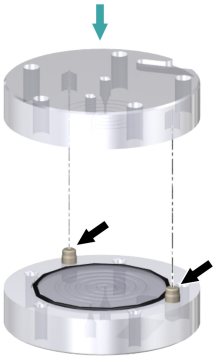
NOTICE

Make sure that the water-soaked dialysis membrane does not dry out before it is inserted, as it can otherwise no longer be used.



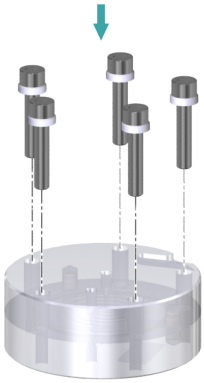
- Place the sealing ring back in the recess.
- Using the tweezers, place the wet dialysis membrane centrally inside the sealing ring onto the cell.

7 Assembling the dialysis cell



- Place the upper part of the dialysis cell on the lower part in such a way that the two guide bolts fit exactly into the two bore holes.

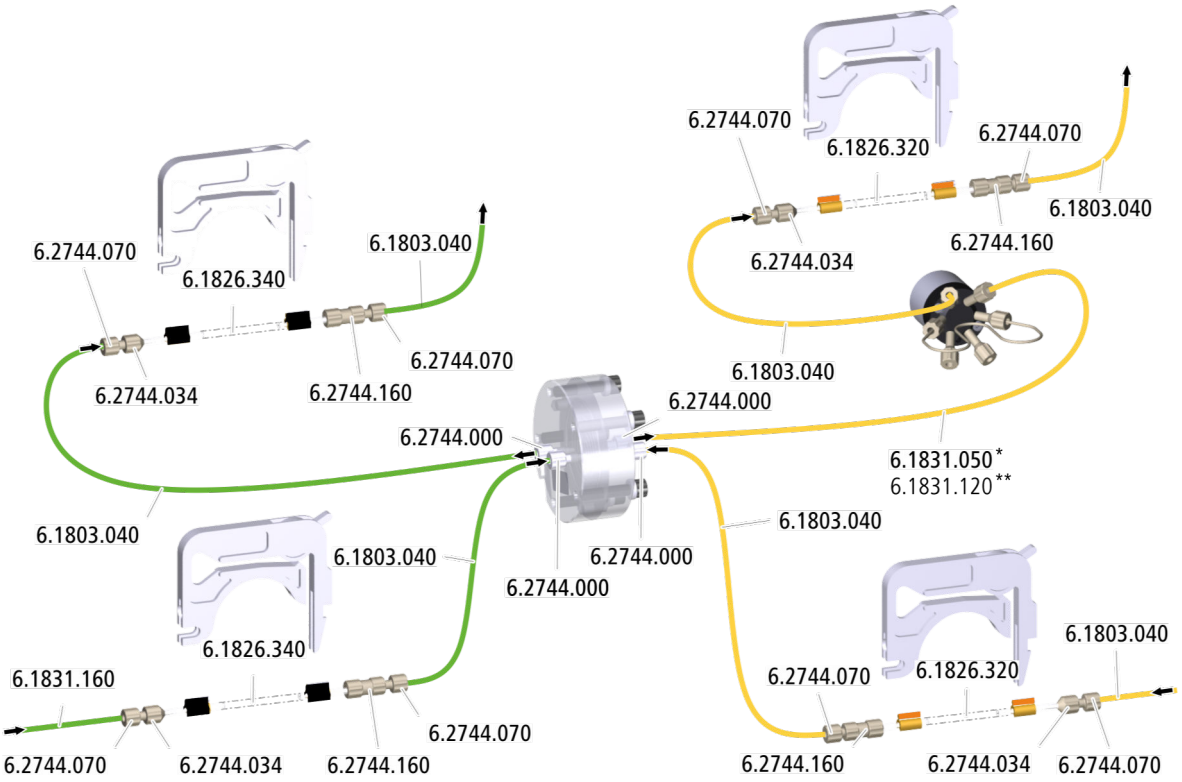
8 Screwing the dialysis cell together



- Screw the five screws with the washers in the dialysis cell by hand first.
- Then firmly tighten them with the hex key in crosswise sequence.

3.2 Connecting the dialysis cell

This chapter describes how to establish the capillary connections of the dialysis system. It does not, however, describe the tubing configuration for the peristaltic pump. Please refer to the *chapter "Installing the peristaltic pump" in the manual for the Sample Processor or the ion chromatograph* for this information.



*	Parts of IC equipment: Dialysis

**	Parts of IC equipment: Dialysis Low Volume

Connections for acceptor solution

Required accessories

- Dialysis cell
  - Dialysis cell (6.2729.100)*
  - Low Volume dialysis cell (6.2729.200)**
- PTFE capillary, 0.5 mm ID / 1 m (6.1803.040)
- Pump tubing LFL (orange/yellow), 3 stoppers (6.1826.320)
- Pump tubing LFL (black/black), 3 stoppers (6.1826.340)
- PEEK capillary
  - 0.5 mm ID / 40 cm (6.1831.050)*
  - 0.25 mm ID / 45 cm (6.1831.120)**

- PEEK capillary, 0.5 mm ID / 70 cm (6.1831.160)
- Pressure screw PVDF (6.2744.000)
- Coupling olive/UNF 10/32 (6.2744.030)
- Pressure screw, short (6.2744.070)
- Pump tubing connection with locking nut (6.2744.160)

We recommend using the peristaltic pump in the ion chromatograph for conveying the acceptor solution.

The acceptor solution is pumped with two pump tubings with yellow/orange stoppers (6.1826.320). Additional information on the tubing configuration of the peristaltic pump can be found in the *chapter "Installing the peristaltic pump" in the manual for your ion chromatograph*.

1 Preparing two pump tubings for the sample

Use the two pump tubings with black stoppers (6.1826.340) for conveying the sample. Proceed as follows for each tubing:

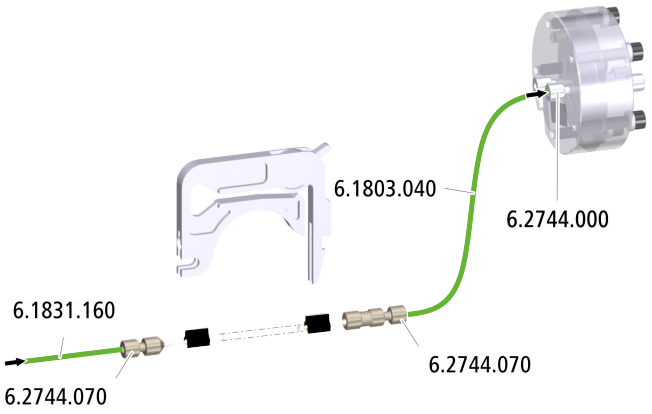
- Attach the coupling olive/UNF 10/32 (6.2744.034) to the inlet.
- Attach the pump tubing connection with locking nut (6.2744.160) to the outlet *(see chapter "Installing the peristaltic pump" in the manual for the ion chromatograph or in the manual for the Sample Processor)*.

2 Preparing two pump tubings for the acceptor solution

Use the two pump tubings with orange/yellow stoppers (6.1826.320) for conveying the acceptor solution. Proceed as follows for each tubing:

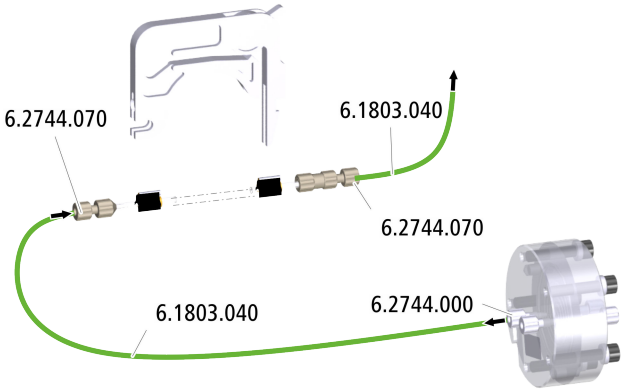
- Attach the coupling olive/UNF 10/32 (6.2744.034) to the inlet.
- Attach the pump tubing connection with locking nut (6.2744.160) to the outlet *(see chapter "Installing the peristaltic pump" in the manual for the ion chromatograph or in the manual for the Sample Processor)*.

3 Connecting the sample inlet



- Tighten the PEEK capillary, 0.5 mm ID / 70 cm (6.1831.160), to the inlet of the pump tubing with black stoppers (6.1826.340) using a pressure screw (6.2744.070).
  Connect the other end of the PEEK capillary to the needle of the Sample Processor *(see manual for the Sample Processor)*.
- Tighten a PTFE capillary, 0.5 mm ID / 1 m (6.1803.040), to the outlet of the pump tubing with black stoppers (6.1826.340) using a pressure screw (6.2744.070).
  Tighten the other end of the PTFE capillary to the sample inlet of the dialysis cell *(3-**4**)* using a pressure screw (6.2744.000).

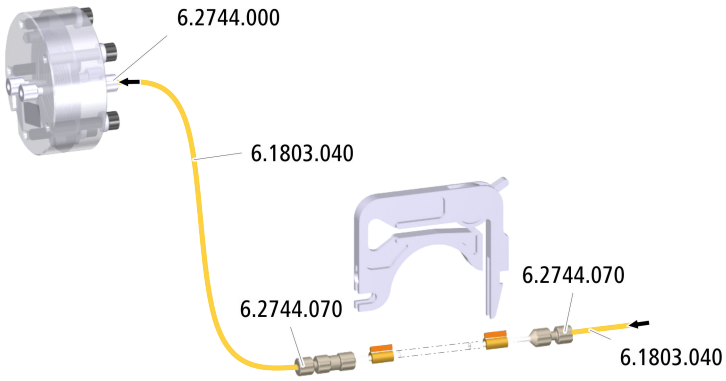
4 Connecting the sample outlet



- Tighten a PTFE capillary 0.5 mm ID / 1 m (6.1803.040), to the sample outlet of the dialysis cell *(3-**3**)* using a pressure screw (6.2744.000).
  Tighten the other end of the PTFE capillary to the inlet of the second pump tubing with black stoppers (6.1826.340) using a pressure screw (6.2744.070).

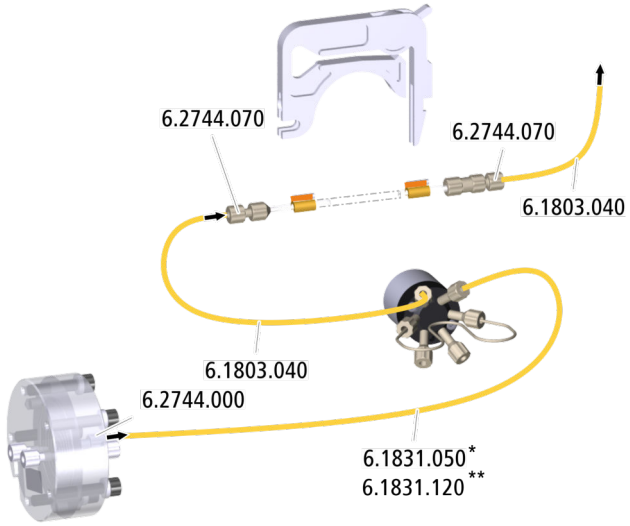
- Tighten another PTFE capillary, 0.5 mm ID / 1 m (6.1803.040), to the outlet of the second pump tubing with black stoppers (6.1826.340) using a pressure screw (6.2744.070).
  Tighten the other end of the PTFE capillary to the waste container.

5 Connecting the inlet of the acceptor solution



- Tighten a PTFE capillary (6.1803.040) to the inlet of the pump tubing with orange/yellow stoppers (6.1826.320) using a pressure screw (6.2744.070).
  Immerse the other end of the PTFE capillary in the vessel containing the acceptor solution (6.1808.070 with 6.1602.150) and fasten with a PVDF pressure screw (6.2744.000).
- Tighten another PTFE capillary (6.1803.040) to the outlet of the pump tubing with orange/yellow stoppers using a pressure screw (6.2744.070).
  Tighten the other end of the PTFE capillary to the acceptor inlet of the dialysis cell *(3-**5**)* using a pressure screw (6.2744.000).

6 Connecting the outlet of the acceptor solution

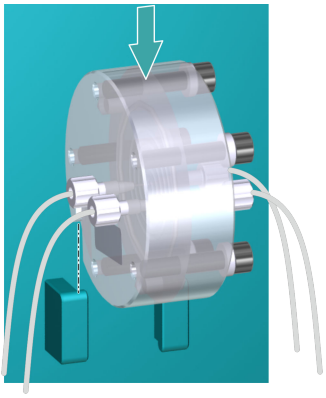


- For the **Dialysis cell (6.2729.100)**, tighten the PEEK capillary 0.5 mm ID / 40 cm (6.1831.050)* to the acceptor outlet of the dialysis cell *(3-**6**)* using a pressure screw (6.2744.000).
  For the **Low Volume dialysis cell (6.2729.200)**, tighten the PEEK capillary 0.25 mm ID / 45 cm (6.1831.120)** to the acceptor outlet of the dialysis cell *(3-**6**)* using a pressure screw (6.2744.000).
  Tighten the other end of the PEEK capillary to the sample inlet of the injection valve (Port 1) using a pressure screw (6.2744.010).
- Tighten a PTFE capillary, 0.5 mm ID / 1 m (6.1803.040), to the sample outlet of the injection valve (Port 2) using a pressure screw (6.2744.010).
  Tighten the other end of the PTFE capillary to the inlet of the second pump tubing with orange/yellow stoppers (6.1826.320) using a pressure screw (6.2744.070).
- Tighten another PTFE capillary, 0.5 mm ID / 1 mm (6.1803.040), to the outlet of the second pump tubing with orange/yellow stoppers (6.1826.320) using a pressure screw (6.2744.070).
  Tighten the other end of the PTFE capillary to the waste container.

3.3 Inserting the dialysis cell

Inserting the dialysis cell into the ion chromatograph

1

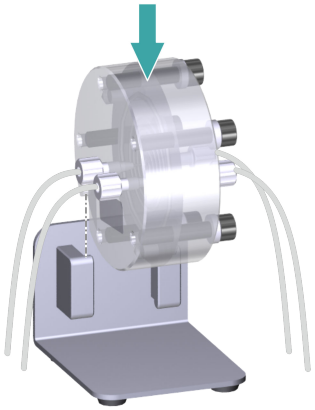


- Insert the dialysis cell into the cell holder provided for this purpose.

Inserting the dialysis cell into the cell holder vertically

If the ion chromatograph is not equipped with a cell holder, then the dialysis cell with the dialysis cell holder (6.2057.130) can be used.

1

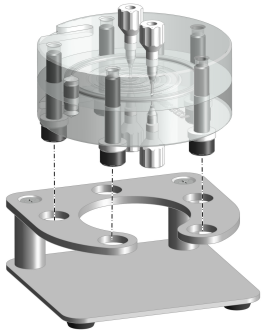


- Insert the dialysis cell into the dialysis cell holder (6.2057.130).
- Insert the dialysis cell with the dialysis cell holder into the detector chamber of the ion chromatograph.

Inserting the dialysis cell into the cell holder horizontally

If the ion chromatograph is not equipped with a cell holder, then the dialysis cell with the dialysis cell holder (6.2057.120) can be used.

1



- Insert the dialysis cell into the dialysis cell holder (6.2057.120).
- Insert the dialysis cell with the dialysis cell holder into the detector chamber of the ion chromatograph.

3.4 Conditioning the dialysis system

Prior to the first analysis, the dialysis cell with dialysis membrane in place and all capillaries must be rinsed with ultrapure water.

1 Setting the injection valve

Set the injection valve to the **FILL** position in the software.

2 Putting both peristaltic pumps into operation

- Immerse the aspiration capillary in the acceptor solution (degassed ultrapure water).
- Use the software to switch on both peristaltic pumps.
- Adjust the contact pressure on both peristaltic pumps *(see the chapter "Installing the peristaltic pump" in the manual for the ion chromatograph or the Sample Processor)*.

3 Conditioning the dialysis system

- Rinse the dialysis system with ultrapure water for 20 min.
- Check whether equal amounts of solution are emerging from both feed lines to the waste container.
- Check whether all capillary connections are tight.
  If liquid is escaping somewhere, then tighten the corresponding connection or redo the connection.
- Check whether any air bubbles remain trapped in the dialysis cell.
  If air bubbles are trapped in the cell, then unscrew the PEEK capillary and the PTFE capillary, *(3-**3**)* and *(3-**6**)*, from the outlets of the dialysis cell and wait until the air bubbles have escaped. Afterwards, tighten the capillaries to the dialysis cell again.

4 Operation and maintenance

4.1 Operation

4.1.1 Optimizing the dialysis

Determining the rinsing time

The dialysis cell is rinsed twice. Rinse the dialysis cell with sample during 2 minutes before the dialysis. After dialysis, rinse the dialysis cell with a rinsing solution, e.g. ultrapure water, during 5 to 6 minutes. The sample channel and the acceptor channel must be completely rinsed. Increase the rinsing times if necessary.

Determining the transfer time

The time for the transfer of the preconcentrated acceptor solution into the sample loop must be chosen in such a way that the part of the acceptor solution with the highest ion concentration will be transferred into the sample loop.

The optimum transfer time should be determined for each analysis problem on the basis of measurements of the individual ion concentrations in relation to the transfer time and periodically verified.

1 Initial measurement

- Set the following values in the software:
  - Dialysis cell (6.2729.100)
    Transfer time: 15 s
    Dialysis time: 10 min
  - Low Volume dialysis cell (6.2729.200)
    Transfer time: 10 s
    Dialysis time: 6 min
- Immerse the sample aspiration capillary in a standard solution with 10 mg/L of the desired anion or cation.
- Start the determination with the appropriate method in the software and wait until the chromatogram has been evaluated.

2 Additional measurements

- Increase the transfer time in the software by 5 s each time and start the determination.
- Repeat the measurements until the measured area starts to decrease again.

3 Determining the optimum transfer time

- Record the area in relation to the transfer time and determine the optimum transfer time.
  Figure 5 exemplifies this relation.

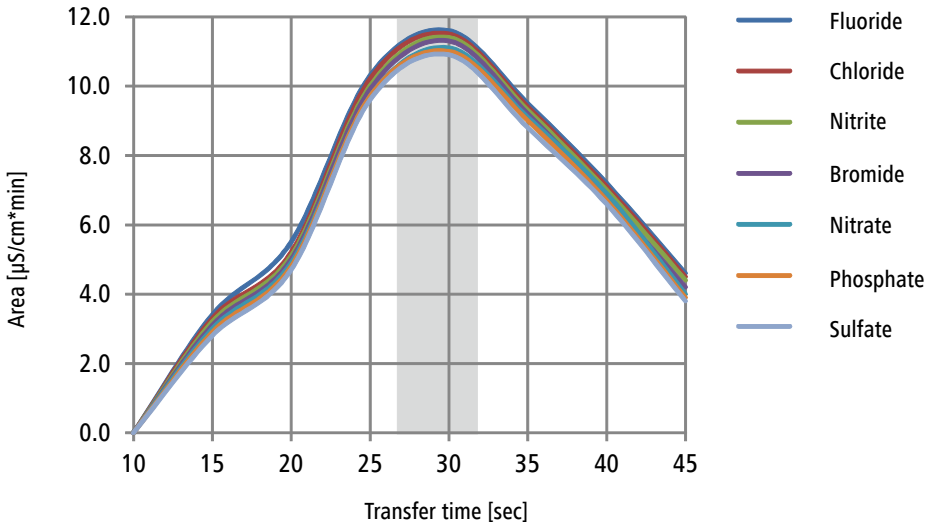


Figure 5 Area / transfer time diagram

According to this curve, the optimum transfer time at peristaltic pump rate 2 is between 27 and 32 seconds.

Determining the dialysis time

After the optimum transfer time has been established, the optimum dialysis time must be determined. This time depends on the total ion concentration in the sample.

The dialysis time is the time during which the acceptor flow is stopped and only sample is pumped. This time must be chosen in such a way that 100% of the sample concentration is achieved in the acceptor solution.

For the **dialysis cell (6.2729.100)** with the dialysis membrane (6.2714.010) (cellulose acetate; thickness = 115 µm; pore size = 0.2 µm), a total ion concentration of ≥ 5 mg/L in the sample and a peristaltic pump rate of 3, the guideline value for the dialysis time is 10 minutes.

For the **Dialysis cell Low Volume (6.2729.200)** with the dialysis membrane (6.2714.010) (cellulose acetate; thickness = 115 µm; pore size = 0.2 µm), a total ion concentration of ≥ 5 mg/L in the sample and a peristaltic pump rate of 2, the guideline value for the dialysis time is 6 minutes.

This guideline value must be verified for each installation.

1 Measuring the standard solution without dialysis

- Remove the capillary that is connected to the dialysis cell outlet for the acceptor solution *(3-**6**)* and immerse it in a standard solution with approximately the same total ion concentration as the sample.
- In the software, start a determination that measures the standard solution directly (i.e. without dialysis).
- Reconnect the capillary to the dialysis cell outlet for the acceptor solution *(3-**6**)* and rinse the acceptor channel for two minutes.
- In the software, stop the peristaltic pump for the acceptor channel.

2 Measuring the standard solution with dialysis

- Set the dialysis time in the software to 5 minutes.
- Immerse the sample aspiration capillary in the standard solution used in step 1.
- Start a determination in the software and wait until the chromatogram has been evaluated.

3 Additional measurements

- Increase the dialysis time in the software by 1 minute each time and start the determination.
- Repeat the measurements until the measured values are stable.

4 Determining the optimum dialysis time

- The recovery rates can be calculated from the result without dialysis and the results with dialysis. You can determine the optimum dialysis time by recording the recovery rate in relation to the dialysis time.

4.1.2 Recommended procedure for the dialysis

For sample determination with dialysis, it is best to proceed according to the following sequence:

Carrying out a dialysis

1 Preparing the acceptor solution

- To avoid disruptions caused by air bubbles in the acceptor flow, degas the ultrapure water used as acceptor solution for at least 10 minutes.

2 Preparing the sample

- To avoid blockage of the sample channel, always centrifuge samples with a high content of suspended or solid particles in a tabletop centrifuge for 5 minutes at 10,000 rpm.

3 Putting the IC system into operation

- Switch on all required devices.
- Start the software and load the required IC system.
- Condition the IC system.

4 Putting the dialysis system into operation

- Immerse the aspiration capillary for the acceptor solution in the acceptor solution.
- Immerse the sample aspiration capillary in a rinsing solution (e.g. ultrapure water).
- Start both peristaltic pumps in the software.
- Rinse the dialysis system with the acceptor solution and the rinsing solution for approx. 10 minutes and then switch off the peristaltic pumps again.

5 Calibrating the IC system

- Immerse the sample aspiration capillary in the standard solution.
- Start the determination in the software and wait until the standard chromatogram has been evaluated.
- Repeat the two steps for all standard solutions.

6 Determining the sample

- Immerse the sample aspiration capillary in the sample solution.
- Start the determination in the software and wait until the chromatogram has been evaluated.

7 Rinsing the dialysis system

- After the end of the measurements, immerse the sample aspiration capillary in the rinsing solution.
- Switch on the peristaltic pump for the sample channel in the software.
- Rinse the dialysis system with the acceptor solution and the rinsing solution for approx. 10 minutes and then switch off the peristaltic pumps again.

8 Taking the dialysis system out of operation

- If the dialysis cell is taken out of operation, then you have to rinse the acceptor channel and the sample channel with ultrapure water for approx. 10 minutes.
  Then remove all four capillaries of the dialysis cell and close each opening with a threaded stopper (6.2744.060).
- If the dialysis cell is taken out of operation for a longer period, then you have to remove the dialysis membrane and clean the dialysis cell *(see chapter 3.1, page 8)*.
- Release the contact pressure in order to relieve the pump tubings (*see the chapter "Peristaltic pump" in the manual for the Sample Processor*).

4.2 Maintenance

The dialysis membrane may need to be replaced:

- if the signal intensity during dialysis decreases.
- if the dialysis membrane dries out.
- if the dialysis membrane becomes damaged as a result of depositions or bacterial growth.
- if the sample channel is blocked (i.e., the sample can no longer be pumped through the dialysis cell).

Replacing the dialysis membrane

1 Disassembling the dialysis cell

- Unscrew the four capillaries from the dialysis cell and remove the cell from the cell holder.
- Remove the five screws completely with the hex key (6.2621.070) and disassemble the dialysis cell.
- Remove the used dialysis membrane.

2 Preparing the dialysis membrane

Carry out steps 2 to 8 in *Chapter 3.1 Preparing the dialysis cell on page 8*.

3 Connecting the dialysis cell

- Tighten the sample inlet capillary to the dialysis cell inlet for the sample *(3-**4**)* using a PVDF pressure screw (6.2744.000).
- Tighten the sample outlet capillary to the dialysis cell outlet for the sample *(3-**3**)* using a PVDF pressure screw (6.2744.000).

- Tighten the acceptor inlet capillary to the dialysis cell inlet for the acceptor solution *(3-**5**)* using a PVDF pressure screw (6.2744.000).
- Tighten the acceptor outlet capillary to the dialysis cell outlet for the acceptor solution *(3-**6**)* using a PVDF pressure screw (6.2744.000).

4 Conditioning the dialysis system

(see chapter 3.4, page 18).

5 Technical specifications

5.1 Dialysis cell (6.2729.100)

Material	PMMA (poly(methyl methacrylate))
Solvent compatibility	Water or water-ethanol mixture (70:30) (**no** other organic solvents)

5.2 Low Volume dialysis cell (6.2729.200)

Material	PMMA (poly(methyl methacrylate))
Solvent compatibility	Water or water-ethanol mixture (70:30) (**no** other organic solvents)

5.3 Dialysis membrane (6.2714.010)

Pore diameter	0.20 µm
Membrane diameter	47 mm
Material	Cellulose acetate

5.4 Dialysis membrane (6.2714.030)

Pore diameter	0.15 µm
Membrane diameter	47 mm
Material	Polyamide

6 Accessories

Up-to-date information on the scope of delivery and optional accessories for your product can be found on the Internet. You can download this information using the article number as follows:

Downloading the accessories list

1. Enter *https://www.metrohm.com/* into your Internet browser.
2. Enter the article number (e.g. **Dialysis Low Volume 6.5330.200**) into the search field.

   The search result is displayed.
3. Click on the product.

   Detailed information regarding the product is shown on various tabs.
4. On the **Included parts** tab, click on **Download the PDF**.

   The PDF file with the accessories data is created.

NOTICE

When you receive your new product, we recommend downloading the accessories list from the Internet, printing it out and keeping it together with the manual for reference purposes.

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