833 IC Liquid Handling Unit

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Instructions for Use
8.833.1003

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Instructions for Use

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Although all the information given in these instructions has been checked with great care, errors cannot be entirely excluded. Should you notice any mistakes please inform the author at the address given above.

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1 Introduction

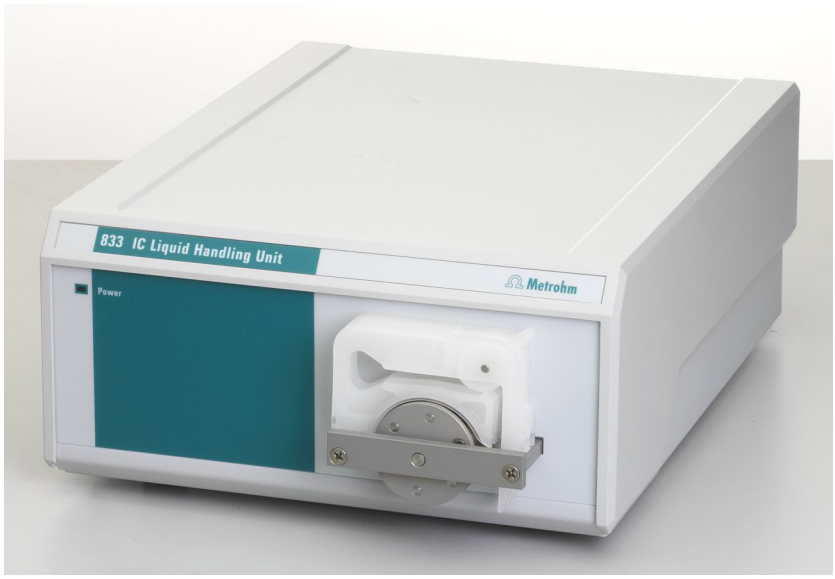
1.1 Instrument description

Within the modular Advanced IC Systems the **833 IC Liquid Handling Unit** is the universal building block for the preliminary preparation and post-treatment of samples and for transporting auxiliary and rinsing solutions. It is available in 5 versions that are matched to the most frequently required applications:

- **2.833.0010 833 IC Liquid Handling Pump Unit**
- **2.833.0020 833 IC Liquid Handling Suppressor Unit**
- **2.833.0030 833 IC Liquid Handling Sample Preparation Unit**
- **2.833.0040 833 IC Liquid Handling Dialysis Unit**
- **2.833.0050 833 IC Liquid Handling Ultrafiltration Unit**

1.1.1 833 IC Liquid Handling Pump Unit

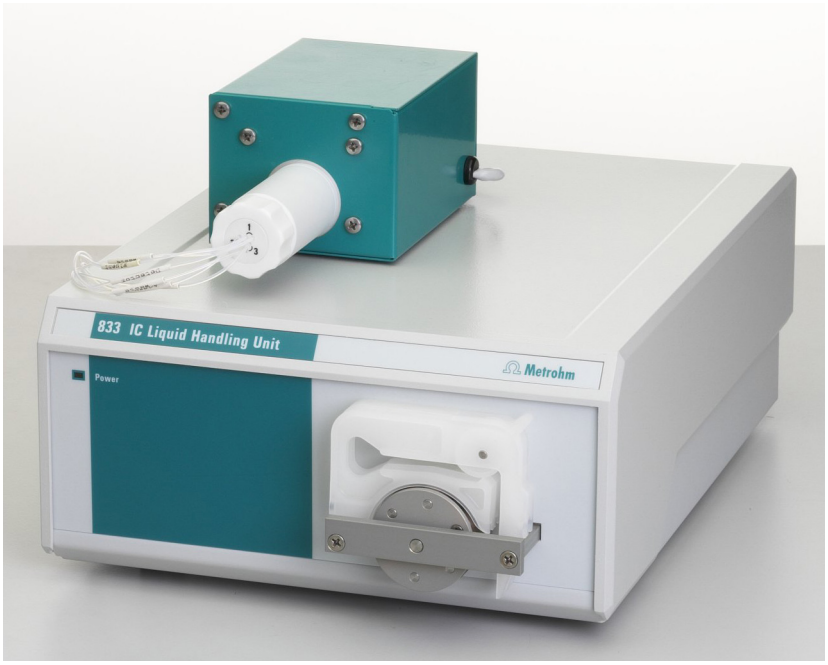
The **833 IC Liquid Handling Pump Unit** corresponds to the basic instrument. It has a 2-channel peristaltic pump and can be included in a modular Metrohm IC system via a remote interface and remotely controlled by the IC Net software.



It can transport two solutions simultaneously and is particularly suitable for the operation of the suppressor module in the **2.820.0230 IC Separation Center** for supplying regeneration and rinsing solution.

1.1.2 833 IC Liquid Handling Suppressor Unit

As well as the basic instrument, the **833 IC Liquid Handling Suppressor Unit** includes a **suppressor module** connected to the basic instrument and also remotely controlled by IC Net.



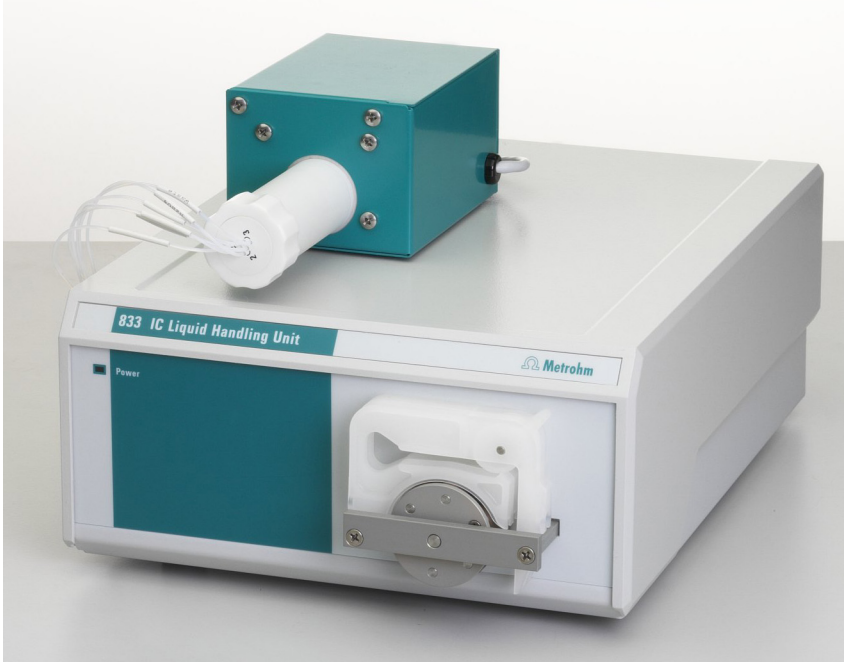
With the suppressor included in the **suppressor module** analyses by ion chromatography with chemical suppression can be carried out. The suppressor consists of a total of 3 suppressor units which are used in rotation for suppression, regeneration with sulfuric acid and rinsing with water. In order that each new chromatogram is recorded under comparable conditions a freshly regenerated suppressor unit is normally used. Switching takes place automatically.

The **833 IC Liquid Handling Suppressor Unit** is particularly suitable for retrofitting existing IC systems for chemical suppression in a simple way. For example, this means that the **833 IC Liquid Handling Suppressor Unit** can be used together with two 819 IC Detectors, two 818 IC Pumps and an 820 IC Separation Center without suppressor (2.820.0220) to realize a complete 2-channel IC system with only a single Separation Center.

1.1.3 833 IC Liquid Handling Sample Preparation Unit

As well as the basic instrument, the **833 IC Liquid Handling Unit** includes a **reactor block (sample preparation module)** that is connected to the basic instrument and also remotely controlled by IC Net.

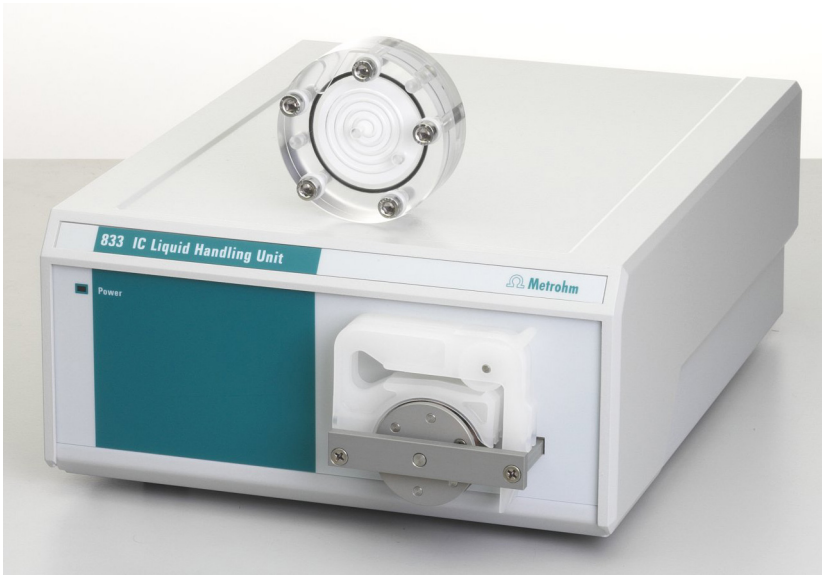
With the cation exchanger built-into the **sample preparation module** such inline sample preparation steps as **neutralization** and **cation separation** can be carried out for analyses by ion chromatography. The sample preparation module contains a total of three units which are used in rotation for cation exchange, regenerated with acid and rinsed with water. In order that each new chromatogram is recorded under comparable conditions a freshly regenerated cation exchanger is normally used. Switching takes place either automatically by the IC system or manually. As sulfate could interfere with the subsequent IC analysis, the cation exchanger of the sample preparation module usually uses perchloric acid ($HClO_4$) instead of sulfuric acid (H_2SO_4) for regeneration.



The **833 IC Liquid Handling Sample Preparation Unit** is particularly suitable for retrofitting a modular IC system for anion analysis for sample preparation in a simple way. Two typical applications (**neutralization:** exchange of e.g. Na^+ for H^+ and **cation separation:** exchange of e.g. heavy metals for H^+) are described in detail in the Instructions for Use. Although the cation exchange technique used is comparable with the principle of suppression of the 833 IC Liquid Handling Suppressor Unit, the 833 IC Liquid Handling Sample Preparation Unit is not suitable for chemical suppression after the separation of anions by ion chromatography.

1.1.4 833 IC Liquid Handling Dialysis Unit

As well as the basic instrument, the **IC Liquid Handling Dialysis Unit 833** includes a **dialysis cell** upstream from the sample injector.



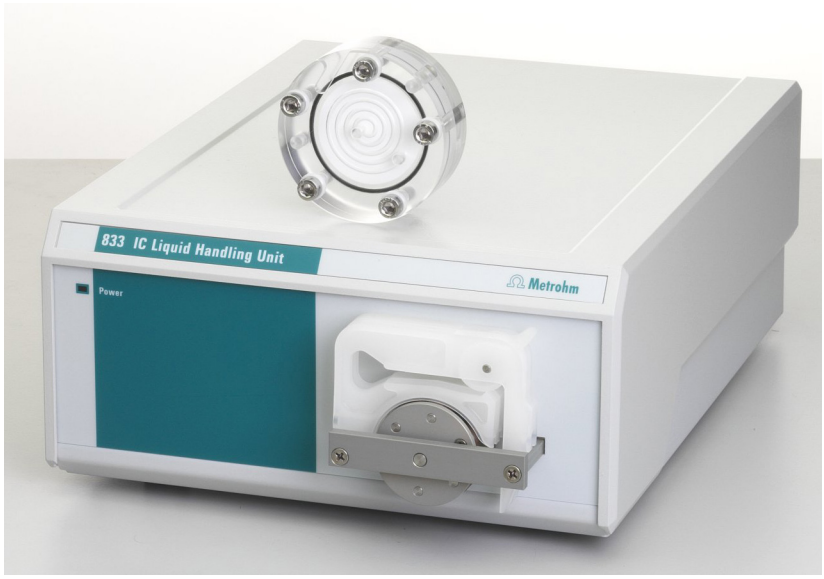
The **833 IC Liquid Handling Dialysis Unit** is used for online sample preparation in ion chromatography and allows the use of automatic sample dialysis immediately before sample injection. As well as the 2-channel peristaltic pump of the basic instrument for transferring the sample and acceptor solution from the **dialysis cell** itself, the ions from the flowing sample solution are enriched in the stationary acceptor solution and then injected directly into the IC system. As a result of this special **stopped flow technique**, for which an application for a patent has been made by Metrohm, 100% sample concentration can be achieved in the acceptor solution and in this way it is possible to carry out calibration with external standards in a very easy manner.

The operation of the **833 IC Liquid Handling Dialysis Unit** requires the use of an 820 IC Separation Center with one injector and an additional 833 IC Liquid Handling Pump Unit for the sample tramsport. These systems, which are described in the Instructions for Use, require the following instruments:

Operation without suppressor		*Operation with suppressor*	
2.819.0110	IC Detector	2.819.0110	IC Detector
2.820.0210	IC Separation Center	2.820.0230	IC Separation Center
2.818.0110	IC Pump	2.818.0110	IC Pump
2.833.0040	IC Liquid Handling Dialysis Unit	2.833.0040	IC Liquid Handling Dialysis Unit
2.833.0010	IC Liquid Handling Pump Unit	2.833.0010	IC Liquid Handling Pump Unit (2 x)

1.1.5 833 IC Liquid Handling Ultrafiltration Unit

As well as the basic instrument, the **IC Liquid Handling Ultrafiltration Unit 833** includes a **filtration cell** upstream from the sample injector.



The **833 IC Liquid Handling Ultrafiltration Unit** is an instrument for online sample preparation in ion chromatography that allows the inline filtration of the sample immediately before it is injected.

The **833 IC Liquid Handling Ultrafiltration Unit** is designed for the filtration of difficult samples that place special demands on the filtration effects and sample throughput.

Of course, all versions of the **833 IC Liquid Handling Unit** can also be used with any other commercially available HPLC components.

1.2 Parts and controls

*In this section you will find the numbers and names of the parts and controls of the 833 IC Liquid Handling Unit. The numbering is valid for the whole of these Instructions for Use, i.e. bold numbers in the text (e.g. **9**) refer to the parts and controls shown here.*

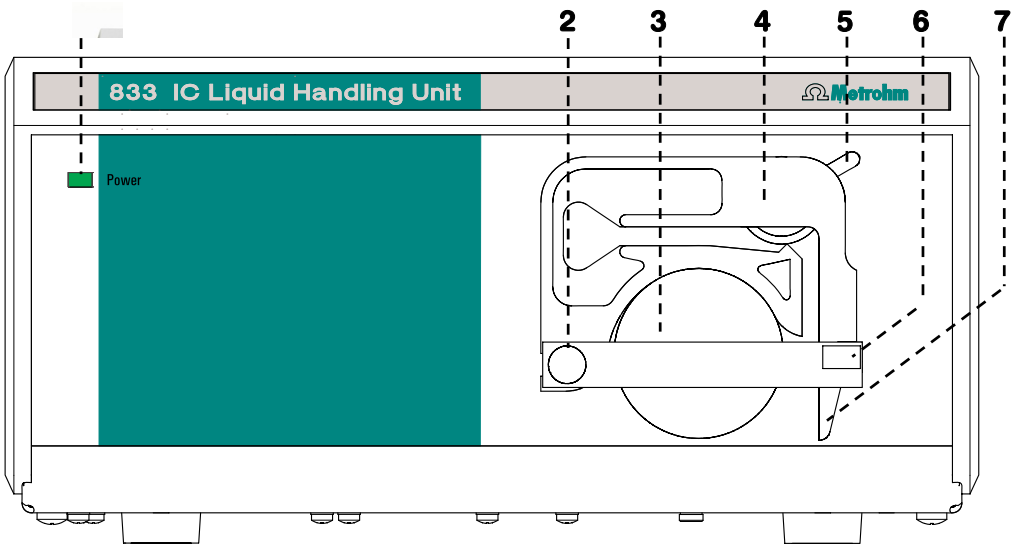


Fig. 1: Front panel of 833 IC Liquid Handling Unit

1 Mains lamp
Lights up when instrument is switched on

2 Holding pin
For inserting the tubing cassettes

3 Pump drive
Roller head with contact rollers

4 Tubing cassette
For 6.1826.0X0 Pump tubing

5 Contact lever
For controlling the contact pressure

6 Holding clip
For clicking the tubing cassette in place

7 Spring lever
For releasing the tubing cassette

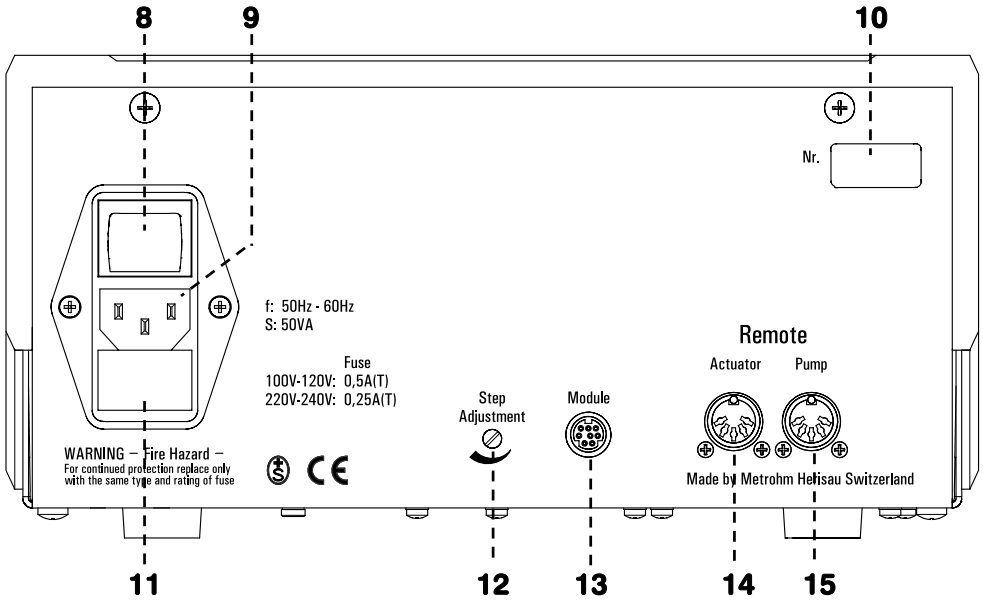


Fig. 2: Rear panelof 833 IC Liquid Handling Unit

8 Mains switch
Switch for switching instrument on/off:
I = ON 0 = OFF

9 Mains connection
Mains connection: see *Section 2.2*

10 Serial number

11 Fuse holder
Changing the fuses: see *Section 2.2.2*.

12 Step adjustment
Adjusts the actuator rotor

13 Module
Connection for suppressor module and sample preparation module

14 REMOTE actuator
Remote interface for actuator
Connection to 761 Compact IC, 819 IC Detector or 830 IC Interface

15 REMOTE pump
Remote interface for pump
Connection to 761 Compact IC, 732/819 IC Detector or 762/830 IC Interface

1.3 Information about these Instructions for Use

Please read through these Instructions for Use carefully before you start to use the 833 IC Liquid Handling Unit. The instructions contain information and warnings that must be observed by the user in order to guarantee the safe use of the instrument.

1.3.1 Arrangement

These **8.833.1003 Instructions for Use** for the 833 IC Liquid Handling Unit provide a comprehensive overview of the installation, start-up, operation and technical specifications of this instrument. They are arranged in the following way:

Sect. 1 **Introduction**
General description of the instrument, numbers and names of the parts and controls, safety information

Sect. 2 **Installation**
Instrument setup, mains connection

Sect. 3 **Basic instrument**
Instrument connection, mounting the pump tubing, control via «IC Net»

Sect. 4 **833 IC Liquid Handling Pump Unit**
Instrument connection

Sect. 5 **833 IC Liquid Handling Suppressor Unit**
Instrument connection, suppressor module handling

Sect. 6 **833 IC Liquid Handling Sample Preparation Unit**
Instrument connection to modular system for cation separation and modular system for neutralization, sample preparation module handling

Sect. 7 **833 IC Liquid Handling Dialysis Unit**
Instrument connection to modular system with manual sample injection, dialysis procedure, dialysis optimization

Sect. 8 **833 IC Liquid Handling Ultrafiltration Unit**
Instrument connection, general information about filtration

Sect. 9 **Troubleshooting -**
Troubleshooting and remedies, care and maintenance

Sect. 10 **Appendix**
Technical data, standard equipment, options, warranty, conformity declarations, index

Please use either the **Table of Contents** or the **Index** to find any information you may require.

1.3.2 Notation and pictograms

The following notation and pictograms (symbols) are used in these Instructions for Use:

Pump	**Menu item, parameter or input value** in «IC Net» program
SYSTEM STATE	**Program window** in «IC Net» program
<OK>	**Button** in «IC Net» program
[RUN/STOP]	**Switch or key**
10	**Part or control of 833**
14	**Part or control of 819/820**
	**Danger/Warning** This symbol indicates a possible risk of death or injury to the user and possible damage to the instrument or its components by electric current.
	**Danger/Warning** This symbol indicates a possible risk of death or injury to the user and possible damage to the instrument or its components.
	**Attention** This symbol indicates important information that you should read before continuing.
	**Information** This symbol indicates additional information and tips which may be of particular use to you.

1.4 Safety information

1.4.1 Electrical safety

Electrical safety when handling the 833 IC Liquid Handling Unit is guaranteed within the scope of Standard IEC 1010-1 (protection class 1, protection code IP40). The following points must be observed:

- **Mains connection**

*The **mains connection** must be made in accordance with the instructions given in Section 2.2.*

- **Opening the instrument**

The housing contains no components which could be set or adjusted by the user .

*When the 833 IC Liquid Handling Unit is connected to the mains supply the instrument must not be opened, nor should any of its components be dismantled as otherwise you could come into contact with current-carrying components. Before opening the instrument separate it from all current sources and make sure that **mains cable has been removed from mains connection socket 9**!*

- **Protection against electrostatic charges**

Electronic components are sensitive to electrostatic charges and can be destroyed by a discharge. Before you touch any electronic components of the 833 IC Liquid Handling Unit you should ground you and your tools by grasping a grounded object (e.g. the instrument housing or a radiator) in order to eliminate any electrostatic charges that may be present.

1.4.2 General safety rules

- **Solvent handling**

Check the pump tubing and inlet and outlet connections for leaks at regular intervals. Observe the relevant regulations when handling and disposing of flammable and/or toxic solutions.

- **Regular replacement of pump tubing**

Pump tubing is a consumable and must be replaced from time to time (see Section 9.2.4). Take suitable measures to ensure that any leak in the pump tubing or connections during unattended and continuous operation cannot cause any damage (placing the instrument in a low position, collection trough for escaping liquid).

2 Installation

2.1 Instrument setup

2.1.1 Packaging

The 833 IC Liquid Handling Unit and its separately packed accessories are supplied in very protective special packaging. These contain impact-absorbing plastic foam linings contained inside a blue plastic film; these are molded to fit the individual components. The instrument itself is contained in a dustproof evacuated polyethylene bag. Please store all this special packaging; it is the only way in which the safe transport of the instrument can be guaranteed.

2.1.2 Checks

Please check that the delivery is complete and undamaged immediately on receipt (compare with delivery note and list of accessories given in Section *10.2*). If transport damage is evident please refer to the information given in Section *10.5.1* "Warranty".

2.1.3 Location

Place the instrument on a vibration-free bench in a favorable position for operation and protected from corrosive atmospheres and contamination by chemicals.

2.1.4 Arranging the instruments

Other IC instruments (e.g. 818, 819, 820) can be stacked on top of the 833 IC Liquid Handling Unit. It is best to place it beside the modular IC system or at the bottom of the stack.

The 833 IC Liquid Handling Unit should always be at the bottom so that any leaks which may occur in the pump tubing or connections cannot cause any great damage by escaping liquids (e.g. acids).

2.2 Mains connection

Please observe the following rules when connecting the instrument to the electricity supply. If the instrument is operated with an incorrectly set mains voltage and/or an incorrect mains fuse then it represents a fire hazard!

2.2.1 Setting the mains voltage

Before you switch on the 833 Liquid Handling Unit for the first time please check that the mains voltage set on the instrument (see *Fig. 3*) corresponds to your local mains voltage. If this is not the case then you must alter the mains voltage as follows:

1 Pull out mains cable

Remove the mains cable from mains supply connection **9** of the 833 IC Liquid Handling.

2 Remove the fuse holder

Use a screwdriver to loosen fuse holder **11** beneath the mains supply connection and remove it completely.

3 Check the fuse

Carefully remove the built-in fuse for the intended voltage from the fuse holder and check its specifications (the position of the fuse in the fuse holder is indicated by the white arrow beside the voltage range):

100…120 V 0.5 A (slow blow) Metrohm No. U.600.0013

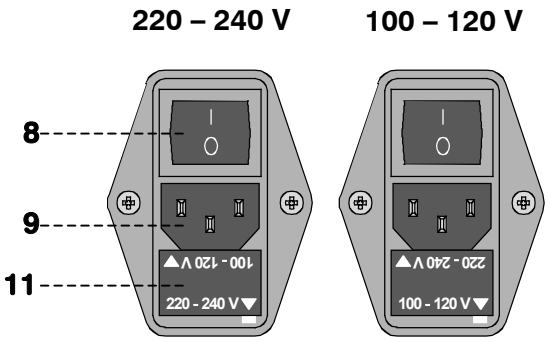
220…240 V 0.25 A (slow blow) Metrohm No. U.600.0010

4 Insert fuse

Exchange the fuse if necessary and replace it in the fuse holder.

5 Insert fuse holder

Depending on the required mains voltage, insert the fuse holder in the 833 IC Liquid Handling Unit 833 so that the appropriate voltage range can be read normally and the adjacent white arrow points to the white bar printed beneath the fuse holder (see *Fig. 3*).



8	**Mains switch**
9	**Mains connection**
11	**Fuse holder**

Fig. 3: Setting the mains voltage

2.2.2 Fuses

The fuse holder of the 833 IC Liquid Handling Unit contains one of the two fuses 0.5 A/slow blow for 100…120 V or 0.25 A/slow blow for 220…240 V.

Make sure that the instrument is never operated with a different type of fuse as otherwise it represents a fire hazard!

Checking and replacing a fuse is described in Section *2.2.1*.

2.2.3 Mains cable

The instrument is supplied with one of the following mains cables:

- 6.2122.020 with SEV 12 plug (Switzerland, …)
- 6.2122.040 with CEE(7), VII plug (Germany, …)
- 6.2133.070 with NEMA 5-15 (USA, …)

which has 3 wires and is fitted with a plug with a grounding pin. If a different plug has to be attached then the yellow/green wire (IEC standard) must be connection to the grounding pin.

Any break in the grounding inside or outside the instrument will make it dangerous!

Insert the mains cable plug in mains connection **9** of the 833 IC Liquid Handling Unit (see *Fig. 2*).

2.2.4 Switching the instrument on/off

The 833 IC Liquid Handling Unit is switched on and off with mains switch **8** (see *Fig. 2*). When the instrument is switched on mains lamp **1** lights up.

3 Basic instrument

3.1 Electrical connection

Always switch off the 833 IC Liquid Handling Unit and the instrument to which the Liquid Handling Unit is to be connected before you make an electrical connection.

The 833 Liquid Handling Unit can be operated and remotely controlled by a **761 Compact IC**, an **819 IC Detector** and in a modular system via the **830 IC Interface**.

3.1.1 Connecting to 761 Compact IC

Connect the remote connection of the 761 Compact IC with the required remote connections **14** and **15** on the 833 IC Liquid Handling Unit. The **peristaltic pump** of the Liquid Handling Unit is controlled via remote connection **Remote Pump 15**, this must always be connected. The connection **Remote Actuator 14** is only required for the 833 IC Liquid Handling Suppressor Unit and the 833 IC Liquid Handling Sample Preparation Unit; it is used to switch the **suppressor or sample preparation module**. The particular modules are connected to the socket **Module 13**.

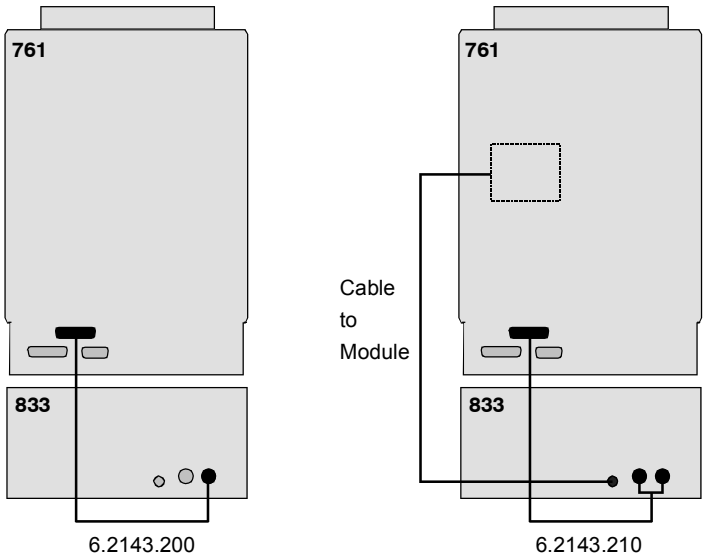


Fig. 4: Connecting the 833 IC Liquid Handling Unit to 761 Compact IC

The following cables are available for these connections:

- **6.2143.200 Cable** for **one** remote connection via **Remote line 1**.

  To connect a Liquid Handling Unit with a peristaltic pump, e.g.:
  2.833.0010 IC Liquid Handling Pump Unit
  2.833.0050 IC Liquid Handling Ultrafiltration Unit

- **6.2143.210 Cable** for **two** remote connections via **Remote lines 1 and 2**.

  To connect a Liquid Handling Unit with a peristaltic pump and a suppressor or sample preparation module, e.g.:
  2.833.0020 IC Liquid Handling Suppressor Unit
  2.833.0030 IC Liquid Handling Sample Preparation Unit

  or
  To connect two peristaltic pumps, e.g. for dialysis:
  2.833.0010 IC Liquid Handling Pump Unit
  2.833.0040 IC Liquid Handling Dialysis Unit

- **6.2143.220 Cable** for **three** remote connections via **Remote lines 1, 2 and 4**.

  To connect up to three Liquid Handling Units, e.g. for dialysis with suppression:

2x	2.833.0010	IC Liquid Handling Pump Unit
and 1x	2.833.0040	IC Liquid Handling Dialysis Unit
	(three peristaltic pumps are switched on and off)	

  or

	Ultrafiltration with suppression	
1x	2.833.0020	IC Liquid Handling Suppressor Unit
and 1x	2.833.0050	IC Liquid Handling Ultrafiltration Unit
	(two peristaltic pumps are switched on and off and the sample preparation module is switched on)	

The remote line via which the control of the Liquid Handling Unit takes place is determined by the wiring of the cable. The active remote line is printed on the 833-end of the cable. This remote line must be set accordingly in the control software **«761 Compact IC»** or **«IC Net»**, see *Section 4.3.7* In the *«761 Compact IC» Instructions for Use* and *Section 6.5.3* in the *«IC Net» Instructions for Use*.

3.1.2 Connecting to 819 IC Detector

Connect the remote connection of the 819 IC Detector to the necessary remote connections **14** and **15** on the 833 IC Liquid Handling Unit. The **peristaltic pump** of the Liquid Handling Unit is controlled via remote connection **Remote Pump 15**, this must always be connected. The connection **Remote Actuator 14** is only required for the 833 IC Liquid Handling Suppressor Unit and the 833 IC Liquid Handling Sample Preparation Unit; it is used to switch the **suppressor or sample preparation module**. The particular modules are connected to the socket **Module 13**.

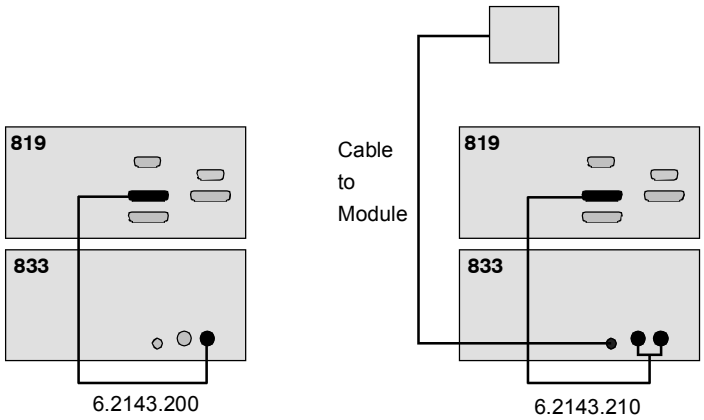


Fig. 5: Connecting the 833 IC Liquid Handling Unit to 819 IC Detector

The following cables are available for these connections:

- **6.2143.200 Cable** for **one** remote connection via **Remote line 1**.

  To connect a Liquid Handling Unit with a peristaltic pump, e.g.:
  2.833.0010 IC Liquid Handling Pump Unit
  2.833.0050 IC Liquid Handling Ultrafiltration Unit

- **6.2143.210 Cable** for **two** remote connections via **Remote lines 1 and 2**.

  To connect a Liquid Handling Unit with a peristaltic pump and a suppressor or sample preparation module, e.g.:
  2.833.0020 IC Liquid Handling Suppressor Unit
  2.833.0030 IC Liquid Handling Sample Preparation Unit

  or
  To connect two peristaltic pumps, e.g. for dialysis:
  2.833.0010 IC Liquid Handling Pump Unit
  2.833.0040 IC Liquid Handling Dialysis Unit

- **6.2143.220 Cable** for **three** remote connections via **Remote lines 1, 2 and 4**.

  To connect up to three Liquid Handling Units, e.g. for dialysis with suppression:

2x	2.833.0010	IC Liquid Handling Pump Unit
and 1x	2.833.0040	IC Liquid Handling Dialysis Unit
	(three peristaltic pumps are switched on and off)	

  or

  Ultrafiltration with suppression

1x	2.833.0020	IC Liquid Handling Suppressor Unit
and 1x	2.833.0050	IC Liquid Handling Ultrafiltration Unit
	(two peristaltic pumps are switched on and off and the sample preparation module is switched on)	

The remote line via which the control of the Liquid Handling Unit takes place is determined by the wiring of the cable. The active remote line is printed on the 833-end of the cable. This remote line must be set accordingly in the control software **«IC Net»**, see *Section 6.4.3* of the *«IC Net» Instructions for Use*.

3.1.3 Connecting to 830 IC Interface

Connect one of the event lines of the 830 IC Interface with one of the required remote connections **14** and **15** on the 833 IC Liquid Handling Unit. The **peristaltic pump** of the Liquid Handling Unit is controlled via remote connection **Remote Pump 15**, this must always be connected. The connection **Remote Actuator 14** is only required for the 833 IC Liquid Handling Suppressor Unit and the 833 IC Liquid Handling Sample Preparation Unit; it is used to switch the **suppressor or sample preparation module**. The particular modules are connected to the socket **Module 13**.

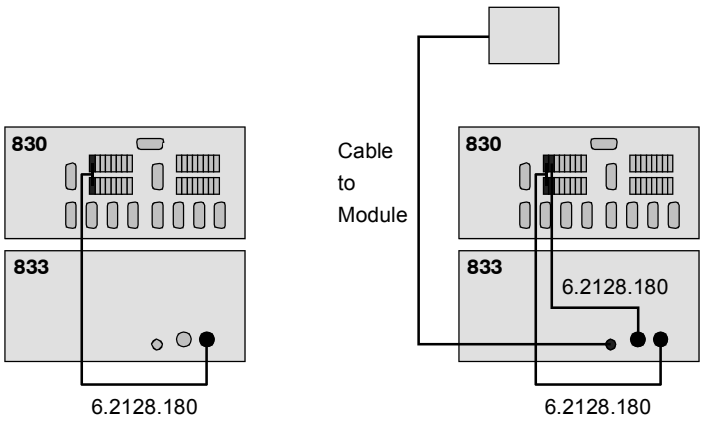


Fig. 6: Connecting the 833 IC Liquid Handling Unit to 830 IC Interface

For **each** remote connection **one 6.2128.180 Cable** is required. At the 830 IC Interface 2 × 7 remote connections can be assembled. Which event lines are used for this does not matter; when a system is set up the assignment must only be given correctly in the **«IC Net»** software when creating a system, see *Section 6.1* of the *«IC Net» Instructions for Use*.

3.2 Assembly the pump tubing

*Pump tubing is a consumable whose working life depends on the contact pressure. This is why when the pump is switched off for a long time, the tubing cassette should be lifted by fully loosening spring lever **7** on the right-hand side (in this way the correctly set optimal contact pressure is retained).*

The 6.1826.0X0 Pump tubing consists of PVC or PP and must therefore not be rinsed with solvents that contain acetone. In this case you should either use different pump tubing or use a different pump for rinsing.

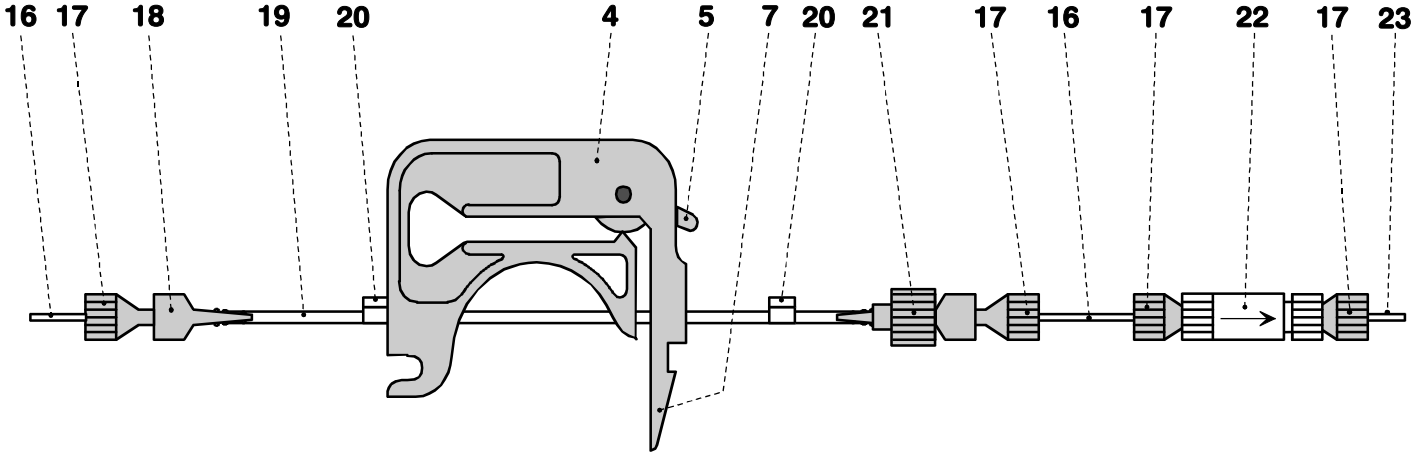


Fig. 7: Assembly the pump tubing

4 Tubing cassette

5 Contact lever

7 Spring lever

16 6.1803.0X0 Aspiration tubeing/capillary
PTFE tubing/capillary, depends on version, see *Section 10.2 Standard equipment*

17 6.2744.010 PEEK compression fitting

18 6.2744.034 PEEK coupling

19 6.1826.0X0 Pump tubing
various tubing is available, depending on the application, *see Tab. 1.*

20 Stopper
The color of the stopper indicates the material and dimensions of the pump tubing, *see Tab. 1*.

21 6.2744.160 PEEK Coupling
with tubing security device

22 6.2821.120 PEEK Filter unit
not contained in all versions, see *Section 10.2 Standard equipment*

23 Discharge capillary
delivery side for connection to:
suppressor module
sample preparation module
dialysis cell
ultrafiltration cell

1 Remove tubing cassettes

- Loosen the two tubing cassettes **4** by pressing in spring lever **7** of holding clip **6** and unhinge them from holding pin **2** of the 833 IC Liquid Handling Unit (see *Fig. 1*).

2 Insert pump tubing

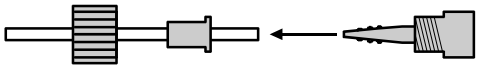
- Press contact lever **5** on the two tubing cassettes down as far it will go.
- Insert pump tubing into each tubing cassette as shown in *Fig. 7*.
  Stopper must click into position in the corresponding holder on the left-hand side of the tubing cassette.

3 Attach tubing cassettes

- Hinge the tubing cassettes on holding pin and press down on the right –hand side until spring lever clicks into position in holding clip **6**. Take care that the pump tubing does not kink.

4 Attach coupling to pump tubing

- Attach PEEK coupling **18** to the aspiration end of pump tubing **19** for both channels (see *Fig. 7*).
- Mount PEEK coupling **21** with the tubing security device (6.2744.160) to the delivery end of pump tubing **19** for both channels.
  This is done by dismantling the tubing security device and first pushing the sleeve nut and the compression piece onto the tubing.



  Attach the tubing to the PEEK coupling and screw the sleeve nut onto the coupling in order to secure the tubing.

5 Mounting of filter unit

- If contained in the standard equipment (see *Section 10.2 Standard equipment*), screw 6.2821.120 PEEK filter unit **22** onto PEEK coupling **21** (6.2744.160) by using two PEEK compression fittings **17** (6.2744.010) and a piece of aspiration tubing/capillary **16** (6.1803.0X0) at the delivery end of pump tubing **19**.

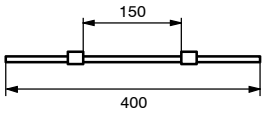
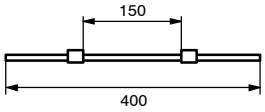
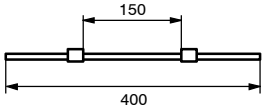
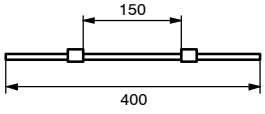
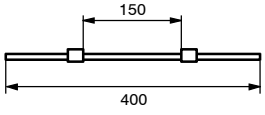
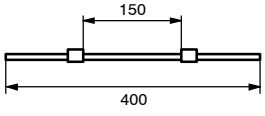
Setting the contact pressure correctly:

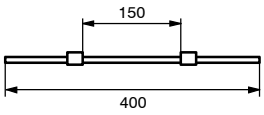
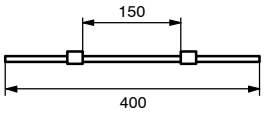
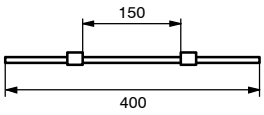
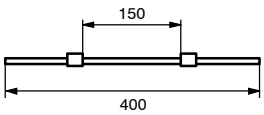
Press contact lever **5** until the solutions are just aspirated. Then press the contact lever up by 1 further click to achieve the optimum contact pressure.

In addition to the correct contact pressure, the delivery rate of the 833 IC Liquid Handling Unit depends primarily on the inner diameter of pump tubing **19**. Different pump tubing can be used depending on the application.

The following table provides information about the properties and use of the available pump tubing.

Tab. 1: Using 6.1826.0X0 Pump tubing

Used with	*Order no.*	*Description*
2.833.0030 IC Liquid Handling Sample Preparation Unit: both channels	**6.1826.010**	**Pump tubing** PVC (Tygon® ST) with 2 permanently mounted **white-white** stoppers; i.d. = 1.02 mm ± 0.05 mm, Delivery rate 1.41 mL/min (20 min^{-1}) 1.69 mL/min (24 min^{-1}) 
optional	**6.1826.020**	**Pump tubing** PVC (Tygon® ST) with 2 permanently mounted **blue-blue** stoppers; i.d. = 1.65 mm ± 0.05 mm, Delivery rate 3.75 mL/min (20 min^{-1}) 4.50 mL/min (24 min^{-1}) 
2.833.0040 IC Liquid Handling Dialysis Unit: channel for supplying acceptor solution **2.833.0050 IC Liquid Handling Ultrafiltration Unit:** channel for transferring filtrate to sample loop	**6.1826.030**	**Pump tubing** PVC (Tygon® ST) with 2 permanently mounted **orange-yellow** stoppers; i.d. = 0.51 mm ± 0.05 mm, Delivery rate 0.40 mL/min (20 min^{-1}) 0.48 mL/min (24 min^{-1}) 
2.833.0040 IC Liquid Handling Dialysis Unit: channel for supplying sample	**6.1826.040**	**Pump tubing** PVC (Tygon® ST) with 2 permanently mounted **black-black** stoppers; i.d. = 0.76 mm ± 0.05 mm, Delivery rate 0.75 mL/min (20 min^{-1}) 0.90 mL/min (24 min^{-1}) 
2.833.0010 IC Liquid Handling Pump Unit, 2.833.0020 IC Liquid Handling Suppressor Unit: both channels	**6.1826.050**	**Pump tubing** PVC (Tygon® ST) with 2 permanently mounted **white-yellow** stoppers; i.d. = 0.57 mm ± 0.05 mm, Delivery rate 0.43 mL/min (20 min^{-1}) 0.52 mL/min (24 min^{-1}) 
optional	**6.1826.060**	**Pump tubing** PP (PharMed®) with 2 permanently mounted **orange-yellow** stoppers; i.d. = 0.51 mm ± 0.05 mm, Delivery rate 0.47 mL/min (20 min^{-1}) 0.56 mL/min (24 min^{-1}) 

2.833.0050 IC Liquid Handling Ultrafiltration Unit: channel for transferring sample to ultrafiltration cell	**6.1826.070**	**Pump tubing** PVC (Tygon® ST) with 2 permanently mounted **yellow-yellow** stoppers; i.d. = 1.42 mm ± 0.05 mm, Delivery rate 2.55 mL/min (20 min^{-1}) 3.06 mL/min (24 min^{-1}) 
optional	**6.1826.110**	**Pump tubing long-life** PVC (Tygon® LFL) with 2 permanently mounted **orange-yellow** stoppers; i.d. = 0.51 mm ± 0.0102 mm, Delivery rate 0.40 mL/min (20 min^{-1}) 0.48 mL/min (24 min^{-1}) 
optional	**6.1826.120**	**Pump tubing long-life** PVC (Tygon® LFL) with 2 permanently mounted **orange-white** stoppers; i.d. = 0.59 mm ± 0.05 mm, Delivery rate 0.44 mL/min (20 min^{-1}) 0.53 mL/min (24 min^{-1}) 
optional	**6.1826.130**	**Pump tubing long-life** PVC (Tygon® LFL) with 2 permanently mounted **white-white** stoppers; i.d. = 1.02 mm ± 0.0127 mm, Delivery rate 1.41 mL/min (20 min^{-1}) 1.69 mL/min (24 min^{-1}) 

3.3 Operation

The 833 IC Liquid Handling Unit is operated completely via the Metrohm «IC Net» software.

This Section only described the most important functions and settings for operating the 833 IC Liquid Handling Unit. Further information is given in the Instructions for Use of the «IC Net» and in the online help for the program.

3.3.1 Switching the instrument on/off

Remote control of the 833 IC Liquid Handling Unit by the software requires that the instruments has been installed correctly as described in Section 2.

Switching the instrument on/off

The 833 IC Liquid Handling Unit is switched on and off with mains switch **8** on the rear panel of the instrument (see *Fig. 2*):

I **Instrument switched on**

0 Instrument switched off

When the instrument has been switched on mains lamp **1** lights up to show that it is ready for use.

3.3.2 Program settings

The 833 IC Liquid Handling Unit is operated completely via the Metrohm «IC Net» software.

This section only describes the most important functions and settings for operating the 833 IC Liquid Handling Unit. Further information is given in the Instructions for Use of the «IC Net» and in the online help for the program.

3.3.2.1 833 IC Liquid Handling Unit icon

2.833.00X0 IC Liquid Handling Unit

For differentiating between which version of the 833 is indicated by the instrument icon a tool tip with the name of the corresponding instrument appears when the mouse cursor is placed on the particular icon.

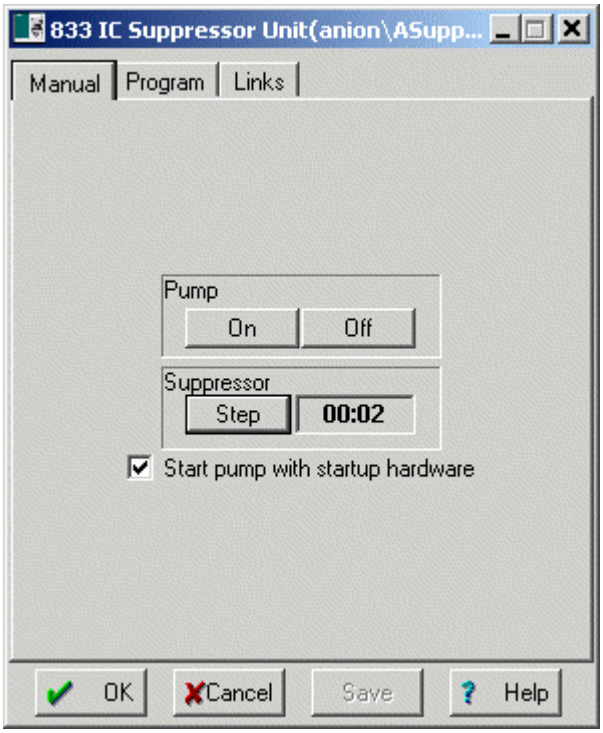
3.3.2.2 Settings in the window "833 IC Liquid Handling Unit"

Selection of this menu item with the right-hand mouse key or a double-click on the 833 instrument icon opens the window **833 IC Liquid Handling Unit** for parameter settings. It consists of three tabs: **Manual**, **Program** and **Links**.

Depending on the version, the title line of the parameter settings window shows **833 IC Pump Unit**, **833 IC Suppressor Unit**, **833 IC Sample Preparation Unit**, **833 IC Dialysis Unit** or **833 IC Ultrafiltration Unit** and (in brackets) the **name** of the system folder and the system file.

Manual

The tab **Manual** of the window **833 IC Liquid Handling Unit** is used for manually operating the peristaltic pump and the suppressor or sample prep module.

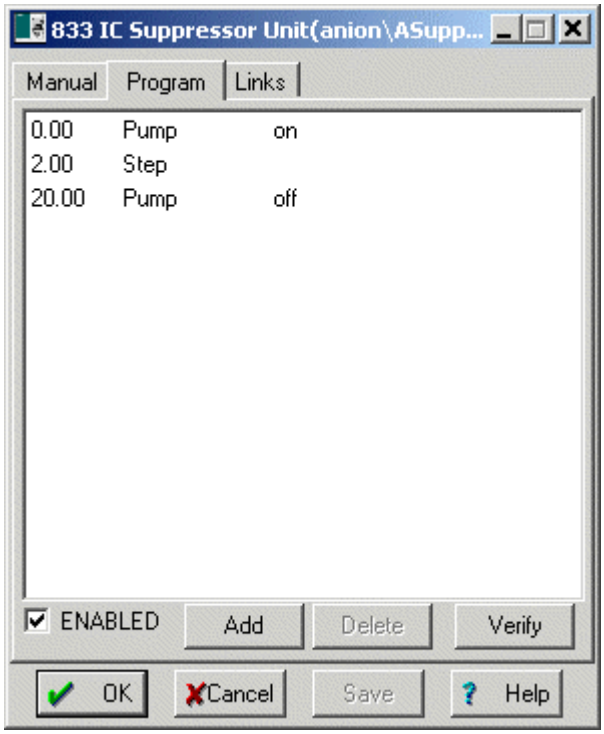


Pump	(available with **all** versions)
<On>	Start pump drive.
<Off>	Stop pump drive.
Suppressor	(only available with **833 IC Suppressor Unit**)
<Step>	Rotate suppressor to the next position. The time since the last step action is displayed in the field beside the **<Step>** button.
Actuator	(only available with **833 IC Sample Preparation Unit**)
<Step>	Rotate sample preparation module to the next position. The time since the last step action is displayed in the field beside the **<Step>** button.

Start pump with startup hardware	Automatic start of pump drive with **Startup hardware**.

Time program

A user-specific time program can be entered on the tab **Program** in the **833 IC Liquid Handling Unit** window. Depending on the settings made in the **Start mode** window (for details see *Section 4.4.3* **8.110.8281 Instructions for Use** for the Metrodata «**IC Net 2.3**» software), this program is started automatically either at the start of the determination (**Start with determination**) or when the sample is injected (**Start with inject**).



Time (1st column)	**Time** at which program instruction is applied. Entry range: **0.0 ... 999.9 min** If no time is entered, the program instruction is applied together with the last instruction with time entry.
Command (2nd. column)	**Program instruction** (see below).
Parameter (3rd column)	**Parameter** for program instruction (see below).
ENABLED	Enable program start (a disabled program is not started).
<Add>	Add new program instruction.
<Delete>	Delete selected program instruction.
<Verify>	Test the time program (error messages are displayed if program is wrong).

List of program instructions

The following program instructions can be added to the time program on the **Program** page:

Instruction	*Parameter entry*	*Meaning*
Pump	**on, off**	Switch on or off the pump drive. (available for **all** versions)
Step		Rotate suppressor or sample prep module to the next position. (only available for **833 IC Suppressor Unit** and **833 IC Sample Prep Unit**)

Links

The **Links** tab of the **833 IC Pump Unit** is used for Event line selection (for details see *Instructions for Use* of «IC Net»).

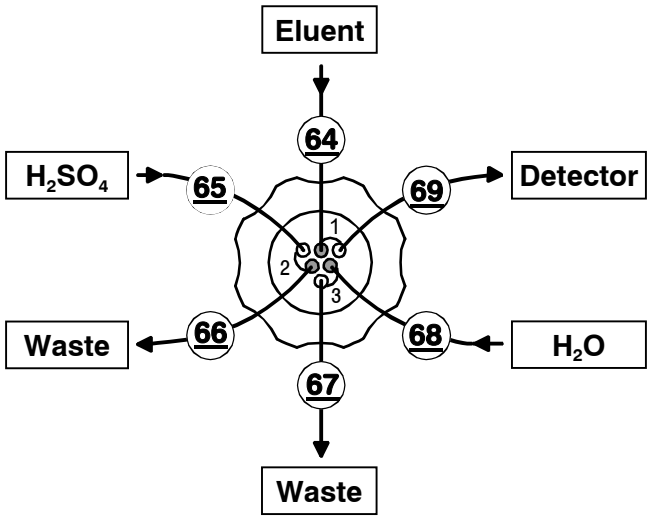
4 833 IC Liquid Handling Pump Unit

This version is mainly used for supplying a **Metrohm Suppressor Module MSM** built into a **2.820.0X30 IC Separation Center** with regeneration and rinsing solutions. The Metrohm Suppressor Module MSM is described in detail in *Section 2.9.7* of the *819/820 Instructions for Use*.

4.1 Connection of the suppressor module

In order to protect the suppressor module against foreign particles an **inline filter** is mounted between the 833 IC Liquid Handling Unit and the inlet capillary of the suppressor module, see *Fig. 7*. The most suitable unit is the **6.2821.120 Filter unit PEEK** included in the standard equipment.

The suppressor module is connected to the 833 IC Liquid Handling Pump Unit in accordance with *Section 2.9.7* of the *819/820 Instructions for Use*. The most important points are described again below, with underlined numbers **##** referring to the parts and controls in the *819/820 Instructions for Use*:



64	**Suppressor inlet capillary for eluent**
65	**Suppressor inlet capillary for H_2SO_4**
66	**Suppressor outlet capillary for H_2SO_4**
67	**Suppressor outlet capillary for H_2O**
68	**Suppressor inlet capillary for H_2O**
69	**Suppressor outlet capillary for eluent**

Fig. 8: Connections to suppressor module of 820 Separation Center

1 Connect column to injector

- Remove end caps from column **53**.
- *without column heating:*
  Screw inlet end of separating column **53** (note flow direction) to column connection capillary **50** mounted on the injector.
- *with column heating:*
  Prepare column heating according to *Section 2.9.2* of the *819/820 Instructions for Use* and screw column connection capillary **50** (see *Fig. 20, 819/820 Instructions for Use*) with a compression fitting to injection valve **51**.
- *With precolumn:*
  Install precolumn according to the supplied leaflet between inlet of the separating column and the injection valve.

2 Rinse column

- Place a beaker beneath the column outlet.
- Start 818 IC Pump in «IC Net» with suitable flow (see *leaflet of the column*) and rinse column for ca. 10 min with eluent.
- Stop 818 IC Pump.

3 Connect column to suppressor module (Suppressor connection 1)

- Cut inlet capillary **64** (marked with "Eluent") of suppressor module **70** to the required length. Use the 6.2126.080 Capillary cutter available as an option.
- *without column heating*
  Screw inlet capillary **64** on to the outlet end of separating column **53** using a 6.2744.010 compression fitting.
- *with column heating*
  Connect capillary **52** at the outlet of the separating column (see *Fig. 20, 819/820 Instructions for Use*) to the inlet capillary **64** using the 6.2744.040 Coupling.

4 Fix column

- *without column heating*
  Insert one or two column holders **59** (6.2027.030, 6.2027.040 or 6.2027.050) in the mounting rails **58** and fasten separating column in the column holder.
- *with column heating*
  Insert column heating according to *Fig. 10* (*819/820 Instructions for Use*) into the Separation Center.

5 Connect suppressor module to detector block (Suppressor connection 1)

- Cut outlet capillary **69** (marked with “Detector”) of suppressor module **70** to the required length. Use the 6.2126.080 Capillary cutter available as an option.
- Screw outlet capillary **69** on to coupling **71** by using a 6.2744.010 Pressure screw.
- Screw inlet capillary **56** of detector block **57** on to the other end of coupling **71**.

6 Mount pump tubing on 833 Pump Unit

- Mount the two lengths of **6.1826.050** Pump tubing (**white-yellow** stopper) with aspirating tube **16** and filter unit PEEK **22** 6.2821.120 as described in *Section 3.2*, see *Fig. 7*.

7 Suppressor connection 2: H_2SO_4

- Pull inlet capillary **65** (marked with "H_2SO_4") by hand as far as required through one of the feedthroughs **14** to the outside (see *Fig. 23* and *Fig.24*, *819/820 Instructions for Use*).
- Screw the filter unit PEEK contained in the standard equipment of the 833 IC LH Pump Unit on to PEEK coupling **21** (6.2744.160) as described in *Section 3.2* at the outlet end of the **first** piece of pump tubing **19**.
- Fasten inlet capillary **65** (**23** in *Fig. 7*) to filter unit PEEK (6.2821.120) by using a compression fitting **17** (6.2744.010) (see *Fig. 7*).
- At the inlet end of the **first** piece of tubing **19** fasten a suitably long piece of PTFE tubing **16** (6.1803.020) to coupling **18** (6.2744.034) by using a compression fitting **17** (6.2744.010).
- Immerse the other end of the aspiration tubing in a container with regeneration solution (normally 50 mmol/L H_2SO_4) and fix it in position.
- Pull outlet capillary **66** of the suppressor module (marked with "Waste") through opening **18** on the rear panel, lead it into a sufficiently large waste bottle and fix it in position.

8 Suppressor connection 3: H_2O

- Pull inlet capillary **68** (marked with "H_2SO_4") by hand as far as required through one of the feedthroughs **14** to the outside (see *Fig. 23* and *Fig.24*, *819/820 Instructions for Use*).
- Screw the filter unit PEEK contained in the standard equipment of the 83 IC LH Pump Unit on to PEEK coupling **21** (6.2744.160) as described in *Section 3.2* at the outlet end of the **second** piece of pump tubing **19.**
- Fasten inlet capillary **68** (**23** in *Fig. 7*) to the filter unit PEEK (6.2821.120) by using a compression fitting **17** (6.2744.010) (see *Fig. 7*).

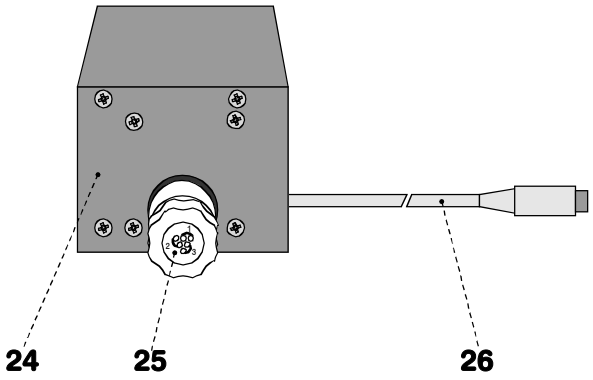
- At the inlet end of the **second** piece of tubing **19** fasten a suitably long piece of PTFE tubing **16** (6.1803.020) to coupling **18** (6.2744.034) by using a compression fitting **17** (6.2744.010).
- Immerse the other end of the aspiration tubing in a container with rinsing solution (normally dist. H_2O) and fix it in position.
- Pull outlet capillary **67** of the suppressor module (marked with "Waste") through opening **18** on the rear panel, lead it into a sufficiently large waste bottle and fix it in position.

9 Start up the 833 Pump Unit

- Switch on the 833 Pump Unit with mains switch **8**.
- Set the contact pressure for both cassettes: press contact lever **5** until the solutions are just aspirated. Then press the contact lever up by 1 further click to achieve the optimum contact pressure.
- Check all the tubing from the storage containers to the 833 IC Liquid Handling Unit and the suppressor module through to the waste bottles for leaks. If any liquid should be leaking then the corresponding connection must be tightened up or replaced.

5 833 IC Liquid Handling Suppressor Unit

This instrument version can be used for retrofitting a **2.820.0X20 IC Separation Center** with two injectors or a **2.761.0010 Compact IC** for chemical suppression in an easy way. It consists of the 833 IC Liquid Handling Unit basic instrument and the **1.753.0100 Metrohm Suppressor Module MSM**.



24 Suppressor module

25 Suppressor connection
with permanently attached inlet and outlet capillaries

26 Connection cable
connection cable to 833 IC Liquid Handling Unit

Fig. 9: Suppressor module 1.753.0100

5.1 Connection of the Suppressor module

The 1.753.0100 Suppressor module must first be inserted in the 2.820.0X20 IC Separation Center and connected to the 833 IC Liquid Handling Unit. Connections are then made to the inlet and outlet capillaries mounted on the suppressor. Proceed as follows (underlined numbers ***##*** refer to parts and controls in the *819/820 Instructions for Use*):

1 Insert suppressor module

- 820.0X20 IC Separation Center (2-channel system):
  Place suppressor module **24** inside the chamber on the floor, see *Fig. 24, 819/820 Instructions for Use*).

2 Connect suppressor module

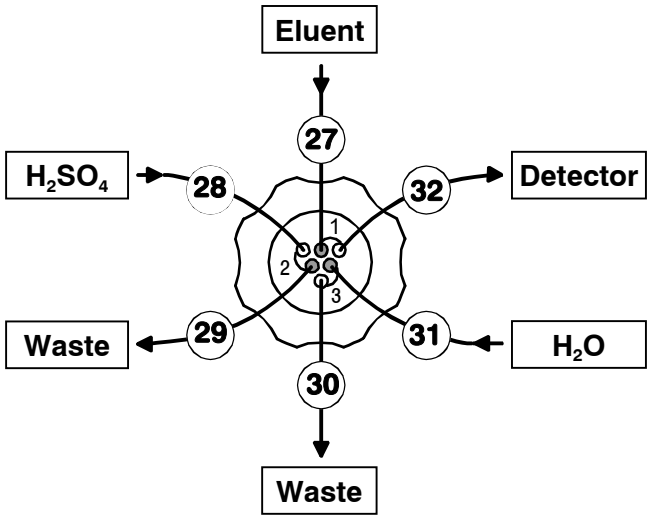
- 820.0X20 IC Separation Center (2-channel system):
  Remove plastic stopper from rear panel opening **18** of the 820 IC Separation Center and lead cable **26** of suppressor module **24** out through one of the openings in the rear panel of the IC Separation Center.
- Connect cable **26** to connection **13** ("Module" of the 833 IC Liquid Handling Unit (see *Fig. 2*).

3 Connect the column to the injector

- Remove end caps from column **53**
- *without column heating:*
  Screw inlet end of separating column **53** (note flow direction) to column connection capillary **50** mounted on the injector.
- *with column heating:*
  Prepare column heating according to *Section 2.9.2* of the *819/820 Instructions for Use* and screw column connection capillary **50** (see *Fig. 20, 819/820 Instructions for Use*) with a compression fitting to injection valve **51**.
- *With precolumn:*
  Install precolumn according to the supplied leaflet between inlet of the separating column and the injection valve.

4 Rinse column

- Place a beaker beneath the column outlet.
- Start 818 IC Pumpe 818 in «IC Net» with suitable flow (see *leaflet of the column*) and rinse column for ca. 10 min with eluent.
- Stop 818 IC Pump.



27	**Suppressor inlet capillary for eluent**
28	**Suppressor inlet capillary for H_2SO_4**
29	**Suppressor outlet capillary for H_2SO_4**
30	**Suppressor outlet capillary for H_2O**
31	**Suppressor inlet capillary for H_2O**
32	**Suppressor outlet capillary for eluent**

Fig. 10: Suppressor module connections for 833 IC Liquid Handling Suppressor Unit

5 Connect column to suppressor module (Suppressor connection 1)

- Cut inlet capillary **27** (marked with "Eluent") at suppressor connection **25** (see *Fig. 9*) to the required length. Use the 6.2126.080 Capillary cutter available as an option.
- *without column heating*
  Screw inlet capillary **27** on to the outlet end of separating column **53** using a 6.2744.010 compression fitting.
- *with column heating*
  Connect capillary **52** at the outlet of the separating column (see *Fig. 20, 819/820 Instructions for Use*) to the inlet capillary **27** using the 6.2744.040 Coupling supplied with the 820 standard equipment.

6 Fix column

- *without column heating*
  Insert one or two column holders **59** (6.2027.030, 6.2027.040 or 6.2027.050) in the mounting rails **58** and fasten separating column in the column holder.
- *with column heating*
  Insert column heating according to *Fig. 10* (*819/820 Instructions for Use*) into the Separation Center.

7 Connect suppressor module to detector block (Suppressor connection 1)

- Cut outlet capillary **32** (marked with "Detector") at suppressor connection **25** (see *Fig. 9*) to coupling **71**(6.2620.060) to the required length. Use the 6.2126.080 Capillary cutter available as an option.
- Screw outlet capillary **32** on to coupling **71** by using a 6.2744.010 compression fitting.
- Screw inlet capillary **56** of detector block **57** on to the other end of coupling **71**.

8 Attach pump tubing to 833 Liquid Handling Unit

- Mount both the **6.1826.050** Pump tubing (**white-yellow** stopper) as described in *Section 3.2*, see *Fig. 7*.

9 Suppressor connection 2: H_2SO_4

- Pull inlet capillary **28** (marked with "H_2SO_4") at suppressor connection **25** (see *Fig. 9*) through one of the openings **18** on the rear panel of the 820 IC Separation Center.
- Attach inlet capillary **28** (**23** in *Fig. 7*) to the filter unit PEEK **22** (6.2821.120) of the **first** pump tubing using a compression fitting **17** (6.2744.010), see *Fig. 7*.
- Mount aspiration tubing: cut a piece of PTFE tubing **16** (6.1803.020) to the required length.
- Attach a PEEK compression fitting **17** (6.2744.010) to one end of the PTFE tubing **16** and screw this on to coupling **18**.

- Immerse the other end of the aspiration tubing in a container with regeneration solution (normally 50 mmol/L H_2SO_4) and fix it in position.
- Pull outlet capillary **29** (marked with "Waste") through one of the openings **41** or **43** in the rear panel of the 820 IC Separation Center.
- Lead outlet capillary **29** into a sufficiently large waste bottle and fix it in position.

10 Suppressor connection 3: H2O

- Pull inlet capillary **31** (marked with "H_2O") at suppressor connection **25** (see *Fig. 9*) through one of the openings **18** in the rear panel of the 820 IC Separation Center.
- Fasten inlet capillary **31** (**23** in *Fig. 7*) to filter unit PEEK **22** (6.2821.120) of the **second** pump tubing using a compression fitting **17** (6.2744.010), see *Fig. 7*.
- Mount aspiration tubing: cut a piece of PTFE tubing **16** (6.1803.020) to the required length.
- Attach a PEEK compression fitting **17** (6.2744.010) to one end of the PTFE tubing **16** and screw this on to coupling **18**.
- Immerse the other end of the aspiration tubing in a container with rinsing solution (normally dist. H_2O) and fix it in position.
- Pull outlet capillary **30** (marked with "Waste") through one of the openings **41** or **43** in the rear panel of the 820 IC Separation Center.
- Lead outlet capillary **30** into a sufficiently large waste bottle and fix it in position.

11 Start up 833 IC Liquid Handling Suppressor Unit

- Switch on 833 Pump Unit with mains switch **8**.
- Set the contact pressure for both cassettes: press contact lever **5** until the solutions are just aspirated. Then press the contact lever up by 1 further click to achieve the optimum contact pressure.
- Before switching the suppressor to the next position for the first time (see *Section 5.2*) rinse the three suppressor units with solution for 5 minutes.
- Check all the tubing from the storage containers to the 833 IC Liquid Handling Unit and the suppressor module through to the waste bottles for leaks. If any liquid should be leaking then the corresponding connection must be tightened up or replaced.

5.2 Handling the suppressor module

General

The **Metrohm Suppressor Module MSM** of the **833 IC Liquid Handling Suppressor Unit** consists of a total of three suppressor units, which are used in sequence for suppression, regenerated with sulfuric acid and rinsed with water. In order to be able to record each chromatogram under comparable conditions, work is normally carried out with a freshly regenerated suppressor. Switching takes place either automatically together with the valve switching or manually.

Correct connection

The three suppressor inlets and outlets numbered 1…3 each have two permanently attached PTFE capillaries that must be connected as described in Section *5.1* (see *Fig. 10*).

Flow direction

The suppressor units must never be regenerated with H_2SO_4 in the same direction as which the eluent is transported. This is why the inlet and outlet capillaries must always be mounted as described in Section 5.1 and shown in Fig. 10.

Never switch to the next position when dry

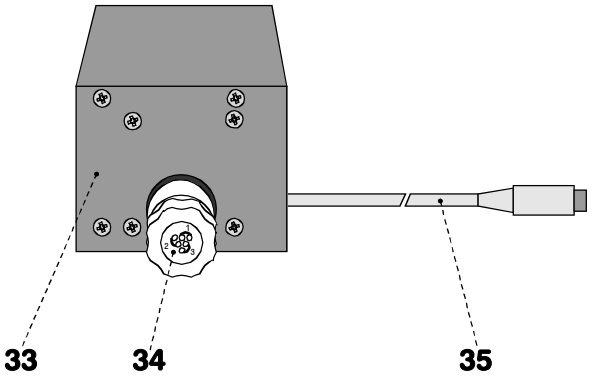
The suppressor module must never be switched to the next position when it is dry, as there is a risk that it could be blocked.

No recycling

The recycling method (return of the eluent to the storage container) must not be used with the suppressor.

6 833 IC Liquid Handling Sample Preparation Unit

This instrument version consists of the 833 IC Liquid Handling Unit basic instrument and the **1.793.0110 Sample Preparation Module**.



33 **Sample preparation module**

34 **Sample preparation connection**
with permanently attached inlet and outlet capillaries

35 **Connection cable**
connection cable to 833 IC Liquid Handling Unit

Fig. 11: 1.793.0110 Sample Preparation Module

6.1 Connection to modular IC system for neutralization

The 833 IC Liquid Handling Sample Preparation Unit is frequently used for the neutralization of an alkaline sample for anion determination with chemical suppression. Excessive amounts of strong bases (e.g. 30% NaOH) should not be fed into the sample preparation module. In order to ensure an adequate capacity for the exchange of Na^+ ions for H^+ ions under all circumstances only a small fraction of the sample is fed into the sample preparation module through a sample loop (e.g. 20 µL). The analyte anions are retained on a downstream enrichment column, then re-eluted with the eluent in counterflow and transferred to the separating column.

This means that the necessary instrument configuration corresponds to the **Modular IC System 6** (**MIC 6 Advanced**: anion system with chemical suppression, enrichment and matrix elimination), extended by the **833 IC Liquid Handling Sample Preparation Unit**. Samples with a low load for the capacity of the sample preparation module can also be added directly to the sample preparation module and transferred to the sample loop. Switching then corresponds to the system described in *Section 6.2*.

The electrical connections of this system to the 766 IC Sample Processor with complete control by the «**IC Net 2.3**» software is described below.

6.1.1 Electrical connections

The electrical connections of the system, consisting of 819 IC Detector, 820 IC Separation Center (2-channel; 2.820.0X20), 818 IC Pump, 833 IC Liquid Handling Pump Unit (2.833.0010), 833 IC Liquid Handling Suppressor Unit (2.833.0020), 833 IC Liquid Handling Sample Preparation Unit (2.833.0030) and 830 IC Interface are shown in *Fig. 12*:

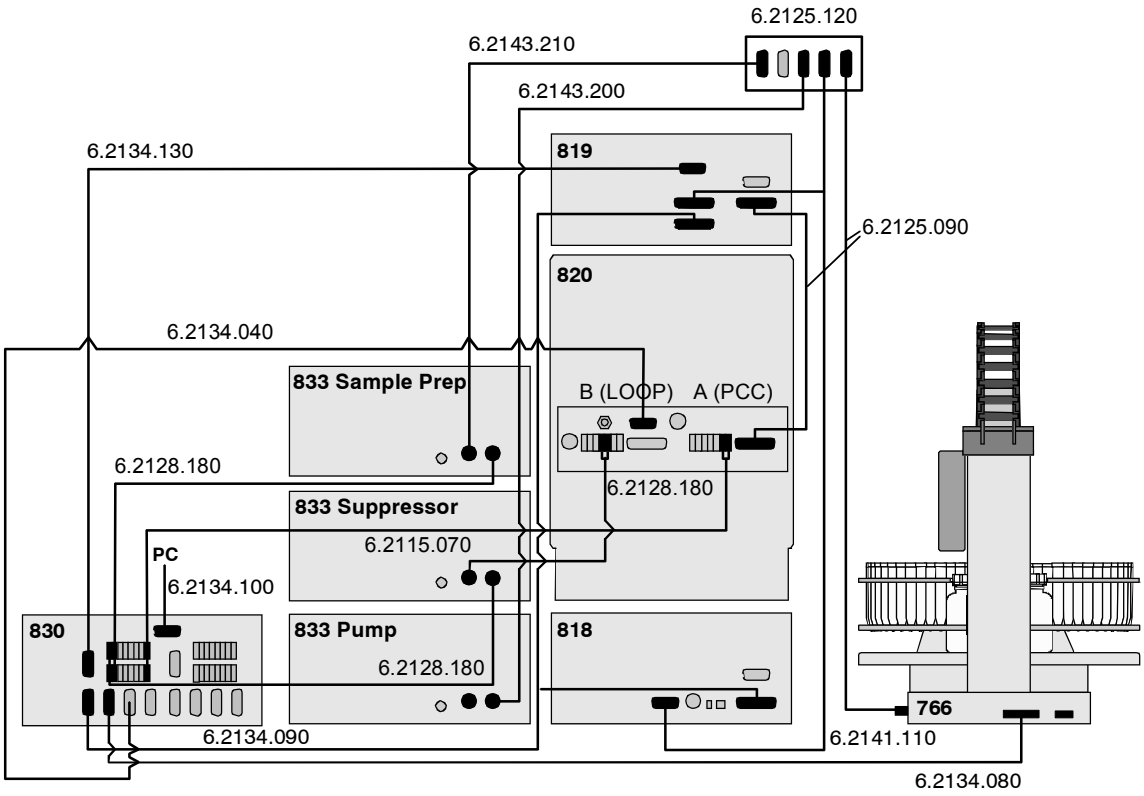


Fig. 12: Electrical connections for 833 IC Liquid Handling Sample Preparation Unit and modular IC system for neutralization

Please note that the signal for switching the connected 833 IC Liquid Handling Suppressor Unit to the next position is not controlled by the program of the 766 Sample Changer. Instead the remote connection **14** of the 833 IC Liquid Handling Suppressor Unit for the Suppressor/Actuator is connected by 6.2128.180 cable with the event line “Fill” of valve B (sample loop before the sample preparation module) to the 820. In this way a move to the next position of the suppressor is triggered by the “Fill” setting of this valve.

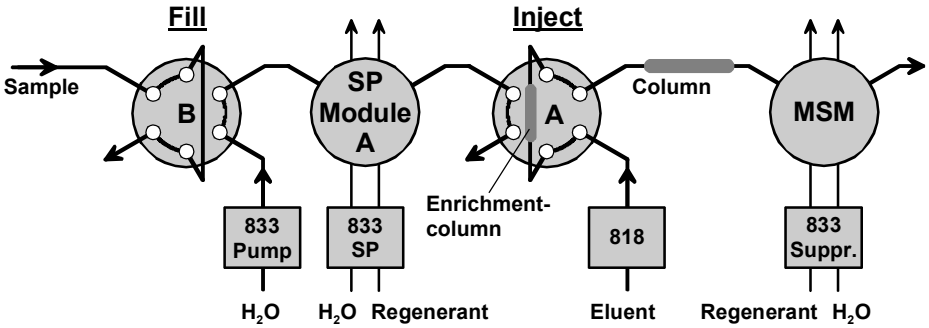
6.1.2 Connection of the sample preparation module

The following description assumes the use of a 2.820.0X20 IC Separation Center (2-channel system).

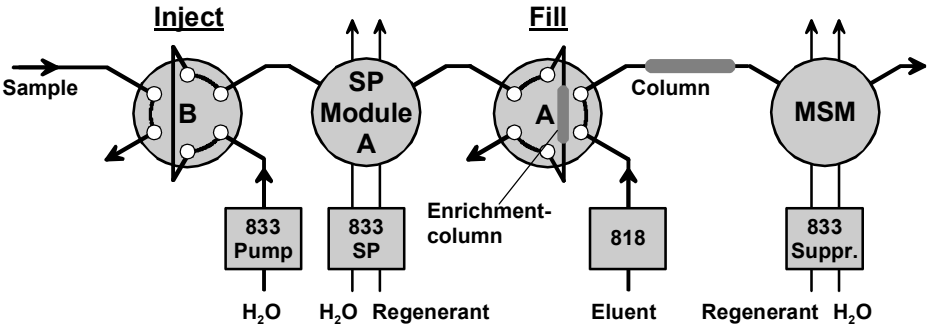
The 1.793.0110 Sample Preparation Module must first be inserted in the 820 IC Separation Center and then connected to the basic instrument of the 833 IC Liquid Handling Sample Preparation Unit (**833 Sample Preparation** in *Fig. 12*). The 1.753.0100 Suppressor Module of the IC Liquid Handling Suppressor Unit is also inserted in the Separation Center and connected to the relevant basic instrument (**833 Suppressor** in *Fig. 12*). This is described in detail in Section *5*.

The components are connected as shown below; this also shows the sample flow scheme:

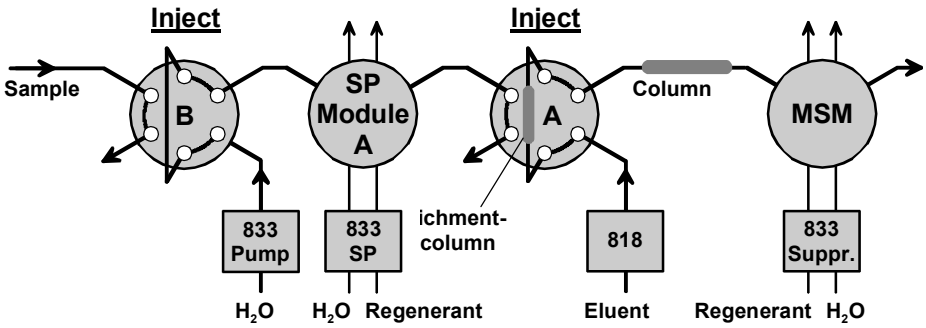
A) Sample loop at valve B is filled.



B) Sample is neutralized in Sample Preparation Module; anions are enriched at valve A.



C) Enriched anions are transferred to the separation column.



The inlet and outlet capillaries mounted on the sample preparation module are connected up as follows:

1 Insert sample preparation module

- Place sample preparation module **33** inside the chamber on the floor.

2 Connect sample preparation module

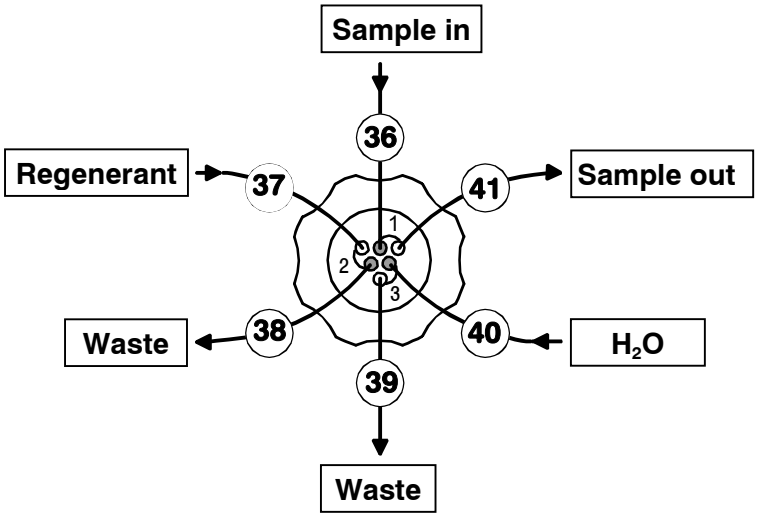
- Remove plastic stoppers from the rear panel openings **18** of the 820 IC Separation Center and lead cable **35** mounted on sample preparation module **33** back through this opening.
- Connect cable **35** to connection **13** "Module" of the 833 IC Liquid Handling Unit (see *Fig. 2*).

3 Connect sample feed to sample preparation module (Sample Preparation connection 1)

- Connect inlet capillary **36** (marked with "Sample in") at the sample preparation module connection **34** (see *Fig. 13*) to connection "5" of injection valve B using a 6.2744.010 compression fitting.

4 Connect sample preparation module to valve A (enrichment column) (Sample Preparation connection 1)

- Connect outlet capillary (marked "Sample out") at sample preparation module connection **34** (see *Fig. 13*) to connection "1" of injection valve A using a 6.2744.010 compression fitting.
- When making the further connections to injection valve A make sure that the "Inject" setting of the enrichment column is rinsed in the reverse direction to the "Fill" setting.



36	**Inlet capillary for sample**
37	**Inlet capillary for acid**
38	**Outlet capillary for acid**
39	**Outlet capillary for H_2O**
40	**Inlet capillary for H_2O**
41	**Outlet capillary for sample**

Fig. 13: Connections at sample preparation module of the 833 IC Liquid Handling Sample Preparation Unit

5 Mount pump tubing on the 833 Liquid Handling Unit

- Mount the two lengths of **6.1826.010** Pump tubing (**white-white** stopper) as described in *Section 3.2*, see *Fig. 7*.

6 Sample preparation module connection 2: Regenerant

- Pull inlet capillary **37** (marked with “Regenerant”) at sample preparation module connection **34** (see *Fig. 13*) through one of the openings **18** on the rear panel of the 820 IC Separation Center.
- Attach inlet capillary **37** (**23** in *Fig. 7*) to filter unit PEEK **22** (6.2821.120) of the **first** pump tubing using a compression fitting **17** (6.2744.010), see *Fig. 7*.
- Mount aspiration tubing: cut a piece of PTFE tubing **16** (6.1803.020) to the required length.
- Attach a PEEK compression fitting **17** (6.2744.010) to one end of the PTFE tubing **16** and screw this on to coupling **18**, see *Fig. 7*.
- Immerse the other end of the aspiration tubing in a container with regeneration solution (normally 20 mmol/L perchloric acid) and fix it in position.
- Pull outlet capillary **38** (marked with “Waste”) at sample preparation module though one of the openings **18** of the rear panel of the 820 IC Separation Center.
- Lead outlet capillary **38** into a sufficiently large waste bottle and fix it in position.

7 Sample preparation module connection 3: H2O

- Pull inlet capillary **40** (marked with “H_2O”) at Sample preparation module connection **34** (see *Fig. 13*) through one of the openings **18** on the rear panel of the 820 IC Separation Center.
- Attach inlet capillary **40** (**23** in *Fig. 7*) to the filter unit PEEK **22** (6.2821.120) of the **second** pump tubing using a PEEK compression fitting **17** (6.2744.010), see *Fig. 7*.
- Mount aspiration tubing: cut a piece of PTFE tubing **16** (6.1803.020) to the required length.
- Attach a PEEK compression fitting **17** (6.2744.010) to one end of the PTFE tubing **16** and screw this on to coupling **18**, see *Fig. 7*.
- Immerse the other end of the aspiration tubing in a container with rinsing solution (normally deionized water) and fix it position.
- Pull outlet capillary **39** (marked with “Waste”) at Sample preparation module connection **34** (see *Fig. 13*) through one of the openings **18** in the rear panel of the 820 IC Separation Center.
- Lead outlet capillary **39** into a sufficiently large waste bottle and fix it in position.

8 Start-up 833 IC Liquid Handling Sample Preparation Unit

- Switch on 833 LH Pump Unit with mains switch **8**.
- Set the contact pressure for both cassettes: press contact lever **5** until the solutions are just aspirated. Then press the contact lever up by 1 further click to achieve the optimum contact pressure.
- Check all the tubing from the storage containers to the 833 IC Liquid Handling Unit and the sample preparation module through to the waste bottles for leaks. If any liquid should be leaking then the corresponding connection must be tightened up or replaced.
- Before the sample preparation module is used for the first time the cation exchanger material must be conditioned. This is done by injecting e.g. 30% NaOH 15 times (5 injections per unit). You can use the program described in the following section for the system "Neutralisation.smt" with a running time of 20 min; the column does not need to be mounted.

6.1.2.2 Settings in IC Net

When setting up the 833 IC Liquid Handling Sample Preparation Unit and the 833 IC Liquid Handling Unit the "New system wizard" of the IC Net program demands the assignment of an "Event line" for the sample preparation module and the suppressor module. Although this does not exist you should still select any unused Event line so that the "New system wizard" can continue. In fact the sample preparation module is controlled from the 766 IC Sample Processor and the suppressor module from the Event Line of the 820 valve B (see *Fig. 12*).

Apart from the main program "Neutralisation.smt" two further programs should be created for the 766 IC Sample Processor in separate system files. The 766 program in the system file "Start-Neutralisation.smt" only starts the peristaltic pump (**833 Pump**) and rinses the sample preparation module in all three positions. "End-Neutralisation.smt" switches the pump off (**833 Pump**).

The peristaltic pumps of the 833 IC Liquid Handling Sample Preparation Unit (**833 Sample Prep**) and the 833 IC Liquid Handling Suppressor Unit (**833 Suppressor,** see *Fig. 12*) start immediately when the system is activated (recording the baseline). This is done by activating the option **'Start pump with startup hardware'** in IC Net for each instrument.

Neutralisation.smt

1. Program input for the 766 IC Sample Processor:

001	Ctrl	INIT 819	– Initializes remote lines at 819
002	Move	sample	– Moves needle to sample position
003	Lift	work	– Moves lift with needle to working position
004	Ctrl	FILL B / STEP 1	– Switches injection valve B at 820 to "Fill"
005	Pump	120 s	– Transfers sample to first sample loop
006	Ctrl	FILL A 1	– Switches injection valve A at 820 to "Fill"
007	Ctrl	INJECT B1	– Switches injection valve B at 820 to "Inject"
008	Wait	60 s	– Transfers sample via sample preparation module to enrichment column (*)
009	Ctrl	ZERO 1	– Triggers autozero at 819 IC Detector
010	Ctrl	INJECT A1	– Switches injection valve A at 820 to "Inject"
011	Ctrl	STEP MSM 833	– Switches sample preparation module to next position

(*) The time for transferring the sample via the sample preparation module must be adequate, but should be kept as short as possible in order to minimize contamination of the downstream enrichment column with unwanted anions from the water used. This is also the reason why the blank value of this water should be measured regularly for calibration purposes.

Start-Neutralisation.smt

2. Save the system “Neutralisation.smt” under a new name “Start-Neutralisation.smt”.

3. Remove the data recorder by clicking on the recorder icon with the right-hand mouse key and then selecting “Unlink”.

4. Change the program for 'Start-Neutralisation.smt' as follows and save it again:

001	Ctrl	INIT 819	– Initializes remote lines at 819
002	Ctrl	PUMP 833 on	– Switches on 833 Pump Unit 833
003	Wait	300 s	– Rinsing time
004	Ctrl	STEP MSM 833	– Switches sample preparation module to next position
005	Wait	300 s	– Rinsing time
006	Ctrl	STEP MSM 833	– Switches sample preparation module to next position
007	Wait	300 s	– Rinsing time

End-Neutralisation.smt

5. Save the system “Start-Neutralisation.smt” under a new name “End-Neutralisation.smt”.

6. Change the program for “End-Neutralisation.smt” as follows and save it again:

001	Ctrl	INIT 819	– Initializes remote lines at 819
002	Ctrl	PUMP 833 off	– Switches off 833 Pump Unit 833

7. The sample queue to be processed then contains the following entries, for example:

	System	Ident	Vial	Chrom. No.
1	**Start-Neutralisation.smt**	**dummy**	**1**	-
2	**Neutralisation.smt**	**Sample 1**	**1**	1
3	**Neutralisation.smt**	**Sample 2**	**2**	2
4	**Neutralisation.smt**	**Sample 3**	**3**	3
5	**Neutralisation.smt**	**Sample 4**	**4**	4
6	**Neutralisation.smt**	**Sample 5**	**5**	5
7	**End-Neutralisation.smt**	**dummy**	**5**	-

This example shows the processing of a sample series with 5 samples. the 'Chrom. No.' column is only used for information.

6.2 Connection to modular IC system for cation separation

A further application for the 833 IC Liquid Handling Sample Preparation Unit is the separation of cations before injecting the sample onto the separation column (e.g. separation of heavy metals). A system for the determination of anions with chemical suppression is described, in which the direct transfer of the sample to the sample preparation module with subsequent transfer of the treated sample to the injection valve is planned. This is why the necessary instrument configuration corresponds to that of the **Modular IC System 2** (**MIC 2 Advanced**: anion system with chemical suppression), extended by the 833 IC Liquid Handling Unit.

If you are not certain whether the capacity of the sample preparation module is sufficient for your application then, for more strongly polluted samples which require matrix elimination and enrichment, you should use such a system as that described in Section *6.1*.

The electrical connections of the system described above to the 766 IC Sample Processor with complete control by the «**IC Net 2.3**» software is described below.

6.2.1.1 Electrical connection

The electrical connections of the system, consisting of 819 IC Detector, 820 IC Separation Center (2.820.0X30; 1-channel + MSM), 818 IC Pump, 833 IC Liquid Handling Pump Unit, 833 IC Liquid Handling Sample Preparation Unit and 830 IC Interface are shown in *Fig. 14*:

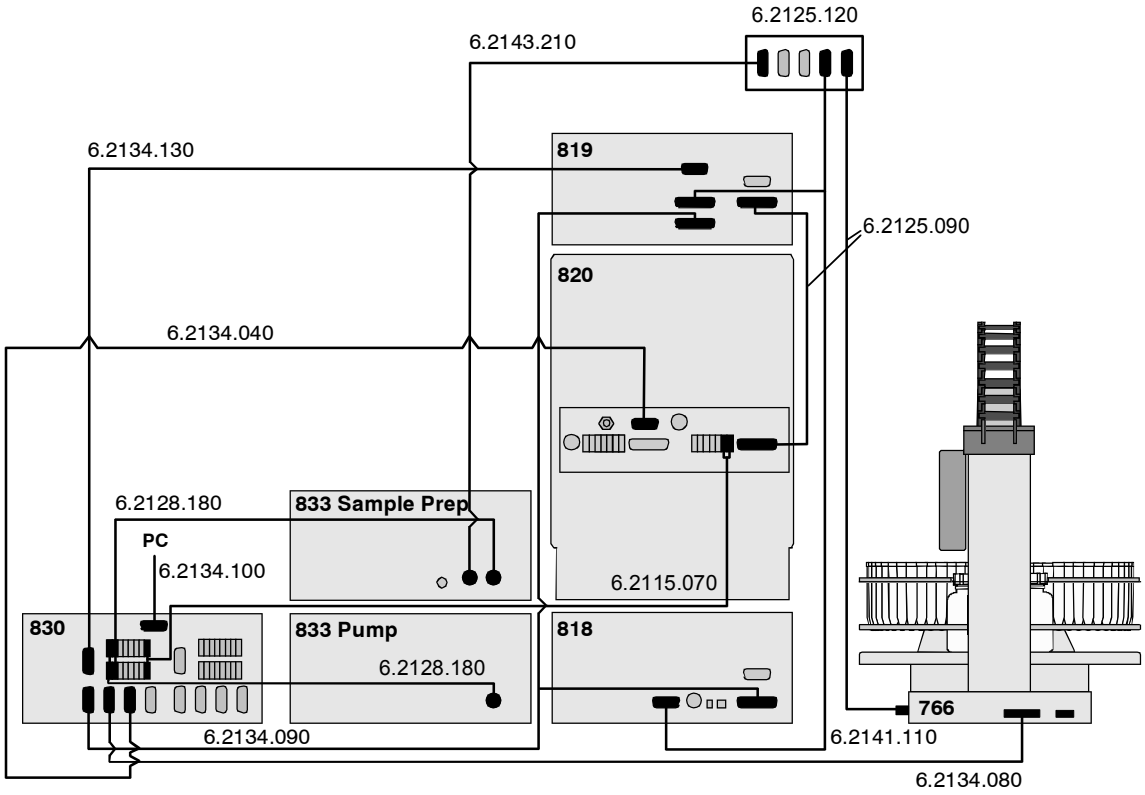


Fig. 14: Connection of 833 IC Liquid Handling Sample Preparation Unit to modular IC system for cation separation

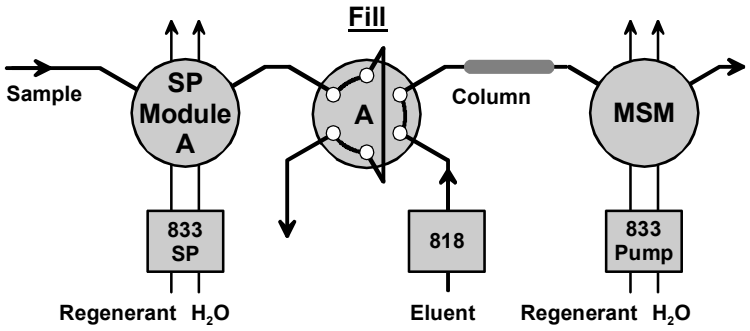
6.2.1.2 Connection of the sample preparation module

The following description assumes the use of a 2.820.0X30 IC Separation Center (1-channel system, MSM).

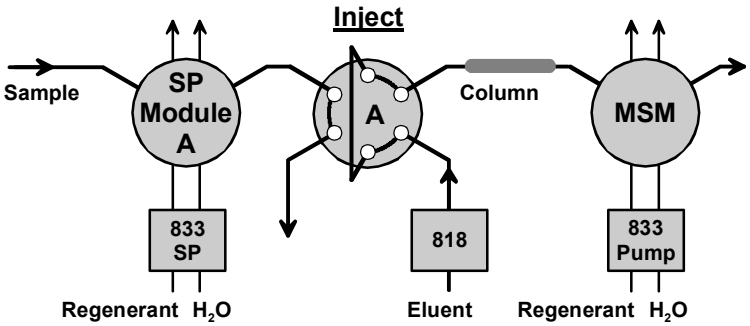
The 1.793.0110 Sample Preparation Module must first be inserted in the 820 IC Separation Center and connected to the basic instrument of the 833 IC Liquid Handling Sample Preparation Unit (**833 Sample Preparation** in *Fig. 14*).

The components are connected as shown below; this also shows the sample flow scheme:

A) Cations of the sample are continuously exchanged for H^+ ions in the ssample preparation module; sample loop at valve A is filled.



B) Sample is neutralized in sample preparation module; anions are enriched at valve A.



The inlet and outlet capillaries mounted on the sample preparation module are connected as follows:

1 Insert sample preparation module

- Place sample preparation module **33** inside the chamber on the floor.

2 Connect sample preparation module

- Remove plastic stoppers from the rear panel openings **18** of the 820 IC Separation Center and lead cable **35** mounted on sample preparation module **33** back through this opening.
- Connect cable **35** to connection **13** "Module" of the 833 IC Liquid Handling Unit (see *Fig. 2*).

3 Connect sample feed to sample preparation module (Sample Preparation connection 1)

- Connect inlet capillary **36** (marked with "Sample in") at sample preparation module connection **34** (see *Fig. 13*) to the 766 Autosampler using the 6.1831.060 PEEK capillary, two 6.2744.010 compression fittings and a 6.2744.040 PEEK coupling.

4 Connect sample preparation module to valve A (Sample Preparation connection 1)

- Connect outlet capillary **41** (marked with "Sample out") at sample preparation module connection **34** (see *Fig. 13*) to connect "1" of injection valve A using a 6.2744.010 compression fitting.

5 Mount pump tubing on 833 Liquid Handling Unit

- Mount the two lengths of **6.1826.010** Pump tubing (**white-white** stopper) as described in *Section 3.2*, see *Fig. 7*.

6 Sample preparation module connection 2: Regenerant

- Pull inlet capillary **37** (marked with "Regenerant")at sample preparation module connection **34** (see *Fig. 13*) through one of the openings **18** on the rear panel of the 820 IC Separation Center.
- Attach inlet capillary **37** (**23** in *Fig. 7*) to filter unit PEEK **22** (6.2821.120) of the **first** pump tubing using a compression fitting **17** (6.2744.010), see *Fig. 7*.
- Mount aspiration tubing: cut a piece of PTFE tubing **16** (6.1803.020) to the required length.
- Attach a PEEK compression fitting **17** (6.2744.010) to one end of the PTFE tubing **16** and screw this on to coupling **18**, see *Fig. 7*.
- Immerse the other end of the aspiration tubing in a container with regeneration solution (normally 50 mmol/L perchloric acid) and fix it in position.
- Pull outlet capillary **38** (marked with "Waste") at sample preparation module though one of the openings **18** of the rear panel of the 820 IC Separation Center.
- Lead outlet capillary **38** into a sufficiently large waste bottle and fix it in position.

7 Sample preparation module connection 3: H2O

- Pull inlet capillary **40** (marked with "H_2O") at sample preparation module connection **34** (see *Fig. 13*) through one of the openings **18** on the rear panel of the 820 IC Separation Center.
- Attach inlet capillary **40** (**23** in *Fig. 7*) to the filter unit PEEK **22** (6.2821.120) of the **second** pump tubing using a PEEK compression fitting **17** (6.2744.010), see *Fig. 7*.
- Mount aspiration tubing: cut a piece of PTFE tubing **16** (6.1803.020) to the required length.
- Attach a PEEK compression fitting **17** (6.2744.010) to one end of the PTFE tubing **16** and screw this on to coupling **18**, see *Fig. 7*.

- Immerse the other end of the aspiration tubing in a container with rinsing solution (normally deionized water) and fix it position.
- Pull outlet capillary **39** (marked with "Waste") at sample preparation module connection **34** (see *Fig. 13*) through one of the openings **18** in the rear panel of the 820 IC Separation Center.
- Lead outlet capillary **39** into a sufficiently large waste bottle and fix it in position.

8 Start-up 833 IC Liquid Handling Sample Preparation Unit

- Switch on 833 LH Pump Unit with mains switch **8**.
- Set the contact pressure for both cassettes: press contact lever **5** until the solutions are just aspirated. Then press the contact lever up by 1 further click to achieve the optimum contact pressure.
- Check all the tubing from the storage containers to the 833 IC Liquid Handling Unit and the sample preparation module through to the waste bottles for leaks. If any liquid should be leaking then the corresponding connection must be tightened up or replaced.
- Before the sample preparation module is used for the first time the cation exchanger material must be conditioned. This is done by injecting e.g. 30% NaOH 15 times (5 injections per unit). You can use the program described in the following section for the system "Neutralisation.smt" with a running time of 20 min; the column does not need to be mounted.

6.2.2 Settings in IC Net

When setting up the 833 IC Liquid Handling Sample Preparation Unit and the 833 IC Liquid Handling Unit the "New system wizard" of the IC Net program demands the assignment of an "Event line" for the Actuator, i.e. the sample preparation module. Although this does not exist you should still select any unused Event line so that the "New system wizard" can continue. In fact the sample preparation module is controlled from the 766 IC Sample Processor (see *Fig. 14*).

The signal for switching the internal suppressor module of the 820 to the next position is not controlled by the program of the 766 IC Sample Changer. Instead the parameter "Auto Step" is set to "fill" in the parameter window of the 820 IC Separation Center in IC Net (double-click on 820 symbol).

The peristaltic pumps of the 833 IC Liquid Handling Pump Unit and the 833 IC Liquid Handling Sample Preparation Unit start immediately when the system is activated (recording the baseline). This is done by activating the option **'Start pump with startup hardware'** in IC Net for each instrument.

Catex.smt

The program for the 766 IC Sample Processor is as follows:

001	Ctrl	INIT 819	– Initializes remote lines at 819
002	Move	sample	– Moves needle to sample position
003	Lift	work	– Moves lift with needle to working height
004	Ctrl	ZERO 1	– Triggers autozero at 819 IC Detector
005	Ctrl	FILL A 1	– Switches injection valve A at 820 to "Fill"
006	Pump	120 s	– Transfers sample to sample loop via sample preparation module (*)
007	Ctrl	INJECT A1	– Switches injection valve A at 820 to "Inject"
008	Ctrl	STEP MSM 833	– Switches sample preparation module to next position

(*) The time for transferring the sample via the sample preparation module must be adequate, but should be kept as short as possible in order to minimize contamination of the downstream enrichment column with unwanted anions from the water used.

6.3 Handling the sample preparation module

General

The **sample preparation module** of the **833 IC Liquid Handling Sample Preparation Unit** contains a total of three cartridges, which are used in sequence for exchanging cations, for regeneration, and for rinsing with water. In order to be able to record each chromatogram under comparable conditions work is normally carried out with a freshly regenerated cartridge. Switching takes place either automatically together with the valve switching or manually.

Correct connection

The three actuator unit inlets and outlets numbered 1, 2, 3 each have two permanently attached PTFE capillaries that must be connected as described in Section *6.1 and 6.2* (see *Fig. 13*).

Flow direction

The cation exchanger units of the sample preparation module must never be regenerated in the same flow direction as that in which the sample is transported. This is why the inlet and outlet capillaries must always be mounted as described in Section 6.1 and 6.2 and shown in Fig. 13.

Never switch to the next position when dry

The sample preparation module must never be switched to the next position when it is dry, as there is a risk that it could be blocked.

No recycling

The recycling method (return of the eluent to the storage container) must not be used with the sample preparation module.

7 833 IC Liquid Handling Dialysis Unit

This version consists of the 833 IC Liquid Handling Unit basic instrument and the **6.2729.100 Dialysis Cell**.

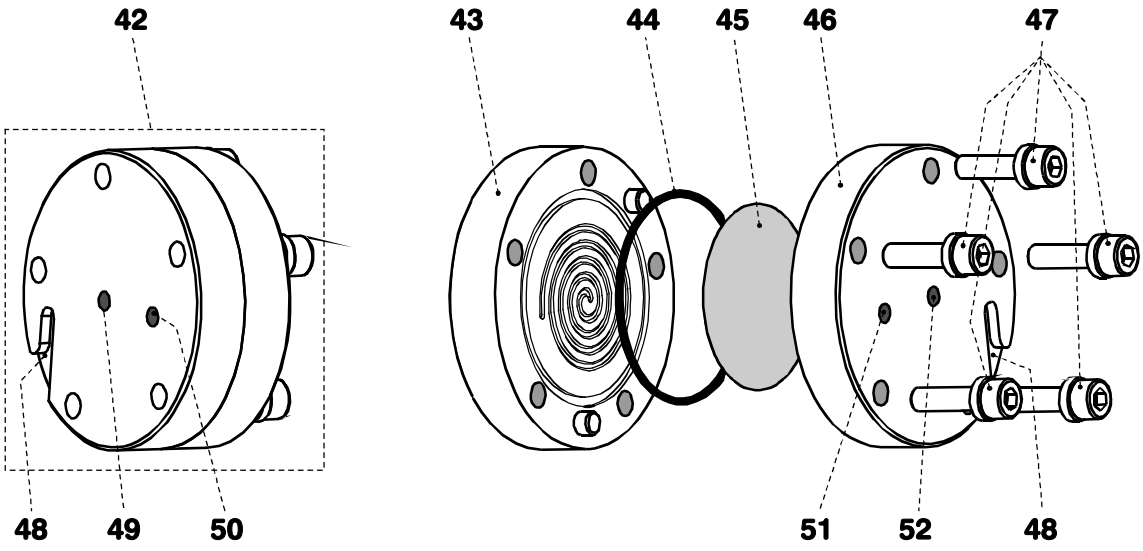


Fig. 15: 6.2729.100 Dialysis Cell

42	**6.2729.100 Dialysis cell**
43	**Upper part of dialysis cell**
44	**E.301.0111 Sealing ring**
45	**6.2714.010 Dialysis membrane**
46	**Lower part of dialysis cell**
47	**V.022.6030 Screw with 4.754.4090 Washer**
48	**Slot for holding the dialysis cell in cell holder 6**
49	**Outlet for acceptor solution**
50	**Inlet for acceptor solution**
51	**Inlet for sample solution**
52	**Outlet for sample solution**

A dialysis system with manual sample injection is described below.

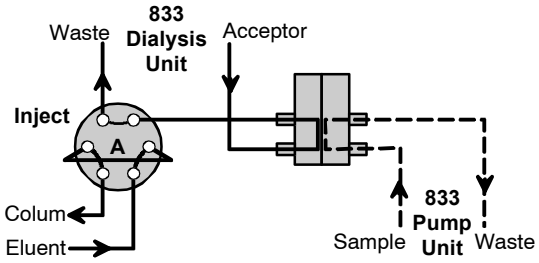
7.1 Flow diagram for dialysis

Sample dialysis with the 833 IC Liquid Handling Dialysis Unit comprises the following four steps for each sample:

1 Rinsing

Valve A: INJECT

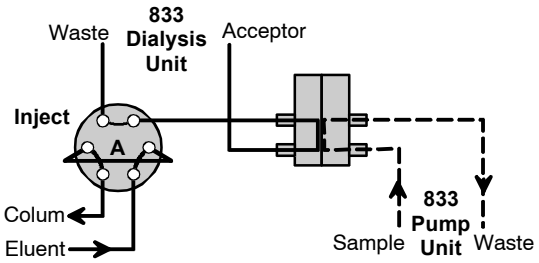
Sample channel, acceptor channel and sample loop are rinsed (for approx. 2 min).



2 Dialysis with «stopped flow»

Valve A: INJECT

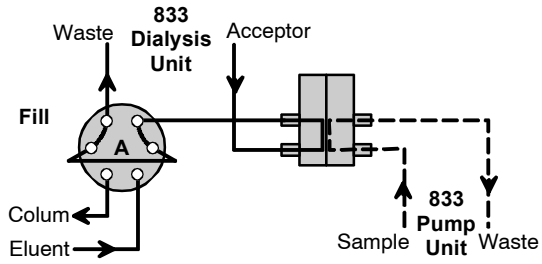
The sample is dialyzed with stationary acceptor solution (dialysis time approx. 10 min).



3 Transfer to sample loop

Valve A: FILL

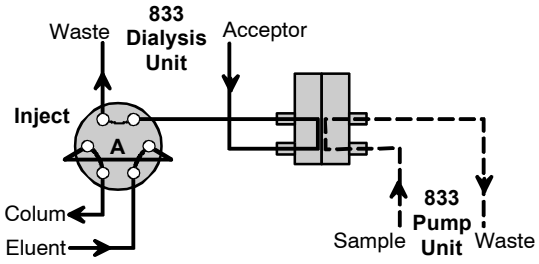
The acceptor solution enriched with ions from the sample is transferred to the sample loop (transfer time approx. 0.5 min).



4 Injection

Valve A: INJECT

The acceptor solution enriched with ions from the sample is injected into the IC system.



To perform dialysis with the 833 IC Liquid Handling Dialysis Unit two peristaltic pumps are required. One pump (833 Dialysis Unit) is delivering the acceptor solution, the other one (833 Pump Unit) is

delivering the sample. One channel of each pump is used to transfer solution to the dialysis cell, the second channel is required to remove solution from the dialysis cell. This setup ensures constant flow and equal pressure conditions on both sides of the dialysis membrane.

7.2 Electrical connection

7.2.1 Dialysis without suppression

The electrical connections of the system, consisting of 819 IC Detector, 820 IC Separation Center (2.820.0X10; 1-channel), 818 IC Pump, 833 IC Liquid Handling Dialysis Unit, 833 IC Liquid Handling Pump Unit and 830 IC Interface are shown in *Fig. 16*:

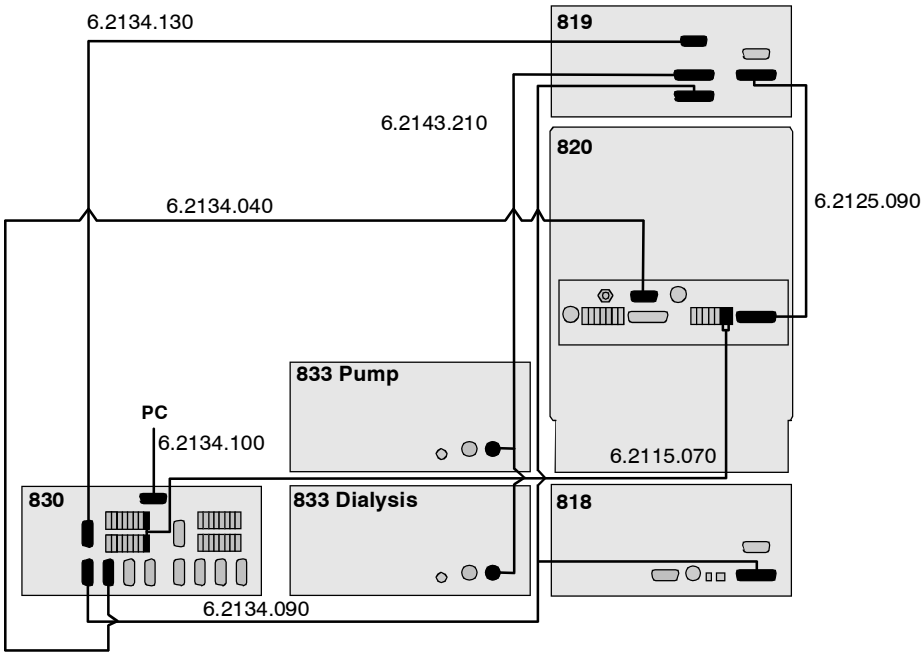


Fig. 16: Connecting the 833 IC Liquid Handling Dialysis Unit to a modular dialysis system without suppression

*Make sure that the remote control of the peristaltic pumps **833 Pump** and **833 Dialysis** via 6.2143.210 cable (see Section 3.1.2) corresponds to the remote configuration of the detector program (see Section 7.3.1).*

7.2.2 Dialysis with suppression

The electrical connections of the system, consisting of 819 IC Detector, 820 IC Separation Center (2.820.0X30; 1-channel with suppressor), 818 IC Pump, 833 IC Liquid Handling Suppressor Unit (2 x), 833 IC Liquid Handling Dialysis Unit and 830 IC Interface is shown in *Fig. 17*:

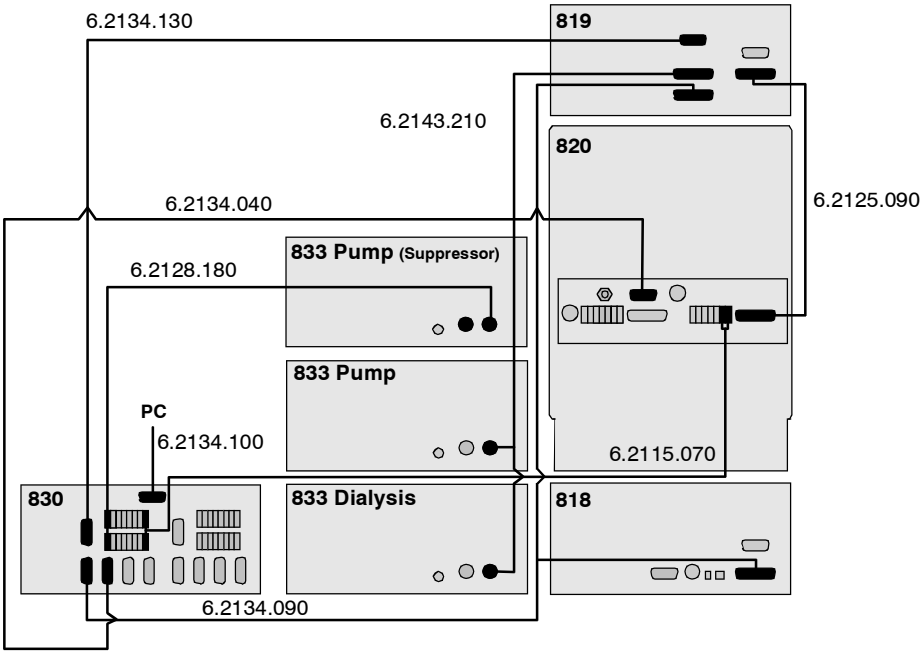


Fig. 17: Connecting the 833 IC Liquid Handling Dialysis Unit to a modular dialysis system with suppression

*Make sure that the remote control of the peristaltic pumps **833 Pump** and **833 Dialysis** via 6.2143.210 cable (see Section 3.1.2) corresponds to the remote configuration of the detector program (see Section 7.3.2).*

7.3 Settings in IC Net

7.3.1 Dialysis without suppression

The program steps required for dialysis are all controlled by the time program of the 819 IC Detector.

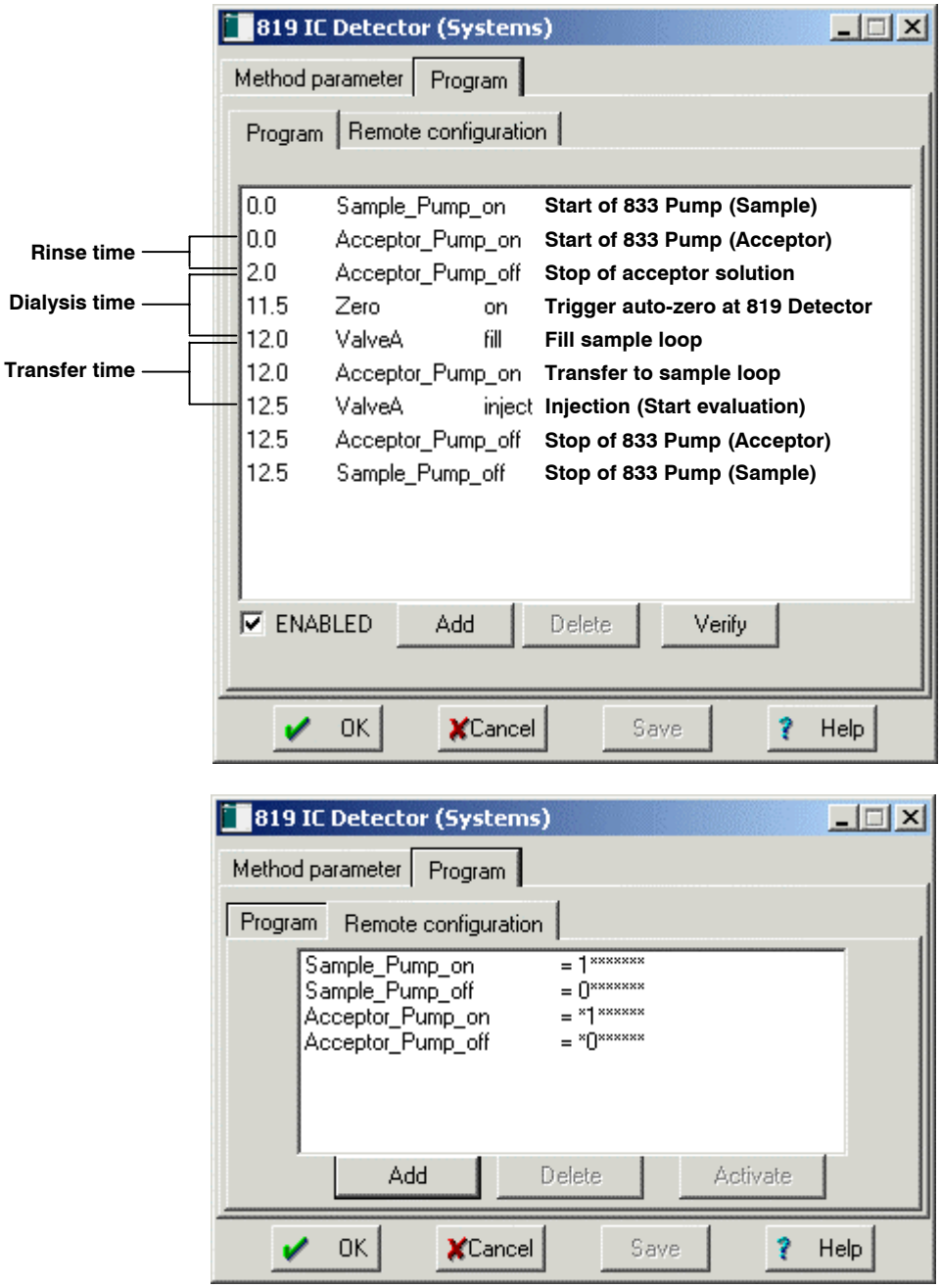


Fig. 18: Time program for dialysis without suppression

*Make sure that the remote control of the peristaltic pumps **833 Pump** and **833 Dialysis** (see Section 7.2.1) via the 6.2143.210 cable (see Section 3.1.2) corresponds to the remote configuration of the detector program.*

7.3.2 Dialysis with suppression

The peristaltic pump of the 833 IC Liquid Handling Suppressor Unit (**833 Suppressor** see *Fig. 17*) starts immediately when the system is activated (recording the baseline). This is done by activating the option **'Start pump with startup hardware'** for the instrument in IC Net.

The program steps required for dialysis are all controlled by the time program of the 819 IC Detector.

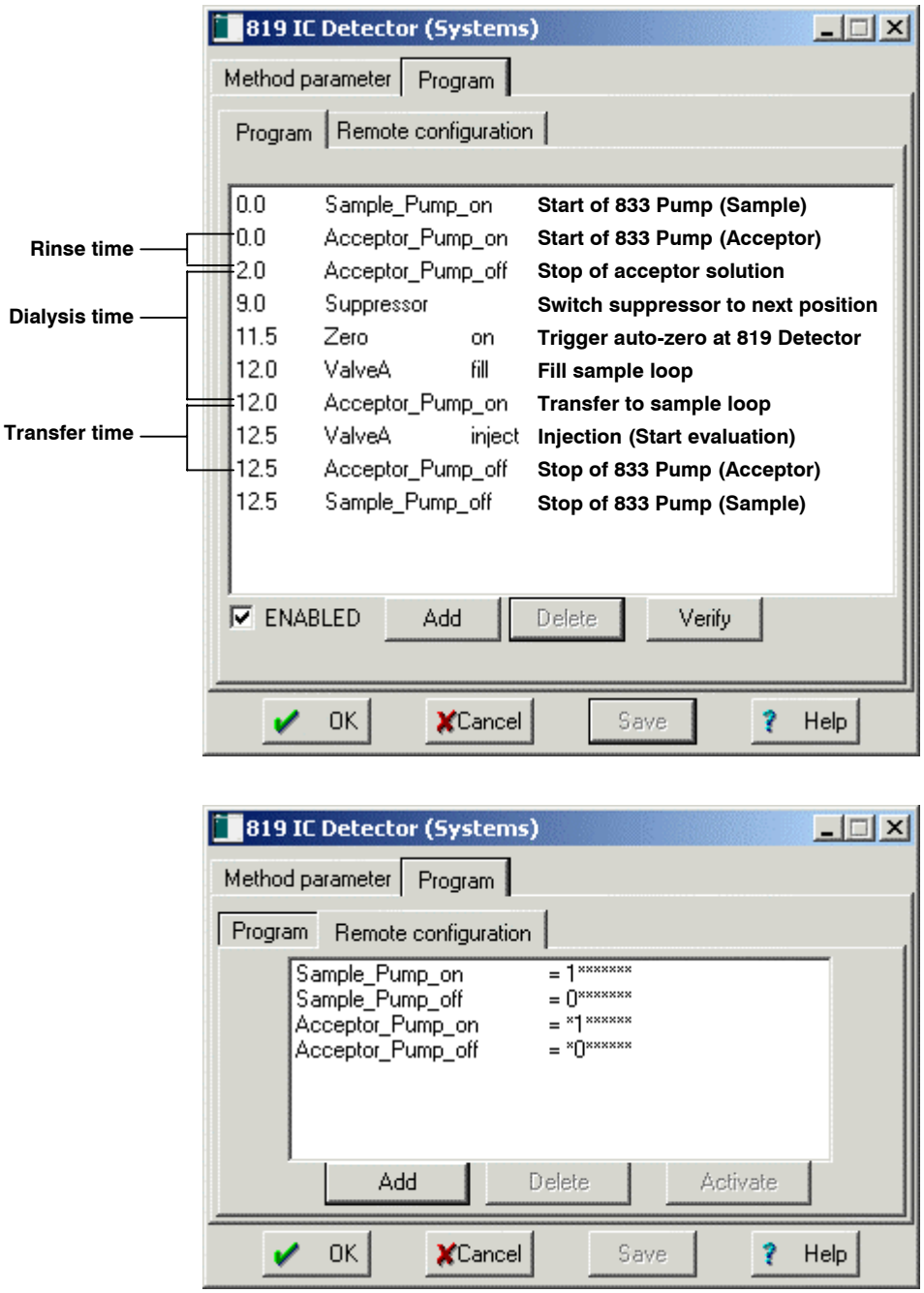


Fig. 19: Time program for dialysis with suppression

*Make sure that the remote control of the peristaltic pumps **833 Pump** and **833 Dialysis** (see Section 7.2.2) via the 6.2143.210 cable (see Section 3.1.2) corresponds to the remote configuration of the detector program.*

7.4 Assembling the dialysis cell

This section describes the initial assembly of the dialysis cell. Before it is used a **dialysis membrane** must be inserted. This is done as follows (see *Fig. 15*):

1 Prepare dialysis cell

- Remove dialysis cell **42** (6.2729.100) from the packaging and screw out the four 6.2744.060 Blank stoppers .
- Use the 6.2621.070 Allen key to loosen the 5 screws **47** completely, remove lower part **46** from upper part **43** and remove sealing ring **44**.

2 Clean dialysis cell

- Thoroughly rinse sealing ring **44**, upper part **43** and lower part **46** of the dialysis cell with ultrapure water and dry with N_2 or a lint-free tissue.

Only ultrapure water *or* ***ethanol*** *should be used for cleaning the dialysis cell, other organic solvents (e.g. acetone) will damage the Plexiglas cell!*

3 Prepare dialysis membrane

- Use the 6.2831.010 Tweezers to remove a new dialysis membrane **45** (e.g. 6.2714.010) from the packaging and immerse in a Petri dish filled with ultrapure water for approx. 2 min until the membrane is thoroughly soaked with water.

4 Insert dialysis membrane

- Place upper part **43** on a paper tissue with its inner side uppermost.
- Place sealing ring **44** in the recess provided for it in upper part **43**.
- Use the 6.2831.010 Tweezers to place the wet dialysis membrane **45** (e.g. 6.2714.010) inside sealing ring **44** on upper part **43**.

Make sure that the dialysis membrane soaked with water does not dry out before insertion as otherwise it cannot be used !

5 Close dialysis cell

- Place lower part **46** on upper part **43** so that the two parts are properly aligned with each other.
- Use the 6.2621.070 Allen key to screw in the 5 screws **47** completely and tighten them up well.

6 Assemble dialysis cell

- Push the 6.2057.010 Cell holder into the free folding guide of the 820 IC Separation Center and insert assembled dialysis cell **42** in the holder.

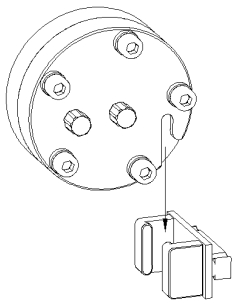


Fig. 20 Inserting the dialysis cell in the holder

7.5 Making the capillary connections

7.5.1 Preparing the 820 IC Separation Center

For operation with the 833 IC Liquid Handling Dialysis Unit the 820 IC Separation Center must be converted as follows (see *Fig. 21*):

1 Dismantle accessories

- Pull the PTFE aspiration tube completely out of the feedthrough **14** and screw it off from connection "1" of valve A **56**.
- Dismantle the PEEK capillary tubing from connection "2" of valve A **56** to the feedthrough **13**.

2 Make connections to suppressor (only for 2.820.0X30)

- Install suppressor module of the 820 IC Separation Center and the additional 833 IC Liquid Handling Pump Unit as described in *Section 4*.

7.5.2 Connection of the dialysis cell

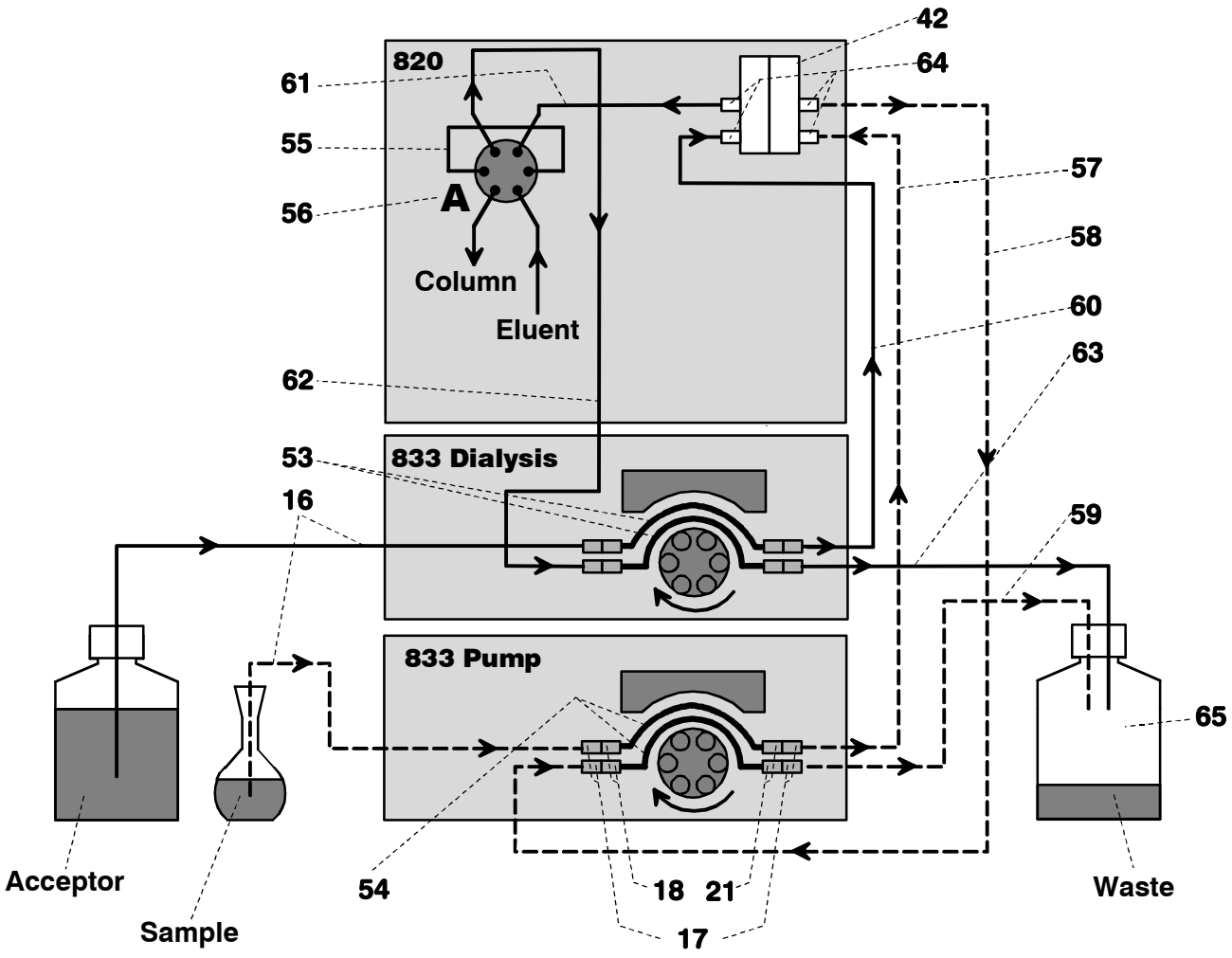


Fig. 21: Tubing connection system

16 6.1803.040 PTFE capillary (1 m) for supplying sample/acceptor solution

17 6.2744.010 PEEK compression fitting

18 6.2744.034 Coupling

21 6.2744.160 PEEK coupling with tubing security device

42 6.2729.100 Dialysis cell

53 6.1826.030 Pump tubing (**19** in *Fig. 7*) with **orange-yellow** stoppers for transferring the **acceptor solution**

54 6.1826.040 Pump tubing (**19** in *Fig. 7*) with **black-black** stoppers for transferring the **sample**

55 6.1825.210 PEEK sample loop (20 µL)

56 Injection valve A

57 6.1803.040 PTFE capillary (1 m) connection peristaltic pump (**channel 1 of 833 Pump Unit** for the supply of fresh sample) – inlet dialysis cell (sample side)

58 **6.1803.040 PTFE capillary (1 m)** connection outlet dialysis cell (sample side) – peristaltic pump (**channel 2 of 833 Pump Unit** for the disposal of dialyzed sample solution)

59 **PTFE capillary 6.1803.040 (1 m)** connection peristaltic pump (**channel 2 of 833 Pump Unit** for the disposal of dialyzed sample solution) – waste container

60 **6.1803.040 PTFE capillary (1 m)** connection peristaltic pump (**channel 1 of 833 Dialysis Unit** for the supply of fresh acceptor solution) – inlet dialysis cell (acceptor side)

61 **6.1831.050 PEEK capillary (40 cm)** connection outlet dialysis cell (acceptor side) – connection "1" of valve A

62 **6.1831.060 PEEK capillary (1 m)** connection of connection "2" valve A – peristaltic pump (channel 2 of 833 Dialysis Unit for the disposal of acceptor solution)

63 **6.1803.040 PTFE capillary (1 m)** peristaltic pump (**channel 2 of 833 Dialysis Unit** for the disposal of acceptor solution) – waste container

64 **6.2744.000 PVDF compression fitting**

65 **Waste container**

To connect dialysis cell **42** to the IC system proceed as follows (see also *Fig.* 21):

*Capillaries fitted with new connectors must have a perfectly flat cut surface. Use the **6.2621.080 Capillary cutter** available as an option to cut capillaries.*

Connections for sample solution

1 Attach pump tubing to 833 Liquid Handling Pump Unit

- Attach the two pieces of pump tubing **6.1826.040** (**black-black** stopper) as described in *Section 3.2* to the 833 IC Liquid Handling **Pump** Unit 833, see *Fig. 7*.

2 Connect aspiration capillary for sample

- Attach one end of aspiration capillary **16** (6.1803.040; L =1 m) to PEEK coupling **18** on the suction side of the **black-black** pump tubing of **channel 1** from the **833 Pump Unit** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7* and *Fig. 21*).
- Immerse the other end of aspiration tubing **16** in the **sample container** and fix it in position.

3 Connect dialysis cell

- Screw PTFE capillary **57** (6.1803.040; L =1 m) (**23** in *Fig. 7*) to PEEK coupling **21** (**6.2744.034**) on the delivery side of the pump tubing with the **black-black stoppers** of **channel 1** from the **833 Pump Unit** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7* and *Fig. 21*).
  Lead the other end of the capillary through one of the feedthroughs **14** at the front or the side of the 820 Separation Center in the column compartment and screw it on to inlet opening **51** of lower part **46** of the dialysis cell using a PVDF compression fitting **64** (6.2744.000) (see *Fig. 15* and *Fig. 21*).
- Screw PTFE capillary **58** (6.1803.040; L =1 m) to outlet opening **52** of lower part **46** of the dialysis cell (see *Fig. 15*) using a PVDF compression fitting **64** (6.2744.000) and lead it out of the column compartment through one of the feedthroughs **14** on the front or side of the 820 Separation Center. Attach the other end of the PTFE capillary **58** to PEEK coupling **18** on the suction side of the **black-black** pump tubing of **channel 2** from the **833 Pump Unit** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7* and *Fig. 21*).

*Use only the above-mentioned **6.2744.000 PVDF compression fittings** for the dialysis cell connections. If 6.2744.010 PEEK compression fittings are used then stress cracks could occur in the dialysis cell !*

4 Connect waste container

- Screw PTFE capillary **59** (6.1803.040; L =1 m) (**23** in *Fig. 7*) to PEEK coupling **21** (**6.2744.034**) on the delivery side of the pump tubing with the **black-black stoppers** of **channel 2** from the **833 Pump Unit** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7* and *Fig. 21*). Lead the other end of the capillary into a sufficiently large waste container and fix it in position.

Connections for acceptor solution

1 Connect pump tubing to 833 Liquid Handling Dialysis Unit

- Attach the two pieces of pump tubing **6.1826.030** (**orange-yellwo** stopper) as described in *Section 3.2* to the 833 IC Liquid Handling **Dialysis** Unit 833, see *Fig. 7*.

2 Connect aspiration capillary for acceptor solution

- Attach one end of aspiration capillary **16** (6.1803.040; L =1 m) to PEEK coupling **18** on the suction side of the **orange-yellow** pump tubing of **channel 1** from the **833 Dialysis Unit** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7* and *Fig. 21*).

- Immerse the other end of aspiration tubing **16** in the **sample container** and fix it in position. **Ultrapure water** is normally used as the acceptor solution; it must first be **degassed** (with N_2, He or vacuum).

3 Connect dialysis cell

- Screw PTFE capillary **60**) (6.1803.040; L =1 m) to PEEK coupling **21** (**6.2744.034**) on the delivery side of the pump tubing with the **orange-yellow stoppers** of **channel 1** from the **833 Dialysis Unit** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7* and *Fig. 21*). Lead the other end of the capillary through one of the feedthroughs **14** at the front or the side of the 820 Separation Center in the column compartment and screw it on to inlet opening **50** of upper part **43** of the dialysis cell with a PVDF compression fitting **64** (6.2744.000) (see *Fig. 15* and *Fig. 21*).
- Screw PEEK capillary **61** (6.1831.050; L =40 cm)(see *Fig.* 21) to outlet opening **49** of cell upper part **43** of the dialysis cell using a PVDF compression fitting **64** (6.2744.000) (see *Fig. 15*).

*Use only the above-mentioned **6.2744.000 PVDF compression fittings** for the dialysis cell connections. If 6.2744.010 PEEK compression fittings are used then stress cracks could occur in the dialysis cell !*

4 Connect injection valve

- Screw the PEEK capillary **61** (6.1831.050; L = 40 cm) attached to outlet **49** to connection "1" of valve A **56** using a 6.2744.010 PEEK compression fitting.
- Screw PEEK capillary **62** (6.1831.060; L =1 m) to connection "2" of valve A **56** using a 6.2744.010 PEEK compression fitting and lead it out of the column compartment through one of the feedthroughs **14** on the front or side of the 820 Separation Center. Attach the other end of the PTFE capillary **62** to PEEK coupling **18** on the suction side of the **orange-yellow** pump tubing of **channel 2** from the **833 Dialsis Unit** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7* and *Fig. 21*).

5 Connect waste container

- Screw PTFE capillary **63** (6.1803.040; L =1 m) (**23** in *Fig. 7*) to PEEK coupling **21** (**6.2744.034**) on the delivery side of the pump tubing with the **orange-yellow stoppers** of **channel 2** from the **833 Dialysis Unit** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7* and *Fig. 21*). Lead the other end of the capillary into a sufficiently large waste container and fix it in position.

Conditioning the dialysis system

Before the first analysis the dialysis cell with the inserted dialysis membrane and all the tubing connections must be rinsed with ultrapure water. Proceed as follows:

1 Settings at 820 IC Separation Center

- Switch injection valves A and B in the 820 IC Separation Center to the setting "FILL" in the «IC Net» software.

2 Start-up the 833 IC Liquid Handling Dialysis Unit

- Immerse the 2 pieces of aspiration tubing **16** (see *Fig.* 21) in the acceptor solution (degassed ultrapure water).
- Switch on 833 Liquid Handling Pump Unit and 833 IC Liquid Handling dialysis Unit with mains switch **8**.
- Start the peristaltic pumps in «IC Net» by setting the remote line 1 (833 Pump Unit) and remote line 2 (833 Dialysis Unit) in the window of the 819 Detector.
- Set the contact pressure for both cassettes: press contact lever **5** until the solutions are just aspirated. Then press the contact lever up by 1 further click to achieve the optimum contact pressure.
- Rinse the dialysis system for approx. 10 min with ultrapure water and check that the same amount of solution emerges from both the waste outlets in the waste bottle.

3 Conditioning the dialysis membrane

- Rinse the dialysis system for approx. 20 min with ultrapure water. Check that the same amount of solution emerges from both the waste outlets in the waste bottle.
- Check all tubing from the storage containers to the tubing cassettes and dialysis cell and up to the waste bottle for leaks. If any leaks are found then the corresponding connection must either be tightened up or replaced.
- If any air bubbles remain in the dialysis cell then screw off PEEK tubing **62** (acceptor solution) and PTFE tubing **58** (sample) from outlets **49** and **52** of the dialysis cell and wait until the air bubbles have vanished. Then screw the tubing back on again.

7.6 Optimizing the dialysis

7.6.1 Determining the rinsing time

A rinsing time of **2 min** is normally sufficient for completely rinsing the sample and acceptor channels. This time can be increased if necessary.

7.6.2 Determining the transfer time

The time for transferring the enriched acceptor solution to the sample loop must be chosen so that the part of the acceptor solution with the highest ion concentration is transferred to the sample loop. The following values can normally be used for the optimal transfer time if the standard accessories are used; they depend on the delivery rate of the pump:

Mains frequency	*Optimal transfer time*
50 Hz	0.5 min
60 Hz	0.4 min

You should determine the optimal transfer time yourself for each analytical problem by measuring the individual ion concentrations as a function of the transfer time and checking them from time to time. Proceed as follows:

1 First measurement

- Set transfer time in program to 0.2 min and dialysis time to 10 min (see *Section 7.3.1/7.3.2*).
- Immerse sample aspiration tubing **16** (see *Fig. 21*) in a standard containing 10 mg/L of the particular anion or cation.
- Start determination in IC Net and wait until chromatogram has been evaluated.

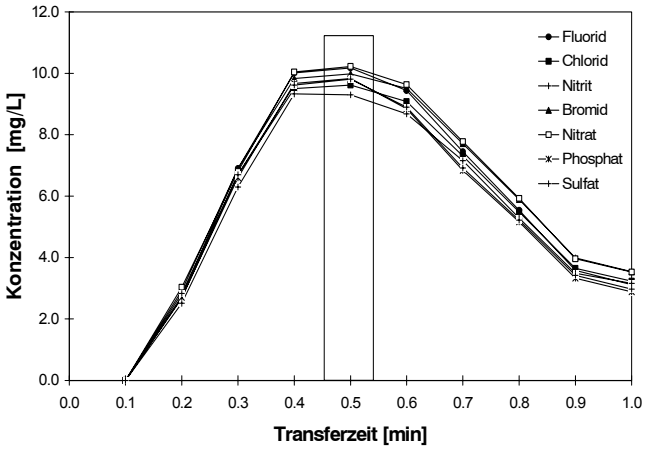
2 Further measurements

- Increase the transfer time in the program (see *Section 7.3.1/7.3.2*) in steps of 0.1 min until the measured concentration starts to decrease.
- Carry out measurements as described in item **1**.

3 Determine the optimal transfer time

- Plot the measured peak area or concentration as a function of the transfer and determine the optimal transfer time from the plot.

The below illustration shows an example of such a determination for anions using the **6.2714.010 Dialysis membrane** from Metrohm (cellulose acetate; thickness= 115 µm; pore size= 0.2 µm). A standard solution containing 10 mg/L of each of the individual anions was used as the sample and dialyzed for10 min (mains frequency 50 Hz).



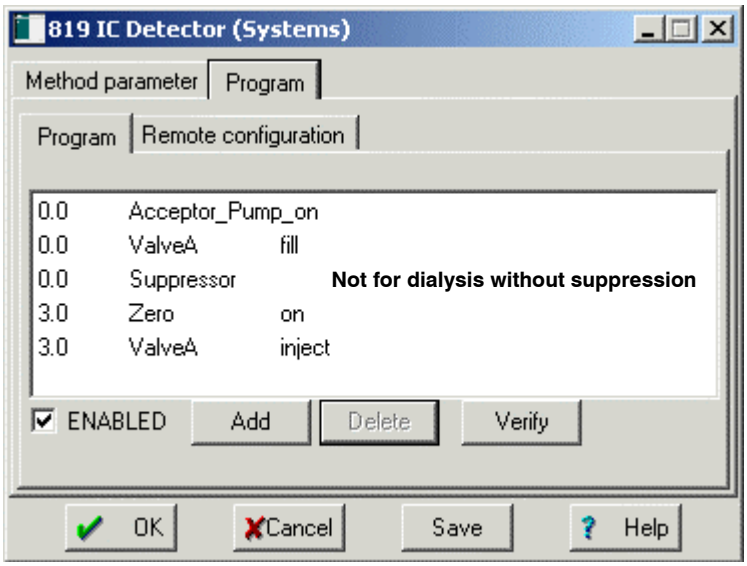
7.6.3 Determining the dialysis time

After the optimal transfer time has been determined the optimal dialysis time must also be determined, this depends on the total ionic concentration. The dialysis time with the stopped acceptor solution flow must be selected so that 100% of the sample concentration is achieved in the acceptor solution. For the **6.2714.010 Dialysis membrane** from Metrohm (cellulose acetate; thickness= 115 µm; pore size= 0.2 µm) the optimal dialysis time is **10 min** for a total ionic concentration ≥ 5 mg/L.

If a different dialysis membrane is used or if a total ionic concentration < 5 mg/L is measured the optimal dialysis time must be determined by measuring the recovery rate as a function of the dialysis time. Proceed as follows:

1 Measure standard directly

- Immerse the aspiration tubing **16** of the acceptor solution in the required ionic standard. This should have approximately the same total ionic concentration as the sample.
- Start a determination in «IC Net» to measure the standard directly; the program could look like that shown below:



- Immerse acceptor solution aspiration tubing **16** (see *Fig. 21*)in the acceptor solution again and rinse the acceptor channel for approx. 2 min.
- Switch pump of the 833 IC Liquid Handling Dialysis Unit off.

2 Dialyze the standard and measure it

- Set the dialysis time to 5 min in the program (see *Section 7.3.1/7.3.2*).
- Immerse sample aspiration tubing **16** in the standard used in item **1**.
- Start the determination in IC Net and wait until the chromatogram has been evaluated.

3 Further measurements

- Increase the transfer time in the program (see *Section 7.3.1/7.3.2*) in steps of 5 min until the measured values are constant.
- Carry out measurements as described in item **2**.

4 Determine the optimal dialysis time

- Plot the relationship between the measured peak areas or concentrations as a function of the dialysis time (i.e. the recovery rate) and determine the optimal dialysis time.

7.7 Dialysis procedure

For determinations of samples by using dialysis it is advisable to proceed in the following sequence:

1 Prepare acceptor solution

- To avoid interference from air bubbles in the acceptor channel the ultrapure water used for the acceptor solution should always be **degassed** for at least 10 min by vacuum, N_2 or He.

2 Prepare sample

- In order to avoid blocking the sample channel, samples containing a large amount of suspended or solid particles should always be **centrifuged** using a benchtop centrifuge at 10'000 min^{-1} for 5 min.

3 Start up IC system

- Switch on all instruments.
- Start the IC Net software and load/create the required system (see «IC Net» *Instructions for Use*).
- Condition the IC column (see *819/820 Instructions for Use*).

4 Start up dialysis system

- Immerse both pieces of aspiration tubing **16** in the acceptor solution.
- Start the peristaltic pumps in «IC Net» by setting the remote line 1 (833 Pump Unit) and remote line 2 (833 Dialysis Unit) in the window of the 819 Detector.
- Rinse the dialysis system with acceptor solution for approx. 10 min and then switch off the pump again.

5 Calibration

- Immerse sample aspiration tubing **16** in the standard solution.
- Start the determination in IC Net and wait until the standard chromatogram has been evaluated and the next standard can be measured.

6 Sample determination

- Immerse sample aspiration tubing **16** in the sample solution.
- Start the determination in IC Net and wait until the chromatogram has been evaluated.

7 Rinse dialysis system

- At the end of the measurements immerse sample aspiration tubing **16** in the acceptor solution.
- Start the peristaltic pumps in «IC Net» by setting the remote line 1 (833 Pump Unit) and remote line 2 (833 Dialysis Unit) in the window of the 819 Detector.
- Rinse the dialysis system with acceptor solution for approx. 10 min and then switch off the pump again.

8 Closing down the dialysis system

- To shut down the dialysis cell the acceptor and sample channels must be rinsed with ultrapure water for approx. 10 min. The inlet and outlet tubing is then screwed off from the dialysis cell and openings **49**, **50**, **51** and **52** (see *Fig. 15*) are each closed with a 6.2744.060 Blank stopper.
- If the dialysis system is not to be used for a long time then the dialysis membrane must be removed and the cell has to be cleaned, see *Section 9.2.7.1* and *Fig. 15*.

8 833 IC Liquid Handling Ultrafiltration Unit

This version consists of the basic 833 IC Liquid Handling Unit and the **6.2729.110 Filtration Cell**.

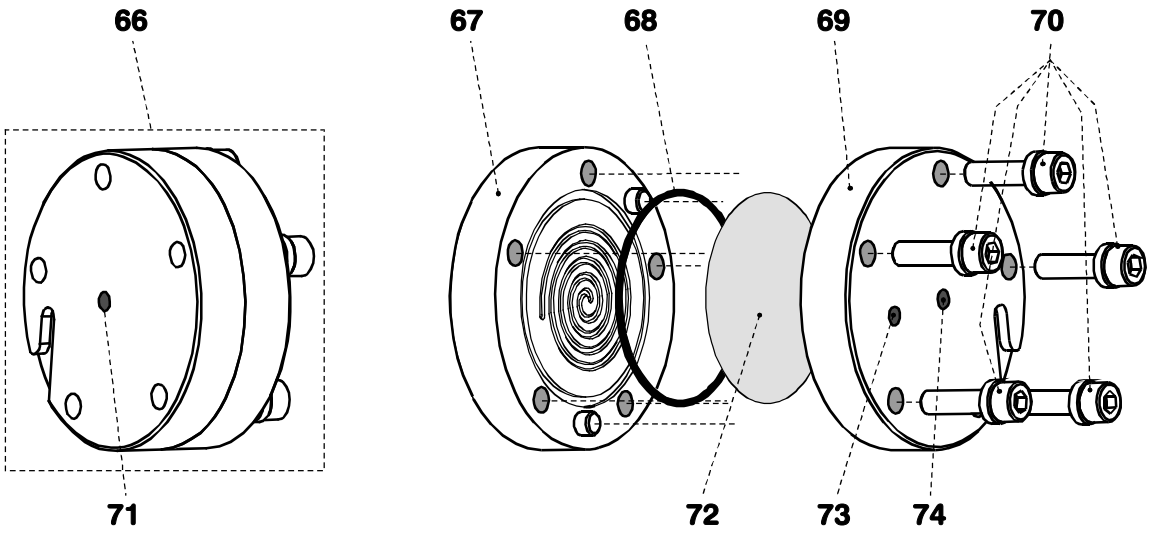


Fig. 22: 6.2729.110 Ultrafiltration cell

66	**6.2729.100 Ultrafiltration cell**
67	**Upper part of ultrafiltration cell**
68	**E.301.0111 Sealing ring**
69	**Lower part of ultrafiltration cell**
70	**V.022.6030 Screw with 4.754.4090 Washer**
71	**Outlet for filtrate**
72	**Filtration membrane (e.g. 6.2714.020)**
73	**Inlet for sample solution**
74	**Outlet for sample solution**

8.2 Assembling the ultrafiltration cell

This section describes the initial assembly of the ultrafiltration cell. Before the ultrafiltration cell is used a **filtration membrane** must be inserted. Proceed as follows (see *Fig. 22*):

1 Prepare ultrafiltration cell

- Remove ultrafiltration cell **66** (6.2729.100) from the packaging and remove the three screwed-in 6.2744.060 Blank stoppers .
- Use the 6.2621.070 Allen key to loosen the 5 screws **70** completely. Separate lower part **69** from upper part **67** and remove sealing ring **68**.

2 Clean ultrafiltration cell

- Thoroughly the clean sealing ring **68**, upper part **67** and lower part **69** of the ultrafiltration cell with ultrapure water and dry with N_2 or a lint-free tissue.

Only ultrapure water *or* ***ethanol*** *should be used for cleaning the dialysis cell, other organic solvents (e.g. acetone) will damage the Plexiglas cell!*

3 Prepare filtration membrane

- Use the 6.2831.010 Tweezers to remove a new filtration membrane **72** (e.g. 6.2714.020) from the packaging and immerse in a Petri dish filled with ultrapure water for approx. 2 min until the membrane is thoroughly soaked with water.

4 Insert filtration membrane

- Place upper part **67** on a paper tissue with its inner side uppermost.
- Place sealing ring **68** in the recess provided for it in upper part **67**.
- Use the 6.2831.010 Tweezers to place the wet filtration membrane **72** (e.g. 6.2714.010) inside sealing ring **68** on upper part **67**.

Make sure that the filtration membrane soaked with water does not dry out before insertion as otherwise it cannot be used !

5 Close ultrafiltration cell

- Place lower part **69** on upper part **67** so that the two parts are properly aligned with each other.
- Use the 6.2621.070 Allen key to screw in the 5 screws **70** completely and tighten them up well.

6 Assemble ultrafiltration cell

- Slide 6.2057.020 Cell holder of ultrafiltration cell **66** into a free holding guide **58** in the column compartment of the IC Separation Center.
- Insert the screwed-together ultrafiltration cell **66** in its 6.2057.020 Cell holder so that the heads of the screws **70** are located in the opening provided for them in the holder.

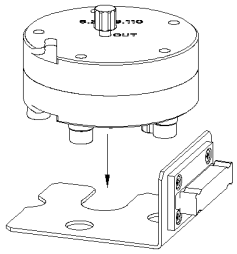


Fig. 23 Inserting the ultrafiltration cell in the holder

8.3 Connect filtration cell

To connect filtration cell **66** to the IC system proceed as follows (see also *Fig. 24*):

Pump tubing

1 Connect pump tubing to the 833 Liquid Handling Unit

- Attach the two pieces of pump tubing **6.1826.030** (**orange-yellow** stopper) and **6.1826.070** (**yellow-yellow** stopper) as described in *Section 3.2*, see *Fig. 7*.

2 Connect pump tubing for sample

- **Screw 6.1803.070 PTFE capillary 77** (**23** in *Fig. 7*) onto PEEK coupling **21** (6.2744.160) at the delivery side of **pump tubing 75** with the **yellow-yellow stoppers** (6.1826.070) using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7*).
- Attach one end of aspiration capillary **16** (6.1803.080) to PEEK coupling **18** on the suction side of the yellow-yellow **pump tubing 75** using a PEEK compression fitting **17** (6.2744.010) (see *Fig. 7*).
- Immerse the other end of aspiration capillary **16** in a container with **sample solution** and fix it in position.

3 Sample feed to filtration cell

- Lead the other end of PTFE capillary **77** through one of the openings at the front of the 820 IC Separation Center into the column compartment.
- Attach this end of the PTFE capillary to inlet opening **73** on the base of the ultrafiltration cell using a PVDF compression fitting **64** (see *Fig. 22*).

4 Tubing connection filtration cell – waste

- Attach one end of PTFE capillary **78** to outlet opening **74** on the base of the ultrafiltration cell with a PVDF compression fitting **64** (see *Fig. 22*).
- Lead the other end of PTFE capillary **77** out through opening **18** on the rear panel of the 820 IC Separation Center and into a waste bottle
  (e.g. optional: 6.1608.070 Bottle with 6.1602.150 GL45 bottle attachment).

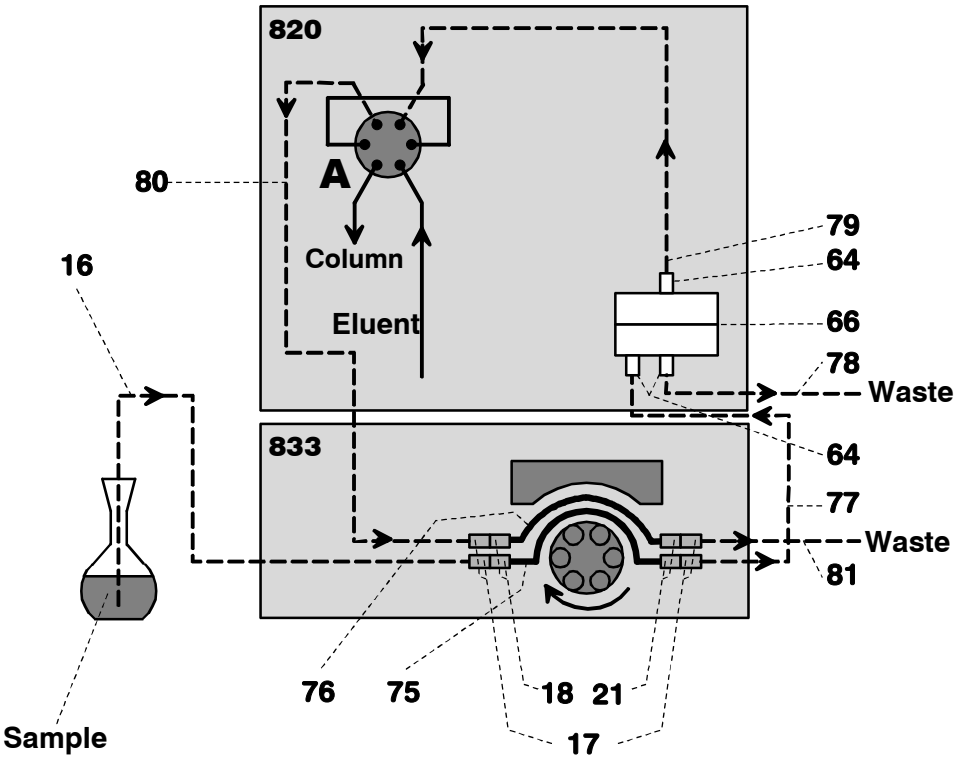


Fig. 24: Tubing connection system

16 **6.1803.080 PTFE capillary** for sample solution feed

17 **6.2744.010 PEEK compression fitting**

18 **6.2744.034 Coupling**

21 **6.2744.160 PEEK coupling** with tubing security device

64 **6.2744.000 PVDF compression fitting**

66 **6.2729.110 Filtration cell**

75 6.1826.070 Pump tubing
(**19** in *Fig. 7*) with **yellow-yellow** stoppers for transferring the **sample**

76 6.1826.030 Pump tubing
(**19** in *Fig. 7*)with **orange-yellow** stoppers for transferring the **filtrate**

77 6.1803.070 PTFE capillary
(**23** in *Fig. 7*)
connection pump tubing – filtration cell (inlet)
for transferring the sample

78 6.1803.080 PTFE capillary
connection filtration cell – waste

79 6.1803.050 PTFE capillary
(**23** in *Fig. 7*)
connection filtration cell (outlet) – pump tubing
for transferring the filtrate

80 6.1831.100 PTFE capillary
connection pump tubing – valve
for transferring the filtrate

81 6.1831.040 PTFE capillary
connection pump tubing – valve
for transferring the filtrate

*Use only the above-mentioned **6.2744.000 PVDF compression fittings** for the ultrafiltration cell connections. If 6.2744.010 PEEK compression fittings are used then stress cracks could occur in the ultrafiltration cell !*

5 Transferring the filtrate
Connection filtration cell – pump tubing

- Attach one end of PTFE capillary **79** to the outlet opening for the filtrate **71** on the top of the ultrafiltration cell using a PVDF compression fitting **64** (see *Fig. 22*) and lead out the other end through one of the openings on the front of the 820 IC Separation Center.
- Screw this end onto PEEK coupling **18** on the suction side of **pump tubing 76** with the **orange-yellow stoppers** (6.1826.030) using a PEEK compression fitting **17** (6.2744.010) (see Fig. 7*, Fig. 24*).

6 Transferring the filtrate
Connection pump tubing – injection valve

- Screw one end of PEEK capillary **80** onto PEEK coupling **21** (**6.2744.034**) at the delivery side of **pump tubing 76** with the **orange-yellow stoppers** (6.1826.030) using a PEEK compression fitting **17** (6.2744.010) (see Fig. 7*, Fig. 24*).
- Lead PEEK capillary **80** through one of the openings **14** on the front or side of the 820 IC Separation Center into the column compartment and screw it onto connection “1” of the injection valve instead of PTFE-aspiration tubing **63** (see *Fig. 21* and *Fig. 23* of the *819/820 Instructions for Use*) with a PEEK compression fitting **17** (6.2744.010).
- Tighten up the rotary nipple on the inside of connections **22** and **28** to fix PEEK capillary **80** in position.

7 Tubing connection injection valve – waste

- Insert 6.2744.020 Coupling (from the 820 accessories) into connection **13** provided for it in the 820 IC Separation Center.
- Screw PTFE aspiration tubing **63** onto the 6.2744.020 Coupling inserted in connection **13** and lead it into the waste bottle.

8 Rinse ultrafiltration cell

- Each time that a new filtration membrane is inserted any air that may still be contained in the filtration cell or tubing must be removed. This is done by rinsing the cell and all the tubing with e.g. ultrapure water:
- Immerse aspiration tubing **16** (see *Fig. 24*) in the rinsing solution (degassed ultrapure water).
- Switch on the peristaltic pump in the «IC Net» software.
- Rinse the filtration system with ultrapure water for approx. 5 min. Check that the same amount of solution emerges from both the waste outlets in the waste bottle.
- Check all tubing from the storage containers to the tubing cassettes and filtration cell and up to the waste bottle for leaks. If any leaks are found then the corresponding connection must either be tightened up or replaced.
- If any air bubbles remain in the dialysis cell then screw off PEEK capillary **80** (filtrate) from outlet **71** and the filtration cell and wait until the air bubbles have vanished. Then screw the tubing back onto the filtration cell again.

8 Closing down the filtration cell

- If the filtration cell is not to be used for a long time then it must be rinsed with ultrapure water for approx. 10 min. The inlet and outlet tubing is then screwed off from the filtration cell and openings **71**, **73** and **74** (see *Fig. 22*) are each closed with a 6.2744.060 Blank stopper.
- If the filtration cell is not to be used for a long time then the filtration membrane must be removed and the cell cleaned, see *Section 9.2.8.1* and *Fig. 22*.

With 820.0X20 IC Separation Center equipped with two injection valves it is possible to fill both sample loops from the same 833 IC Liquid Handling Ultrafiltration Unit. In this case connection "1" at valve A (sample loop outlet) must be connected to connection "2" of valve B (sample loop inlet) using a 6.1831.040 PEEK capillary (15 cm).

8.4 Filtration

8.4.1 Selection of possible sample types

Each filtration process using a filtration membrane with a small pore size could be subject to a membrane blockage.

The following table lists some types of sample that have been filtered with the 833 IC Liquid Handling Ultrafiltration Unit with the standard 6.2714.020 Filtration membrane (0.15 µm) or a second filter membrane (0.2 µm) and then analyzed on a Metrohm IC system. The concentrations of the following 7 anions were determined: F^-, Cl^-, NO_2^-, Br^-, NO_3^-, HPO_4^{2-}, SO_4^{2-}.

Sample type	*Pore size of membrane*	*No. of samples per filter*
Orange juice with fruit pulp	0.15	40
Surface water	0.15	500
Drinking water	0.15	1000
Ground water	0.15	500
Wastewater 1	0.15	1000
Wastewater 2	0.15	130
Wastewater 3	0.15	40
Wastewater 4	0.15	80
NaCl solution (1%)	0.2	5000
Schöninger digestion soln.	0.2	100
Acidic soil extracts	0.2	1000
Aqueous soil extracts	0.2	200

The given number of samples that can be filtered on a filter membrane without any loss of quality being observed are empirical values. They have been determined at Metrohm AG and by various customers and should be used as an orientation guide for estimating the application of the ultrafiltration cell for sample preparation. These values must be determined individually for each new application.

8.4.2 Filter working life

A reduction in the recovery rate when analyzing standard solutions can be used as a possible indicator for the early recognition of an impending blockage. Ideally these solutions should be made up in the sample matrix being analyzed.

This means that if a large number of samples are to be analyzed then it is advisable to measure standard solutions at regular intervals, for example after every 5th or 10th sample for sample with a high particle load. However, it is not possible to make any general prediction about the number of possible filtration processes. The development of the recovery rate with the number of samples may also be subject to large variations. While with one sample matrix the recovery rate may remain

stable rate for many samples and then drop sharply, with a different sample matrix it may diminish slowly and continuously.

The time when the filter membrane should be replaced ultimately depends on the sample matrix and the specifications of the analytical method used. In our experience very fine and suspended particles in the sample matrix will block the filter membrane more rapidly than coarse particles, which tend to be carried past the membrane in the sample flow.

Instructions for replacing the filter membrane are given in Section *9.2.8.1*.

8.4.3 Filter membrane selection

You can apply existing sample preparation rules to filtration with the 833 IC Liquid Handling Ultrafiltration Unit. If you wish to use a different filter membrane from that supplied as standard then please note that, even if the particle size is known, the selection of a membrane with an appropriate pore size does not automatically produce the required results.

Some investigations have shown that the retention capability of normal filter membranes does not always correspond to their specified pore size. The following table shows the qualitative filtering effect of filter membranes with different nominal pore sizes. The tests were carried out on aqueous solutions containing silica particles with particles sizes 1.5 µm and 5 µm.

Test solutions: silica particles in water	*Pore size of filter membrane* [1]	*Effect*
0.5%, 5 µm	0.15 µm	no breakthrough
0.5%, 5 µm	3 µm	no breakthrough
0.5%, 5 µm	8 µm	no breakthrough
0.5%, 5 µm	10 µm	breakthrough [2]
0.5%, 5 µm	12 µm	no breakthrough
0.5%, 1.5 µm	0.15 µm	no breakthrough
0.5%, 1.5 µm	3 µm	breakthrough

(1) Nominal pore size according to information supplied by manufacturer.
(2) All the membranes came from a single manufacturer except this one.

Please also note that, because of their lack of thickness, the retention capability of filter membranes may be lower than that of thicker filters with the same nominal pore size. This should be taken into account when choosing a suitable filter membrane.

9 Troubleshooting - maintenance

9.1 Faults and their remedies

If difficulties occur when carrying out analyses with the IC system, then it is advisable to search for their causes in the following sequence **column → pump → eluent → IC system**. An overview of faults, their possible causes and remedies can be found in the Instruction for Use of both the 761 Compact IC (*Section 5.3*) and the 819/820 Modular IC System (*Section 4.3.2*).

In addition to these general faults, the following table lists those faults that could occur during the operation of an IC Liquid Handling Unit.

Fault	*Cause*	*Remedy*
Inadequate or no supply at all from pump	• Contact pressure too low	• Set contact pressure correctly: first press contact lever **5** on the tubing cassette down as far as it will go, then up again until the solution is just aspirated. Then press the contact lever up by 1 click to achieve the optimal contact pressure.
	• Pump tubing faulty	• Replace pump tubing (see *Section 9.2.4*)
	• 6.2821.120 PEEK filter unit blocked	• Replace 6.2821.130 filter (see connection description, *Section 9.2.5)*
	• Connection blocked	• Check tubing and connections step by step and clean or replace as necessary. If the suppressor inlets or outlets are blocked then dismantle the suppressor and clean it (see *Section 9.2.6.2*).
	Suppressor module / Sample preparation module	
	• Actuator rotor blocked	• Replace actuator rotor (see *Section 9.2.6.3*).

Fault	*Cause*	*Remedy*
Inadequate or no supply at all from pump	**Dialysis cell**	
	• Dialysis cell inlets blocked	• Replace dialysis membrane and clean the cell (see *Section 9.2.7.1*).
	• Sample tubing blocked by too large particles	• Replace blocked tubing, always centrifuge sample (see *Section 9.2.4*).
	• Bacterial growth in sample channel and dialysis cell	• Replace tubing**16**, **57** und **58** for sample channel regularly, replace dialysis membrane
	• Narrowed PTFE tubing by compression fittings tightened too much	• Use capillary cutter to cut off narrowed tubing ends or replace tubing.
	Filtration cell	
	• Filter membrane blocked, filtration cell inlets blocked	• Replace filter membrane and clean the cell (see *Section 9.2.8.1*).
	• Narrowed PTFE tubing by compression fittings tightened too much	• Use capillary cutter to cut off narrowed tubing ends or replace tubing.
Leaks	• Tubing nipple leaks	• Tighten up or replace tubing nipples.
Air bubbles in pump circulation system	• Aspiration tubing not immersed	• Completely immerse aspiration tubing.
	• Tubing nipple leaks	• Tighten up or replace tubing nipples.
	Dialysis cell	**Dialysis cell**
	• Acceptor not properly degassed	• Degas acceptor solution again.
	• Standing air bubbles	• Small air bubbles do not interfere. For larger air bubbles rinse the sample channel with degassed acceptor solution (possibly open outlet briefly).
Reduced phosphate sensitivity and/or large baseline increase (suppressor)	• Suppressor capacity reduced by heavy metal load or organic contaminants	• Regenerate suppressor (see *Section 9.2.6.1*) or replace it (see *Section 9.2.6.3)*.
Suppressor module / Sample preparation module switches to next position, but does not work properly	• Suppressor module/Sample preparation module dry	• Rinse all 3 actuator units with solution for at least 10 min.
	• Actuator rotor temporarily in wrong position	• Switch instrument off and on again. Activate suppressor with <STEP>. Check that actuator rotor is in correct position (see *Section 9.2.6.3*). Repeat process 2-3 times, before each switch to next position with <STEP> wait at least 10 s. If necessary set actuator step again (see below).
	• Actuator step not set correctly	• Readjust actuator step (see *Section 9.2.6.3*).

Fault	*Cause*	*Remedy*
Suppressor module / Sample preparation module do not switch to next position	• Connection to suppressor module / sample preparation module interrupted	• Check cable connection from suppressor module / sample preparation module to 833 IC Liquid Handling Unit and from 833 IC Liquid Handling Unit to 830 IC Interface / 819 IC Detector.
	• Suppressor module/Sample preparation module dry	• Rinse all 3 suppressor units with solution for at least 10 min.
	• Actuator rotor temporarily blocked	• Switch instrument off and on again. Activate suppressor with <STEP>. Check that actuator rotor is in correct position (see *Section 9.2.6.3*). Repeat process 2-3 times, before each switch to next position with <STEP> wait at least 10 s. If the suppressor is blocked again then it must be cleaned or replaced (see below).
	• Actuator dirty	• Clean actuator (see *Section 9.2.6.2*).
	• Actuator has mechanical fault	• Replace actuator (see *Section 9.2.6.3*).
Unsatisfactory yield for dialysis	• Transfer time not determined correctly	• Check optimal transfer time (see *Section 7.6.2*).
	• Dialysis time too short (e.g. at too low concentration)	• Check optimal dialysis time (see *Section 7.6.3*).
	• Dry or damaged dialysis membrane	• Replace dialysis membrane (see *Section 9.2.7.1*).
	• Deposits on dialysis membrane, recognizable by discoloration at sample inlet	• Replace dialysis membrane (see *Section 9.2.7.1*).
	• Unsuitable dialysis membrane	• Use different dialysis membrane.

9.2 Care and maintenance

9.2.1 Instrument care

The 833 IC Liquid Handling Unit and its associated modules require a reasonable amount of care. If the instrument becomes excessively dirty this could affect the functioning and shorten the working life of the basically robust mechanism and electronics.

Split chemicals and solvents should be cleaned up immediately. Above all, the connection strip (the mains plug in particular) must be kept clean.

Although this prevented to a large extent by constructive measures, if aggressive media should penetrate the interior of the instrument then the mains plug of the 833 IC Liquid Handling Unit should be pulled out immediately in order to prevent massive damage to the electronics. If such damage should occur please contact the Metrohm service department.

The instrument must not be opened by untrained personnel. Please observe the safety information given in Section 1.4.

9.2.2 Maintenance by Metrohm service

Servicing the 833 IC Liquid Handling Unit should be carried out within the framework of an annual service visit by technicians from Metrohm. If aggressive or corrosive chemicals are used then shorter service intervals are necessary.

The Metrohm service department is always pleased to provide competent advice about the servicing and maintenance of all Metrohm instruments.

9.2.3 Shut down

Suppressor module/Sample preparation module

If the IC system is not to be used for a long time then the whole IC system (**without** column and suppressor module/sample preparation module) must be **rinsed salt-free** with methanol/water (1:4) to prevent eluent salts from crystallizing out and causing subsequent damage. Rinsing is carried out by disconnecting the column and suppressor and connecting the injector directly to the detector. Rinsing is carried out with methanol/water (1:4) until the conductivity falls below 10 µS/cm.

Each of the three suppressor units is rinsed with ultrapure water for approx. 5 min.

Dialysis cell

To shut down the dialysis cell the acceptor and sample channels must be rinsed with ultrapure water for approx. 10 min. The inlet and outlet tubing is then screwed off from the dialysis cell and openings **49**, **50**, **51** and **52** (see *Fig. 15*) are each closed with a 6.2744.060 Blank stopper.

If the dialysis system is not to be used for a long time then the dialysis membrane must be removed and the cell has to be cleaned, see *Section 9.2.7.1* and *Fig. 15*.

Filtration cell

If the filtration cell is not to be used for a long time then must be rinsed with ultrapure water for approx. 10 min. The inlet and outlet tubing is then screwed off from the filtration cell and openings **71**, **73** and **74** (see *Fig. 22*) are each closed with a 6.2744.060 Blank stopper.

9.2.4 Replacing the pump tubing

The pump tubing is a consumable with a limited working life, which is why it should be replaced at regular intervals (approx. every 2 weeks for continuous use).

The working life of the pump tubing depends primarily on the contact pressure. This is why you should set the contact pressure correctly as described in *Section 3.2* and lift up the tubing cassettes completely when the pump is switched off for a long time releasing spring lever **7** on the right-hand side (this means that the optimally set contact pressure is retained).

As the pump always operates with the same direction of rotation this means that the supplied 6.1826.0X0 Pump tubing can be used on both sides. The pump tubing is replaced as follows:

1 Remove old pump tubing

- Press contact lever **5** on the tubing cassette down as far as it will go.
- Loosen tubing cassette **4** from holding clip **6** by pressing down spring lever **7** and unhinge it from the holding pin **2** on the 833 IC Liquid Handling Unit (see *Fig. 1*).
- Remove the old pump tubing.

2 Insert new pump tubing

- Insert new pump tubing **19** (6.1826.0X0) in the tubing cassette as shown in *Fig. 7*. Stopper **20** must click into position in the corresponding holder on the left-hand side of the tubing cassette.
- Hinge the tubing cassettes on holding pin and press down on the right-hand side until spring lever clicks into position in holding clip **6**. Take care that the pump tubing does not kink.

3 Set the contact pressure

- Press contact lever **5** until the solution is just aspirated. Then press the contact lever up by 1 further click to achieve the optimum contact pressure.

9.2.5 Changing the filter

The **6.2821.120 Filter unit PEEK 22** (see *Fig. 25*) serves to avoid contamination by abrasive particles of the pump tubings. The filter unit consists of the housing **82**, the filter **83** and the connector **84** to be screwed into the housing **82**. For the connection of capillaries PEEK compression fittings **17** (6.2744.010) must be used.

New filter **83** are available as an option with the ordering number 6.2821.130 (10 pieces).

To change the filter **83** dismantle the Filter unit PEEK **22** according to *Fig. 25*, replace the filter **83** and put it together again. Install the Filter unit PEEK **22** according to *Fig. 7* in the flow path again.

For the connection of the filter unit, please note the flow direction arrow printed on the housing.

The filter unit is filled with isopropanol when new. Rinse your IC system carefully after the first installation of a new filter unit.

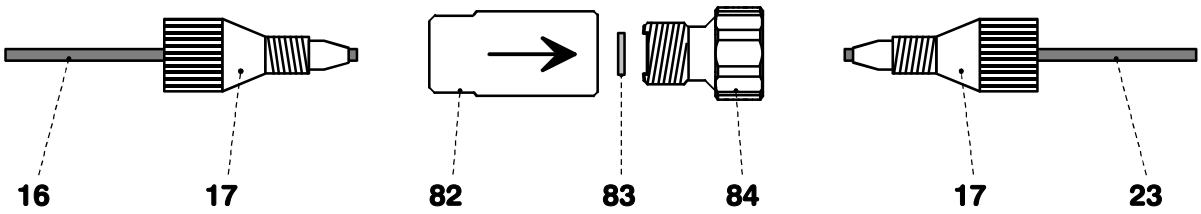


Fig. 25: Filter unit PEEK 6.2821.120

16 6.1803.0X0 Aspiration tube/capillary
PTFE tubing/capillary, depends on version, see *Section 10.2 Standard equipment*

17 6.2744.010 PEEK compression fitting

23 Discharge capillary
delivery side for connection to:
suppressor module
sample preparation module
dialysis cell
ultrafiltration cell

82 Filter housing

83 Filter 6.2821.130

84 Filter connector

9.2.6 Suppressor module / Sample preparation module

The 1.753.0010 Suppressor Module and the 1.793.0010 sample preparation module have the same technical construction so their maintenance is described jointly. Wherever the different chemistry requires a different treatment for the modules this is expressly mentioned in the text.

9.2.6.1 Regenerating the actuator units

If the suppressor units of the suppressor module or the cation exchanger units of the sample preparation module come into contact with certain heavy metals (e.g. iron) or organic contaminants for a longer period of time then these can no longer be completely removed with the regeneration solutions normally used (50 mmol/L H_2SO_4 or 50 mmol/L $HClO_4$). This affects the capacity of the actuator units of the module. If such capacity problems occur then the actuator units must be treated as follows:

1 Disconnect suppressor module/sample preparation module from IC system

- Disconnect the module from column and detector.

2 Regenerate suppressor module

- Rinse all 3 actuator units in sequence for approx. 10 min with one of the following solutions:

Contamination with heavy metals

0.2 mol/L H_2SO_4
+ 0.1 mol/L oxalic acid (for Fe^{2+}/Fe^{+3})

Contamination with organic substances

0.2 mol/L H_2SO_4 / acetone ≥ 20%

Regenerate sample preparation module

- Rinse all 3 actuator units in sequence for approx. 10 min with one of the following solutions:

Contamination with heavy metals

0.2 mol/L $HClO_4$
+ 0.1 mol/L oxalic acid (for Fe^{2+}/Fe^{+3})

Contamination with organic substances

0.2 mol/L $HClO_4$ / acetone 20%

The 6.1826.050/6.1826.010 Pump tubing consists of PVC and must therefore not be rinsed with solvents that contain acetone. In this case you should either use different pump tubing or use a different pump for rinsing.

3 Connect suppressor module/sample preparation module to IC system

- Reconnect the module to the IC system. If there are still capacity problems then the actuator rotor must be replaced (see *Section 9.2.6.3*).

9.2.6.2 Cleaning the actuator module

Cleaning the suppressor module or sample preparation module may be necessary in the following cases (see also *Section 9.1*):

- Irreparable blockage of the suppressor module/sample preparation module (solutions can no longer be transported by the suppressor)
- Irreparable blockage of the actuator of the particular module (actuator can no longer be switched to next position)

Clean the connection piece and actuator rotor as follows (see *Fig. 26*):

1 Disconnect suppressor module/sample preparation module from IC system

- Disconnect the inlet of the suppressor module/sample preparation module from the column and detector outlet.

2 Dismantle actuator module

- Unscrew sleeve nut **85** from actuator holder **88**.
- Pull connection piece **86** and actuator rotor **87** out of actuator holder **88**.
- Loosen connection piece **86** from actuator rotor **87**.

3 Clean inlets and outlets

- Connect each of the 6 pieces of capillary tubing attached to connection piece **86** to the pump in sequence and pump ultrapure water through them.
- Check whether any liquid is escaping from connection piece **86**. If one of the inlets or outlets remains blocked then the connection piece must be replaced.
  Order number 6.2832.010 for suppressor module
  6.2835.010 for sample preparation module

4 Clean actuator rotor

- Clean the sealing surface of actuator rotor **87** using a lint-free cloth and ethanol.

5 Insert actuator rotor

- Place actuator rotor **87** in actuator holder **88** so that the tubing connections on the rear of the rotor fit into the corresponding recesses inside the holder and one of the three holes of the rotor can be seen from below in one of the openings of the holder.
- When the rotor has been correctly inserted its sealing surface is approx. 4 mm inside the holder. If this is not the case then the rotor must be brought into the correct position from below by using a pointed object (e.g. screwdriver).

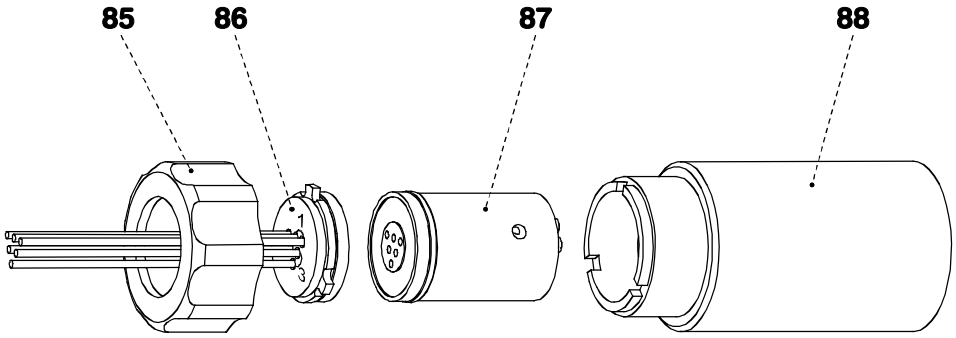


Fig. 26: Actuator assembly

85 Sleeve nut

86 Connection piece with inlets and outlets
6.2832.010 for suppressor module
or
6.2835.010 for sample preparation module

87 Actuator rotor
6.2832.000 for suppressor module
or
6.2835.000 for sample preparation module

88 Actuator holder

6 Clean connection piece

- Clean the sealing surface of connection piece **86** using a lint-free cloth and ethanol.

7 Insert connection piece

- Insert connection piece **86** in actuator holder **88** so that connection "1" is at the top and the three connection piece projections fit into the corresponding recesses in the holder.
- Tighten up sleeve nut **85** on the thread of suppressor holder **88** by hand (do not use any tools).

8 Connect and condition suppressor module

- Reconnect suppressor module to the IC system (see Section *5.1*).
- Before moving the suppressor to the next position for the first time rinse the 3 actuator units with solution for 5 min.

Connect and condition sample preparation module

- Reconnect sample preparation module to the IC system (see Section *6.1* and Section *6.2*).
- Before moving the suppressor to the next position for the first time rinse the 3 actuator units with solution for 5 min.

9.2.6.3 Replacing the actuator rotor

It may be necessary to replace actuator rotor **87** contained in the cation exchanger of the suppressor module or sample preparation module in the following cases (see also *Section 9.1*):

- Irreparable loss of exchanger capacity (recognizable at suppressor by reduced phosphate sensitivity and/or large increase in baseline)
- Irreparable blockage of the suppressor (solutions can no longer be transported by the suppressor)

As well as replacing actuator rotor **87** (6.2832.000 in suppressor module, 6.2835.000 in sample preparation module), it may also be necessary to replace connection piece **86** (6.2832.010 in suppressor module, 6.2835.010 in sample preparation module). Exchange these components in the following way (see *Fig. 26*):

1 Disconnect suppressor module/sample preparation module from IC system

- Disconnect the inlet of the suppressor module/sample preparation module from the column and detector outlet.

2 Dismantle actuator module

- Unscrew sleeve nut **85** from actuator holder **88**.
- Pull connection piece **86** and actuator rotor **87** out of actuator holder **88**.
- Loosen connection piece **86** from actuator rotor **87**.

3 Clean actuator rotor

- Clean the sealing surface of the **new** actuator rotor **87** using a lint-free cloth and ethanol.

4 Insert actuator rotor

- Place actuator rotor **87** in actuator holder **88** so that the tubing connections on the rear of the rotor fit into the corresponding recesses inside the holder and one of the three holes of the rotor can be seen from below in one of the openings of the holder.
- When the rotor has been correctly inserted its sealing surface is approx. 4 mm inside the holder. If this is not the case then the rotor must be brought into the correct position from below by using a pointed object (e.g. screwdriver)..

5 Clean connection piece

- Clean the sealing surface of connection piece **86** using a lint-free cloth and ethanol.

6 Insert connection piece

- Insert connection piece **86** in actuator holder **88** so that connection "1" is at the top and the three connection piece projections fit into the corresponding recesses in the holder.
- Tighten up sleeve nut **85** on the thread of suppressor holder **88** by hand (do not use any tools).

7 Connect and condition suppressor module

- Reconnect suppressor module to the IC system (see Section *5.1*).
- Before moving the suppressor to the next position for the first time rinse the 3 actuator units with solution for 5 min.

Connect and condition sample preparation module

- Reconnect sample preparation module to the IC system (see Section *6.1* and Section *6.2*).
- Before moving the suppressor to the next position for the first time rinse the 3 actuator units with solution for 5 min..

8 Check actuator step

- Check that the actuator rotor moves to the next position as described in Section *9.2.6.3* and readjust it if necessary.

9.2.6.4 Adjusting the actuator step

It may be necessary to readjust the actuator step on the suppressor module or sample preparation module in the following cases (see also *Section 9.2.6.3*):

- Suppressor/Sample preparation module does move to next position but its functions are impaired.
- After replacement of the actuator rotor (see *Section 9.2.6.3*)

The actuator step is adjusted by using the setting screw **Step Adjustment 12** on the rear panel of the 833 IC Liquid Handling Unit. Proceed as follows:

1 Condition cation exchanger

- If the actuator rotor has been cleaned or replaced the three cation exchanger units must be conditioned before the actuator rotor is moved to the next position for the first time.

Condition suppressor module

- see Section *5.1*.
- Before the suppressor is switched to the next position for the first time the actuator units should be rinsed with solution for 5 min.

Condition sample preparation module

- See Section *6.1* and Section *6.2*.
- Before the sample preparation module is switched to the next position for the first time the actuator units should be rinsed with solution for 5 min.

2 Check position of actuator rotor

- Switch the instrument off and then on again and activate the suppressor in «IC Net» with <STEP>.
- By turning the suppressor module or using a mirror check the position of the actuator rotor as shown in *Fig. 27*: in one of the openings in the base of the suppressor module it should be possible to see one of the three holes on the suppressor rotor, at least partially.
- Repeat the process 2-3 times; before each switch to the next position with <STEP> wait at least 10 s.
- If the rotor stops in an invalid position then the step of the actuator rotor must be readjusted (continue with item **3**).

3 Adjust actuator step

- Turn setting screw **12** as shown in *Fig. 27* a little in the required direction so that the rotor comes to rest in a valid position.
- Activate <STEP> in the software.
- Check the position of the rotor in all 3 possible settings as shown in *Fig. 27*.
- Repeat the setting procedure until the rotor is in a valid position in all of the 3 possible settings. Always wait for at least 10 s before triggering the next STEP command.

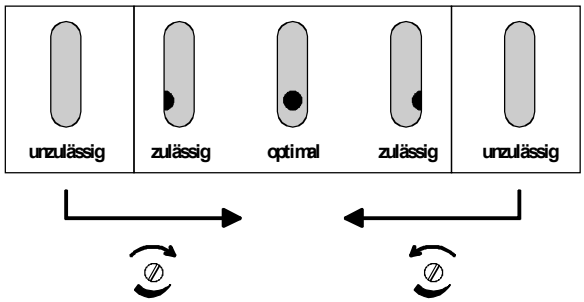


Fig. 27: Adjusting the actuator step

9.2.7 Dialysis cell

The dialysis membrane is very sensitive to contact and drying out, so avoid touching it with your fingers and ensure that the membrane never dries out when inserted in the cell.

The working life of a dialysis membrane is approx. 1 week if used frequently. It should always be exchanged if there are any indications that the yield has become reduced or that it is being blocked.

Follow the instructions for the installation of the dialysis cell (*Section 7.4* and *7.5*), its shut down (*Section 9.2.3*) and for replacement of the dialysis membrane (*Section 9.2.7.1)*.

9.2.7.1 Replacing the dialysis membrane

It may be necessary to replace the dialysis membrane in the following circumstances (see also *Section 9.1*):

- Reduced yield after dialysis
- Membrane damaged by drying out or deposits or bacterial growth
- Irreparable blockage of sample channel (sample can no longer be transported through dialysis cell)

Proceed as follows when replacing the membrane (see *Fig. 15*):

1 Dismantle dialysis cell

- Screw off the four inlets and outlets of dialysis cell **42** and take the cell out of the cell holder.
- Use the 6.2621.070 Allen key to loosen the 5 screws **47** and separate lower part **46** from upper part **43**
- Remove old dialysis membrane **45**.

2 Clean dialysis cell, insert dialysis membrane and reassemble cell

- See **Steps 2-6** *Section 7.4 Assembling the* dialysis cell.

3 Connect dialysis cell

- See **dialysis cell** *Section 7.5.2 Connection of the dialysis cell.*

4 Condition dialysis membrane

See also *Section 7.5.2*.

- Immerse the 2 pieces of aspiration tubing **16** (see *Fig.* 21) in the acceptor solution (degassed ultrapure water).
- Switch on the peristaltic pump in «IC Net».
- Rinse the dialysis system for approx. 20 min with ultrapure water. Check that the same amount of solution emerges from both the waste outlets in the waste bottle.
- Check all tubing from the storage containers to the tubing cassettes and dialysis cell and up to the waste bottle for leaks. If any leaks are found then the corresponding connection must either be tightened up or replaced.
- If any air bubbles remain in the dialysis cell then screw off PEEK tubing **61** (acceptor solution) and PTFE tubing **58** (sample) from outlets **49** and **52** of the dialysis cell and wait until the air bubbles have vanished. Then screw the tubing back on again.
- Switch off peristaltic pump.

9.2.8 Ultrafiltration cell

The perfect condition of the filter membrane used is a necessary requirement for the constant high quality of the analytical results, which is why it must be replaced at regular intervals.

In order to asses the necessity of replacing the membrane please consult *Section 8.4*.

To replace the filter membrane please proceed as follows (see also *Fig. 22* in *Section 8.2*):

9.2.8.1 Replacing the filter membrane

1 Prepare ultrafiltration cell

- Loosen all capillary connections at ultrafiltration cell **66** by unscrewing the PVDF compression fittings **64**.
- Use the 6.2621.070 Allen key (5 mm) to completely loosen the 5 screws **70**, Separate upper part **67** from lower part **69** and remove sealing ring **72** and the used filter membrane.

2 Clean filtration cell, insert new filter membrane and reassemble the cell

- See **steps 2-6** *Section 8.2 Assembling the* ultrafiltration cell.

3 Connect filtration cell

- See **steps 3-5** *Section 8.3 Connect filtration* cell.

4 Rinse ultrafiltration cell

- See also **step 8** *Section 8.3.*
  Each time that a new filtration membrane is inserted any air that may still be contained in the filtration cell or tubing must be removed. This is done by rinsing the cell and all the tubing with e.g. ultrapure water:
- Immerse aspiration tubing **16** (see *Fig. 24*) in the rinsing solution (degassed ultrapure water).
- Switch on the peristaltic pump in the «IC Net» software.
- Rinse the filtration system with ultrapure water for approx. 5 min. Check that the same amount of solution emerges from both the waste outlets in the waste bottle.
- Check all tubing from the storage containers to the tubing cassettes and filtration cell and up to the waste bottle for leaks. If any leaks are found then the corresponding connection must either be tightened up or replaced.
- If any air bubbles remain in the dialysis cell then screw off PEEK capillary **80** (filtrate) from outlet **71** and the filtration cell and wait until the air bubbles have vanished. Then screw the tubing back onto the filtration cell again.

10 Appendix

10.1 Technical data

Unless anything to the contrary is mentioned, the published data represent typical values for the 833 IC Liquid Handling Unit at an ambient temperature of 25°C.

10.1.1 Basic instrument: 833 IC Liquid Handling Unit 1.833.0010

Pump

Pump type: 2-channel peristaltic pump with
20 min^{-1} (50 Hz)
24 min^{-1} (60 Hz)

Capacity (with water, no counterpressure): Typically

with pump tubing	at: 20 min^{-1}	24 min^{-1}
6.1826.010	1.41 mL/min	1.69 mL/min
6.1826.030	0.40 mL/min	0.48 mL/min
6.1826.040	0.75 mL/min	0.90 mL/min
6.1826.050	0.43 mL/min	0.52 mL/min
6.1826.070	2.55 mL/min	3.06 mL/min

Pressure: max. 4 bar (0.4 MPa)

Pumpable liquids: Clear liquids with no solid particles

Pump tubing material: PVC (Tygon® ST), PVC (Tygon® LFL), PP

Mains connection

Voltage: 115 V: 100...120 V ± 10 %
230 V: 220...240 V ± 10 %
Switched with voltage selection insert in fuse holder (see *Section 2.2.1*)

Frequency: 50...60 Hz

Power consumption: 50 VA

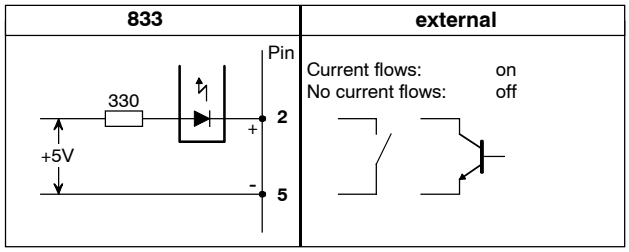
Fuses: 5 mm dia., 20 mm long
100…120 V: 0.5 A (slow-blow)
220…240 V: 0.25 A (slow-blow)

Remote interface 15 for pump

Purpose Remote control of pump (on/off)

Socket DIN

Socket occupancy

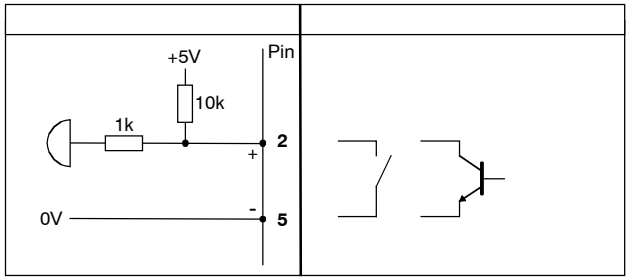


Remote interface 14 for actuator

Purpose Remote control of actuator (switches to next position), input signal

Socket DIN

Socket occupancy



* A requirement for a step to be triggered is that current flows for at least 10 ms. For a further step to be triggered the current must not previously flow for at least 10 ms.

Interface 13 for actuator module

Purpose Connection of suppressor module or sample preparation module

Socket Mini DIN

Safety specification

Construction / Testing As per EN/IEC 61010-1 / UL 3101-1, Protection class 1, Protection code IP40

Safety information These Instructions for Use contain information and warnings that must be observed by the user in order to guarantee the safe operation of the instrument.

Electromagnetic compatibility (EMV)

Emission	Complies with standards: - EN/IEC 61326 - EN 55022 - CISPR 22 - EN/IEC 61000-3-2
Immunity	Complies with standards: - EN/IEC 61326 - EN/IEC 61000-4-2 - EN/IEC 61000-4-3 - EN/IEC 61000-4-4 - EN/IEC 61000-4-5 - EN/IEC 61000-4-6 - EN/IEC 61000-4-11 - EN/IEC 61000-4-14 - NAMUR

Ambient temperature

Nominal working range	+5…+45°C (at 20…80% rel. humidity)
Storage, Transport	–40…+70°C

Housing

Cover material	Rigid polyurethane foam (PUR) with flame proofing for fire class UL94VO, CFC-free
Base material	Lacquered steel

Dimensions

Width	260 mm
Height	129 mm
Depth	366 mm
Weight	6.0 kg (with accessories)

10.1.2 6.2729.100 Dialysis cell

Material	Plexiglas (polymethylmethacrylate)
Solvent compatibility	Water, water-ethanol mixture (no organic solvents!)
Cell volume	240 µL (from inlet to outlet openings)
Pore size	0.20 µm (dialysis membrane 6.2714.010)
Membrane diameter	47 mm

10.1.3 6.2729.110 Ultrafiltration cell

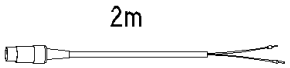
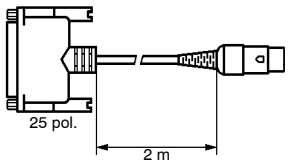
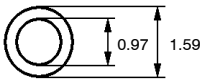
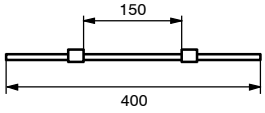
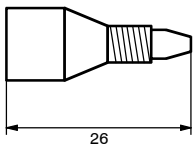
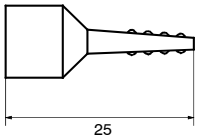
Material	Plexiglas (polymethylmethacrylate)
Solvent compatibility	Water, water-ethanol mixture (no organic solvents!)
Cell volume	240 µL (from inlet to outlet openings)
Pore size	0.15 µm (filter membrane 6.2714.020)
Membrane diameter	47 mm

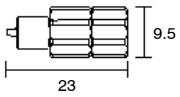
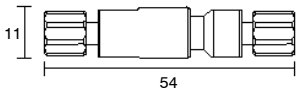
10.2 Standard equipment

We reserve the right to make alterations!
All dimensions are given in mm.

10.2.1 833 IC Liquid Handling Pump Unit

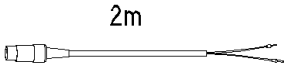
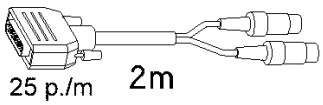
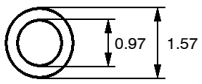
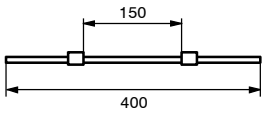
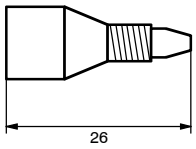
The 2.833.0010 IC Liquid Handling Pump Unit includes the following accessories:

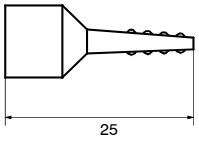
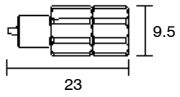
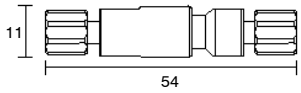
Number	*Order no.*	*Description*
1	**1.833.0010**	**833 IC Liquid Handling Unit**
1	**6.2122.0X0**	**Mains cable** to customer's specification: Cable socket — Cable plug Type IEC 320/C 13 — Type SEV 12 (CH…) ..... 6.2122.020 Type IEC 320/C 13 — Type CEE (7), VII (D…) ..... 6.2122.040 Type CEE (22), V — Type NEMA 5-15 (USA…) 6.2122.070
1	**8.833.0010**	**Instructions for Use (English)** for 833 IC Liquid Handling Unit
1	**6.2128.180**	**Remote connection cable** Connection cable 830 IC Interface– 833 IC Liquid Handling Unit 
1	**6.2143.200**	**Connection cable** Connection cable 732/819 IC Detector – 833 IC Liquid Handling Unit Control via **Remote line 1**. 
1	**6.1803.020**	**PTFE capillary tubing** Length = 5 m 
2	**6.1826.050**	**Pump tubing** PVC (Tygon®) with 2 permanently attached **white-yellow** stoppers; i.d. = 0.57 mm ± 0.05 mm, delivery rate 0.43 mL/min (20 min^{-1}) 0.52 mL/min (24 min^{-1}) 
2	**6.2744.010**	**PEEK compression fitting** For connecting 6.1831.010 PEEK capillaries or 6.1803.020 PTFE capillaries, Set of 5 pieces 
1	**6.2744.034**	**PEEK coupling** Connection between 6.2744.010 PEEK compression fitting and 6.1826.0X0 Pump tubing; Set of 2 pieces 

2	6.2744.160	**PEEK coupling** With tubing security device for connecting to pressure side of 6.1826.0X0 Pump tubing. 
2	6.2821.120	**Filter unit PEEK 2 µm** To avoid contamination by abraded pump tubing particles. Spare part: 6.2821.130 Filter 

10.2.2 833 IC Liquid Handling Suppressor Unit

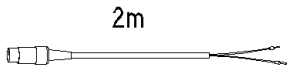
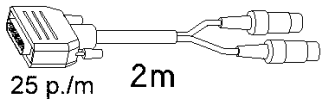
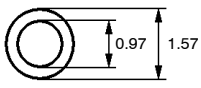
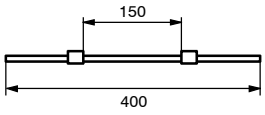
The 2.833.0020 IC Liquid Handling Suppressor Unit includes the following accessories:

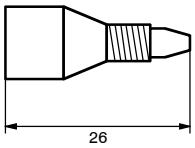
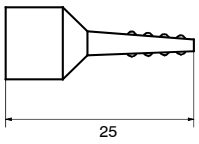
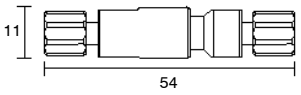
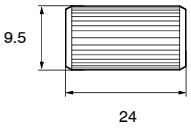
Number	*Order no.*	*Description*
1	1.833.0010	**833 IC Liquid Handling Unit**
1	6.2122.0X0	**Mains cable** to customer's specification: Cable socket — Cable plug Type IEC 320/C 13 — Type SEV 12 (CH…) ..... 6.2122.020 Type IEC 320/C 13 — Type CEE (7), VII (D…) ..... 6.2122.040 Type CEE (22), V — Type NEMA 5-15 (USA…) 6.2122.070
1	8.833.0010	**Instructions for Use (English)** for 833 IC Liquid Handling Unit
2	6.2128.180	**Remote connection cable** Connection cable 830 IC Interface–833 IC Liquid Handling Unit 
1	6.2143.210	**Connection cable** Connection cable 732/819 IC Detector – 833 IC LH Suppressor Unit Control via **Remote line 1 and 2**. 
1	1.753.0100	**Suppressor module**
1	6.1803.020	**PTFE capillary tubing** Length = 5 m 
2	6.1826.050	**Pump tubing** PVC (Tygon®) with 2 permanently attached **white-yellow** stoppers; i.d. = 0.57 mm ± 0.05 mm, delivery rate 0.43 mL/min (20 min^{-1}) 0.52 mL/min (24 min^{-1} 
2	6.2744.010	**PEEK compression fitting** For connecting 6.1831.010 PEEK capillaries or 6.1803.020 PTFE capillaries, Set of 5 pieces 

1	6.2744.034	**PEEK coupling** Connection between 6.2744.010 PEEK compression fitting and 6.1826.0X0 Pump tubing; Set of 2 pieces 
2	6.2744.160	**PEEK coupling** With tubing security device for connecting to pressure side of 6.1826.0X0 Pump tubing. 
2	6.2821.120	**Filter unit PEEK 2 µm** To avoid contamination by abraded pump tubing particles. Spare part: 6.2821.130 Filter 

10.2.3 833 IC Liquid Handling Sample Preparation Unit

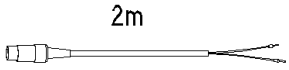
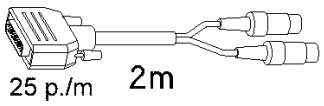
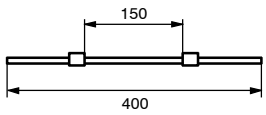
The 2.833.0030 IC Liquid Handling Sample Preparation Unit includes the following accessories:

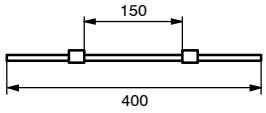
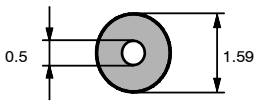
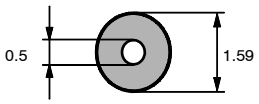
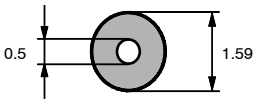
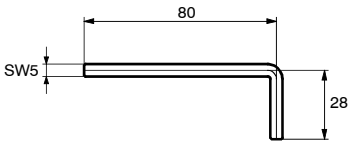
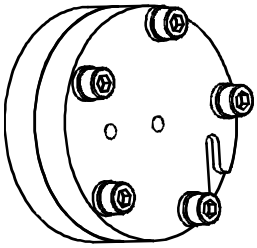
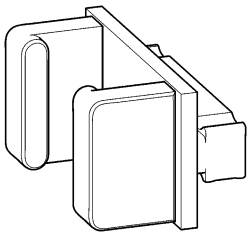
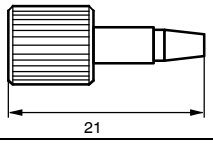
Number	*Order no.*	*Description*
1	1.833.0010	**833 IC Liquid Handling Unit**
1	6.2122.0X0	**Mains cable** to customer's specification: Cable socket — Cable plug Type IEC 320/C 13 — Type SEV 12 (CH…) ..... 6.2122.020 Type IEC 320/C 13 — Type CEE (7), VII (D…) ..... 6.2122.040 Type CEE (22), V — Type NEMA 5-15 (USA…) 6.2122.070
1	8.833.0010	**Instructions for Use (English)** for 833 IC Liquid Handling Unit
2	6.2128.180	**Remote connection cable** Connection cable 830 IC Interface–833 IC Liquid Handling Unit 
1	6.2143.210	**Connection cable** Connection cable 732/819 IC Detector – 833 IC LH Suppressor Unit Control via **Remote line 1** and **2**. 
1	1.793.0110	**Sample preparation module**
1	6.1803.020	**PTFE capillary tubing** Length = 5 m 
2	6.1826.010	**Pump tubing** PVC (Tygon®) with two permanently attached **white-white** stoppers; i.d. = 1.02 mm ± 0.05 mm, delivery rate 1.41 mL/min (20 min^{-1}) 1.69 mL/min (24 min^{-1}) 

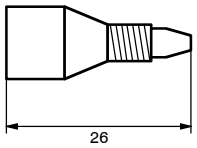
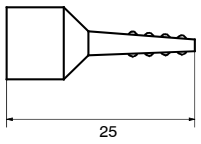
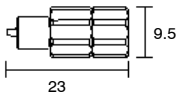
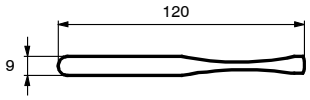
2	6.2744.010	**PEEK compression fitting** For connecting 6.1831.010 PEEK capillaries or 6.1803.020 PTFE capillaries, Set of 5 pieces	
1	6.2744.030	**PEEK coupling** Connection between 6.2744.010 PEEK compression fitting and 6.1826.0X0 Pump tubing; Set of 4 pieces	
2	6.2821120	**Filter unit PEEK 2 µm** To avoid contamination by abraded pump tubing particles. Spare part: 6.2821.130 Filter	
1	6.2744.040	**PEEK coupling** For connecting 1/16" capillaries	

10.2.4 833 IC Liquid Handling Dialysis Unit

The 2.833.0040 IC Liquid Handling Dialysis Unit includes the following accessories:

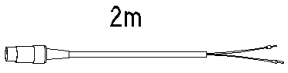
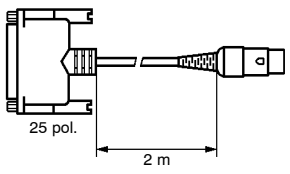
Number	*Order no.*	*Description*
1	1.833.0010	**833 IC Liquid Handling Unit**
1	6.2122.0X0	**Mains cable** to customer's specification: Cable socket — Cable plug Type IEC 320/C 13 — Type SEV 12 (CH…) ..... 6.2122.020 Type IEC 320/C 13 — Type CEE (7), VII (D…) ..... 6.2122.040 Type CEE (22), V — Type NEMA 5-15 (USA…) 6.2122.070
1	8.833.0010	**Instructions for Use (English)** for 833 IC Liquid Handling Unit
1	6.2128.180	**Remote connection cable** Connection cable 830 IC Interface– 833 IC Liquid Handling Unit 
1	6.2143.210	**Connection cable** Connection cable 732/819 IC Detector – 2 x 833 IC Liquid Handling Unit Control via **Remote line 1** and **2**. 
2	6.1826.030	**Pump tubing** PVC (Tygon®) with 2 permanently attached **orange-yellow** stoppers; i.d. = 0.51 mm ± 0.05 mm, delivery rate 0.40 mL/min (20 min^{-1}) 0.48 mL/min (24 min^{-1}) 

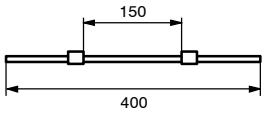
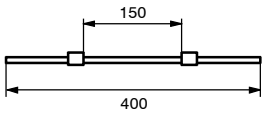
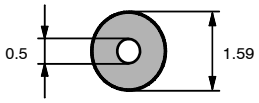
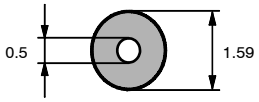
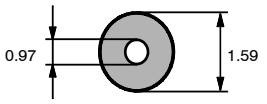
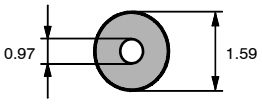
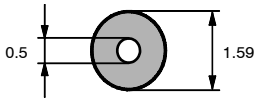
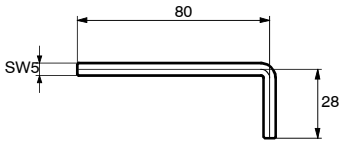
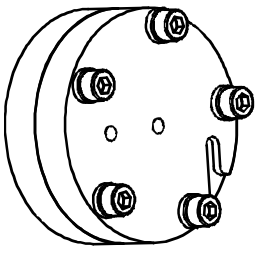
2	**6.1826.040**	**Pump tubing** PVC (Tygon®) with 2 permanently attached **black-black** stoppers; i.d. = 0.76 mm ± 0.05 mm, delivery rate 0.75 mL/min (20 min^{-1}) 0.90 mL/min (24 min^{-1})	
7	**6.1803.040**	**PTFE capillary** Length = 1 m	
1	**6.1831.050**	**PEEK capillary** Length = 40 cm	
1	**6.1831.060**	**PEEK capillary** Length = 1 m	
1	**6.2621.070**	**Allen key 5 mm** For socket head screws of dialysis cell	
1	**6.2729.010**	**Dialysis cell, Plexiglas** with following accessories: 1 × E.301.0111 Sealing ring made of NBR 5 × V.022.6030 Screw made of steel 5 × 4.754.4090 Washer made of POM for screw 4 × 6.2744.060 Blank stopper for closing off inlet and outlet openings	
1	**6.2714.010**	**Dialysis membrane** Cellulose acetate; 47 mm dia.; nominal pore size 0.2 µm. Set of 50 pieces	
1	**6.2057.010**	**Cell holder** For fixing the dialysis cell in the 820 IC Separation Center	
1	**6.2744.000**	**PVDF compression fitting** For connecting 6.1803.0X0 PTFE capillaries to the dialysis cell, Set of 5 pieces	

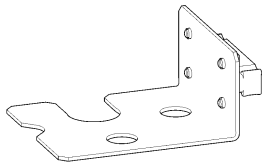
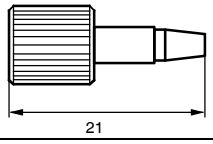
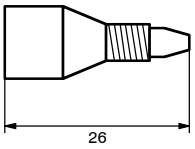
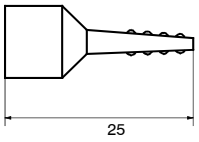
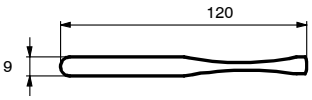
2	6.2744.010	**PEEK compression fitting** For connecting 6.1831.010 PEEK capillaries or 6.1803.020 PTFE capillaries, Set of 5 pieces	
2	6.2744.034	**PEEK coupling** Connection between 6.2744.010 PEEK compression fitting and 6.1826.0X0 Pump tubing; Set of 2 pieces	
4	6.2744.160	**PEEK coupling** with tubing security device for connection to pressure side of 6.1826.0X0 Pump tubing.	
1	6.2831.010	**Tweezers** For handling dialysis membranes	

10.2.5 833 IC Liquid Handling Ultrafiltration Unit

The 2.833.0050 IC Liquid Handling Ultrafiltration Unit includes the following accessories:

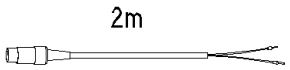
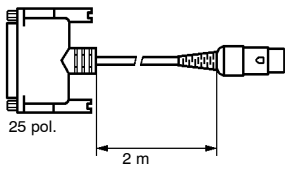
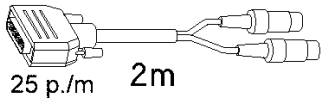
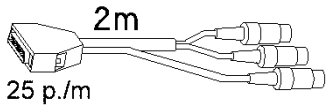
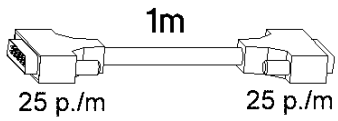
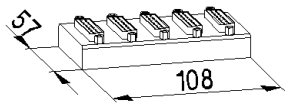
Number	*Order no.*	*Description*
1	1.833.0010	**833 IC Liquid Handling Unit**
1	6.2122.0X0	**Mains cable** to customer's specification: Cable socket — Cable plug Type IEC 320/C 13 — Type SEV 12 (CH…) 6.2122.020 Type IEC 320/C 13 — Type CEE (7), VII (D…) 6.2122.040 Type CEE (22), V — Type NEMA 5-15 (USA…) 6.2122.070
1	8.833.0010	**Instructions for Use (English)** for 833 IC Liquid Handling Unit
1	6.2128.180	**Remote connection cable** Connection cable 830 IC Interface–833 IC Liquid Handling Unit 
1	6.2143.200	**Connection cable** Connection cable 732/819 IC Detector – 833 IC Liquid Handling Unit Control via **Remote line 1**. 

2	6.1826.030	**Pump tubing** PVC (Tygon®) with 2 permanently attached **orange-yellow** stoppers; i.d. = 0.51 mm ± 0.05 mm, delivery rate 0.40 mL/min (20 min^{-1}) 0.48 mL/min (24 min^{-1})	
2	6.1826.070	**Pump tubing** PVC (Tygon®) with 2 permanently attached **yellow-yellow** stoppers; i.d. = 1.42 mm ± 0.05 mm, delivery rate 2.55 mL/min (20 min^{-1}) 3.06 mL/min (24 min^{-1})	
1	6.1803.040	**PTFE capillary** Length = 1 m	
1	6.1803.050	**PTFE capillary** Length = 20 cm	
2	6.1803.070	**PTFE capillary** Length = 40 cm	
2	6.1803.080	**PTFE capillary** Length = 1 m	
1	6.1803.100	**PTFE capillary** Length = 40 cm	
1	6.2621.070	**Allen key 5 mm** For socket head screws of filtration cell	
1	6.2729.110	**Ultrafiltration cell, Plexiglas** with following accessories: 1 × E.301.0111 Sealing ring made of NBR 5 × V.022.6030 Screw made of steel 5 × 4.754.4090 Washer made of POM for screws 4 × 6.2744.060 Blank stopper for closing off inlet and outlet openings.	
1	6.2714.020	**Filter membrane** Regenerated cellulose; 47 mm dia.; nominal pore size 0.15 µm. Set of 50 pieces	

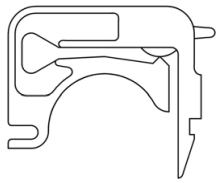
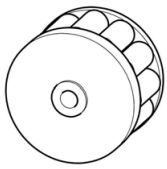
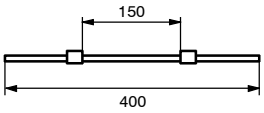
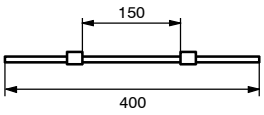
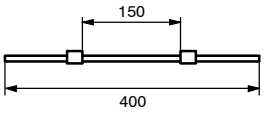
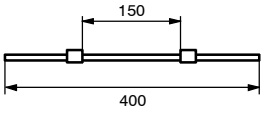
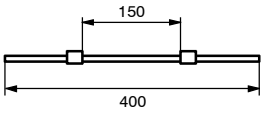
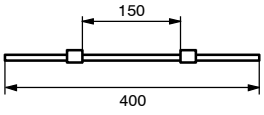
1	6.2057.020	**Cell holder** For fixing the ultrafiltration cell in 820 IC Separation Center	
1	6.2744.000	**PVDF compression fitting** For connecting 6.1803.0X0 PTFE capillaries to the filtration cell, Set of 5 pieces	
1	6.2744.010	**PEEK compression fitting** For connecting 6.1831.010 PEEK capillaries or 6.1803.020 PTFE capillaries, Set of 5 pieces	
1	6.2744.030	**PEEK coupling** Connection between 6.2744.010 PEEK compression fitting and 6.1826.0X0 Pump tubing; Set of 4 pieces	
1	6.2831.010	**Tweezers** For handling the tilter membranes	

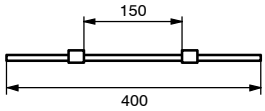
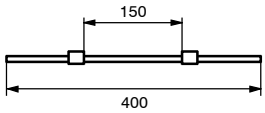
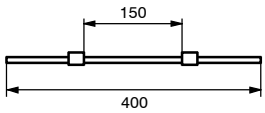
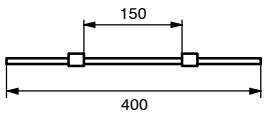
10.3 Optional accessories

10.3.1 Connection cables

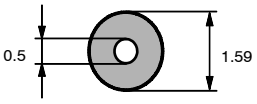
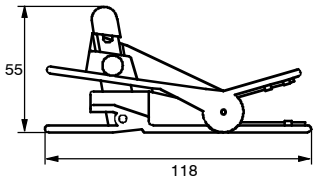
Order no.	Description	
6.2128.180	**Remote connection cable** Connection cable 830 IC Interface– 833 IC Liquid Handling Unit For controlling a function of the LH unit via a remote line.	
6.2143.200	**Connection cable** Connection cable 732/819 IC Detector – 833 IC Liquid Handling Unit For controlling the pump via **Remote line 1**.	
6.2143.210	**Connection cable** Connection cable 732/819 IC Detector – 833 IC Liquid Handling Unit For controlling pump and actuator via **Remote line 1 and 2**.	
6.2143.220	**Connection cable** Connection cable 732/819 IC Detector – 833 IC Liquid Handling Unit For controlling pump and actuator of a LH unit and the pump of a second LH unit via **Remote line 1, 2 and 4**.	
6.2125.090	**Remote connection cable** Extension cable (1:1); specially shielded	
6.2125.120	**Adapter** Distributor of remote lines to five 25-pin sockets	

10.3.2 Pumps

Order no.	Description
6.2755.000	**Tubing cassette** 1 piece 
6.2759.000	**Roller head** with 12 rollers for reduced pulsation, 1 piece 
6.1826.010	**Pump tubing** PVC (Tygon® ST) with 2 permanently attached **white-white** stoppers; i.d. = 1.02 mm ± 0.05 mm, delivery rate 1.41 mL/min (20 min^{-1}) 1.69 mL/min (24 min^{-1}) 
6.1826.020	**Pump tubing** PVC (Tygon® ST) with 2 permanently attached **blue-blue** stoppers; i.d. = 1.65 mm ± 0.05 mm, delivery rate 3.75 mL/min (20 min^{-1}) 4.50 mL/min (24 min^{-1}) 
6.1826.030	**Pump tubing** PVC (Tygon® ST) with 2 permanently attached **orange-yellow** stoppers; i.d. = 0.51 mm ± 0.05 mm, delivery rate 0.40 mL/min (20 min^{-1}) 0.48 mL/min (24 min^{-1}) 
6.1826.040	**Pump tubing** PVC (Tygon® ST) with 2 permanently attached **black-black** stoppers; i.d. = 0.76 mm ± 0.05 mm, delivery rate 0.75 mL/min (20 min^{-1}) 0.90 mL/min (24 min^{-1}) 
6.1826.050	**Pump tubing** PVC (Tygon® ST) with 2 permanently attached **white-yellow** stoppers; i.d. = 0.57 mm ± 0.05 mm, delivery rate 0.43 mL/min (20 min^{-1}) 0.52 mL/min (24 min^{-1}) 
6.1826.060	**Pump tubing** PP (PharMed®) with 2 permanently attached **orange-yellow** stoppers; i.d. = 0.51 mm ± 0.05 mm, delivery rate 0.47 mL/min (20 min^{-1}) 0.56 mL/min (24 min^{-1}) 

6.1826.070	**Pump tubing** PVC (Tygon® ST) with 2 permanently attached **yellow-yellow** stoppers; i.d. = 1.42 mm ± 0.05 mm, delivery rate 2.55 mL/min (20 min^{-1}) 3.06 mL/min (24 min^{-1})	
6.1826.110	**Pump tubing longlife** PVC (Tygon® LFL) with 2 permanently attached **orange-yellow** stoppers; i.d. = 0.51 mm ± 0.0102 mm, delivery rate 0.40 mL/min (20 min^{-1}) 0.48 mL/min (24 min^{-1})	
6.1826.120	**Pump tubing longlife** PVC (Tygon® LFL) with 2 permanently attached **orange-white** stoppers; i.d. = 0.59 mm ± 0.05 mm, delivery rate 0.44 mL/min (20 min^{-1}) 0.53 mL/min (24 min^{-1})	
6.1826.130	**Pump tubing longlife** PVC (Tygon® LFL) with 2 permanently attached **white-white** stoppers; i.d. = 1.02 mm ± 0.0127 mm, delivery rate 1.41 mL/min (20 min^{-1}) 1.69 mL/min (24 min^{-1})	

10.3.3 Modules

Order no.	*Description*
6.2832.000	**Actuator rotor for suppressor module**
6.2832.010	**Connection piece for suppressor module** with inlet and outlet
6.2835.000	**Actuator rotor for sample preparation module**
6.2835.010	**Connection piece for sample preparation module** with inlet and outlet
6.2714.010	**Dialysis membrane** Regenerated cellulose; 47 mm dia.; nominal pore size 0.2 µm. Set of 50 pieces
6.2714.020	**Filter membrane** Regenerated cellulose; 47 mm dia.; nominal pore size 0.15 µm. Set of 50 pieces
6.2714.030	**Nylon membrane** Regenerated nylon; 47 mm dia.; nominal pore size 0.2 µm. Set of 50 pieces
6.1831.040	**PEEK capillary** Length = 15 cm For connecting two injection valves to 820 IC Separation Center, see *Section 8.3* 
6.2621.080	**Capillary cutter for plastic capillaries** For 6.1831.010 PEEK capillaries and 6.1822.010 PTFE micro-capillaries with 5 spare blades 

10.4 Validation / GLP

GLP (**G**ood **L**aboratory **P**ractice) requires, among other things, that the precision and correctness of analytical instruments is checked at regular intervals by using SOPs (**S**tandard **O**perating **P**rocedures, **SOP**). An example of such a standard operating procedure is available from Metrohm under the title **«Application Bulletin No. 277 – Validation of Metrohm Ion Chromatography Systems by using Standard Operating Procedures (SOP)»**. This SOP can be adapted for your ion chromatography system and used for its validation.

833 IC Liquid Handling Unit must be included as a part of the whole ion chromatography system, whose most important components include the pumps, separation columns and evaluation system, in the all-embracing validation of the whole system.

Please contact your local Metrohm agency in order to receive support in validating your 819 IC Detector and 820 IC Separation Center. It can also provide you with validation documentation which will help you to carry out your installation qualification (IQ) and operational qualification (OQ).

Further information about QA, GLP and validation can also be found in the brochure «**Quality management with Metrohm**» which is also obtainable from your local Metrohm agency.

10.5 Warranty and Conformity

10.5.1 Warranty

The warranty on our products is limited to defects that are traceable to material, construction or manufacturing error which occur within 12 months from the day of delivery. In this case, the defects will be rectified in our workshops free of charge. Transport costs are to be paid by the customer.

For day and night operation, the warranty is limited to 6 months.

Glass breakage in the case of electrodes or other parts is not covered by the warranty. Checks which are not a result of material or manufacturing faults are also charged during the warranty period. For parts of outside manufacture insofar as these constitute an appreciable part of our instrument, the warranty stipulations of the manufacturer in question apply.

With the regard to the guarantee of accuracy, the technical specifications in the instruction manual are authoritative.

Concerning defects in material, construction or design as well as the absence of guaranteed features, the orderer has no rights or claims except those mentioned above.

If damage of the packaging is evident on receipt of a consignment or if the goods show signs of transport damage after unpacking, the carrier must be informed immediately and a written damage report demanded. lack of an official damage report releases Metrohm from any liability to pay compensation.

If any instruments and parts have to be returned, the original packaging should be used if at all possible. This applies above all to instruments, electrodes, burette cylinders and PTFE pistons. Before embedment in wood shavings or similar material, the parts must be packed in a dustproof package (for instruments, use of a plastic bag is imperative). If open assemblies are enclosed in the scope of delivery that are sensitive to electromagnetic voltages (e.g. data interfaces etc.) these must be returned in the associated original protective packaging (e.g. conductive protective bag). (Exception: assemblies with built-in voltage source belong in a non-conductive protective packaging).

No warranty responsibility whatsoever will be accepted by Metrohm for damage which arises as a result of non-compliance with these instructions.

10.5.2 Declaration of Conformity

Metrohm
Ion analysis
CH-9101 Herisau, Switzerland
Tel. +41 71 353 85 85
Fax +41 71 353 89 01
www.metrohm.com

This is to certify the conformity to the standard specifications for electrical appliances and accessories, as well as to the standard specifications for security and to system validation issued by the manufacturing company.

Name of commodity	**833 IC Liquid Handling Unit**
Name of manufacturer	Metrohm Ltd., Herisau, Switzerland

Description

Remote controlled two-channel peristaltic pump, versions available with additional modules for chemical suppression, sample preparation, dialysis or filtration.

This Metrohm instrument has been built and has undergone final type testing according to the standards:

Electromagnetic compatibility: Emission
EN/IEC 61326, EN 55022 / CISPR 22, IEC 61000-3-2

Electromagnetic compatibility: Immunity
EN/IEC 61326, EN/IEC 61000-4-2, EN/IEC 61000-4-3, EN/IEC 61000-4-4, EN/IEC 61000-4-5, EN/IEC 61000-4-6, EN/IEC 61000-4-11, EN/IEC 61000-4-14, NAMUR

Safety specifications
EN/IEC 61010-1, UL 3101-1 protection class I

It has also been certified by ElectroSuisse, which is member of the International Certification Body (CB/IEC).

The instrument meets the requirements of the CE mark as contained in the EU directives 89/336/EEC and 73/23/EEC and fulfils the following specifications:

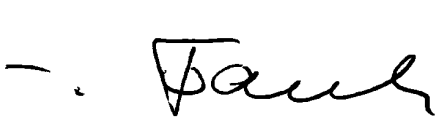
EN 61326	Electrical equipment for measurement, control and laboratory use – EMC requirements
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use

Metrohm Ltd. is holder of the SQS-certificate of the quality system ISO 9001 for quality assurance in design/development, production, installation and servicing.

The system software, stored in Read Only Memories (ROMs) has been validated in connection with standard operating procedures in respect to functionality and performance.

The technical specifications are documented in the instruction manual.

Herisau, May 28, 2003



Dr. J. Frank
Development Manager

Ch. Buchmann
Production and
Quality Assurance Manager

10.5.3 Quality Management Principles

Metrohm Ltd., CH-9101 Herisau, Switzerland

Metrohm
Ion analysis
CH-9101 Herisau/Switzerland
E-Mail info@metrohm.com
Internet www.metrohm.com

Metrohm Ltd. holds the ISO 9001 Certificate, registration number 10872-02, issued by SQS (Swiss Association for Quality and Management Systems). Internal and external audits are carried out periodically to assure that the standards defined by Metrohm's QM Manual are maintained.

The steps involved in the design, manufacture and servicing of instruments are fully documented and the resulting reports are archived for ten years. The development of software for PCs and instruments is also duly documented and the documents and source codes are archived. Both remain the possession of Metrohm. A non-disclosure agreement may be asked to be provided by those requiring access to them.

The implementation of the ISO 9001 quality system is described in Metrohm's QM Manual, which comprises detailed instructions on the following fields of activity:

Instrument development
The organisation of the instrument design, its planning and the intermediate controls are fully documented and traceable. Laboratory testing accompanies all phases of instrument development.

Software development
Software development occurs in terms of the software life cycle. Tests are performed to detect programming errors and to assess the program's functionality in a laboratory environment.

Components
All components used in the Metrohm instruments have to satisfy the quality standards that are defined and implemented for our products. Suppliers of components are audited by Metrohm as the need arises.

Manufacture
The measures put into practice in the production of our instruments guarantee a constant quality standard. Production planning and manufacturing procedures, maintenance of production means and testing of components, intermediate and finished products are prescribed.

Customer support and service
Customer support involves all phases of instrument acquisition and use by the customer, i.e. consulting to define the adequate equipment for the analytical problem at hand, delivery of the equipment, user manuals, training, after-sales service and processing of customer complaints. The Metrohm service organisation is equipped to support customers in implementing standards such as GLP, GMP, ISO 900X, in performing Operational Qualification and Performance Verification of the system components or in carrying out the System Validation for the quantitative determination of a substance in a given matrix.

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