Operator´s Manual

RO MEDICAL

Description: NRO-MED-IFU-1001

Date: 06.10.2021 | Version: 12

Written by: Nipro Pure Water

Table of Contents

CE 0297

For the reverse osmosis type RO medical, conformity according to EC directives is declared

Foreword

This Operator's Manual includes all information required for the installation and operation for the reverse osmosis model RO medical.
Please keep this Operator's Manual readily available and near the unit.

This Operator's Manual applies for the units with the serial number:

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Rev#	Date / Name	Description
1	16.05.11 / N.Bürkle	First edition
2	07.07.11 / N.Bürkle	Disposal added
3	31.08.11 / N.Bürkle	Disinfection added
4	28.02.12 / N.Bürkle	Limit values added
5	28.02.14 / N.Bürkle	Company name
6	20.12.19 / N.Bürkle	New Design / EMC
7	10.01.20 / N.Bürkle	Air pressure added
8	29.06.20 / N.Bürkle	Changes accord. EN 60601
9	29.06.20 / N.Bürkle	LOGO Control
10	24.02.21 / T. Barretto	Cosmetic corrections
11	03.03.21/ R.Tille	Water pressure input
12	06.10.21/G.Biscardi	Information Service point

1 General

1.1 Scope of supply

The scope of delivery includes the following parts:

- 1 reverse osmosis
- 1 connection set

1.2 Unit combinations

The unit model RO may be combined with the following devices:

- * Permeate tank
- * City water tank

1.3 Notes for the Operator

The operator is responsible for:

- Competent and intended operation
- Compliance with work safety and accident prevention provisions
- Technical instruction of operating personnel

1.4 Laws and Standards

The following laws and standards are adhered to:

- Council Directive 93/42 EEC Medical Devices
- EN 60601
- DIN EN 1717 Protection of potable water against contamination

1.5 Symbols used in this Manual

Stands for a dangerous situation. Disregard can result in personal injury or material damage.

Stands for information and valuable tips.

1.6 Transport and Storage

Protect unit against frost and moisture

Protect against strong jolting and collisions.

Only move unit upright and with an appropriate lift.

The system may be stored for a maximum of 1 year.

1.7 Model Plate

	Attention, take note of accompanying documents
	CE mark with the number of the notified body. Here DQS
IPX 4	Protection against the ingress of liquids. Here splash-water protection
	Protection Scheme according to EN 1717. Here free outlet
	Serial number
	Year of construction
	Manufacturer
	Pay attention to manual

1.8 Warning on the Unit.

Caution voltage. Turn mains switch off before opening housing. Fixed on control cabinet.

1.9 Shutdown

If a unit is shutdown for more than 5 days, conservation will be necessary.

Please contact Nipro Pure Water before performing conservation.

1.10 Disposal

Regarding the WEEE guidelines of the European Union, the disposal of electronic devices and electronic sub-assemblies and parts into the general garbage is not lawful. These parts must be disposed environmentally appropriate:

If not appointed otherwise and no private disposal management is available, these devices or possibly other environmental hazardous items can be sent back.

The filters and membrane can be disposed via the general garbage

1.11 Instruction / Further Documentation

The using personnel must be warned against the hazards during operation and must be warned against the hazards of misusing the product.

The personnel gets the instruction of operation and the specialties of usage. Instructed adult only are allowed to operate this device.

This instruction by the manufacturer or authorized personnel takes place during the commissioning of the device.

Further trainings are not necessary for this device.

For qualified personnel the following documents can be made available upon request.

Circuit diagrams
Spare parts list

1.12 Duration of usage

The device is designed for a use of 10 years

2 Intended operation

The unit is designed for the treatment of potable water. The pure water (permeate) thus produced may be used for dialysis treatment.

Other applications are only possible after consulting the manufacturer and receiving their approval.

The unit can only be maintained by the manufacturer or technicians trained by the manufacturer.

Only original replacement parts may be used for maintenance and repairs.

Installation operations, modifications or reparations, are only allowed to be performed by persons authorised by the manufacturer and may only be done with original replacement parts. Improper performed reparations or modifications can lead to hazards to the user and/or may damage the device.

The device may only be operated in perfect condition.
Before operating, check the following:

- Lose or defect parts
- Defect cables and/or isolations
- Serious soiling

The device may only be operated with the appropriate ring line.

The device does not produce water for injections.

The device has pressurized parts.

If the temperature sensor fails, the temperature in the permeate can increase. (Max 60°C)

The water treatment system RO medical may only be used for permeate supply of dialysis devices, which have a temperature measurement (permeate temperature).

The device has no direct patient contact and no patient application part.

2.1 Contraindications / side effects

None

3 Safety

3.1 Risk Assessment

There will be no dangers associated with the reverse osmosis model RO medical D if the operating instructions are followed.

The device can automatically start by way of an auto-start.

3.2 EMC

The device was developed and tested in accordance with current standards. Nevertheless, influence through electromagnetic fields cannot be completely excluded.

3.3 Emissions

The device does not produce dust or vibrations.
The noise level is under 609 dB (A).

4 Technical Data

Permeate performance

Temperature	1 Membrane	2 Membranes	3 Membranes	4 Membranes
15° C	350 l/h	700 l/h	1050 l/h	1400 l/h

Inlet water

Quality	Potable Water
Hardness	< 1 °dH
Silicate	< 25 mg/l
Chlorine	< 0,1 ppm (mg/l)
Iron	< 0,1 ppm (mg/l)
Fouling Index (S.D.I)	< 3
Temperature	5-25°C
Pressure	1-3 bar

Connections

Water feed	1” internal thread
Pure water connection	Hose nozzle d20
Drain	HT 40

Electrical data

Supply voltage	220-230 V, 1 Phase, 50/60 Hz
Fuse	Automat 16 A-K, Fi ΔI 30mA
Current consumption	9,9 A x 60 Hz
Degree of pollution	1

Ambient temperature

Storage / transport	3-40°C
Operation	10-35°C
Air pressure	795-1062 hPa

Display system

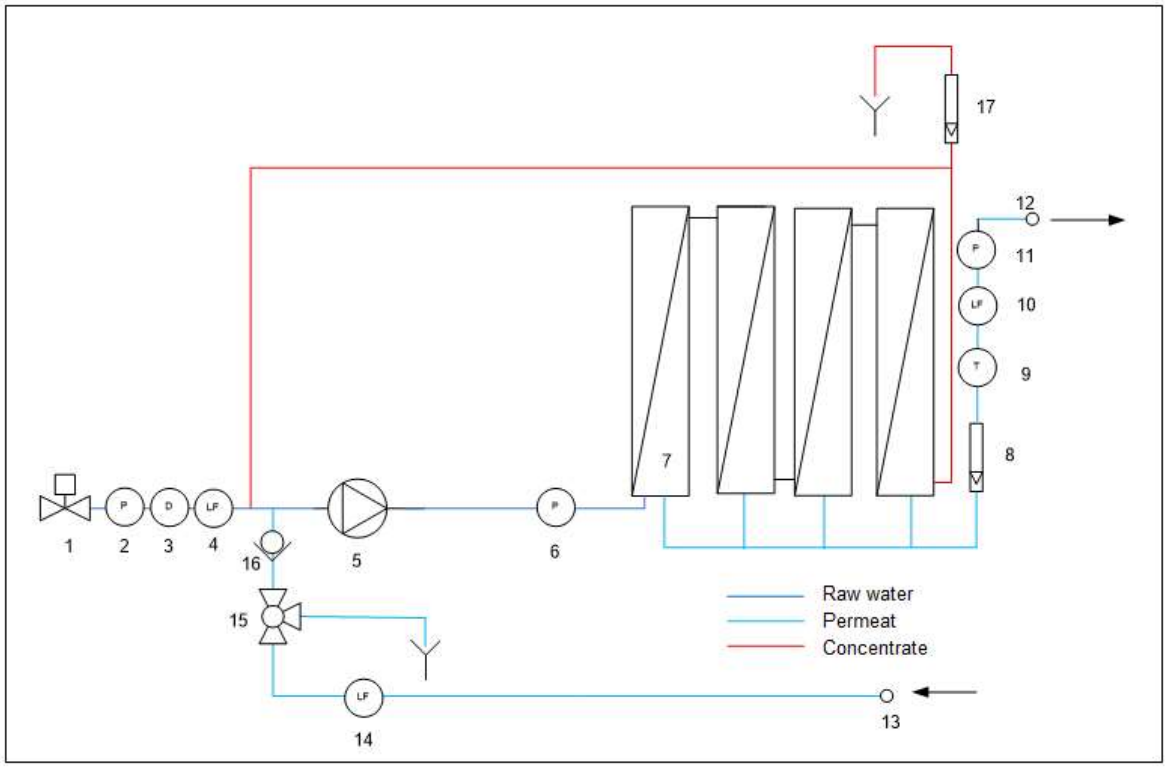
Conductivity	0-1000 µS/cm ±5%
pressure switch	0-10 bar ±5%
Flow (sight glass)	300-3000 l/h ±5% 100-1000 l/h

Size

RO Medical	1000x500x1640

5 Description of the device

5.1 Flow-Chart

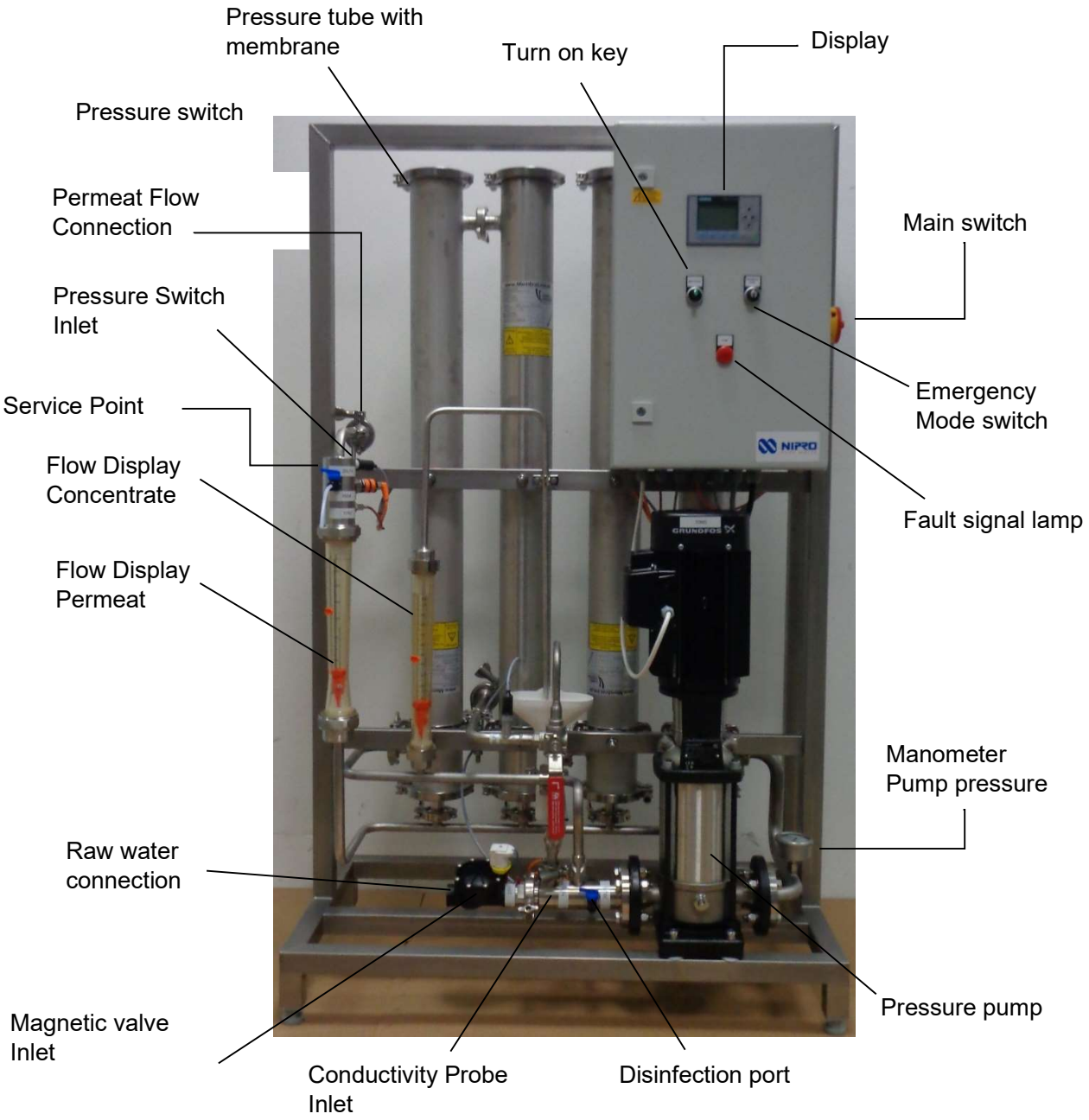


1. Magnetic valve inlet
2. Pressure switch input
3. Disinfection point
4. Conductivity input
5. Pump (pressure 10-13bar)
6. Manometer (pressure 10-13 bar)
7. Reverse osmosis membrane (1-4 pieces)
8. Permeate flow rate indicator
9. Temperature sensor
10. Conductivity probe permeate flow
11. Permeate pressure switch
12. Connection back flow hose nozzle d20
13. Connection back flow hose nozzle d20
14. Conductivity ring back flow
15. Discard three-way ball valve permeate
16. Check valve
17. Flow indicator concentrate outflow

5.2 Functional sequence

If the toggle switch is turned to the ‘On‘ position, the magnetic valve (1) opens and water flows into the system. After a short delay, the pump (4) will start.
Now the water is pressed into the reverse osmosis membrane at a pressure of 10-15 bar. The flow is divided into a permeate and a concentrate part. The permeate content flows through the flow indicator (7), the temperature sensor (8), the conductivity probe (9) and the pressure switch (10) into the ring line. The unused permeate flows back into the RO medical via the connection (12).
To save water, the concentrate portion is divided up again, one portion is given into the drain via the flow indicator (17), the other is fed back in front of the pump.

5.3 Safety devices / Components



6 Installation

The installation must be conducted by the manufacturer or by personnel trained and authorized by the manufacturer.

6.1 Environmental Condition

Conditions for the osmosis room:

- Relative air moisture < 90% at 20°C
- Room temperature between +10°C and +35°C (frost proof)
- Equipped with floor drain, water supply and electrical supply

6.2 Assembly

- Bring the device into the appropriate position
- Adjust machine feet until the device stands level and secure on the floor.

Do not store easily flammable materials in the vicinity of the device.

Do not store chemicals in the vicinity of the device.

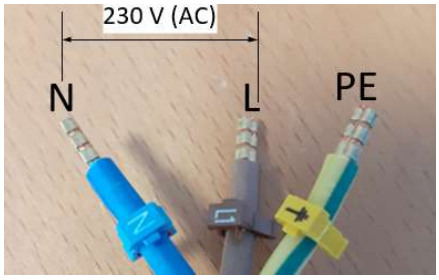
Only operate the device with the necessary water pre-treatment.

Room of osmosis may not be freely accessible. (Access for instructed personnel only)

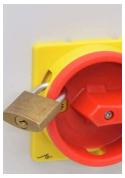
6.3 Electrical installation

The installation may only be performed by a qualified electrician.

The device must be supplied by a permanent connection, connectors are not valid. The disconnection via the main switch at the control cabinet. The power cord must be provided with a strain relief.



Connection cable RO Medical



For protection against a re-start of the unit, the main switch can be locked with a padlock.

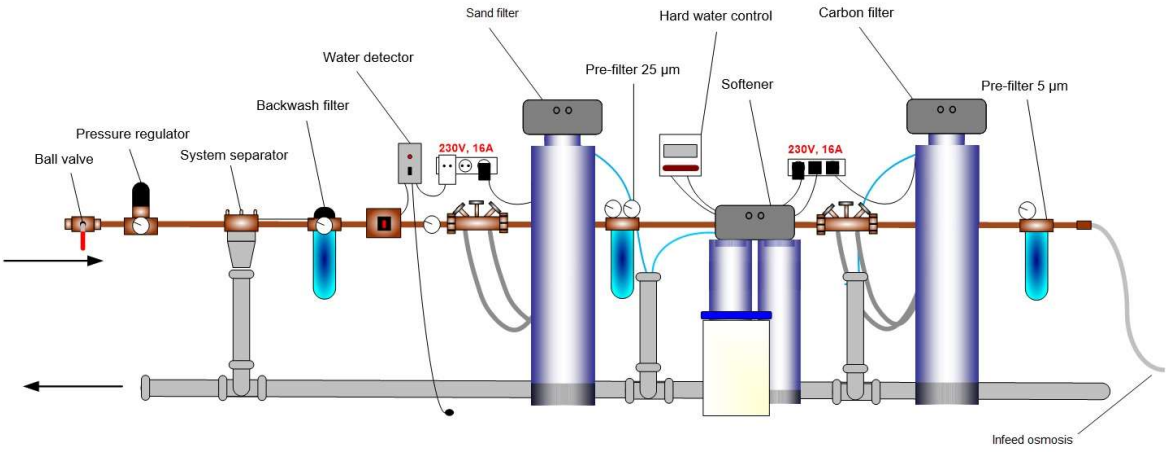
Safety class I

The device is equipped with a Protective earth terminal for prevention against high touch current
For prevention of the hazard of an electric shock, this device may only be connected to a power supply with protective earth.

The power cord is fixed to the device and cannot be replaced.

6.4 Prefiltration (Example)

Install the necessary water pre-treatment equipment first!
Only then connect the RO medical and start up



Local water works regulations and DIN EN 1717 must be followed.

The water pre-treatment must be adapted to the local potable water quality.

6.5 Commissioning

Caution, device damage!
The device must be preconnected by a suitable pre-filter and a softening system as well as a pressure reducer.

6.6 Initial commissioning

1. Connect and check the raw water connection (1), permeate flow (2), permeate back flow (3) and waste water (4)

2. Open the inlet valve manually. To do this, turn the white magnet coil 45° counter clockwise.

   Now water is running into the device.

3. Carefully open the screw for the pump venting until a water outlet can be seen. Then close the screw again and reset the solenoid.

4. Make sure that the wall-mounted taps at the start and end of the ring are open.

5. Start the device using the toggle switch.

6. Check all connections for leaks.

7. Open the three-way valve permeate to the drain.

8. Allow the device to discard permeate for at least 30 minutes.

7 Operation

7.1 Control Panel

1. **Toggle switch system on**
   This is used to switch the device on and off

4. **Key switch emergency operation**
   The device can be switched to emergency operation here.

2. **Fault light**
   Lights up when there is a fault
3. **Display**
   Display of conductivity and faults
5. **Main switch**
   With this the device can be switched off completely

7.2 System on / off without permeate tank

System on
To start the device, turn the toggle switch to the right (on position).
The green lamp lights up.
The pump starts after a short delay

System off
Reset toggle switch (position 0)
The green lamp goes out.
Pump stops.

If the device is switched off using the toggle switch, the rinse intervals are carried out as programmed. If no rinsing is to take place, the device must be switched off completely at the main switch. However, this is only recommended for decommissioning.

7.3 Device on / off with permeate tank

If the RO medical is connected to a permeate tank, the toggle switch must be set to "Auto". Since the device switches off automatically when the tank is full, it is not necessary to reset it to position 0.

Caution, danger of overflow!
If the RO medical is operated with a permeate tank, the system may only be started via "Auto". **In the "On" position there is a risk of overflow**.

Device on
To start the system, turn the knob switch to the right.
If the permeate tank is empty, the system starts automatically.
If the tank is already full, the osmosis waits to start until the level in the tank drops.

7.4 Emergency operation

Caution!

If the HC Medical hot cleaning system is connected, the following steps must be carried out before emergency operation:

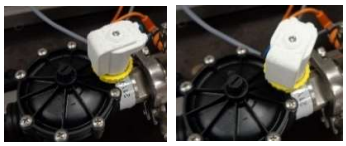
1. Check HC Medical for pending alarms.
2. Carefully touch the lines of the HC Medical and check whether they are warm.

Do not carry out emergency operation when the lines are warm !!

Only use emergency operation if the automatic function fails. Have device repaired as soon as possible.

Attention!

There is no monitoring of the water inflow during the emergency operation. Therefore a continuous water inflow has to be guaranteed.
Absent water causes the **destruction of the pump**.



1. Open the inlet valve manually. To do this, turn the white magnet coil 45° counter clockwise.

   Now water runs into the device.

2. Set the key switch to position 1. Pump starts up

To turn off the device, turn switch to position 0.

In emergency operation all automatic functions are turned off. No cleaning cycle and no automatic start and/or stop will be conducted.

7.5 Operating displays

System Off **Set: 90:00** **Actual: 25:22** **Until rinsing**	**Device is off**. Rinsing interval (target) is set to 90 minutes. 25:22 min have already passed. If the actual value reaches the set point, the system goes into rinsing.
System On **LF Flow 008** **LF Backflow 008** **Microsiemens**	**Device is on**. The current conductivities are displayed.
Rinsing **LF Flow 008** **LF Backflow 008** **Microsiemens**	**Device is being rinsed.** The current conductivity is displayed.

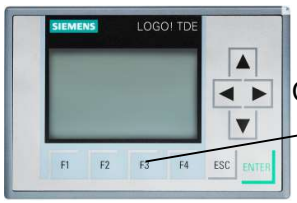
8 Error messages / troubleshooting

8.1 Error messages

Display	*Error Description*	*Troubleshooting*
Error Motor protection triggered Check 1Q5	The motor protection switch of the pump has triggered. Check motor protection switch. If this alarm occurs frequently, the pump must be checked.	Turn the motor protection switch back to position 1.
Error Over temperature Check 16S12	The temperature of the permeate has reached to 38 °C. The system switches off to protect the membranes.	The system must be cooled (see next page).
Error Over pressure Check 16S08	The permeate pressure has exceeded 6 bar.	Check the start and end of the ring taps. Check setting of permeate pressure retention valve.
Error Inlet water missing Check 16S6	The pressure switch 1 has responded.	Check water inlet.
Error Conductivity	The conductivity has exceeded the limit of 100µS/cm.	There is probably a defect in the membranes. **Call service.**

8.2 Clear alarms

Correct the error
Follow the notes in Display.



Clear the alarm by pressing the F3 key

9 Maintenance and cleaning

9.1 External Cleaning

Stains and dust can be removed with a cloth and a commercially available cleaner.

Do not clean the device with solvents.

Stains from softening salts or disinfectants must be removed immediately.

9.2 Maintenance Intervals

Measure	period	Notes	user
Fill salt at softener	Daily		user
Chemical disinfection	If needed		Manufacturer or persons authorized by manufacturer
Maintenance	Yearly		Manufacturer or persons authorized by manufacturer
Safety related check	Every 2 years		Manufacturer or persons authorized by manufacturer
Microbiological analysis	Every 3 months		User
Chemical analysis	Every 12 months		User

Not replacing the filter or replacing it too late can lead to damaging of the reverse osmosis.

9.3 Chemical Disinfection

A chemical disinfection should only be performed upon new installation or when high pathogen values are encountered

Disinfection may only be performed by **Nipro Pure Water** or by **instructed** persons.

Caution when handling disinfectants!
Per acetic acids can cause damage to your health. Always **read** safety **guidelines** before handling.

Before the next **dialysis each** consumption point must be tested for **disinfectant traces.**

9.4 Microbiological Inspection

Necessary Values[1]

□	Pathogens	< 100 CFU/ml no traces of Pseud. aeruginosa and E. coli
□	Endotoxins	< 0,25 EU/ml

Inspection Interval [2]

Inspection of permeate every 3 months.

Inspection method [2]

Pathogen count determination:

Nutrient medium: TGEA (OXID Nr.CM 127), R2A
Incubation temperature: 22°C ± 2°C

Endotoxins determination:

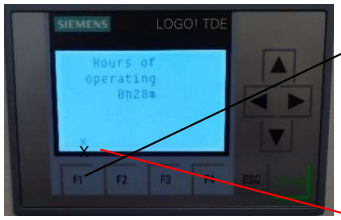
Method: GEL-Clot; Cromogen; Turbid metric

[1] According to the European Pharmacopoeia

[2] Recommendations according to the guideline for the practice of applied hygiene in treatment units for dialysis

10 Display / Parameter

10.1 Retrieval of the operating hours / conductivities



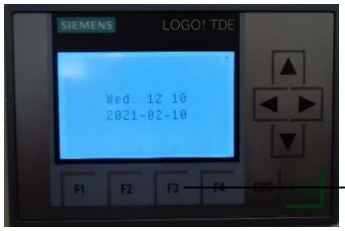
Press the F1 key. The operating hours are displayed.

If the key is pressed again, the display changes back to the standard display.

The X indicates which key can be used to switch back to the standard display.

Press the F2 key. The conductivities are displayed.

If the key is pressed again, the display changes back to the standard display.



To view the time and date, press the down arrow.

10.2 Change the conductivity parameter

Press the F4 key and F2 key simultaneously.

The conductivity in the return is displayed.

Press the ESC key for 3 seconds, the first value is marked.

Press enter

Set the value with the arrow keys (up / down). Complete the entry with ENTER.

Press the ESC key.

Press the F4 and F2 keys simultaneously to return to the standard display

Both parameters (MAX1 and MAX2) must be set to the same value.

Standard value = 100 µS / cm

If the conductivity in the back flow reaches the value set here, the conductivity alarm is activated.

10.3 Change parameter temperature

Press the F4 key and F3 key simultaneously.

The temperature is displayed.

Press the ESC key for 3 seconds, the first value is marked.

Select corresponding value with the arrow keys.

Press enter

Set the value with the arrow keys (up / down). Complete the entry with ENTER.

Press the ESC key.

Press the F4 and F3 keys simultaneously to return to the standard display

Both parameters (MAX1 and MAX2) must be set to the same value.

Default value = 38°C

If the temperature reaches the value set here, the over temperature alarm is activated.
CAUTION!
Max. 40°C is allowed, higher temperatures damage the membranes.

Technical appendix

The settings and functions described below may only be carried out by technically trained personnel.

ATTENTION. DANGER TO PERSONS AND SYSTEM TECHNOLOGY!
Incorrect settings can lead to hazards.

No service or maintenance work may be carried out during treatment.

11 Replacement of the reverse osmosis membrane

Caution pressure!
Membrane tubes are under pressure. Please open carefully.

The settings and functions described below may only be carried out by technically trained personnel.

1. Switch off the system at the main switch.

2. Open wing screw and take off the clip

3. Lift module cover by using a screwdriver.

4. Take off cover.

5. Take the end plug out of the module.

6. Pull out the membrane by using a tong.

7. Reinstall the new membrane in reverse order.
Take care of the flow direction and
position of the gasket

Rinse membrane!
After the new membrane has been installed the mode “drain permeate” has to be started for 20 minutes.

12 Service Parameters

The settings and functions described below may only be carried out by technically trained personnel.

ATTENTION, SYSTEM DAMAGE!
Incorrect settings can lead to damage.

Arrow key down and then press the ESC key. (Service mode)

Then Logo settings> ENTER> Program> ENTER> Set parameters> ENTER> select the appropriate parameter (B001-B040)

Parameter	Function	default value
B001	Pump start time delay	3sec
B002	Rinse waiting time	60m
B003	Rinse time	10m
B005	Dry flow alarm delay	5sec
B019	Conductivity alarm delay	30sec
B021	Adjustment of conductivity (permeate)	
B034	Alarm delay temperature	30sec
B036	Calibration of conductivity (inflow)	
B037	Adjustment of conductivity (permeate back flow)	
B040	Timer (auto start)	

12.1 Adjustment of the conductivity

- Call up parameters B21, B36 or B37.

- "Ax" value = displayed conductivity

- Select value "B" and confirm with Enter.

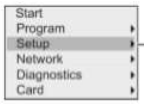
- Change the value with the arrow keys. (+00001 = current value +1)

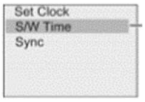
- press enter

- Press ESC several times (until time is displayed), then arrow key up.

12.2 Setting date and time

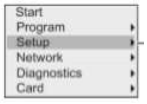
- Call up service mode
- LOGO Settings <ENTER> Setup <ENTER> Clock <ENTER> Set Clock <ENTER>
- Set the time and date with the arrow keys <ENTER

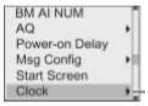


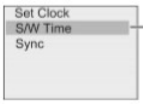


12.3 Summer / winter time

- Call up service mode
- Setup <ENTER> Clock<ENTER>S/W Time – Select the S/W Time





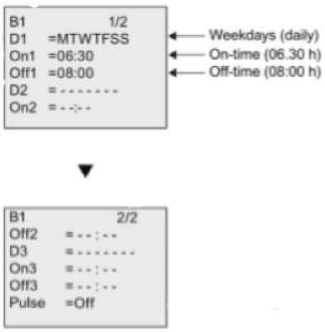


– "④": disables automatic S/W time conversion.
– "⑤" represents the start and end of European summertime.
– "⑥" represents the start and end of summertime in the United Kingdom.
– "⑦" represents the start and end of daylight-saving time (summertime) in the United States prior to 2007.
– "⑧" represents the start and end of daylight-saving time (summertime) in the United States in 2007 and later years.
– "⑨" represents the start and end of Australian summertime.
– "⑩" represents the start and end of Australian/ Tasmanian summertime.
– "⑪" represents the start and end of New Zealand summertime.
– "⑫": Here you can enter any month, day and time zone difference.

12.4 Auto Start (Timer)

Call up service mode

Logo settings < ENTER > Program < ENTER > Set parameters
< ENTER > Select parameter B040<ENTER>



To set the on-/off-times:
-Move the cursor to one of the parameters of the timer.
-Press ENTER. The cursor is positioned on the day of the week.
-Press up and down key to select one or several days of the week.
-Press right arrow key to move the cursor to the first position of the on-time.
-Set the on-time.
Modify the value at the respective position, using the up and down keys and move to the cursor to the various positions, using the right and left arrow keys.
At the first position, you can only select the value - -:- - (- -:- - means: No on-/off-times set).
-Press right arrow key to move the cursor to the first position of the off-time.
-Set the off-time
-Confirm your entries with ENTER

The prefix "D=" (Day) has the following meaning: ● M: Monday ● T: Tuesday ● W: Wednesday ● T: Thursday ● F: Friday ● S: Saturday ● S: Sunday

Uppercase letters indicate a specific day of the week. A "-" indicates no selection for the day of the week.

12.5 Service point

The service point can be used for water withdrawal to check water temperature and conductivity.

Service point may only be opened, if operating pressure in the system is reached.
Service point must be closed prior to each system start. Service point may only be operated by **technically trained personnel**.

13 Disinfection

Disinfection may only be performed by **Nipro Pure Water** or by **instructed** persons.

Caution when handling disinfectants!
Per acetic acids can cause damage to your health. Always **read safety guidelines** before handling.

To be performed precisely!
Danger!
Ensure that no dialysis can be performed while disinfecting. Only approve thoroughly rinsed system for treatment use.


CAUTION!
While using chemicals.
Wear safety gloves and safety goggles during the here described jobs.


ATTENTION!
Do not eat, drink or smoke during work.

Disinfectant: MINNCARE® Cold Sterilant (Artikelnr.:489)

Detection method: MINNCARE® Test Strips Residual (Artikelnr.:490)
MINNCARE® Test Strips 1 Indication (Artikelnr.:491)

1. Connect the disinfection pump to the disinfection point.

2. Open the three-way valve permeate to the drain.

3. Start the device

4. Start the disinfectant pump.

5. Check for correct disinfectant concentration at the permeate outlet with test strips. Use Minncare Test Strips Indication 1% for this.

6. Let the disinfectant pump run until sufficient disinfectant is detected.

7. Close the three-way valve permeate to the drain.

8. Switch off the system

9. Restart the system after 20 minutes.

10. Open the three-way valve permeate to the drain.

11. Let the system run until no more disinfectant can be detected at the permeate drain. Use Minncare residual test strips for this.

12. Close the three-way valve permeate to the drain.

13. Check that all dialysis stations are free from disinfectants.

Switches the system off during disinfection with a conductivity alarm, clear the alarm and restart the system.

RISK OF DEATH !

Before the next dialysis, each sampling point must be tested again to ensure that it is free from disinfectants.

*** Free of disinfection means 0ppm-** no discoloration of the test strip.
See the colour scale on the packaging of the test strip Residual.

13.1 Disinfection Protocol

Dialysis centre	
Section	
Contact person	
Function	
Street / Bldg. No.	
Postcode / City	
Unit model :	RO Medical
Serial number:	
Ring line length	

Disinfectant type	Inoculated amount in litres	
Wash time in minutes	Wait time in minutes	
Rinse time in minutes	Tested for disinfectant at all dialysis stations and results were negative?	☐ yes

If disinfection was performed the operator is obligated by its signature to re-test **all** dialysis stations for **disinfectant**. This test must be conducted before the dialyses are performed

_____
Date

_____
Signature

14 EMC manufacturer's declaration

Electromagnetic emissions and electromagnetic immunity

The RO device is intended for use in electromagnetic environments as described below.
The customer or the operator of the RO should ensure that the device is only used in such an environment.

This EMC manufacturer's declaration is based on the use of the power supply unit from Phoenix Contact.
The power supply is installed in the control cabinet.
The cable length between the power supply unit and the cable entry through the housing wall is 150 cm.

Warning
The use of other accessories, other power supply units and cables than specified can lead to increased emissions and/or reduced interference immunity of the RO.

Requirements
During the interference immunity tests, the temperature accuracy and conductivity accuracy were checked.

Emission measurement	**Compliance**	**Electromagnetic environment - Guidelines**
RF emission in accordance with CISPR 11 / EN 5511	Group 1	The device only uses RF energy for its internal function. Its RF emissions are therefore very low and interference to nearby electronic devices is unlikely.
RF emission in accordance with CISPR 11 / EN 55011	Class B	The device is suitable for use at any location, including residential areas and facilities directly connected to the public low-voltage grid for residential buildings.
Harmonics in accordance with IEC 61000-3-2	Class A	
Voltage fluctuations / flickers in accordance with IEC 61000-3-3	Fulfilled	

Immunity test	**Test level – IEC 60601**	**Compliance level**	**Electromagnetic environment - Guidelines**
Discharge of static electricity (ESD) in accordance with EIC 61000-4-2	± 6 kV contact discharge ± 8 kV air discharge	± 6 kV contact discharge ± 8 kV air discharge	The floor should be made of wood, concrete, or of tiles. In case of synthetic flooring, relative air humidity should be at least 30%.
Electrical fast transient burst/immunity test in accordance with IEC 61000-4-4	± 2 kV for power cables ± 1 kV for input and output cables	± 2 kV for power cables ± 1 kV for input and output cables	The quality of supply voltage should comply with that of a typical commercial or hospital environment.
Surge voltage in accordance with IEC 61000-4-5	± 1 kV outer conductor-outer conductor ± 2 kV outer conductor-ground	± 1 kV outer conductor-outer conductor ± 2 kV outer conductor-ground	The quality of supply voltage should comply with that of a typical commercial or hospital environment.
Voltage drops, short interruptions, and fluctuations in supply voltage in accordance with IEC 61000-4-11	95% voltage drop for ½ period 60% voltage drop for 5 periods 30% voltage drop for 25 periods 95% voltage drop for 5 s	95% voltage drop for ½ period 60% voltage drop for 5 periods 30% voltage drop for 25 periods 95% voltage drop for 5 s	The quality of supply voltage should comply with that of a typical commercial or hospital environment. If the device is to continue functioning uninterruptedly in case of power interruptions, it is recommended that the device be operated via uninterrupted power supply or a battery.
Magnetic field at supply frequency (50/60 Hz) in accordance with IEC 61000-4-8	3 A/m	3 A/m	In supply frequency, the magnetic fields should comply with the values characteristic of locations in a typical commercial or hospital environment.
Conducted RF disturbances in accordance with IEC 61000-4-6	3 V rms 150 kHz to 80 MHz	3 V rms 150 kHz to 80 MHz	When operating portable or mobile RF communication devices (transmitters), a safety distance should be observed to all parts of the device, including cables, calculated on the basis of one of the following equations depending on the transmission frequency. Recommended safety distance: $d = 1.2\sqrt{P}$ 150 kHz to 80 MHz $d = 1.2\sqrt{P}$ 80 MHz to 800 MHz
Radiated RF disturbances in accordance with IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m 80 MHz to 2.5 GHz	

			d = $2.3\sqrt{P}$ 800 MHz to 2.5 GHz Whereby P is the maximum nominal output of the respective transmitter specified by the manufacturer in Watts (W), and d is the recommended safety distance in meters (m). The field strength of stationary RF transmitters, which is definable via electromagnetic site survey a, should be below the compliance level of the individual frequency ranges b. Disturbances are possible near devices which bear the symbol below. 
Note: These guide values may not apply to all situations. Spreading of electromagnetic waves is also influenced by absorption and reflection via buildings, items, persons, and animals.			
a. The field strength of stationary transmitters (e.g. base stations of mobile phones (mobile/cordless) and mobile land mobile radios, amateur radio stations, AM and FM radio, and TV transmitters), cannot be theoretically calculated in advance. To identify the electromagnetic environment with regard to stationary RF transmitters, an electromagnetic site survey should be considered. If the field strength identified at the location at which the device is used exceeds the RF compliance level specified above, the device should be closely observed. It may be necessary to take additional measures (e.g. changing the alignment or transposition of the device). b. Across the frequency range of 150 kHz to 80 MHz, the field strength should be less than 3 V/m.			

Recommended minimum distances between portable and mobile RF communication devices and the RO

The RO is intended for use in electromagnetic environments in which radiated RF disturbances are controlled. The buyer or user of the RO can help prevent electromagnetic interference by maintaining a minimum distance between portable/mobile RF communications equipment (transmitters) and the RO as recommended below, according to the maximum output power of the communications equipment

Max. output of the transmitter (W)	Minimum distance in accordance with the frequency of the transmitter (m)		
	150 kHz to 80 MHz $d=1.2\ \sqrt{P}$	80 MHz to 800 MHz $d=1.2\ \sqrt{P}$	800 MHz to 2.5 GHz $d=2.3\ \sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters with a maximum output not specified above, the recommended distance d in meters (m) can be calculated in accordance with the equation appropriate for the frequency of the transmitter, whereby P is the maximum output of the transmitter in Watts (W) in accordance with the specifications of the manufacturer.

NOTE 1:
For 80 MHz and 800 MHz, the safety distance applies for the higher frequency range.

NOTE 2:
These guide values may not apply to all situations. Spreading of electromagnetic waves is also influenced by absorption and reflection via buildings, items, and persons.