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"The function of education is to teach one to think intensively and to think critically."

Martin Luther King

Important information

Intended purpose and indications

The Aquarius™ System is indicated for continuous renal replacement therapies (CRRT) in patients with acute renal failure or fluid overload. The Aquarius™ System may also be used in Therapeutic Plasma Exchange (TPE) therapies and Hemoperfusion therapies.

The Aquarius™ System controls and monitors the extracorporeal blood circuit and the fluid balance circuit. The fluid balance circuit is defined as a filtrate/substitution system in hemofiltration, a filtrate/dialysate system in hemodialysis, a filtrate/dialysate-substitution system in hemodiafiltration, a plasma/substitution system in therapeutic plasma exchange, and a filtrate system only in slow continuous ultrafiltration. The fluid balance circuit is inactive in hemoperfusion. The fluid balance is controlled by pumps and scales.

Wastes and toxins are removed from the blood and the blood composition is corrected by means of filters and solutions, using filtration and/or adsorption in the extracorporeal circuit. The blood is then returned to the patient.

Details of treatment procedures are described in section "Proper usage/Treatment procedures" of the present Aquarius™ Instructions for Use (IFU).

All therapies using the Aquarius™ System must be prescribed by and performed under the responsibility of a physician who is familiar and well informed about continuous renal replacement therapies. The prescribed treatment must be performed by trained medical personnel in medical facilities.

The Aquarius™ System is intended to enable anticoagulation with heparin by using the integrated heparin syringe driver in all treatment procedures.

The use of the Aquarius™ System is limited to patients weighing a minimum of 20 kg and the extracorporeal blood volume, including tubing set and filter (in ml), should not exceed 10 % of the patient's blood volume.

Contraindications

No contraindications associated specifically to the Aquarius™ System are currently known when it is used according to indications.

General

All generally applicable side effects and contraindications for extracorporeal therapies must be observed. An extracorporeal treatment procedure with the Aquarius™ System should be performed after careful consideration of the risks and benefits by the responsible physician, in patients

- incapable to tolerate an extracorporeal treatment procedure because of their age and their physical development or their clinical condition,
- with known hypersensitivity to the substances used in the extracorporeal circuit,
- with severe anaemia,
- with hemorrhagic diathesis (bleeding tendencies),
- with coagulopathy (blood clotting disorders).

Disposables

The contraindications for the disposable medical devices/medicinal products used as accessories with the Aquarius™ System must be considered. It is essential to observe the Instructions for Use supplied with the medical device/medicinal product, as these contain updated information on areas of use, side effects, and contraindications for the respective disposable product.

Side Effects

No side effects associated specifically with the Aquarius™ System are currently known. General side effects associated to extracorporeal procedures are the following:

Stress from extracorporeal circuit

Non-specific side effects, such as tiredness, nausea, sweating, dizziness, headache, reduction in blood pressure, change in pulse rate, arrhythmia, shock, chills, fever, or bleeding.

Vascular access

Extracorporeal treatment procedures require vascular access mainly created by vein puncture. There is therefore a possibility that incorrect vein puncture may lead to haematoma, thrombosis, nerve injury, vasovegal reaction and/or inflammation of the vascular area.

Blood loss

Extracorporeal treatment procedures may result in blood loss caused by leaks from the circuit or clotting.

Circulatory complications

Extracorporeal treatment procedures may result in circulatory complications, such as hypertension and/or hypotension from temporary fluid displacement within or from the extracorporeal circuit.

Anaphylactic reaction

Extracorporeal treatment procedures may result in anaphylactic reaction from intolerance to the accessories, exchange fluid, dialysate solution, or anticoagulants. All Aquarius™ System consumables are Latex free.

Heparin anticoagulation

The heparin administration can lead to side effects. Bleeding, heparin induced thrombocytopenia and other general side effects associate with heparin must be considered.

Warnings

- Read all warnings (see in the Aquarius™ Instructions for Use), precautions and instructions carefully before use
- This symbol is used to draw attention to a "Warning". "Warnings" are used to alert the reader about a situation which, if not avoided, could result in death or serious injury



Disclaimers

- For complete instructions including warnings and precautions please refer to the Aquarius Instructions for Use Platinum Software Version 6 onwards. This booklet is not intended to replace the Instructions for Use.
- Settings shown in screenshots featured are for demonstration purposes only. They are not indicative of recommended programming parameters.

Introduction to Aquarius™ System

Lesson 1

Learning objectives

- To understand the set-up, priming and operation of the Aquarius™ System
- To understand pressure monitoring and alarm troubleshooting
- To understand the importance of Total Fluid Loss (TFL) Management and the Renal Dose display
- To complete the return portion of this training program in conjunction with local training initiatives



Aquarius™ System Design Concepts

- Patient safety
- Innovation
- Flexibility
- Ease of use
- Consistent messaging

The operator interfaces with the Aquarius™ System by turning and pushing the Main Selector button. This button is a rotary switch located below the display screen.
It is used to select and confirm different functions and to modify treatment parameters.



Main Selector button

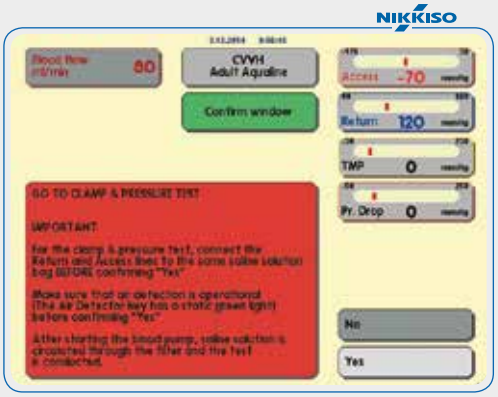
USING THE SELECTOR BUTTON:

Turn: to highlight the parameter
Push once: to select the parameter
Turn right: to ▲
Turn left: to ▼
Push once: to confirm new values

Notes

Navigating Between Screens

The operator moves between screens by selecting a parameter and confirming the choice: “Are you sure“ messages indicate that the operator will need to confirm this choice before moving forward. The default choice is “No”.

Next	Moves to the next screen	
Previous	Moves back to previous screen	
Yes	Confirms the selected choice	
No	Cancels the selected choice and moves back to previous screen	
Help	In the presence of an alarm the options for error removal are displayed in the ‘Help’ screen. ‘Help’ screens will provide detailed information about individual screens and allow direct access to ‘History’	

Notes

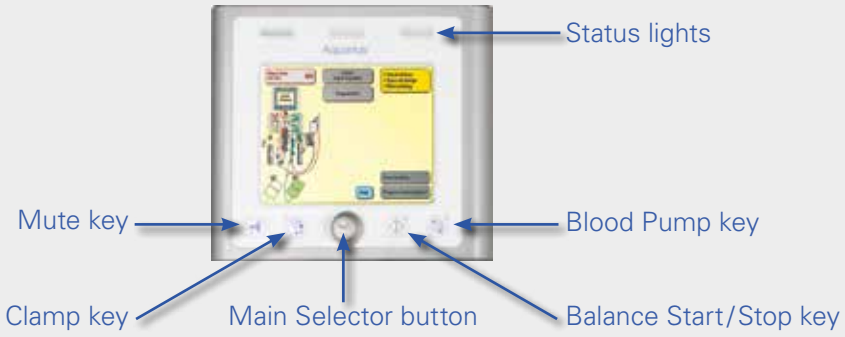
Consistent Messaging

The Aquarius™ System uses clear and consistent messaging, delivered in yellow or red message boxes, to inform and guide the operator through the screens.

Example

Messages in a yellow box may describe a set up instruction, a parameter that is being programmed or an alarm that reminds the user that something needs to be done.	Messages in a red box (without a green confirm window) may describe the alarm condition that is currently underway and needs the immediate attention of the user.	Messages in a red box accompanied by a green confirm window Confirm Window may indicate that a secondary confirmation of the selection is required and emphasise the importance of following the on-screen instructions.

Key functions of the Aquarius™ System user interface



Notes

Individual Function Keys

The individual function keys and their displayed functions are explained below.

1. Operation status display

Three status lights indicate the different operation modes.

Status lights			Operation Mode
		Steady	Warning! Alarm or system error
Steady	Flashing		Caution! Heater self-test is running Priming mode is not accessible
Steady	Steady		Caution! Treatment time has run down or Treatment was stopped Caution! Bag change required Caution! Heparin syringe is empty Caution! Aquarius™ System is in Preparation or Recirculation or Connection mode
Steady			Treatment is running. No alarms are active
	Steady		Caution during Preparation mode Caution during Recirculation mode Caution during Patient Connection mode
Flashing Alternatively			Machine is performing system test

Notes

2. Mute function key



Pressing the Mute key enables the operator to silence the alarm for a period of 2 minutes. The LED integrated into the Mute key changes from flashing to ON. If the cause of the alarm cannot be removed within the given period, the audible alarm is reactivated. If another alarm occurs during this period, an audible alarm will override the mute.
Having resolved the alarm "Check Degassing Chamber" pressing the Mute key will reset the alarm and clear it from the 'Treatment' screen display.

3. Clamp function key



Pressing the Clamp key opens the return line clamp during an "Air detected" alarm to allow removal of air bubbles from within the tubing set. The LED integrated into the key flashes.
When the air is removed, treatment may be resumed by pressing the Blood pump key. The return line clamp is automatically reactivated after 1 minute.
The red indicator on the return line clamp is illuminated when the clamp is closed and extinguished when the clamp is open. Also see 'Help' screen for step-by-step guide on how to resolve the alarm.

4. Main Selector button



The Main Selector button is a multi-function rotary button. These functions include:

a) Selecting function windows by turning the Main selector button
b) Confirming selected functions by pressing the Main selector button
c) Selecting input parameters by turning the Main selector button and having the corresponding parameter highlighted
d) Opening the input window for the selected parameter by pressing the Main selector button
e) Raising the parameter input for the selected parameter by turning the Main selector button to the right
f) Lowering the parameter input for the selected parameter by turning the Main selector button to the left
g) Confirming the entered parameter by pressing the Main selector button. The modified parameter is displayed on the screen

Notes

5. Balance Start / Stop function key (also called Treatment Start / Stop key)



Pressing the Balance Start/Stop key starts the selected treatment whilst maintaining the selected parameters as programmed by the operator.
Pressing the Balance Start/Stop key stops the filtrate and substitution pumps. This can be used to temporarily stop treatment, for example, to exchange bags.
If an alarm occurs in the filtrate and/or the substitution circuits, the pumps stop and the LED integrated into the key starts flashing. After correcting the cause of the alarm, the pumps may be restarted by pressing the Balance Start/Stop key. The treatment restarts with the parameters previously programmed by the operator.
When therapy is running and no filtrate or substitution alarm is active, the Balance Start/Stop key's indicator is green.
During pre- and post-treatment, the Balance Start/Stop key's indicator is extinguished.

6. Blood Pump function key



Pressing the Blood pump key starts or stops the flow of blood through the blood circuit. If the pumps are running, pressing the Blood pump key stops all pumps and the Blood pump indicator flashes. If an alarm occurs in the blood circuit, all pumps stop and the LED integrated in the Blood pump key starts flashing. After correcting the cause of the alarm, the alarm is cleared by pressing the Blood pump key. The system is restarted by pressing the Blood pump key again. The filtrate, pre-dilution and post-dilution pumps start after the blood pump.
The Blood pump key is also used to immediately stop all pumps in case of an unpredictable occurrence.

Notes

Preparing Aquarius™ System

Lesson 2

Learning objectives

- To understand the preparation and setting-up of the Aquarius™ System incl. anticoagulation, replacement and priming solutions.
- To understand the process of priming the Aquarius™ System, the significance of 'Clamp & Pressure test' and appropriate use of recirculation.
- To understand and demonstrate the programming of the Aquarius™ System to achieve a desired Renal Dose and appropriate fluid balance.



Power Supply

The Aquarius™ System has two power supply switches. The Main switch, on the left side of the machine should be set to position 1.
The ON/OFF soft key switch is on the right side of the monitor display screen.


Main Switch


ON/OFF Soft key

System Test

The system test takes approximately four minutes. When it is finished, an audible alarm is generated and the green and yellow status lights are illuminated. The pumps stop in the correct position for the tubing set to be installed. The operator can now proceed to select a therapy.
If the yellow status light is flashing (and the green status light is steady) after the system test is finished, the heater self-test is still running:

- Priming cannot be accessed
- The yellow message "Wait! Heater Self Test Running" will be displayed



! The Aquarius™ system test must be performed before lining the device. The pump doors must be closed and no replacement/dialysate or waste bags must be placed on the relevant scales.

Notes

Setting Up Aquarius™

1. Select the therapy to be used and confirm

- Slow Continuous Ultrafiltration (SCUF)
- Continuous Veno-Venous Hemofiltration (CVVH)
- Continuous Veno-Venous Hemodialysis (CVVHD)
- Continuous Veno-Venous Hemodiafiltration (CVVHDF)
- Hemoperfusion
- Therapeutic Plasma Exchange (TPE)



2. Select the type of Aqualine tubing set to be used and confirm

Aqualine tubing set for adult treatment
- Blood flow rates from 30-450 ml/min
- Extracorporeal volume 100 ml (drip chamber 2/3 full)

Aqualine for adult treatment

Aqualine S tubing set for pediatric treatment
- Blood flow rates from 10-200 ml/min
- Extracorporeal volume 61 ml (drip chamber 2/3 full)

Aqualine S for pediatric treatment



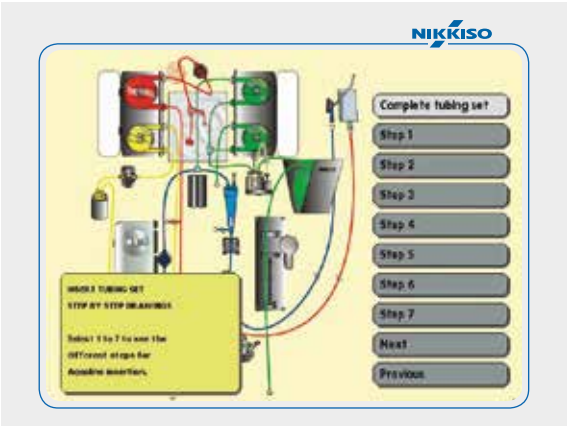




Notes

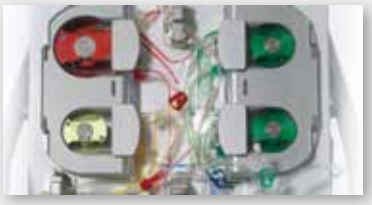
3. Place selected Aqualine tubing set on the Aquarius™ System

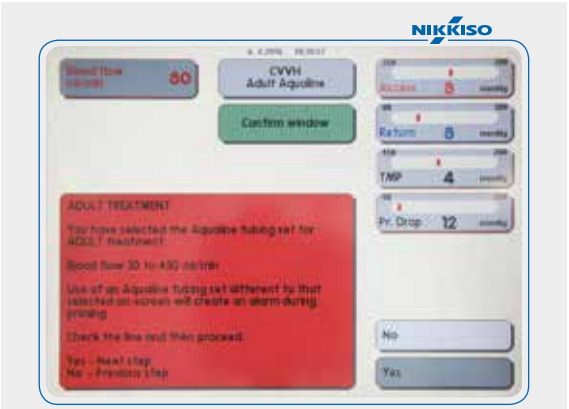
Follow the detailed instructions listed below to place the lines and filter on the machine.



NOTE:
Alternatively, step-by-step, on-screen instructions for the placement of the lines and filters can be accessed in the 'Zoom graphic' screens of the Aquarius™ System.

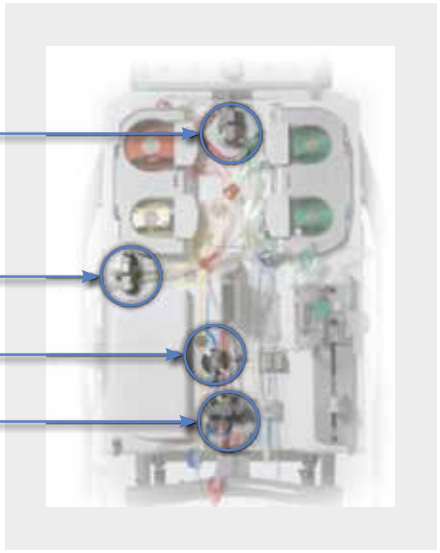
A. Place colored pump indicators in pumps.
The colored pump holder segments are always at the bottom of the pumps:

Blood pump (red): top left pump		Post-dilution pump (green): top right pump
Filtrate pump (yellow): bottom left pump		Pre-dilution / dialysate pump (green): bottom right pump



Notes

B. Attach the pressure domes securely/firmly to the four pressure sensors (Pre-filter, Filtrate, Return, Access) and close the dome/gate clamps.



C. Insert blood leak chamber into the blood leak detector on the left side of the Aquarius™ System (above the yellow scale).



D. Insert the heater coil into the fluid heater with the smooth side facing the machine/heater plate on the right side of the machine, above the green scale, close the door. Ensure the lines are not trapped or twisted under the heater door.



E. Place the Automatic Degassing Chamber into the holder of the Automatic Degassing Unit (ADU), under the green pumps. Ensure that the short tubing with the green clamp is positioned towards the back and the fixation plate/chamber cover is closed securely around the short tubing.

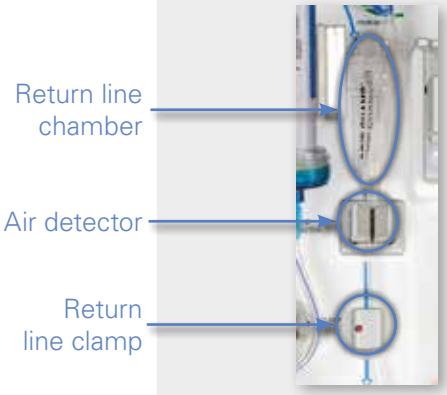
F. Attach the line with the Luer-lock, hydrophobic filter to the ADU sensor. The clamp should remain open.



If a "Check Degassing Chamber" alarm occurs during the first two minutes of priming post-dilution line and fluid is in the heater line, up to 120 ml of dialysate or substitution fluid may be pumped into the saline bag when the alarm is cleared and priming restarts.

Notes

G. Locate the return line chamber (also referred to as the 'drip chamber') on the Aqualine tubing set, then insert the line underneath it through air detector channel and line clamp. Push and lock the air detector.



H. Place prescribed hemofilter in filter holder and attach the red ISO connector of the tubing set to the red ISO connector of the filter.
Attach the blue ISO connector of the tubing set to the blue ISO connector of the filter.

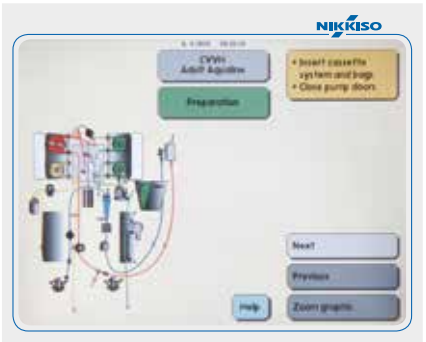


I. Attach filtrate line, short line from the blood leak chamber, to the clear Luer-lock filtrate port at the top of the filter.



J. Attach the clear free line from the pre-dilution/dialysate pump (bottom green pump) depending on the treatment required.





Notes

CVVH, SCUF, TPE or Hemoperfusion:
Attach free line from the bottom green pre-dilution pump to the access line prior to the filter.



Free line connection

CVVHD or CVVHDF:
Attach free line from the bottom green dialysate pump to the dialysate port at the bottom of the filter.



K. Hang empty prime collection bag on the IV pole located on the top right side of the Aquarius™ System.



L. Connect the red access line, long red line with red clamp on the Aqualine tubing set, to the bag.

M. Hang a one-litre bag of priming solution on the IV pole (usually heparinised saline). Insert the spiked Y-connector provided with the Aqualine tubing set into the priming solution bag.

N. Remove the blue capped spiked end from the Aqualine tubing set (return line) and connect the blue Luer-lock end to the Y-connector. If a Y-connector is not used, connect the spiked end of the return line to the priming solution.



NOTE:
The Aquarius™ System primes with a reverse flow through the blood circuit.

Notes

O. Hang empty filtrate bag/s on yellow filtrate scale and connect the filtrate line, long line from the blood leak chamber with yellow clamp, to the bag/s.



NOTE:
Ensure that an equal number of bags are used on the substitution/dialysate scale and the filtrate scale. Use empty 5-litre bags on the filtrate scale. Up to four bags of solution may be used at one time. If using more than one bag, a manifold will be required, i. e. an Aquaspike.

P. Hang prepared solution (substitution/dialysate) on green substitution scale and connect the substitution/dialysate line.



NOTE:
The Aquarius™ System uses a single solution source that is split by the machine and delivered as both dialysate and substitution solution, depending upon the therapy chosen. Up to four bags of solution may be used at one time. If using more than one bag, a manifold (Aquaspike) will be required. To ensure adequate, simultaneous emptying of multiple bags, all clamps must be open.

Important Warnings

Ensure that the filtrate bags and substitution bags do not touch the cart frame. Ensure that the tubing lines are not supported by and are not resting on the cart frame. Do not touch the filtrate or substitution solution bags while the balance system is active. Observe this warning to avoid patient fluid balance errors.



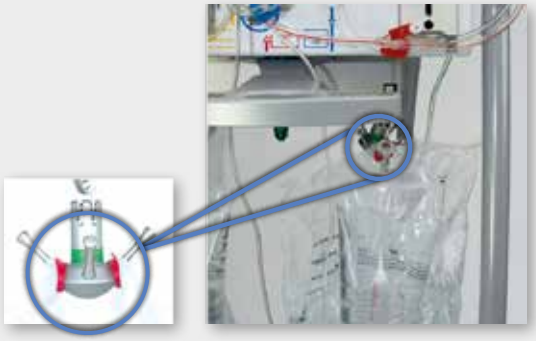
Fluid leaks lead to a patient fluid balance error and can harm the patient seriously. Ensure that all connectors are closed properly to prevent any potential fluid leak. Ensure that unused tubing lines of the 4-way connectors are properly clamped.

Notes

Hanging multiple bags

The Aquaspike is used to connect multiple bags to the tubing set, hanging up to 2 bags per hook.

- If using 3 bags, hang one bag per hook on the relevant scales.
- Ensure filtrate bags and substitution bags are not touching the cart frame.
- Ensure tubing lines are not supported by and are not resting on the cart frame.
- Utilise the line tidies on the ADU and integrated syringe driver.



4. Prepare heparin syringe

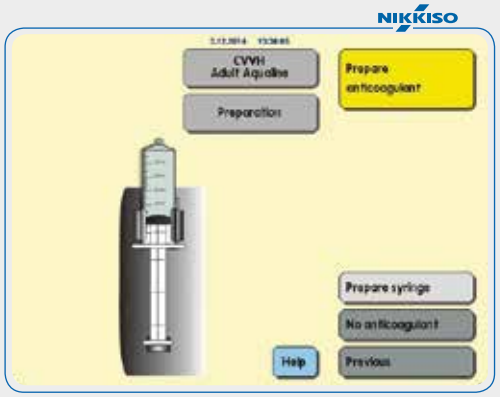
A. The Aquarius™ System requires a 50 ml or 60 ml syringe filled to a maximum of 50 ml.

Only use the heparin syringe type that the Aquarius™ System has been calibrated to use.

The Aquarius™ System must be calibrated for the particular type of syringe you are using by a certified technician. The syringe size is shown at the right of the 'Prepare syringe' screen.
The authorized syringes are:
1. Fresenius Injektomat Syringe 50 ml
2. Original Braun Perfusor Syringe 50 ml
3. Becton-Dickinson Plastipak 50 ml or 60 ml

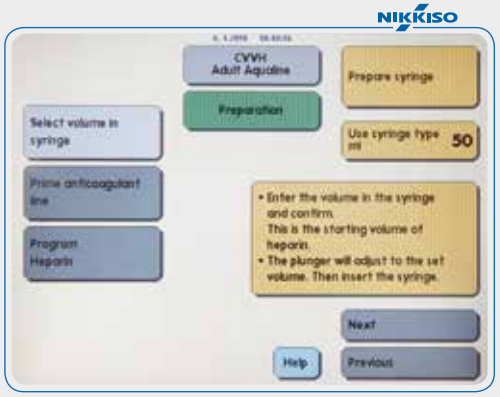
The syringe size that should be used is shown at the right of the 'Prepare syringe' screen.

When no heparin is used, the heparin line should be clamped and the cap replaced with a fully occlusive cap/bung.



Notes

B. Select the volume in the syringe and confirm. Wait until the syringe driver moves to the correct position and has stopped before loading the syringe.



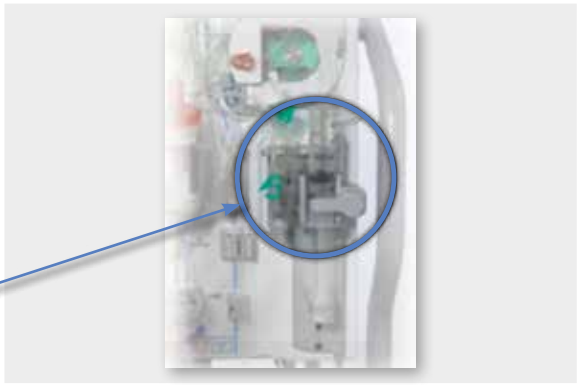
C. Attach syringe to the anticoagulant line.



D. Install syringe into syringe driver.

E. Prime heparin line by selecting and confirming "Prime anticoagulant line". Each press of the Selector button delivers 1 ml.

F. Program heparin infusion rate.



Use only Luer-lock syringes and ensure that the heparin line is not clamped prior to the start of heparin infusion. Use of non Luer-lock syringes or failing to unclamp the heparin line can result in patient blood loss due to coagulation.

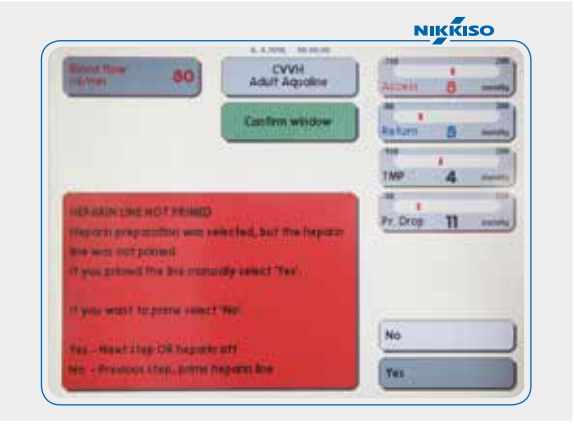
Notes

Programming rate

During treatment if the heparin rate is programmed to zero an additional message appears and informs the user that the heparin pump is programmed to zero during treatment. The message is just for information and does not need to be confirmed.



When heparin anticoagulant is selected, before priming, and the rate is programmed to zero, the following screen appears asking confirmation to the user.



Priming Aquarius

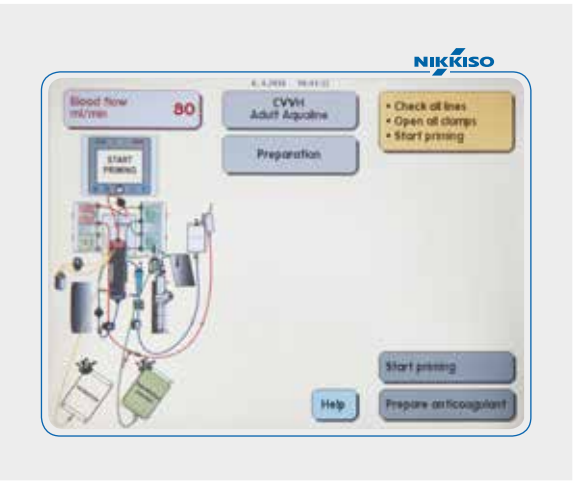
1. Select "Next" to go to Priming

A. Check all lines are securely connected and open all clamps.

When no heparin is used, the heparin line should be clamped and the cap replaced with a fully occlusive cap/bung.

B. Confirm that the correct solutions are used.

All solutions used must be sterile, of appropriate composition and prescribed by a physician. Use of incorrect solutions can result in patient injury or death.



Notes

2. Select “Start priming”

A. The automated priming procedure requires about 800 ml of saline and takes approximately 9 minutes. (The Aquarius™ System displays the message “Priming. Please wait” and the clock counts down to zero.)

B. The pre- and post-dilution lines are primed with fluid from the substitution/dialysate bag(s). The blood circuit and the filtrate lines are primed with fluid from the priming solution bag (usually heparinized normal saline).

NOTE:
If the message “Incorrect Aqualine type selected or clamp closed” or “Incorrect Aqualine type selected” appears within the first 2 minutes of priming this could be due to:
a) The tubing set is pinched in the air detector clamp
b) A clamp is closed on the substitution line or the substitution bag(s) are not open
c) The long and short seals are not broken
d) The lines are trapped under the heater door
e) An incorrect Aqualine has been installed on the Aquarius™ by the operator.

If an “Incorrect Aqualine type” confirm window appears and fluid is in the heater line, up to 120 ml of dialysate or substitution fluid may be pumped into the saline bag when “Yes” is selected to confirm the correct tubing set. When priming completes, replace the saline bag and reprime the blood circuit if the dialysate or substitution fluid is not indicated for infusion.

C. Lines being primed are highlighted and Access, Return and TMP pressures are displayed.



D. When priming is completed, you will hear an alarm and see the message “Priming completed” displayed on the screen.



Notes

E. If needed, the option to reprime is available to reprime sections or all of the circuit. Repriming may require additional priming solution and a new priming collection bag. Select "Reprime completed" to stop the automated reprime procedure.

F. If the priming procedure is satisfactory, select "Next" and confirm.



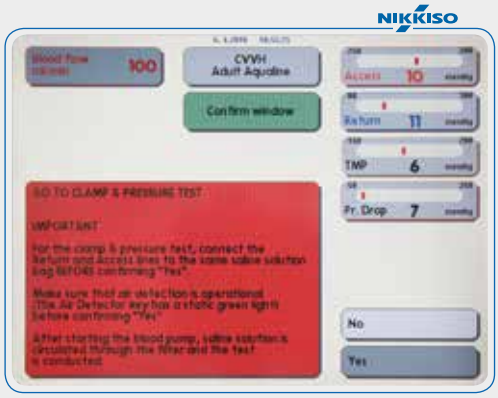
INFORMATION:
Priming the Aquarius™ System may be delayed due to high heater plate temperature from the previous treatment. The message "Wait! Heater Self Test Running" will be displayed until the "Start Priming" selection is available.

To prevent overfilling or rupturing of the priming collection bag, please ensure that the capacity of the priming collection bag is sufficient to allow a safe reprime or replace the priming collection bag with a new one.



Clamp and Pressure Test

- The 'Clamp & pressure test' checks the clamp, the air detector, and the access, return and pre-filter pressures.
- It MUST be successfully completed before you can proceed to Connection mode. Connect access and return lines to a bag of normal saline using the Y-connector provided as part of the Aqualine tubing set, or any other appropriate connector.
- The test takes just a few moments. If the test fails, follow the instructions displayed on the screen to determine the point of failure. Select "Help" for further assistance on troubleshooting the alarm before selecting "Retest".
- When 'Clamp & pressure test' is completed, the Aquarius™ System switches to Start connection mode.



Notes

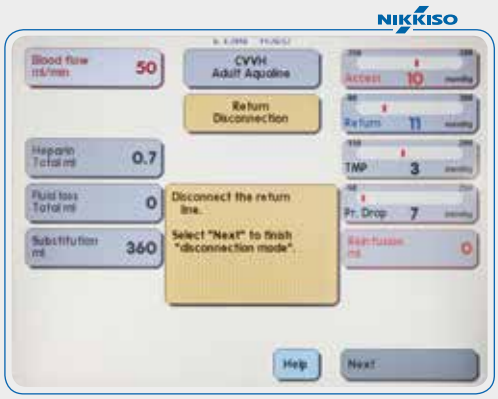
Recirculation prior to connection

- Recirculation mode can be entered immediately after 'Clamp & pressure test'.
- During Recirculation mode the blood pump will turn clockwise allowing saline to recirculate through the blood circuit.
- Recirculation of normal saline through the circuit prior to patient connection may facilitate the removal of air trapped in the circuit.
- Using Recirculation mode for 5 to 20 minutes prior to connection is considered to be adequate to saturate the filter fibres which may improve circuit life. Once 20 minutes has been reached, if treatment is delayed the Aquarius™ can be switched off using the soft ON/OFF switch on the right side of the screen.
- Recirculation may be continued through the blood circuit until connection is needed.
- Programming of prescribed parameters may be done during recirculation (recommended).
- Select "Go to programming" at any time during recirculation to enter treatment parameters.



Recirculation mode during treatment

- Recirculation can be entered during treatment by selecting "Options" and "Recirculation". The yellow information box displayed when Recirculation is selected prompts the user that this is a temporary disconnection procedure which allows for the same circuit to be used.



Notes

Renal Dose

The **Renal Dose** is defined as the dose of treatment related to the patient's body weight, the blood flow rate and the pre- and post-dilution volumes, given in ml/kg/h.

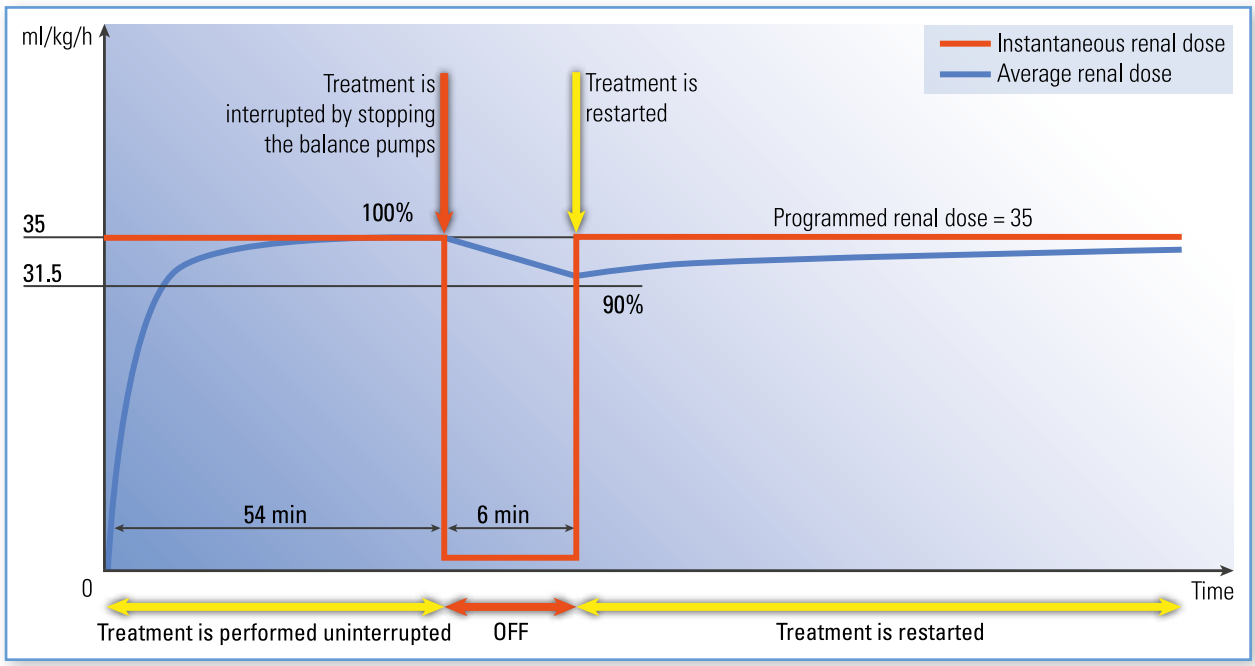
At the start of treatment or **after a programmed value change** for blood flow rate, pre-dilution flow rate, post-dilution flow rate, or patient body weight, the **programmed Renal Rose** is displayed for the first 2 minutes.

After 2 minutes of uninterrupted therapy, the actual delivered Renal Dose (time average) is displayed based on the actual pump rates.

Renal Dose at a given time instant:

$$\text{Renal Dose}\left(\frac{ml}{kg \times h}\right) = \frac{\text{Post-dilution flow rate}\left(\frac{ml}{h}\right) + \text{Fluid Loss rate}\left(\frac{ml}{h}\right) + \left[\frac{\text{Pre-dilution flow rate}\left(\frac{ml}{h}\right)}{1 + \left(\frac{\text{Pre-dilution flow rate}\left(\frac{ml}{h}\right)}{\text{Blood flow rate}\left(\frac{ml}{min}\right) \times 60}\right)}\right]}{\text{Patient weight (kg)}}$$

Effect of the treatment interruption on the average Renal Dose:



The actual Renal Dose is the time average of the previous formula.

Notes

- After the 'Clamp & Pressure test' it is possible to enter the patient body weight by selecting the "Patient Weight" window and modifying it.
- This data will be taken into account in the Renal Dose calculation for CCVH, CVVHD and CVVHDF therapy modes.
- Patient body weight can be changed at any time during the treatment if the Renal Dose is displayed by entering in the "Renal Dose" window.
- If the patient body weight is not entered at this time, the Renal Dose calculation will not display on the screen during treatment.



- The Renal Dose is displayed on the 'Treatment' screen ('Main' screen) in the upper left hand corner.

INFORMATION:
The purpose of displaying the delivered Renal Dose on the 'Main' screen is to show the treatment dose delivered vs. the programmed dose allowing the physician to adjust the programmed dose to achieve the desired treatment dose.



Programming Aquarius™

- All parameters are programmed in this screen.
- Each parameter shows a yellow screen that provides detailed information about the selected parameter only.
- Programming can be done after priming, during recirculation, or immediately before connection to the patient. Parameters may also be adjusted at any time during treatment.
- Select "Exit" to return to the 'Main' screen.
- Select "Go to connection" when ready to connect the patient.

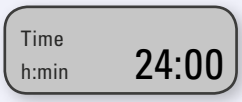
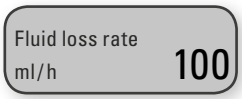
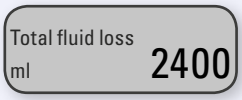
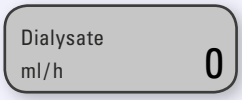
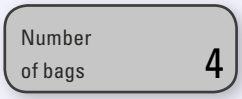
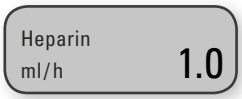


USING THE SELECTOR BUTTON:
Turn: to highlight the parameter
Push once: to select the parameter
Turn right: to ▲
Turn left: to ▼
Push once: to confirm new values

Notes

Programming Parameters

The parameters available include:

	This parameter is optional and may be left at 0:00 h:min during fluid loss programmes. When set, the Aquarius™ System will run for the indicated length of time and then displays the message "Therapy target achieved by time". The operator may now program more time to continue the treatment or move to the disconnection phase.
	Enter the amount of fluid that is prescribed for the patient to lose per hour.
	Enter the amount of fluid to be removed. After this goal is achieved, the Aquarius™ System will display the message "Therapy target achieved by fluid loss". If there is a fluid loss rate set, then this value must be programmed.
	Available in CVVH and CVVHDF modes only, this is the amount of fluid that will be delivered after the filter.
	Available in CVVHD and CVVHDF modes only, this is the amount of fluid that will be delivered as dialysate.
	Available in CVVH mode only, this is the amount of fluid that will be delivered before the filter.
	The number of bags hanging from the substitution/dialysate scale. An equal number of empty 5 l bags must also be hung on the filtrate scale.
	This is the infusion rate from the integrated heparin syringe pump in ml/h.
	If a bolus of heparin is prescribed, enter it here for immediate administration when in Treatment mode.
	When set at zero, the fluid warmer will be off. It is adjustable from 35 °C to 39 °C. The warmer heats both substitution and dialysate fluid. The temperature (°C) displayed in the 'More' screen corresponds to the calculated temperature of the fluid inside the ADU chamber.
	 DO NOT rely on the temperature displayed as a basis for clinical assessment of hypothermia or hyperthermia. The Aquarius™ System is not designed to monitor the patient's body temperature. The patient body temperature should be closely monitored to detect potential patient hypothermia or hyperthermia.
	 DO NOT rely on the temperature displayed on the 'More' screen as a basis for clinical assessment of hypothermia or hyperthermia. The accuracy of the calculated substitution fluid temperature displayed on the 'More' screen is affected by the ambient temperature.

Notes

Connection Mode

Select Single Connection or Double Connection and follow the instructions on the screen.



Single Connection

Only the access line is attached to the patient's access port, initially, and the blood pump is started to discard the saline from the circuit, up to the air detector. A blood sensor, located inside the air detector, will automatically stop the pump.

Double Connection

Both access and return lines are simultaneously attached to the patient's access and return ports.

During the blood prime, blood starts filling the circuit up to the air detector. Once blood is detected, the machine will display the 'Treatment/home' screen. It is recommended to increase the blood pump speed to the minimum pump speed for the programmed treatment before starting the treatment pumps.

Aquarius™ Fluid Balance

- Values are programmed in the 'Programming' screen.
- Dialysate and/or substitution fluid are automatically removed by the Aquarius™ System.
- When programming 'Hourly patient fluid loss', a 'Total fluid loss' MUST also be programmed.
- Treatment proceeds until a programmed target is achieved.

NOTE:
The Aquarius™ System records all fluids as a cumulative number from the start of treatment.

NOTE:
When the target is reached, the message "Therapy target achieved by fluid loss" or "Therapy target achieved by time" is displayed. The target can be reprogrammed and the treatment continued.



- Programmed patient fluid removal will be recorded hourly on the 'Treatment' screen as a cumulative value.
- Non-Aquarius patient fluid intakes and outputs must be calculated and controlled by the operator.
- Ultrafiltration (UF) variation is monitored and displayed in the 'More' screen.
- 'Reset totals' in the 'Programming' screen resets all cumulative totals for fluid loss, and dialysate and substitution fluid. Treatment clocks are also reset. These values are located on the 'Treatment' screen.

NOTE: Heparin volumes are NOT reset.

Notes

Notes

Treatment Mode

Lesson 3

Learning objectives

- To understand the observation and monitoring of the patients during treatment with Aquarius™ System.
- To demonstrate and understand the use of recirculation during treatment.
- To understand the change within the extracorporeal circuit leading to the end of treatment.
- To understand and perform appropriate reinfusion of patient blood and safe disposal of the Aquaset.
- To prepare Aquarius™ System for a new treatment.

Treatment Mode

The 'Treatment' screen displays pertinent information and allows the operator to monitor several parameters throughout the therapy:

- Blood flow
- Renal Dose
- Cumulative totals of fluid loss and substitution/dialysate since last total reset (heparin is not reset)
- Pressures (Access, Return, TMP and Pressure Drop)

  (See detailed information on Pressures in Module 2 I Lesson 4)



Reset totals

Screen selection choices:

Go to programming

Allows the operator to return to the 'Programming' screen any time during treatment to change parameters.

More

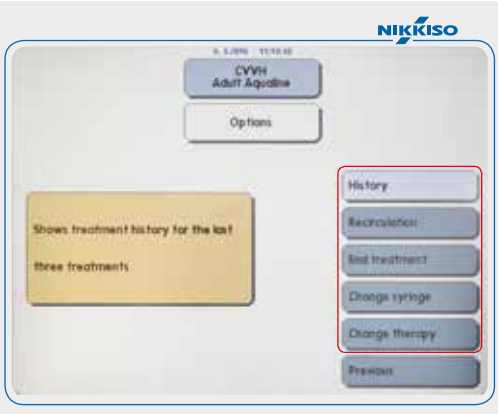
Allows the operator to view additional treatment information, with no ability to make changes.



Options

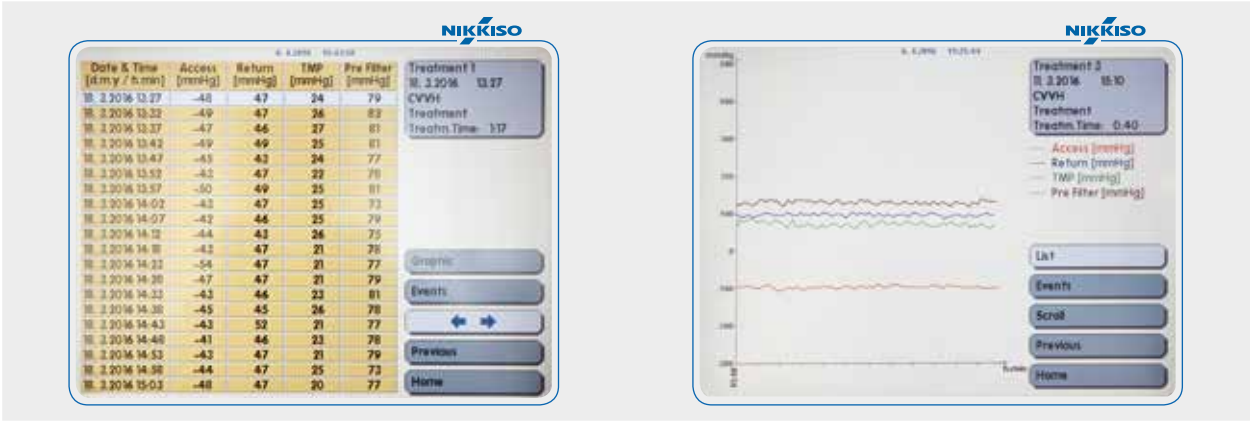
Provides the following options:

- View history
- Go to recirculation
- End treatment
- Change syringe
- Change therapy



Notes

The history of the last three treatments is available. Data is visible as a list or a graph. Pressures, programmed parameters, patient data and events (errors) are stored at 5-minute intervals



Disconnecting Patient from Aquarius™

The patient may be disconnected from the Aquarius™ System by selecting and confirming "Recirculation" or "End treatment" from the 'Options' screen.

- Disconnecting the patient from the 'Recirculation' screen allows temporary disconnection for a limited period of time. The filter, lines, bags and solutions all remain on the machine and the blood pump runs in Recirculation mode until the patient is ready to be reconnected to the same circuit.
- Disconnecting the patient from the 'End treatment' screen will mean the patient treatment will end. The filter, lines, bags and all solutions must be removed from the machine and the Aquarius™ System must be turned off. A new set up will be needed if the patient therapy is to be continued.

In the event of clotting in the filter or in other parts of the extracorporeal circuit, the "High pre-filter pressure" alarm, "High TMP" alarm and "High return pressure" alarm will not permit the reinfusion of blood to the patient. In this case, do not remove pressure domes from the pressure sensors without first reducing the pressure level inside the tubing set to below 100 mmHg.

NOTE: The following supplies may be needed:

1. One bag of normal saline for returning blood back to patient
2. Three-way tap and a spike or a Y-connector
3. Two saline syringes and the prescribed heparin to lock the vascular catheter in accordance with your facility's protocol
4. Caps for the vascular catheter

Always follow hospital policy for standard precautions. Gloves, mask and a face shield should be worn when connecting or disconnecting blood lines from patients and removing lines from the Aquarius™ System.

Notes

Recirculation Mode for Temporary Disconnection

- Go to the 'Options' screen and select

  Recirculation

- This option starts the temporary disconnection of the patient. The screen menu guides the operator through the disconnection procedure.
- On-screen directions guide the operator through the access and return disconnection process.
- Volume of reinfusion fluid is displayed on the 'Main' screen.
- All treatment parameters remain active and are stored in 'History'

! In case of emergency, the recirculation procedure can be used until the patient can be properly assessed.



End Treatment Mode

- Before ending treatment, please record all pertinent data from the 'Treatment' screen.
- To end the treatment and disconnect the patient from the Aquarius™ System, go to the 'Options' screen and select

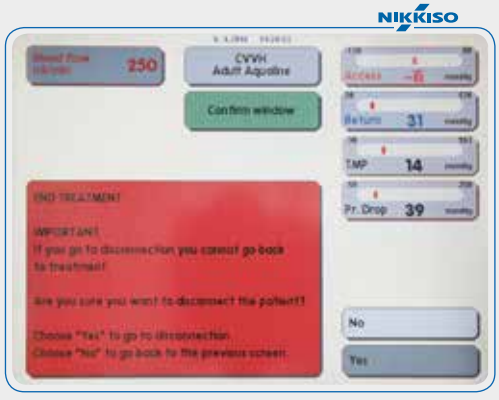
  End treatment

! REMINDER: Once you confirm the "End treatment" selection, it is not possible to go back to treatment.



- Follow instructions on the screens to disconnect the patient from the Aquarius™ System
- The volume of fluid used to return blood to the patient will be recorded on the disconnection screens as the reinfusion volume in millilitres.

  Reinfusion ml 21



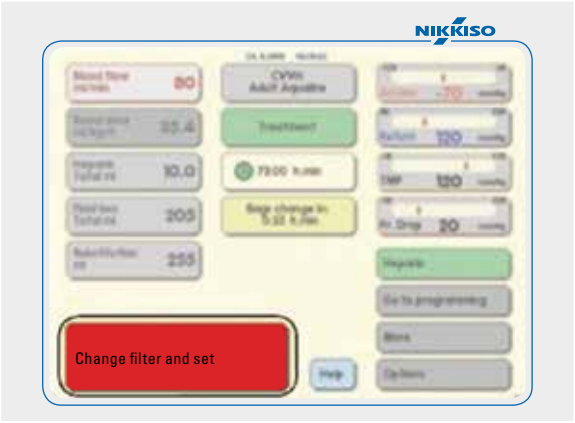
Notes

Treatment time messages

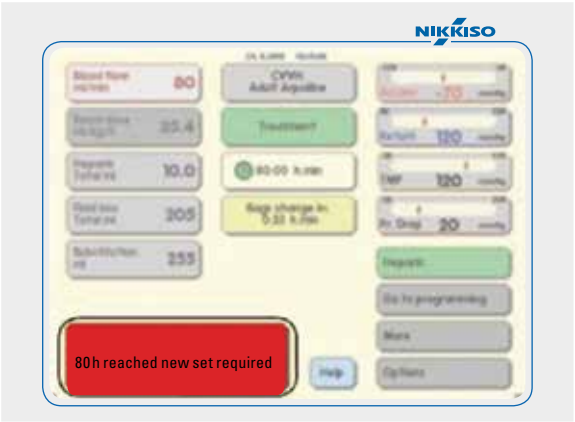
NOTE:
A yellow message is displayed notifying the operator that the machine has been running for **24 hours (recirculation included). The message disappears when the reset button is pressed.**



NOTE:
A red message "Change filter and set" is displayed notifying the operator that the machine has been running for **72 hours (recirculation included). The message cannot be reset and stays on for 8 hours.**



NOTE:
An alarm "80 h reached: new set required" is displayed notifying the operator that the treatment will end if the machine has been running for **80 hours (recirculation included). At that time the lines and filter need to be disconnected and replaced by new ones.**



Notes

Safe Line Removal

After the disconnection, check that all four pressure levels (filtrate, pre-filter, access, and return pressures) are below **400 mmHg** before removing the pressure domes as there may be a risk of the pressure dome membrane bursting if the pressure is still too high.

If necessary, a 50 ml syringe or an **Aquasafe** bag can be used to decrease the pressure.

! Never switch off the Aquarius™ System before complete removal of the Aqualine tubing set, in order to allow pressure monitoring during treatment termination.



Safe Removal of the Aqualine Tubing Set

1. Ensure that the Access and Return lines are connected to the saline bag and all clamps are open.
2. Place the saline bag in a disposal container in front of the machine.
3. Ensure that the filtrate and the substitution or dialysate lines are still connected to the corresponding filtrate and substitution or dialysate bags and that both lines are **unclamped**.
4. Remove the return line from the air detector and clamp.
5. Remove the pump tubing segments from the pumps in the following order:
   a. Filtrate pump (yellow) – in direction of arrow.
   b. Pre-dilution or dialysate pump (green) – in opposite direction of arrow.
   c. Post-dilution pump (green) – in opposite direction of arrow.
   d. Blood pump (red) – in opposite direction of arrow.
6. Check if pressures are below **400 mmHg** (100 mmHg if circuit clotted).

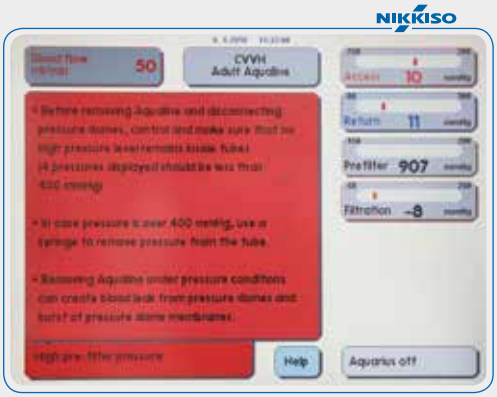
If not all pressures are below 400 mmHg (100 mmHg if circuit clotted), refer to the instructions to decrease pressure level (Page 41). Otherwise continue as follows:

7. Disconnect the bags as follows:
   a. Clamp the access and return line and disconnect the saline solution bag.
   b. Clamp the filtrate line and disconnect the filtrate bag(s).
   c. Clamp the substitution or dialysate line and disconnect the substitution or dialysate bag(s).
8. Disconnect the hydrophobic connector line of the degassing chamber from the ADU unit.
9. Remove the heater coil line spiral from the heating unit.
10. Remove the blood leak detector pot.
11. Remove all the pressure domes from the transducers.
12. Remove the filter from the holder and discard complete **Aqualine** set into disposal container.
13. When the **Aqualine** tubing set is completely removed from the Aquarius™ System, "Aquarius off" can be confirmed by pressing the Main selector button to switch the **Aquarius** off. Select and confirm "Aquarius off" or press the ON/OFF key located on the right side of the display screen, then the Aquarius™ System will shut down.

Notes

If One of the Pressures is Above 400 mmHg

A 'Warning' Screen will be displayed if at least one of the four pressures (filtrate, pre-filter, access, and return) is above **400 mmHg**.



Step 1: Prepare an empty 50 ml syringe or an Aquasafe.

In case of high pre-filter pressure:

Step 2: Close the red clamp on the pre-dilution line (A).

Step 3: Connect an empty syringe or Aquasafe to the pre-dilution access port (A) and open the line clamp.

In case of high return pressure:

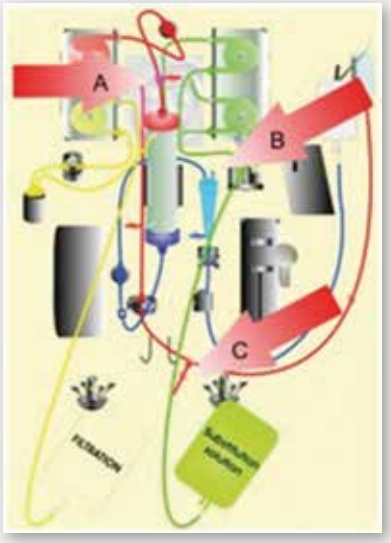
Step 2: Close the blue clamp on the short tubing on the drip chamber (B).

Step 3: Connect an empty syringe or Aquasafe to the Luer-lock connector fitting on the drip chamber (B) and open the line clamp.

In case of high access pressure:

Step 2: Close the red clamp on the access port line (C).

Step 3: Connect an empty syringe or Aquasafe to the access port (C) and open the line clamp.



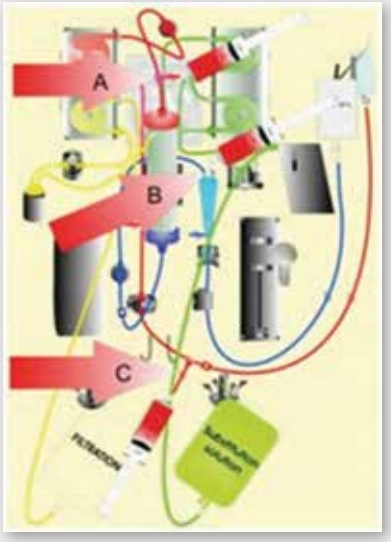
Notes

Step 4: Fill the syringe(s) or Aquasafe bag(s) with fluid until the pressures value displayed on the screen is below 400 mmHg.

If any pressure is above 400 mmHg, go back to Step 2 and reduce it to a level below 400 mmHg.

Never switch the Aquarius™ System off before complete removal of the Aqualine tubing set.

Remove the Aqualine tubing set and bags from the Aquarius™ System.



Safe line removal in case of clotting

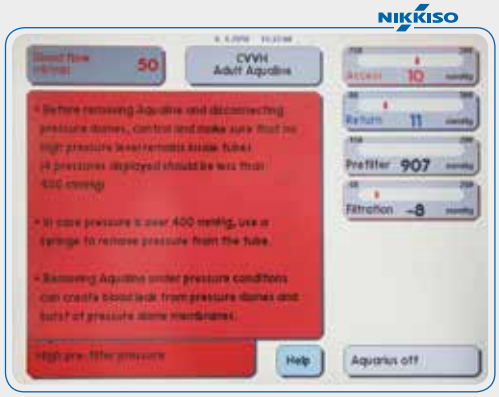
In the event of **clotting in the filter** (or in other parts of the extracorporeal circuit), the "High pre-filter pressure" alarm, "High TMP" alarm and "High return pressure" alarm will not permit the reinfusion of blood to the patient.

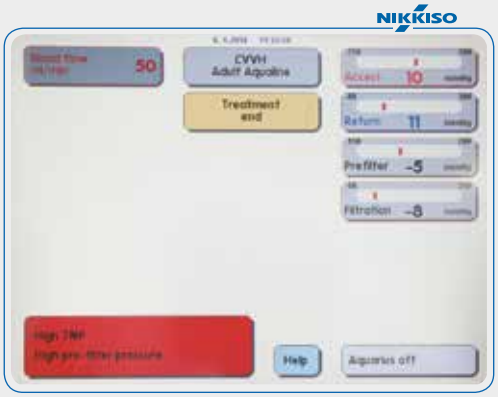
In this case do not remove Aqualine tubing pressure domes from the Aquarius™ System pressure sensors, without first reducing (**below 100 mmHg** for this procedure) the pressure level inside the tubing set.

If the above warnings are not followed, the risk of the pre-filter pressure dome bursting and the operator being contaminated with biological fluid increases.

Aquarius off

is highlighted. Push the **Main selector** button to turn the Aquarius™ System off.





Notes

Notes

Pressure Monitoring, Alarms & Troubleshooting

Lesson 4

Learning objectives

- To understand the common reasons for most typical pressure alarms and their troubleshooting.
- To demonstrate and understand the clinical significance of fluid balance and the operation of TFL.

Aquarius™ Pressure Monitoring

All extracorporeal circuits are run by pressures. The Aquarius™ System uses four pressure readings to monitor and control the system. Three pressures (Access, Return and Pre-filter) monitor the blood side and one pressure (Filtrate) monitors the fluid side. All four pressures are used in combination to help you manage the treatment safely and effectively. Aquarius™ system pressures are upgraded from Version 6.02.09 and later.

Access pressure

- Access pressure is usually negative and is generated to remove blood from the patient.
- Access pressure may be positive under certain conditions.
- The patient's catheter and Aquarius' blood flow rates affect this pressure.
- Measuring range:
  -250 to +350 mmHg, step 1 mmHg
- Upper alarm limit:
  automatic setting between -50 and +350 mmHg
- Lower alarm limit:
  automatic setting between -250 and 0 mmHg
- Alarm window size during treatment:
  +/- 100 mmHg around the actual value
- Displayed on the 'Treatment' screen.



Return pressure

- Monitors the positive pressure generated to return the blood to the patient.
- The patient's catheter and Aquarius' blood flow rates affect this pressure.
- Return line kinks or occlusions affect this pressure (for example, the line is pinched between the bed rail and the bed).
- Clotting in circuit affects this pressure.
- Measuring range:
  -80 to +350 mmHg, step 1 mmHg
- Upper alarm limit:
  automatic setting between 120 and 350 mmHg
- Lower alarm limit:
  automatic setting between 20 and 200 mmHg
- Alarm window size during treatment: 100 mmHg
- Displayed on the 'Treatment' screen.



Notes

Pre-filter pressure

- Monitors the positive pressure generated in the circuit immediately before the blood enters the hemofilter.
- Blood flow rate and return pressure affect this pressure.
- Highest pressure point in the circuit.
- A rising pre-filter pressure may be indicative of filter clogging.
- Measuring range:
  -500 to +800 mmHg, step 2 mmHg
- Upper alarm limit: +450 mmHg
- Lower alarm limit: -100 mmHg
- Displayed on the 'More' screen.



Filtrate pressure

- Monitors the negative and/or positive pressure generated in the filtrate compartment of the hemofilter. This affects the movement of fluid across the membrane.
- A rising filtrate pressure may be indicative of filter clogging.
- Blood flow rates and fluid flow rates affect this pressure.
- Measuring range:
  -400 to +800 mmHg, step 2 mmHg
- Upper alarm limit: +450 mmHg
- Lower alarm limit: -400 mmHg
- Displayed on the 'More' screen.



Notes

TMP (Transmembrane pressure)

- Calculated using Return, Pre-filter and Filtrate pressures.
- Calculated as:

$$TMP = \frac{\text{Return Pressure + Pre-filter Pressure}}{2} - \text{Filtrate Pressure}$$

- TMP is a combination of the total pressure exerted on the membrane (positive pressure inside the fibres and negative pressure outside the fibres).
- Measuring range:
  -50 to +450 mmHg, step 1 mmHg
- Upper alarm limit:
  automatic setting between +30 and +400 mmHg (CVVH, CVVHD, CVVHDF, SCUF)
- Upper alarm limit:
  automatic setting between +30 and +100 mmHg (TPE)
- Lower alarm limit: -30 mmHg



INFORMATION:
The TMP value displayed in hemoperfusion therapy is not transmembrane pressure. It is the pressure inside the cartridge. The hemoperfusion principle is based on adsorption. The cartridge does not have a membrane. TMP does not exist for hemoperfusion therapy.

Pr. Drop (Pressure drop)

- Calculated using pressure loss from top to bottom of hemofilter.
- Length of hemofilter affects pressure.
- Calculated as:

Pr. Drop = Pre-filter Pressure - Return Pressure + 35
(35 is the offset value. It is the distance between the pre-filter and the return sensors in cm divided by 1.3)

- Working range:
  +5 mmHg to +250 mmHg, step 1 mmHg
- Displayed on the 'Treatment' screen.



Notes

Aquarius™ Alarms

The Aquarius™ System Safety mode is determined by the nature of occurring alarms:

Alarm type	Aquarius™ System Safety mode
Alarms in blood circuit	• Visual and audible signals will be generated • All pumps will stop • LEDs in Blood Pump and Balance Start/Stop keys flash • The return line clamp will close if air or micro-foam is detected or the return pressure drops below the lower alarm limit
Alarms in filtrate/ dialysate circuit	• Visual and audible signals will be generated • The filtrate, pre-dilution and post-dilution pumps will stop • LED in Balance Start/Stop key flashes
System error	• Visual and audible signals will be generated • All pumps will stop • The return line clamp will close if air or micro-foam is detected or the return pressure drops below the lower alarm limit

- Alarm signals are audible and visual.
- The status lights change from green to red, yellow, or a combination depending on the type of alarm.
- Cause of the alarm is displayed in a message box in the lower left corner of the screen.
- Alarms may be silenced for two minutes by pressing the Mute key.
- Blood circuit alarms are cleared by pressing the Blood Pump key. Once the blood pump has been restarted, press the Balance Start/Stop key to restart the fluid pumps.
- Fluid circuit alarms are cleared by pressing the Balance Start/Stop key.

Notes

Ultrafiltration variation

- The variation of the measured patient fluid loss versus the programmed target is displayed in the ‘More’ screen.
- The ultrafiltration variation is calculated as follows:

UF variation =
Expected Fluid Loss - (Fluid Volume OUT - Fluid Volume IN)



Notes

Balance alarm

- A UF variation greater than ±50 g (**Aqualine** tubing, regular) and ±20 g (**Aqualine S** tubing, pediatric) will cause a balance alarm.
- All the treatment pumps will stop and a yellow message appears displaying the number of balance alarms.
- The cause of the balance alarm needs to be resolved.
- When the pumps are reactivated by pressing the Balance Start/Stop key, the volume discrepancies are automatically compensated for by the system.



Types of Balance Alarms

On the Aquarius™ System we have two types of balance alarms:

- Balance alarms are **counted** by the counter on the 'Main' screen (yellow box) when the actual patient fluid loss deviates from the expected fluid loss.
- The patient's fluid balance deviates more than 50 g in adult treatment (or 20 g in pediatric treatment) for **more than 15 seconds** and the deviation is **less than 120 g.**

or

- The deviation could not be compensated during TFL. (If the cause is not solved by the user, the balance alarm is repeated).



- Balance alarms are **not counted** when the patient fluid balance is not impacted and the UF variation is given either by a manipulation error or a device defect:
  - **UF variation >120 g for 15 seconds:**
    manipulation of bags or scales while the balance system is active
  - **CPU 2 Balance alarms:**
    system error

Notes

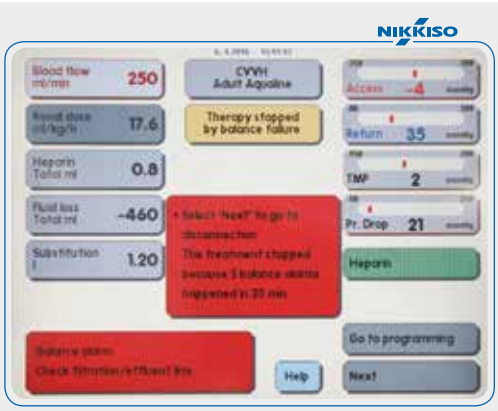
Total Fluid Loss (TFL) Management

TFL management is a function of the Aquarius™ System that automatically compensates for ultrafiltration (UF) variations that generate a COUNTED balance alarm.

- During **TFL compensation the yellow message** "Balance initialising..." is displayed and the yellow indication light is on and either the filtrate or the substitution/dialysate pumps will begin to turn.
- When a "Balance" alarm is detected, a yellow message appears displaying the number of balance alarms during a 20 minute period.



- **If within 20 minutes 5 balance alarms are detected, a red message appears warning the operator that the treatment has stopped. Only the blood pump continues.**
- At this time select "Next", to go to Disconnection mode.
- To continue treatment after disconnection, a new set of disposables must be used.



- Balance alarms are **not counted** when the patient fluid balance is not impacted and the UF variation is given either by a manipulation error or a device defect:
  - **UF variation > 120 g for 15 seconds:**
    manipulation of bags or scales while the balance system is active
  - **CPU 2 Balance alarms:**
    system error

NOTE:
The balance alarm count will reset to zero only after the Aquarius™ System has operated for 20 minutes continuously without stopping the pumps. An alarm that stops the balancing system or the operator manually stopping the balancing system will re-start the 20-minute period.

Notes

How the software works, with resolution of the error, during the TFL compensation

- **If UF variation ABOVE +50 ml (+20 ml pediatric patients) and problem resolved**
  The filtration pump will start first to compensate until the UF variation will reach +35 ml for an adult (and +5 ml for pediatric patients).
- **If UF variation BELOW -50 ml (- 20 ml pediatric patients) and problem resolved**
  The substitution pumps will start first to compensate until the UF variation will reach -35 ml for an adult (and -5 ml for pediatric patients).
- If the user **does not solve the problem** and then resets the alarm and restarts the treatment.
  Only the pump causing the balance alarm (the filtrate pump) will start running. The other pumps will not start and **a balance alarm occurs again.**

Heater cool down management

- The heater is used to warm the substitution fluid before it is given to the patient.

INFORMATION:
Due to safeguards designed into the system, the temperature of the fluid infused into the blood and/or dialysate circuit is less than 41 °C.

- Heater cool down management is a function of the Aquarius™ System to avoid the infusion of high temperature substitution/dialysate fluid to the patient. Heater cool down may take **up to 10 minutes.**
- Substitution pumps will then run at a slow rate to help cool down of the fluid.
- **Both active and passive heater cool down** are present in the Aquarius™ System.



NOTE:
Heater cool down management is not used in:
- SCUF and hemoperfusion as there are NO replacement fluids
- TPE - Plate temperature is set to the programmed temperature

Notes

Heater management in CVVH, CVVHD and CVVHDF

Cause	Message	Function
Either one or both of the following: • Plate temperature is higher than 43 °C and the balance pumps are stopped for more than 15 seconds • Temperature displayed on the 'More' screen is higher than 40 °C	"Heater cools down..."	**Active (Default option)** • Substitution/dialysate and filtration pumps will run at a slow rate to help cooling • The pumps will **restart automatically at the programmed rate** **Passive (During TFL compensation)** • Substitution and filtration pumps DO NOT run • TFL compensation will wait until passive heater cool down is completed • Once completed, TFL compensation will start

Notes

Troubleshooting System Errors, Alarms and Messages

System Errors: Red indication

During the system test (after switching the system on) and also during operation, the Aquarius™ System automatically performs tests to check the safety-critical components. If errors occur during these tests, the system switches to the Safety mode and generates a red system error message as well as an audible alarm. **This error message appears with the abbreviation CPU1 (control processor unit 1) or CPU2.**

If the following system errors cannot be corrected, please call technical service.



If there are errors during the initial functional system test, the Aquarius™ System must not be used. Refer to on-screen help and repeat. Notify technical service if the system test continues to fail on the same error

Display:	Cause:	Test Frequency:
CPU1: error1 CPU	Master CPU Register test failed	Initial self-test
CPU1: error2 CPU	Master CPU RAM test failed	Initial self-test
CPU1: error3 CPU	Master CPU jump test failed	Initial self-test
CPU1: XRAM	Master CPU extern RAM failed	Initial self-test
CPU1: CODE	Master CPU program code test failed	Initial self-test
CPU1: EEPROM	Master CPU calibration data test failed	Initial self-test
CPU2: error1 CPU	Controller CPU Register test failed	Initial self-test
CPU2: error2 CPU	Controller CPU RAM test failed	Initial self-test
CPU2: error3 CPU	Controller CPU jump test failed	Initial self-test
CPU2: XRAM	Controller CPU external RAM test failed	Initial self-test
CPU2: CODE	Controller CPU program code test failed	Initial self-test
CPU2: EEPROM	Controller CPU calibration data test failed	Initial self-test
CPU1: program run	Program failure Master CPU	Initial self-test
CPU2: program run	Program failure Controller CPU	Initial self-test
CPU1: ADC/Voltage CPU2	Voltage supply or AD-converter failure	< 2 s^{-1}
CPU1: sensor voltage	Voltage supply or AD-converter failure	< 2 s^{-1}
CPU1: ADC/Voltage CPU2	Voltage supply or AD-converter failure	< 2 s^{-1}
CPU2: balance alarm	Controller CPU balance alarm	< 1 s^{-1}

Notes

Display:	Cause:	Options for error removal:	Test Frequency:
Access sensor	• Access pressure sensor values deviate from limits. • During clamp and pressure test no pressure increase is detected.	After system test: ✓ Ensure that no tubing is on the machine during the system test. ✓ Repeat the system test. If it fails again, call technical service. During pressure and clamp test: ✓ Ensure the access dome is positioned properly. ✓ Press the Blood pump key to reset the alarm and to continue the pressure and clamp test.	Continuous: < 2 s^{-1}
ADC/Voltage	• Voltage supply or AD- converter failure – the master CPU detects high or low voltage at the power supply for the controller-CPU.	✓ End the treatment and call technical service.	Continuous: < 2 s^{-1}
Air detector	• Air detector test failed. • Master-CPU and controller-CPU have different information regarding air alarm.	✓ Repeat the system test. If it fails again, call technical service. ✓ Press Blood pump key. If error cannot be reset, put system out of operation and notify technical service.	Continuous: <1 s^{-1} (Master) <3 s^{-1} (Protection)
Backup	• No dates at the backup.	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test
Balance filtration	• Check filtration scale. • Values between protective and control system deviate from each other (outside the limits). • Actual values are outside the limits.	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test
Balance substitution	• Check substitution scale. • Values between protective and control system deviate from each other (outside the limits). • Actual values are outside the limits.	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test
BLD	• Blood leak detector (BLD) does not work properly.	✓ Press the Blood pump key. If the system error cannot be reset, put system out of operation and notify technical service.	Continuous: < 5 s^{-1}

Notes

Display:	Cause:	Options for error removal:	Test Frequency:
Blood pump	• Flow rate test failed. • Blood pump drive is defective. • Blood pump did not stop. • Actual value of number of revolutions deviates from set value outside the limits.	✓ Ensure the pump door is closed. ✓ Switch system off and on again after approx. 1 minute (no tubing must be installed). ✓ Press Blood pump key. ✓ If the error cannot be removed, notify technical service.	Continuous: < 25 s^{-1}
CPU 2: balance alarm	• Protective system detects different value from master. • The balance alarm is not counted and not compensated.	✓ Note the alarm in the treatment protocol. ✓ Restart the balance pumps by pressing the Balance Start/Stop key ✓ If the alarm appears repeatedly, terminate treatment and call technical service.	Continuous: < 1 s^{-1}
Clamp doesn't close Clamp doesn't open	• Clamp test failed. • Clamp does not close. • Clamp does not open.	✓ Correct tubing set position in clamp. ✓ Press Blood pump key. If the error cannot be reset, put system out of operation and notify technical service.	Continuous: <1 s^{-1}
CODE	• Controller CPU program code test failed. • Master CPU program code test failed.	✓ Restart system (no tubing may be installed). ✓ If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test
Commu control system	• The communication between master and controller failed.	✓ If the message cannot be reset, turn off the Aquarius™ System and turn it back on.	Continuous: <5 s^{-1}
Commu front system	• The communication between the master-CPU and the display failed.	✓ Set up Safety mode for the patient. ✓ Switch system off and on again after approx. 1 minute (no tubing must be installed). ✓ If the error cannot be reset, put system out of operation and notify technical service.	Continuous: <5 s^{-1}
Commu protection system	• Error during data transfer. • Power supply for protective system is defective.	✓ Press Blood pump key or Balance Start/Stop key. ✓ Switch system off and on again after approximately 1 minute. If the error cannot be reset, put system out of operation and notify technical service.	Continuous: < 2 s^{-1}
EEPROM	• Master CPU calibration data test failed. • Controller CPU calibration data test failed.	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service	Initial self-test
Blood detected	• Blood at optic sensor (air detector).	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test

Notes

Display:	Cause:	Options for error removal:	Test Frequency:
Error1 CPU	• Master CPU Register test failed. • Controller CPU Register test failed.	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test
Error2 CPU	• Master CPU RAM test failed. • Controller CPU RAM test failed.	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test
Error3 CPU	• Master CPU jump test failed. • Controller CPU jump test failed.	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test
Error blood detection	• Blood at optic sensor (air detector).	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test
Filtration pump	• Flow rate test failed. • Filtrate pump drive defective. • Filtrate pump did not stop. • Actual value of number of revolutions deviates from set value outside the limits.	✓ Ensure the pump door is closed. ✓ Switch system off and on again after approximately 1 minute (no tubing must be installed). ✓ Press Balance Start/Stop key ✓ If error cannot be reset, notify technical service.	Initial self-test Continuous: < 30 s^{-1}
Heater	During system test: • The heater failed the system test. During treatment: • Master and controller detect different values at the temperature sensors.	✓ Repeat the system test. ✓ If message appears again, call technical service. ✓ The system cannot be used for treatment. ✓ Check for air in the heater coil. If air is present, remove air as follows: • Large amounts of air - approximately more than 1/3 of the heating coil - or in pediatric treatment: the air may be removed via the access port on the degassing chamber using a syringe. • Small amounts of air - approximately less than 1/3 of the heating coil: remove heater coil from heater, clear the alarm, wait for treatment pumps to start, and then shake the heater coil gently while the treatment pumps are running. The air will be automatically removed by the degassing chamber. ✓ Ensure that the heater door is closed after reinsertion of the heater coil. If problem still persists, call technical service.	Initial self-test Continuous: < 1 s^{-1}

Notes

Display:	Cause:	Options for error removal:	Test Frequency:
Heparin pump	• Actual values of control and protective systems deviate from each other (outside the limits). • Actual values deviate from limits. • Pump stall. • The plunger is incorrectly positioned.	After system test: Restart system (no tubing must be installed). If the error cannot be reset, put system out of operation and notify technical service. During treatment: 1. Check the heparin line is not clamped. 2. Go to "Options" and "Change syringe", following the on-screen text. Note: It is not necessary to remove the syringe during this process 3. If problem persists, program the pump to 0, clamp the line and remove the syringe. If problem still persists, end treatment and call technical service.	Continuous: < 2 s^{-1}
Operation mode	• Master CPU RAM test failed. • Controller CPU RAM test failed.	✓ Press Blood pump key to start a new check. ✓ If the alarm appears again, call technical service.	Continuous: < 2 s^{-1}
Postdilution pump	• Master CPU jump test failed. • Controller CPU jump test failed.	✓ Ensure the pump door is closed. ✓ Switch system off and on again after approximately 1 minute (no tubing may be installed). ✓ Press Balance Start/Stop key. ✓ If the error cannot be reset, put system out of operation and notify technical service.	Continuous: < 30 s^{-1}
Predilution pump	• Blood at optic sensor (air detector).	✓ Ensure the pump door is closed. ✓ Switch system off and on again after approximately 1 minute (no tubing may be installed). ✓ Press Balance Start/Stop key. ✓ If the error cannot be reset, put system out of operation and notify technical service.	Continuous: < 30 s^{-1}
Program run	• Flow rate test failed. • Filtrate pump drive defective. • Filtrate pump did not stop. • Actual value of number of revolutions deviates from set value outside the limits.	✓ Press the Blood pump key to reset the alarm. ✓ If message appears repeatedly, end the treatment and call technical service.	Continuous: < 25 s^{-1}

Notes

Display:	Cause:	Options for error removal:	Test Frequency:
Return sensor	• Return pressure sensor values deviate from limits. • During clamp and pressure test no pressure increase is detected. • Error during data transfer.	After system test: ✓ Ensure that no tubing is on the machine during the system test. ✓ Repeat the system test. If it fails again, call technical service. During clamp and pressure test: ✓ Ensure the return and pre-filter domes are positioned properly. ✓ Press the Blood pump key to reset the alarm and to continue the pressure and clamp test.	Initial self-test Continuous: < 2 s^{-1}
Sensor Voltage	• High or low voltage is detected at the power supply for the sensors. • Voltage supply or AD-converter failure.	✓ Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Continuous: < 2 s^{-1}
Timer	• Timer deviation between master and controller.	✓ Press Blood pump key to clear the message. ✓ If the message appears repeatedly, end the treatment and call technical service.	Continuous: < 2 s^{-1}
TMP sensor	• The TMP calculation or the filtrate pressure sensor is out of range.	✓ Ensure no tubing is on the machine during the system test. ✓ Repeat the system test. If it fails again, call technical service.	Continuous: < 2 s^{-1}
Vcc Master/ communication	• A high or low voltage has been detected at the master power supply. • RAM, EPROM or EEPROM are defective. • Values between protective and control system deviate from each other (outside of limits).	✓ Press the Blood pump key to reset the message. ✓ If it appears repeatedly, end the treatment and call technical service.	Continuous: < 2 s^{-1}
XRAM	• During system test the RAM of the controller-CPU was found to be defective.	Restart system (no tubing may be installed). If the error cannot be reset, put system out of operation and notify technical service.	Initial self-test

Notes

Alarms: Red indication

If the Aquarius™ System detects an out-of-range condition during the system test or during operation or if parameters exceed or drop below the respective limits, an alarm message is generated and the Aquarius™ System switches to the Safety mode. Please note that some alarms require a manual restart of the blood pump.

Do not repeatedly clear alarms and restart the treatment without having identified and solved the alarm cause.

Display:	Cause:	Test Frequency:
High access pressure	Access pressure has exceeded the upper alarm limit. • Coagulation in the return drip chamber • Problem with the catheter • Lines are kinked	✓ Change the Aqualine tubing set. ✓ Check position of patient access. ✓ Check access blood line, including access and pre-filter sensors, for kinks or occlusions. ✓ Press the Blood pump key to resume treatment.
Low access pressure	• Timer deviation between master and controller.	✓ Check blood flow rate. Note: if blood flow rate is changed, check the filtration ratio displayed on the 'More' screen. ✓ Check position of the catheter and of the patient access. ✓ Reprime catheter or change it. ✓ Check access blood line, including access and pre-filter sensors, for kinks or occlusions.
Air Detected	• Timer deviation between master and controller.	✓ Make sure that the tubing line does not contain air. ✓ Check access and filter connections for sources of air leaks. ✓ When you clear the "Air detected" alarm, make sure there is no air or foam trapped in the line between the drip chamber and the patient end. ✓ To remove air from the tubing line: **Step 1:** Attach syringe to the top of the return chamber after carefully release the pressure from the line. **Step 2:** Press the Clamp key to open the return line clamp. **Step 3:** Remove all air from return chamber with the syringe. **Step 4:** Place the tubing back into the air detector and put it back in place. **Step 5:** If level in drip chamber is correct and the bubbles are out of the tubing, press the Clamp key to close the return line clamp. **Step 6:** Resume treatment by pressing the Blood pump key. If the "Air detected" alarm does not clear and air is visible in the return drip chamber, disconnect the patient from the machine and recirculate per your centre's procedure. NOTE: You may see micro-bubbles smaller than the air detector sensitivity.

Notes

Display:	Cause:	Options for error removal:
Balance alarm Check substitution/ dialysate line or Balance alarm Check filtration/ effluent line	If the Balance alarm is counted (see the alarm counter in the yellow box on the 'Main' screen) it indicates that: • The patient's fluid balance deviates more than 50 g in adult treatment or 20 g in pediatric treatment for more than 15 seconds. The deviation is less than 120 g. • The deviation could not be compensated during TFL. Possible causes are: • Fluid lines/manifold set is kinked or clamped. • Clampex connector on fluid bag is not broken. • Bags are swinging on scales or touching the cart frame of the Aquarius™. • When multiple bags are hung on the scale, if the bags are touching each other or the tubing lines are resting on the cart frame, the draining of the bags can cause them to shift position, resulting in a temporary weight change on the scale. • Tubing lines are supported by or are resting on the cart frame. • Fluid is leaking or a bag is detached from the scale. • Touching the filtrate or substitution bags while the Balance system is active. • Adding or removing a bag without stopping the Balance system. • Moving the Aquarius™ System while the Balance system is active.	If the Balance alarm is counted, ensure that: ✓ All clamps are open. ✓ Lines and bags are hanging freely. ✓ Lines and bags are not kinked or blocked. ✓ Bag connections are correct. ✓ Bags and lines are not resting on the cart frame. Restart the balance pumps by pressing the Balance Start/Stop key.
	If the Balance alarm is NOT counted (see the alarm counter in the yellow box on the 'Main' screen) it indicates that: • The patient's fluid balance deviates more than 120 g for more than 15 seconds. Possible causes are: • Bags are swinging on scales or touching the cart frame of the Aquarius. • When multiple bags are hung on the scale, if the bags are touching each other or the tubing lines are resting on the cart frame, the draining of the bags can cause them to shift position, resulting in a temporary weight change on the scale. • A bag is detached from the scale. • Adding or removing a bag without stopping the Balance system. • Moving the Aquarius™ System while the active Balance system.	If the Balance alarm is NOT counted, ensure that: ✓ All bags are hanging on the scale. ✓ All bags are hanging freely and do not move. Restart the balance pumps by pressing the Balance Start/Stop key.

Notes

Display:	Cause:	Options for error removal:
Balance system off	The Balance system has been off for 5 minutes. All fluid pumps are stopped.	✓ Correct the cause and switch Balance system on again.
Check substitution/ dialysate line or Check filtration/ effluent line	Balancing deviates from the set values entered by the operator.	✓ Check flow rates of the pumps. ✓ Check fluid removal and turnover input parameters. ✓ Check bag hanging on scale (filtration or substitution). ✓ Check tubing set for narrow sections (filtration or substitution). NOTE: During very high volume programs there is a potential for inadequate fluid delivery due to pressure peaks.
Blood flow failure	The number of revolutions of the pump exceeds or falls below the alarm limits by ±5%.	✓ Check blood flow rate. ✓ Check blood pump tubing. ✓ Check tubing set for narrow sections.
Blood leak	• Filtrate/plasma contains blood. • Filter membrane is damaged/ruptured. • During treatment the BLD chamber has been removed from its housing. • BLD chamber not filled with fluid. • Dust on mirror of housing.	✓ Discontinue treatment. ✓ Exchange circuit. ✓ Reposition the BLD chamber. ✓ Go to "Reprime" and choose "Ultrafiltrate line". ✓ Remove mirror. ✓ Clean and replace as found.
Blood pump off	The blood pump has not been running for 1 minute.	✓ Press the Blood pump key to switch blood pump on again.

Notes

Display:	Cause:	Options for error removal:
Check Degassing Chamber	• If the motor works for more than 25 seconds without detecting a filled chamber. • If the hydrophobic filter is blocked (measured pressure less than –300 mmHg). • If the system detects a positive pressure higher than +30 mmHg. • If system test fails. • The fluid is detected in the ADU sensor line. A "Check Degassing Chamber" alarm occurs during the first two minutes of priming (post-dilution line) and fluid is in the heater line, up to 120 ml of dialysate or substitution fluid may be pumped into the saline bag when the alarm is cleared and priming restarts. When priming completes, replace the saline bag and reprime the blood circuit if the dialysate or substitution fluid is not indicated for infusion.	✓ Check if all clamps are open. ✓ Check if substitution line is kinked. ✓ Check if the 4-way connector is kinked. ✓ Check if the frangible pins of the bags are well broken. ✓ Clamp the line to the hydrophobic filter. ✓ Open the clamp to the substitution line or from the 4-way connector. ✓ Disconnect the line with the hydrophobic filter. ✓ Open the clamp and reconnect it. ✓ Press the **Mute** key. After system test: Degassing pressure sensor or degassing module defect. Do not use the Aquarius™ System and call technician. During use: Pressure sensor detects less than -300 mmHg. Degassing filter is wet. Clamp the pressure line, disconnect filter from sensor and use a syringe to dry it. Reconnect the line and unclamp it. ✓ When an ADU alarm **("Check Degassing Chamber", "No Fluid Chamber Detected" or "Degassing Chamber Missing")** cannot be cleared anytime during self-test, setup, priming or treatment, remove the Aquarius™ System from service and call technical service. If in Treatment mode and an "Check Degassing Chamber" alarm cannot be cleared, select "Go to Programming" and set the temperature to 0 °C to prevent delivering overheated solution to the blood circuit.
Check transducer connections	The pressure domes have not detected any pressure change for 15 seconds.	✓ Ensure the domes are properly connected. ✓ Press the **Blood pump** key to resume treatment. ✓ IMPORTANT: do not remove any pressure sensors. ✓ If domes are in place: increase blood pump speed if return pressure reading is low.
Clamp heparin line	The heparin syringe has been removed.	✓ Clamp heparin line.

Notes

Display:	Cause:	Options for error removal:
Degassing chamber missing	The substitution degassing chamber is not properly inserted or the sensors are defective.	✓ Insert the substitution chamber properly. ✓ Ensure the chamber is in contact with the sensor of the holder. ✓ Start balance pumps. ✓ If this does not help, switch off heater to end the treatment and then call technical service.  If in Treatment mode and an ADU alarm cannot be cleared, select "Go to Programming" and set the temperature to 0°C to prevent delivering overheated solution to the blood circuit
High filtrate pressure Low filtrate pressure	Filtrate pressure exceeds or falls below the alarm limits.	✓ Check pressure sensor. ✓ Check tubing set for narrow sections. ✓ Check filter and exchange circuit if required. ✓ Check blood flow to filtration ratio.
Filtrate flow failure	The number of revolutions of the pump exceeds or falls below the alarm limits by ± 5%.	✓ Check filtration flow rate. ✓ Check filtration tubing. ✓ Check tubing set for narrow sections.
Keyboard failure	A key press longer than 60 seconds was detected by master CPU.	✓ If alarm does not clear, call technical service.
Line/ Substitution failure	A substitution deviation is detected that influences the patient balance.	✓ Check lines. ✓ Check clamps. ✓ Check bags. ✓ Check for leakages.
Master key transfer	• A key press longer than 60 seconds was detected by the master CPU. • Short disturbances in the communication between the master and the controller CPU.	✓ Alarm should be cleared by pressing the Blood pump key (the error is automatically cleared by the system; the alarm is to notify the user that an issue occurred only). ✓ If alarm does not clear, call technical service.
Main battery high	A high voltage has been detected in the main battery.	✓ Control charging voltage/unit. ✓ Control/change battery. ✓ Control AD-converter/CPU.
Postdilution failure	The number of revolutions of the post-dilution pump exceeds or falls below alarm limits by ± 5%.	✓ Check post-dilution flow rate. ✓ Check post-dilution tubing. ✓ Check tubing set for narrow sections.
Predilution failure	The number of revolutions of the pre-dilution pump exceeds or falls below alarm limits by ± 5%.	✓ Check pre-dilution rate. ✓ Check pre-dilution tubing. ✓ Check tubing set for narrow sections.

Notes

Display:	Cause:	Options for error removal:
High pre-filter pressure Low pre-filter pressure	The pre-filter pressure exceeds upper alarm limit. A rapid increase in pre-filter pressure without any change in parameters indicates filter clotting or coagulation in the return drip chamber.	✓ Check pressure sensor. ✓ Check filter and exchange circuit if required. ✓ Check blood flow. ✓ Check tubing set for narrow sections. ✓ Check access line for kinks or occlusions. ✓ Press the Blood pump key to resume treatment (in case of low pre-filter pressure). In case of clotting, prepare to end treatment; increase pre-dilution flow rate and blood flow rate on next circuit.
High return pressure	• Return line is kinked or clamped. • Return chamber is clotting. • Return line is occluded or clotted.	✓ Check return line for kinks or occlusions. ✓ Prepare to end treatment. ✓ Check position of patient access. ✓ Check return pressure transducer. In the case of a faulty transducer, stop treatment and call technical service.
Low return pressure	• Blood flow rate is too low. • Blood pump has stopped. • Return line is disconnected.	✓ Increase blood speed. ✓ Clear any initial alarm and restart blood pump. ✓ Reattach the return line to the catheter.
Pump door	One of the pump doors is open.	✓ Close the door.
Syringe removed	• Heparin rate has been programmed and no syringe has been inserted in the plunger. • The syringe is not inserted properly.	✓ Correctly insert heparin syringe if heparin is needed. ✓ Set anticoagulant rate to zero if anticoagulant is not required. ✓ Press the Blood pump key to resume treatment.
High temperature	• Temperature value on the 'More' screen exceeds 40 °C. (For more information regarding the temperature displayed on the 'More' screen, see Instructions for Use Section 5.8.6). • The Aquarius™ System detects a plate temperature of the heater above 57 °C.	✓ Check for air inside the heater coil. If air is present, remove the air by shaking the heater coil when the pumps have restarted. Ensure that the heater door is closed after reinsertion of the heater coil. ✓ Wait until the temperature has cooled down. ✓ If the alarm disappears, the pump will start automatically.
Low temperature	The heater plate temperature has been below 33 °C for more than 10 minutes.	✓ Check substitution temperature setting. ✓ Ensure that the substitution solution bags are warm enough (ambient temperature) for infusion.
Temperature controller	High temperature of the heater at the controller.	✓ Refer to "High temperature" options for error removal. ✓ If the alarm persists, contact technical service.

Notes

Display:	Cause:	Options for error removal:
High TMP	• TMP has risen slowly – filter is clogging. • TMP has risen rapidly – filtrate line or bags clamped or kinked. • High TMP from the start.	✓ Check 'More' screen for pressure details. The rate of change over initial TMP (with same filtration and exchange rate) indicates pressure changes in the filter. ✓ Reduce post-dilution flow rate and increase pre-dilution flow rate. ✓ Unclamp or remove kink from line. ✓ Check blood flow/exchange ratio. ✓ Increase blood flow rate accordingly.
Low TMP	• Filtrate pump runs slower than the dialysate pump. • The filtrate line is closed between filter and bag.	✓ Check 'More' screen for pressure details. The rate of change over initial TMP (with same filtration and exchange rate) indicates pressure changes in the filter. ✓ Modify blood flow rate and/or fluid exchange, this will impact the blood flow-to-fluid removal or blood flow-to-turnover ratio.

Turnover failure	Balance pump speed is consistently higher (or lower) than the programmed speed for more than 20 consecutive minutes to ensure accurate fluid delivery. Possible causes are:
	• Fluid leakage
	• Fluid delivery restrictions due to:
	  • Incorrect line installation (kinked tubes, closed or partially closed clamps, twisted lines)
	  • Incorrect bag installation (incorrect spiking of the substitution bag, spike or frangible pin blocking the fluid path, frangible pin only partially broken, bag not hanging freely, bag swinging)
	  • Pump calibration out of range.
	  • Filter inappropriate for fluid delivery rates.
		Stop the balance pumps and:
		✓ Check for fluid leakage.
		✓ Ensure lines and bags are hanging freely.
		✓ Ensure lines and bags are not kinked or blocked.
		✓ Check that all clamps are open.
		✓ Ensure that the bags are not swinging.
		✓ Ensure filter is capable of the prescribed flow rates. If necessary, use a larger surface area filter.
		
		Restart the balance pumps.
		
		If the problem persists contact technical service.

Change filter and set	Notifies the operator that the machine has been running for more than 72 hours. It cannot be reset and stays on for 8 hours.	✓ Exchange filter and tubing set. ✓ Disconnect and start a new treatment with new filter and a new tubing set.
80 h reached: new set required	The machine has been running for 80 hours. The treatment will be terminated.	✓ Exchange filter and tubing set. ✓ Disconnect and start a new treatment with new filter and a new tubing set.

Notes

Messages: Yellow indication

If the Aquarius™ System detects out-of-range conditions or reminders that do not conform to the intended use of the system, the operator gets detailed information defined for the individual conditions and the system switches to the Safety mode.



Do not repeatedly clear messages and restart the treatment without having identified and solved the message cause.

Display:	Cause:	Test Frequency:
Air detected or Pressure test disabled	• Air detection system does not detect "air free" tubing. • The clamp and pressure test is disabled.	✓ Make sure that tubing set does not contain air ✓ Make sure that the return line is properly installed in the clamping system of the air detector. ✓ Ensure that the return line is not scratched at the contact part.
Balance initializing…	• Scales and fluid pumps initialise when the balance system is started.	✓ This is just a reminder. ✓ Occurs each time the balance system is turned ON ✓ Occurs during TFL volume compensation.
Balance system off	• The balance system is off, all fluid pumps are stopped.	✓ Correct the cause and switch the balance system on again.
Blood detected	• During the connection or recirculation phase blood is detected in the return line.	✓ The blood pump stops and starts now only for 5 seconds. ✓ Switch to Treatment mode.
Blood pump off	• The blood pump was manually switched off.	✓ Press **Blood pump** key to switch blood pump on again.
Change substitution/ dialysate bag or Change filtrate/ effluent bag	• The filtrate bag has reached maximum permissible weight or the substitution solution bags do not contain solution.	✓ Replace full filtrate bag with empty bag. ✓ Replace empty substitution solution bag with new bag filled with solution. ✓ Open the bag(s). Ensure the line is not kinked or clamped. ✓ Ensure proper placement of bags on the scale hooks. ✓ Inlets should always hang from the bottom. NOTE: If substitution bag is far from empty: check that the number of bags on 'Program' screen is equal to bags on scale. If yes, change filtrate bag (s) alone.
Check access transducer	• The access/return transducer does not register a pressure change with the blood pump running. • During clamp and pressure test no pressure increase is found when the clamp is closed.	✓ Check dome connection. ✓ To reconnect: 1. Stop blood pump. 2. Wait for 15 seconds. 3. Properly connect the dome. 4. Start blood pump.
Check degassing chamber	Refer to "Check degassing chamber" causes as stated in Instructions for Use Section 6.2.1: Alarms.	Refer to "Check degassing chamber" causes as stated in Section 6.2.1: Alarms.
Check transducer connections	• The pressure domes have not detected any pressure change for 15 seconds.	✓ Ensure the domes are properly connected.

Notes

Display:	Cause:	Options for error removal:
Check lines	• The post-dilution pump has been stopped for longer than 3 minutes to regulate the fluid loss.	✓ Check that the substitution line, the filtration line and all bags are open, all clamps are open and the tubes and bag inputs are not kinked.
End of Treatment	• End of treatment.	✓ Disconnect patient or reprogram patient parameter.
Exchange filter and set	• This message is displayed every 24 hours of use of the same filter and line set (including priming, connection, recirculation and treatment time). • It is possible to clear this message if the filter and line have been used for less than 72 hours.	✓ Exchange filter and tubing set ✓ Disconnect and start a new treatment with new filter and a new tubing system.
Filt./effluent bag change soon	• Filtrate/effluent bag change in less than 10 minutes.	✓ Prepare the filtrate/effluent bag change.
Function not available	• During treatment the Off key is used.	✓ To switch off the machine, select "End treatment", perform the disconnection program until the Aquarius off mode.
Heater cools down	• Balance system has stopped for more than 15 seconds and the heater plate temperature is above 43 °C.	✓ Ensure the balance system is active (indicated by steady green light on balance key). ✓ The treatment is paused until the temperature is in a safe condition (below 42 °C). Substitution pumps will run at a slow rate to help cooling. (Exception: during TFL compensation balance substitution pumps will not run). ✓ Heater cool down management may take up to 10 minutes. The treatment will restart automatically.
Heater self test running	• Heater self-test is in progress when the 'Start Priming' screen is reached.	✓ Wait until heater self-test is completed. ✓ During the heater self-test, the green status light is illuminated, whilst the yellow status light is flashing. When the heater self-test is finished, the yellow status light stops flashing.
Heparin syringe missing	• A heparin rate has been programmed and no syringe has been inserted in the plunger. • The heparin syringe is not inserted properly.	✓ Insert heparin syringe if heparin is needed. ✓ Set heparin rate to zero if no anticoagulant is required.
High filtration ratio	• Fluid removal rate exceeds 30 % of the blood flow rate. • Exchange of fluid or plasma across the membrane is too high in comparison to the blood flow rate. • The post dilution substitution rate is higher than what is acceptable for the current blood flow rate.	✓ Decrease fluid removal or plasma exchange rate ✓ Increase blood flow rate. ✓ Evaluate ratio of pre- vs. post-dilution substitution solutions.
Indication battery low	• Power failure indication (beep) battery is low.	✓ The battery is automatically charged if you go on with this treatment. ✓ This message indicates that in the event of a power failure the Aquarius™ System will beep for less than 2 minutes.

Notes

Display:	Cause:	Options for error removal:
Insert BLD- chamber	• The blood leak detector is not properly inserted into the blood leak chamber.	✓ Correctly insert the chamber. ✓ Reprime to correctly fill up the chamber. ✓ Ensure no scratches or marks are present on the Aqualine tubing set chamber.
Insert tube Insert tube to air detector	• The air detection system is not operational after priming.	✓ Insert correctly the return line into the air detection system. ✓ Make sure that the air detection system is well inserted, if not push it back firmly. ✓ Ensure the green diode of the Clamp key is on
Main battery low	• After a power failure, the main power supply battery must be charged.	✓ The battery is automatically charged if you go on with this treatment. ✓ This message indicates that in the event of a power failure the Aquarius™ System will run for less than 2 minutes.
Negative UF	• A negative UF is programmed.	✓ This is a reminder.
No bag	Less than 45 g are detected on one scale. Possible causes are: • No bag installed on filtration scale. • Bag weighs less than 45 g • Incorrect bag installation (lines or spike touching the Aquarius™ cart frame or lines twisted) • Aquarius™ system test performed with bag(s) hanging on the scales. • Scale calibration out of tolerance.	✓ Ensure that the filtrate bag is hanging on the filtration scale. ✓ Check the filtration line and make sure they are not resting on the Aquarius™ cart frame and that it is not twisted. Make sure the filtration bag hangs freely from the scale. ✓ Ensure that a correct waste bag is used (refer to the Instructions for Use Section 3.3 of the Aquarius™ System) ✓ Use an additional bag on each scale: • Go to "Programming" window. • Program 2 bags. • Ensure that 2 empty effluent bags are hanging on the filtration scale and connect both filtration bags to the filtrate line. • Ensure that 2 substitution bags are hanging on the substitution scale and connect both substitution bags to the substitution line. ✓ If the above mentioned measures do not solve the issue, start a new treatment and ensure that during the system test there is no weight on the scales. If the problem persists, contact technical service.

Notes

Display:	Cause:	Options for error removal:
No fluid chamber detected	• The substitution degassing chamber is not inserted.	✓ Insert the chamber correctly. ✓ When an ADU alarm ("Check Degassing Chamber", "No Fluid Chamber Detected" or "Degassing Chamber Missing") cannot be cleared anytime during self-test, setup, priming or treatment, remove the Aquarius™ System from service and call technical service. If in Treatment mode and an ADU alarm cannot be cleared, select "Go to Programming" window and set the Temperature to 0 °C to prevent delivering overheated solution to the blood circuit.
Please program	• Hourly fluid loss or fluid loss total is not programmed.	✓ Select "Programming mode" and program both hourly fluid loss and fluid loss total. ✓ In CVVH, CVVHD, and CVVHDF, if no fluid loss is required, treatment time must be programmed.
Power Failure	• The power supply is interrupted. Depending on the charge status of the main battery the blood pump will run for around 2 minutes.	✓ Start blood pump. ✓ Check power cord connection. ✓ Use crank handle to manually return blood to the patient if the power failure lasts longer than the battery supports.
Pressure test disabled	• During the pressure and clamp test a failure has occurred.	✓ Check that pressure domes are correctly placed. ✓ If the error persists, contact technical service.
Program dialysate	• In CVVHD, dialysate rate is not programmed.	✓ Select "Programming" and program a dialysate rate.
Program goal	• Treatment goal is not programmed.	✓ Select "Programming" and program time, fluid loss and fluid loss total.
Program treatment pumps	• In CVVH/CVVHDF pre- and post- dilution/ post-dilution and dialysate are not programmed.	✓ Select "Programming" and program pre- and post- dilution or post-dilution and dialysate rate.
Pump door open	• One of the pump doors is open.	✓ Close pump door.
Read error help instructions	• To solve the alarm further information is needed.	✓ Further information is available from the 'Help' screen.
Return pressure low	• The return pressure is below 20 mmHg.	✓ During the first minute of treatment this is a reminder.
Subst./ dialysate bag change soon	• Substitution/dialysate bag change in less than 10 minutes.	✓ Prepare substitution and/or dialysate bag change.

Notes

Display:	Cause:	Options for error removal:
Syringe empty: change in OPTIONS	• The syringe located in the heparin pump is empty.	Follow instructions on 'Change syringe' screens – removing syringe ONLY when directed. ✓ Clamp heparin line. ✓ Take syringe out of driver and disconnect from line. ✓ Fill new syringe with heparin. ✓ Enter syringe volume and confirm. ✓ Place syringe in driver and connect line. ✓ Ensure that plunger and wings are inserted. ✓ Open clamp and confirm. NOTE: If using BD syringe: ensure the grooves on the plunger are running towards the machine.
Syringe pump off	• The heparin rate is programmed to zero.	✓ If heparin is not required proceed to next screen. ✓ If heparin is required, insert a syringe containing heparin and program the desired heparin rate.
Too much weight	• One of the scales has detected more than 20 kg.	✓ Ensure that the same number of substitution solution and filtrate bags hang on the scale hooks. NOTE: The maximum number of bags on each scale is 4.
Wait!	• The balance system has stopped.	✓ This is an indication that the system will start automatically after some minutes.

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