



# Dialog<sup>+</sup> SW 9.xx

## Hydraulics

Technical Support International

Enter

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DialogP SW9.xx\_std\_Hydraulics Rev 1.02 2011-12-08

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SHARING EXPERTISE

## Dialog<sup>+</sup> Overview

Welcome to the Dialog<sup>+</sup> Component Overview. Here you will have the opportunity to look at different components in the machine. You will find out what there functions are, and how they work together with other components.

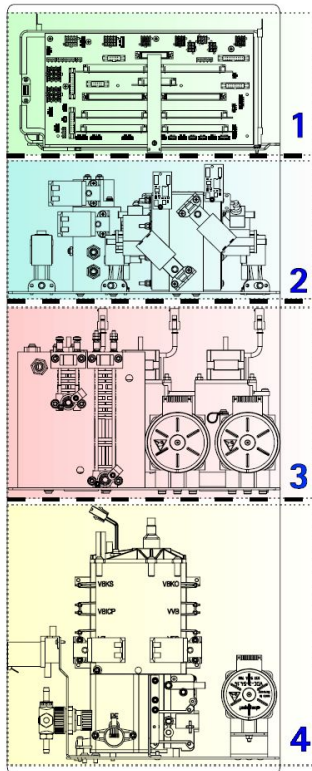


Internal Hydraulics

Hydraulics Test

## Hydraulics

The hydraulics of the machine is divided into four parts.  
Please choose a part or look at the flow diagram.



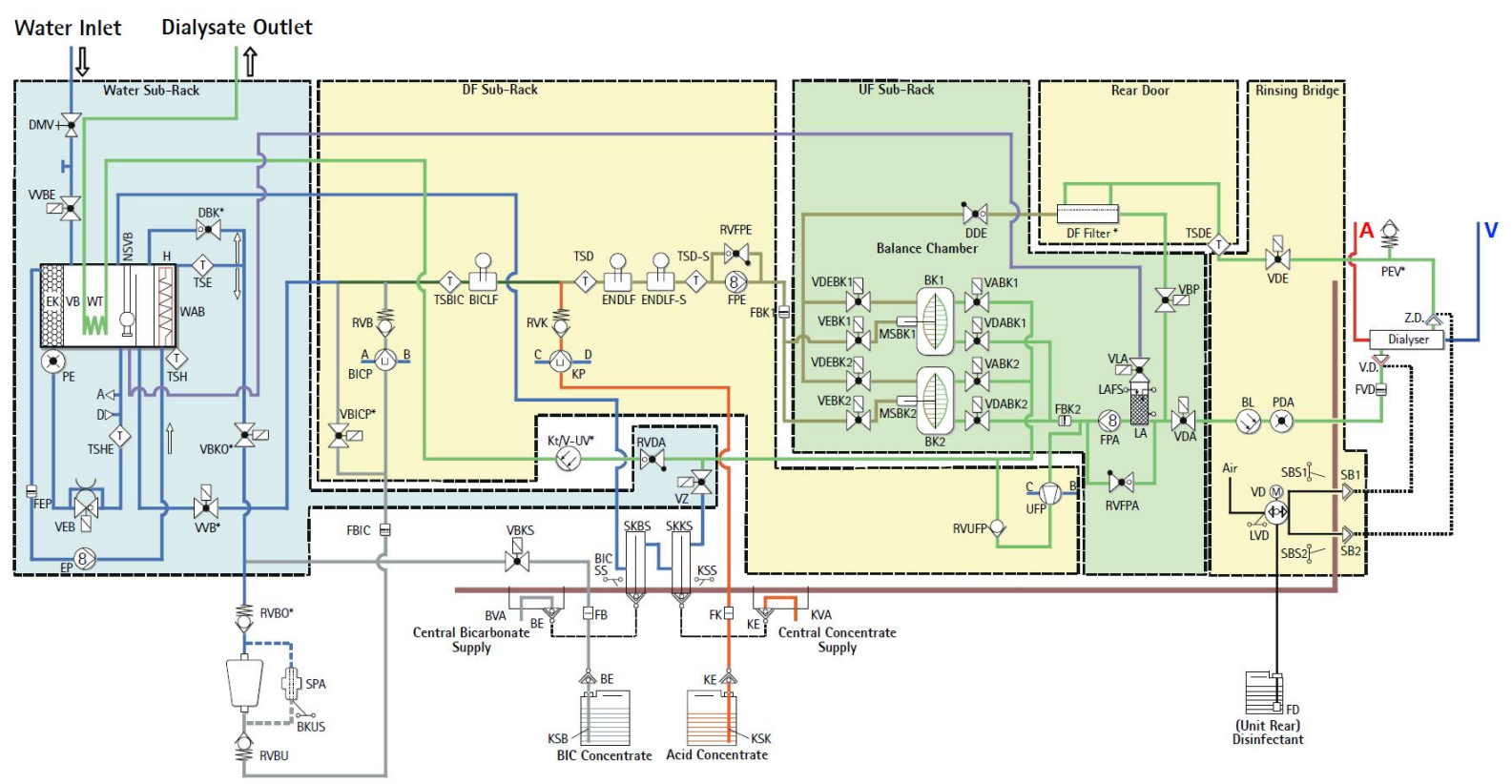
The Sub-Racks are divided in:

1. Low Level Electronics
2. UF Sub-Rack
3. DF Sub-Rack
4. Water Sub-Rack

[Flow Diagram](#)[Back](#)

# Hydraulic Flow Diagram

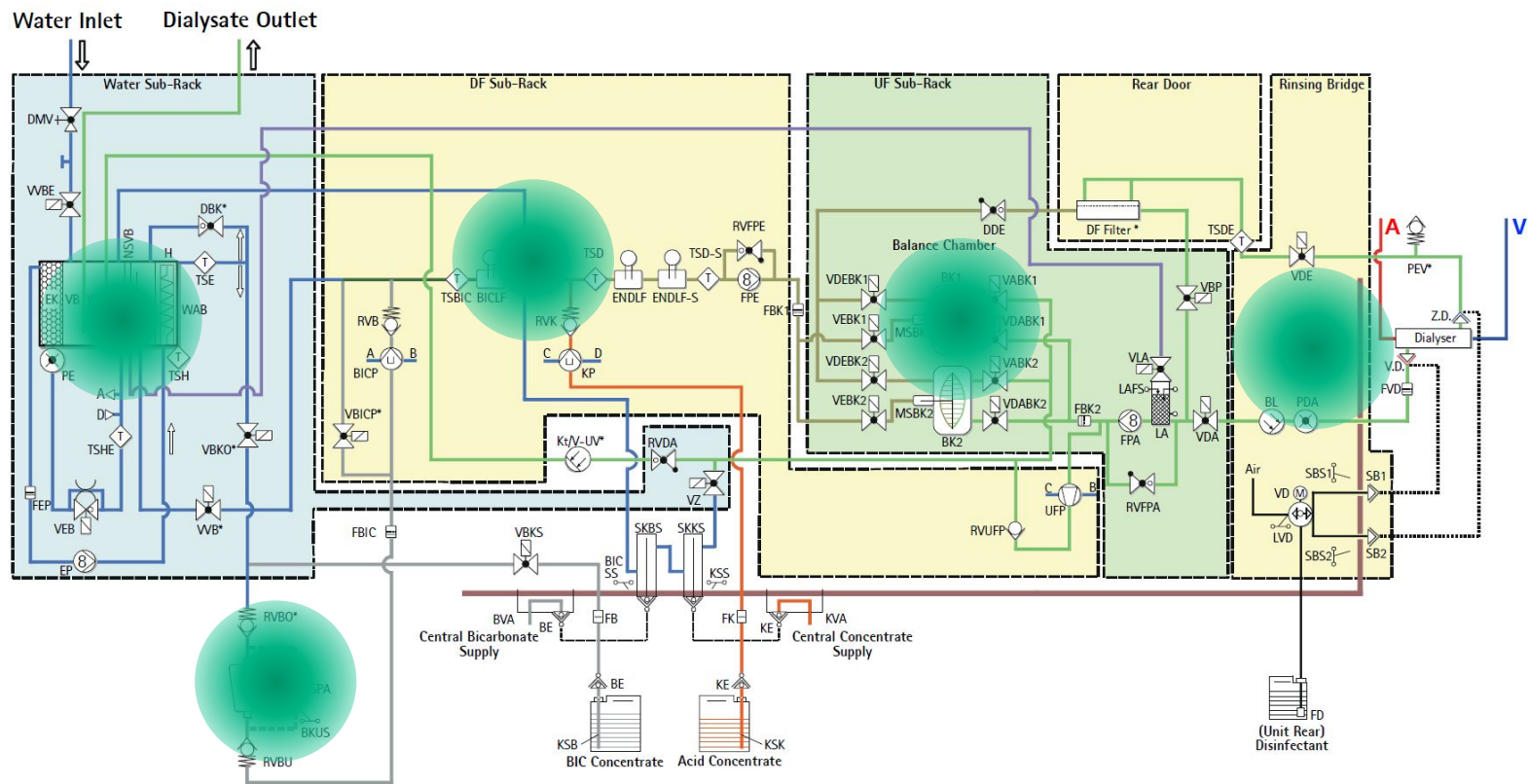
Please choose a part of the flow diagram that you would like to look at.





# Hydraulic Flow Diagram

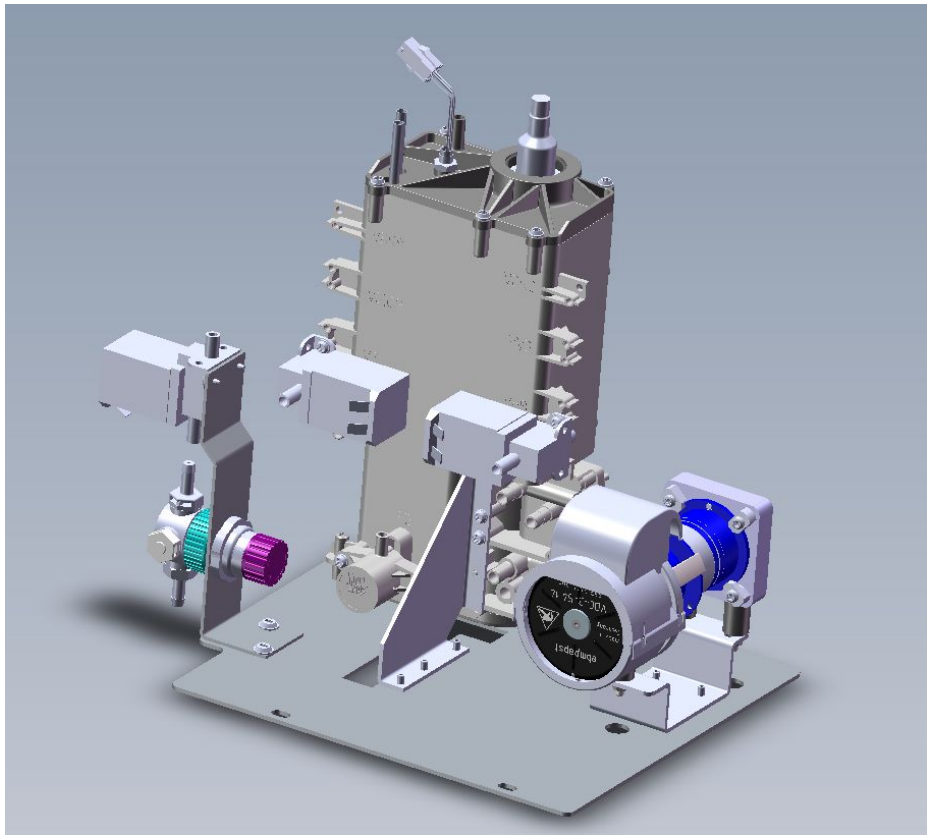
Please choose a part of the flow diagram that you would like to look at.  
Touch one of the green areas.



## Sub-Rack View

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## Water Sub-Rack



- Functions of the Water Sub-Rack
- Controls incoming water amount
  - Degasses the water
  - Heats the water
  - Contains bicarbonate valves

Degassing Circuit

Heating Regulation

Water Inlet

Water Block

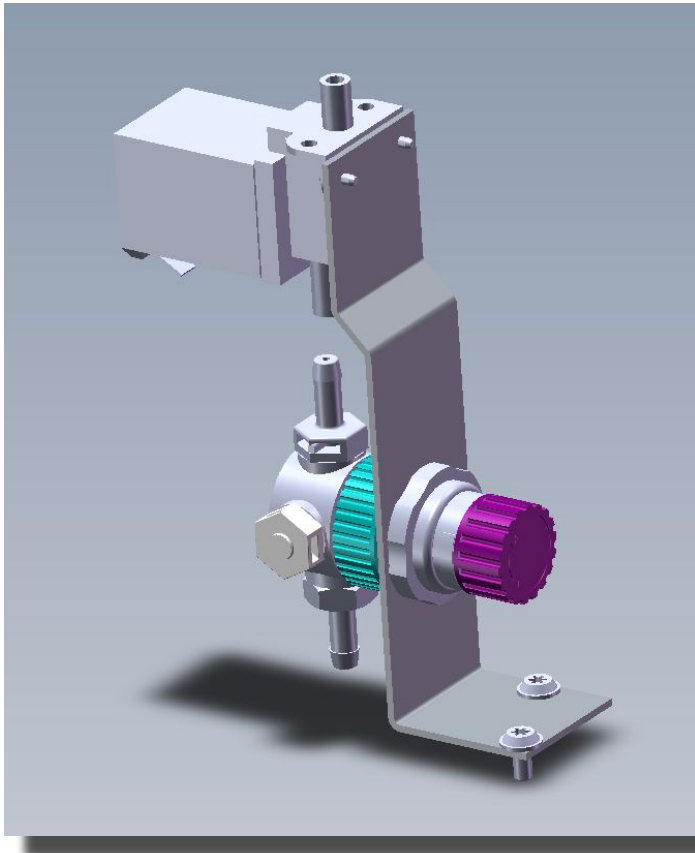
Degassing Pump

Back

## Pressure Reduction Valve

### Functions of the Pressure Reduction Valve

- Reduces ring-line pressure to 0.9 bar



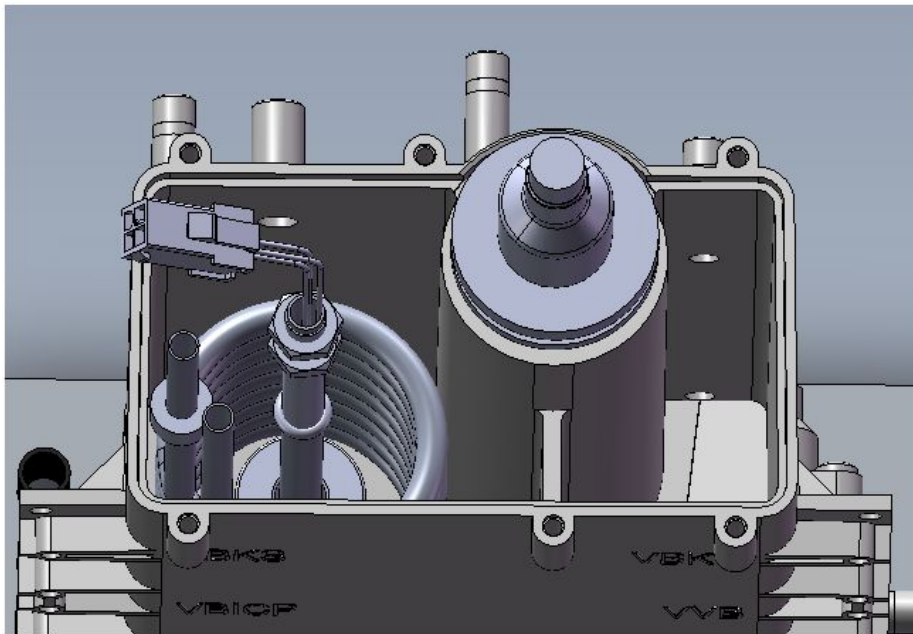
## Water Inlet Valve

### Functions of the Water Inlet Valve

- Controls incoming water amount
- Regulated by the float switch
- Opening time is dependent on flow



## Upline Tank



## Components in the Upline Tank

- Heat exchanger
- Float Switch
- Heater rod

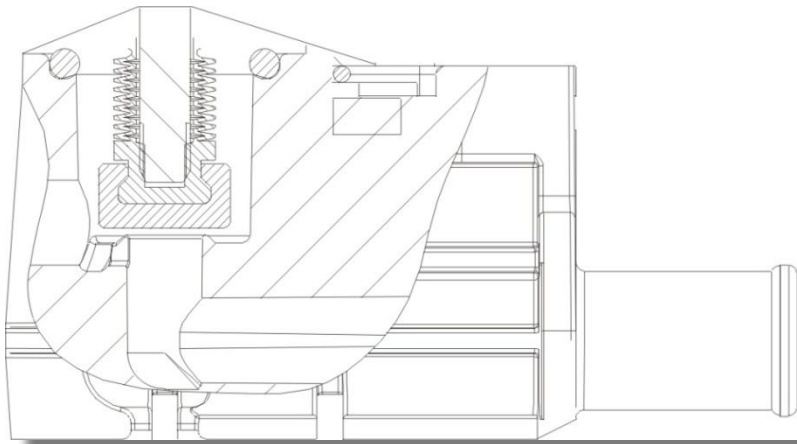
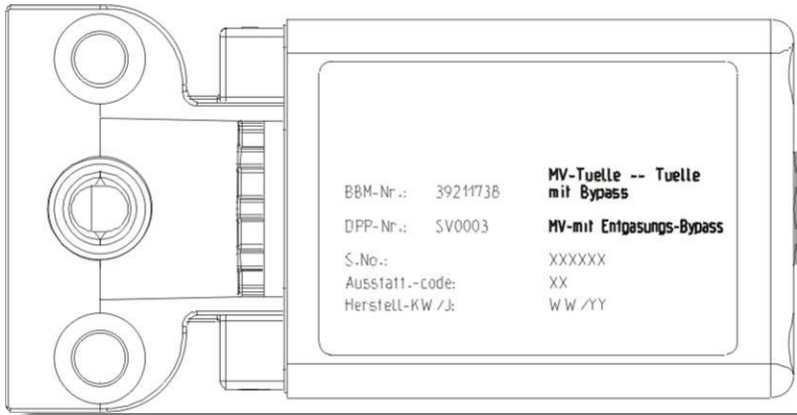
Heat Exchanger

Float Switch

Heater Rod

Back

## Degassing Valve VEB

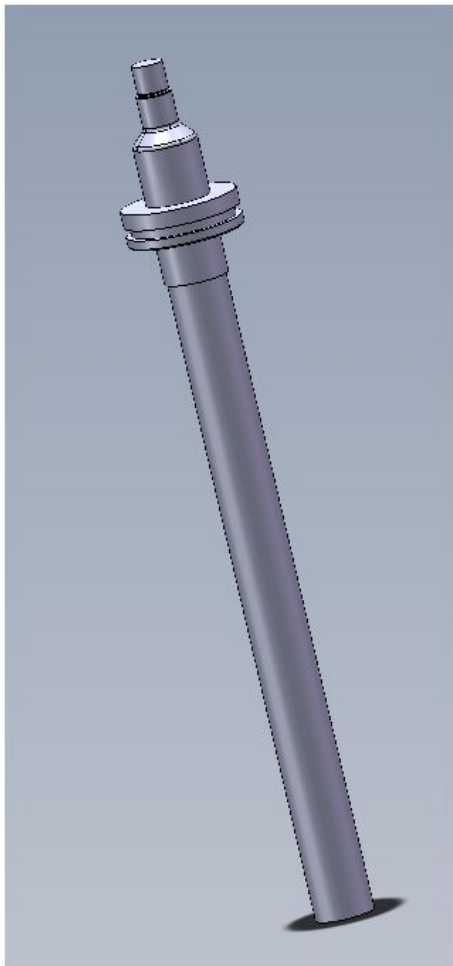


### Functions of the Degassing Valve

- Creates a restriction in the water flow
- The restriction creates a negative pressure
- If the valve is open there is no restriction in the flow
- If the valve is closed there is a fixed gap for the water to pass
- The valve will always be open during disinfections



## Heater Rod



### Functions of the Heater Rod

- Heats up incoming water

### Properties of the Heater Rod

- It consists of 2 heating elements with 900 W each
- The heater rod has a thermal fuse that burns out at 120 °C
- The thermal fuse is not resettable

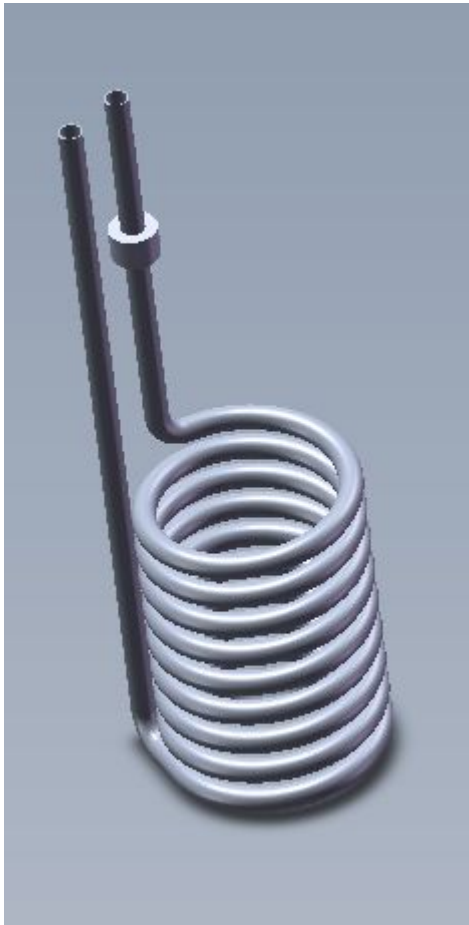
## Float Switch



### Functions of the Float Switch

- Regulates the water level in the upline tank
- Turns off the heater and stops all pumps when the tank is empty

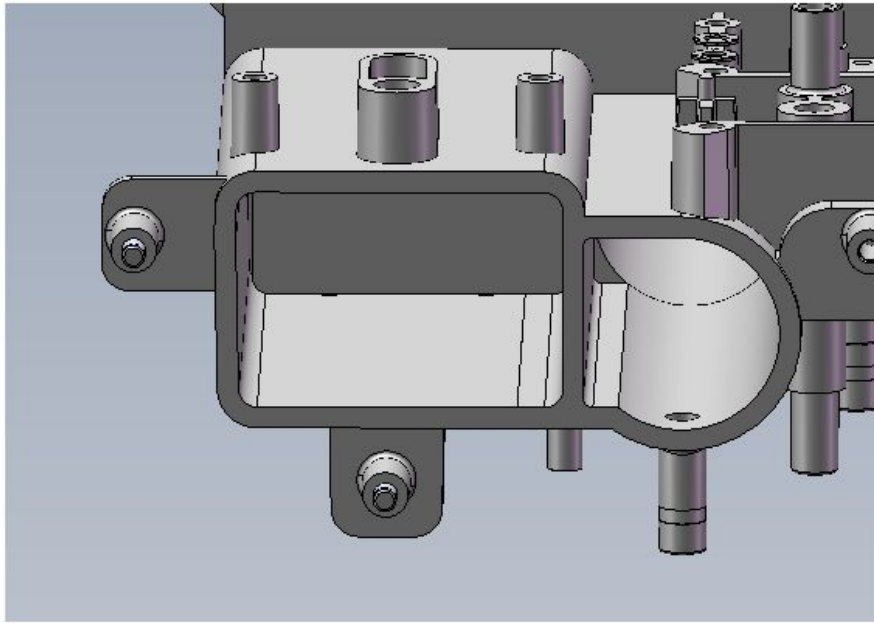
## Heat Exchanger



### Function of the Heat Exchanger

- Pre-heats the incoming water to increase energy efficiency
- The tube is made of stainless steel
- It is shaped in a spiral form to increase the contact surface area

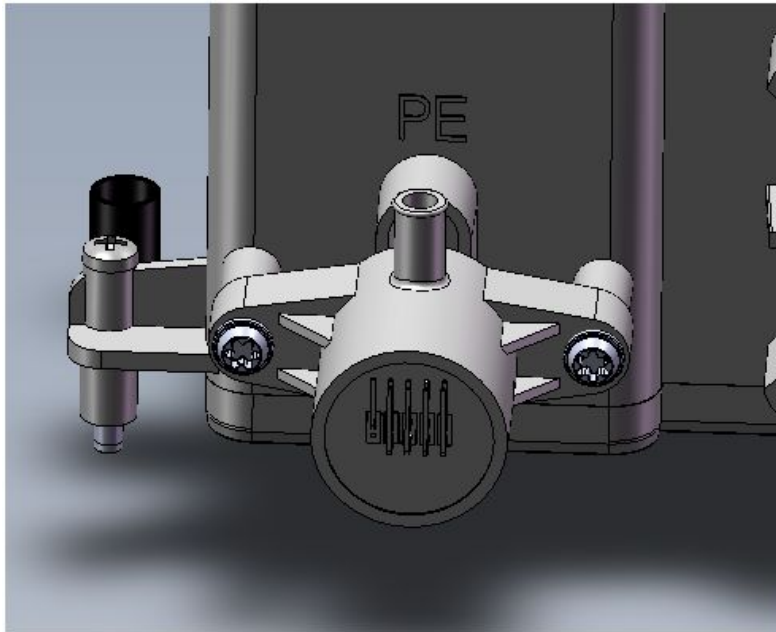
## Degassing Chamber



### Functions of the Degassing Chamber

- Allows water to degas
- Slow flow of water
- Contains granulate to allow bubbles to form

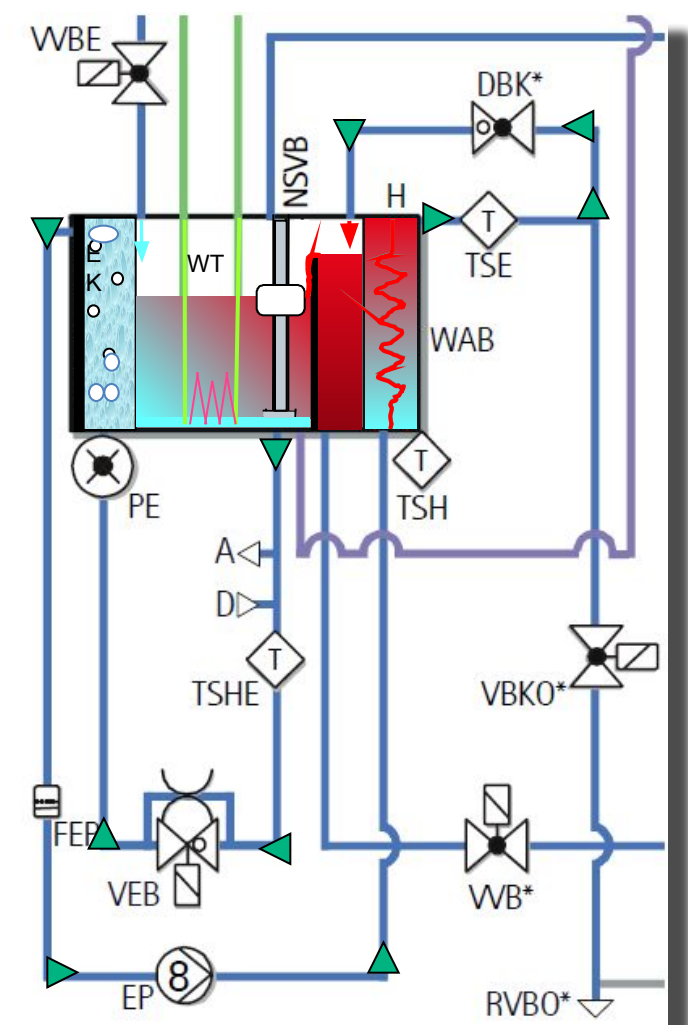
## Degassing Pressure Sensor



### Functions of the Degassing Pressure Sensor

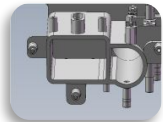
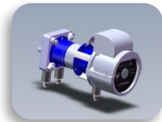
- Measure the degassing pressure
- Feedback for the degassing pump speed
- Protects the heater rod during disinfection by monitoring the pressure. If the pressure is too low, the heater is turned off.
- The same type of sensor is used for PDA

## Degassing Circuit



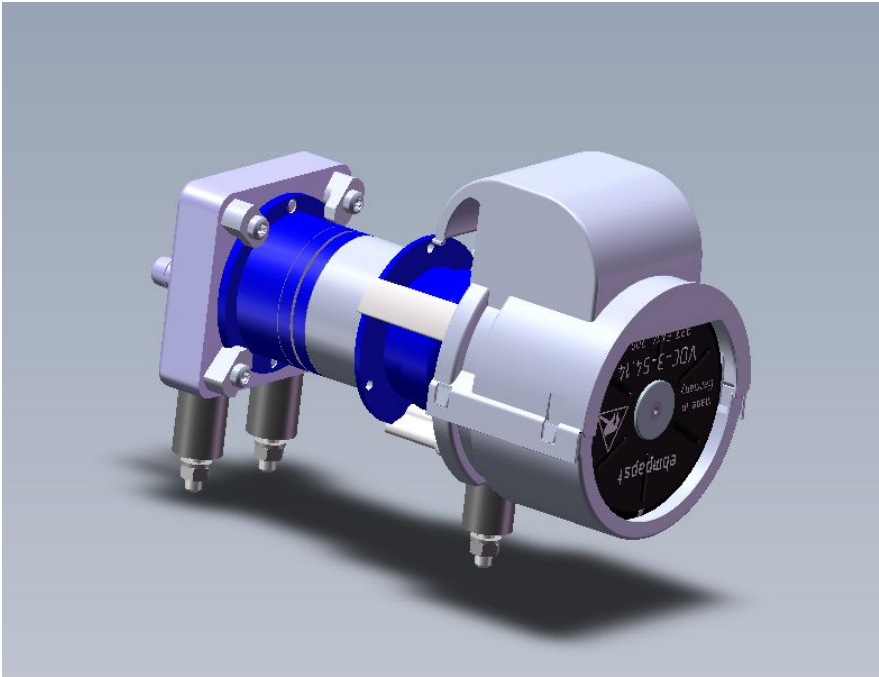
### The Flow Path of the Water

- Water is taken from the upline tank
- If VEB is closed, a restriction in the flow causes a negative pressure
- A negative pressure is measured at PE
- The degassing chamber allows bubbles to form
- The FEP protects the degassing pump from particles that might damage the pump
- The EP generates the negative pressure by pumping water to the heater rod





Degassing Pump, Micropump Vers. 2



Functions of the Degassing Pump

- Degasses the water
- Creates a negative pressure

Adapter Block

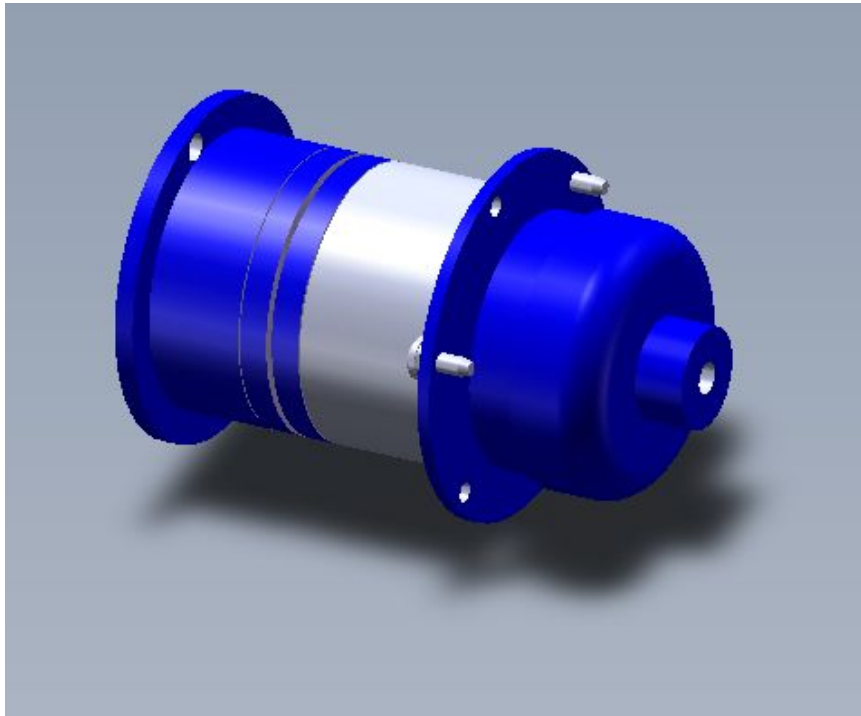
Gear Pump

Motor

Cover

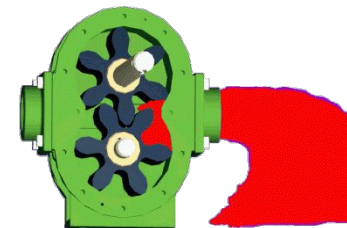
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## Degassing Pump

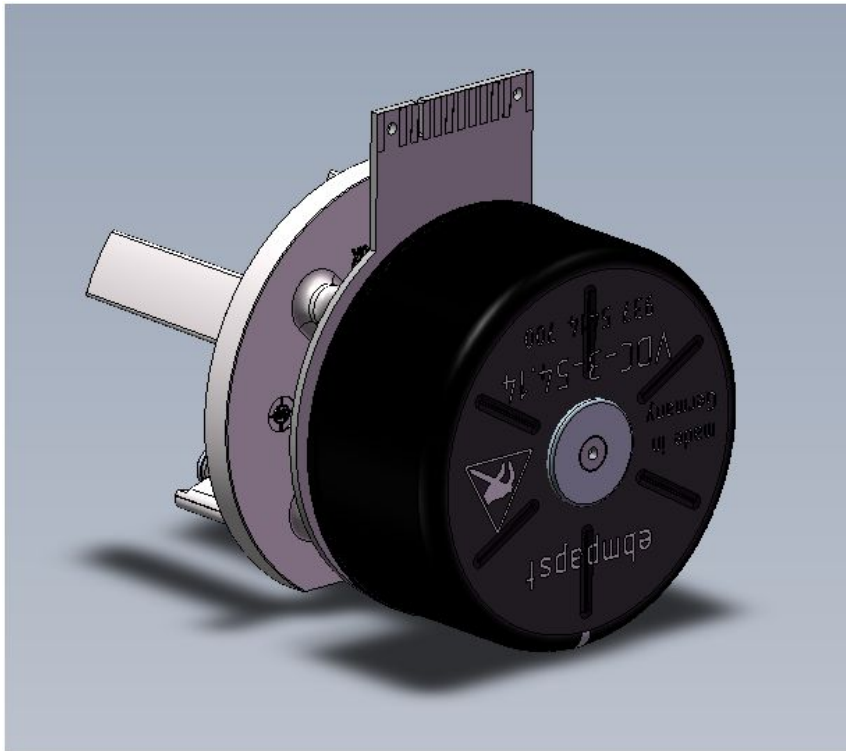


### Functions of the Degassing Pump

- Creates a negative degassing pressure
- Pumps fluid with two interlocked gears
- The gears are driven by a magnet
- The pump can only pump water
- If the pump speed is too low the heater is turned off
- Degassing pressure should be between -500 mmHg to -550 mmHg
- Normal speed is around 2100 rpm

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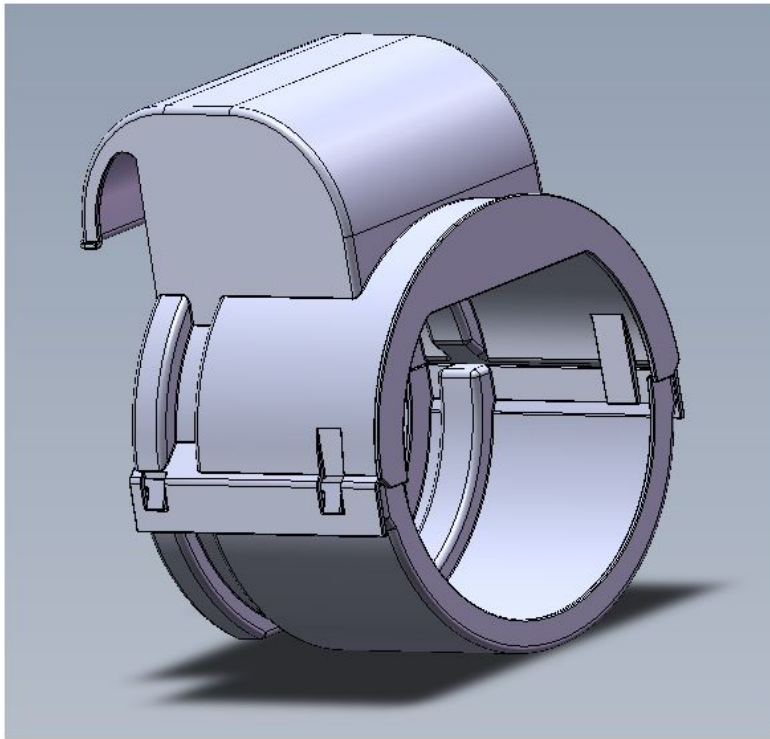
## Degassing Motor



### Functions of the Degassing Motor

- Drives the degassing pump
- Onboard driving circuits
- Is regulated by the degassing pressure

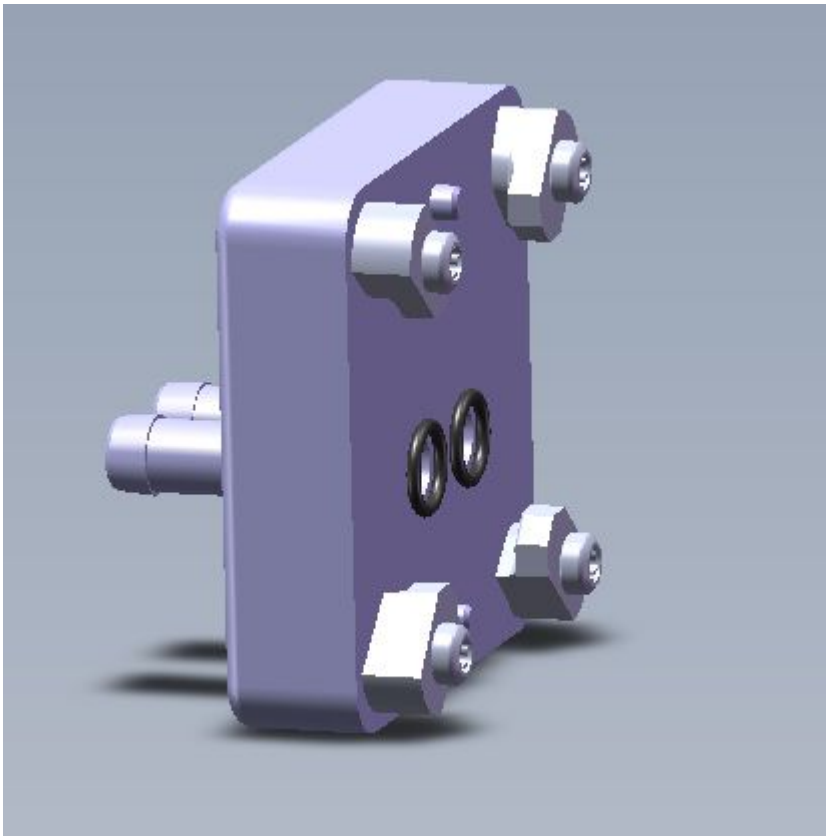
## Degassing Motor Cover



### Functions of the Degassing Motor Cover

- Protects the moving parts of the motor
- Protects the electronics of the motor

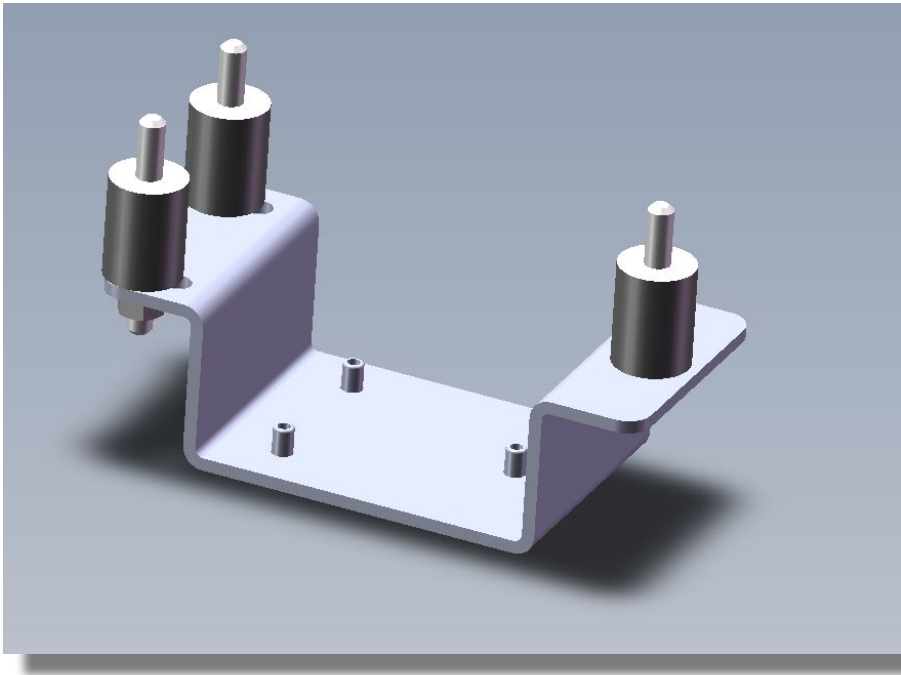
## Degassing Adapter Block



Function of the Adapter Block

- Mounting of the degassing pump
- O-rings to seal the connection with the motor
- Four clips to hold the pump head

## Degassing Pump Foot Piece

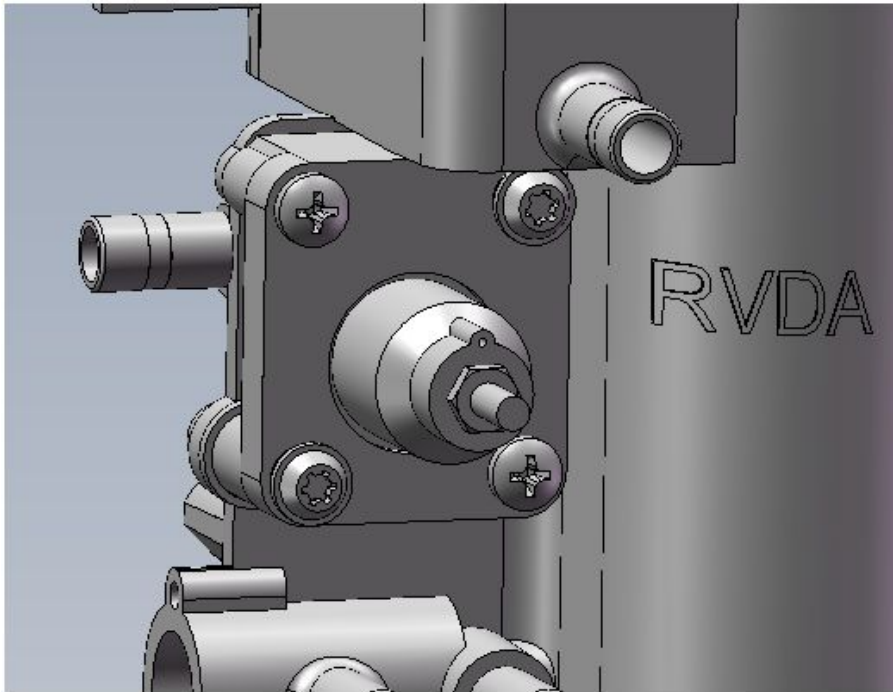


### Functions of the Foot Piece

- Holds the degassing pump module
- Absorbs vibrations from the pump
- Reduces the sound volume

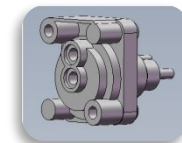


## RVDA



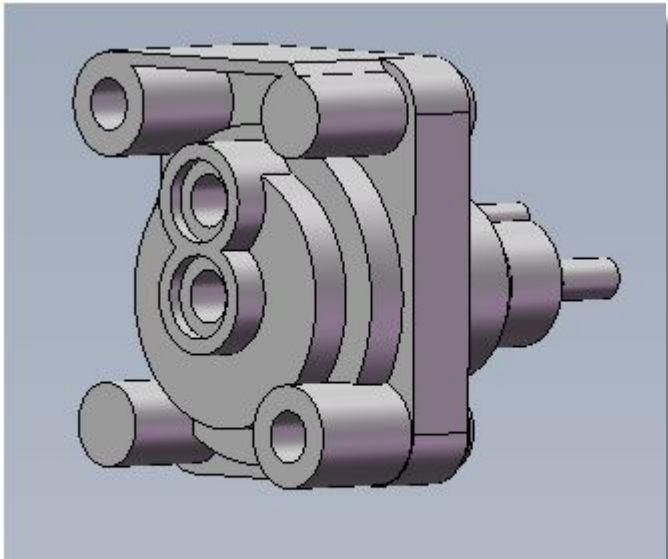
## Functions of the RVDA

- Ensures a minimum pressure of 400 mmHg on the balance chamber
- Must be set to 500 mmHg for HDF-Online machines



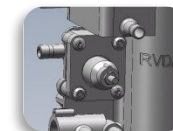
Back

## RVDA



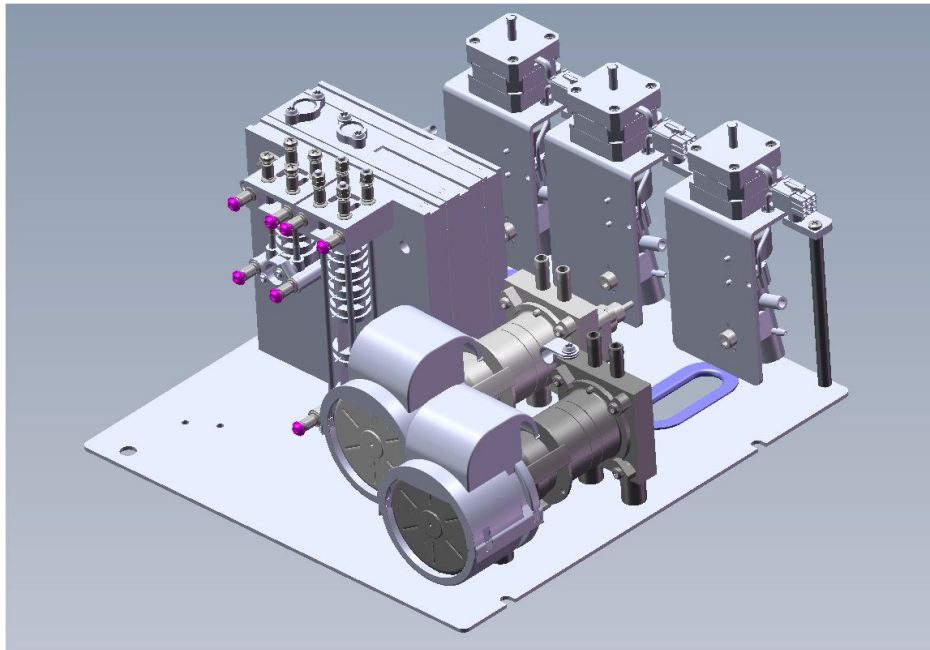
Rear view of the RVDA

- Pay attention to the assembly direction



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## DF Sub-Rack



## Functions of the DF Sub-Rack

- Contains the pumps that push water in and out of the balance chamber
- Responsible for mixing the dialysate fluid
- Contains the piston pumps
  - Concentrate pump
  - Bicarbonate pump
  - UF pump

Flow Pump Inlet

Flow Pump Outlet

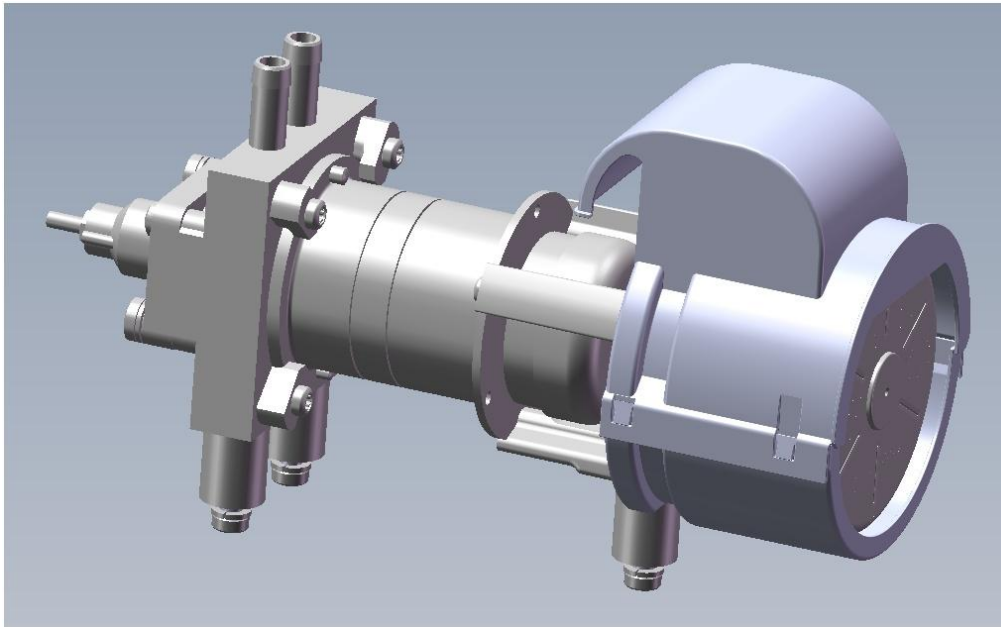
DF Block

Concentrate Pumps

UF Pump

Back

## Inlet Flow Pump



### Functions of the FPE

- Pumps fresh dialysate into the balance chamber
- Pumps used dialysate to the drain
- Creates a high positive pressure for the DFS pressure test

RVFPE

Adapter Block

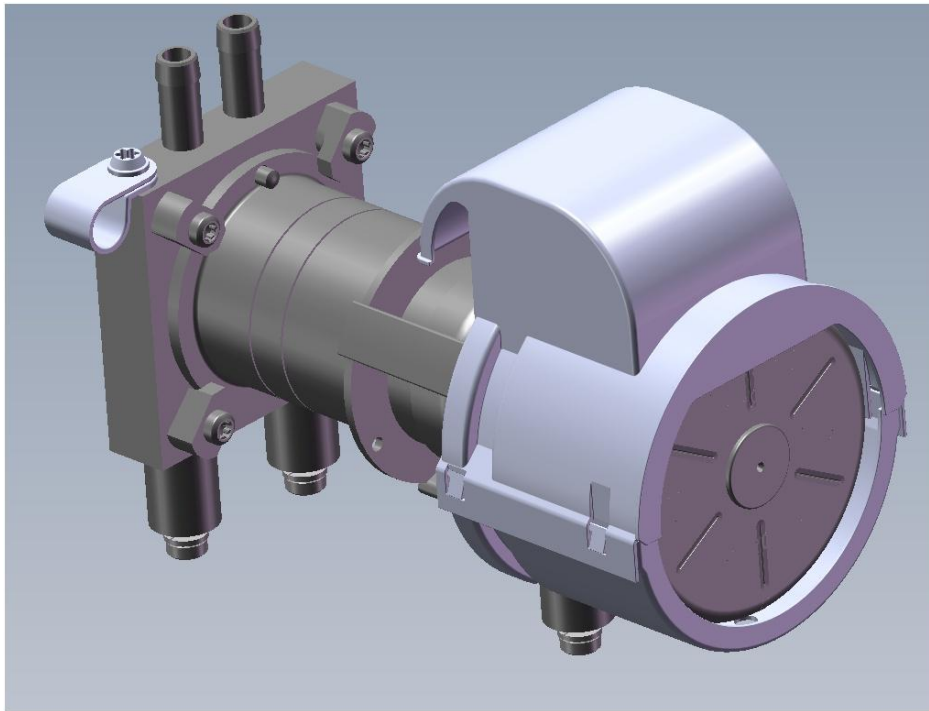
Gear Pump

Motor

Cover

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## Outlet Flow Pump

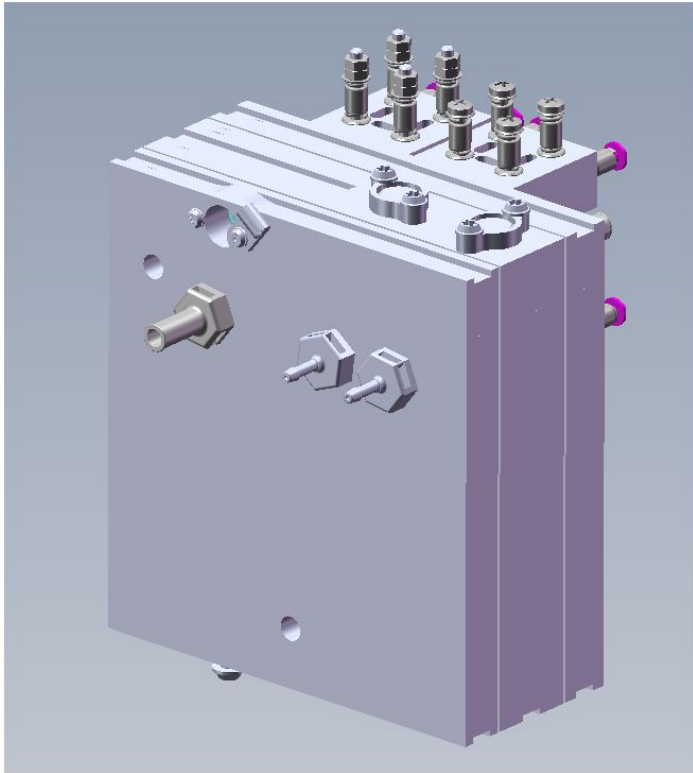


### Functions of the FPA

- Pumps used dialysate from the dialyser to the balance chamber
- Creates a negative pressure for the tests of the HDF Online system
- Creates a negative pressure for the VBICP test at the end of disinfection

[Adapter Block](#)[Gear Pump](#)[Motor](#)[Cover](#)[Back](#)

## DF Block



## Functions of the DF Block

- Measures conductivity
- Measures temperature
- Mixes the dialysate fluid

Inner View

Rear View

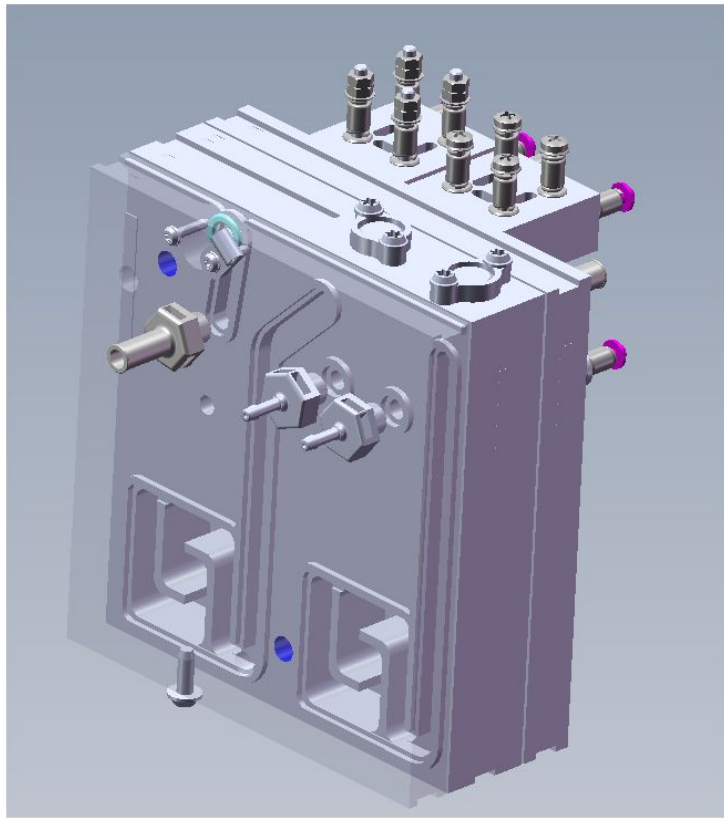
Temperature Sensor

RVK &amp; RVB

Back



## DF Block



## Functions of the DF Block

- Measures conductivity
- Measures temperature
- Mixes the dialysate fluid

Front View

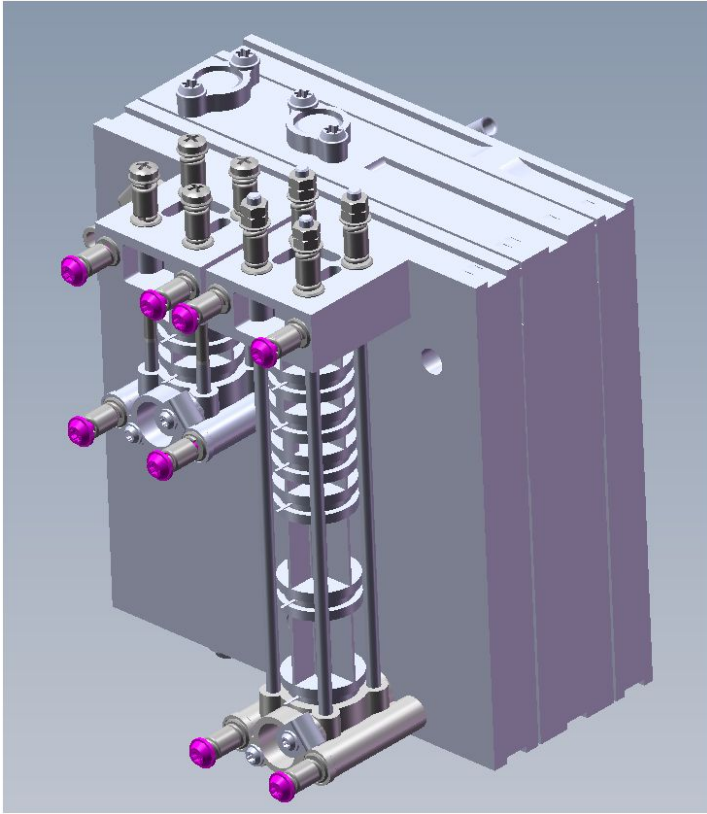
Rear View

Back

Temperature Sensor

RVB &amp; RVK

## DF Block



## Functions of the DF Block

- Measures conductivity
- Measures temperature
- Mixes the dialysate fluid

Inner View

Front View

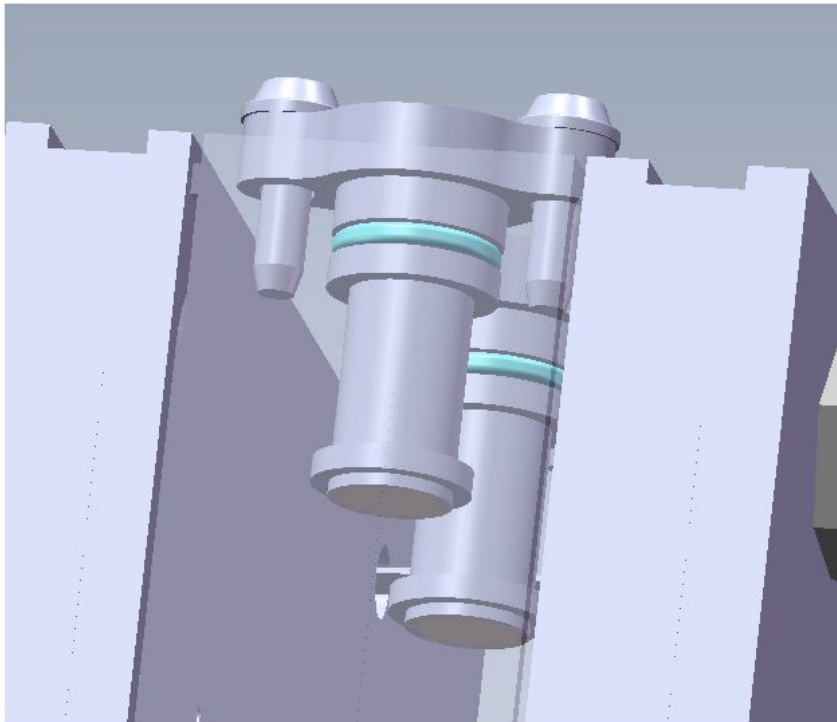
Temperature Sensor

RVB &amp; RVK

Conductivity Sensors

Back

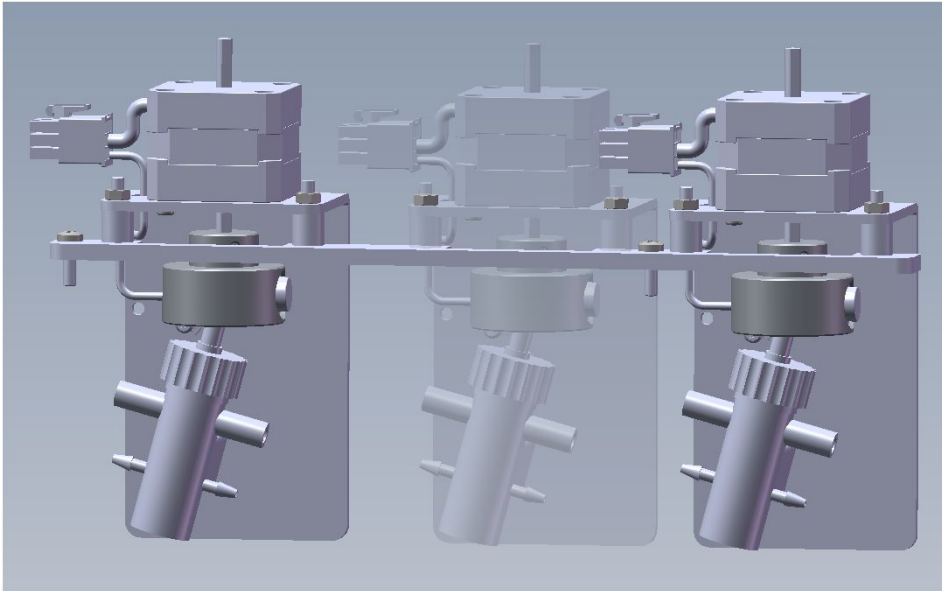
## RVB &amp; RVK



## Functions of RVB and RVK

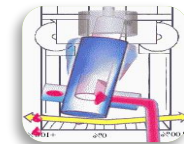
- Absorbs the shock from the piston pumps
- This causes a steady inflow of concentrate and bicarbonate
- Stabilizes conductivity
- Contains a 500 mmHg spring

## Concentrate and Bicarbonate Pumps

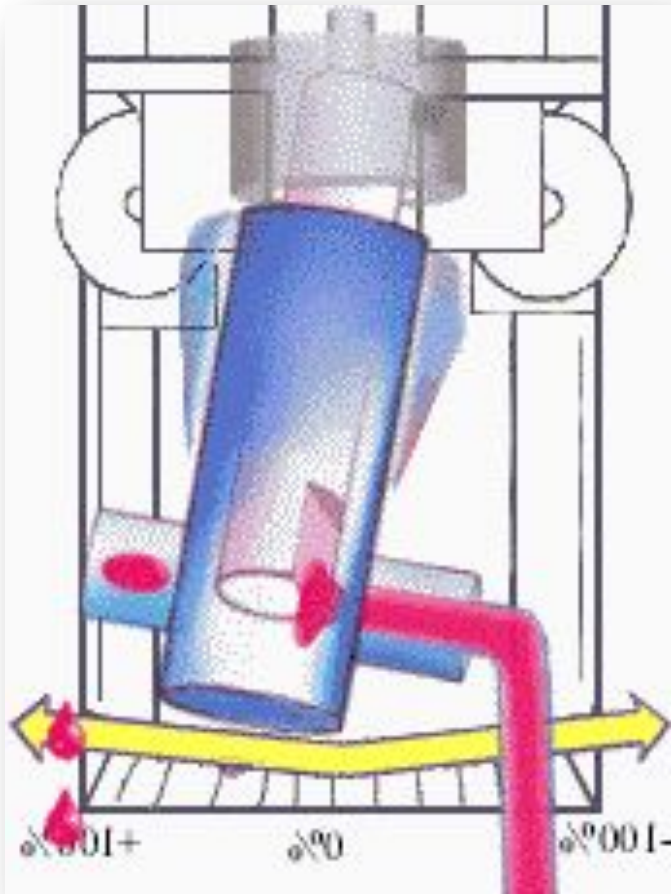


### Pump Functions

- Pumps concentrate and bicarbonate into the DF block
- Normal speed is 60 to 70 rpm
- Consists of
  - Pump body
  - Bell joint
  - Hall sensor
  - Motor
- The speed is regulated by the conductivity cells

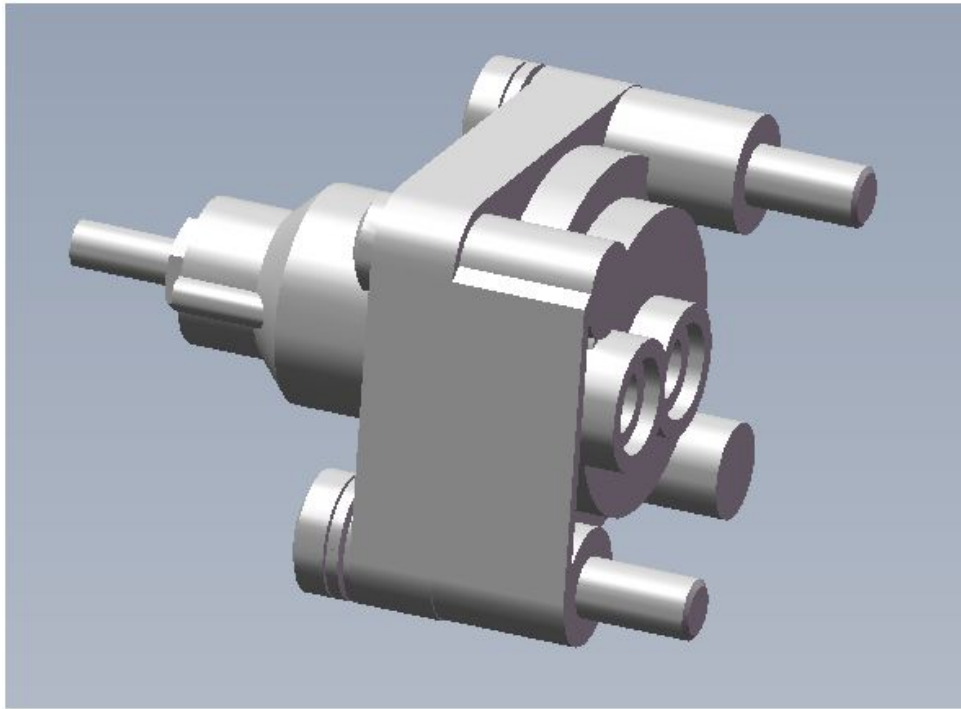
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## Working concept of the Piston Pump



- Fluid is sucked in on the one side of the pump.
- By rotating the shaft fluid is pushed out the other side of the pump.
- The volume for each stroke is the same.

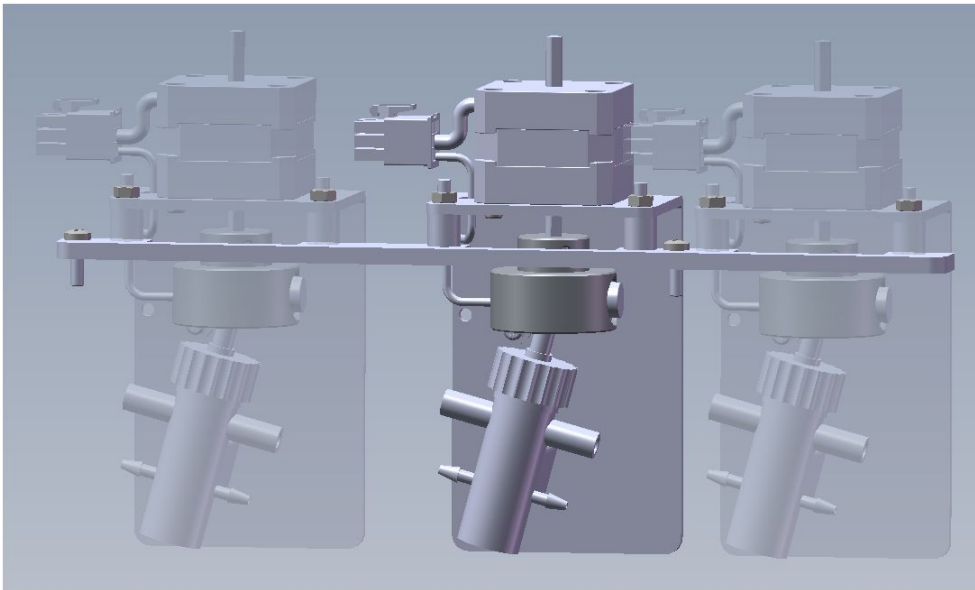
## RVFPE



## Functions of the RVFPE

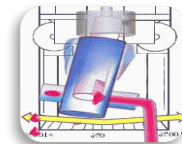
- Prevents an over pressure
- Set to 1.3 bar
- Prevents tubes from popping off

## UF Pump



## UF Pump Functions

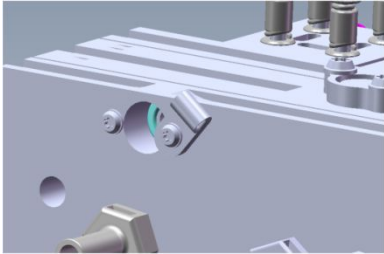
- Pumps the UF volume to drain
- Removes fluid from the patient
- Calibrated accurately
- Tolerance of  $<1\%$
- Consists of
  - Pump body
  - Bell joint
  - Hall sensor
  - Motor



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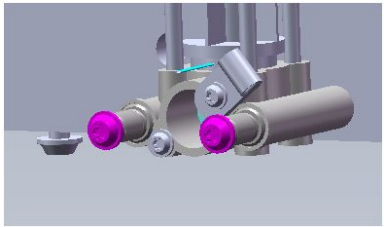


## Temperature Sensors



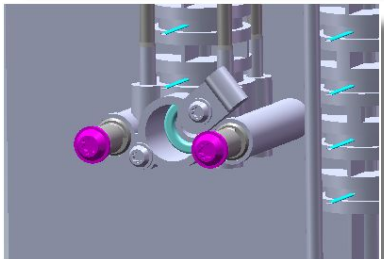
### Functions of TSD\_S

- Measures the temperature for ENDLF\_S
- Is used to compensate the conductivity measurement
- Should be equal to TSD



### Functions of TSD

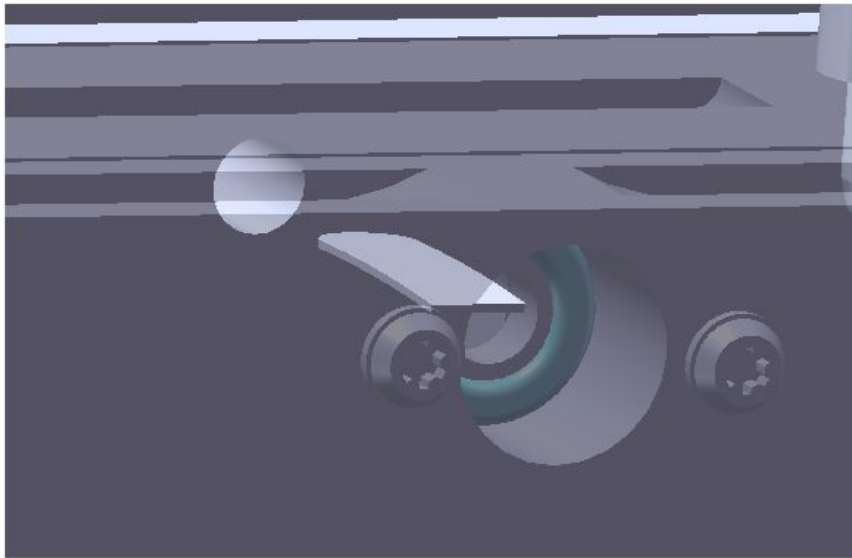
- Measures the temperature for ENDLF
- Is used to compensate the conductivity measurement
- Should be equal to TSD\_S



### Functions of TSBIC

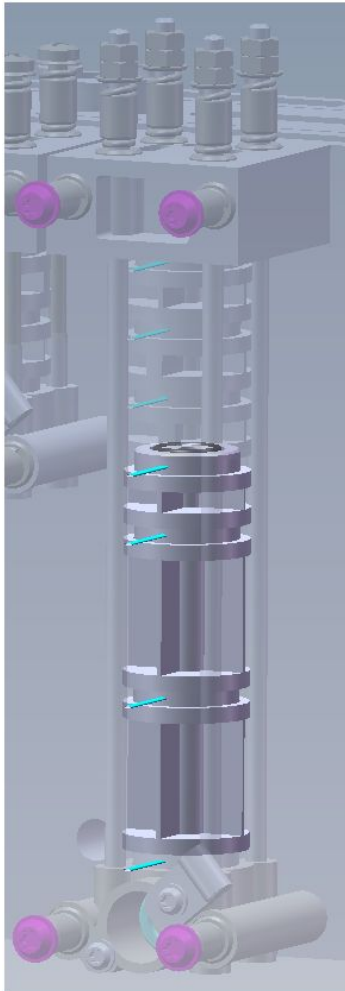
- Measures the temperature for TSBIC
- Is used to compensate the conductivity measurement
- Should be slightly warmer than TSD

## Turbulence Spacer



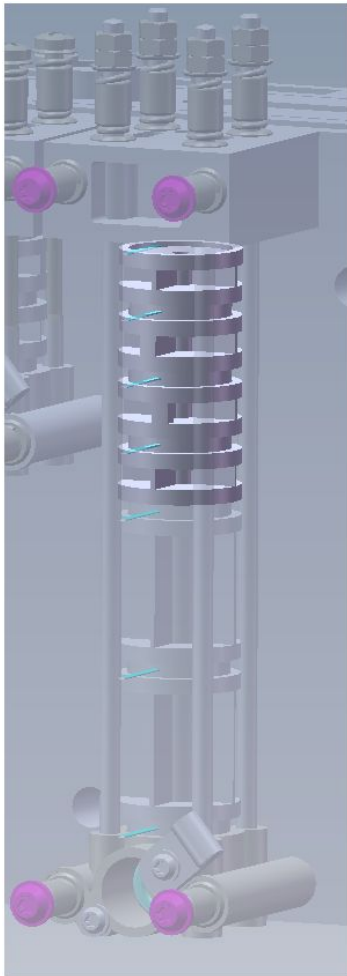
### Functions of the Turbulence Spacer

- Creates turbulence on the temperature sensor
- Removes dead spaces from the sensor

**ENDLF****Functions of the Final Conductivity Sensor**

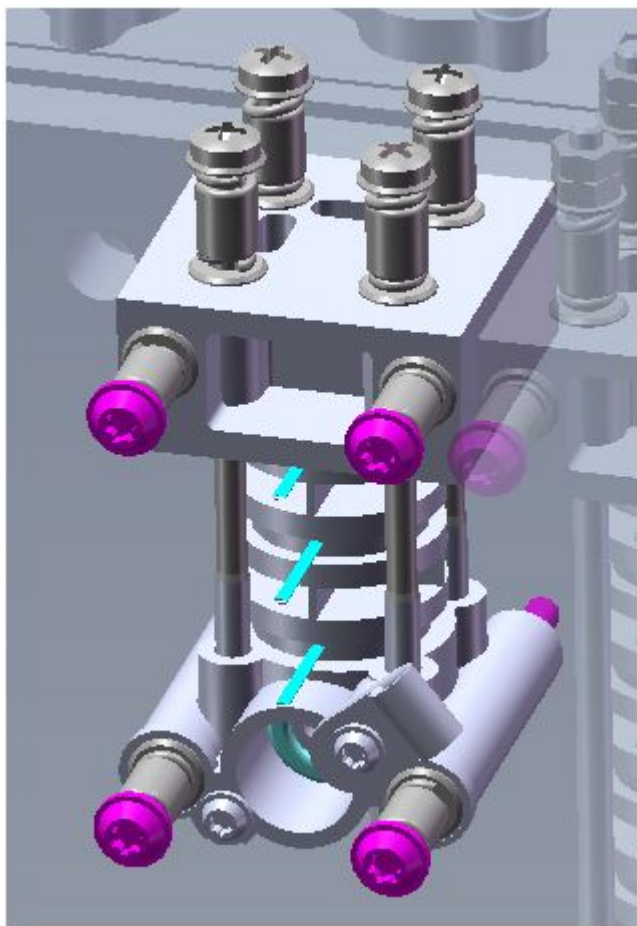
- Measures the final conductivity
- The conductivity controls the speed of the concentrate pump
- Is dependent on TSD

## ENDLF\_S



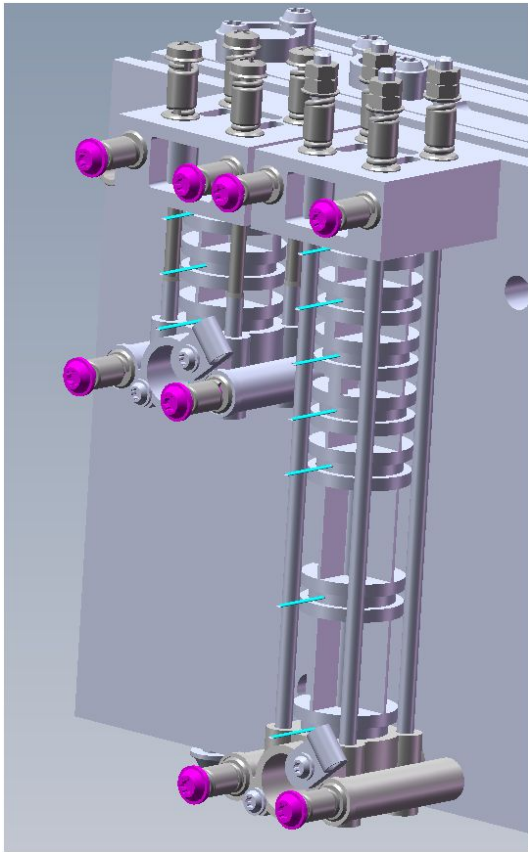
Functions of the Final Conductivity Sensor for the Supervisor

- Measures the final conductivity
- Is dependent on TSD\_S

**BICLF****Functions of the Bicarbonate Conductivity Sensor**

- Measures bicarbonate conductivity
- The conductivity controls the speed of the bicarbonate pump
- Is dependent on TSBIC

## Conductivity Sensors



Functions of the conductivity cells

- ENDLF measures the final conductivity
- ENDLF\_S supervises the ENDLF
- BICLF measures the bicarbonate conductivity
- Conductivity is dependent on temperature

Conductivity Regulation

BICLF

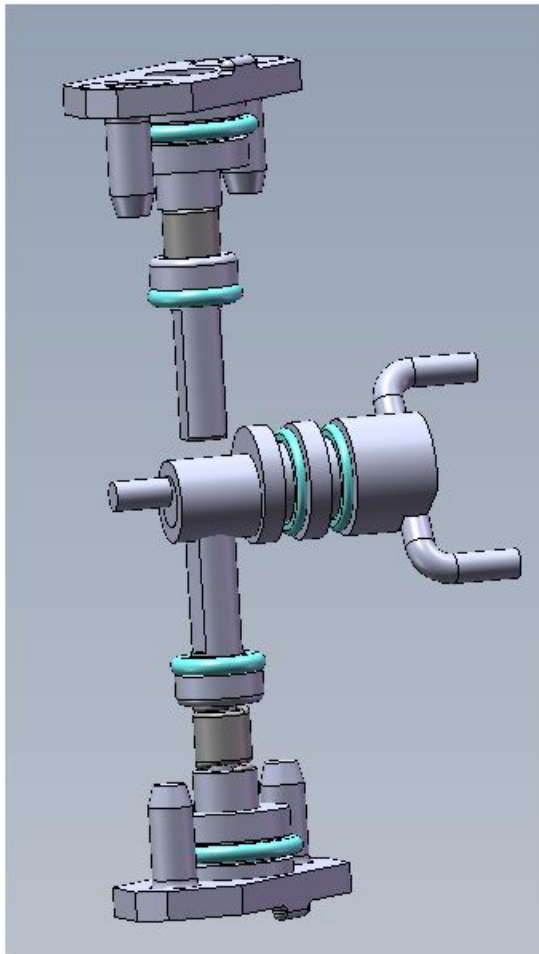
ENDLF

ENDLF-S

Temperature Sensors

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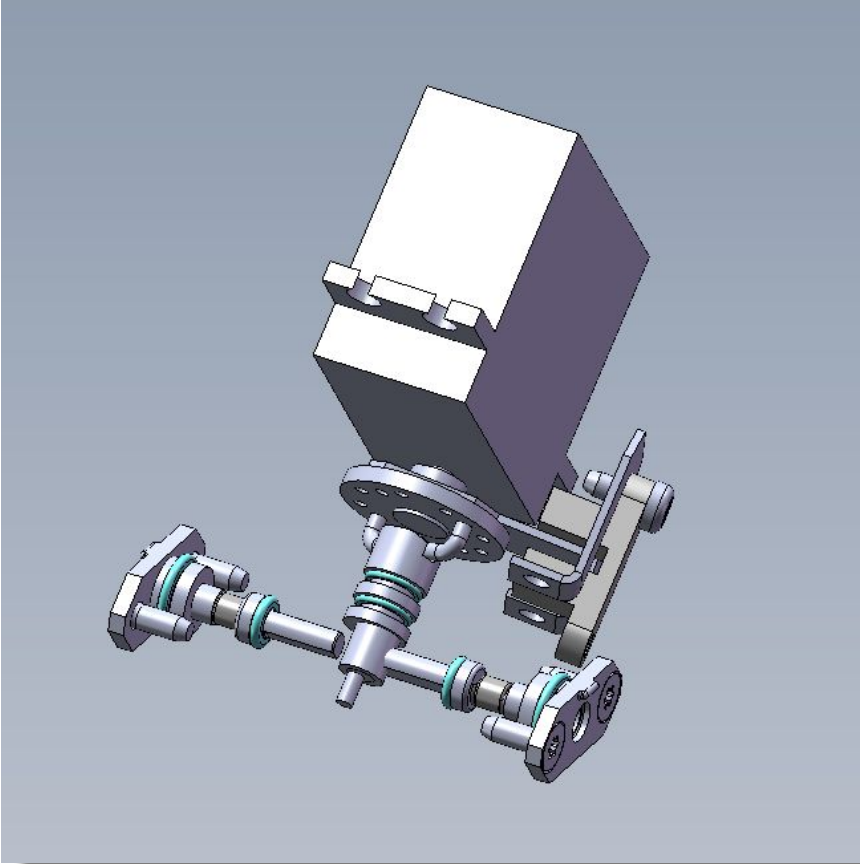
## O-Rings of the Disinfection Valve



### Function of the O-Rings

- Lower O-ring: seals off the disinfection port from the dialysate lines
- Upper O-ring: prevents the machine from sucking air when disinfectant is taken into the machine

## Disinfection Valve



### Functions of the Disinfection Valve

- Opens when the machine needs to suck in disinfectant
- Closes to allow air back into the disinfection tube
- Is controlled by a servo motor

Disinfection Procedure

Disinfection Valve

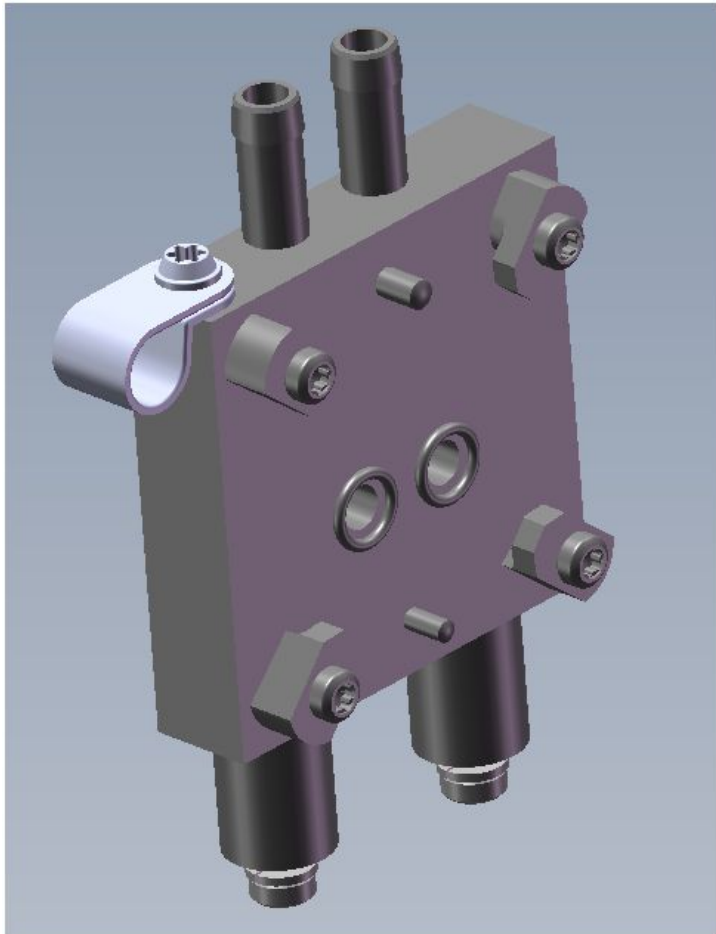
Light Barrier

Servo Motor

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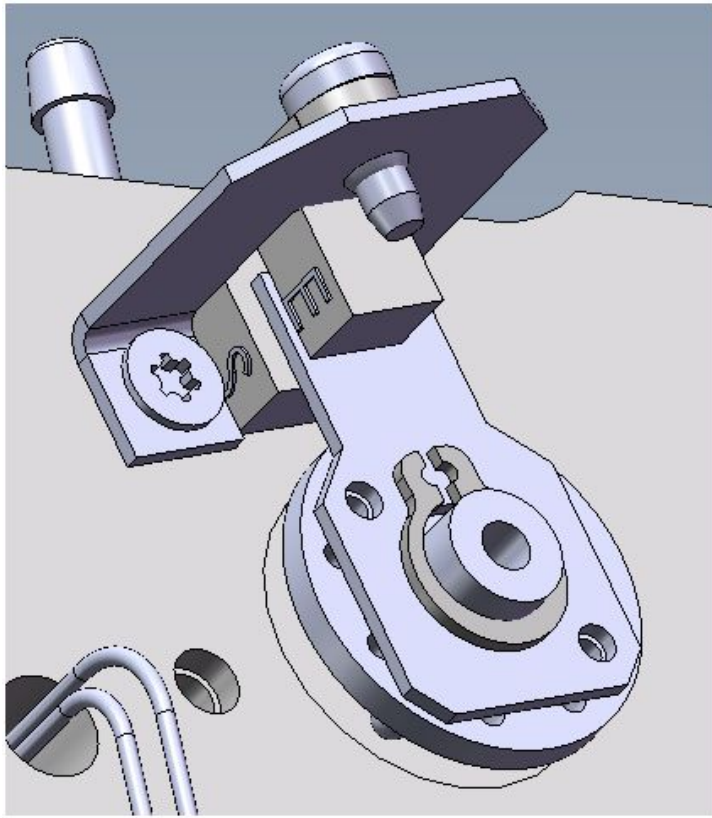
## FPA Adapter Block



### Functions of the FPA Adapter Block

- Mounts the FPA
- Absorbs vibrations for noise reduction

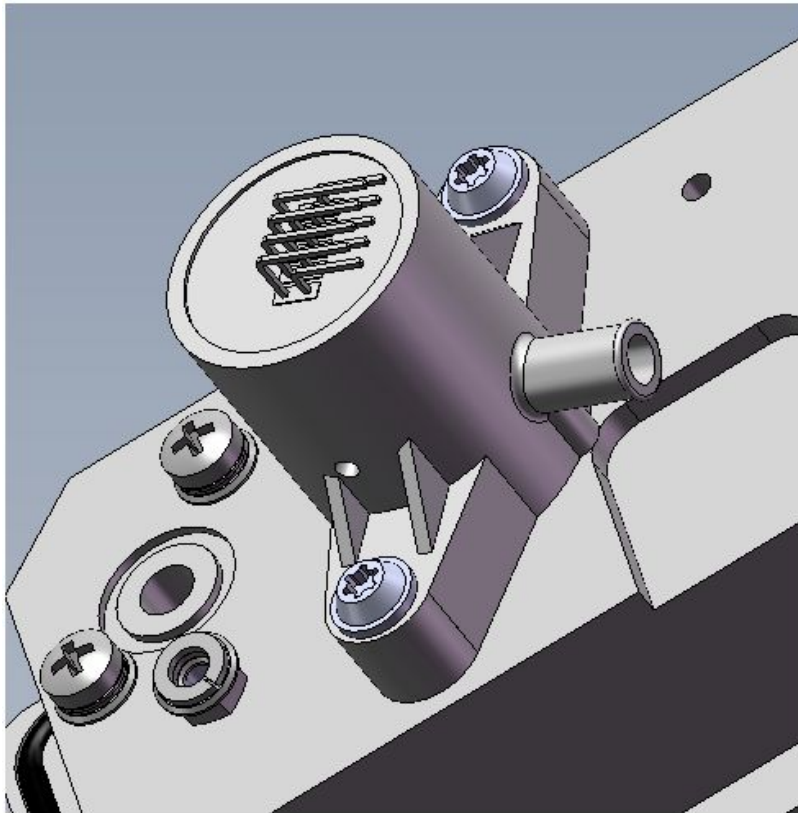
## Light Barrier



### Function of the Light Barrier

- Senses the position of the disinfection valve

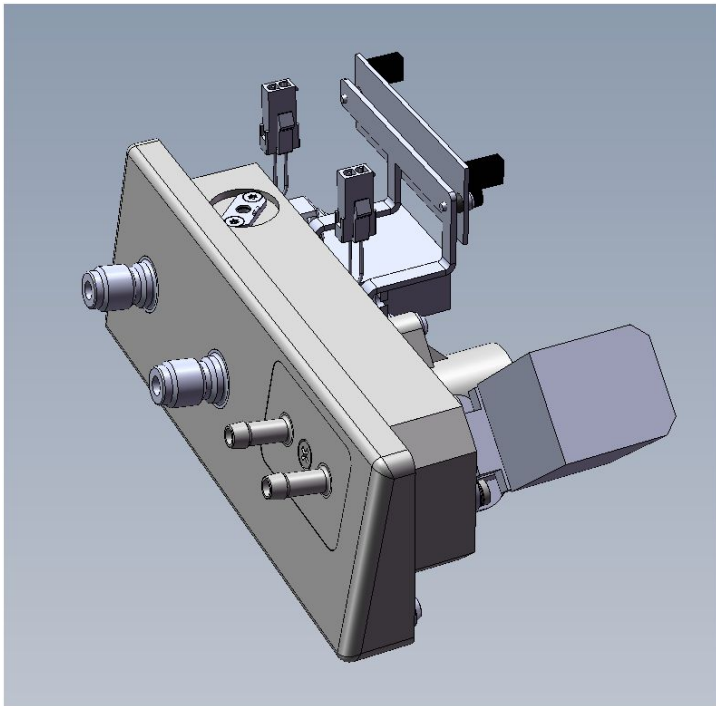
## Pressure Sensor Dialysate



### Functions of PDA

- Measures the dialysate pressure
- This is used to calculate TMP
- Used as testing device during the DFS Pressure Test
- Large working range
- The same type of sensor as PE

## Rinsing Bridge



### Functions of the Rinsing Bridge

- Contains the disinfection valve
- Contains the dialysate pressure sensor
- The dialyser couplings are connected to the rinsing bridge

Dialysate Pressure Sensor

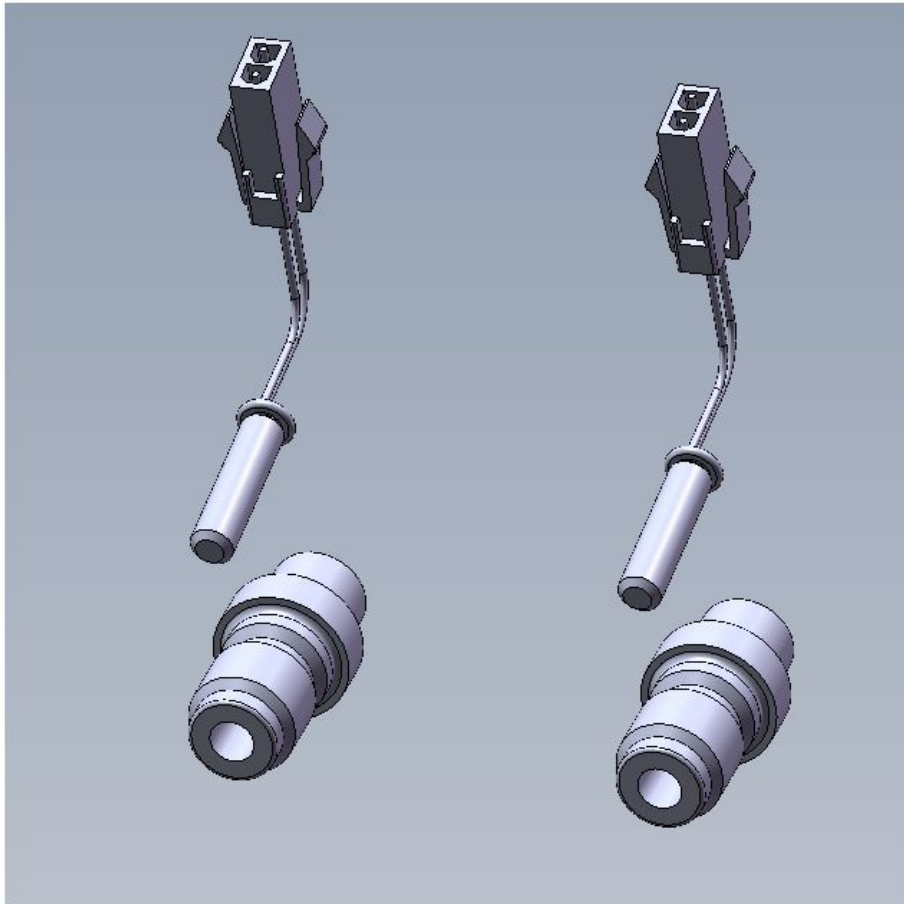
Servo Motor

Rinsing Bridge Sensors

Disinfection Valve

Back

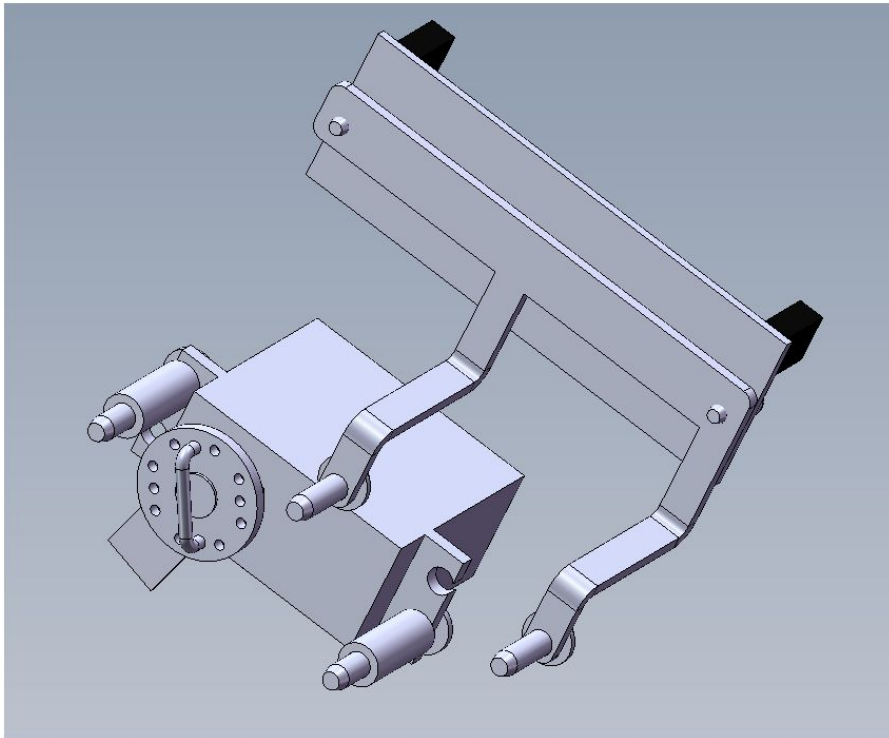
## Rinsing Bridge Sensors



### Function of the Sensors

- Detects whether the dialyser couplings are connected to the rinsing bridge

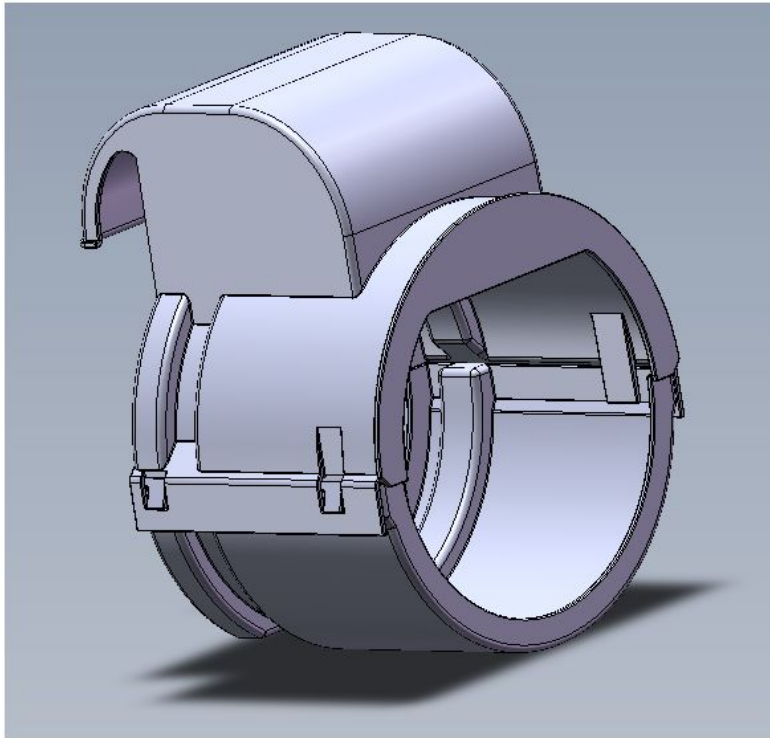
## Servo Motor and Controller Board



### Function of the Servo Motor

- The motor opens and closes the disinfection valve
- A flag moves into the light barrier when the valve is closed
- The electronics of the motor is also mounted on the rinsing bridge

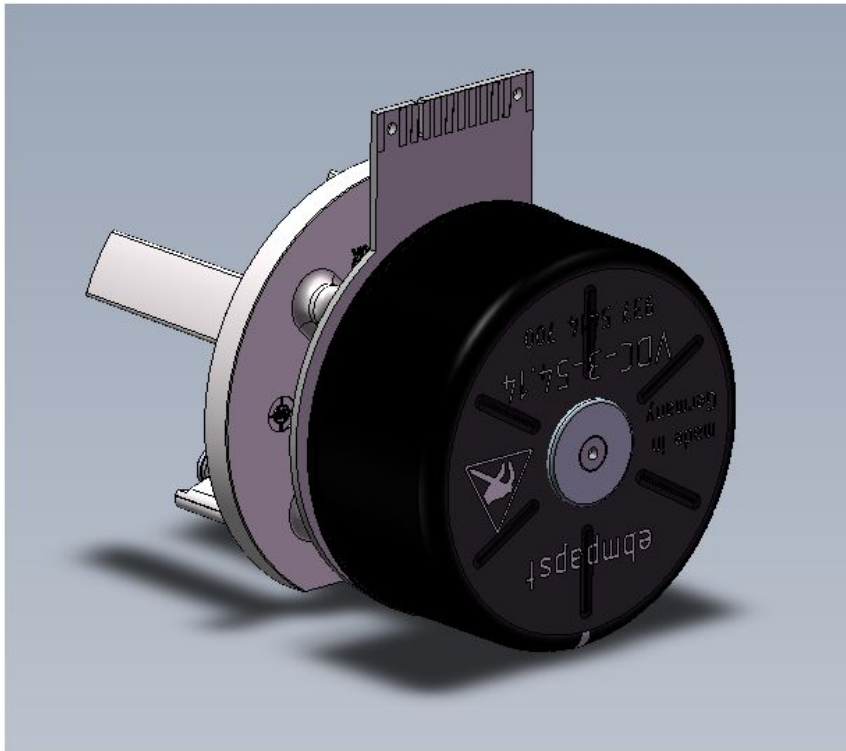
## FPE Motor Cover



### Functions of the FPE Motor Cover

- Protects the moving parts of the motor
- Protects the electronics of the motor

## FPE Motor

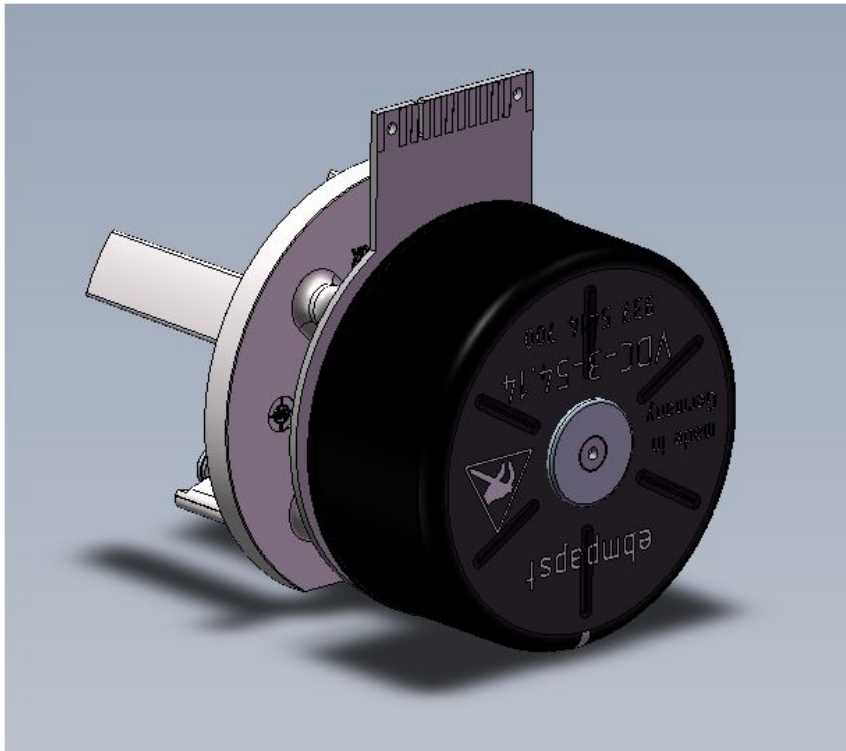


### Functions of the FPE Motor

- Drives the Flow Pump Inlet pump
- Onboard driving circuits
- Is regulated by the movement of the membranes



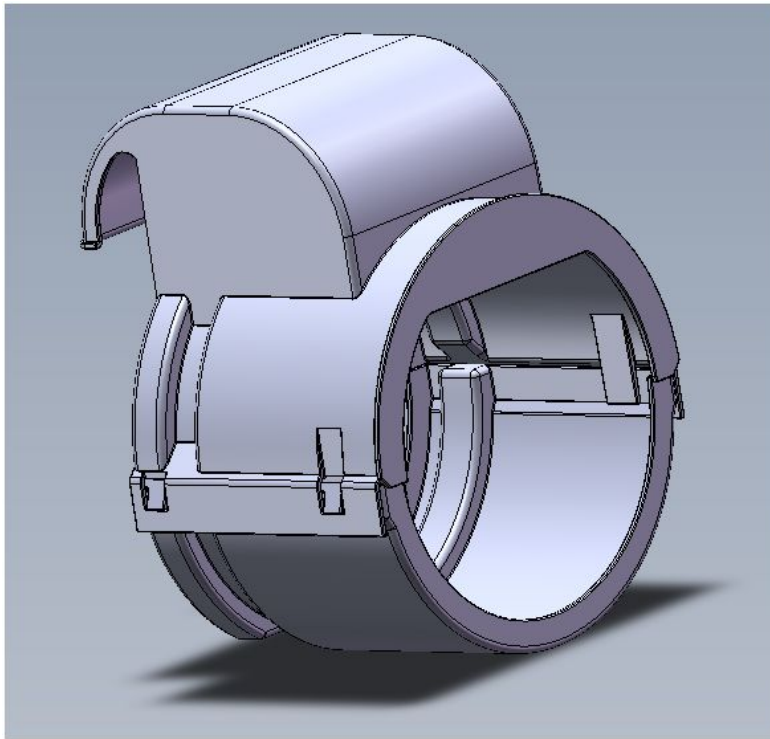
## FPA Motor



### Functions of the FPA Motor

- Drives the outlet pump
- Onboard driving circuits
- Is regulated by the movement of the membranes

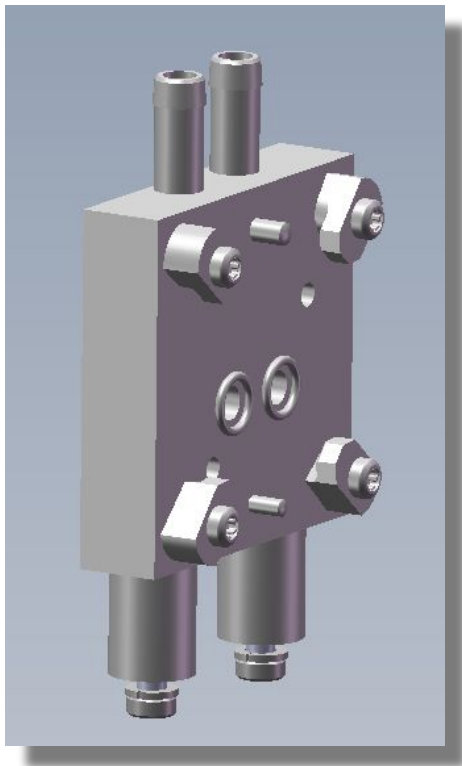
## FPA Motor Cover



### Functions of the FPA Motor Cover

- Protects the moving parts of the motor
- Protects the electronics of the motor

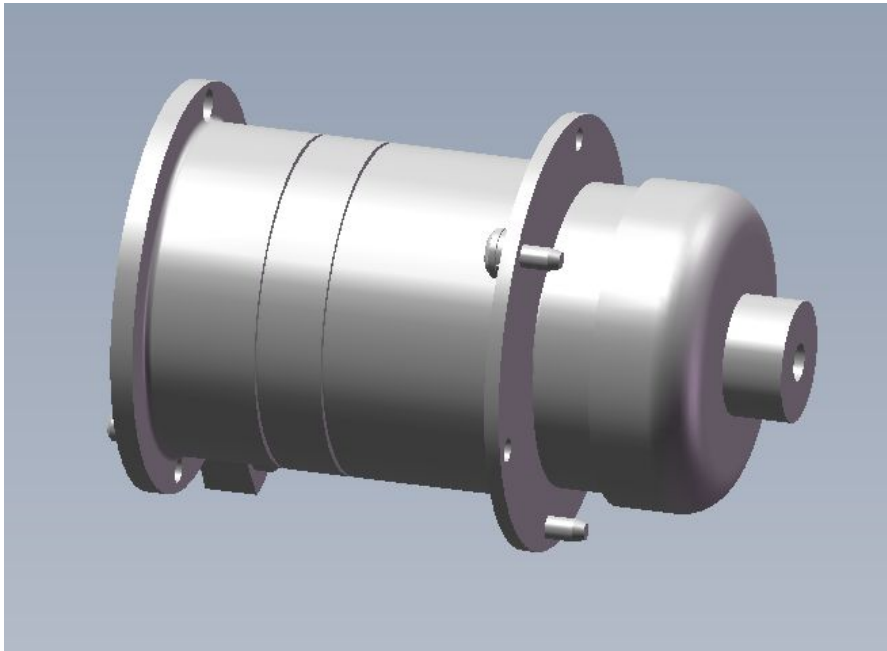
## FPE Adapter Block



### Functions of the FPE Adapter Block

- Mounts the FPE
- Absorbs vibrations for noise reduction

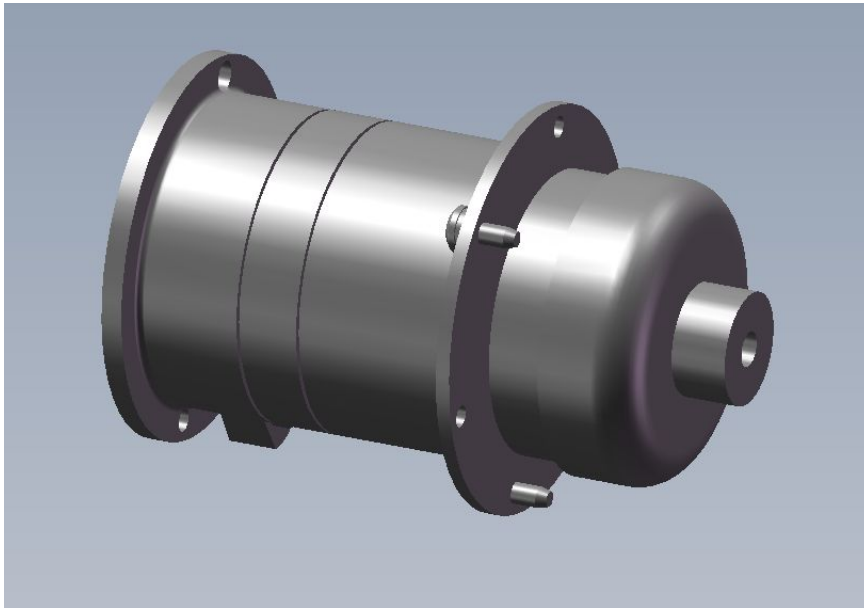
## FPE, Micropump Vers. 1



### Functions of the FPE Pump

- Creates a positive pressure to refill the balance chamber
- Pumps fluid with two interlocked gears
- The gears are driven by a magnet
- The pump can only pump fluid
- A normal speed during treatment is about 1000 rpm if the dialysate flow is set to 500 ml / min.

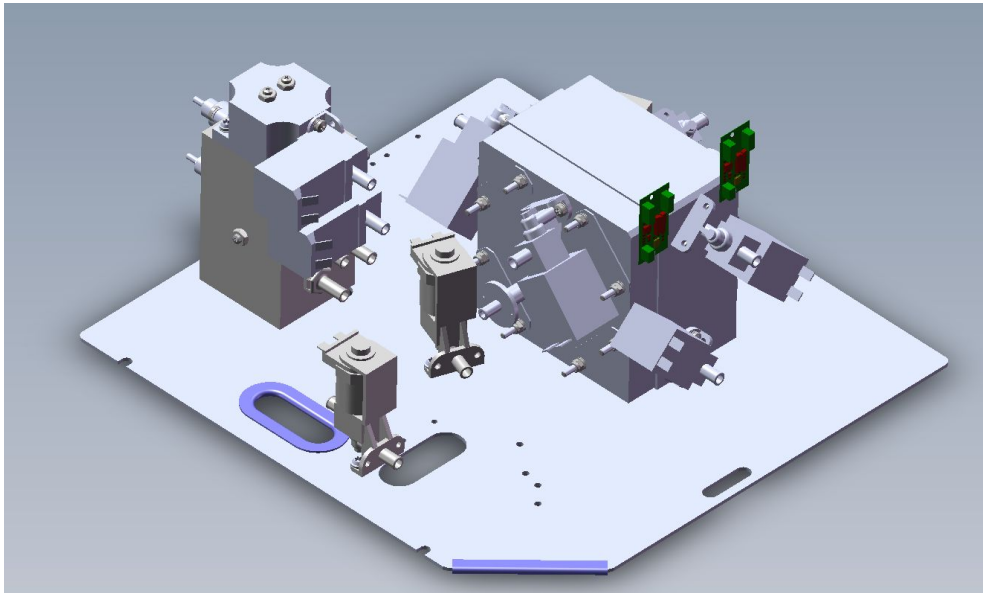
## FPA, Micropump Vers. 1



### Functions of the FPA Pump

- Creates a positive pressure to fill the balance chamber used dialysate
- Pumps fluid with two interlocked gears
- The gears are driven by a magnet
- The pump can only pump fluid
- A normal speed during treatment is about 1000 rpm if the dialysate flow is set to 500 ml / min.

## UF Sub-Rack



## Functions of the UF Sub-Rack

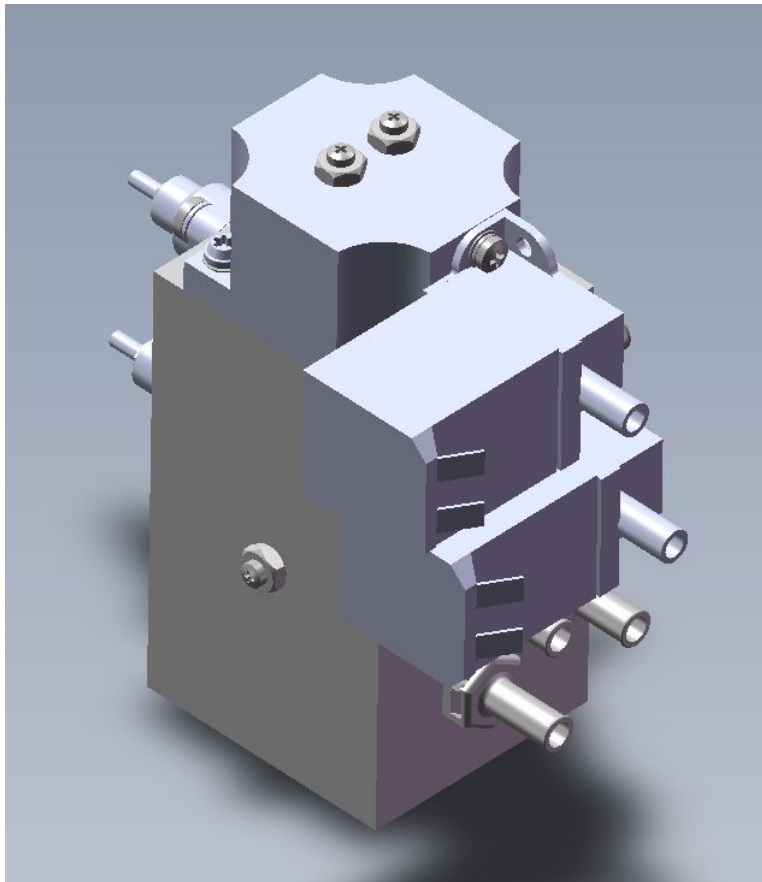
- Contains the balance chamber
- Is responsible for controlling the UF during dialysis
- Contains the air separator

Air Separator

Balance Chamber

Back

## Air Separator



### Functions of the Air Separator

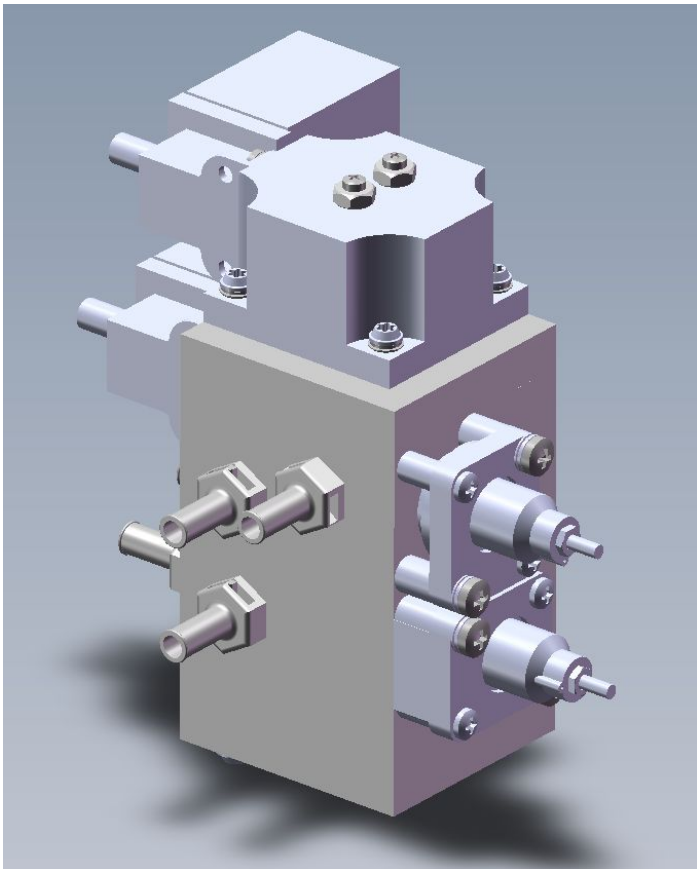
- Prevents air from entering the balance chamber
- Contains VLA and VBP
- Contains DDE and RVFPA

Front View

Level Sensors

Back

## Air Separator

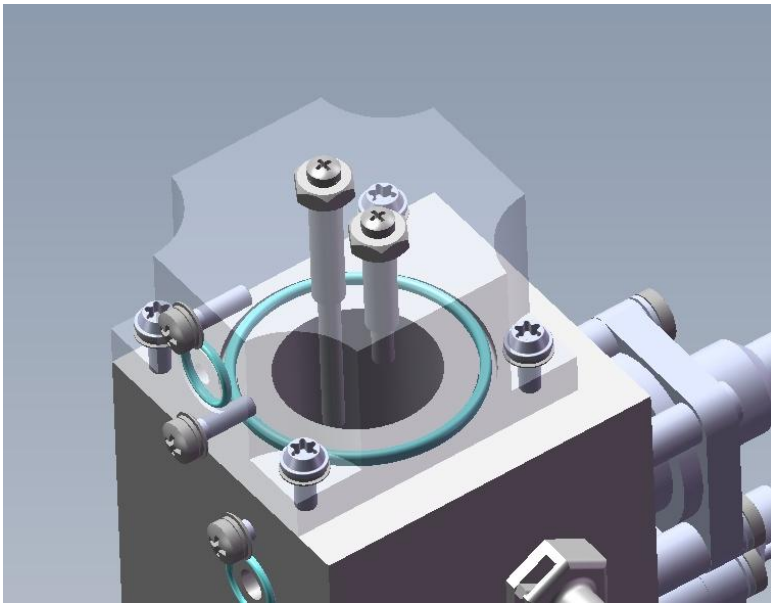


### Functions of the Air Separator

- Prevents air from entering the balance chamber
- Contains VLA and VBP
- Contains DDE and RVFPA



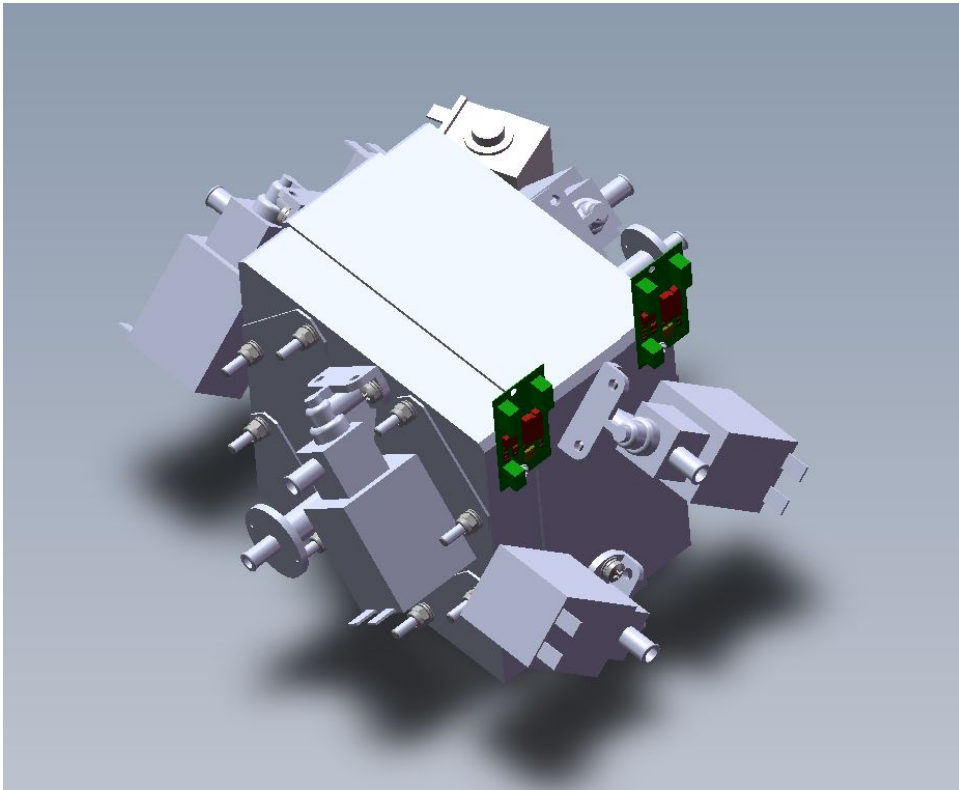
## Air Separator



### Functions of the Air Separator

- There are 2 pins that sense the level of fluid in the air separator
- VLA is opened when air is detected on both sensors
- VLA is closed when the top sensor detects fluid
- The sensors do not work on pure RO Water

## Balance Chamber

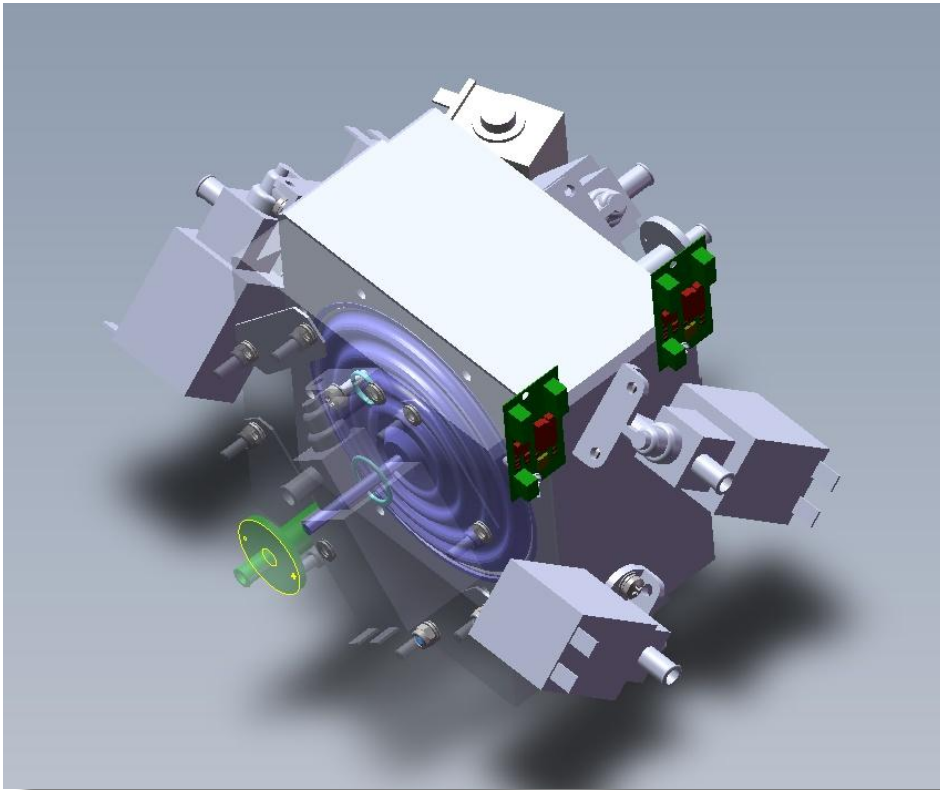


### Functions of the Balance Chamber

- Consists of 2 chambers, with 8 valves
- Induction coils measure the membrane positions

[Inner View](#)[Balance Membranes](#)[Back](#)

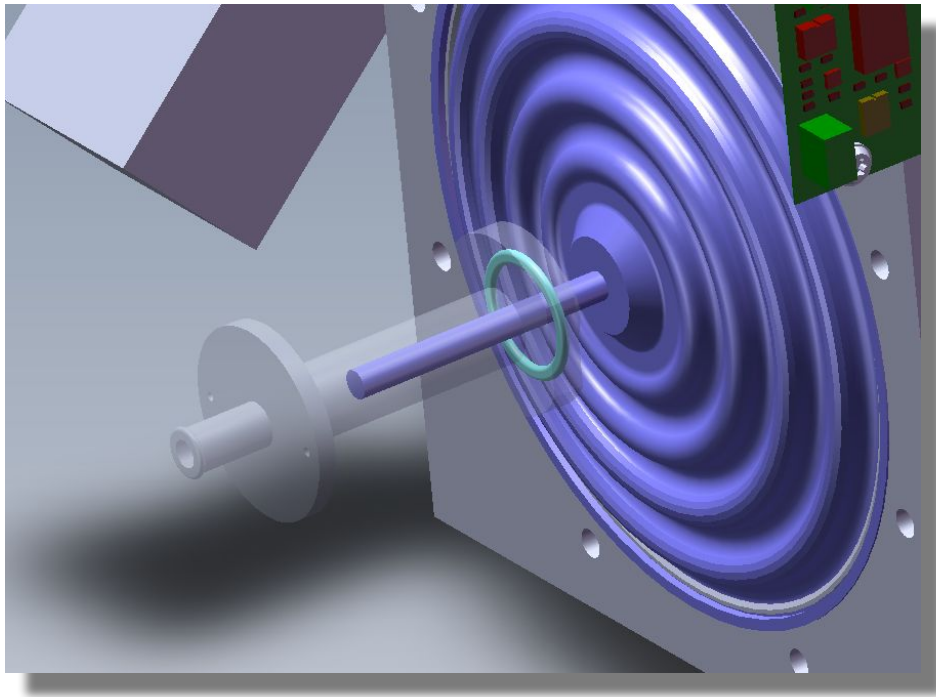
## Balance Chamber Membrane



### Functions of the Balance Chamber Membrane

- Separates fresh and used dialysate
- Controls incoming and outgoing fluid volume
- The position of the membrane is measured with MSBK

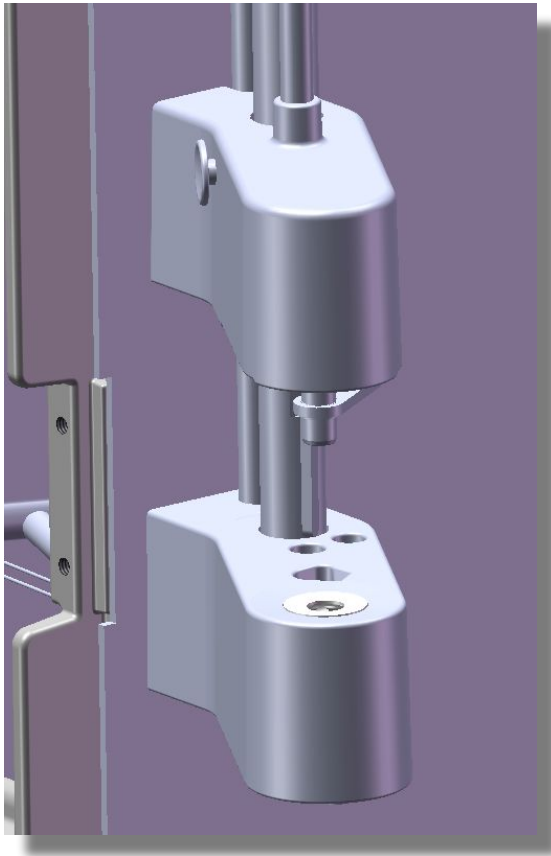
## Membrane Position Sensor



Functions of the membrane position sensor

- Measures the position of the membrane
- Uses induction to sense the position of a metal pin inside the membrane
- The pin moves in and out of the coil in the sensor
- The result is shown in  $\mu\text{s}$ .

## Bicarbonate Cartridge Holder



Please select a part of the cartridge holder that you want to look at.

Functions of the cartridge holder

- Holds the bicarbonate cartridge
- Supplies the machine with fresh bicarbonate

Filling the Cartridge

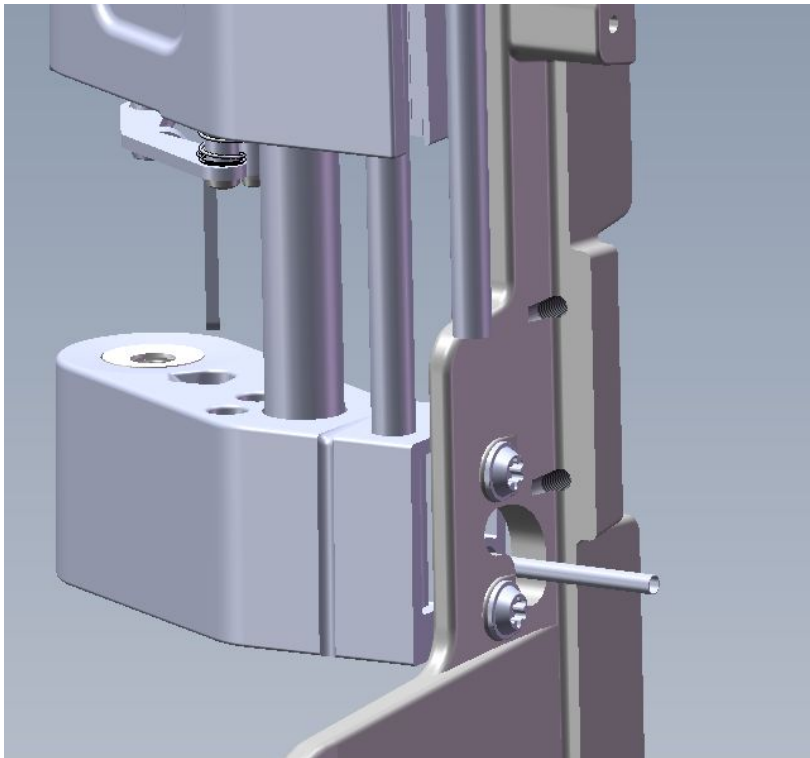
Mounting

Swivel Arm

Check Valve

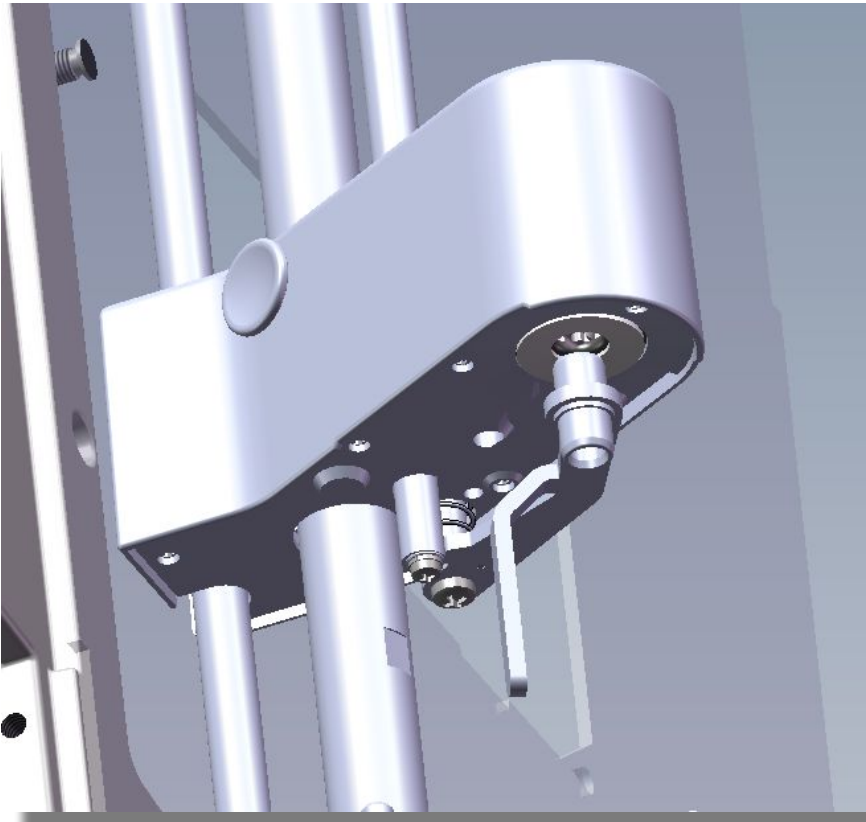
Back

## Mounting



- The cartridge holder is fixed to the housing using 2 screws.
- These screws are accessible from the inside of the machine.
- The IV pole is part of the cartridge holder.

## Swivel Arm

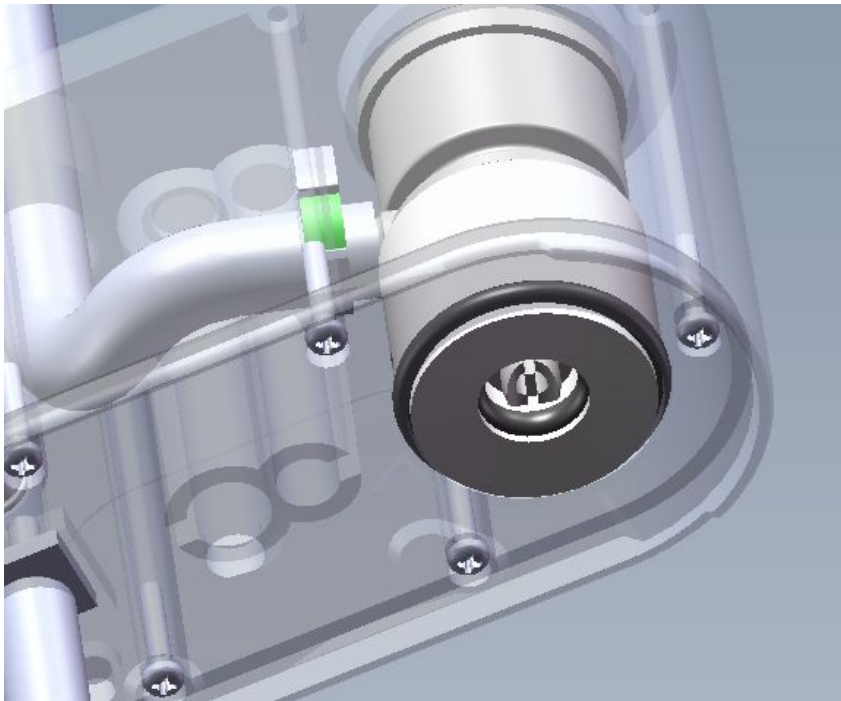


Functions of the swivel arm

- Closes the bicarbonate circuit when no cartridge is inserted
- Opens the check valves

The swivel arm must be adjusted if it is not in the center position

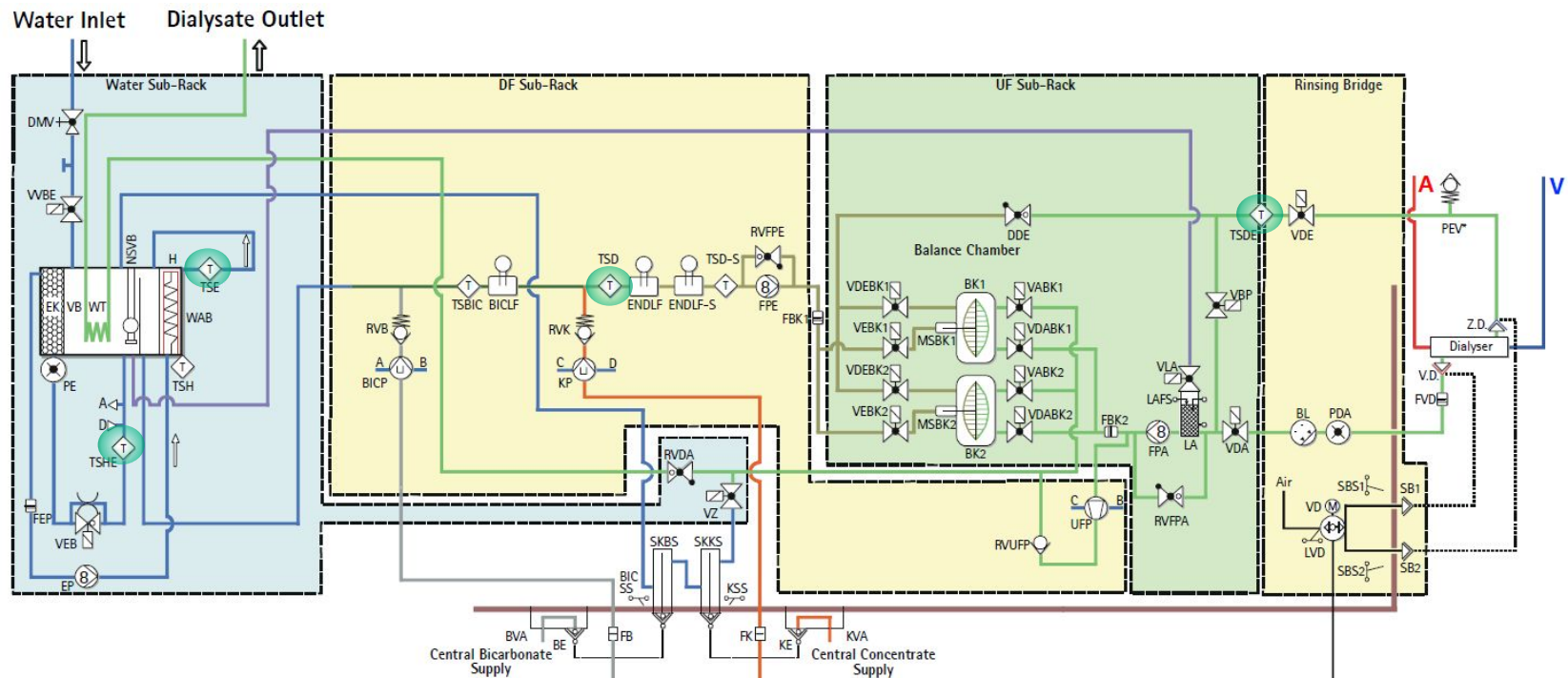
## Check Valve



- The check valve is opened when a cartridge or the swivel arm is inserted.
- There is a O-ring to seal the connection
- A clear silicone O-ring can also be used



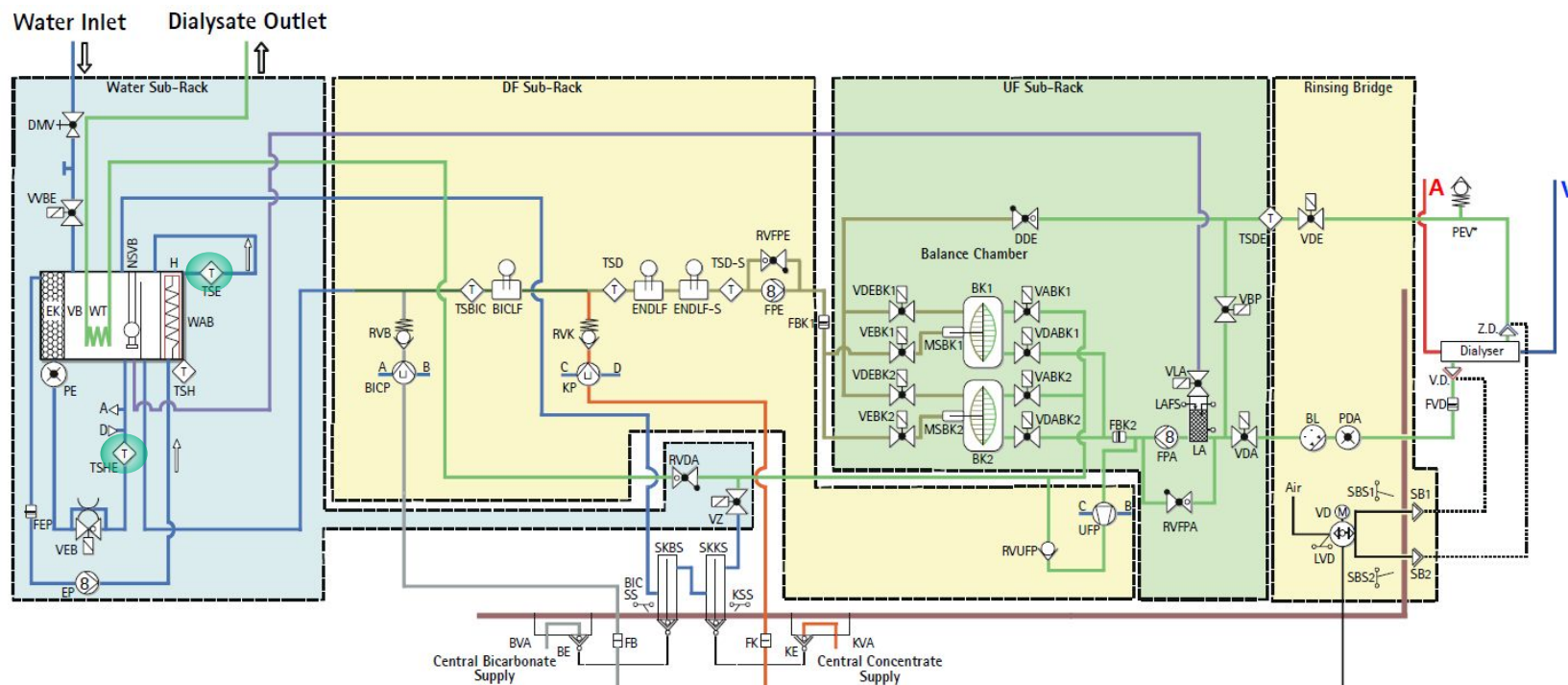
# Temperature Regulation



The temperature regulation is done by the following components

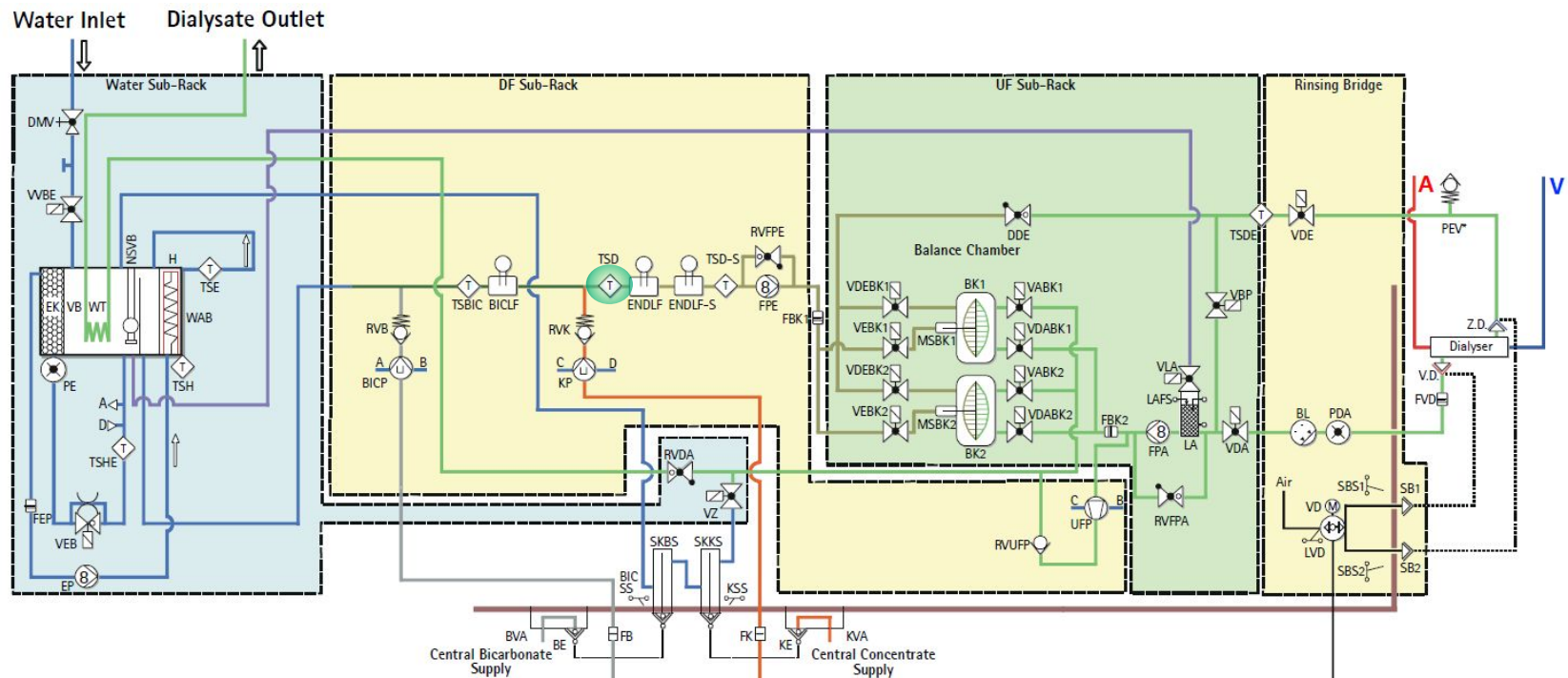
- TSE
- TSHE
- TSD
- TSDE

# Temperature Regulation



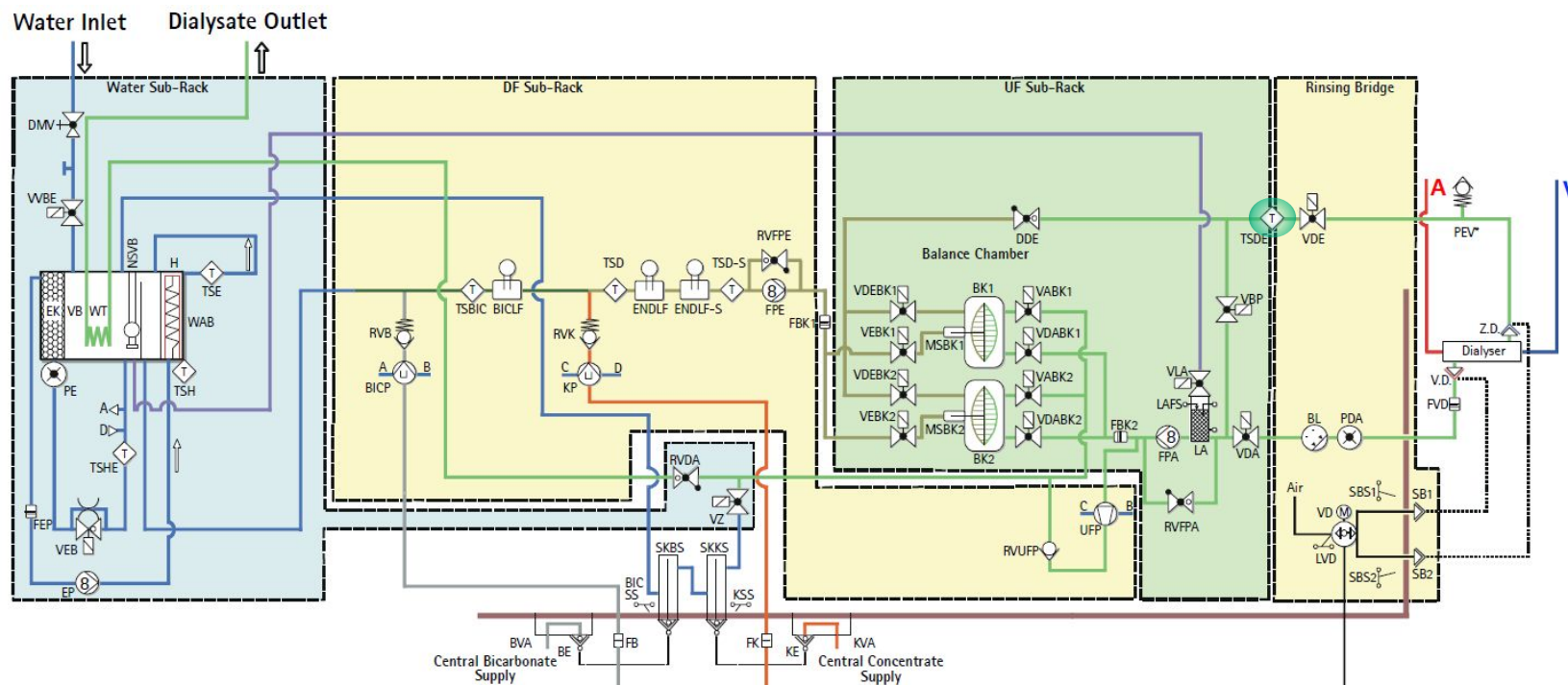
The first temperature regulation is done with TSE. This sensor is used until the temperature is stable. If a sudden flush of cold water reaches TSHE, the heater will be given an extra boost to compensate.

# Temperature Regulation



Once the temperature is stable at TSE, the controller starts to regulate the temperature with TSD.

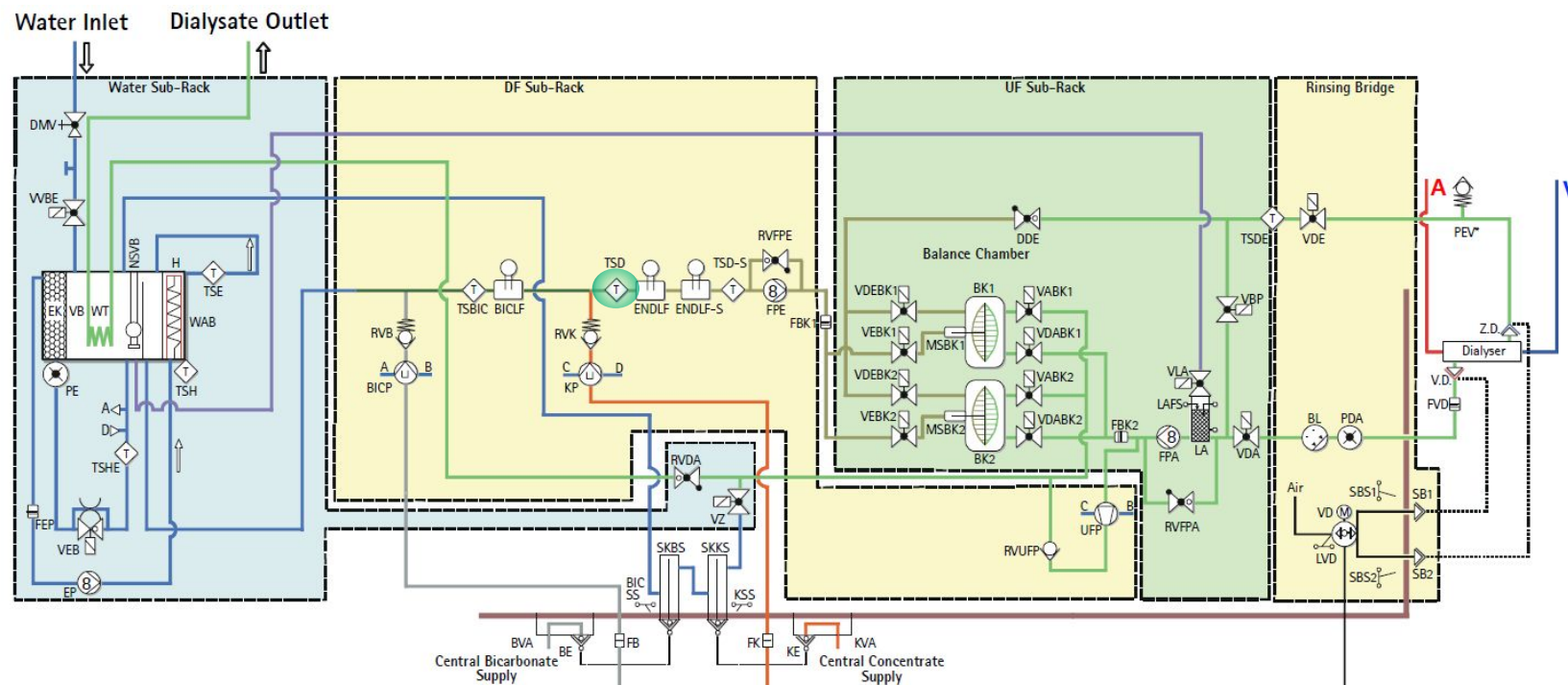
## Temperature Regulation



Depending on Bypass or Mainflow the machine will use TSDE to regulate the final temperature. This ensures a stable temperature at the dialyser throughout the therapy. For temperature testing wait at least 10 minutes for all components to reach working temperature.

[Previous](#)[Next](#)[Back](#)

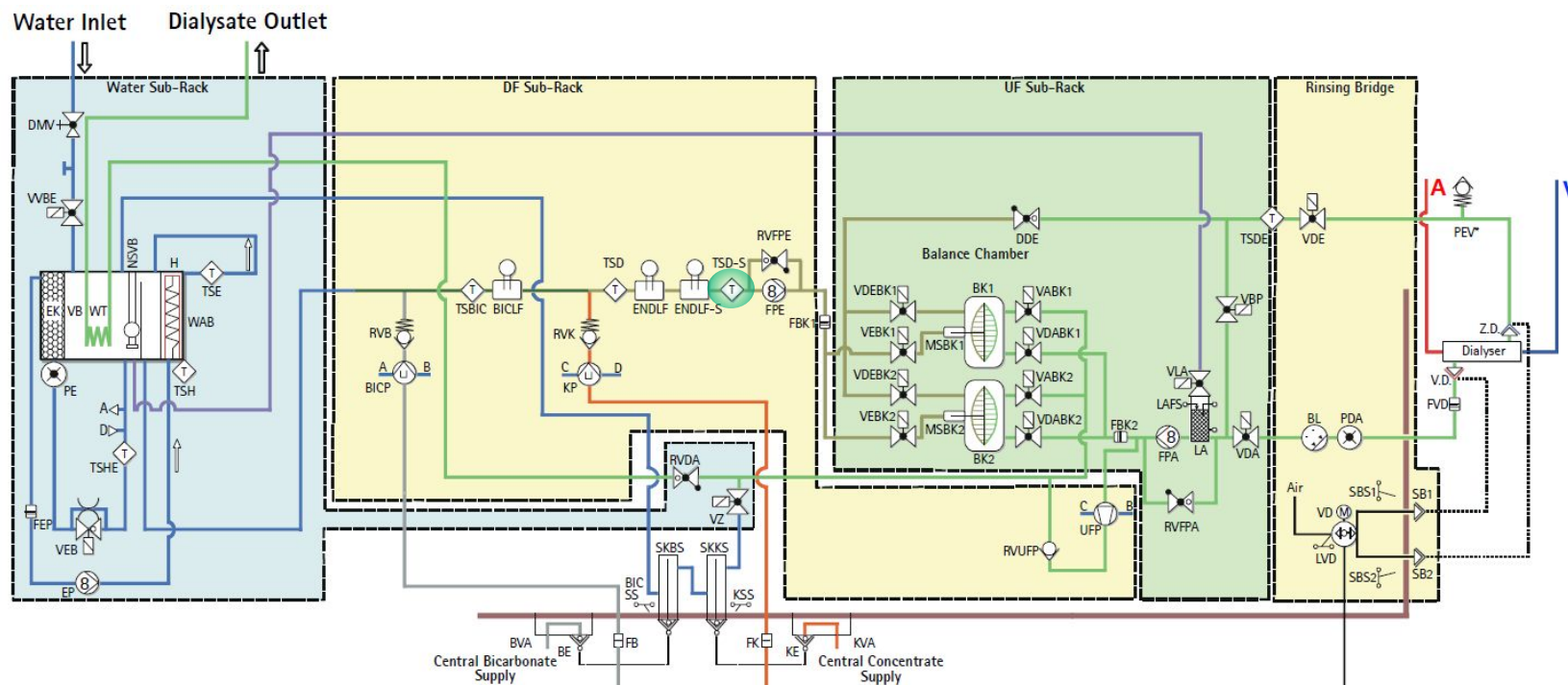
# Temperature Regulation



If the machine is switched to bypass, TSD will take over regulation of the temperature, because there is no flow through TSDE. Regulation by TSDE is restored once the temperature is stable again at TSD.

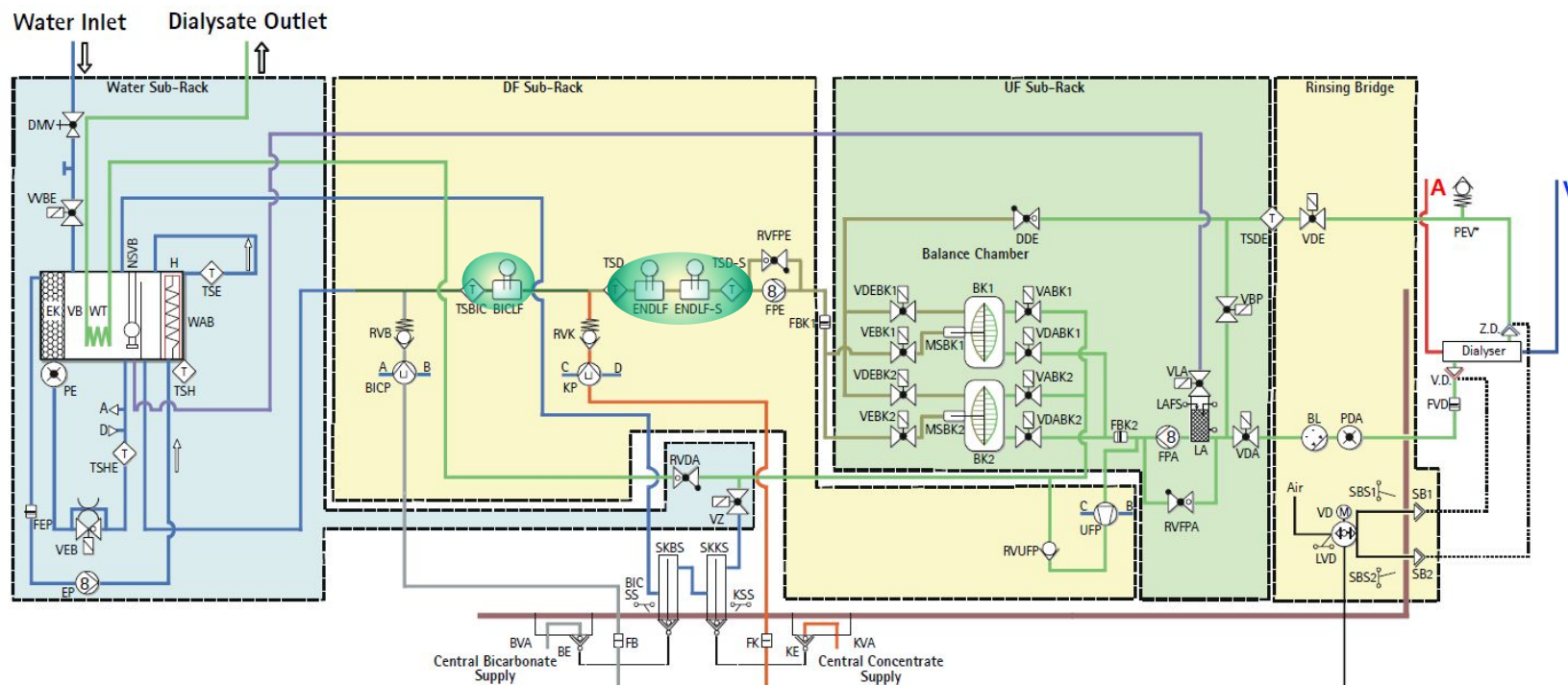


## Temperature Regulation



At all times during the therapy TSD-S is active to ensure patient safety. The machine will switch to bypass if the temperature exceeds 41°C at any time.

# Conductivity Regulation



## Controller Sensors

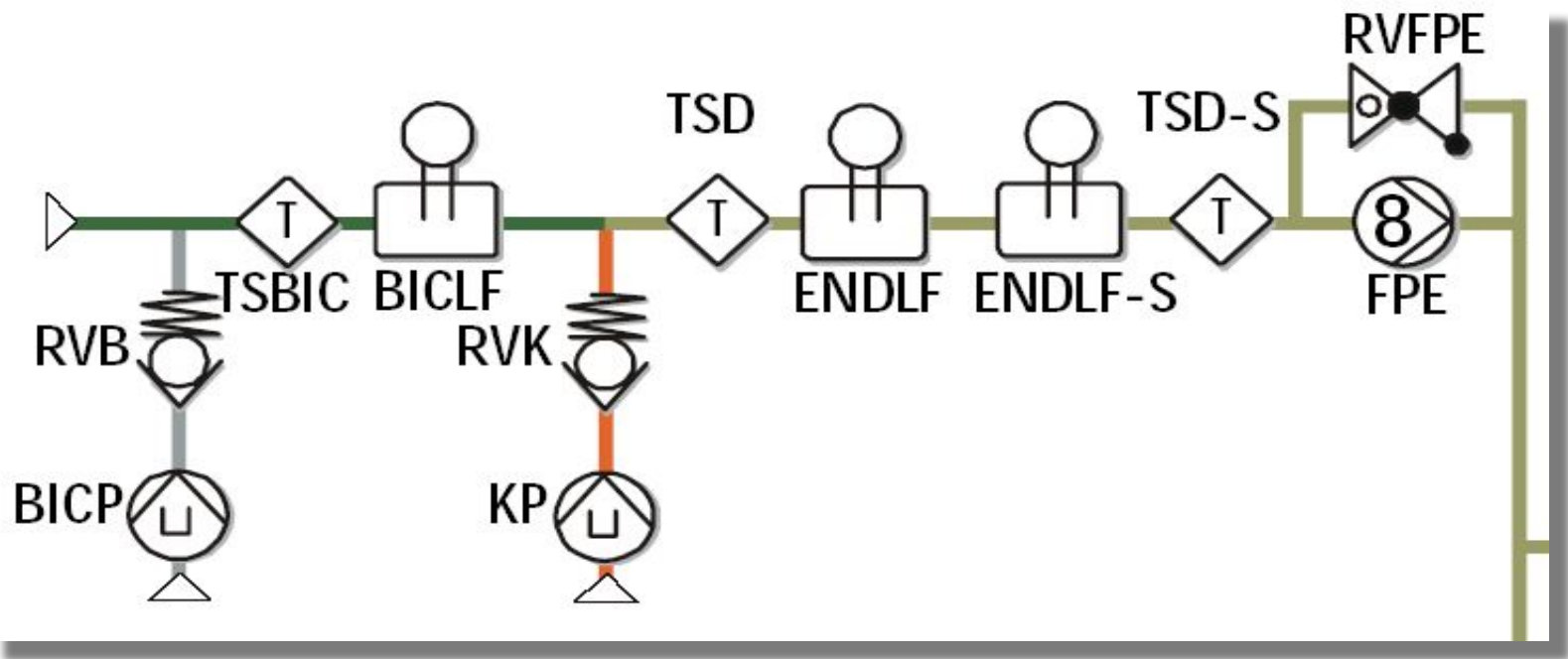
- TSBIC & BICLF
- TSD & ENDLF

## Supervisor Sensors

- TSD-S & ENDLF-S

## Conductivity Regulation

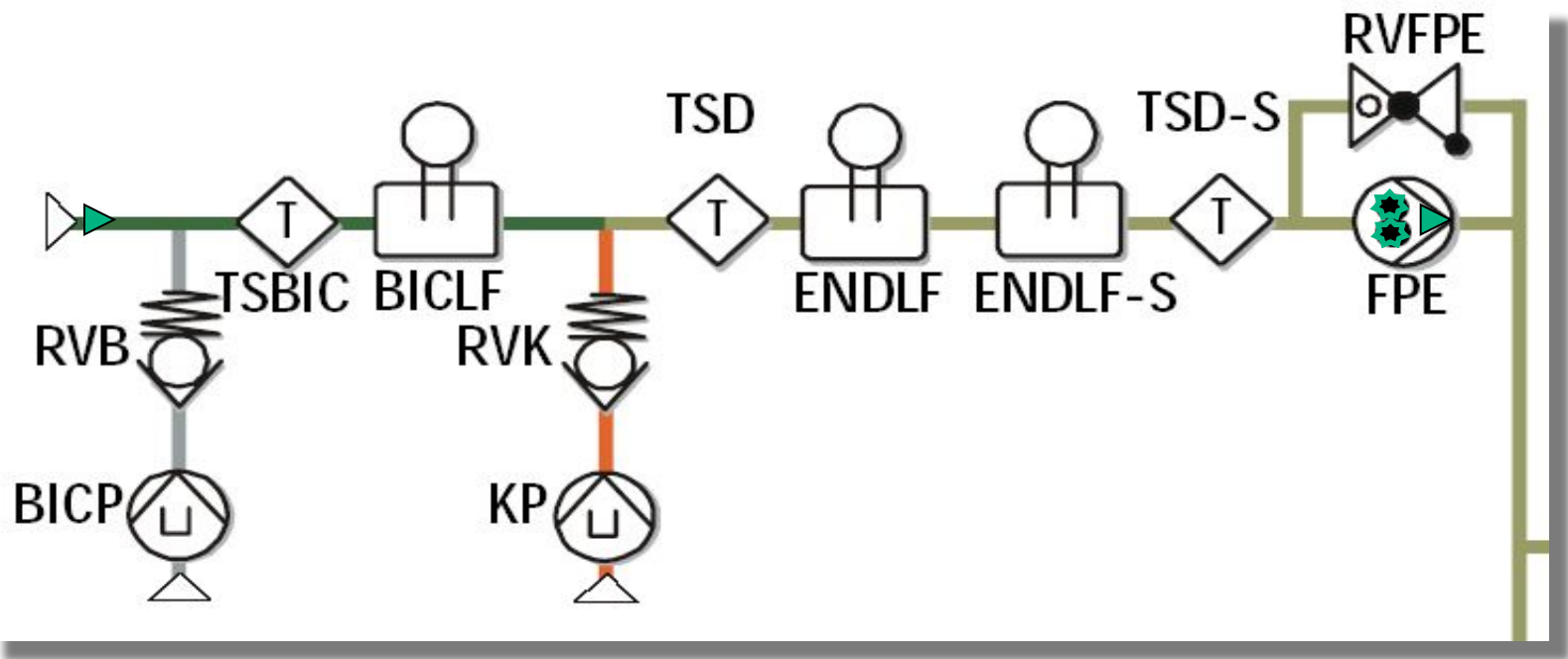
The main components of the dialysate preparation are the bicarbonate concentrate pump **BICP** and the concentrate pump **KP**, with the conductivity cells **BICLF** and **ENDLF** and a flow pump **FPE**.





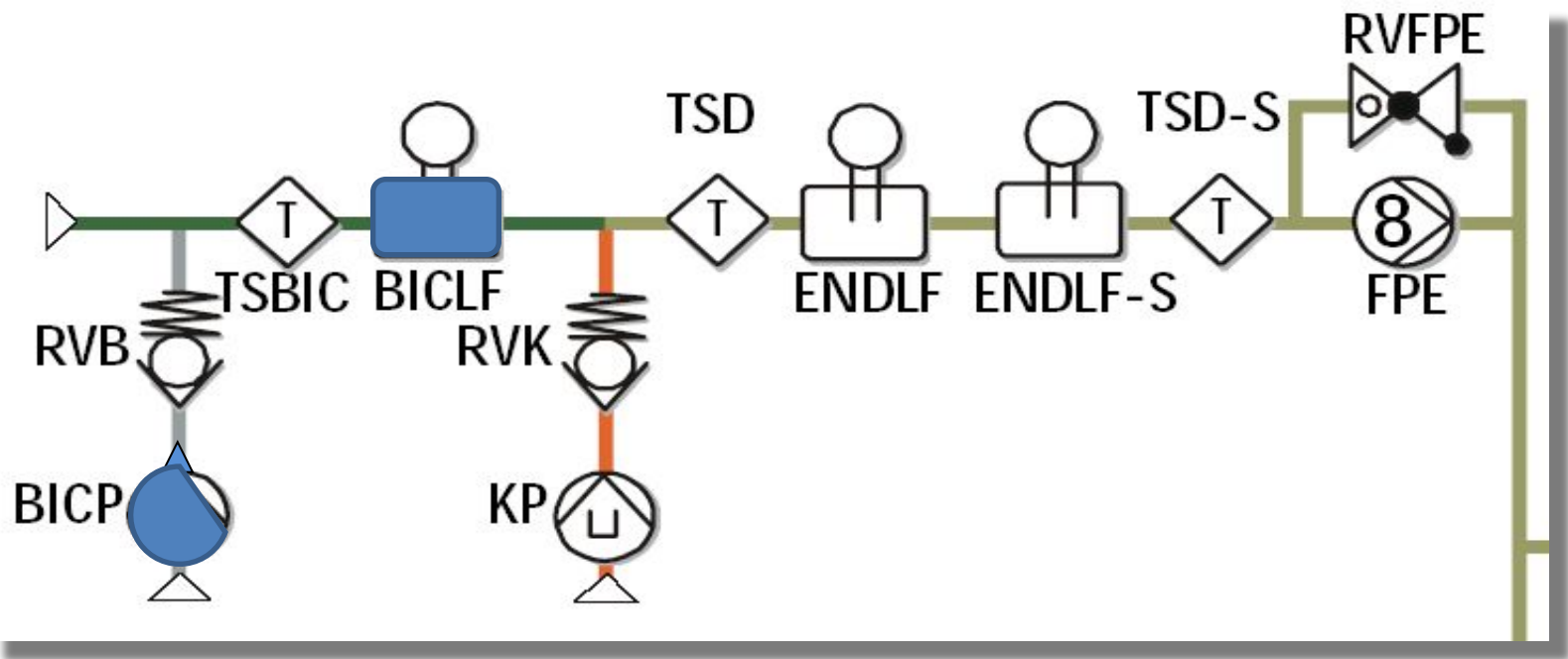
## Conductivity Regulation

**FPE** pumps dialysate into the balance chamber



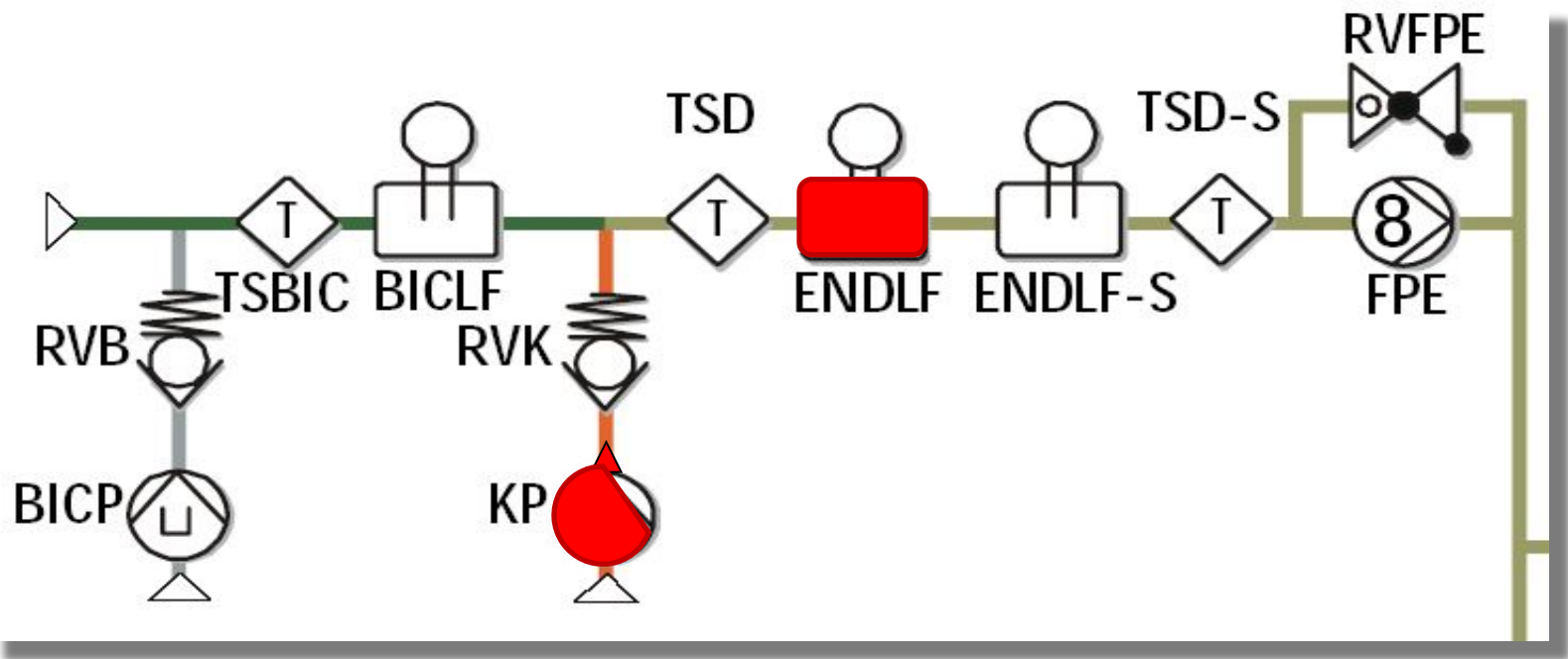
## Conductivity Regulation

The **BICP** adds bicarbonate to the RO water. The pump speed regulated by the conductivity at **BICLF**.



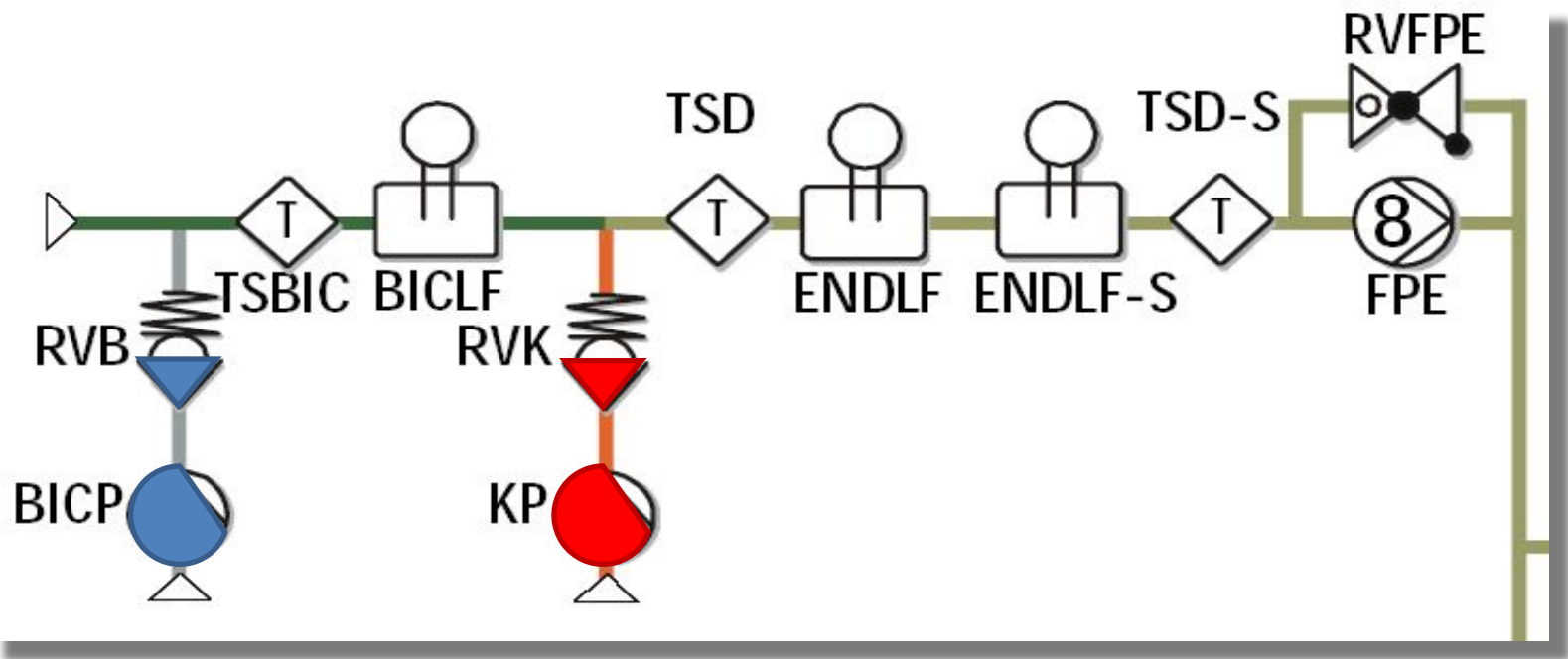
## Conductivity Regulation

The **KP** adds concentrate to the Bicarbonate and RO water. The pump speed is regulated by the conductivity at **ENDLF**.



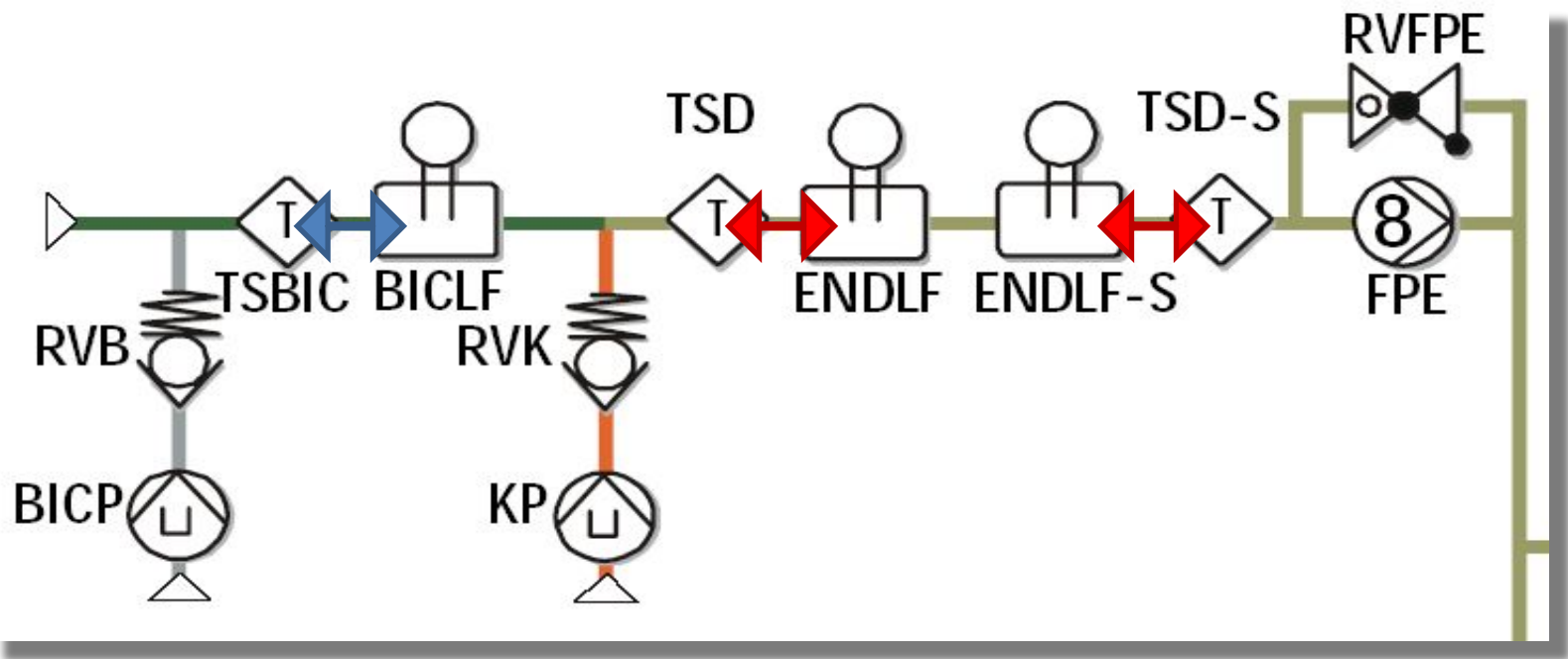
## Conductivity Regulation

**RVB** and **RVK** are non-return valves that stabilise the concentrate flow.



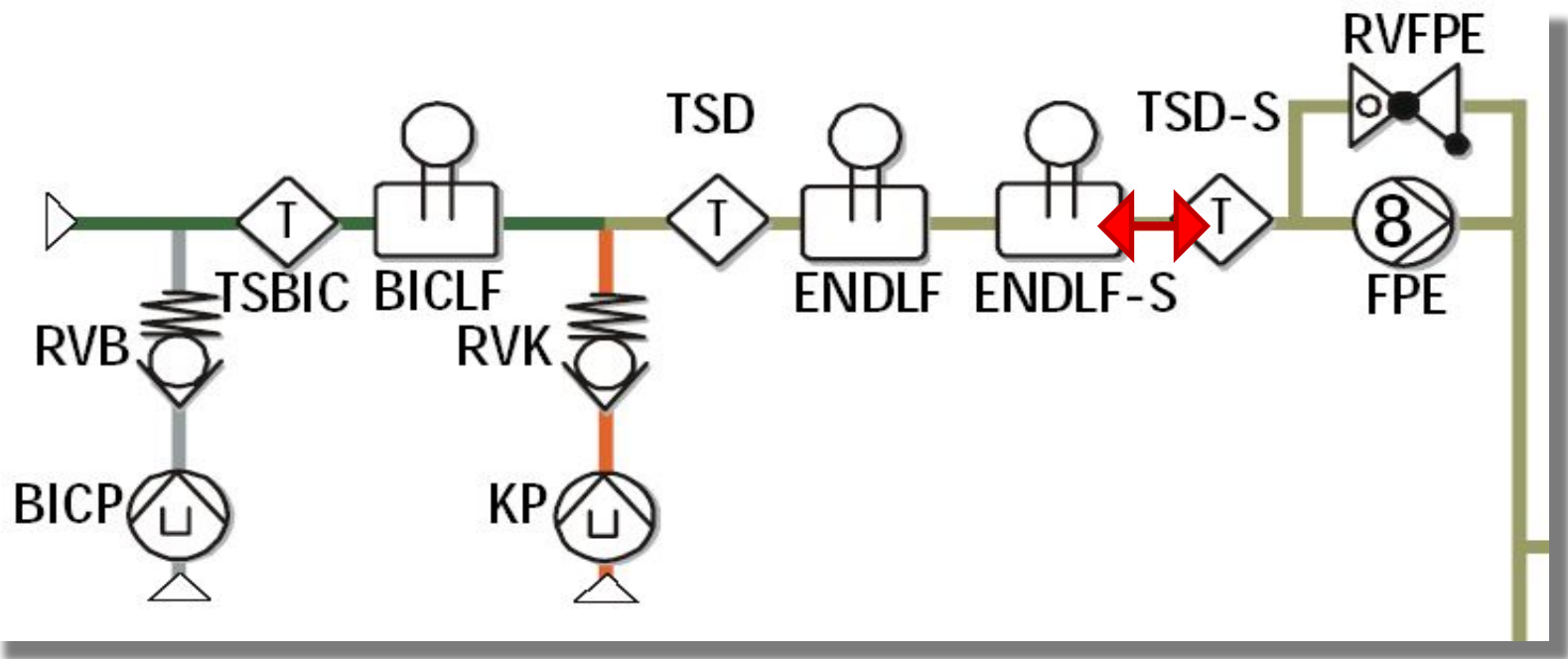
## Conductivity Regulation

Temperature fluctuations cause a change in the conductivity measurements. Each conductivity sensor has a separate temperature sensor to correct the conductivity value. This is called temperature compensation.

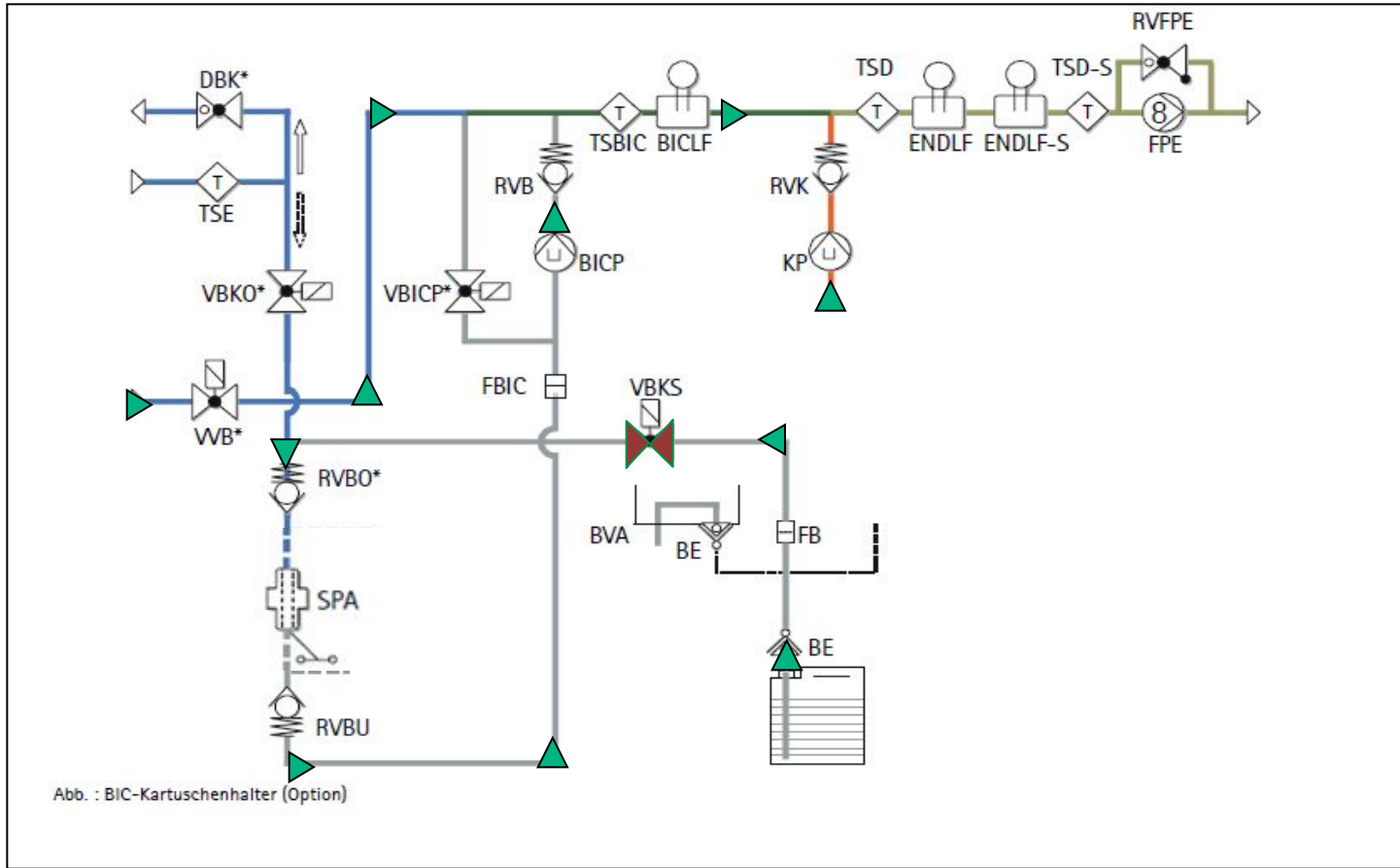


## Conductivity Regulation

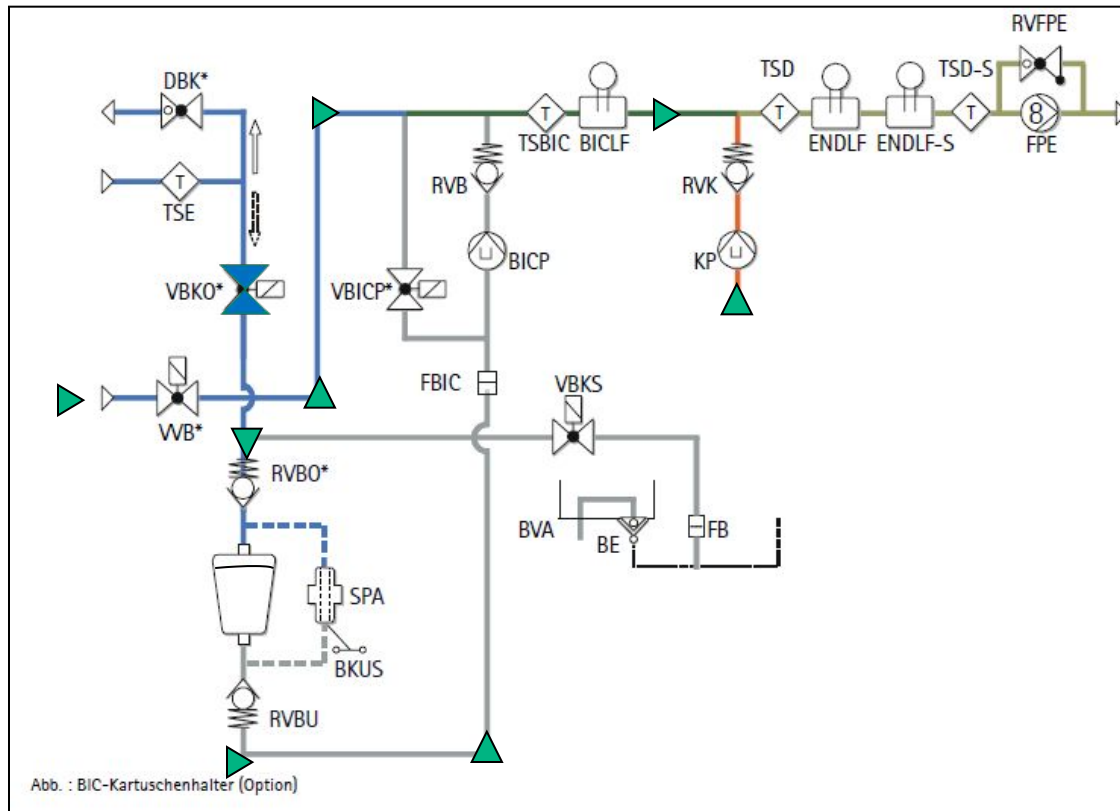
TDS-S and ENDLF-S are used by the Supervisor only. They have no influence on the regulation of the dialysate fluid.



# Dialysate Preparation with BIC Cartridge Option

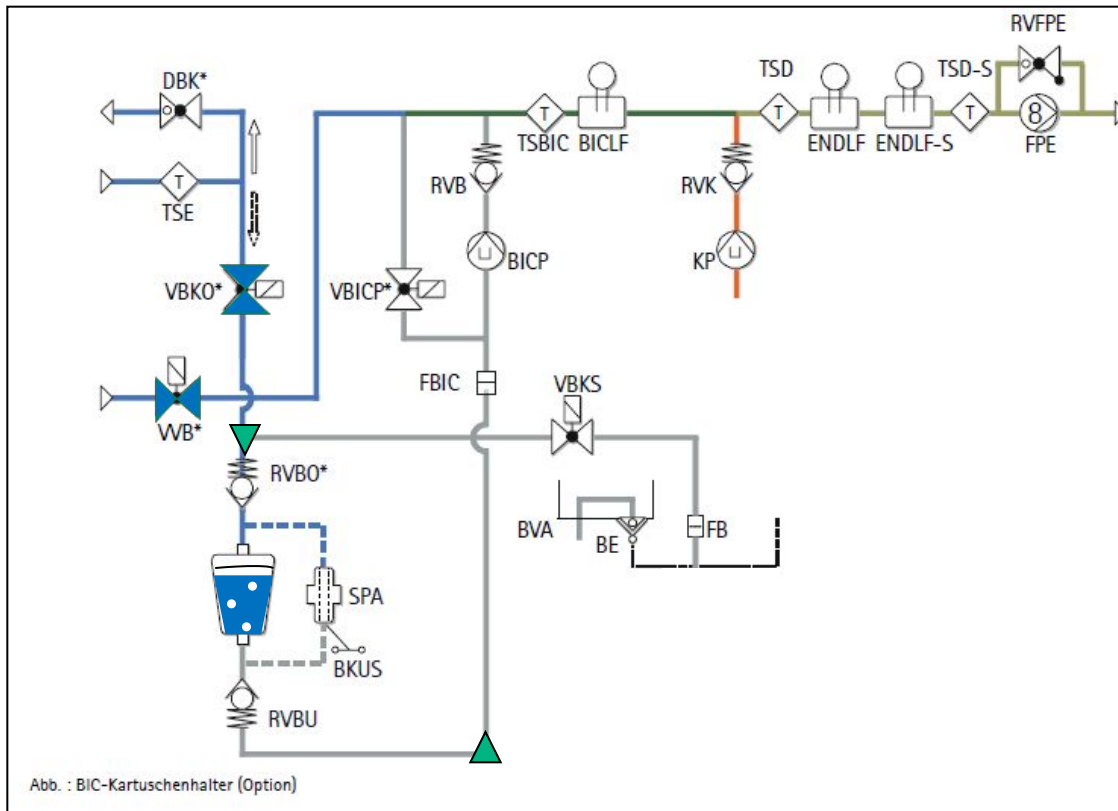


## Dialysate Preparation with BIC Cartridge

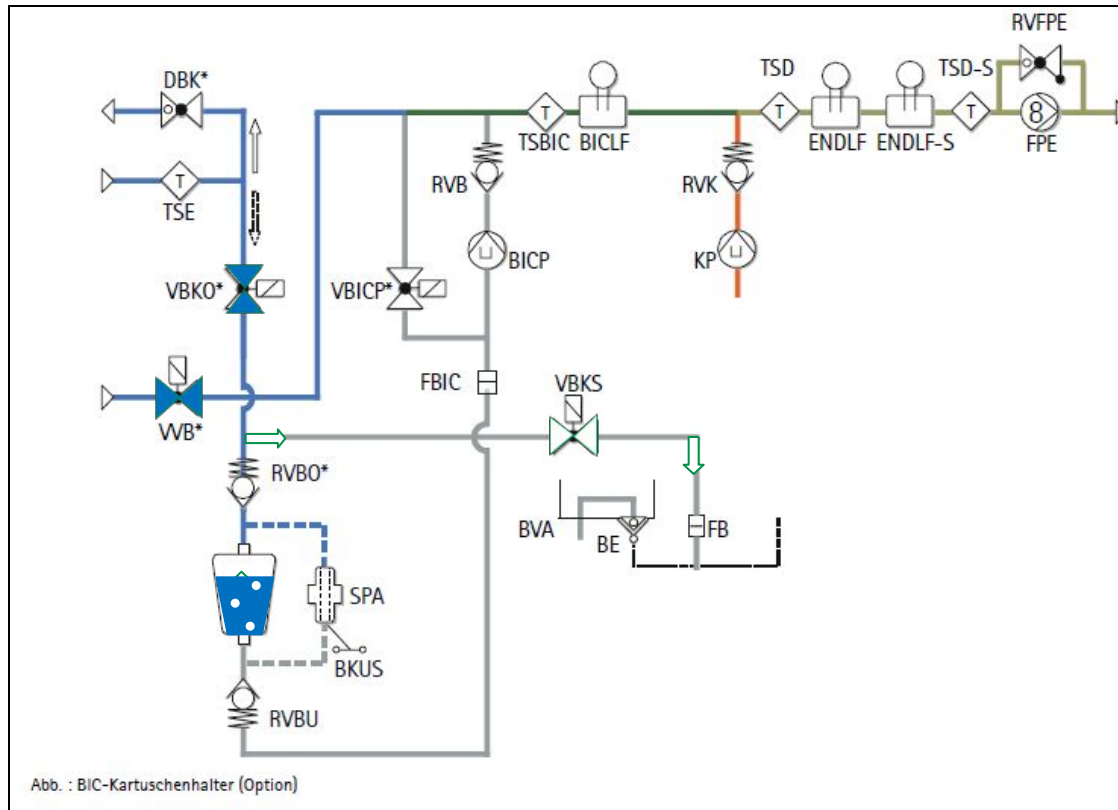




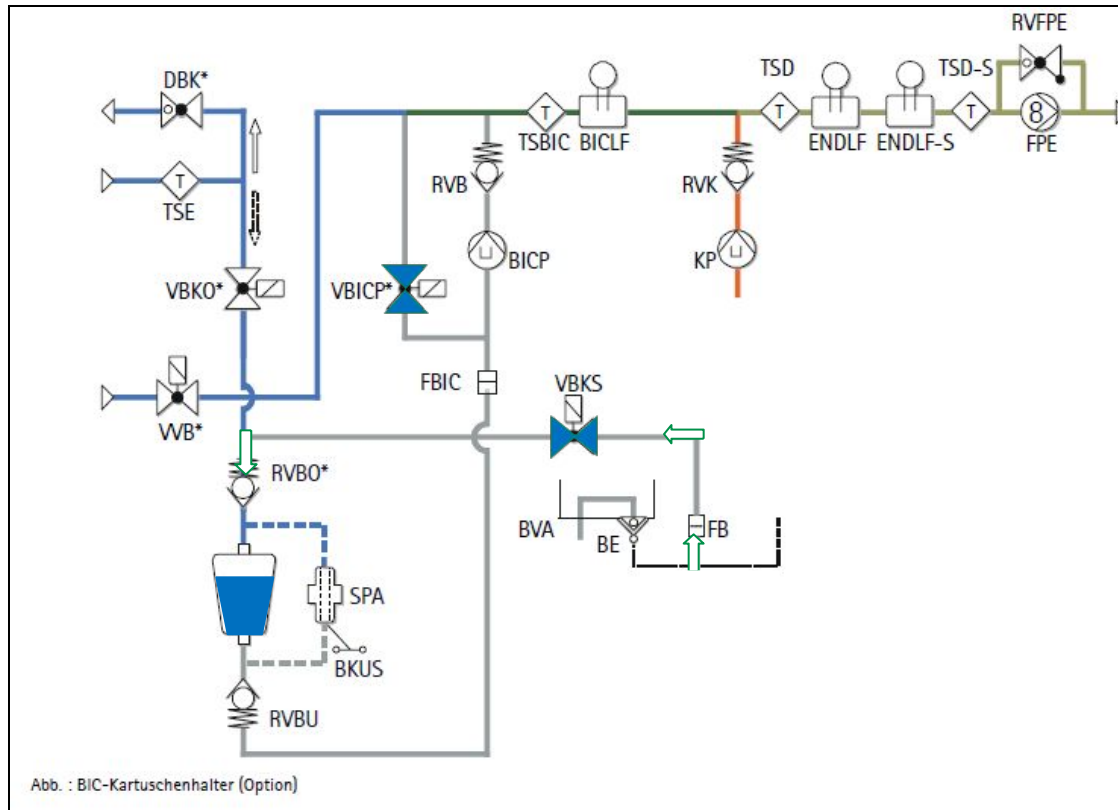
## Filling the Cartridge



## Expeling Air from the Cartridge



## Emptying the Cartridge

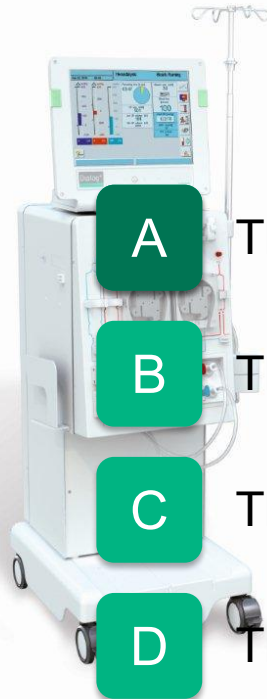


## Dialog<sup>+</sup> Hydraulic Test

Welcome to the Dialog<sup>+</sup> Component Overview. Here you will have the opportunity to look at different components and find out what their functions are, and how they work together.

### Question 1

What component is not part of the water sub-rack?

**A**

The Disinfection Valve

**B**

The Degassing Valve

**C**

The Degassing Temperature Sensor

**D**

The Water Inlet Valve

**Next**

## Dialog<sup>+</sup> Hydraulic Test

### Question 2

How many temperature sensors are in the machine?

A

4

B

5

C

6

D

7

Next

## Dialog<sup>+</sup> Hydraulic Test

### Question 3

What is the status of the degassing valve during disinfection?

- ☐ A Closed
- ☐ B Open
- ☐ C Switches between open and closed
- ☐ D Only open for short times

Next

Dialog<sup>+</sup> Hydraulic Test

## Question 4

Which pump is responsible for pumping fresh dialysate fluid into the balance chamber?

- A** Flow Pump Inlet
- B** Flow Pump Outlet
- C** Flow Pump Inlet and Flow Pump Outlet
- D** Degassing Pump

[Next](#)

Dialog<sup>+</sup> Hydraulic Test

## Question 5

What is the pressure of RVDA set to on a standard and Online machine?

- A** Standard: 400mbar, Online: 400mbar
- B** Standard: 500mbar, Online: 400mbar
- C** Standard: 400mbar, Online: 500mbar
- D** Standard: 500mbar, Online: 500mbar

Next



Dialog<sup>+</sup> Hydraulic Test

## Question 6

Wat is the approx. speed for EP, FPE, FPA during therapy?

- A** EP: 1500 rpm, FPE: 1800 rpm, FPA: 1800 rpm
- B** EP: 2000 rpm, FPE: 1000 rpm, FPA: 2000 rpm
- C** EP: 2000 rpm, FPE: 2000 rpm, FPA: 1000rpm
- D** EP: 2000 rpm, FPE: 1000 rpm, FPA: 1000rpm

[Next](#)

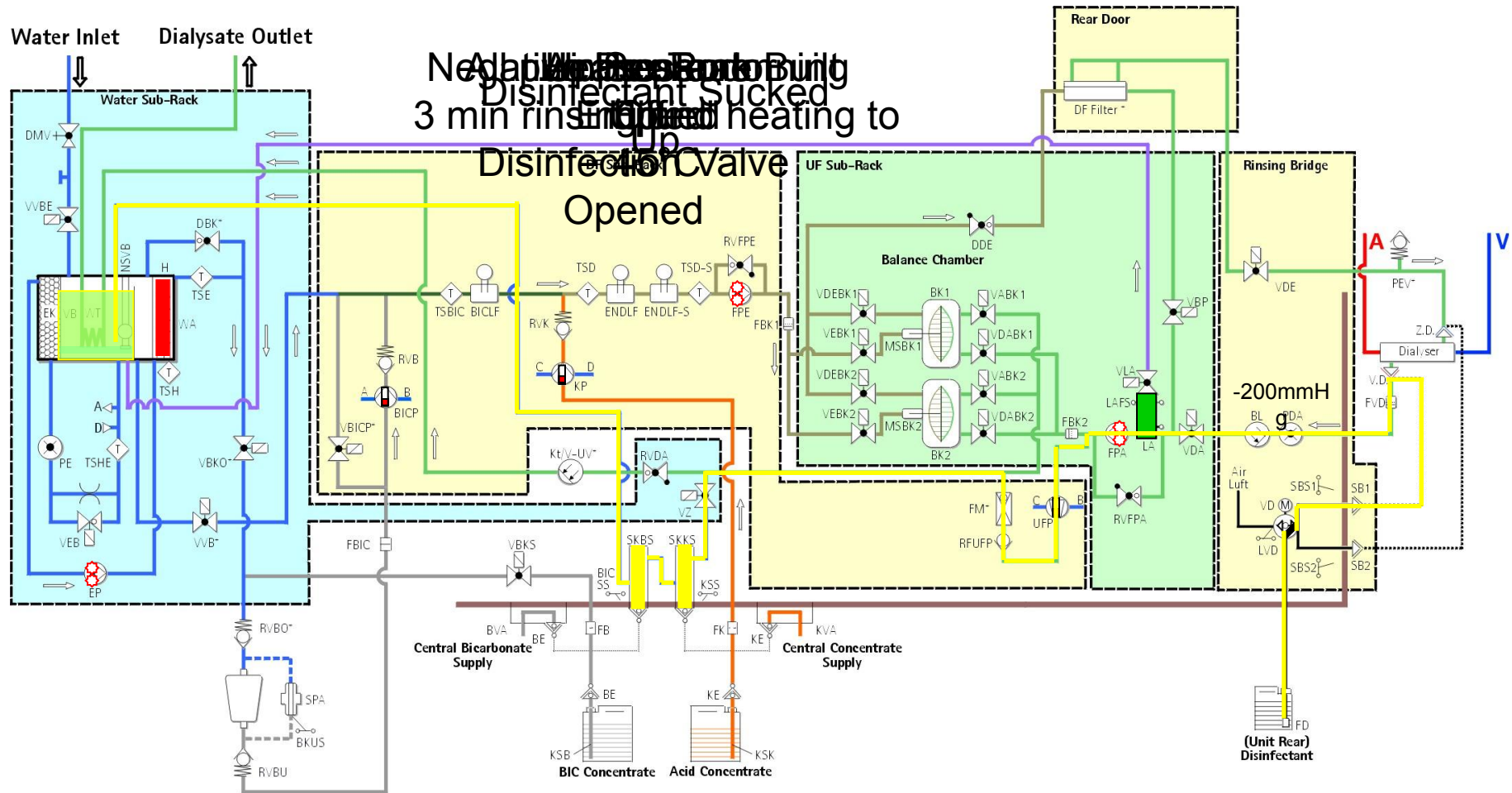
## Dialog<sup>+</sup> Hydraulic Test

### Test Completed

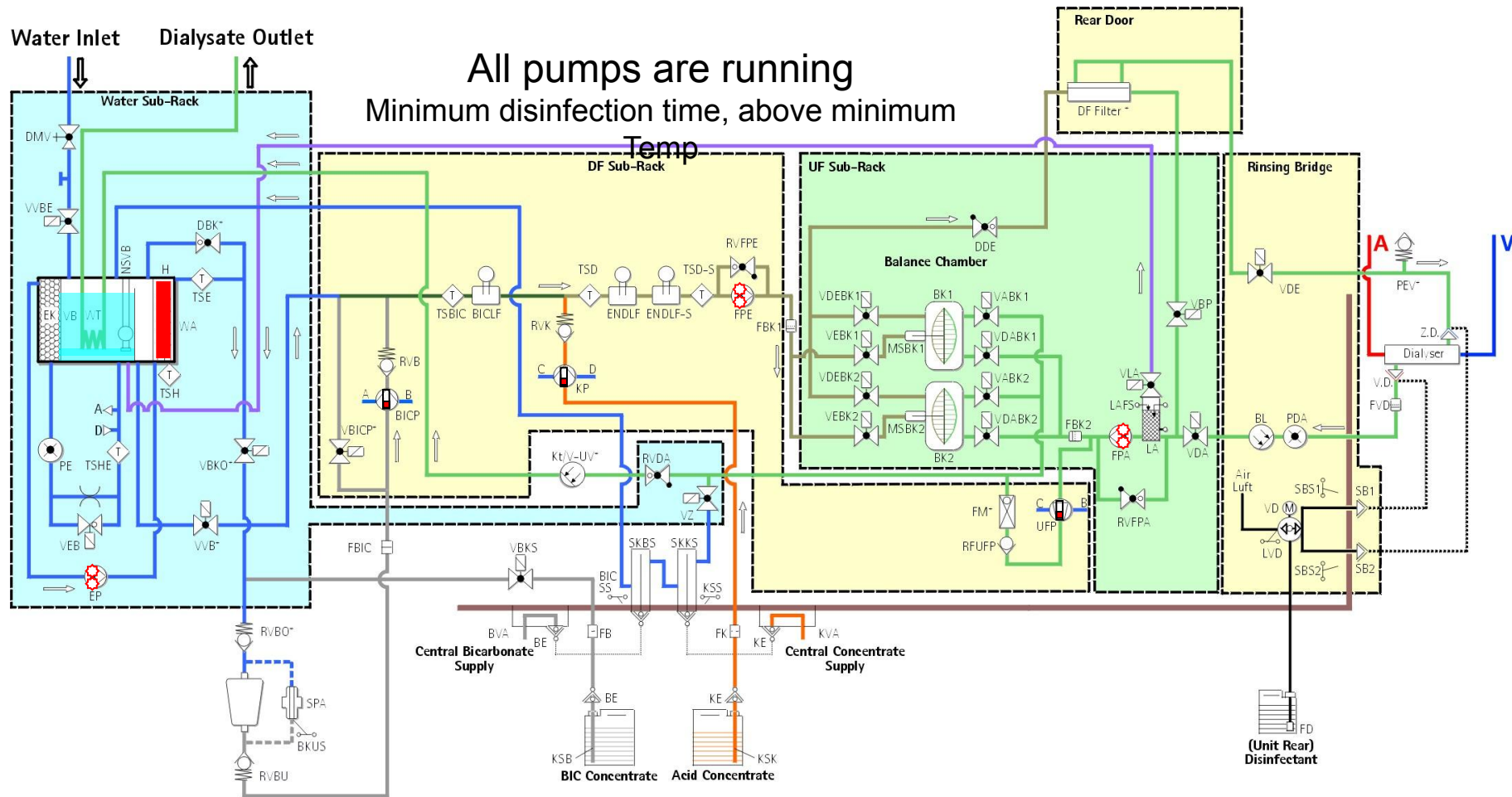
All the letters that have turned dark green were answered correctly. Please Restart the test to see how it went.

[Restart Test](#)[Back](#)

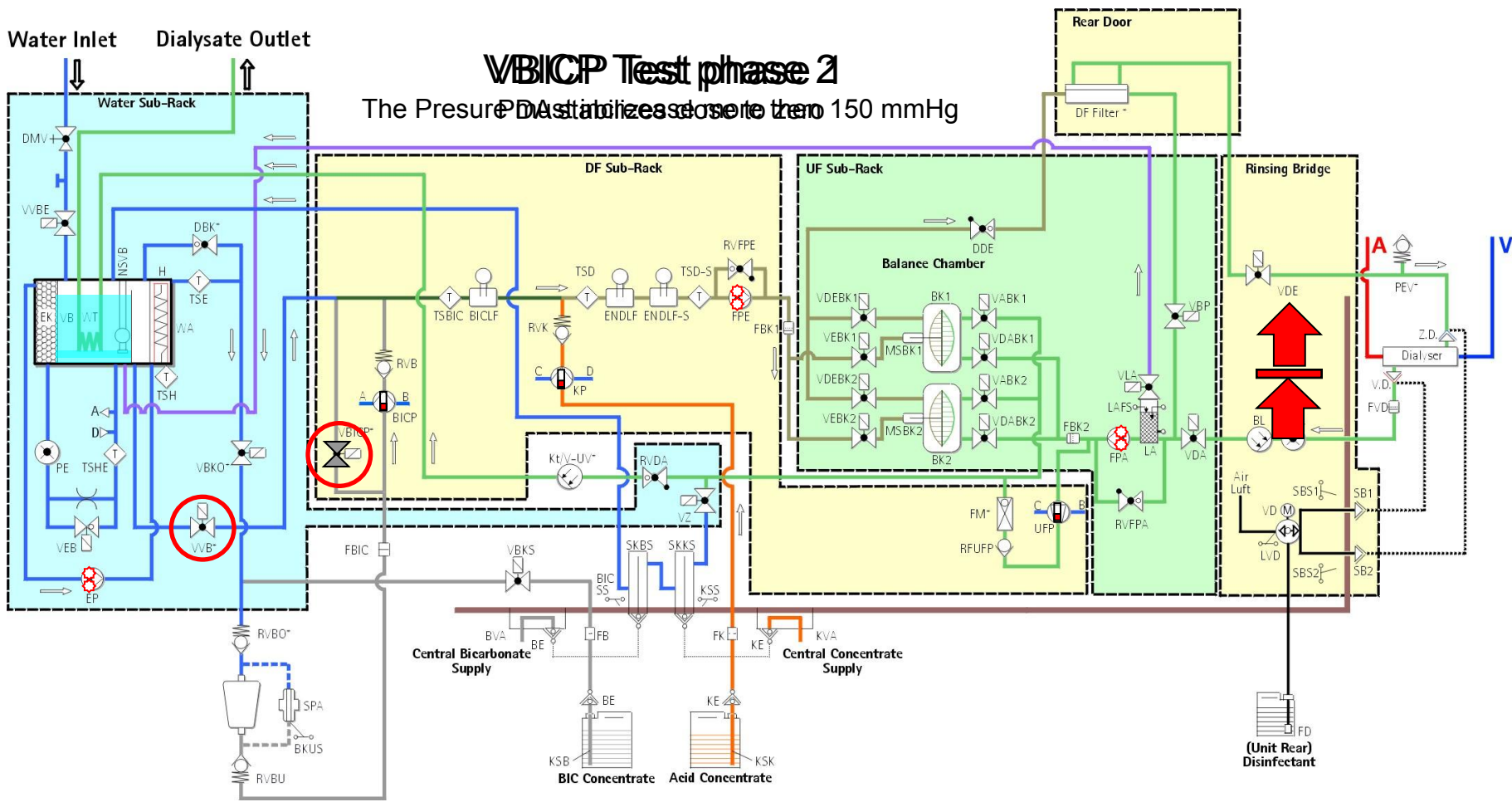
# Chemical Thermal Disinfection



# Chemical Thermal Disinfection

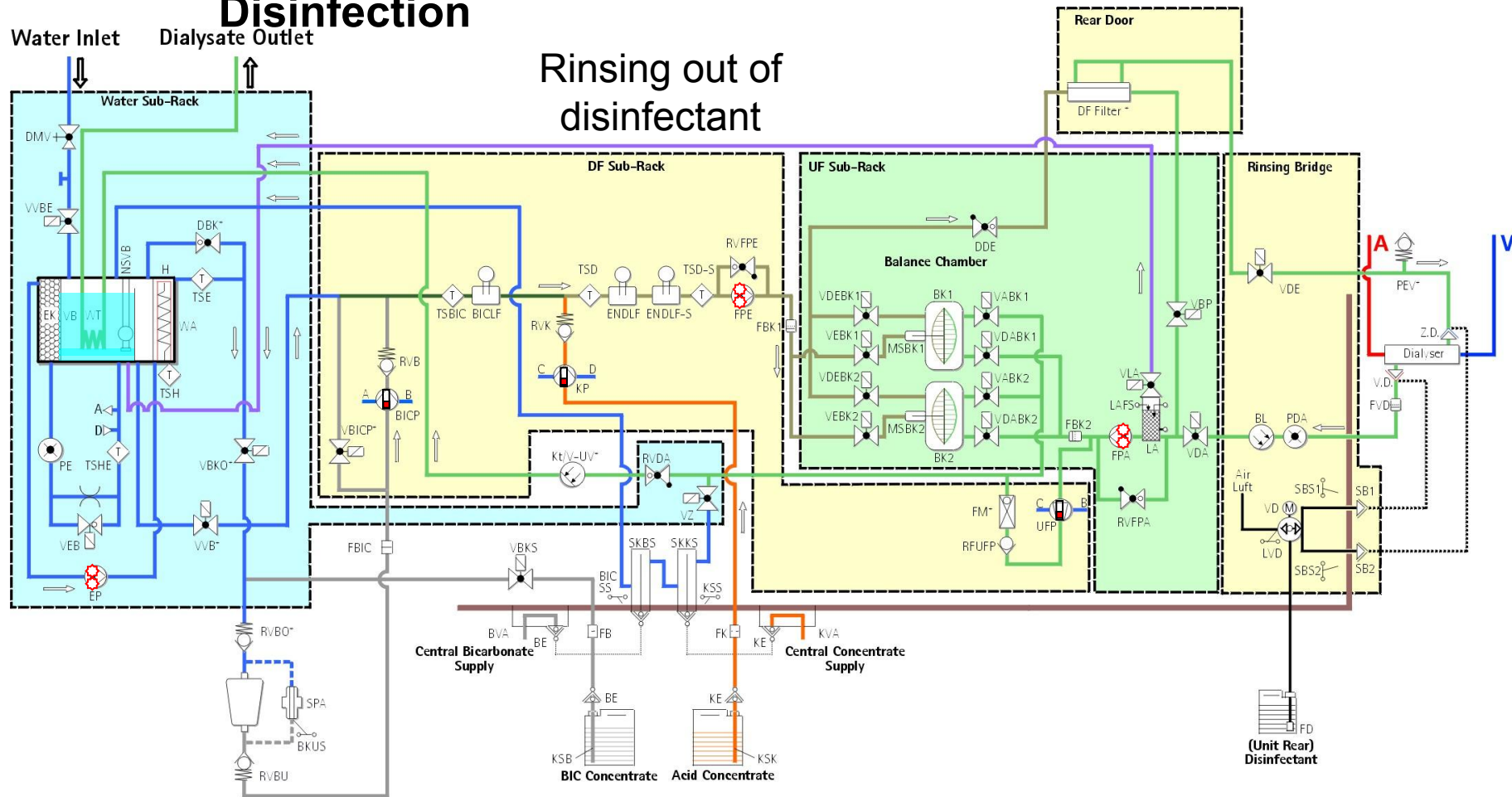


# Chemical Thermal Disinfection



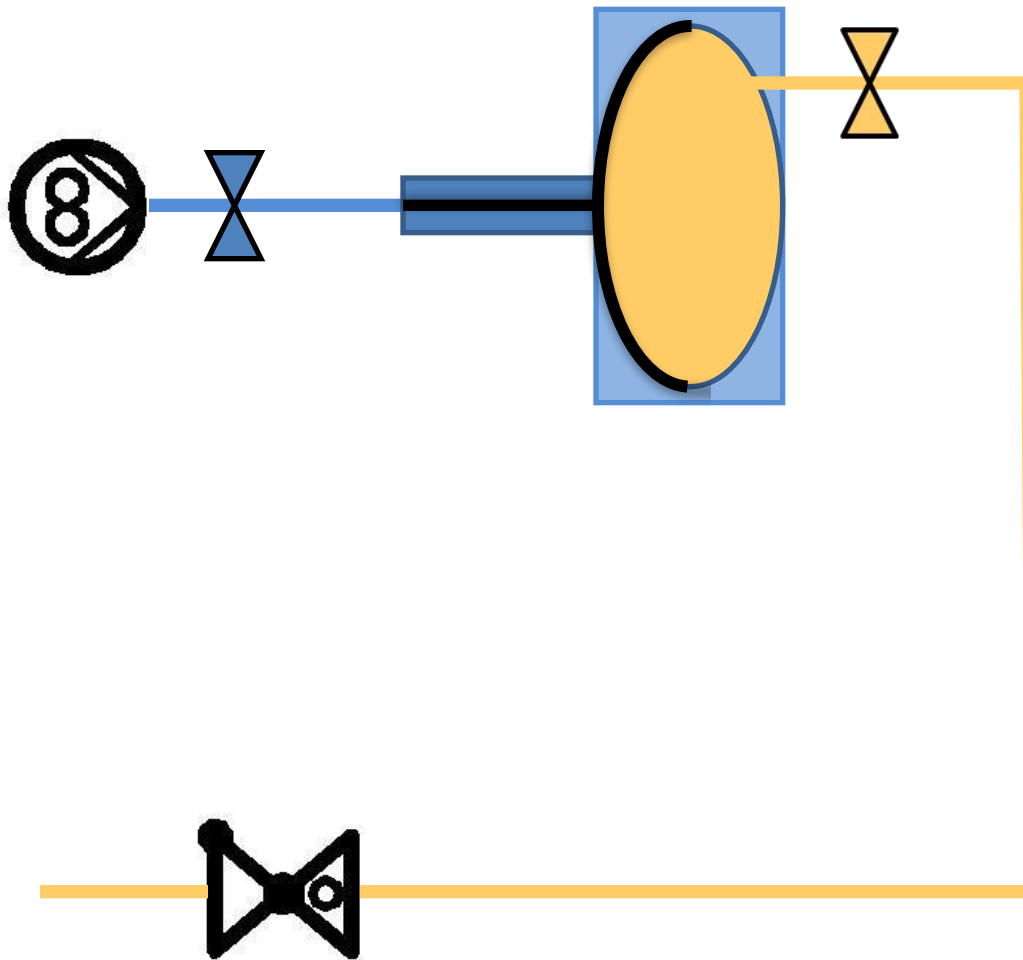
# Chemical Thermal Disinfection

## Rinsing out of disinfectant





## Phase 1

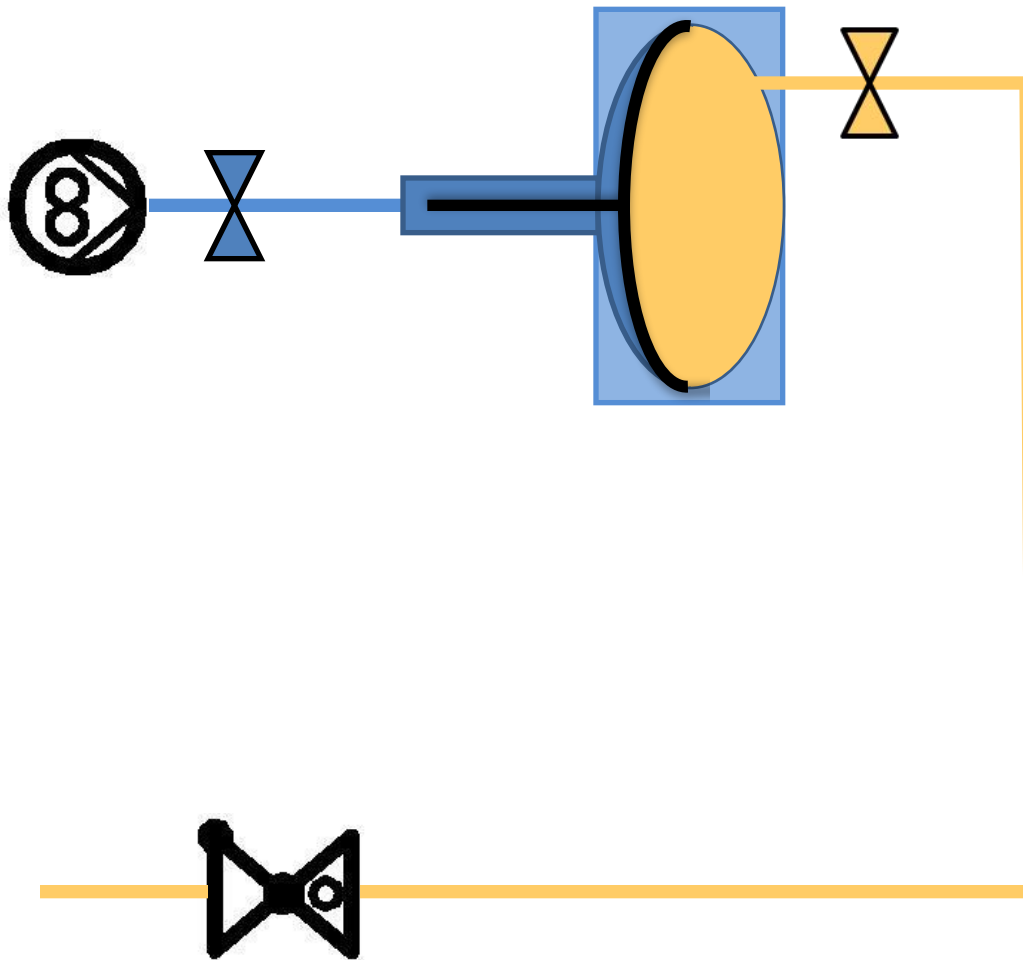


From FPE to drain

- The FPE pumps fresh dialysate into the balance chamber
- Pressure on the membrane forces the same amount of used dialysate to drain
- The fluid is pushed through RVDA to create a back pressure of 400 mbar

Back

## Phase 1



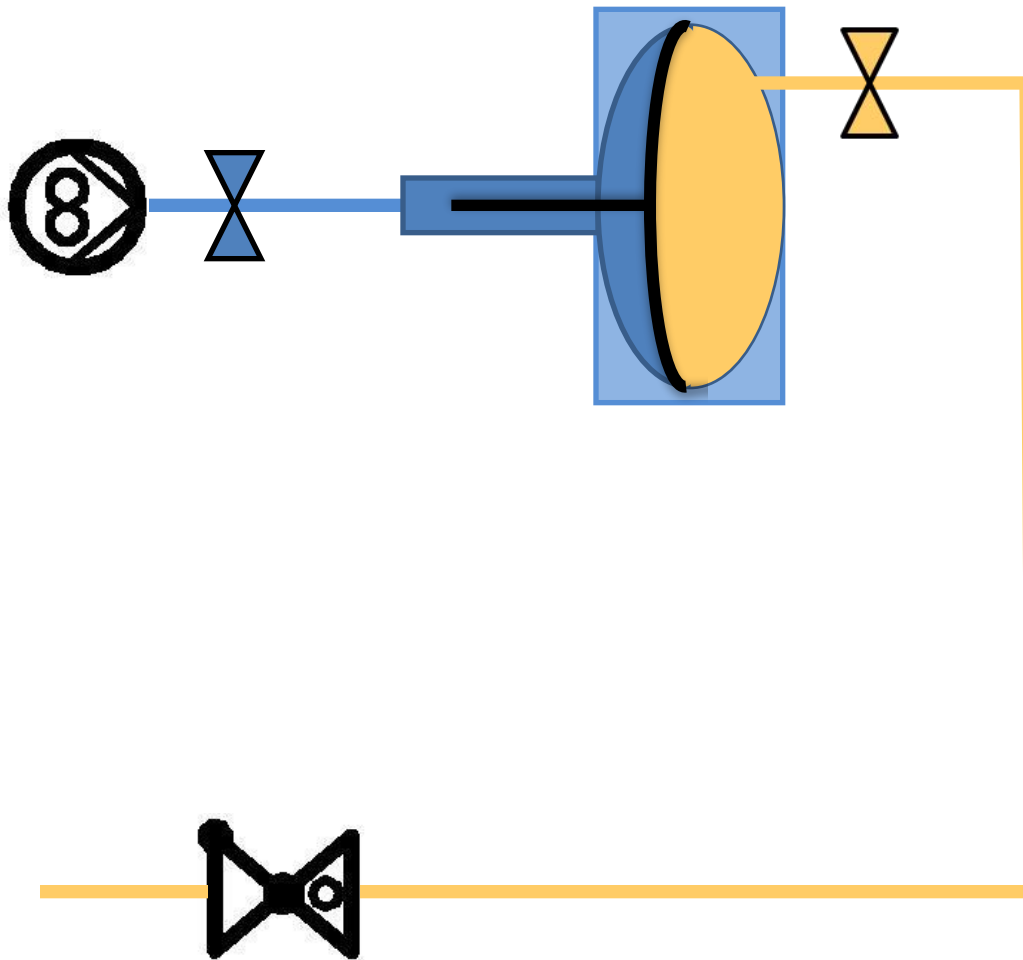
From FPE to drain

- The FPE pumps fresh dialysate into the balance chamber
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- The fluid is pushed through RVDA to create a back pressure of 400 mbar

[Back](#)



## Phase 1

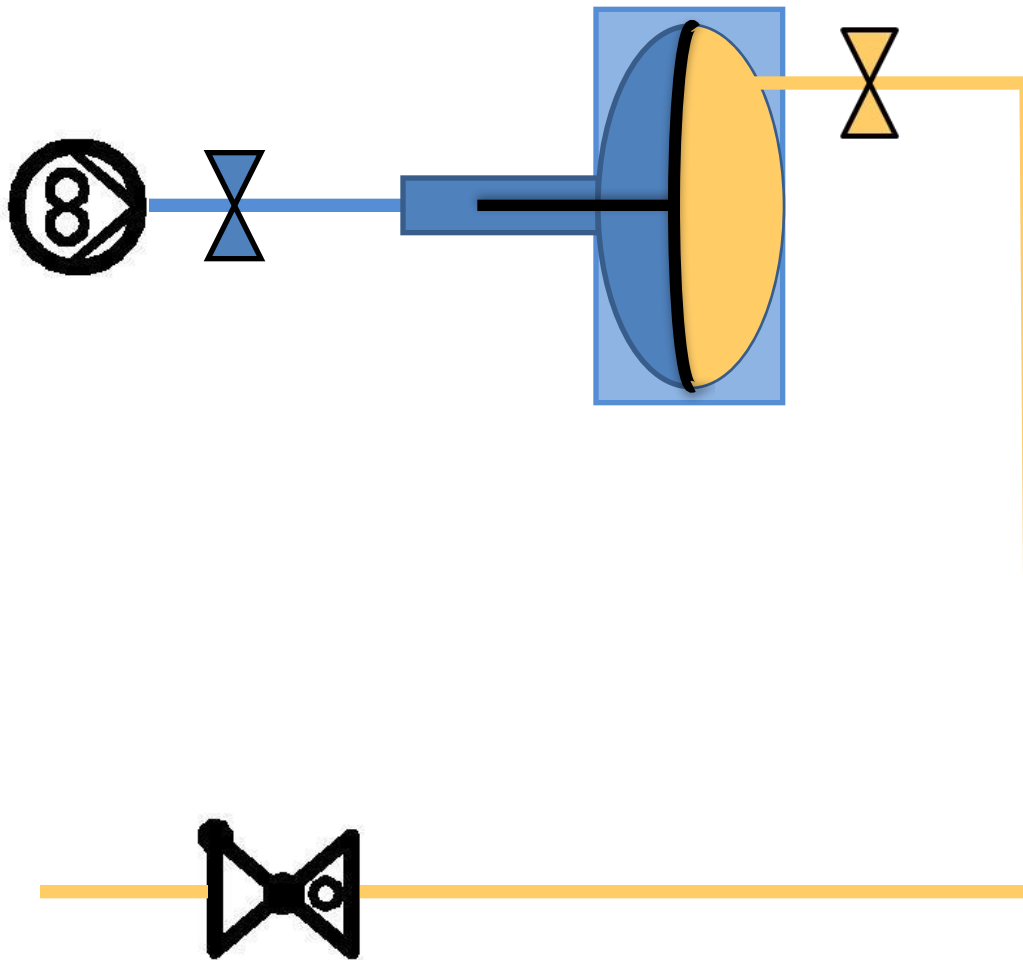


From FPE to drain

- The FPE pumps fresh dialysate into the balance chamber
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- The fluid is pushed through RVDA to create a back pressure of 400 mbar

[Back](#)

## Phase 1

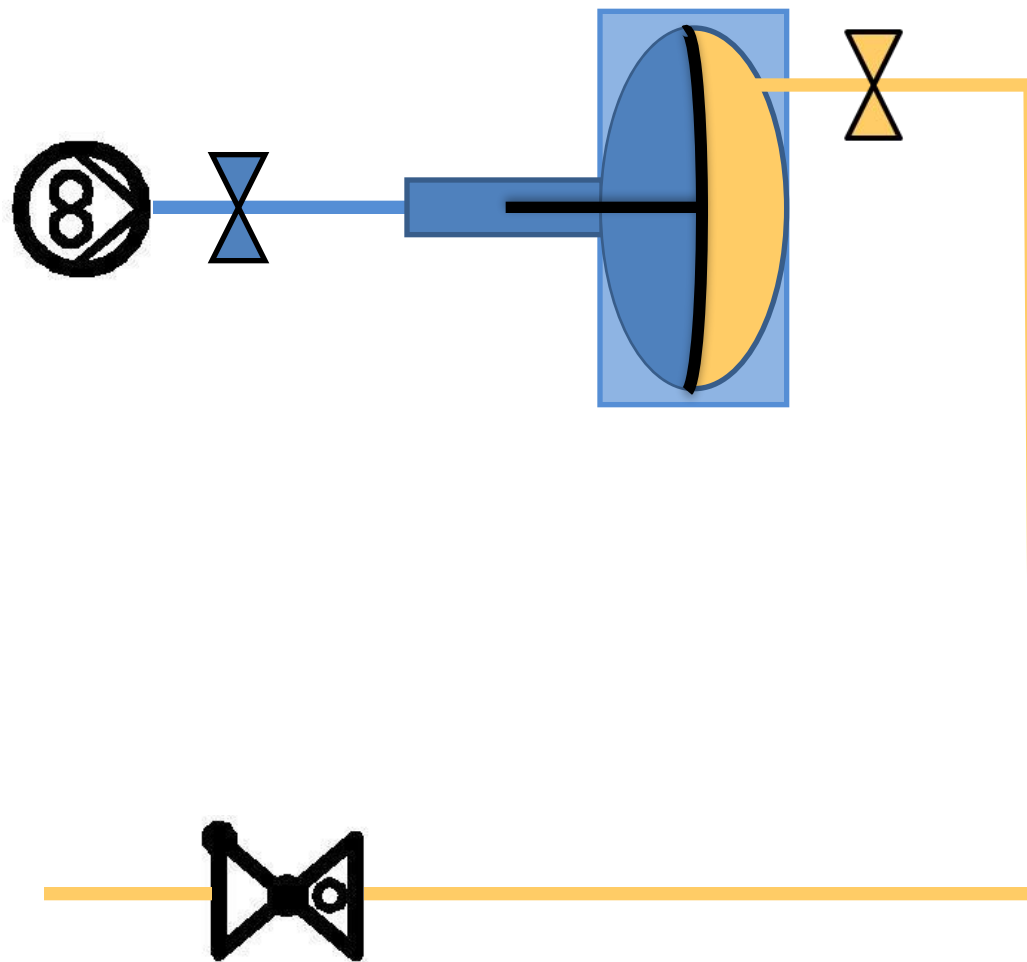


From FPE to drain

- The FPE pumps fresh dialysate into the balance chamber
- Pressure on the membrane forces the same amount of used dialysate to drain
- The fluid is pushed through RVDA to create a back pressure of 400 mbar

[Back](#)

## Phase 1

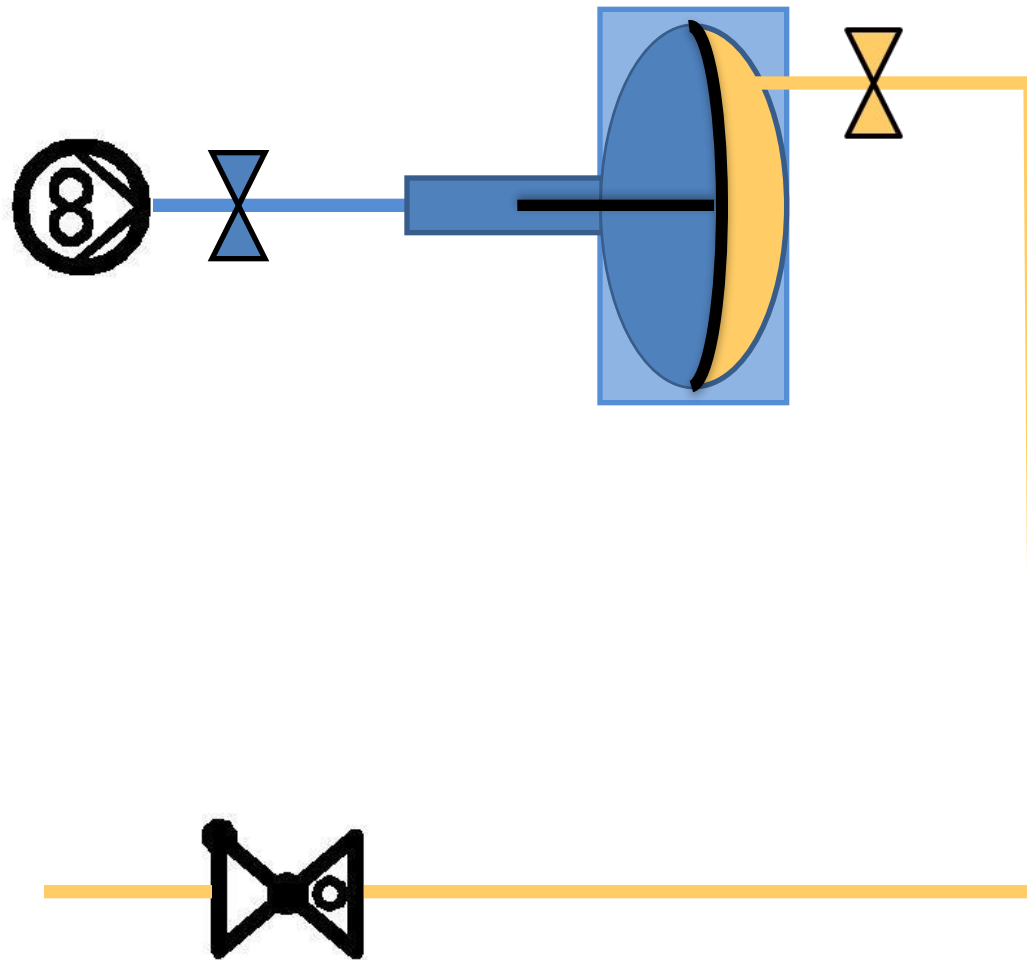


From FPE to drain

- The FPE pumps fresh dialysate into the balance chamber
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- The fluid is pushed through RVDA to create a back pressure of 400 mbar

Back

## Phase 1

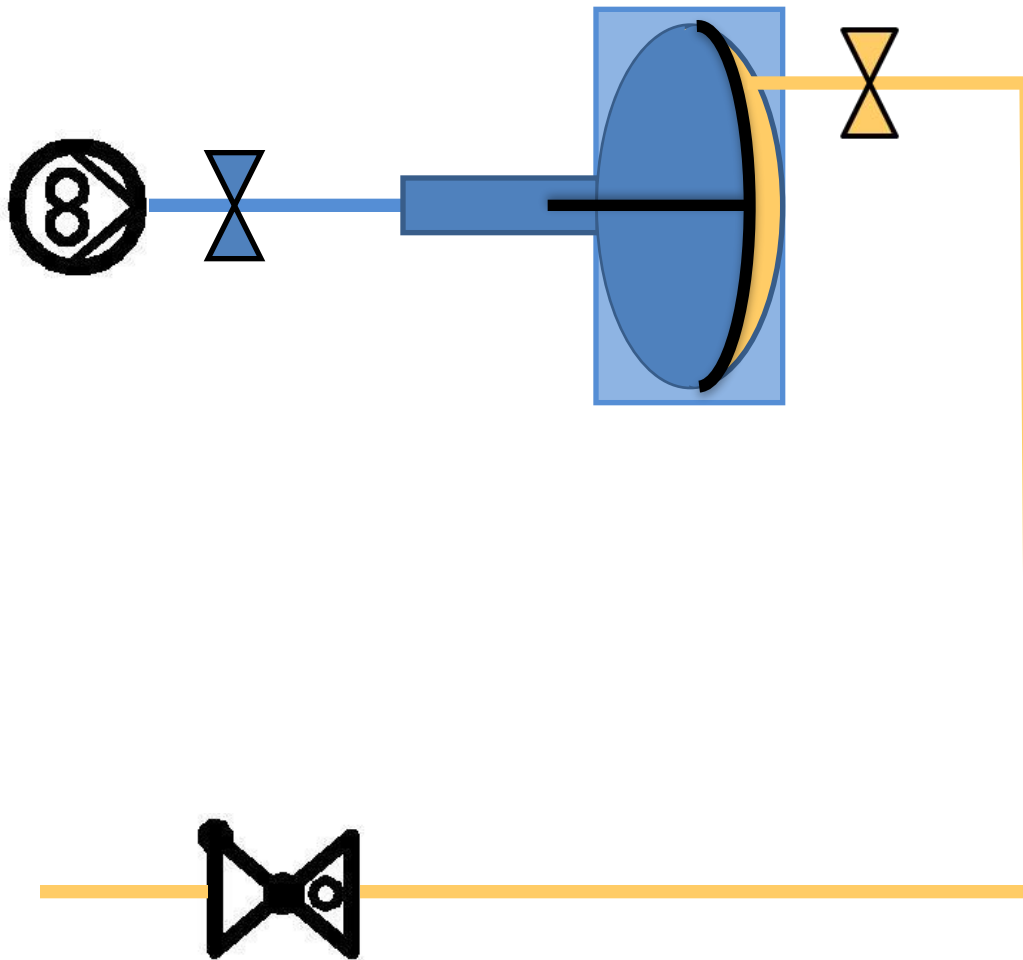


From FPE to drain

- The FPE pumps fresh dialysate into the balance chamber
- Pressure on the membrane forces the same amount of used dialysate to drain
- The fluid is pushed through RVDA to create a back pressure of 400 mbar

[Back](#)

## Phase 1

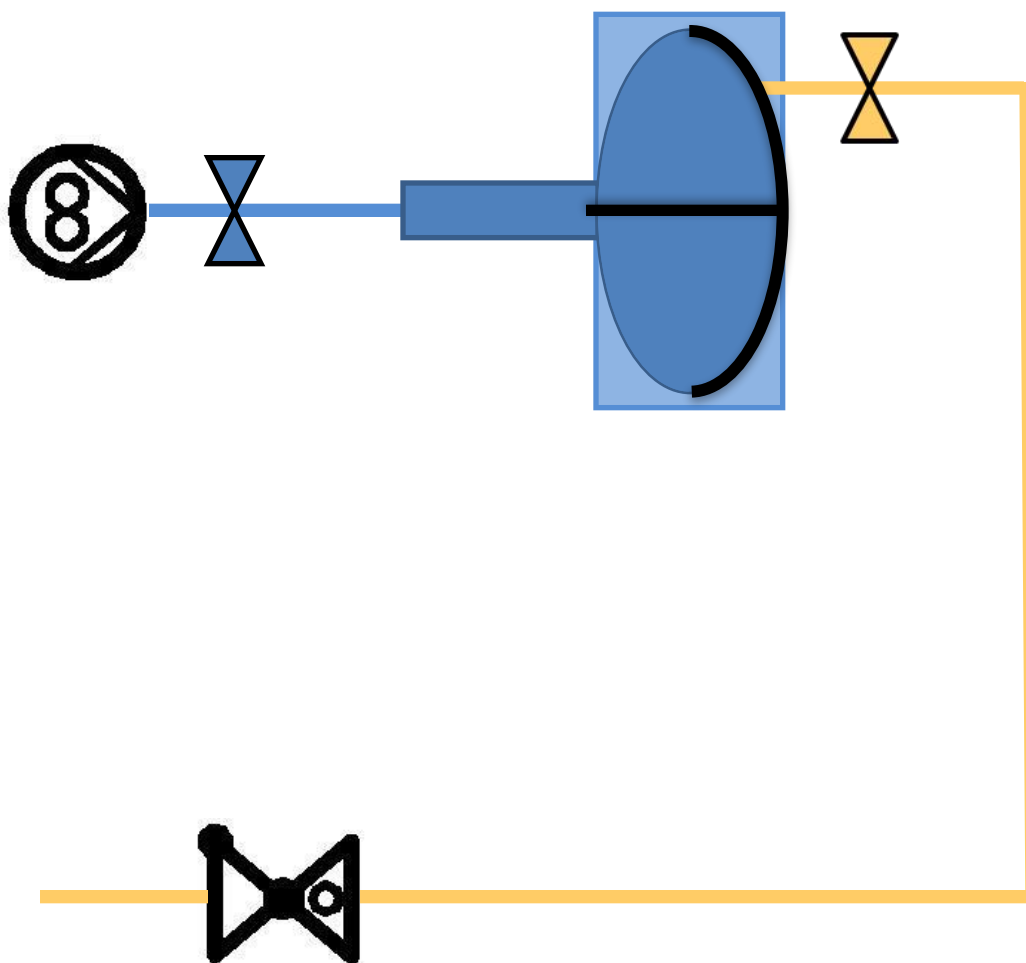


From FPE to drain

- The FPE pumps fresh dialysate into the balance chamber
- Pressure on the membrane forces the same amount of used dialysate to drain
- The fluid is pushed through RVDA to create a back pressure of 400 mbar

[Back](#)

## Phase 1



From FPE to drain

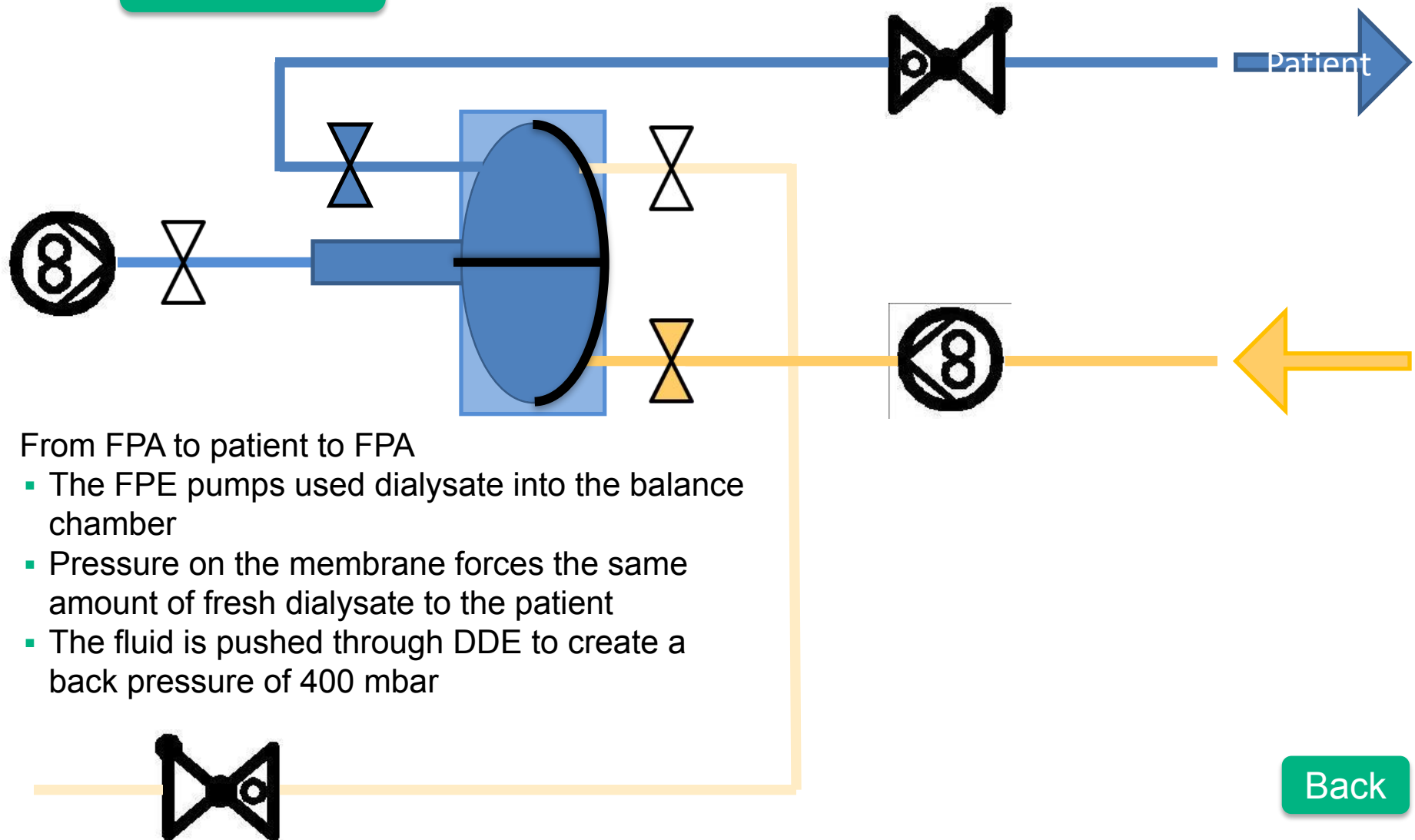
- The FPE pumps fresh dialysate into the balance chamber
- Pressure on the membrane forces the same amount of used dialysate to drain
- The fluid is pushed through RVDA to create a back pressure of 400 mbar

Repeat

Next

Back

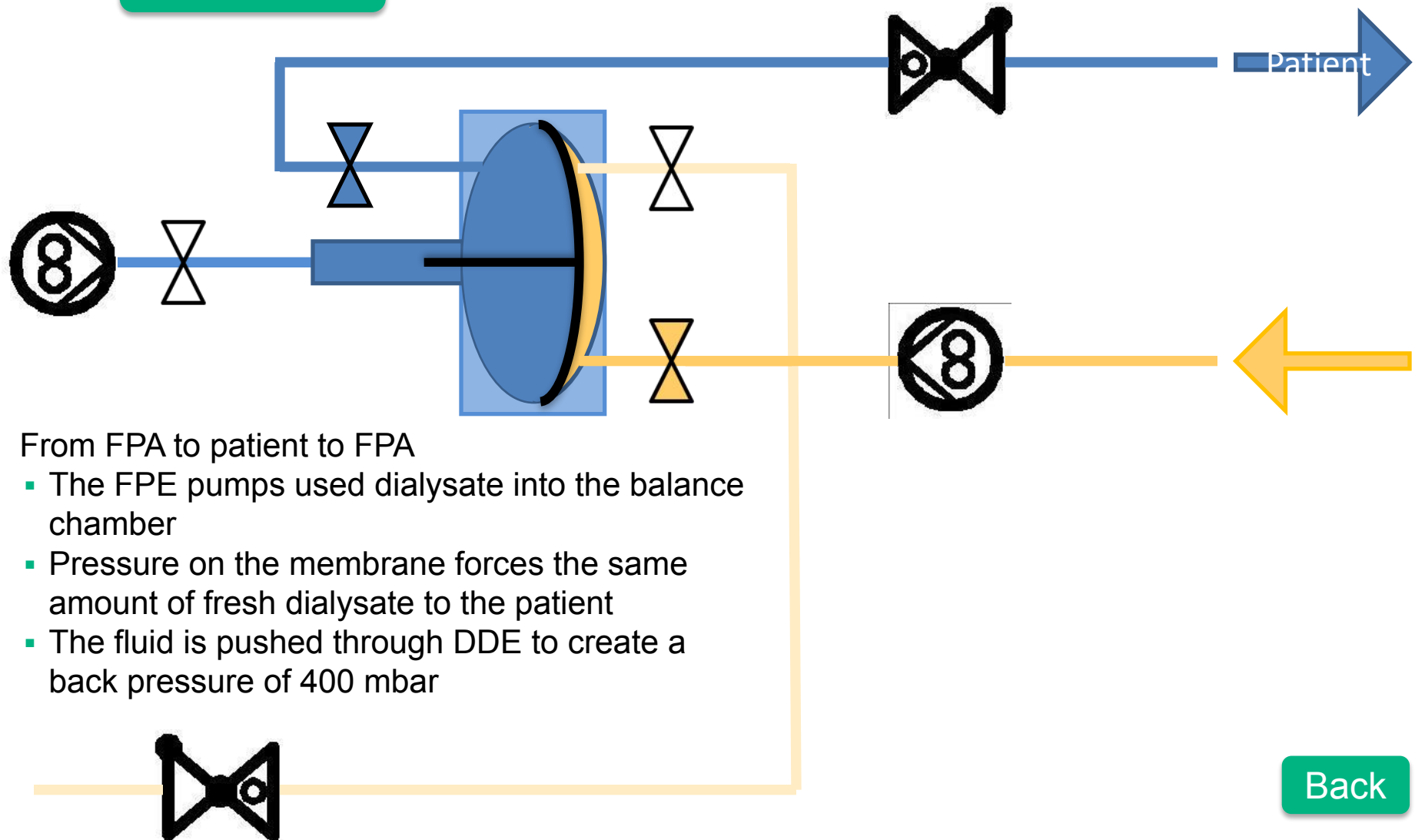
## Phase 2



From FPA to patient to FPA

- The FPE pumps used dialysate into the balance chamber
- Pressure on the membrane forces the same amount of fresh dialysate to the patient
- The fluid is pushed through DDE to create a back pressure of 400 mbar

## Phase 2



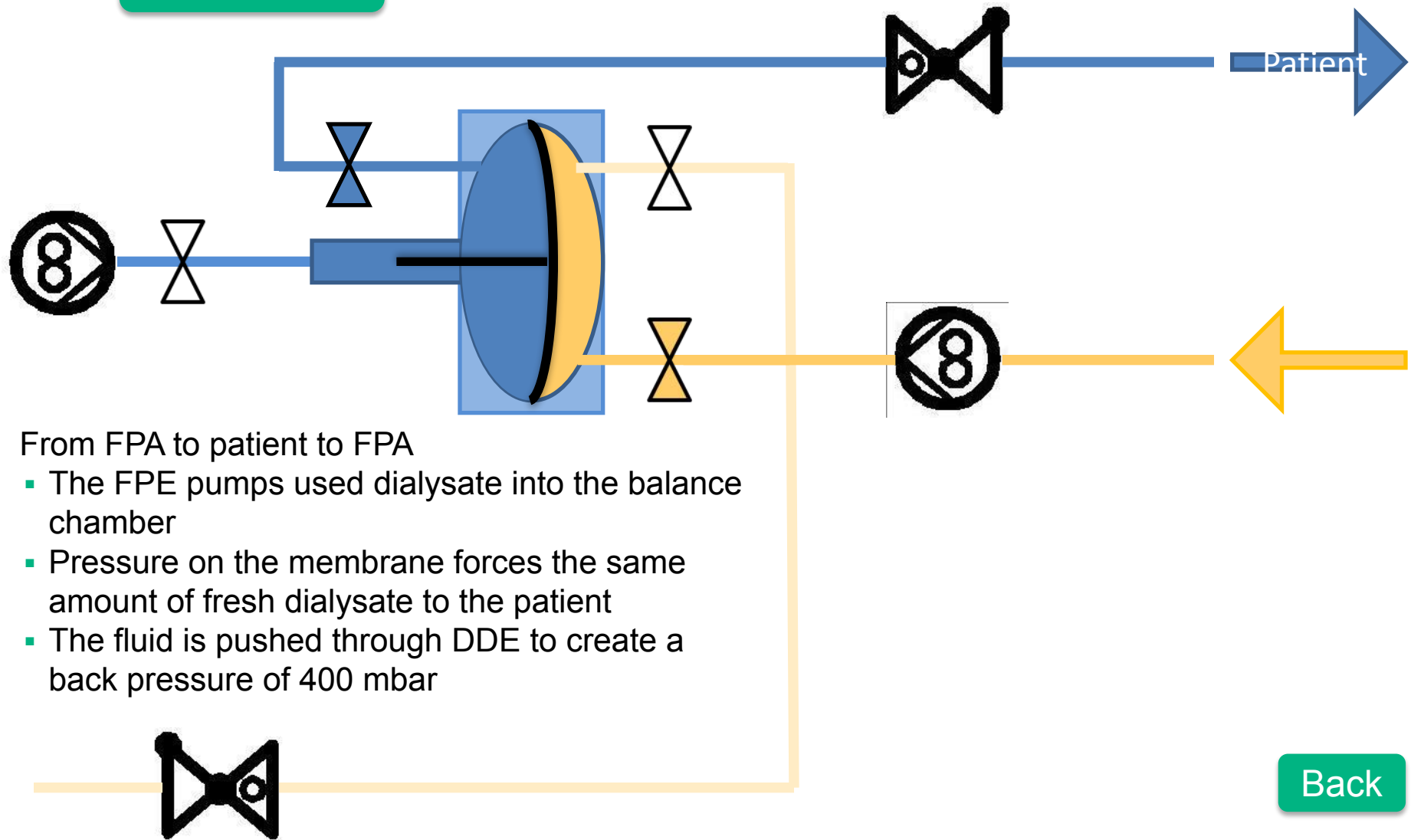
From FPA to patient to FPA

- The FPE pumps used dialysate into the balance chamber
- Pressure on the membrane forces the same amount of fresh dialysate to the patient
- The fluid is pushed through DDE to create a back pressure of 400 mbar

Back



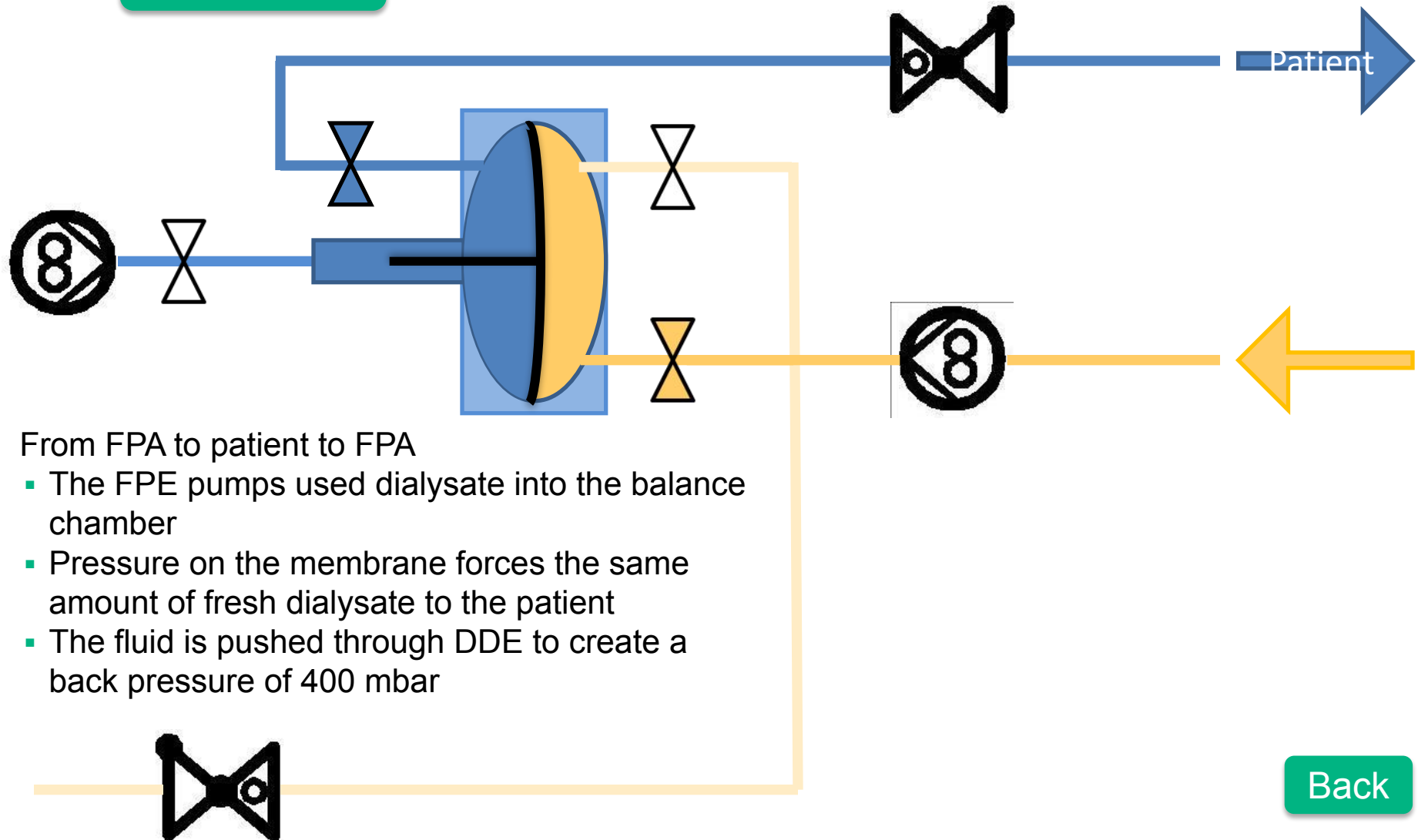
## Phase 2



From FPA to patient to FPA

- The FPE pumps used dialysate into the balance chamber
- Pressure on the membrane forces the same amount of fresh dialysate to the patient
- The fluid is pushed through DDE to create a back pressure of 400 mbar

## Phase 2

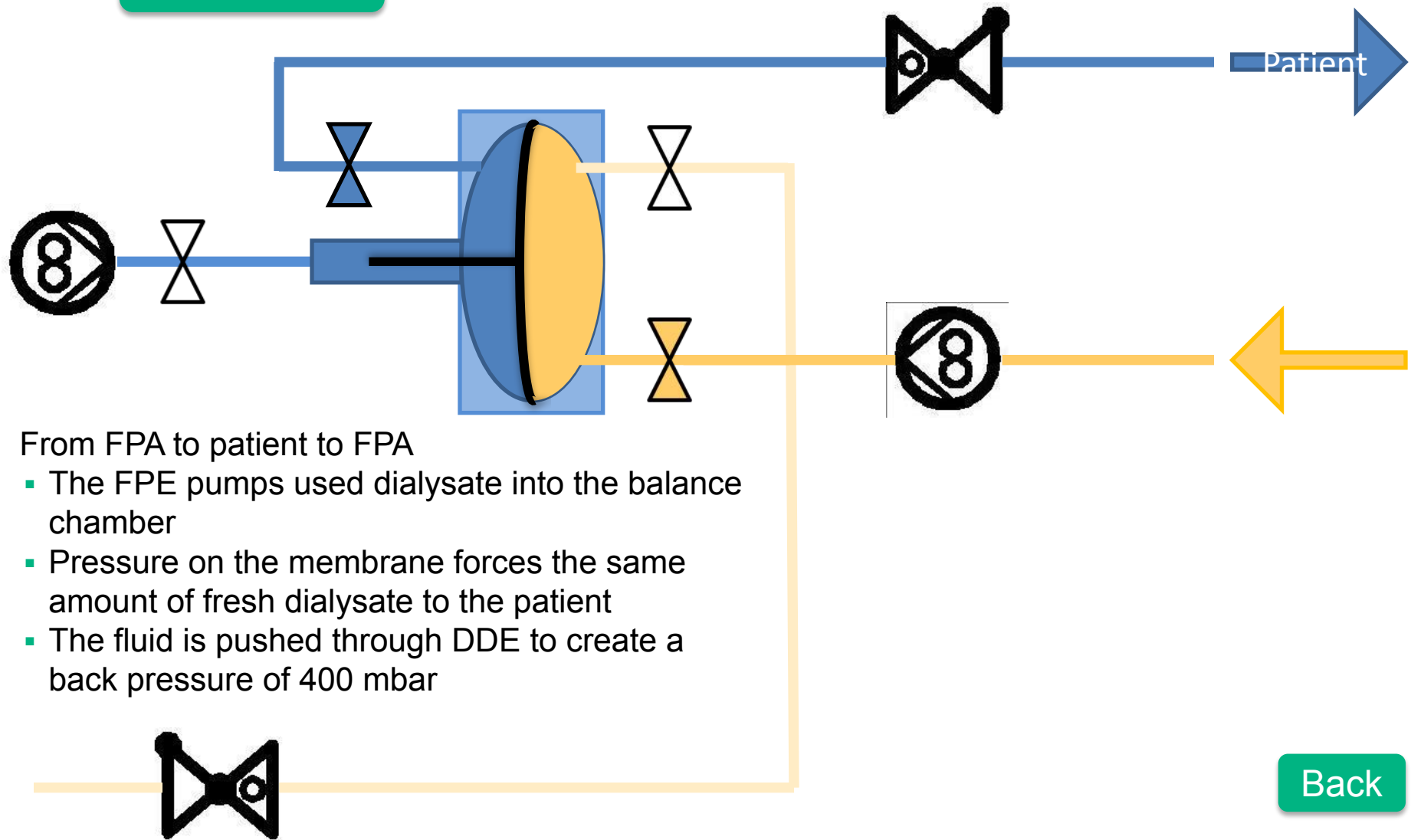


From FPA to patient to FPA

- The FPE pumps used dialysate into the balance chamber
- Pressure on the membrane forces the same amount of fresh dialysate to the patient
- The fluid is pushed through DDE to create a back pressure of 400 mbar

Back

## Phase 2

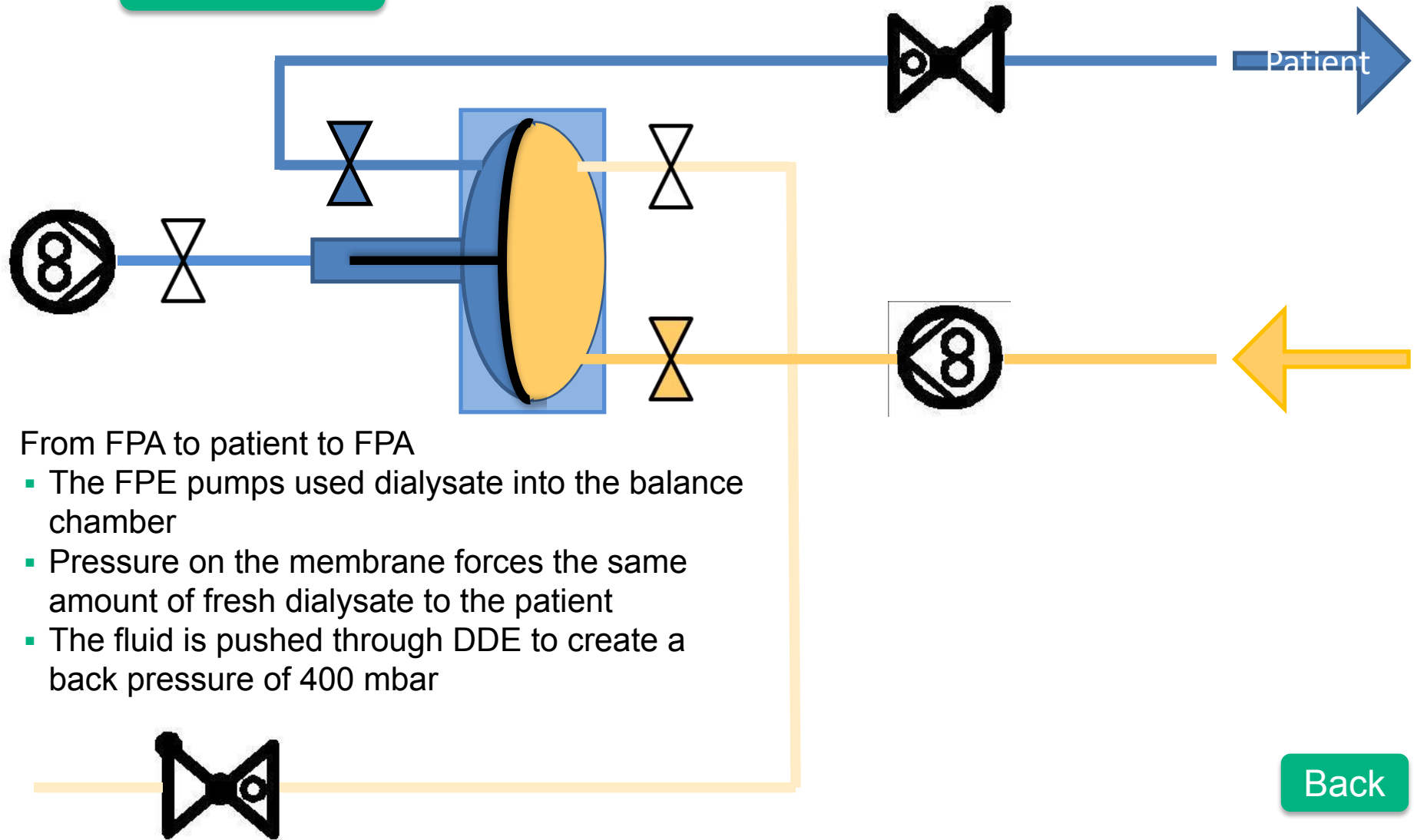


From FPA to patient to FPA

- The FPE pumps used dialysate into the balance chamber
- Pressure on the membrane forces the same amount of fresh dialysate to the patient
- The fluid is pushed through DDE to create a back pressure of 400 mbar

Back

## Phase 2

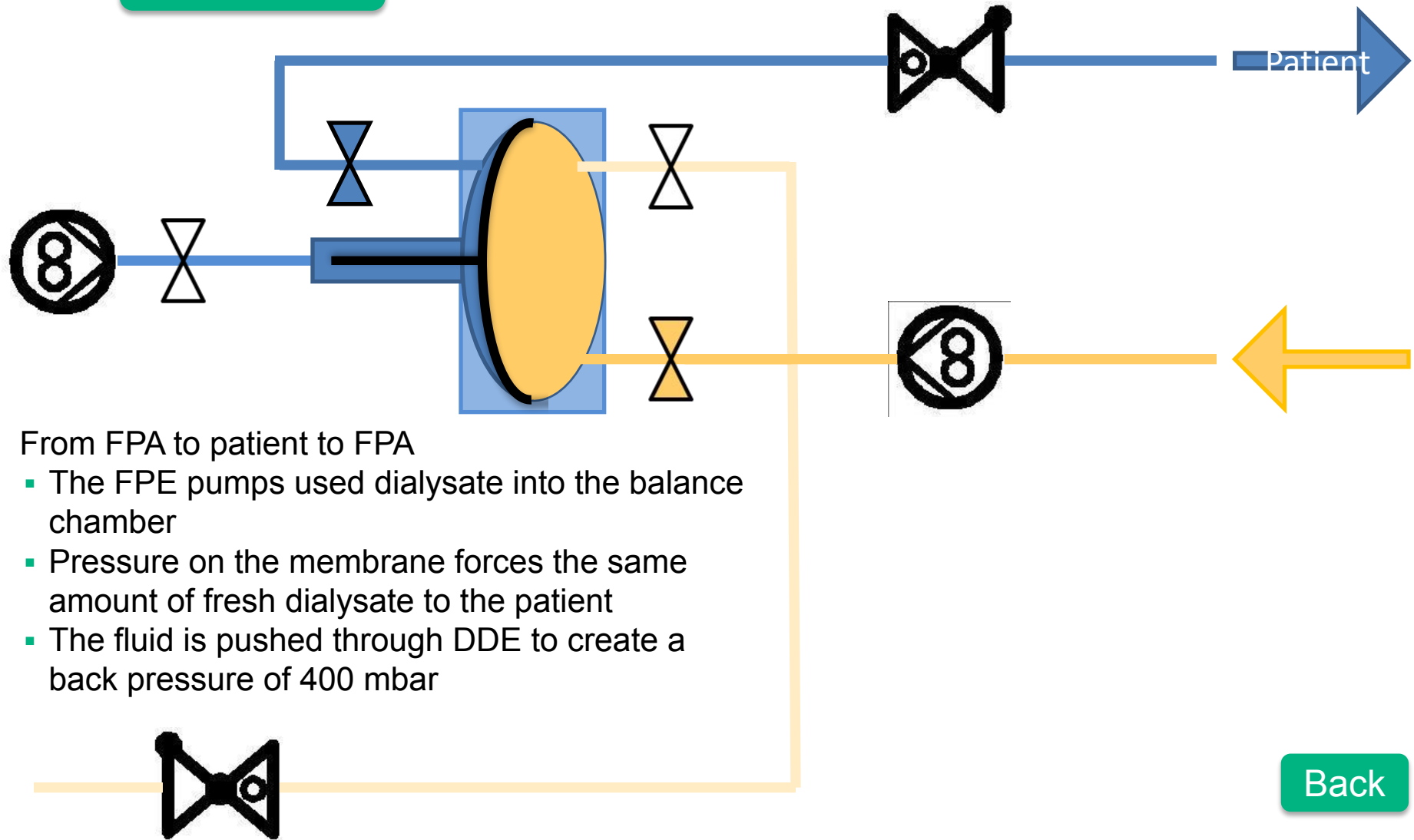


From FPA to patient to FPA

- The FPE pumps used dialysate into the balance chamber
- Pressure on the membrane forces the same amount of fresh dialysate to the patient
- The fluid is pushed through DDE to create a back pressure of 400 mbar

Back

## Phase 2

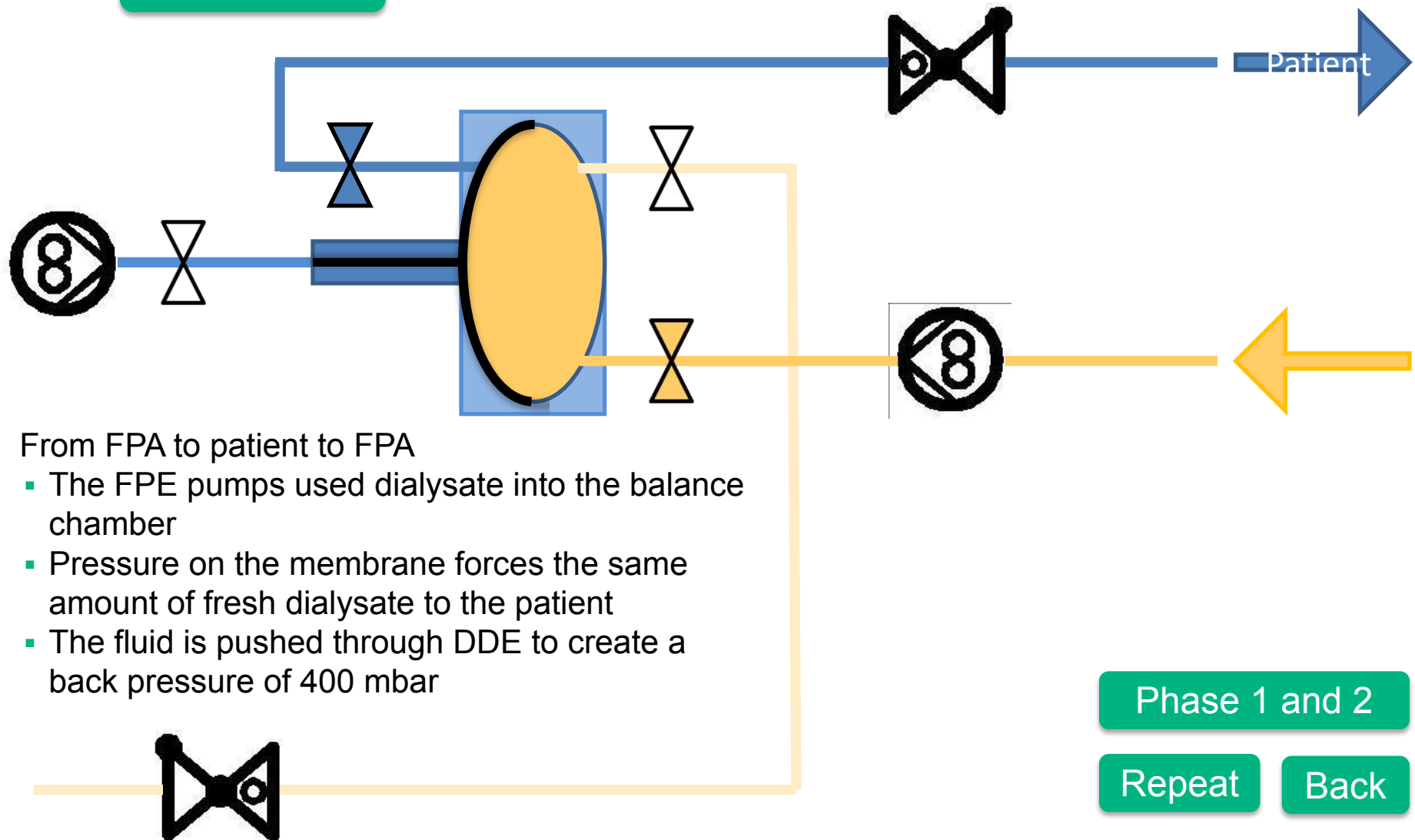


From FPA to patient to FPA

- The FPE pumps used dialysate into the balance chamber
- Pressure on the membrane forces the same amount of fresh dialysate to the patient
- The fluid is pushed through DDE to create a back pressure of 400 mbar

Back

## Phase 2



From FPA to patient to FPA

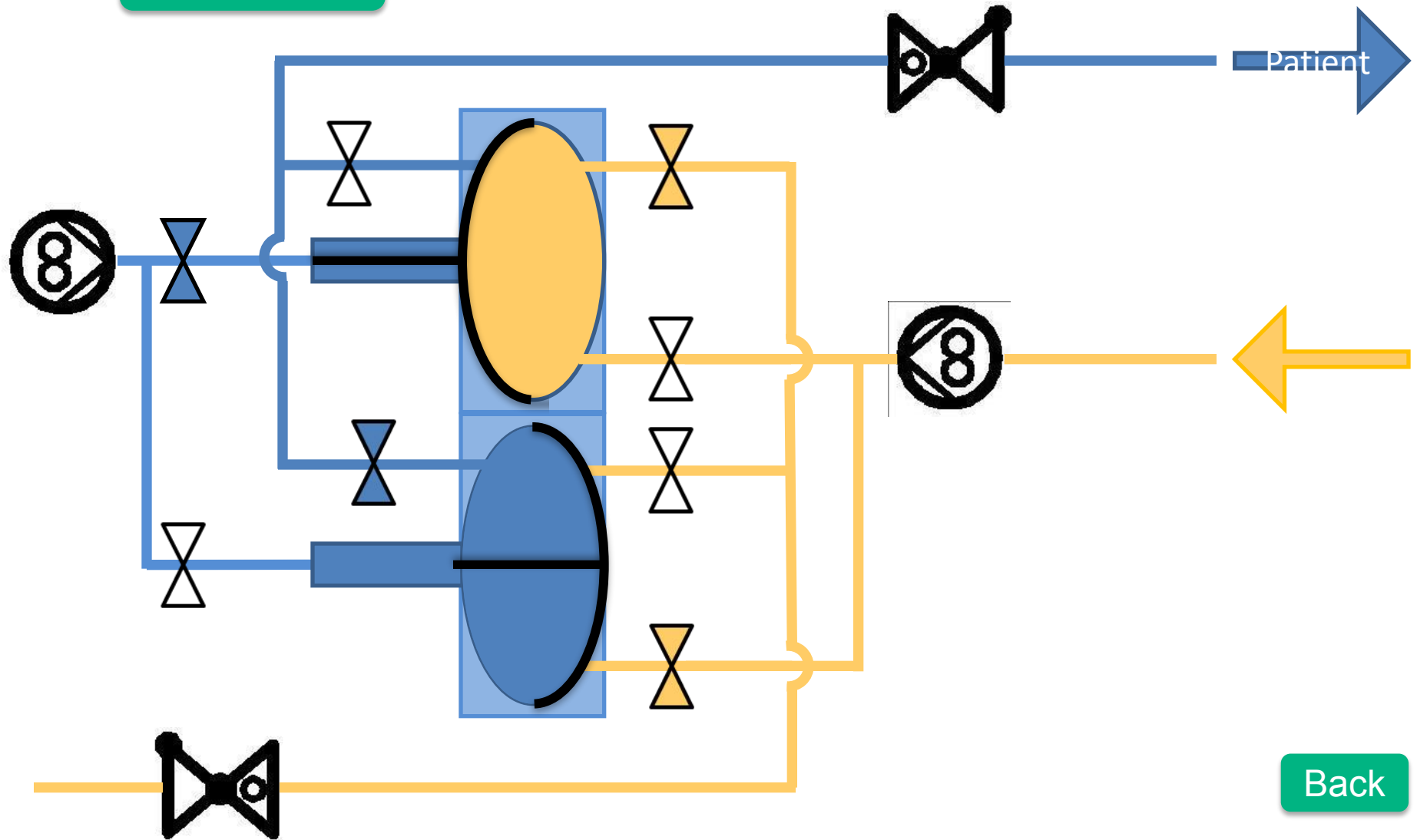
- The FPE pumps used dialysate into the balance chamber
- Pressure on the membrane forces the same amount of fresh dialysate to the patient
- The fluid is pushed through DDE to create a back pressure of 400 mbar

Phase 1 and 2

Repeat

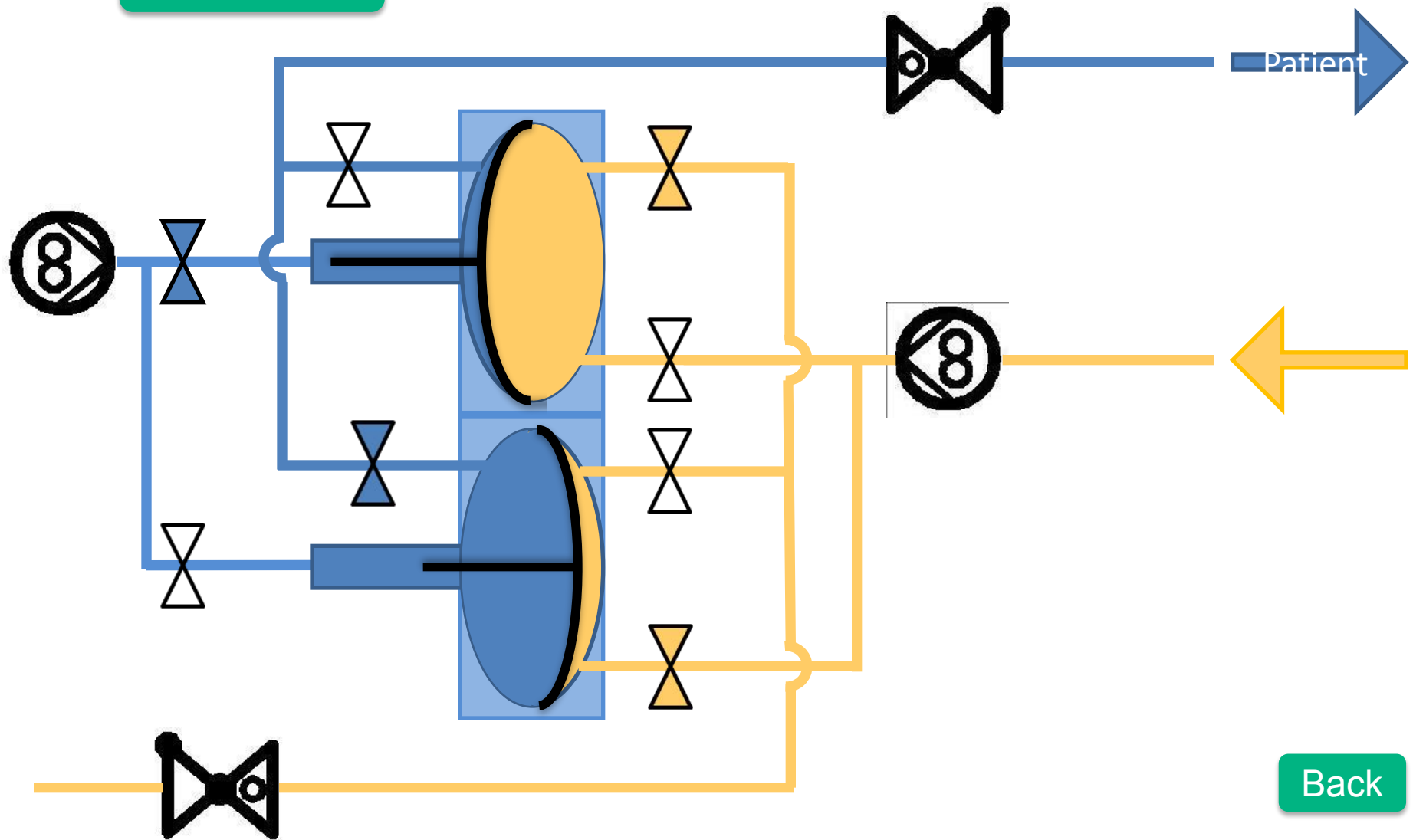
Back

Phase 1



Back

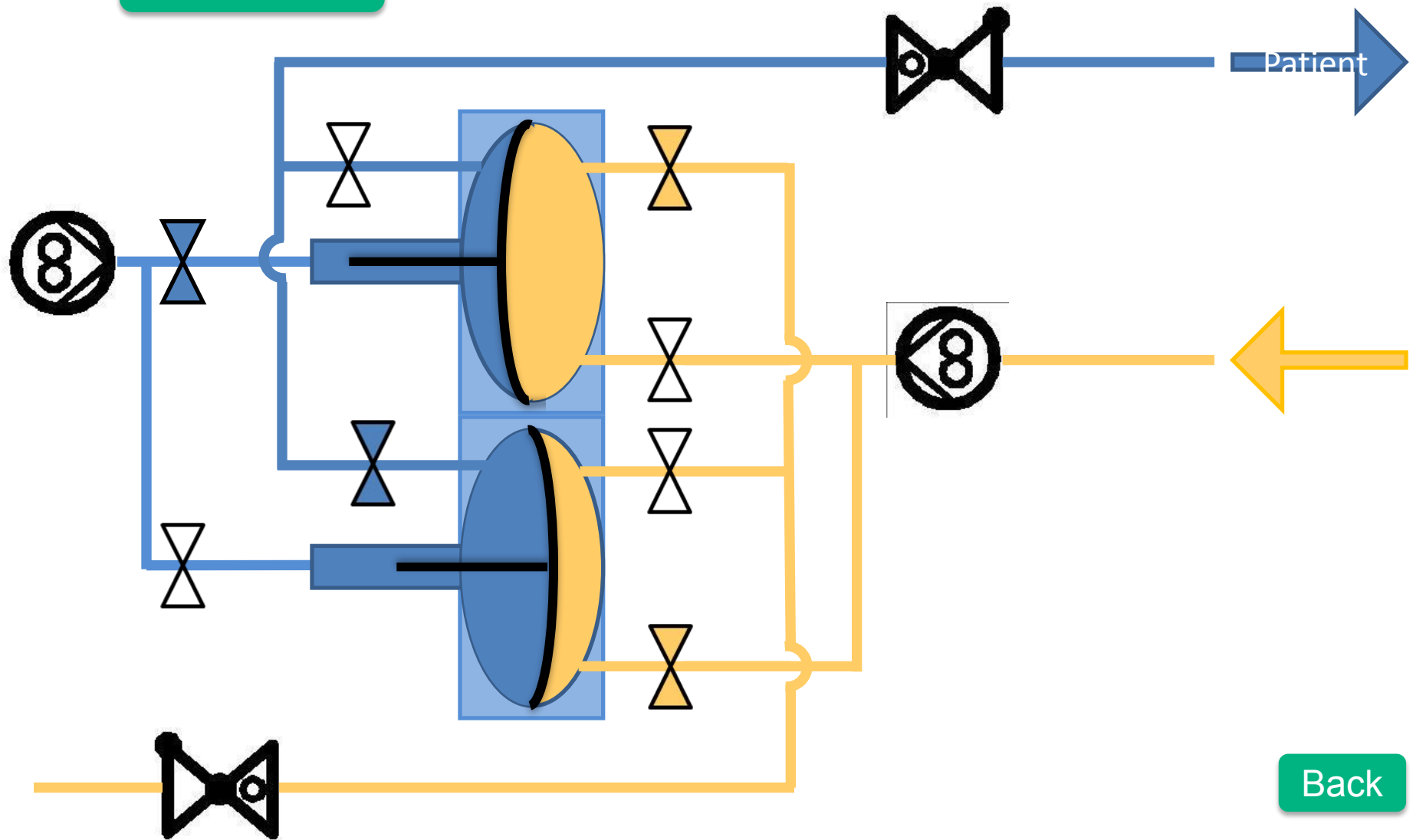
Phase 1



Back

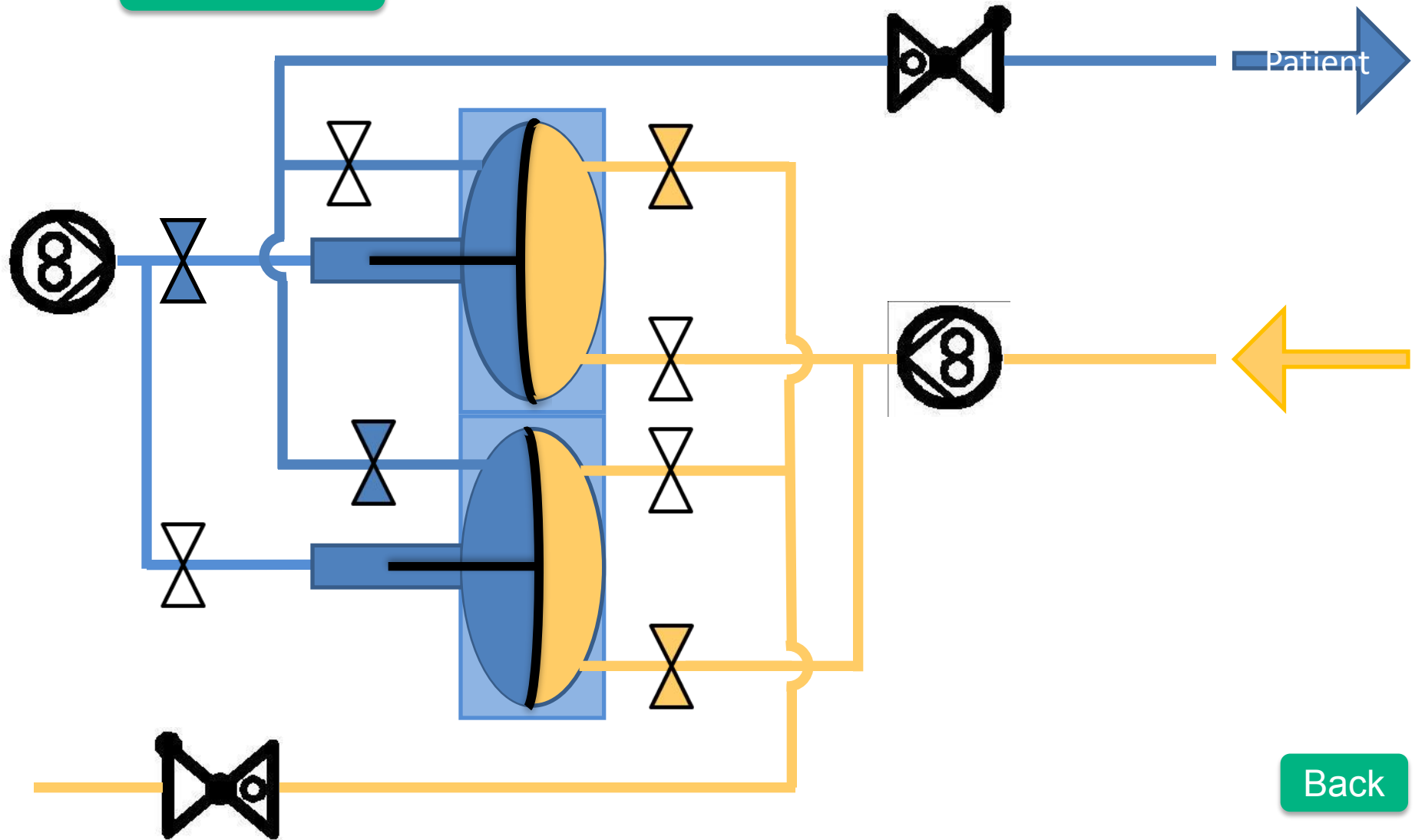


Phase 1



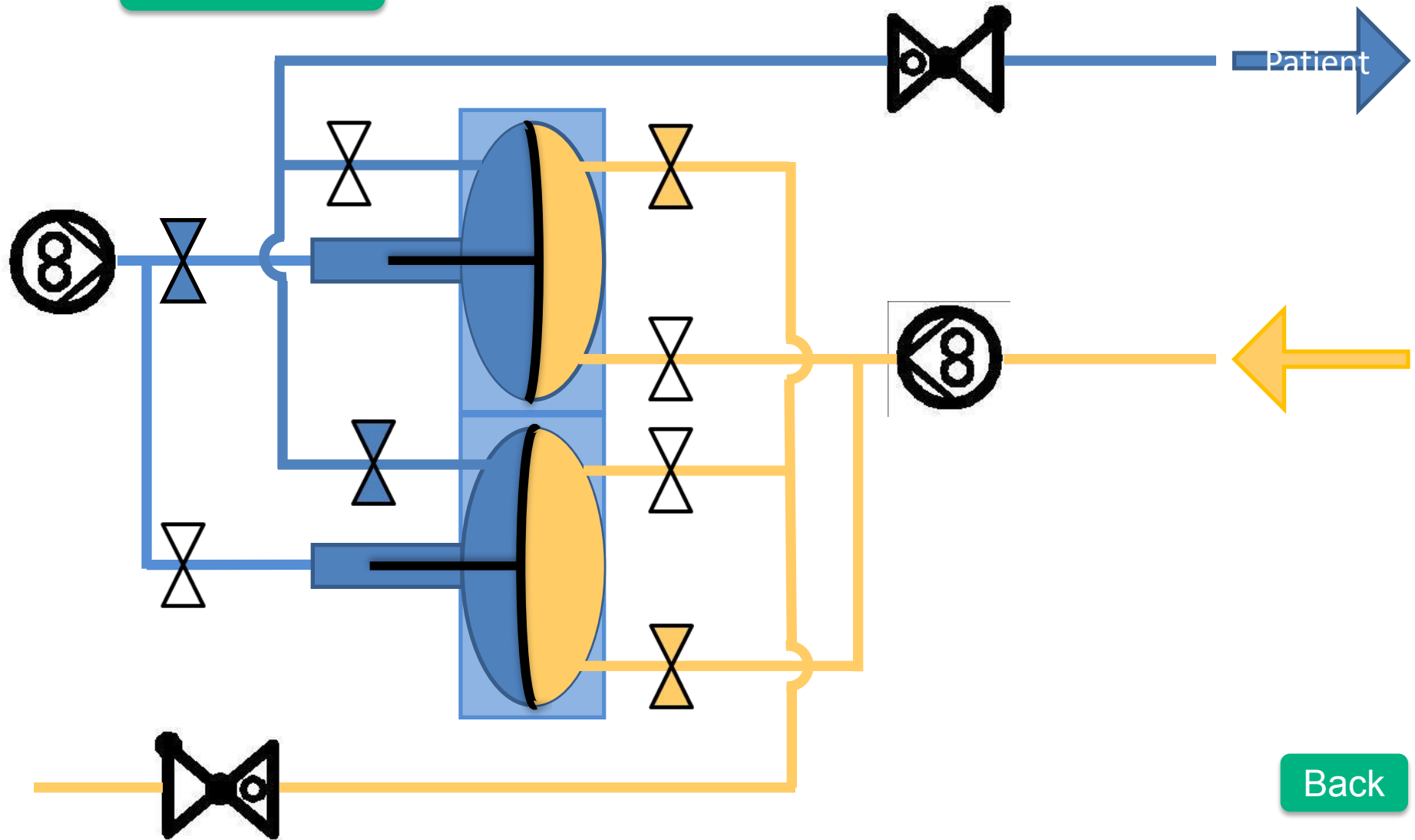
Back

Phase 1



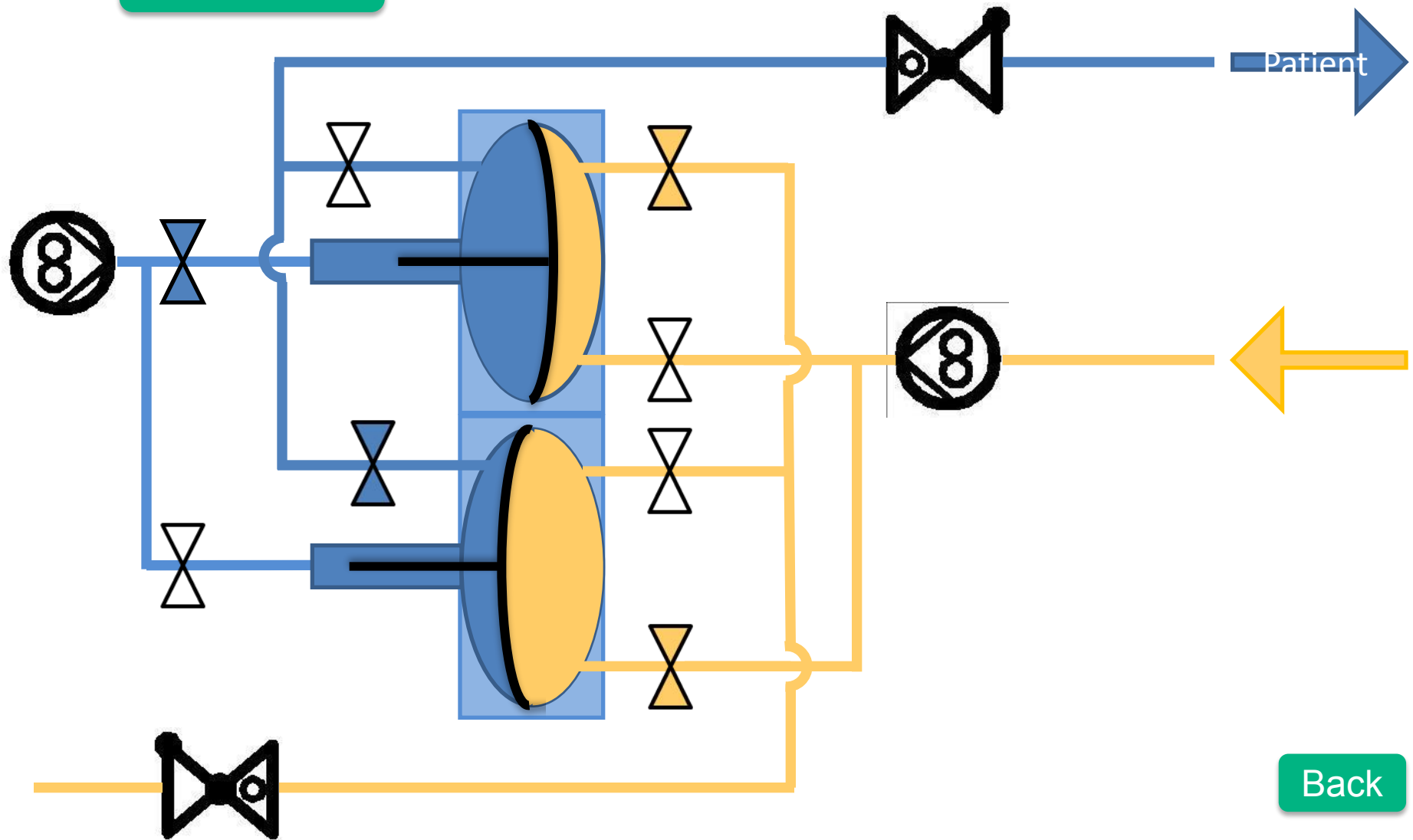
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Phase 1



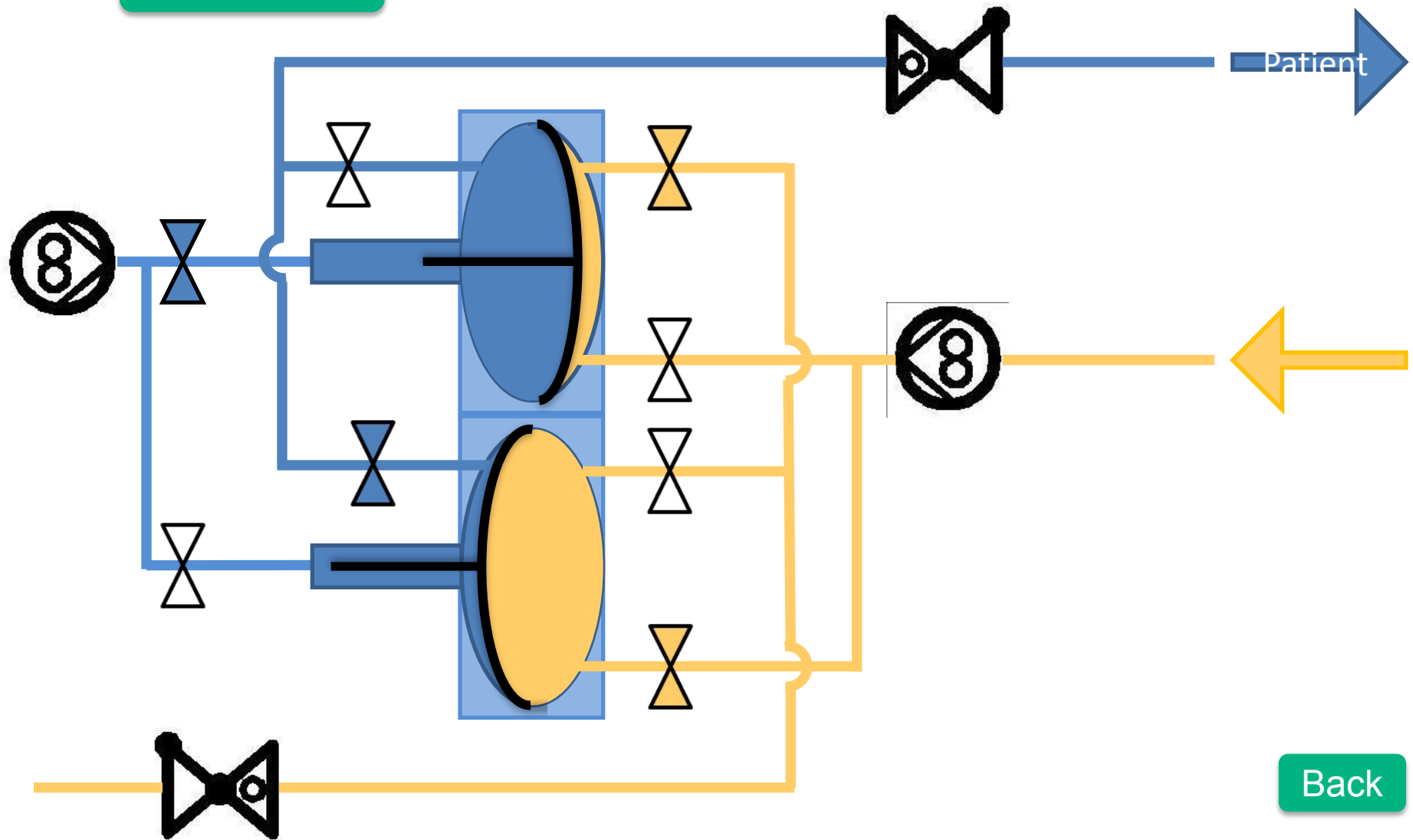
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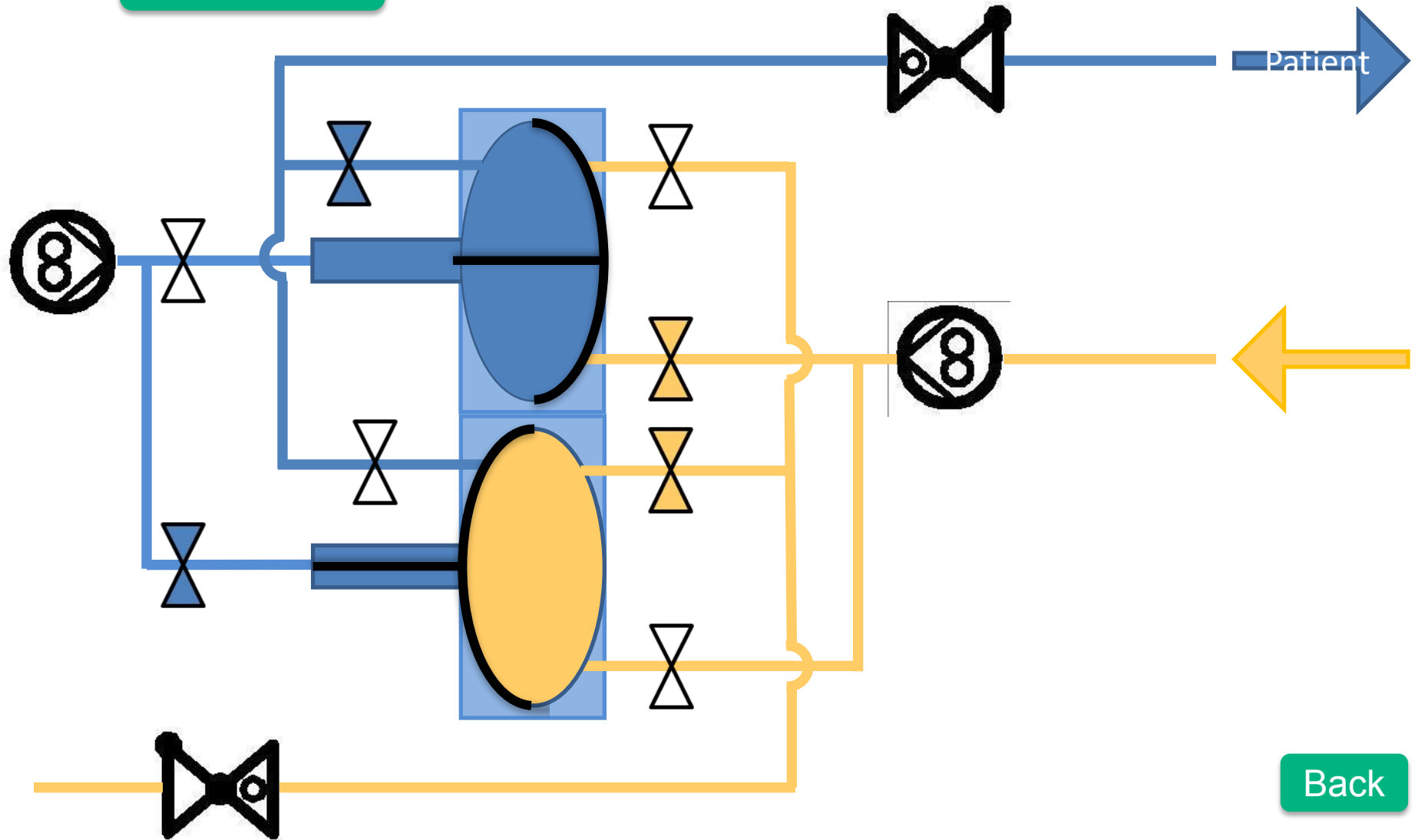


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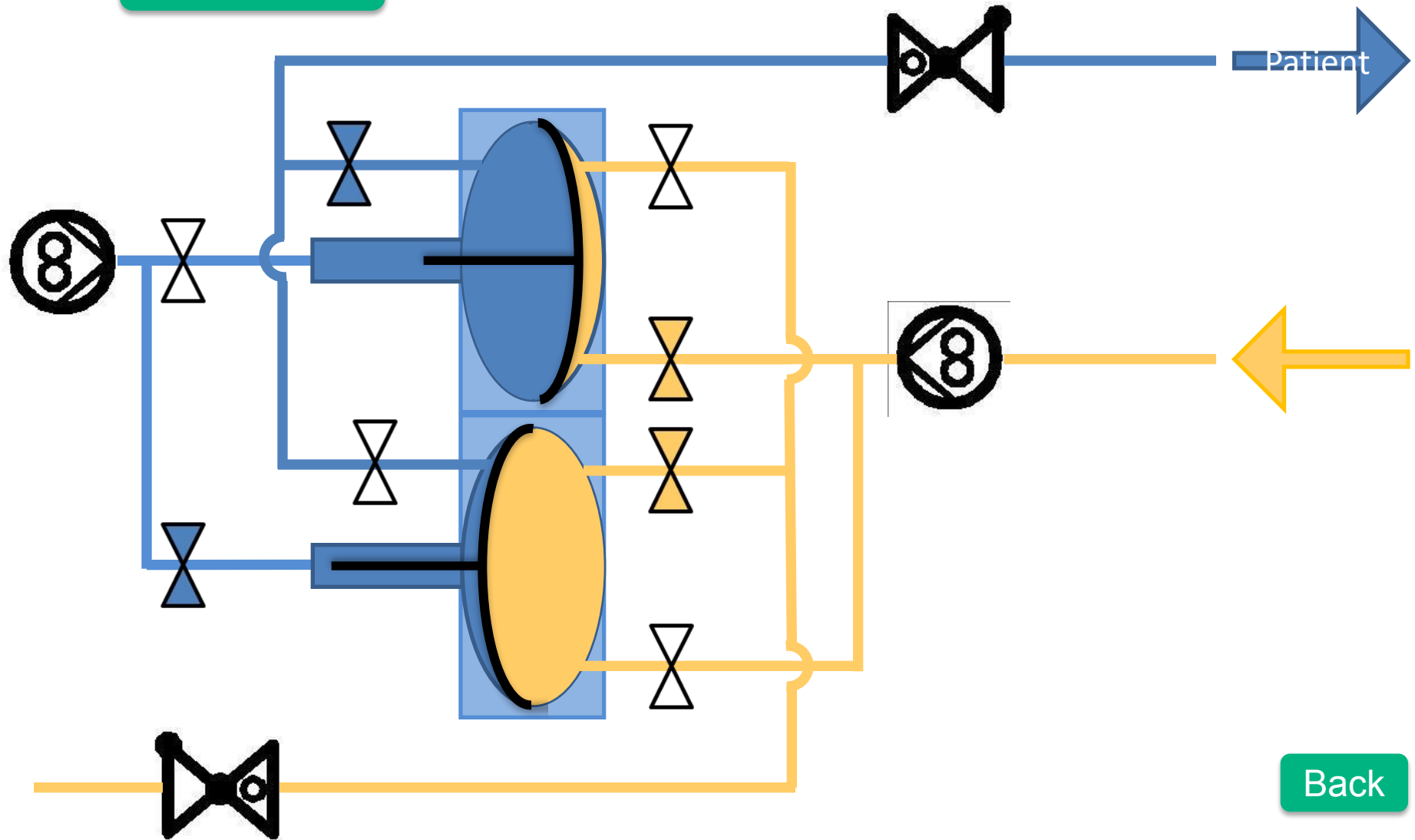


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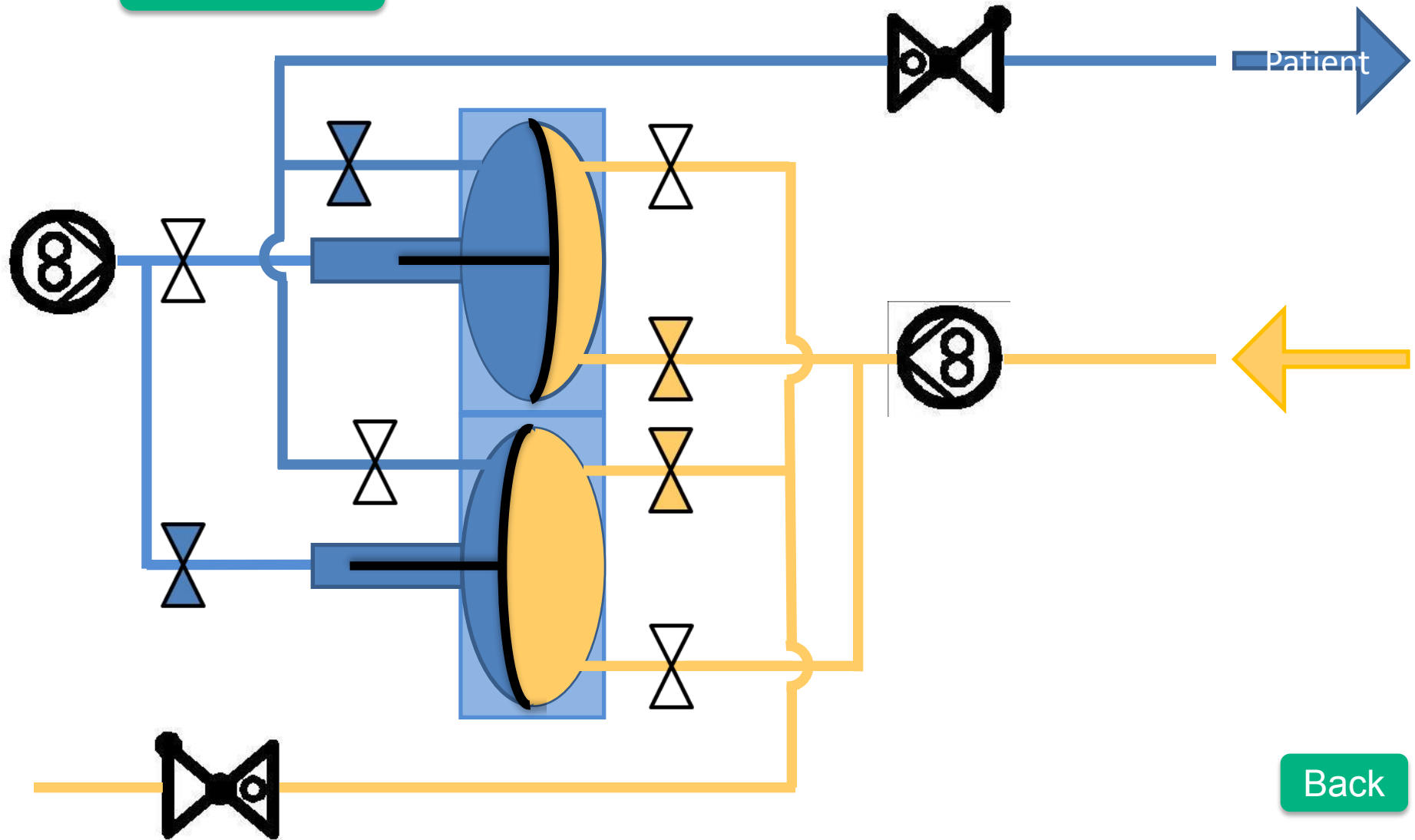
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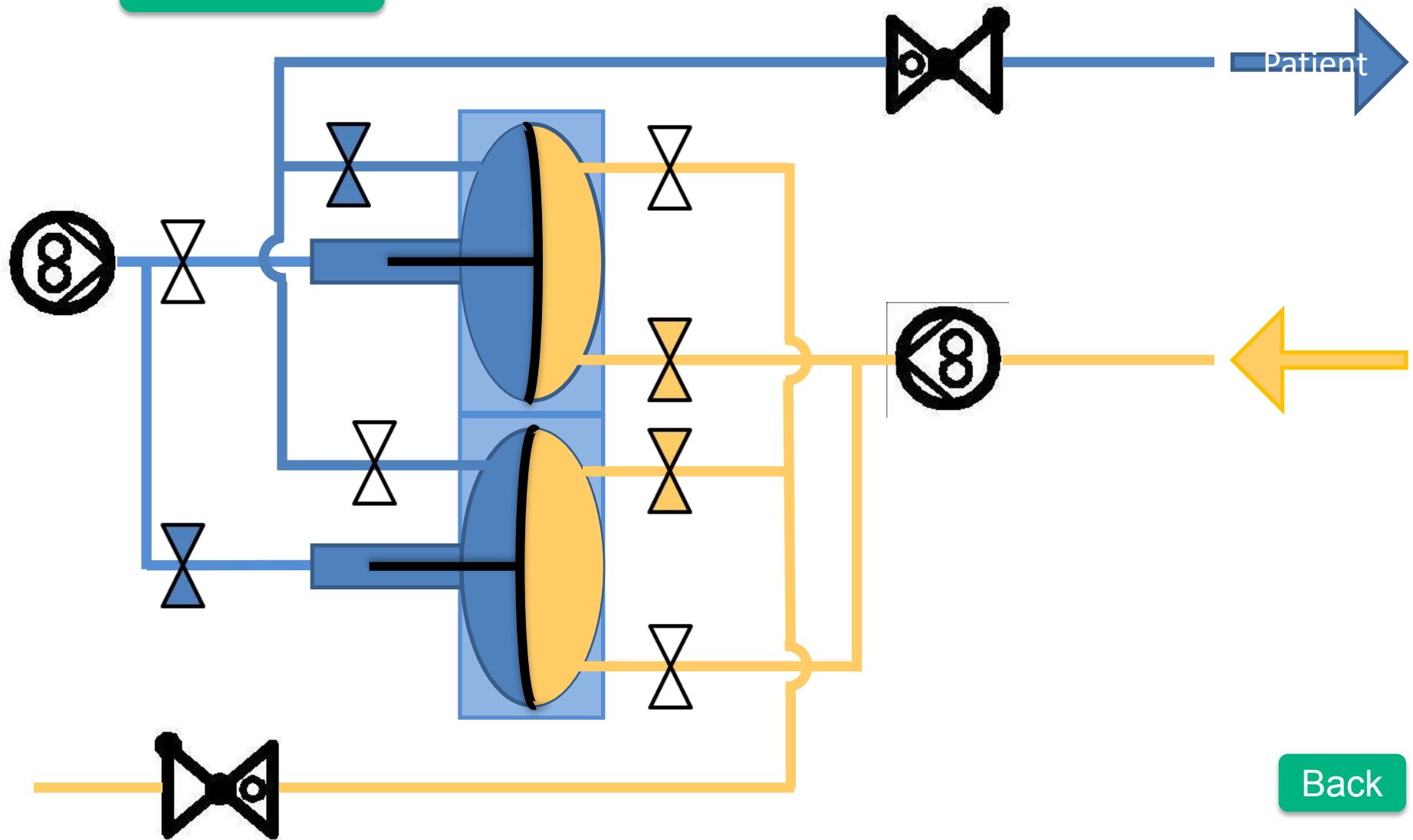
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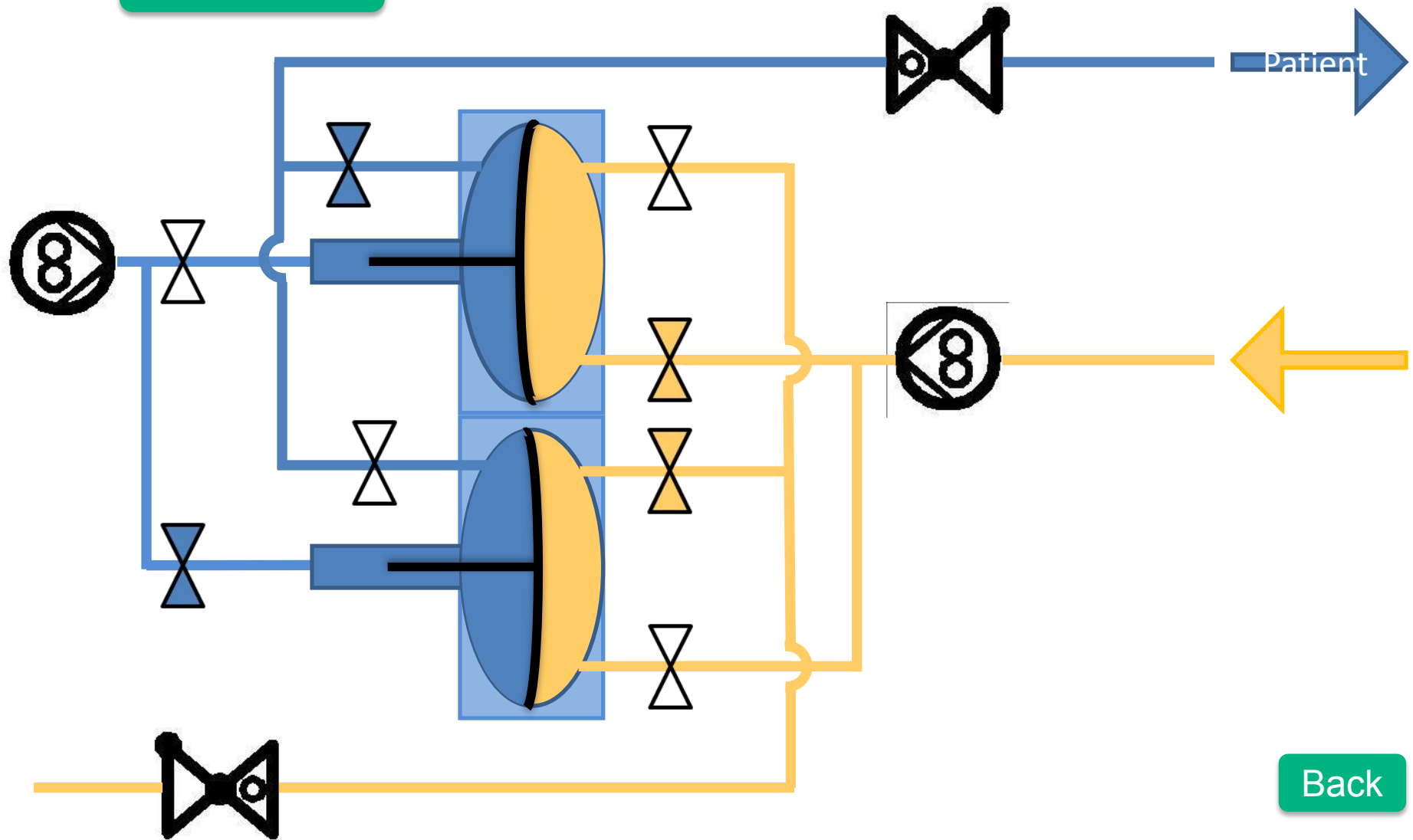
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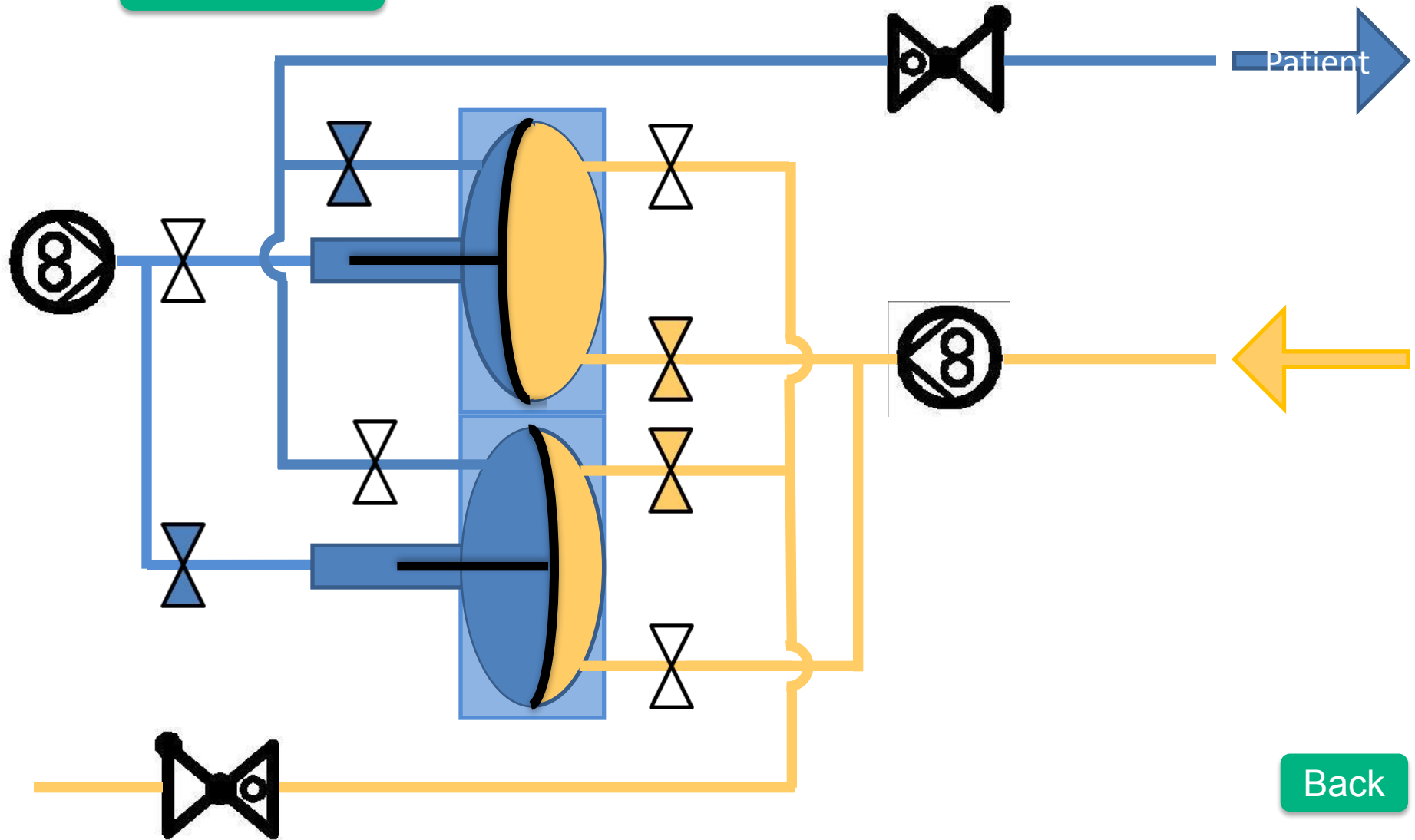
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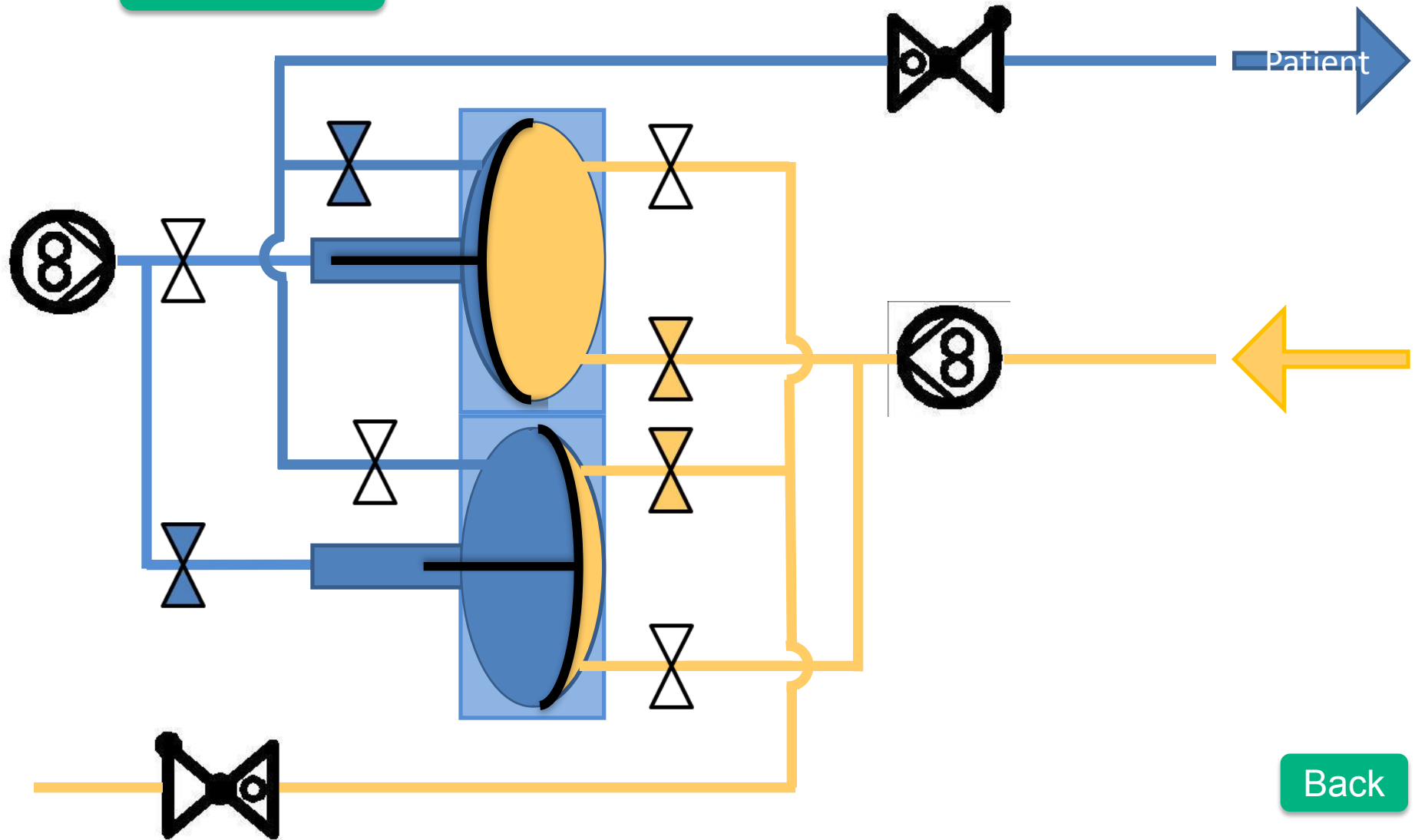


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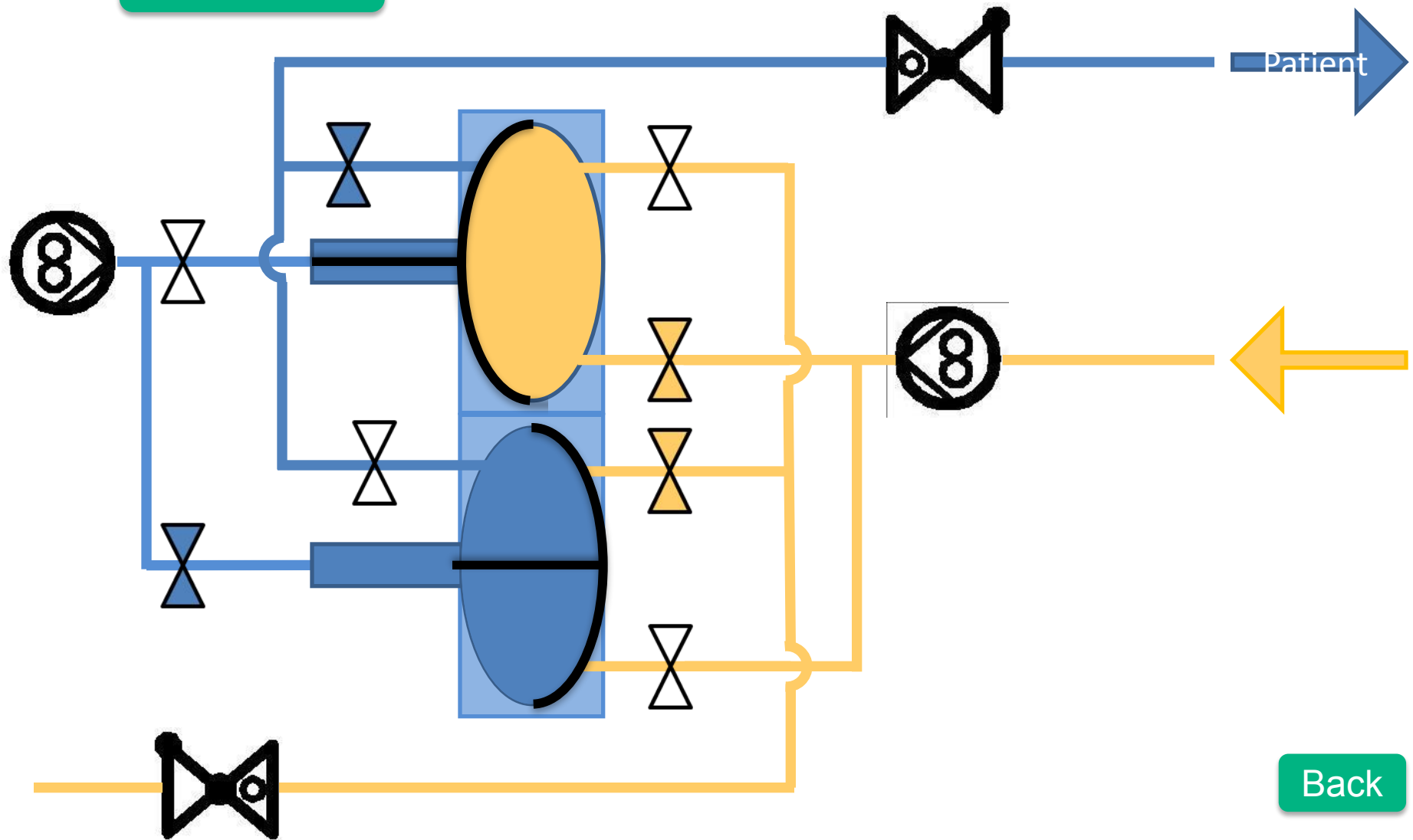
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