



Aquaboss®

Dialysis

Water

Purification

Aquaboss Global Water Summary

Leading manufacturer of proprietary water purification systems, initially targeting the \$1.2 billion international dialysis water purification market

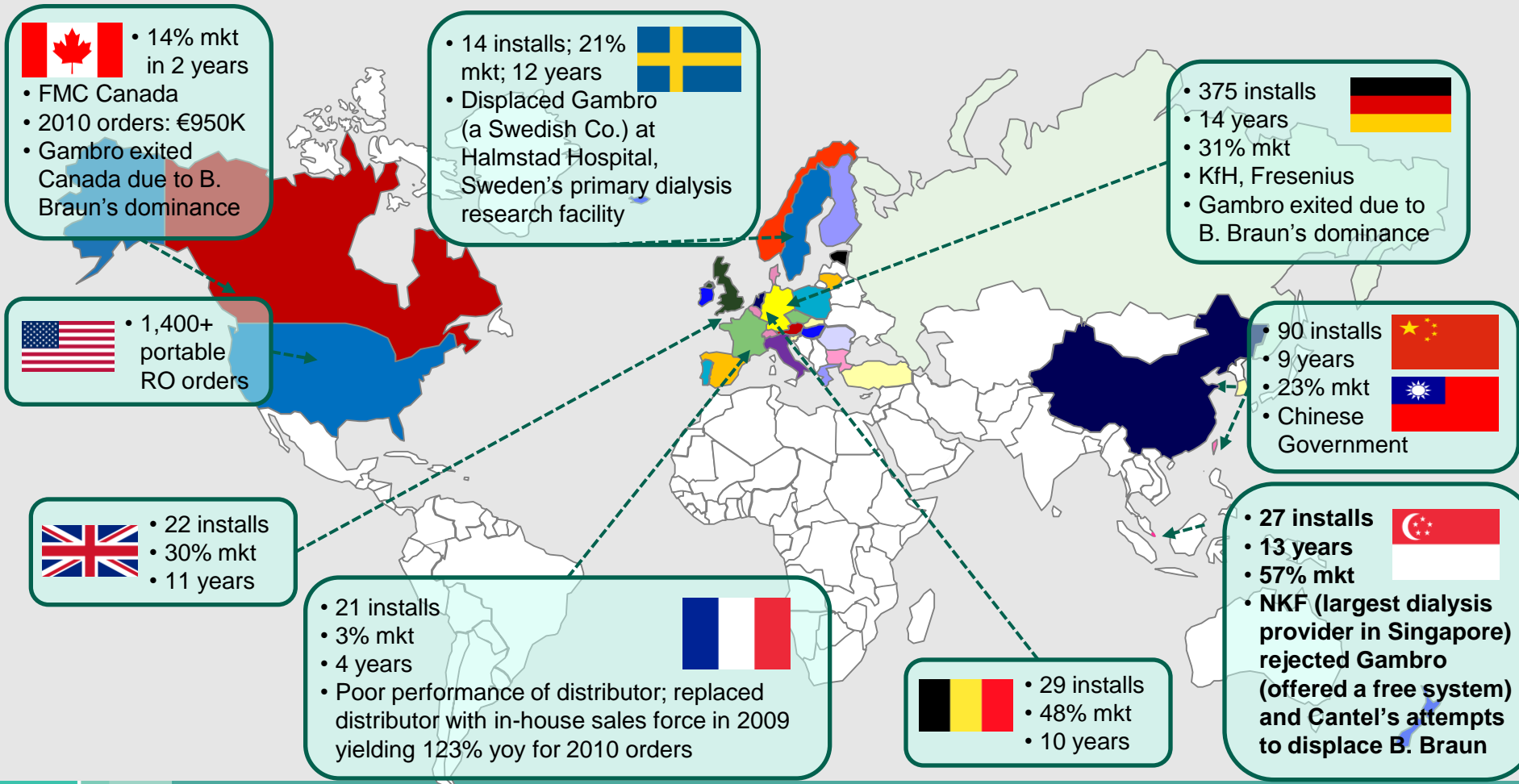
Successfully combined superior technology and measured growth strategies to establish itself as an industry leader in dialysis

Aquaboss systems are installed in more than 35 countries and have been embraced by the world's leading dialysis companies, including Fresenius, which uses Lauer equipment in facilities located in Asia, Europe & Canada

The Aquaboss has a demonstrated track record of increasing market share in multiple major international markets

Founded by H.G. Lauer in 1989, headquartered in Lörrach, Germany

Loyal International Customer Base with Significant Penetration in Each Market



U.S. Dialysis Market Dynamics

New AAMI water standards introduced in the U.S.

Current water purification systems may require expensive changes in operating processes or equipment upgrades to comply with the higher water quality standards

Water, utility and labor costs continue to increase

Improved technology reduces operating costs for dialysis providers and produces water with lower levels of toxins and bacteria, reducing the risk of additional costs related to infection

B. Braun's competitive position in the U.S.

- Higher water quality – lower levels of endotoxins improve patient's outcome
- Stainless steel construction – increased useful life
- Lower operating costs, water utilization and risk profile
- Smaller footprint – reduces space requirement and construction costs for new facilities
- Fewer breakdowns – Redundant RO and pumps reduce breakdowns saving

By unique & innovative products / reliable service

Dialog+ Hemodialysis machine system

ADIMEA Real-time Kt/V monitoring

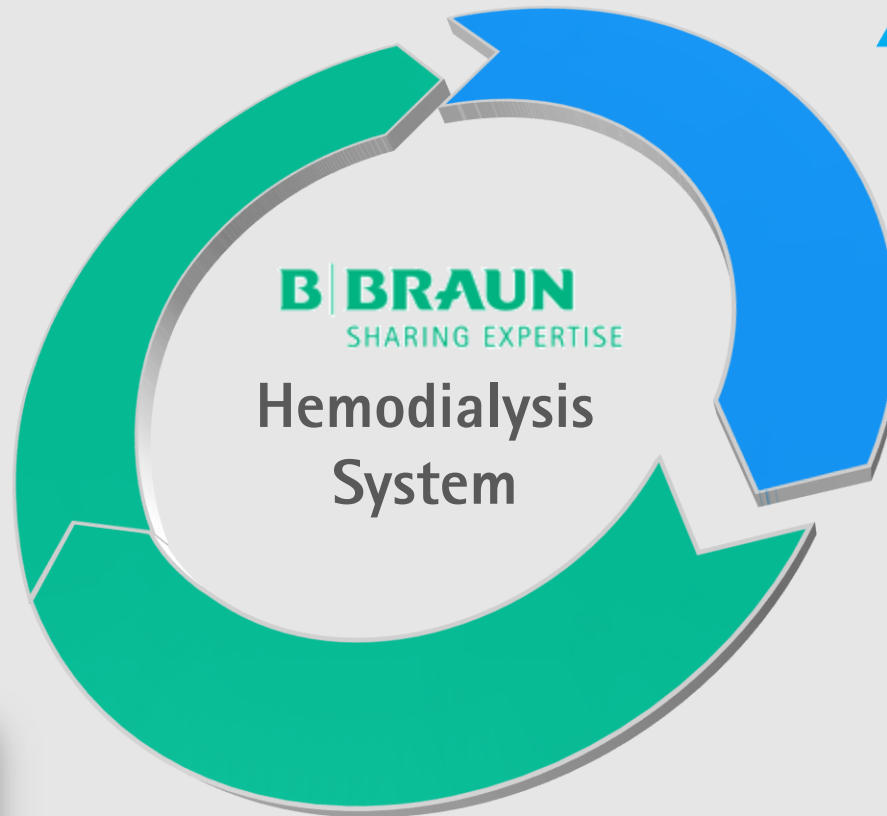
Streamline Airless bloodline system

Diacap High quality dialyzer

SolCart Bic cartridge machine option



24 Hour Technical & Clinical Support



Aquaboss®

Modular RO system

Pure/Ultra Pure water quality

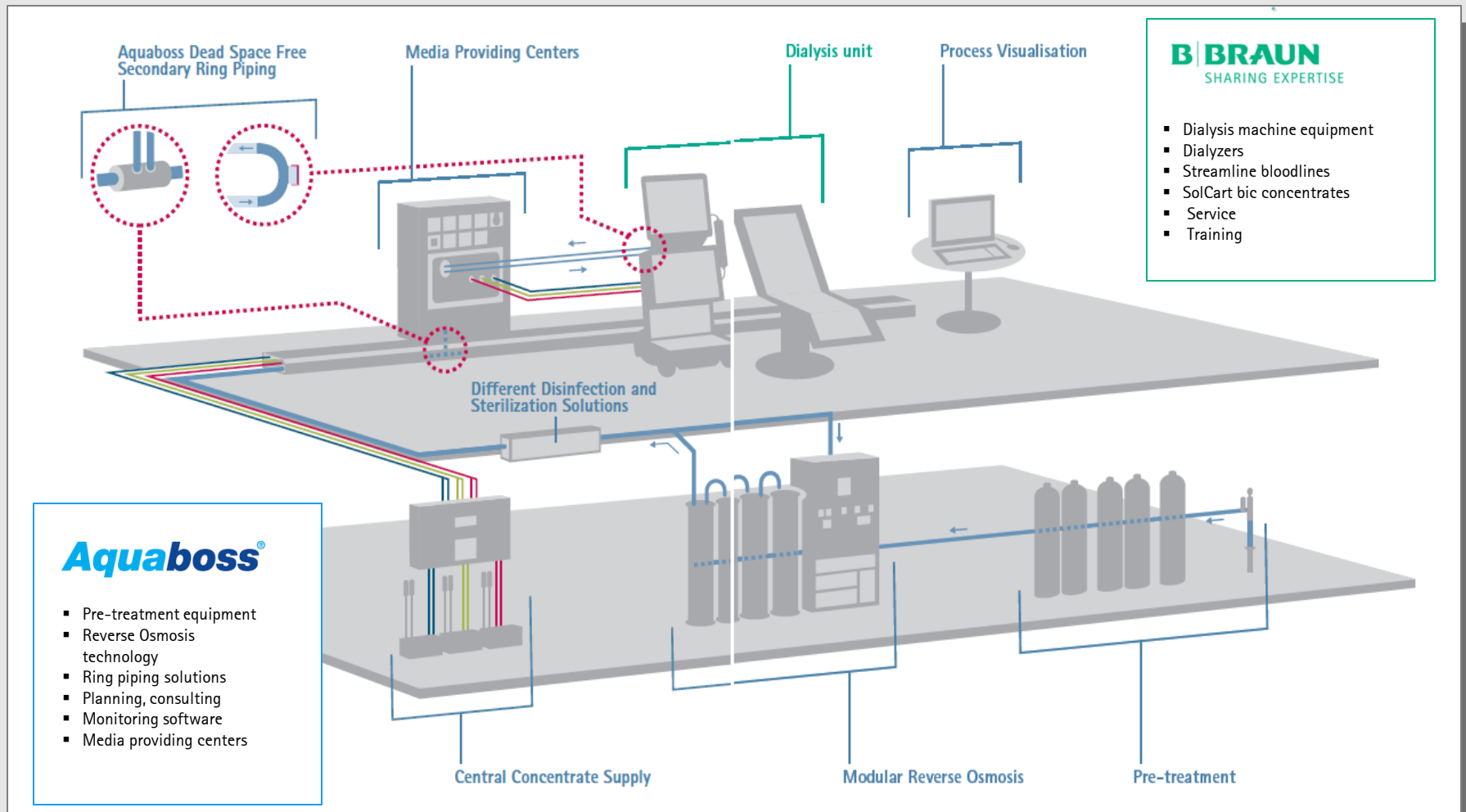
Impulse back washing

Complete heat disinfection

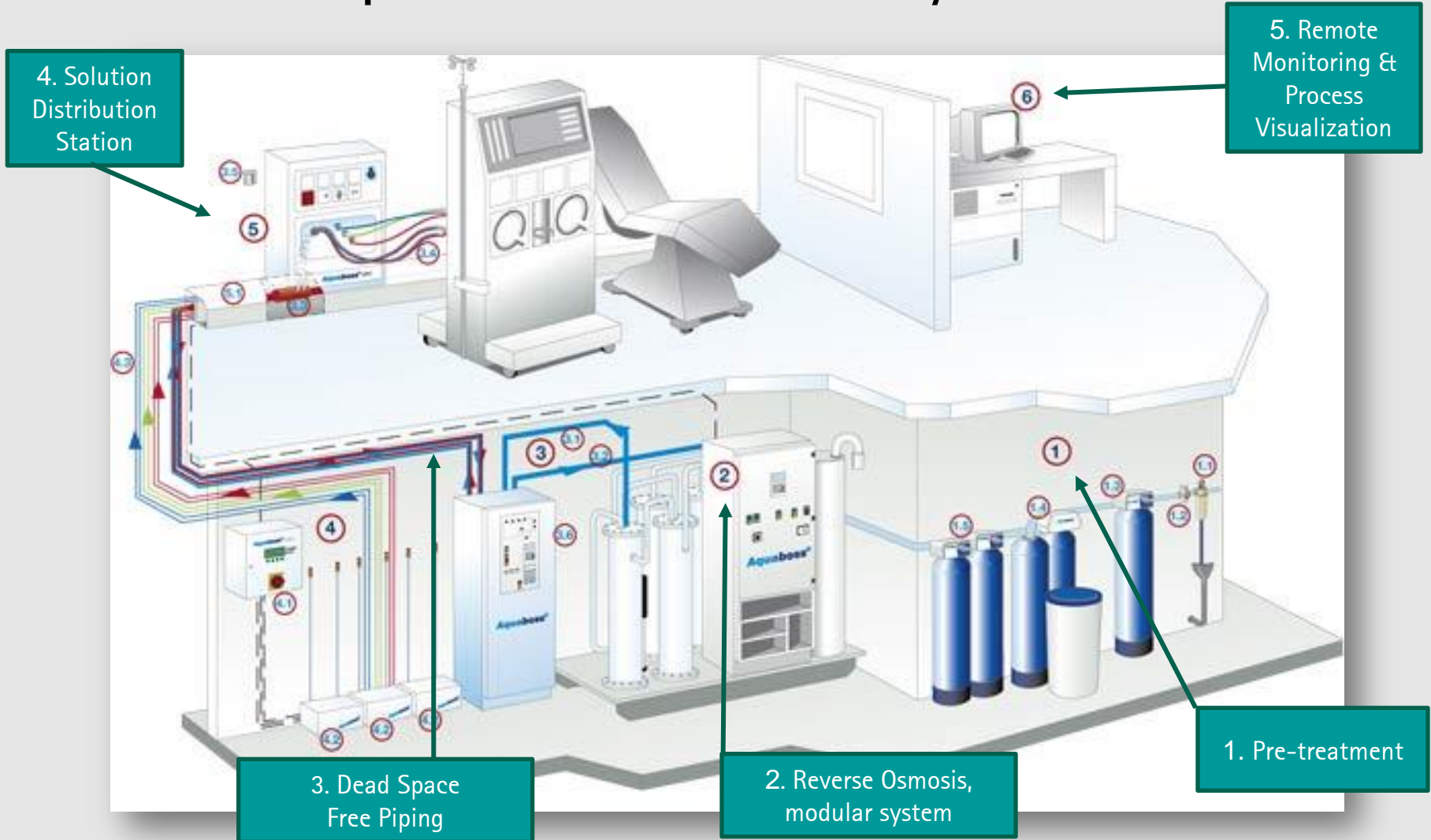
Water saving technologies

Dead space free system concept

All products and related services from one supplier



Aquaboss Water Treatment System



4. Solution Distribution Station

5. Remote Monitoring & Process Visualization

3. Dead Space Free Piping

2. Reverse Osmosis, modular system

1. Pre-treatment

Green technology approach in water purification



- Reduced usage of chemicals
- Water savings
- Energy conservation
- 3.9 Billion gallons of municipal quality water is used each year in the US for dialysis treatments alone.

▶ The **Aquaboss®** system offers improvements in all areas

Water is an essential key factor in modern dialysis!

Clinical data show that contaminants in dialysis water are contributory factors for acute and chronic problems as well as severe injuries to hemodialysis patients.¹

- ▶ Increasing water quality standards

According to a USA TODAY study of 100 municipalities, the cost of water has doubled over the past 12 years and in more than a quarter of the locations, even tripled in a few.²

- ▶ Increasing trend of water costs



¹: Cannata-Andía, JB, Fernández-Martin, JL. The clinical impact of aluminium overload in renal failure. *Nephrol Dial Transplant* 17 [Suppl 2]: 9-12, 2002

Usuda, K, Kono, K, Yoshida, Y. The effect of hemodialysis upon serum levels of fluoride. *Nephron* 75:175-178, 1997

Calderaro, RV, Heller, L. Outbreak of hemolytic reactions associated with chlorine and chloramine residuals in hemodialysis water. *Rev Saude Publica* 35:481-486, 2001

Yamagami, S, Adachi, T, Sugimura, T, Wada, S, Kishimoto, T, Maekawa, M, Yoshimura, R, Niwa, M, Terano, Y, Shaldon, S. Detection of endotoxin antibody in long-term dialysis patients. *Int J Artif Organs* 13:205-210, 1990

²: <http://www.usatoday.com/story/money/business/2012/09/27/rising-water-rates/1595651/>

Why Water Must be Treated

Average Person

- ❖ Drinks 14 liters of water/week
- ❖ GI tract more selective
- Functioning kidney

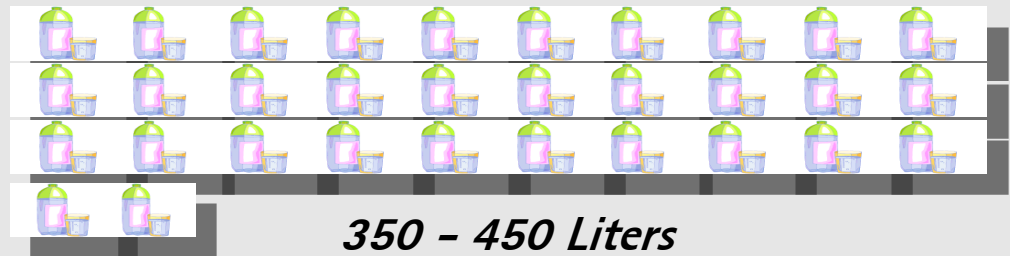


10 - 14 Liters

Person on Hemodialysis

- ❖ Blood is exposed to 360+ liters of water/week
- ❖ Dialyzer membrane is thin, non-selective
- Nonfunctioning kidney

Can experience harm or death from untreated water



350 - 450 Liters

New Standards for WTS Design



Aquaboss Double Stage, Heat Disinfected design

Innovative & Differentiating Technology

Dead space free reverse osmosis design
Dead space free distribution system
Dead space free secondary loop

} **No dead space is critical to mitigating the development of biofilm and limiting bacteria proliferation**

Dual stage reverse osmosis units

→ **Improves water quality and reduces water consumption**

Impulse backwashing

→ **Improves membrane performance, water quality and reduces costs**

Heat disinfection of complete system

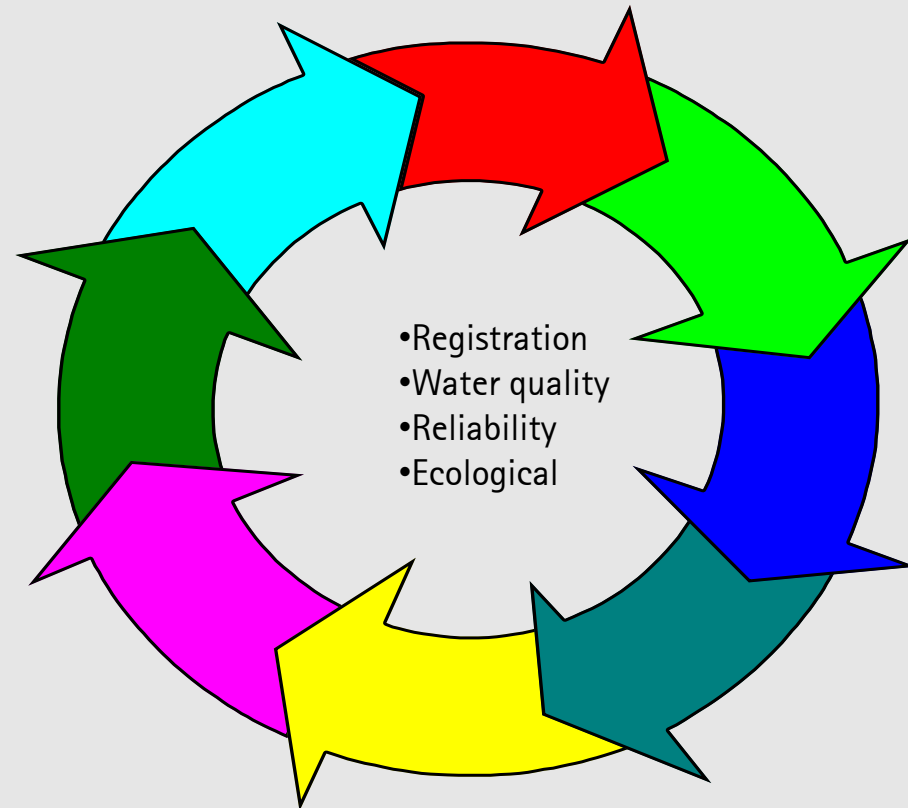
→ **Allows chemical free sterilization and improves water quality – minimizes risks of patient exposure to harmful chemicals**

Stainless steel construction

Software interface & central monitoring

Water Treatment System Components

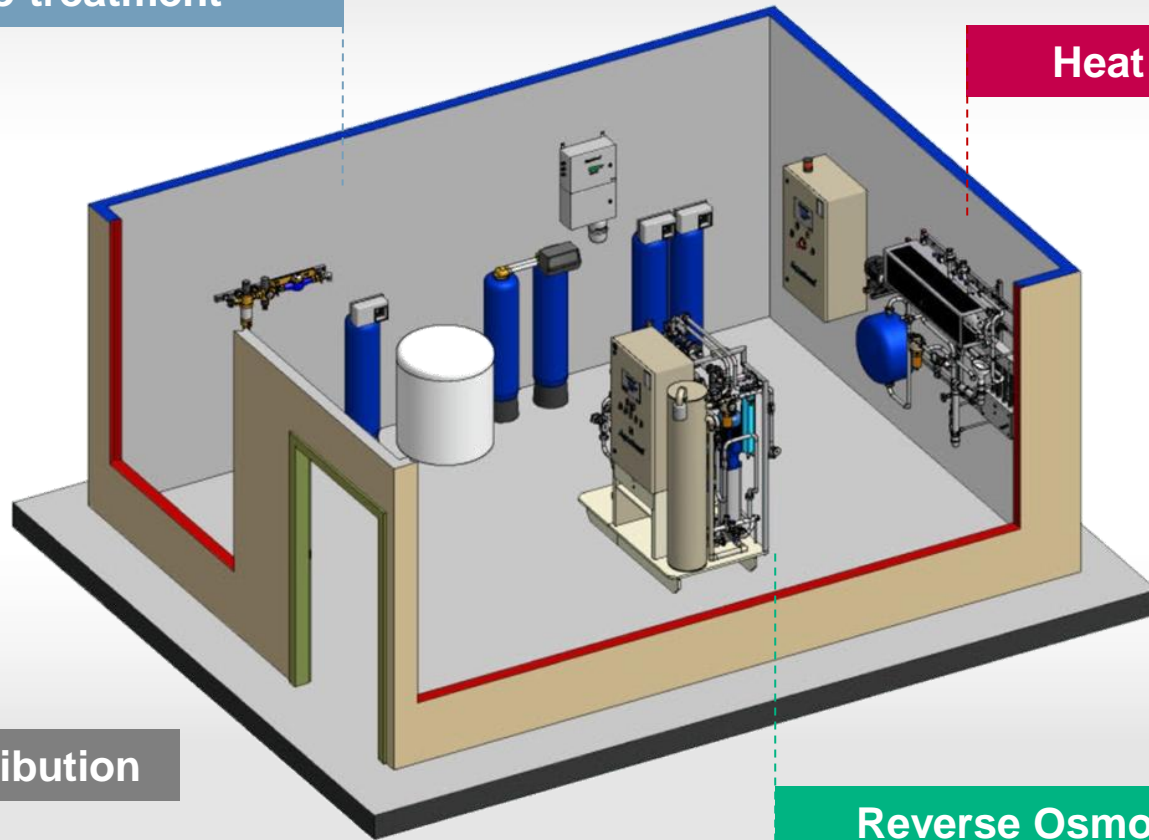
- ❖ Temperature Blending Valve
- ❖ Booster Pump
- ❖ Sediment, Depth, or Multimedia Filter
- ❖ Water Softener
- ❖ Carbon Tanks
- ❖ Micron Filters
- ❖ Reverse Osmosis (R.O.)
- ❖ Flow path, Pipes, and Gauges



Exemplary installation

Pre-treatment

Heat Disinfection



Permeate Distribution

Reverse Osmosis

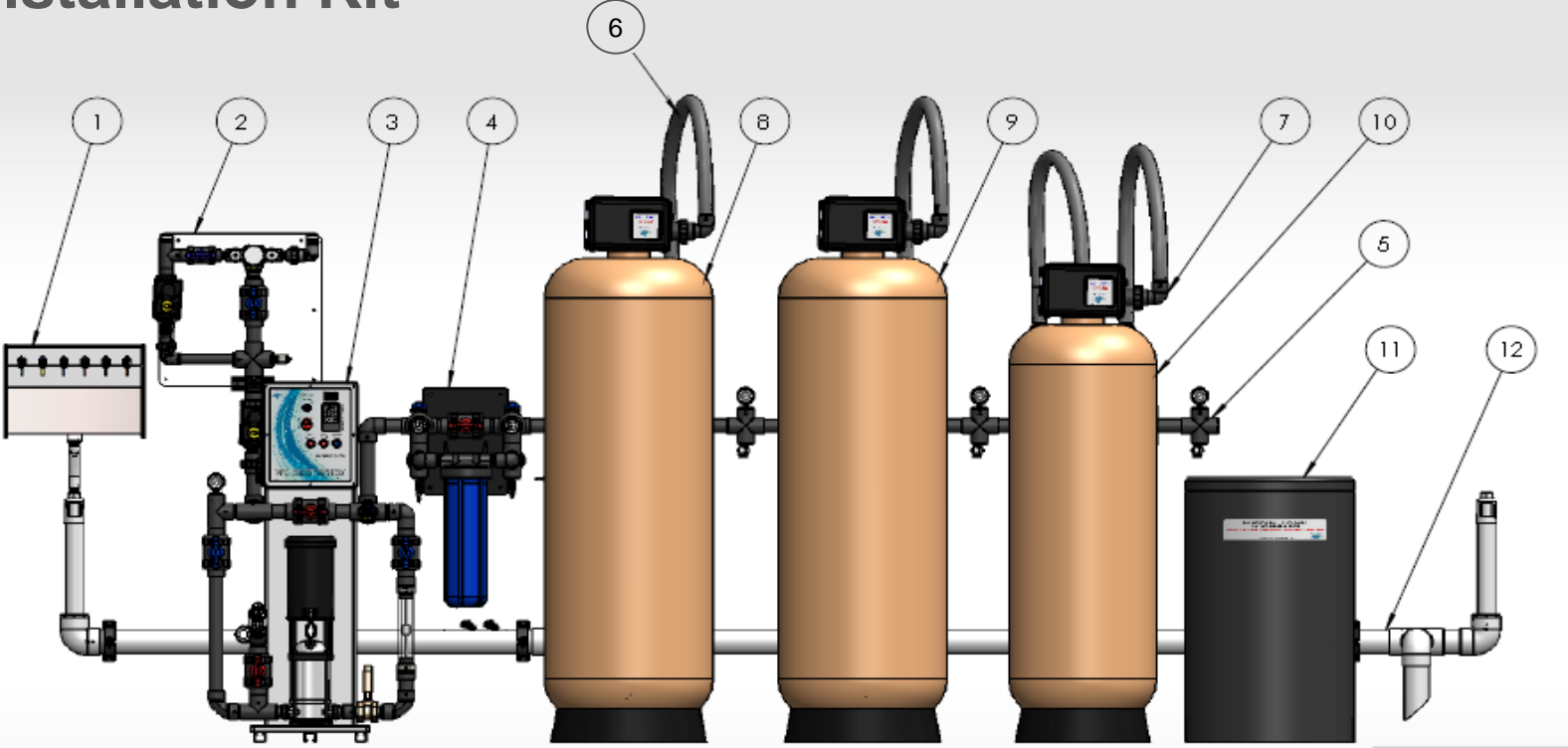
Pre-treatment

Reverse Osmosis

Heat Disinfection

Permeate Distribution

Installation Kit



1 Central Sampling station

2 Symmons Blending Valve

3 Municipal Boost System

4 Dual Bank BB Filter Assembly

5 Media Tank Trunk Assembly

6 Fleck 2850 Tubing Connection

7 Fleck 2850 Plumbing Kit

8 Carbon Tank Worker

9 Carbon Tank Polisher

10 Softener Tank

11 Brine Tank

12 Pre-treatment drain trunk

Pre-treatment

Reverse Osmosis

Heat Disinfection

Permeate Distribution

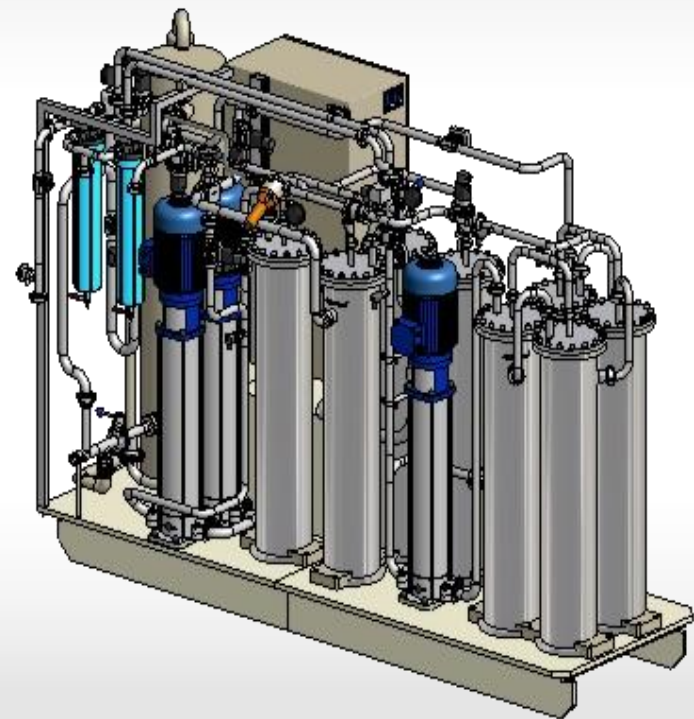
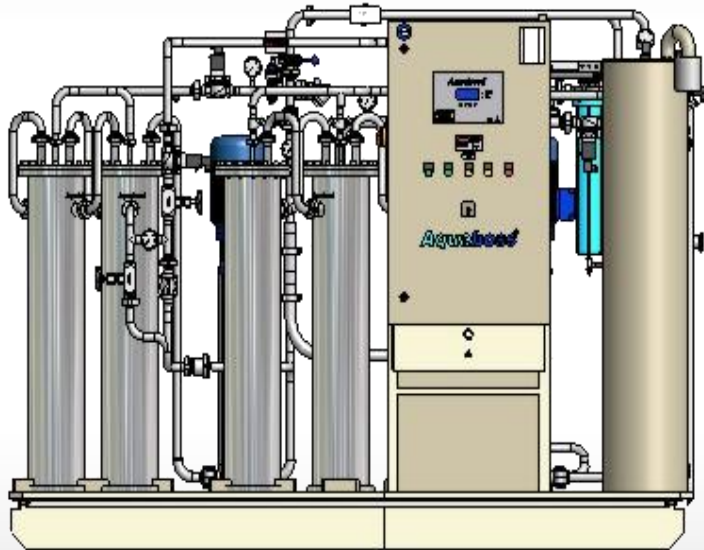
The **Aquaboss®** dialysis water purification system



- ▶ Patented features
- ▶ Available as single or double stage version (pure/ultra pure fluid)
- ▶ Wide range of permeate production capacities (from 14 up to 120 stations)
- ▶ Compact design
- ▶ Long lasting/reliable components
- ▶ Later upgrades in size and features possible without restrictions and major renovations.

RoDia II / Double Stage Reverse Osmosis System

Break tank



Pre-treatment

Reverse Osmosis

Heat Disinfection

Permeate Distribution

The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and highest water quality

Cost effectiveness and flexibility

Double stage RO

Impulse back washing

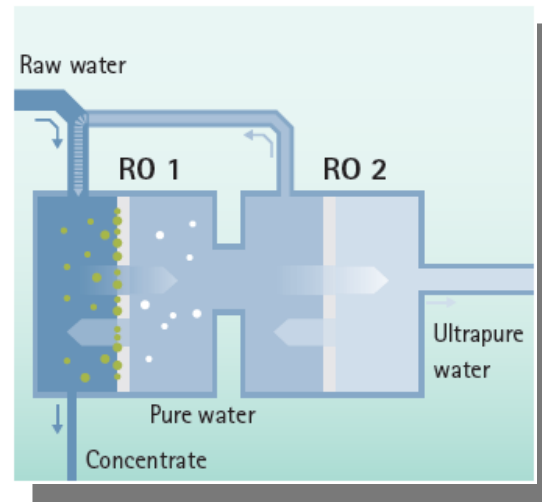
Dead space free design

Complete heat disinfection

Stainless steel design

Modular and compact design

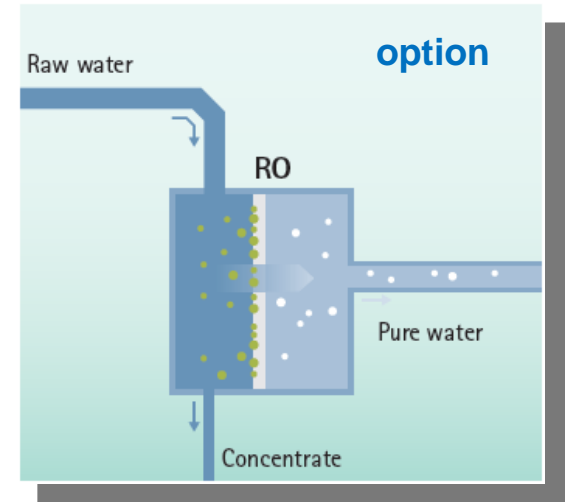
A second stage for a maximum of security



Double Stage RO: Further reduction of substances (e.g. nitrate / aluminum) for highest chemical and microbiological water quality.

Additional water savings/no water loss of 2nd stage.

Full redundancy in case of system failure. **No need to install a second RO or deionisation.**



Single Stage RO: Reliable solution for all standard treatment applications .

The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

Dead space free
design

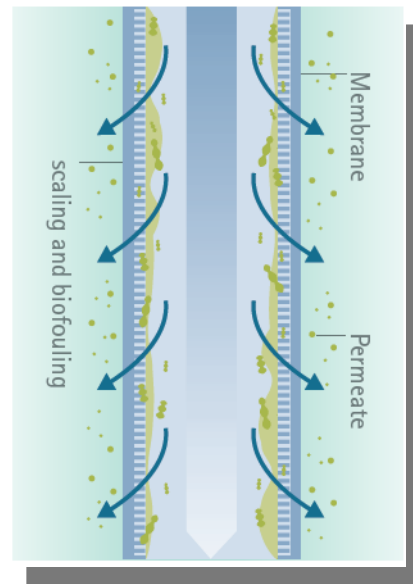
Complete heat
disinfection

Stainless steel design

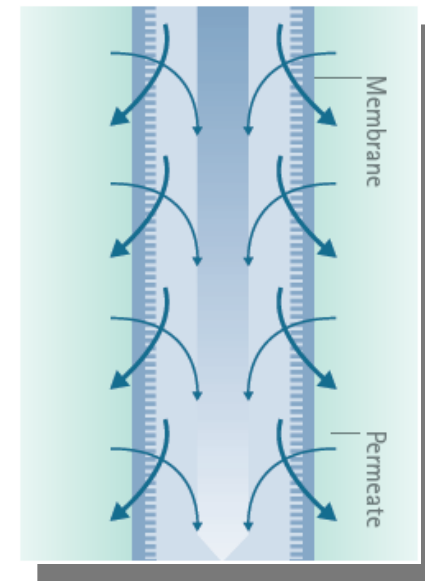
Modular and compact
design

Higher permeate quality and reduced water consumption

Conventional technology



Aquaboss® technology



Aquaboss® impulse backwashing function minimizes deposits on the membrane for higher permeate quality and reduced water consumption.

The **Aquaboss®** dialysis water purification system/Reverse Osmosis

Innovation and highest water quality

Cost effectiveness and flexibility

Double stage RO

Impulse back washing

Dead space free design

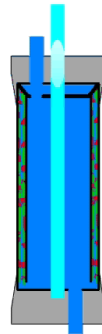
Complete heat disinfection

Stainless steel design

Modular and compact design

Prevent biofilm

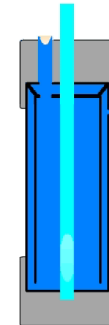
Conventional technology



Dead spaces between the outside of the spiral wound membrane and the inside of the pressure vessel.

- ▶ Bacterial growth/left chemicals

Aquaboss® technology



Dead space **free** membrane module. Space between the outside of the spiral wound membrane and the inside of the pressure vessel is flushed continuously.

- ▶ High permeate quality
- ▶ Increase membrane lifetime

The **Aquaboss®** dialysis water purification system/Ring Piping

Innovation and highest water quality

Cost effectiveness and flexibility

Double stage RO

Impulse back washing

Dead space free design

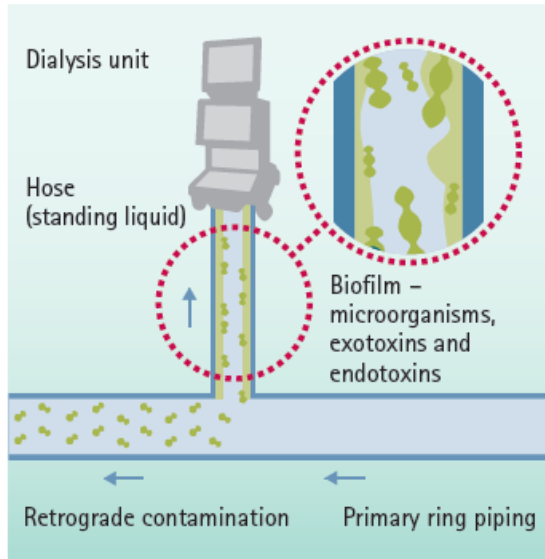
Complete heat disinfection

Stainless steel design

Modular and compact design

Dead space free Secondary Ring Piping

Conventional technology

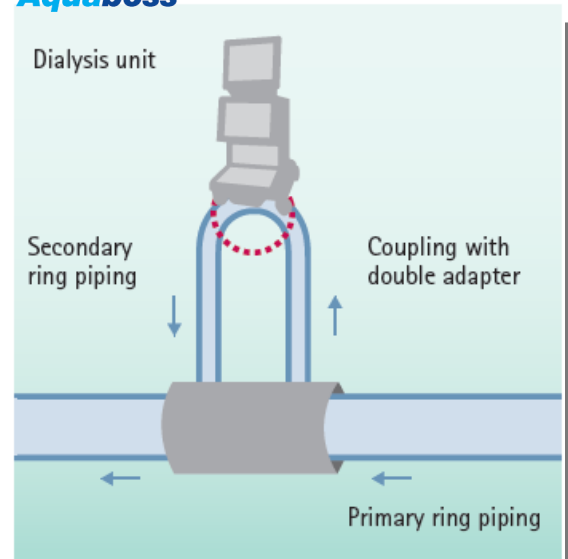


Stagnant permeate triggers the proliferation of a biofilm.

Risk of retrograde ring contamination.

technology

Aquaboss®



Patented Bernoulli principle valve enables constant flow also in hose connection to machine.

Dialog+ machine connection right at secondary ring.

The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and highest water quality

Cost effectiveness and flexibility

Double stage RO

Impulse back washing

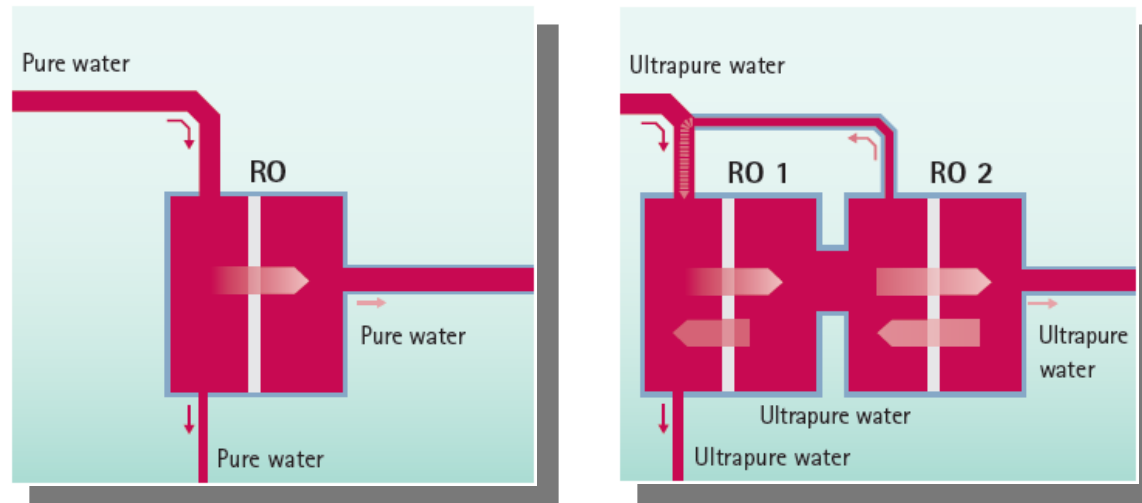
Dead space free design

Complete heat disinfection

Stainless steel design

Modular and compact design

Hot disinfection from the break tank up to the point of use

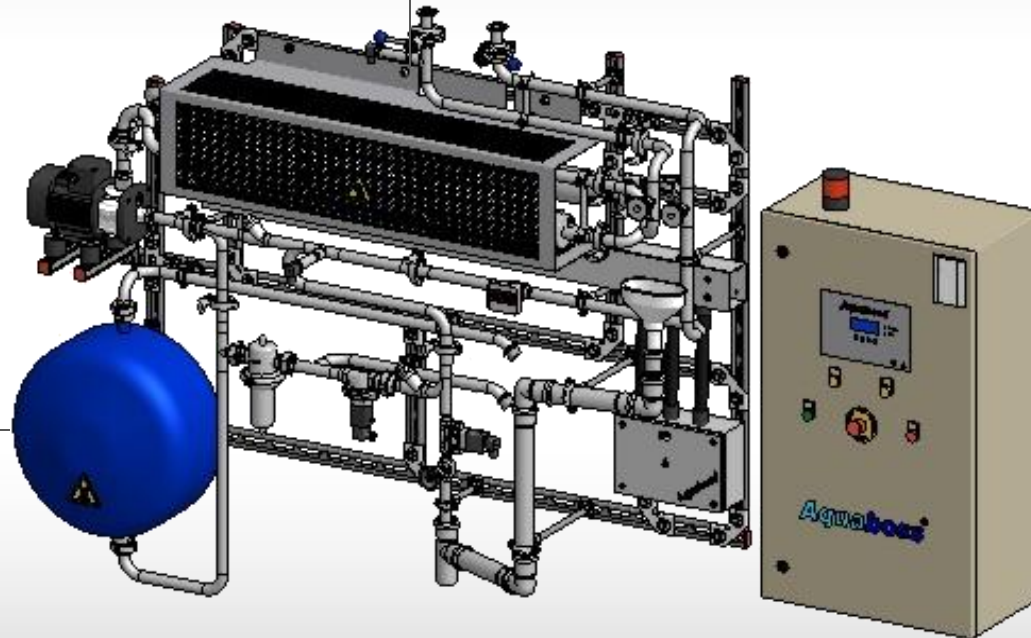


- ▶ Only the **Aquaboss®** technology incorporates the RO membrane in the heat disinfection cycle.
- ▶ RO heat and ring piping disinfection can be integrated with Dialog+ central heat disinfection. ➔ real system disinfection without dead spots.
- ▶ No stagnant permeate (like in conventional tank systems)

Hot Rinse Smart

Flow Through Heater

Description



Control Unit

Pre-treatment

Reverse Osmosis

Heat Disinfection

Permeate Distribution

The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

Dead space free
design

Complete heat
disinfection

Stainless steel design

Modular and compact
design

Aquaboss® Hot Rinse Smart | Heat on demand by flow through heater



Energy cost savings
more than 90%

(compared to conventional tank system)

- ▶ Dead space free, no tank.
- ▶ Permeate heat up only on demand. No constant heating of big water tank reservoir.
- ▶ > 80°C can be achieved on first and second RO stage.
- ▶ Disinfection of the raw water break tank included.

The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

Dead space free
design

Complete heat
disinfection

Stainless steel design

Modular and compact
design

Extremely reliable / outstanding long life cycle



Stainless steel offers many advantages:

- Long lasting quality
- Smooth surfaces that prevent bacterial growth



Also sampling ports are stainless steel – integrated in sanitation process.

The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

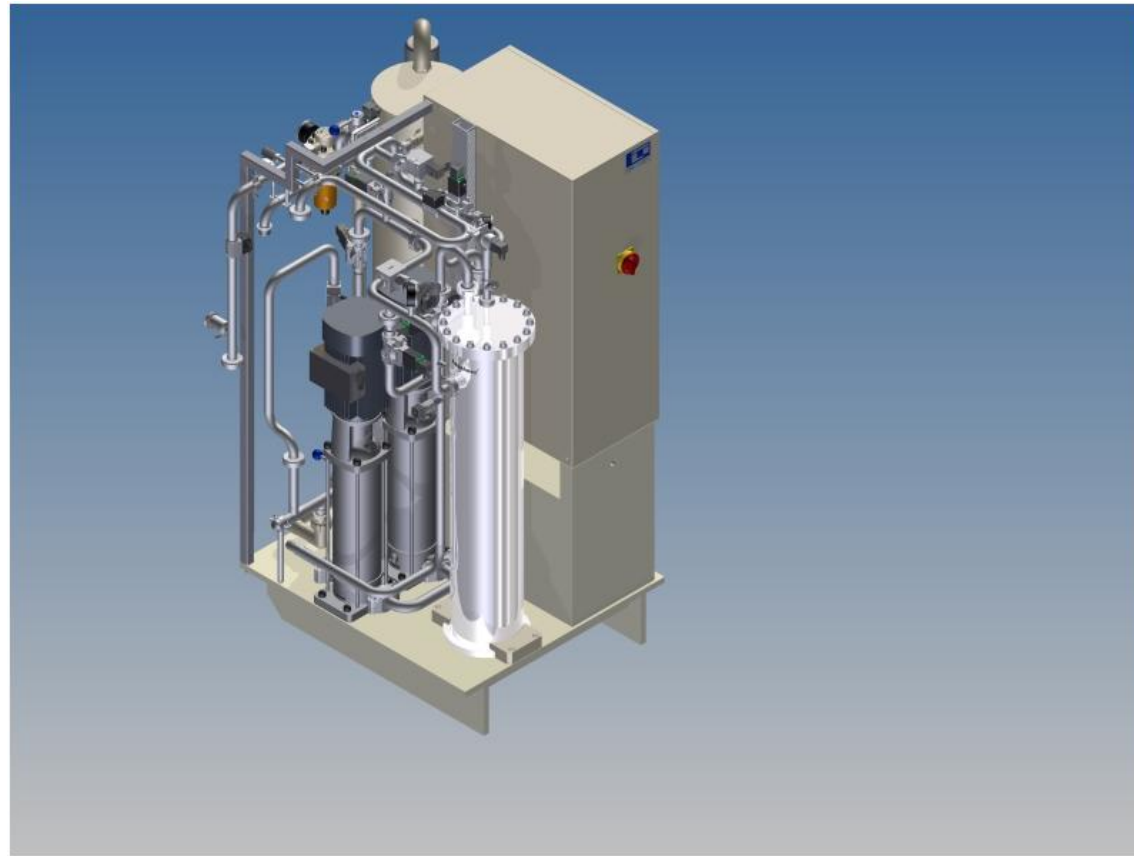
Dead space free
design

Complete heat
disinfection

Stainless steel design

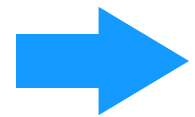
Modular and compact
design

Easy to expand system capacity and features



Single stage RO
with basic
production
capacity

- ▶ 1 membrane modules
- ▶ 2 pumps in standard config.



The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

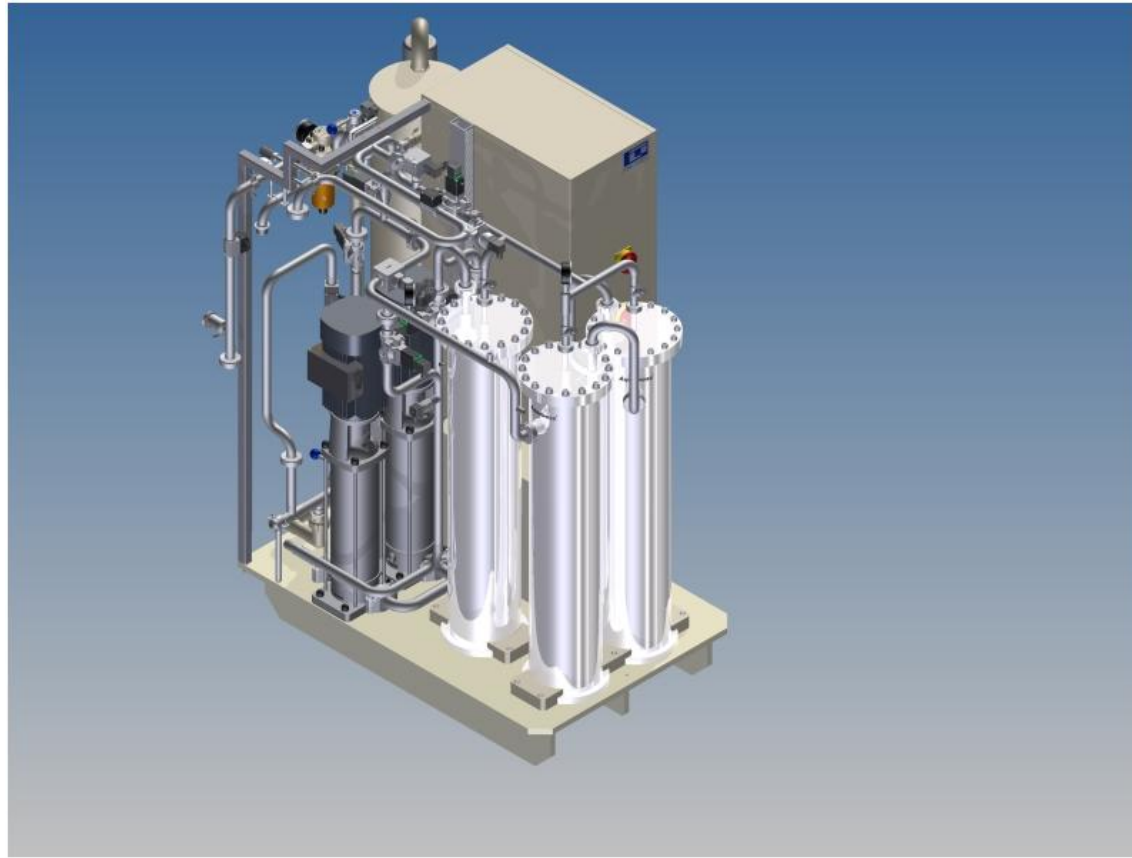
Dead space free
design

Complete heat
disinfection

Stainless steel design

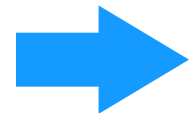
Modular and compact
design

Easy to expand system capacity and features



Single stage RO
with extended
permeate
production
capacity.

- ▶ + 2
membrane
modules



The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

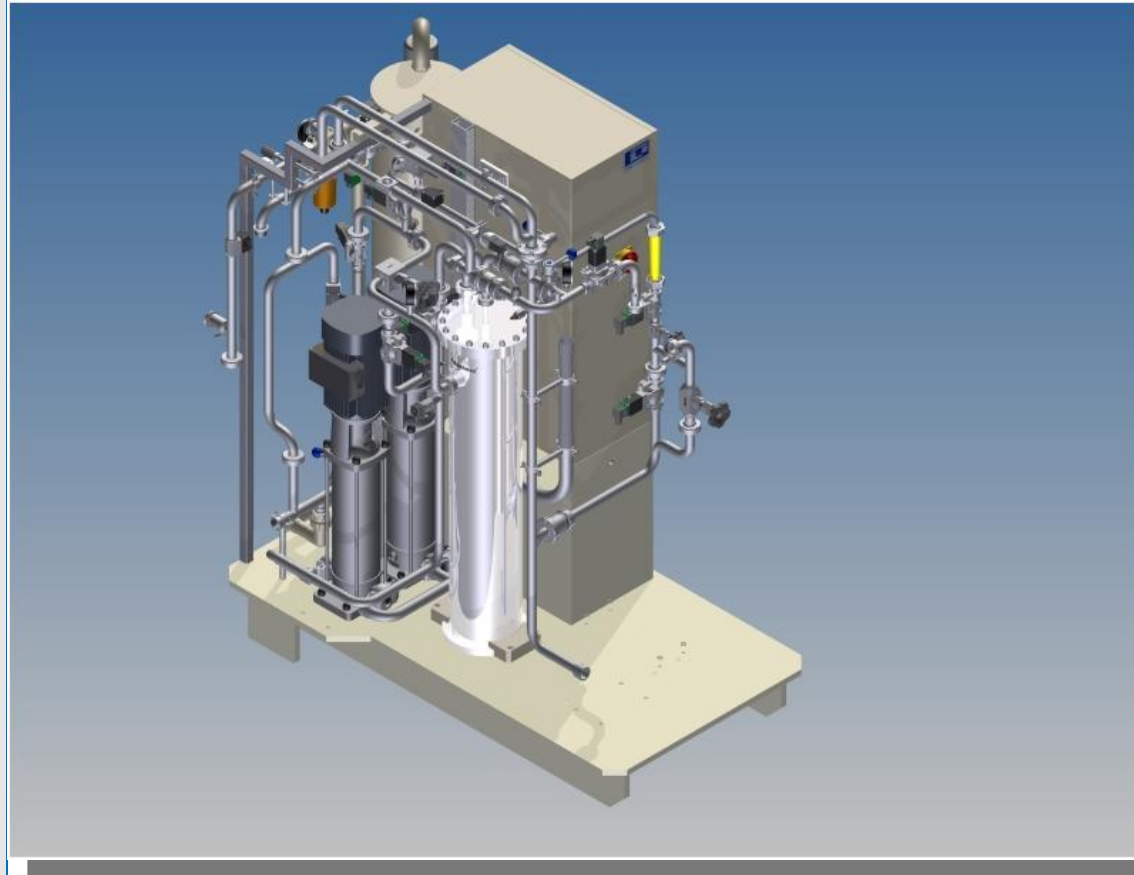
Dead space free
design

Complete heat
disinfection

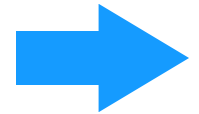
Stainless steel design

Modular and compact
design

Easy to expand system capacity and features



Extended
ground module
for further
extension.



The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

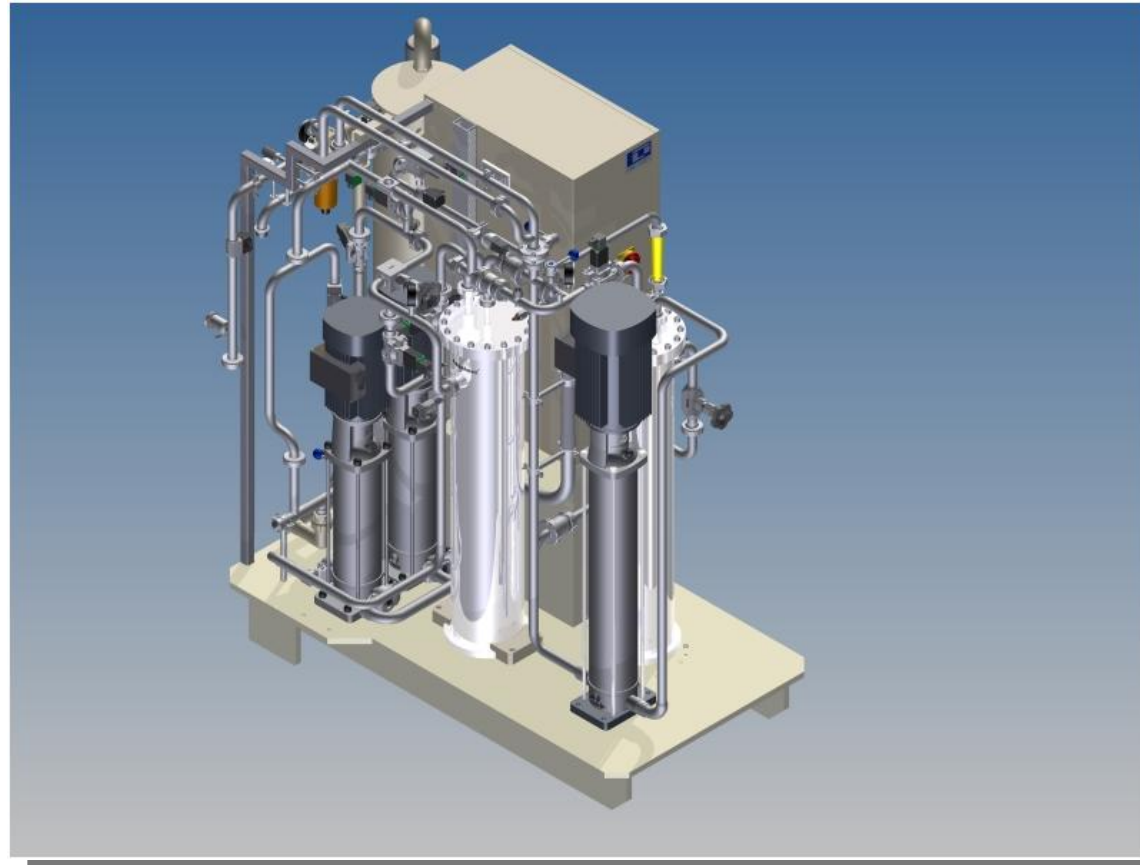
Dead space free
design

Complete heat
disinfection

Stainless steel design

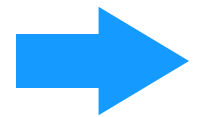
Modular and compact
design

Easy to expand system capacity and features



Double stage
RO

▶ 3 pumps



The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

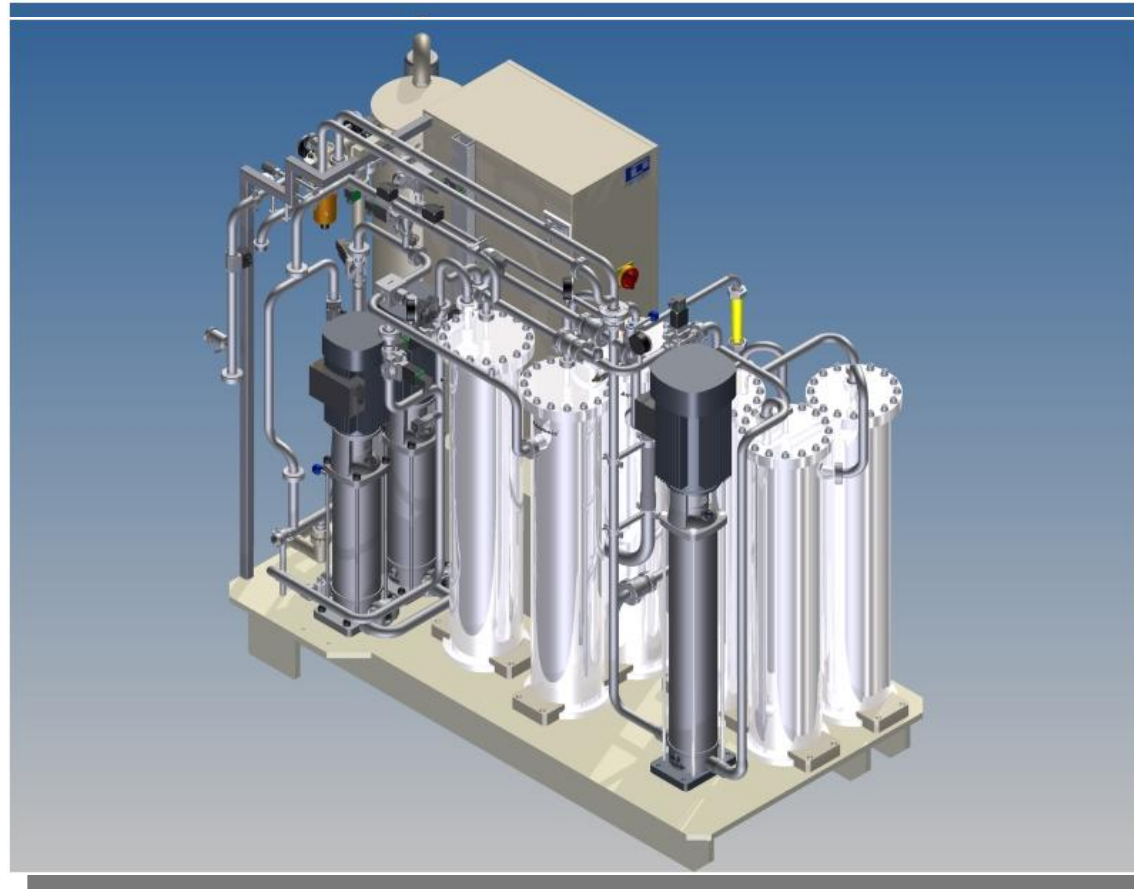
Dead space free
design

Complete heat
disinfection

Stainless steel design

Modular and compact
design

Easy to expand system capacity and features



Double stage
RO with
maximum
permeate
production
capacity.

- ▶ 6 membrane modules for production capacity up to 3.600 l per hour.

The **Aquaboss®** dialysis water purification system/Reverse Osmosis (RO)

Innovation and
highest water quality

Cost effectiveness
and flexibility

Double stage RO

Impulse back washing

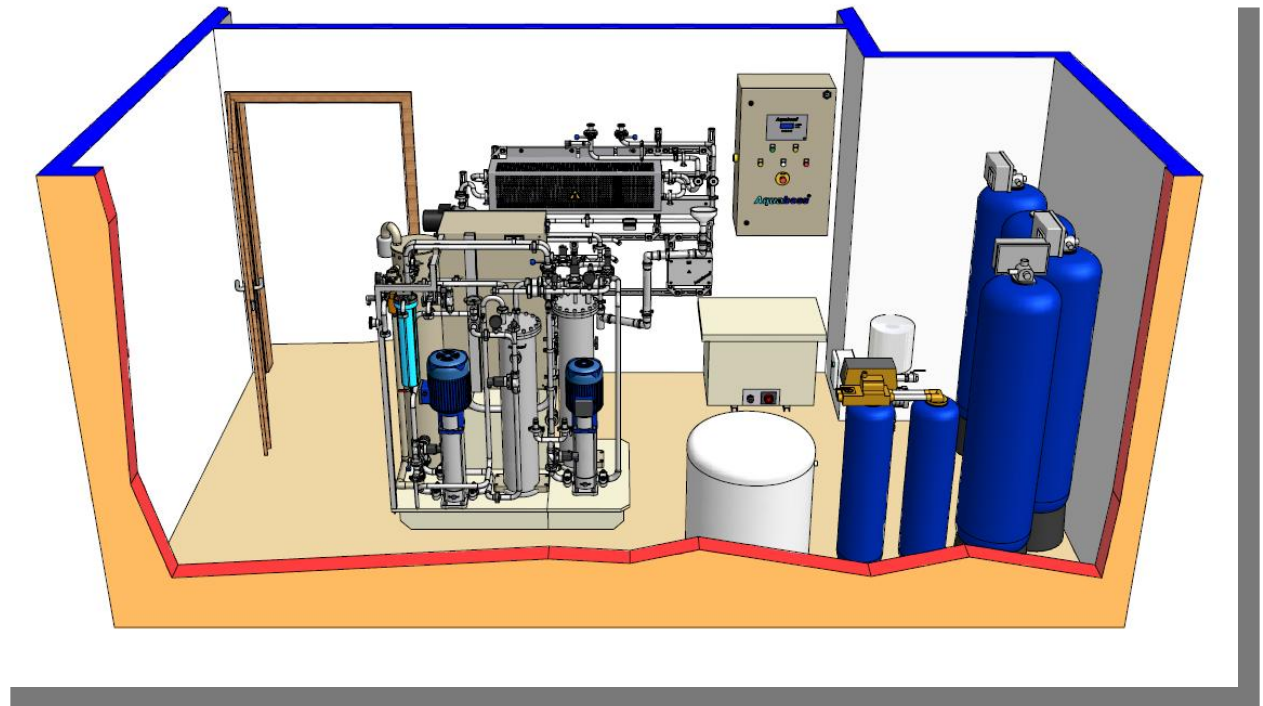
Dead space free
design

Complete heat
disinfection

Stainless steel design

Modular and compact
design

Easy installation in existing centers and de novo clinics.



The reduced water consumption reduce the size and cost of pre-treatment equipment!

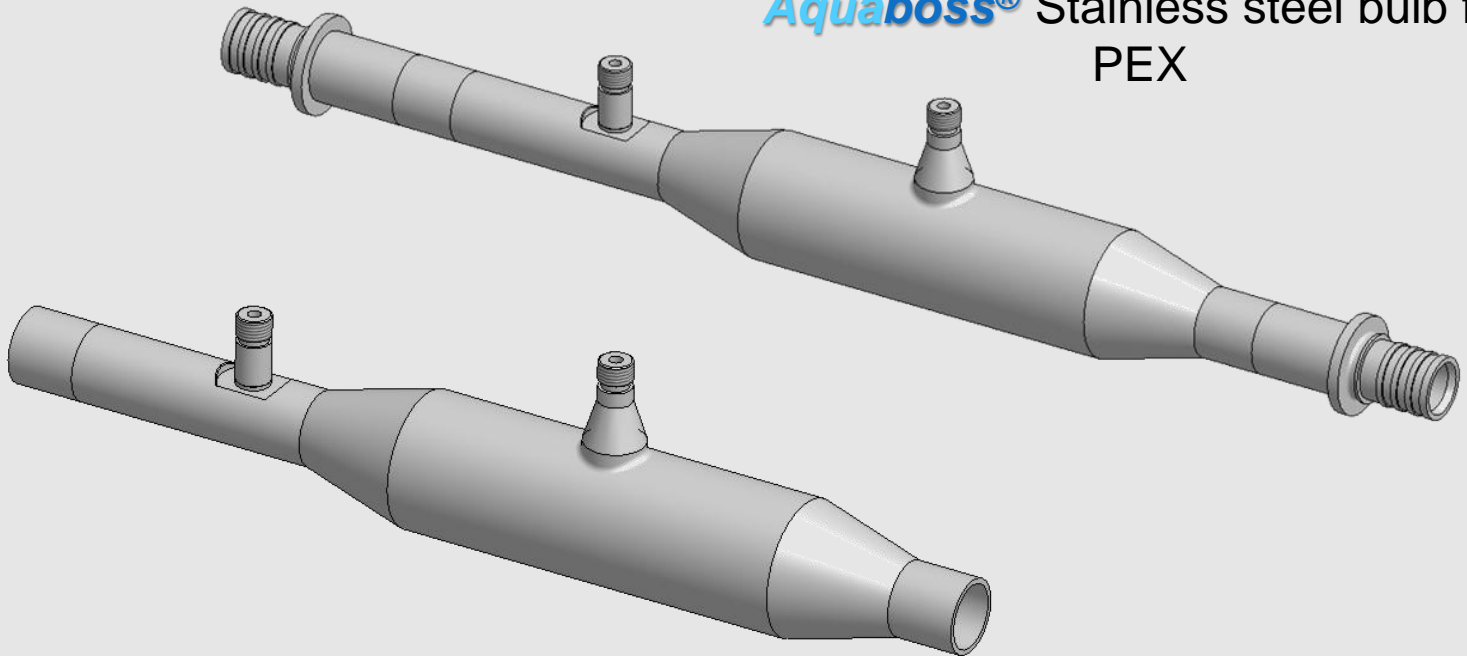


Aquaboss® Reverse Osmosis

Secondary loop | Differential pressure valves

Patented

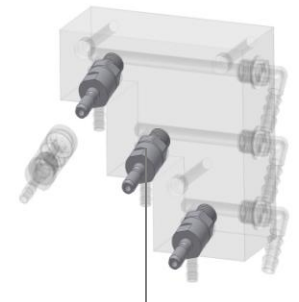
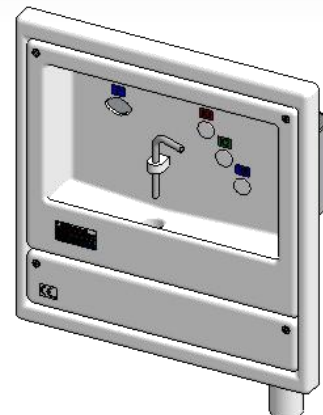
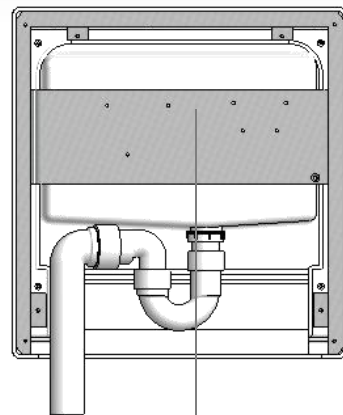
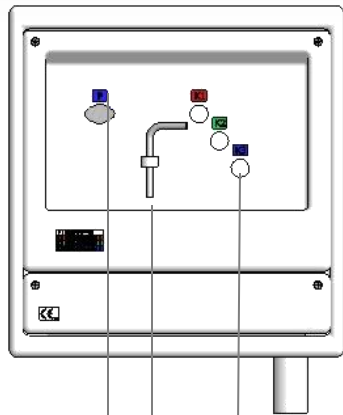
Aquaboss® Stainless steel bulb for PEX



Aquaboss® Stainless steel bulb for Orbital Welding

Media Providing Center (MPC)

The Aquaboss® MPC **in-wall** media providing centre has been developed according to the latest ergonomic and hygienic aspects. The MPC-FW comprises all required fluid part interfaces to the dialysis unit and all modules for an up-to-date medical care of the patient for the hygienic provision of all liquid media.



Permeate Water Outlet

HD Machine Drain
Connection

Up to 3 Acid Concentrate
Connections

Backing Plate for box
reinforcement

Molded Concentrate Block for
even flow and pressure

Secondary Ring Piping (and Insulation)

Patented



Secondary Ring –Main connections for the HD machine. Using the distribution bulb, dead-space between the main distribution line and HD machine are eliminated.

- Comes with 316L Stainless Steel female connector
- Comes in lengths of 3,000mm to 7,000mm

EMERGENCY OPERATION OF EcoRO Dia I/II

Emergency Mode provides peace of mind with continuous operation of the Aquaboss EcoRO for any type of malfunction until the problem can be resolved.

The Aquaboss EcoRO will continue to supply purified water to the permeate loop if at minimum, AC input voltage and the pre-treated water supply are available.

If any pump or a complete RO stage including a membrane fails, the system can be quickly switched to resume operation by another motor or stage.

If the CPU fails, the RO will continue to run using relays without any User intervention. Conductivity and temperature are still monitored independently.

If a DC power supply failure occurs, a back-up DC power supply is available on all systems.

For all of the cases stated above, the device will generate an alarm and display instructions to the User for how to activate the necessary Emergency mode.

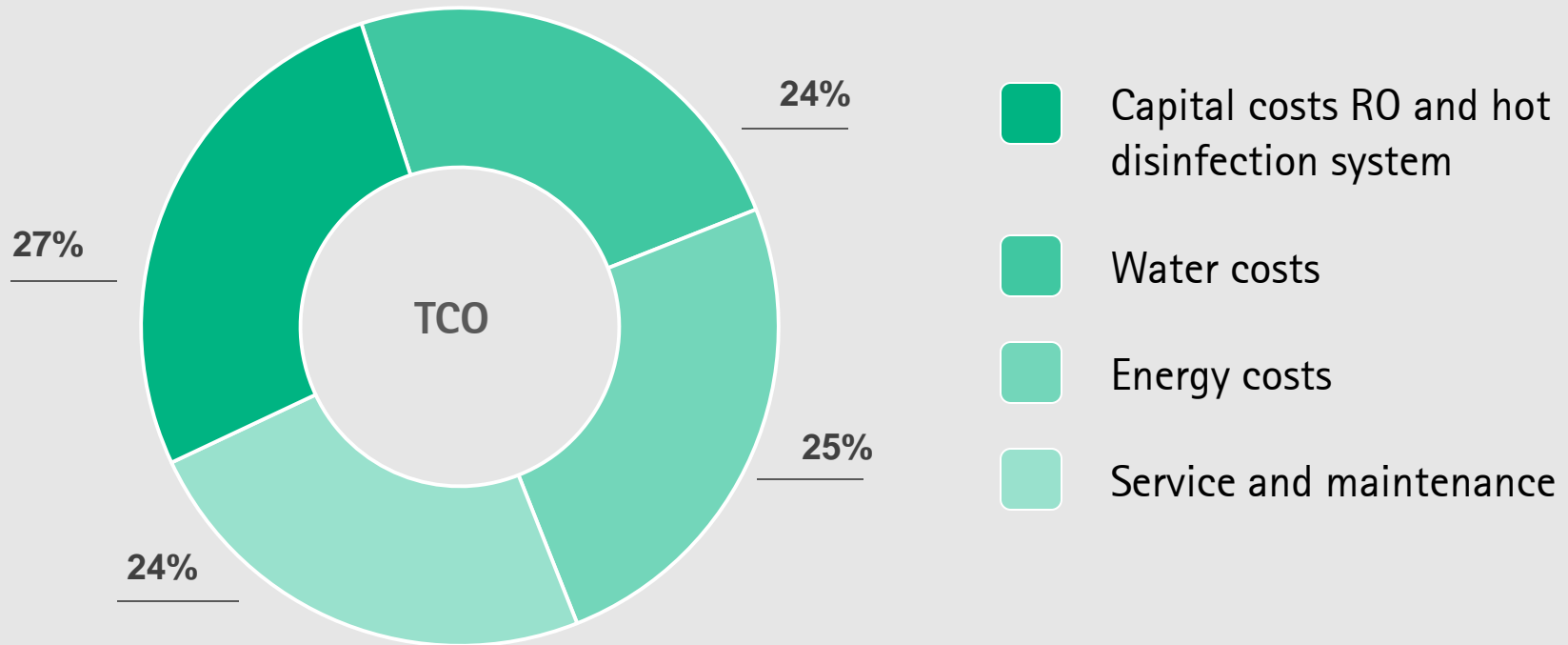


End to End Thermal Disinfection

- **Used in combination with thermal distribution loop disinfection.**
- **Activated manually or may be programmed to work at designated dates and times**
- **Heated water enters the machine at a specified rate and time**

The **Aquaboss®** system Technology that reduces the total cost of ownership

Average cost structure

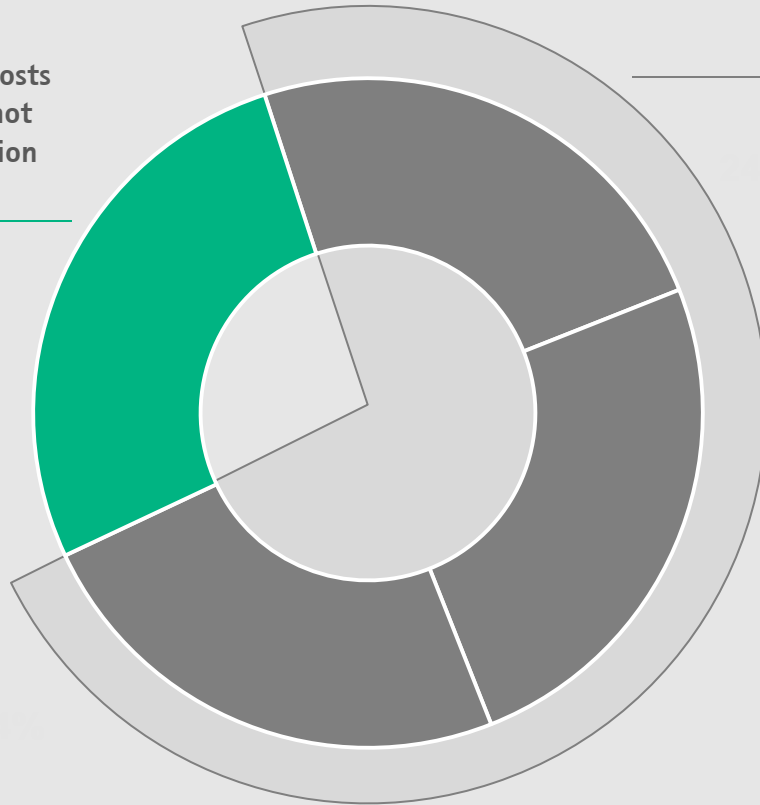


Assumptions:

76 patients and 12,000 treatments per year, 210 liters permeate per dialysis treatment, 15 years operating life, Water costs: € 2.57/m³

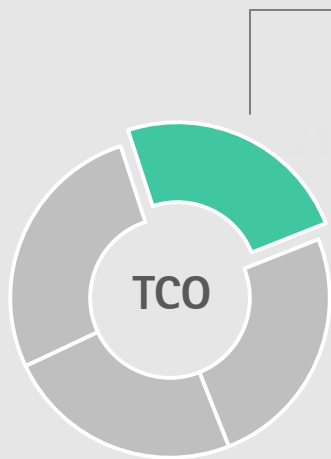
The **Aquaboss®** system Technology that reduces the total cost of ownership

Capital costs
RO and hot
disinfection
system

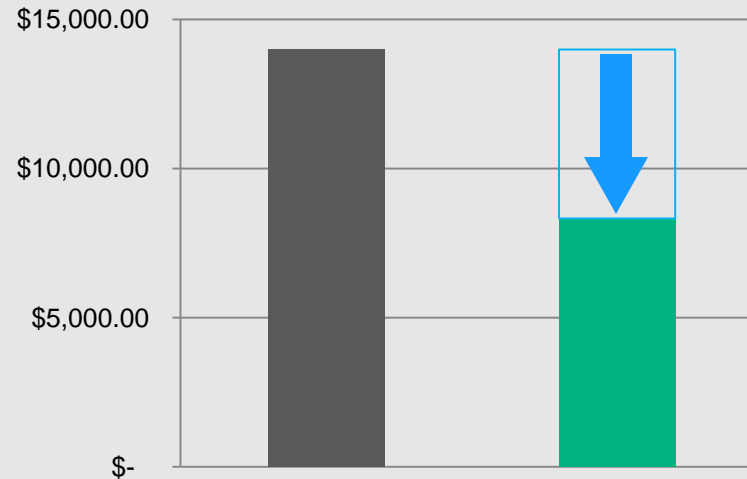


...can reduce the lifetime costs to a minimum and makes it even possible to reach ROI.

The **Aquaboss®** system Technology that reduces the total cost of ownership



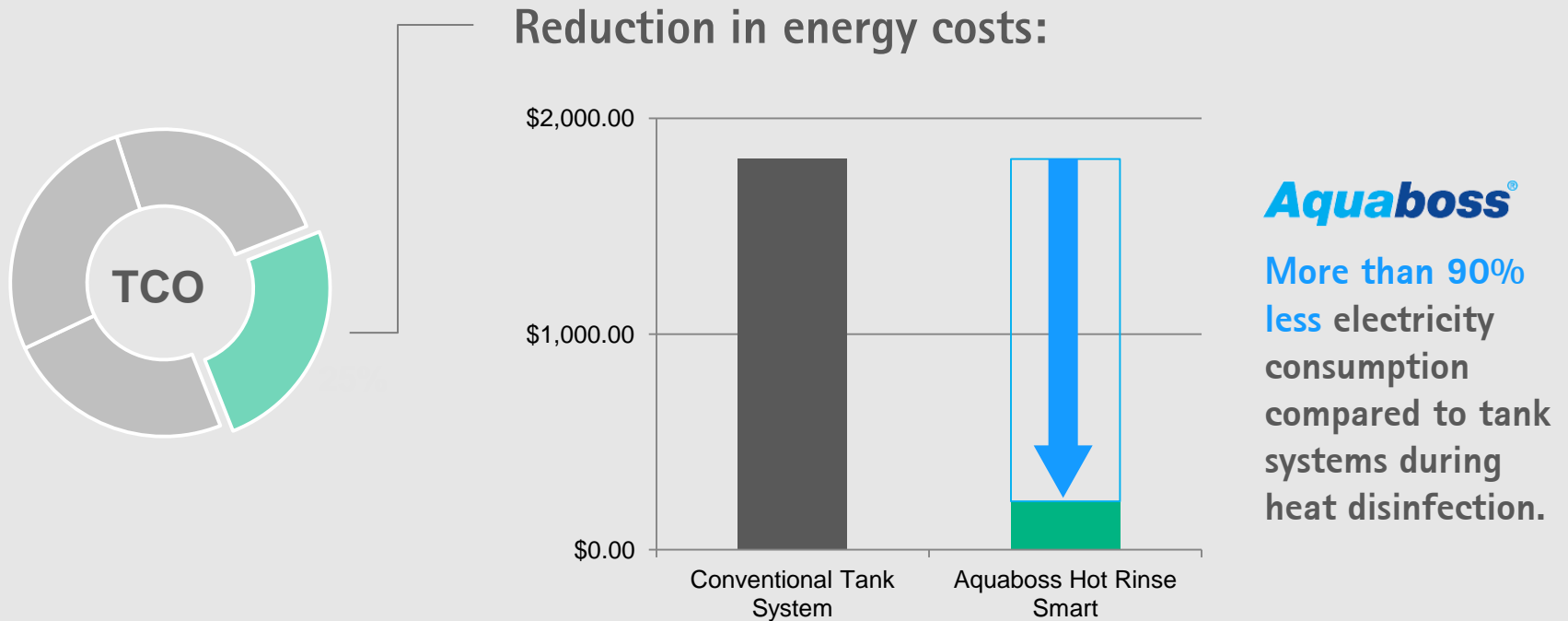
Reduction in water costs:



Aquaboss®
40% less water consumption than conventional systems.

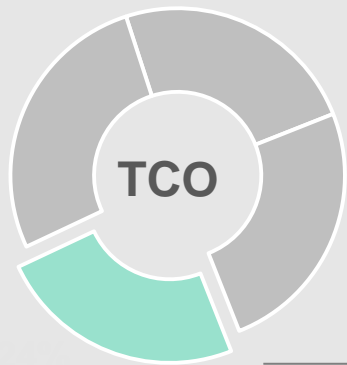
- **Impulse back washing** feature keep membranes clear. Constant amount of water can pass the membrane.
- **Double stage RO** system further reduces water discharge
- Highest recovery rate of 85% (double stage RO)

The **Aquaboss®** system Technology that reduces the total cost of ownership

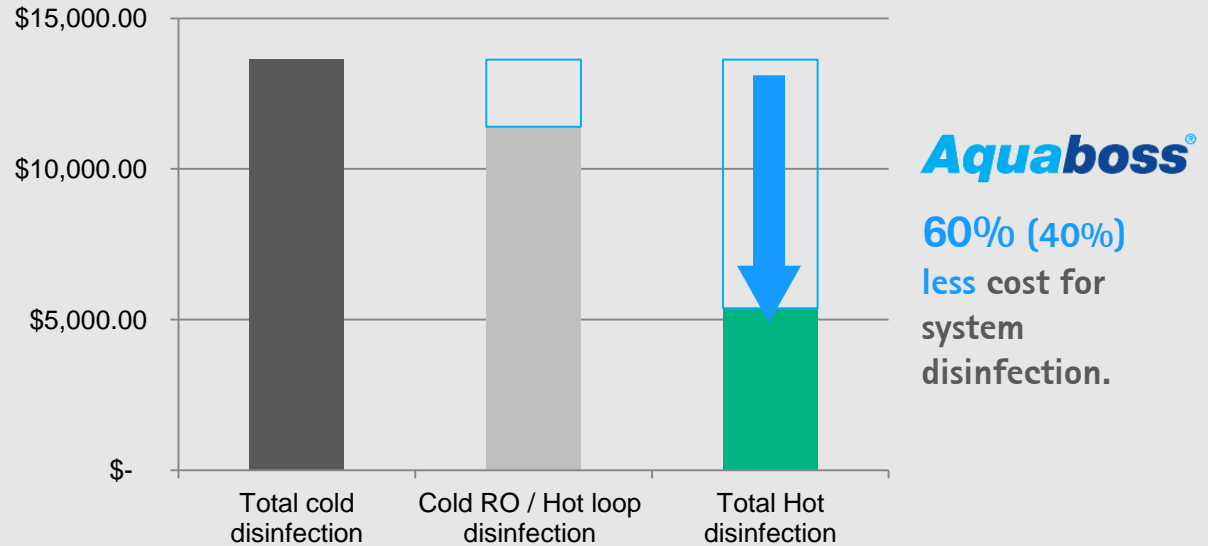


- **Flow through heater** ensure continuous recirculation and only heats up permeate only during hot disinfection. **This means: no constant heating of a large water reservoir.**

The **Aquaboss®** system Multiple sources to reduce total cost of ownership



▶ Reduced effort in disinfection procedures



- Automatic heat disinfection reduces labor and eliminates the need to test for the presence of disinfectants.

The **Aquaboss®** system Technology that reduces the total cost of ownership



- Impulse back washing increases membrane life while maintaining a consistent water recovery rate.

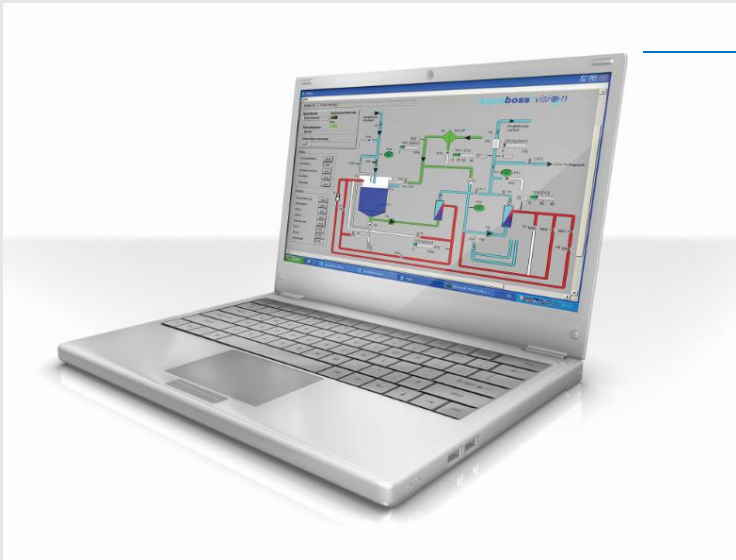
① De novo installation	Conventional System	Aquaboss®	Savings
Investment	\$120,000	\$150,000	(25%)
Water cost per year \$1.12 per 100 gal progressive calc	\$20,835	\$12,254	>40%
Energy cost heat disinfection	\$1,994	\$10	>90%
Disinfection procedures	\$9,096	\$5,376	>40%
Sum	\$31,925	\$17,640	
Cost advantage per year		> \$14,000	>43%

➡ Return on investment is less than 3 years! Impulse back washing savings is not included in the ROI calculation.

Summary

- ▶ Higher treatment quality by higher water quality
- ▶ Lower risk of residual disinfectants in RO and ring piping system.
- ▶ More effective technology for preventing biofilm.
- ▶ Additional savings potential from Impulse back washing function
- ▶ Full flexibility in system capacity and features. Later upgrade possibilities means no invest in unused over capacities.
- ▶ Fully automated end to end thermal disinfection
- ▶ The innovative [Aquaboss Vision](#) monitoring software.

Aquaboss Vision monitoring software/Process Visualization & Optimization



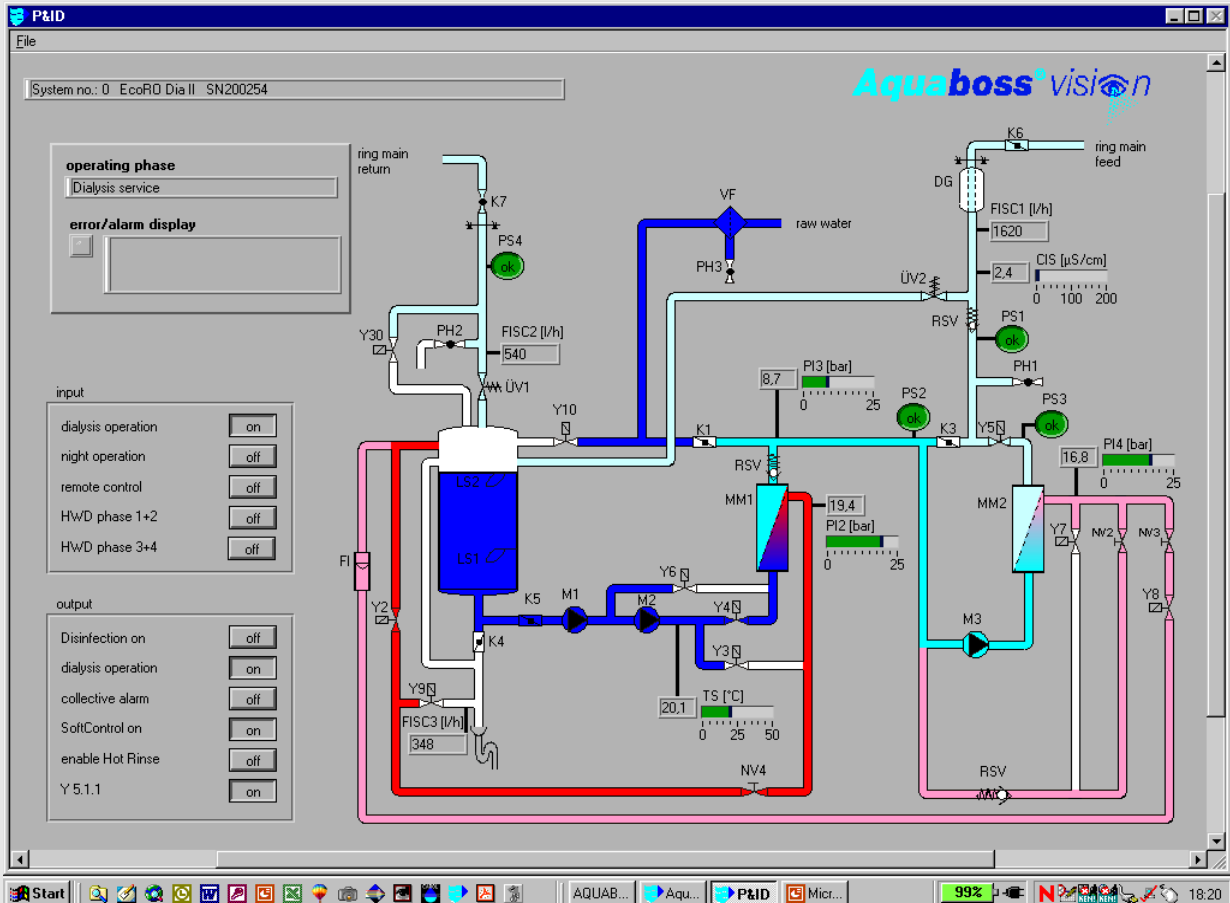
- Visualization of operating parameters.
- Status and digital reading (and display) of all sensors.
- Log file exchange file to track the operation status online for quick fault finding and error prevention.
- Disinfection history storage

▶ Thus **Aquaboss Vision** helps to provide cost-effective maintenance as well as an optimized and paperless process for the user.

Vision Monitoring Software

EcoRO Dia I/II Flow Diagram

- Status of RO
- Digital Signals
- Pressure
- Temperature
- Flow



Carefree Service Packages

Option III: Premium

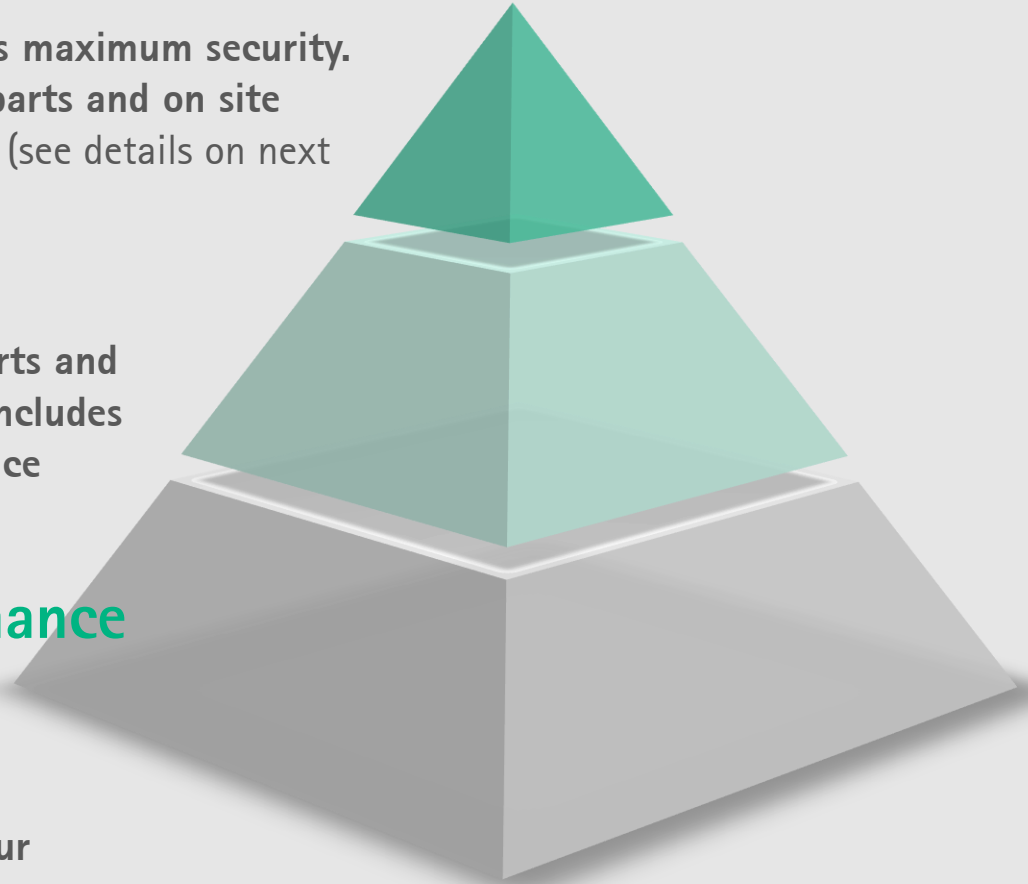
An ultimate carefree package that provides maximum security. It includes preventive maintenance, spare parts and on site technical support under one standard cost. (see details on next slides)

Option II: Advanced Team

The advanced package covers all service parts and on-site support on a second level basis. It includes all advantages of the preventive maintenance package. (see details on next slides)

Option I: Preventive Maintenance

Rely on the annual preventive maintenance inspection by a B. Braun expert. Ensure top operating performance from your dialysis equipment and increase productivity of your staff. (see details on next slides)



Ask us for a concept of an individual system solution that meets your specific needs and requirements.

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