AQUAPHOR
PROFESSIONAL

APRO 150-750 LPH

MANUAL

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Technical modification	Revision No 2

Table of contents

1. GENERAL INFORMATION

1.1 SAFETY

Content

This manual contains the most important pointers regarding a safe installation, commissioning, use, check, and maintenance of the unit and its equipment.

Target group

This manual has been written with the intention to be read, understood, and completely considered by everyone responsible for the activation, monitoring, care, check, and maintenance.

Symbols

The following symbols are used in this manual:

DANGER
Denotes a direct threat of danger. Not observing this pointer may be life-threatening or lead to serious injuries.

WARNING
Denotes a possibly dangerous situation. Not observing this pointer may be life threatening or lead to serious injuries.

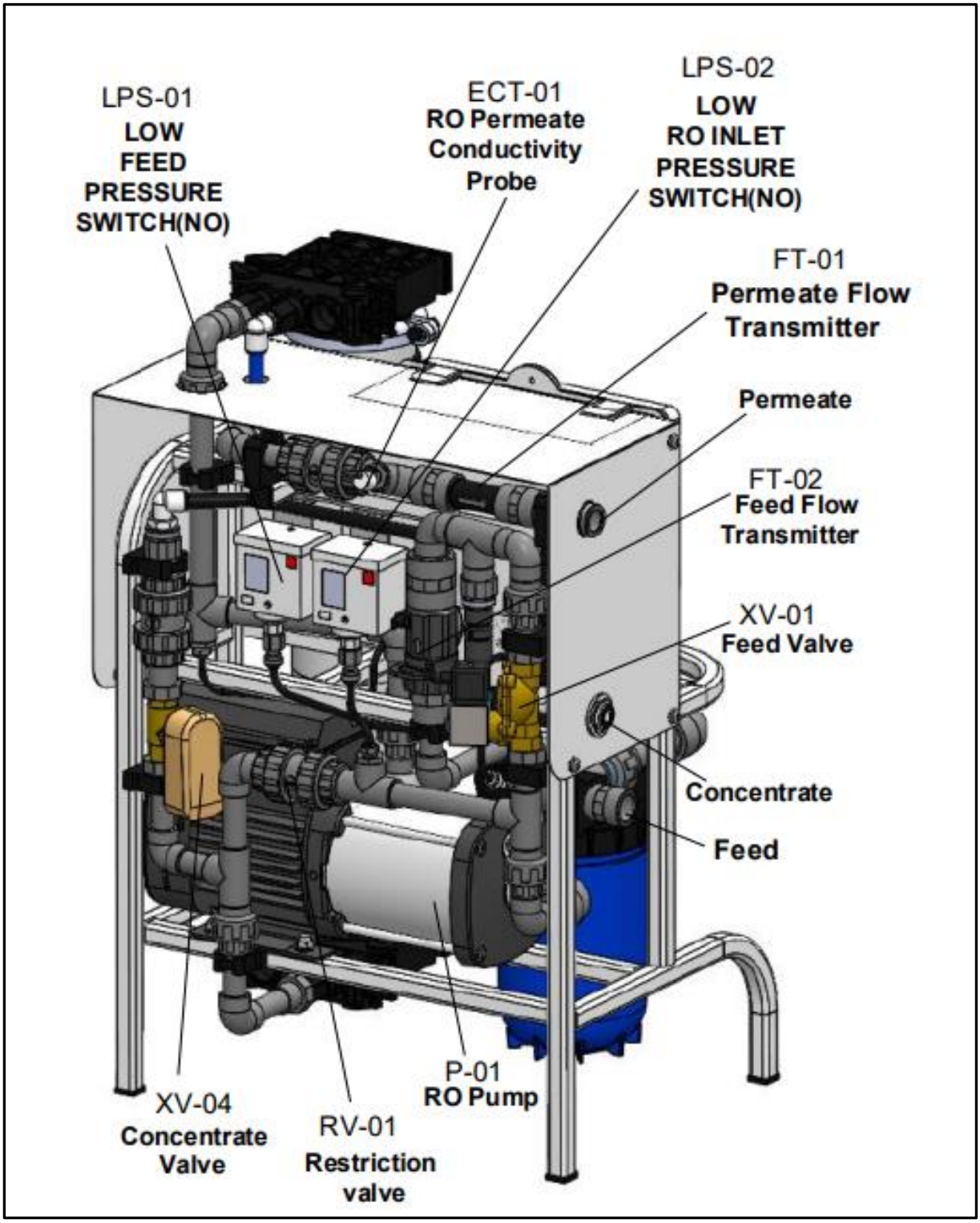
CAUTION
Denotes a possibly dangerous situation. Not observing this pointer can cause minor injuries.

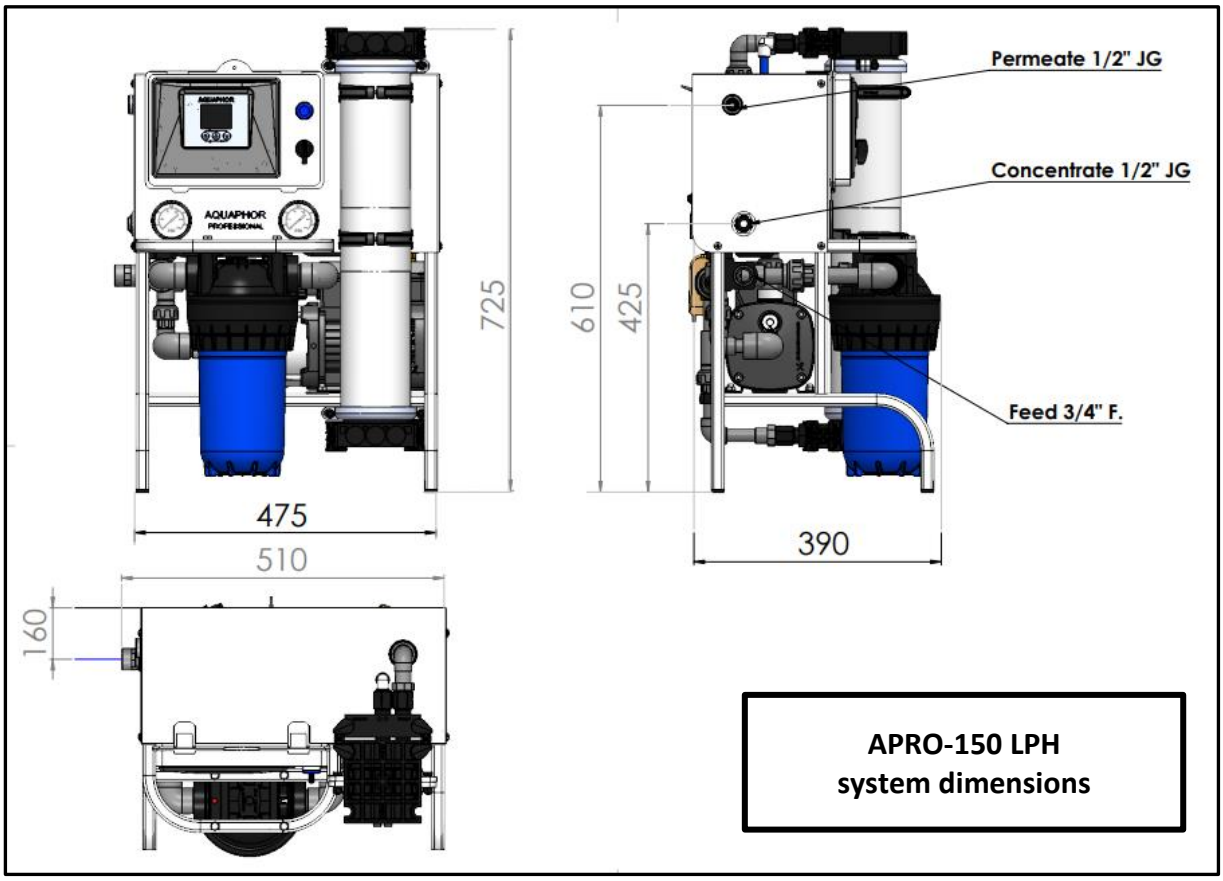
ATTENTION
Denotes a possibly dangerous situation. Not observing this pointer can cause material damage.

INFORMATION
Denotes application pointers and other useful information.

2. SYSTEM OVERVIEW

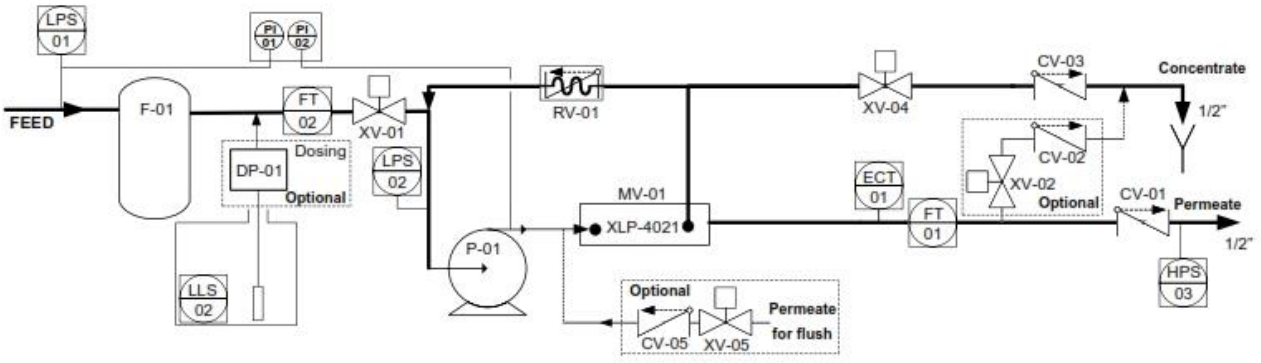
2.1 APRO-150 LPH





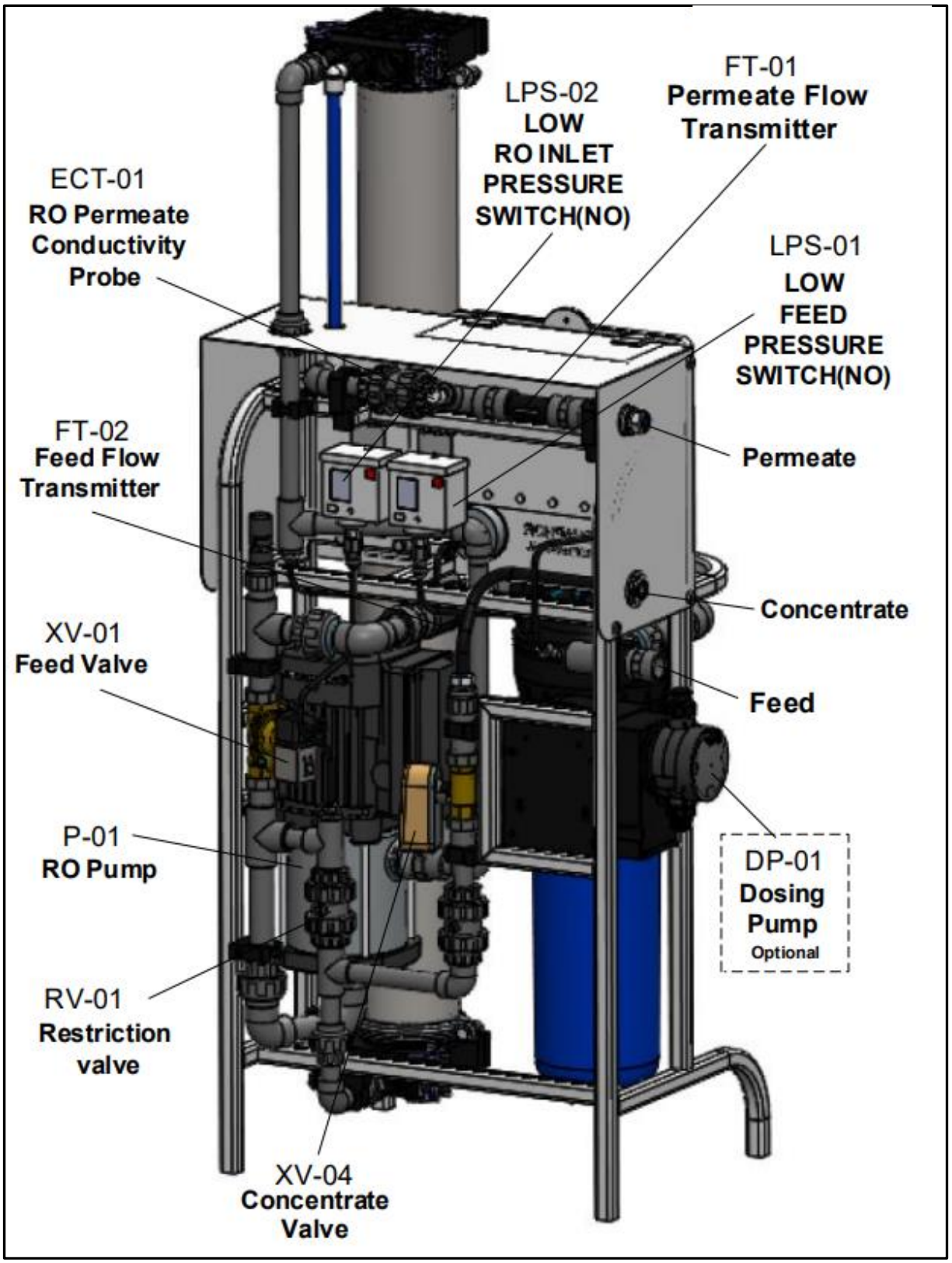
APRO-150 LPH
system dimensions

APRO-150 LPH

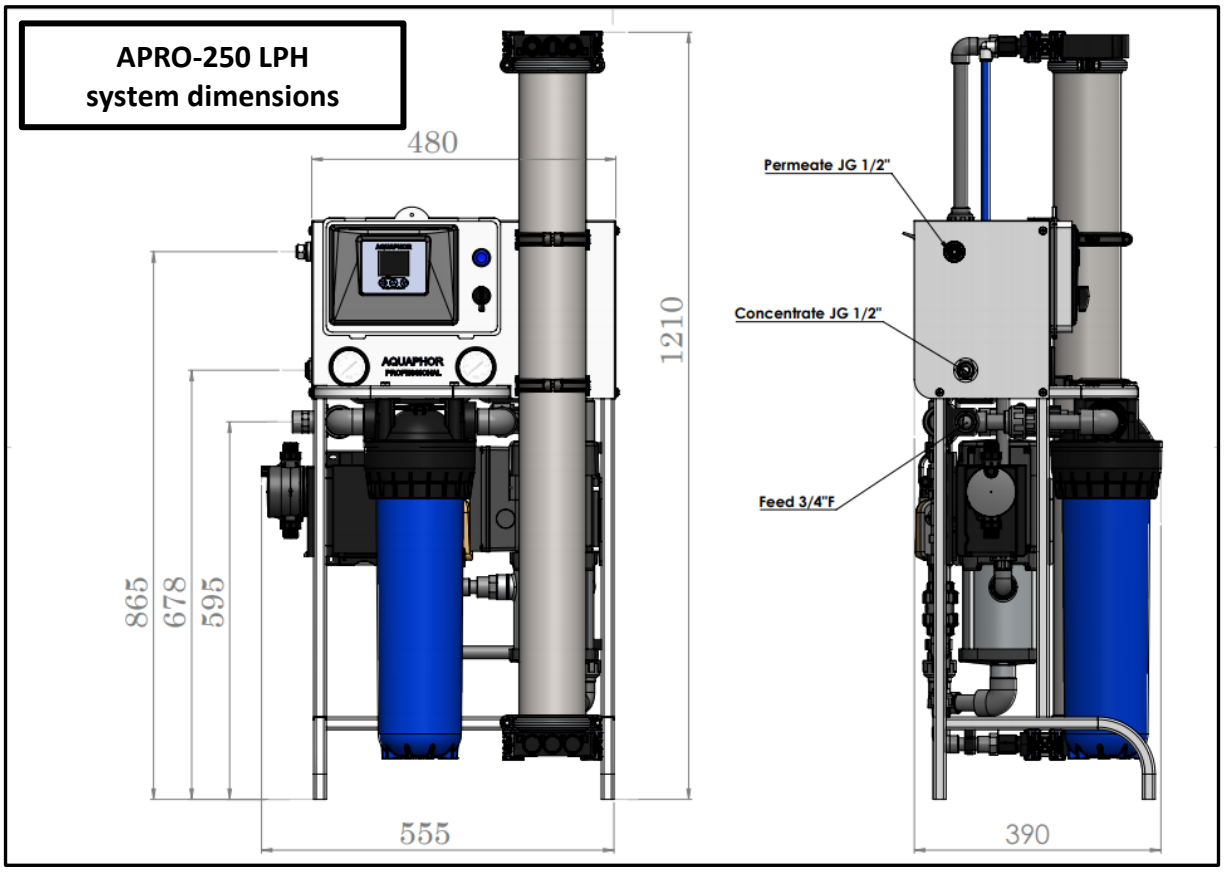


Item	Description	Item	Description	Item	Description	Item	Description
FT 01	Flow trans.		Actuated valve		Check valve		Pump
LPS 01	Pressure switch	LLS 02	Level Switch.	PI 01	Pres. indicator	MV-01	Memb. housing
ECT 01	Conductiv. trans		Restriction valve	HPS 03	Pressure switch		Filter housing

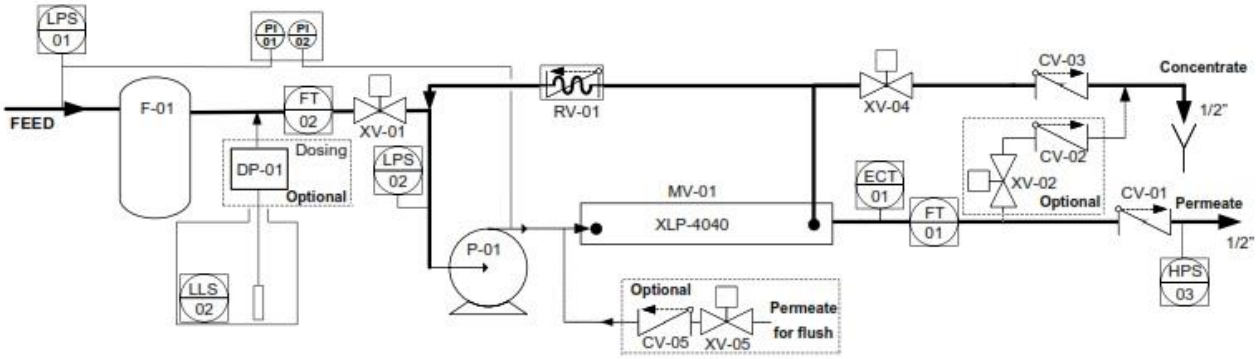
2.2 APRO-250 LPH



APRO-250 LPH system dimensions

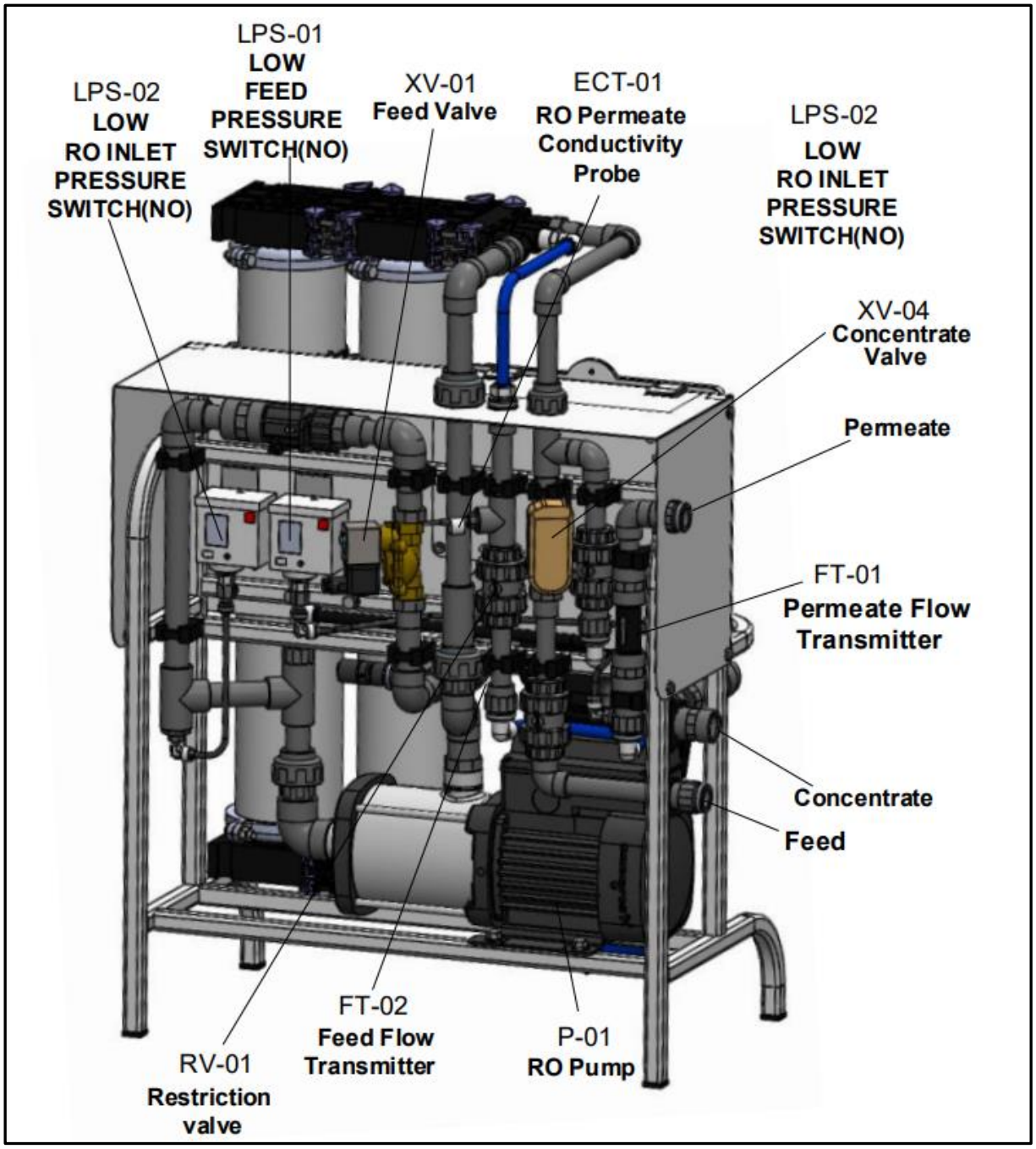


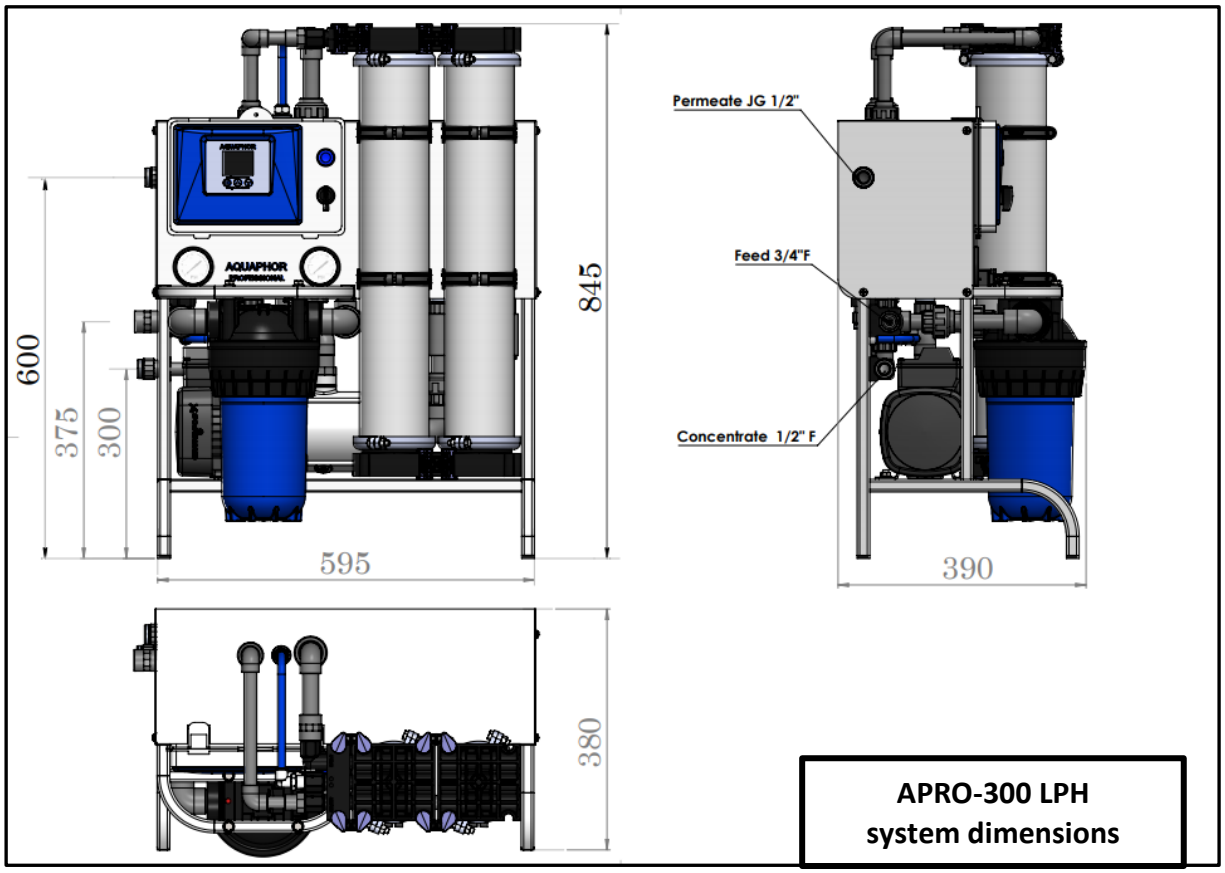
APRO-250 LPH



Item	Description	Item	Description	Item	Description	Item	Description
FT 01	Flow trans.		Actuated valve		Check valve		Pump
LPS 01	Pressure switch	LLS 02	Level Switch.	PI 01	Pres. indicator	MV-01	Memb. housing
ECT 01	Conductiv. trans		Restriction valve	HPS 03	Pressure switch		Filter housing

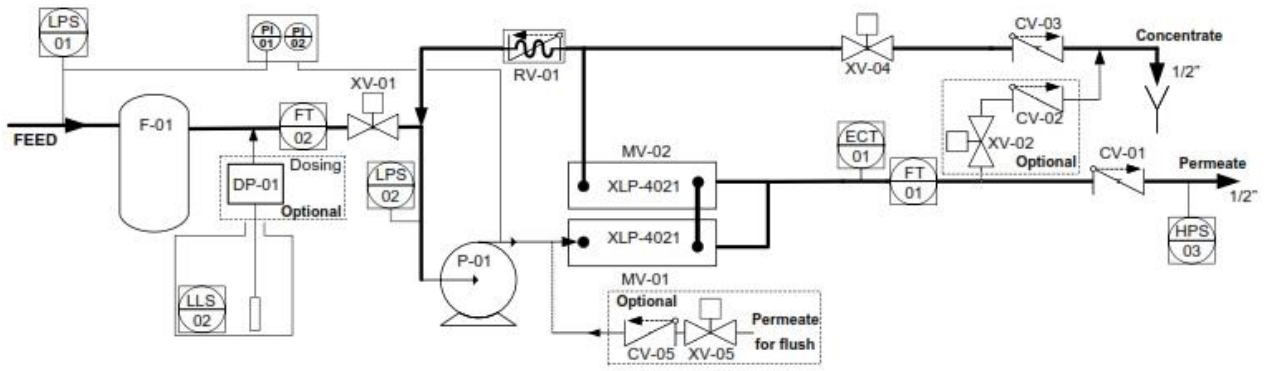
2.3 APRO-300 LPH





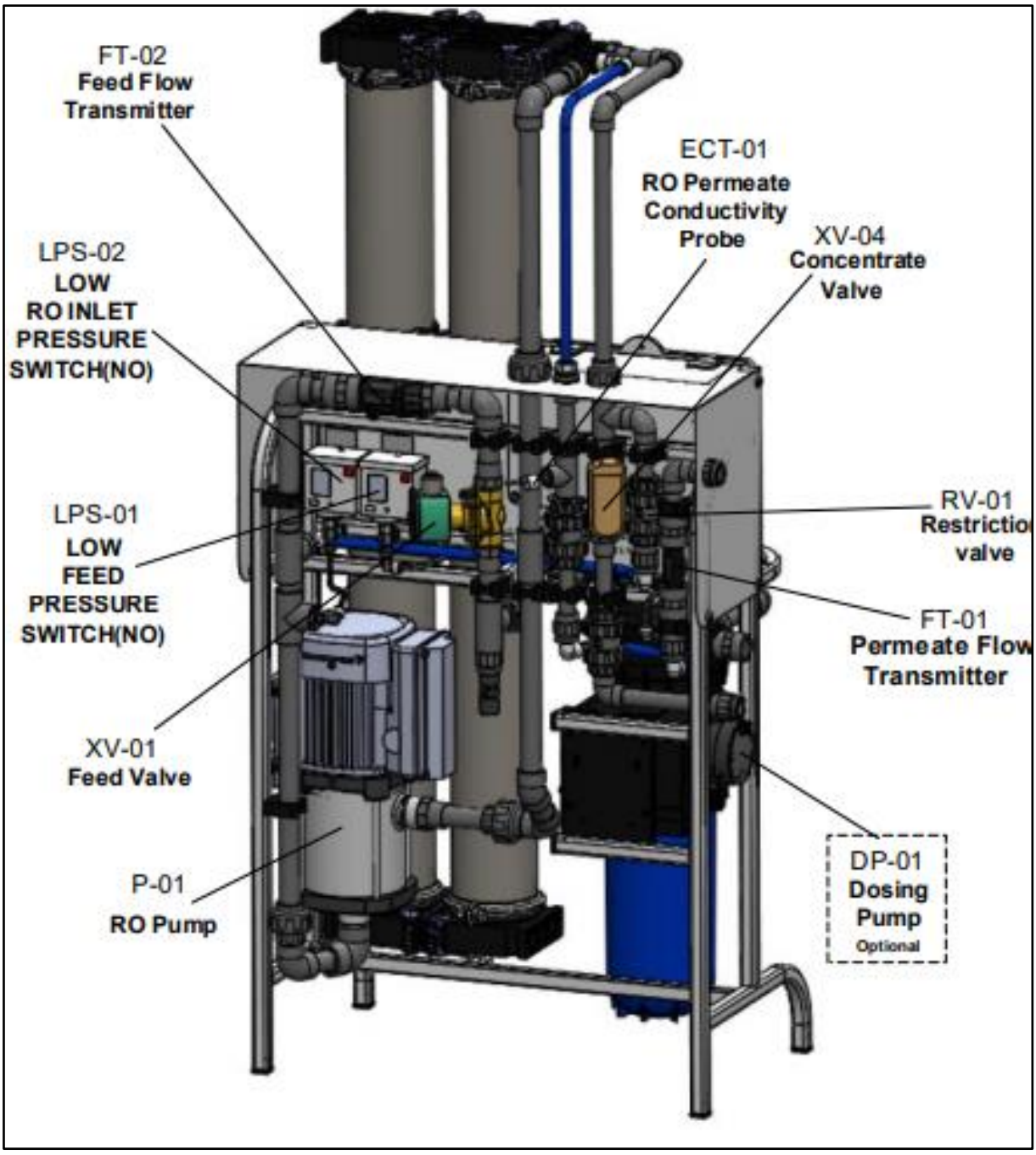
APRO-300 LPH
system dimensions

APRO-300 LPH

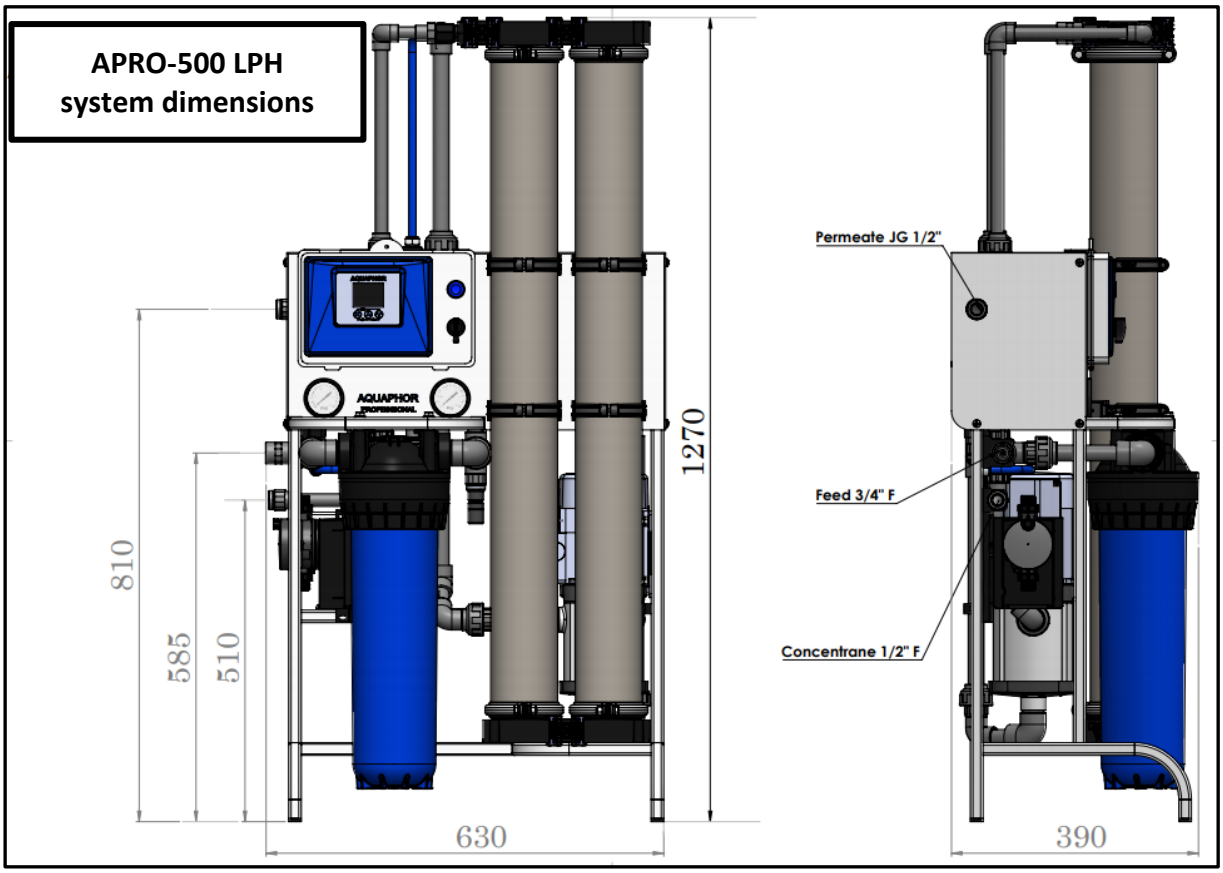


Item	Description	Item	Description	Item	Description	Item	Description
FT 01	Flow trans.		Actuated valve		Check valve		Pump
LPS 01	Pressure switch	LLS 02	Level Switch.	PI 01	Pres. indicator	MV-01	Memb. housing
ECT 01	Conductiv. trans		Restriction valve	HPS 03	Pressure switch		Filter housing

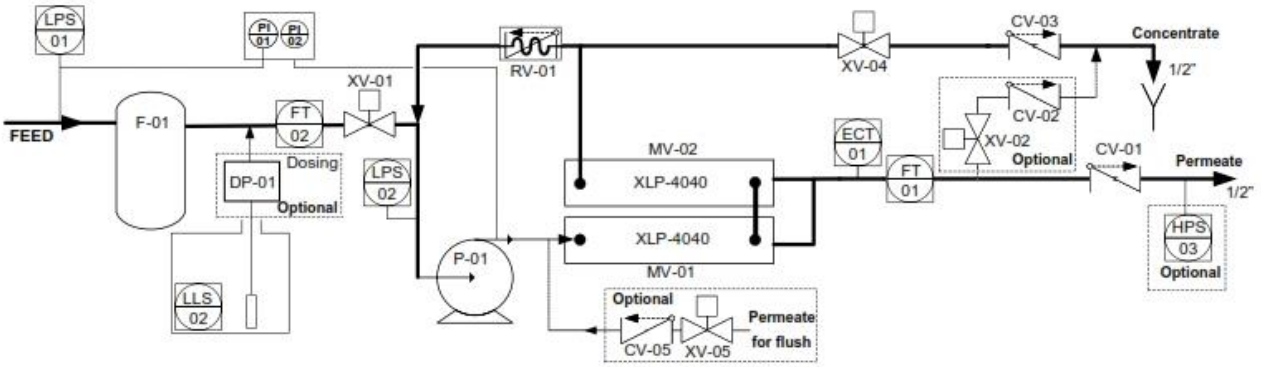
2.4 APRO-500 LPH



APRO-500 LPH system dimensions

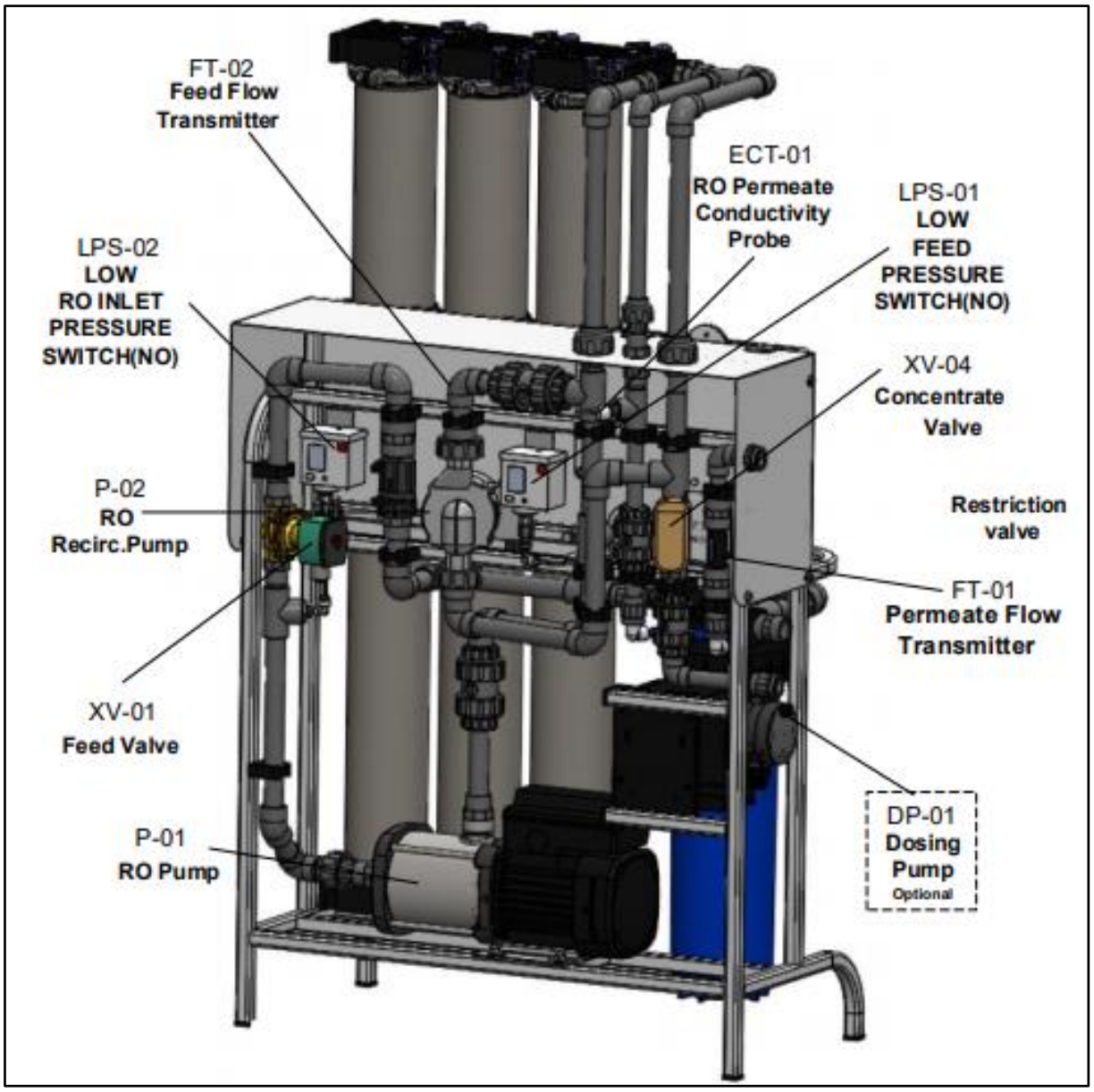


APRO-500

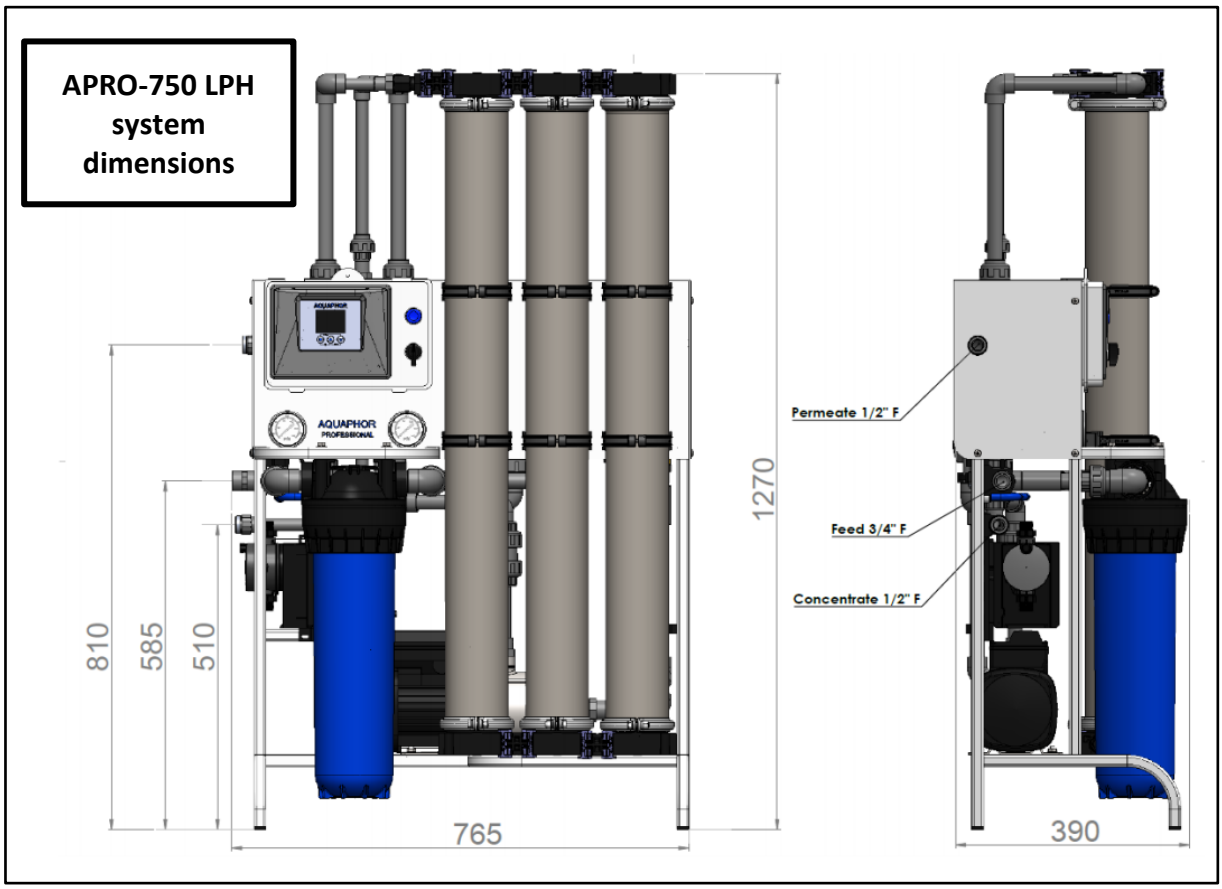


Item	Description	Item	Description	Item	Description	Item	Description
FT 01	Flow trans.		Actuated valve		Check valve		Pump
LPS 01	Pressure switch	LLS 02	Level Switch.	PI 01	Pres. indicator	MV-01	Memb. housing
ECT 01	Conductiv. trans		Restriction valve	HPS 03	Pressure switch		Filter housing

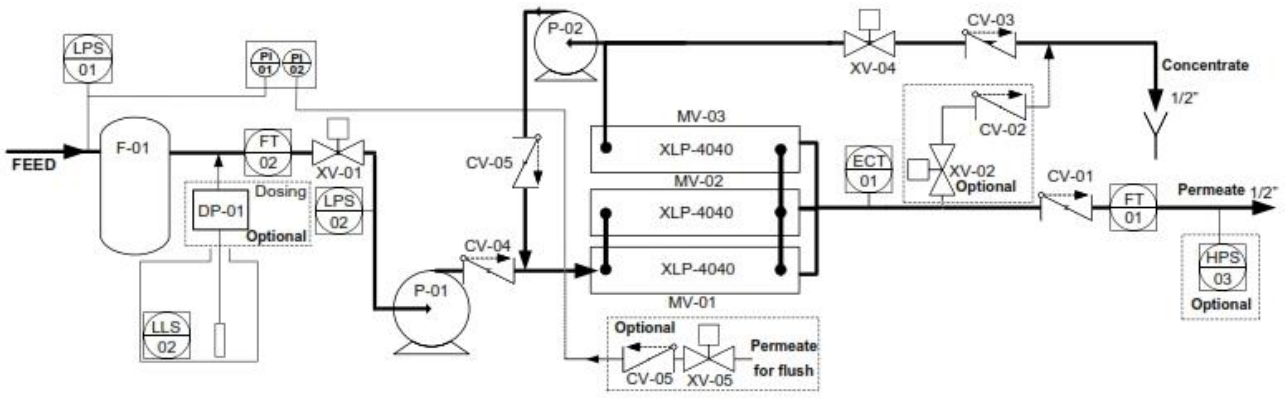
2.5 APRO-750 LPH



APRO-750 LPH system dimensions



APRO-750

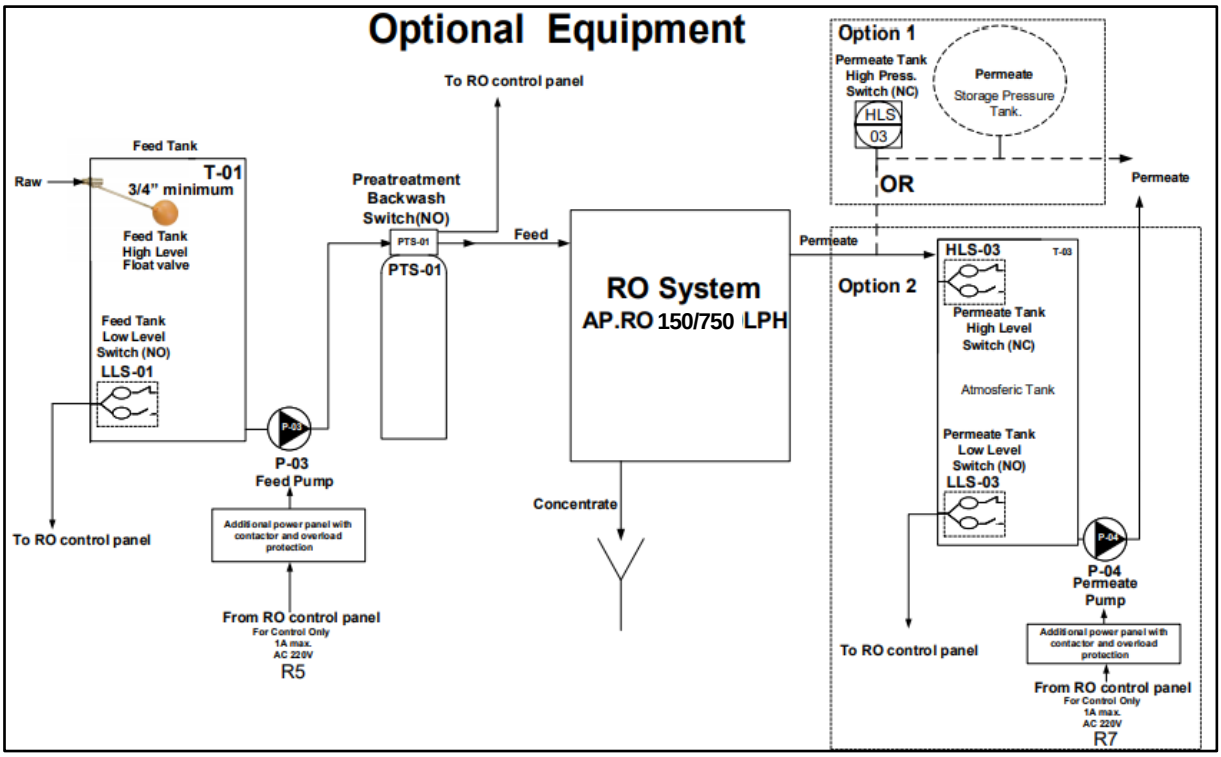


Item	Description	Item	Description	Item	Description	Item	Description
FT 01	Flow trans.		Actuated valve		Check valve		Pump
LPS 01	Pressure switch	LLS 02	Level Switch.	PI 01	Pres. indicator	MV-01	Memb. housing
ECT 01	Conductiv. trans		Restriction valve	HPS 03	Pressure switch		Filter housing

2.6 TABLE OF SYSTEM'S EQUIPMENT

Tag	Name	Function
F-01	Cartridge Filter Housing	Feed water filtration cartridge
P-01	Pressure pump	Builds up pressure and supply water to reverse osmosis membranes.
P-02	Recirculation pump	Concentrate recirculation pump. Serves to recirculate concentrate through the osmotic membranes.
DP-01	Dosing pump (optional)	Doses feed water antiscalant
LLS-02	Low Level Sensor (optional)	Protects DP-01 from dry running (antiscalant low level).
LPS-02	Low pressure switch	Low-pressure sensor at the RO inlet. Protects the system from dry running in case of failure of XV-01 or depletion of the cartridge resource.
PI-01	Pressure Indicator	
PI-02	Pressure Indicator	
FT-02	Feed flow sensor	Inlet water flow sensor.
FT-01	Permeate flow sensor	Permeate line flow sensor.
XV-01	Feed valve	The valve for supplying feed water to the reverse osmosis system.
XV-02	Drainage valve (optional)	First permeate drainage.
XV-04	Concentrate valve	Concentrate drainage valve.
XV-05	Flushing valve (optional)	Stand-by permeate membrane flushing valve.
ECT-01	Permeate conductivity sensor	Reverse osmosis permeate conductivity sensor.
CV-01	Check valve	Permeate supply check valve.
CV-02	Check valve (optional)	Permeate drainage check valve.
CV-03	Check valve	Check and back pressure valve.
CV-04	Check valve	Check valve.
CV-05	Check valve (optional)	Stand-by permeate check flushing valve.
MV-01	Membrane housing	XLP-4040 membrane housing (XLP-4021 for APRO-150 LPH and APRO-300 LPH)
MV-02	Membrane housing	XLP-4040 membrane housing (XLP-4021 for APRO-300 LPH)
MV-03	Membrane housing	XLP-4040 membrane housing
RV-01	Restriction Valve	
HPS-03	Pressure Switch (optional)	

2.7 TABLE OF SYSTEM'S ADDITIONAL EQUIPMENT



Tag	Name	Function
T-01	Feed tank	Feed water collection tank
P-03	Feed water pump	Boost up pressure and supply water to reverse osmosis system.
P-04	Permeate pump	Boost up pressure to supply RO water to the customer
DP-01	Dosing pump (optional)	Doses feed water antiscalant
LLS-02	Low Level Sensor (optional)	Protects DP-01 from dry running (antiscalant low level).
LPS-02	Low pressure switch	Low-pressure sensor at the RO inlet. Protects the system from dry running in case of failure of XV-01 or depletion of the cartridge resource.
PI-01	Pressure Indicator	
PI-02	Pressure Indicator	
FT-02	Feed flow sensor	Inlet water flow sensor
FT-01	Permeate flow sensor	Permeate line flow sensor

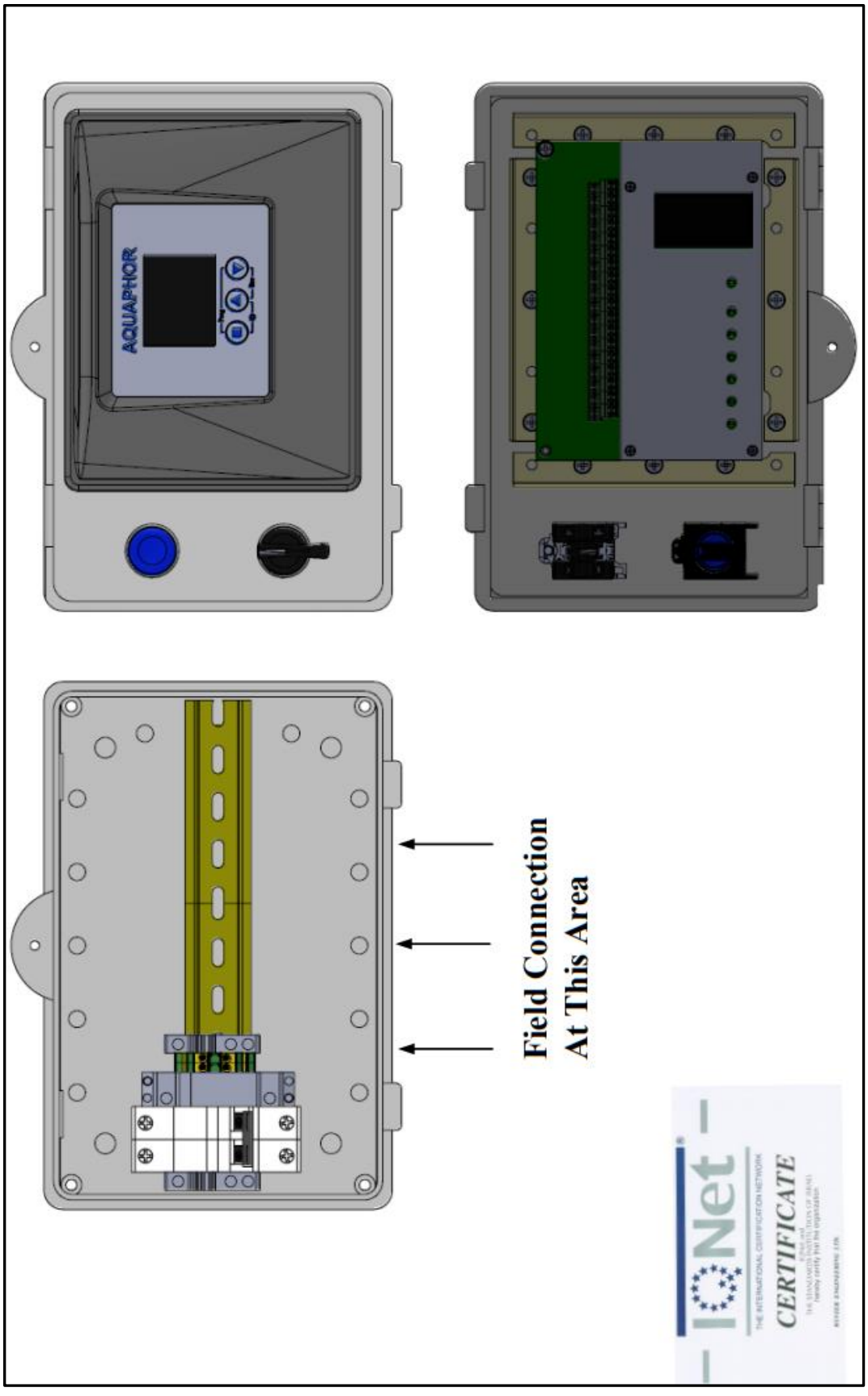
3. ELECTRIC CIRCUITS

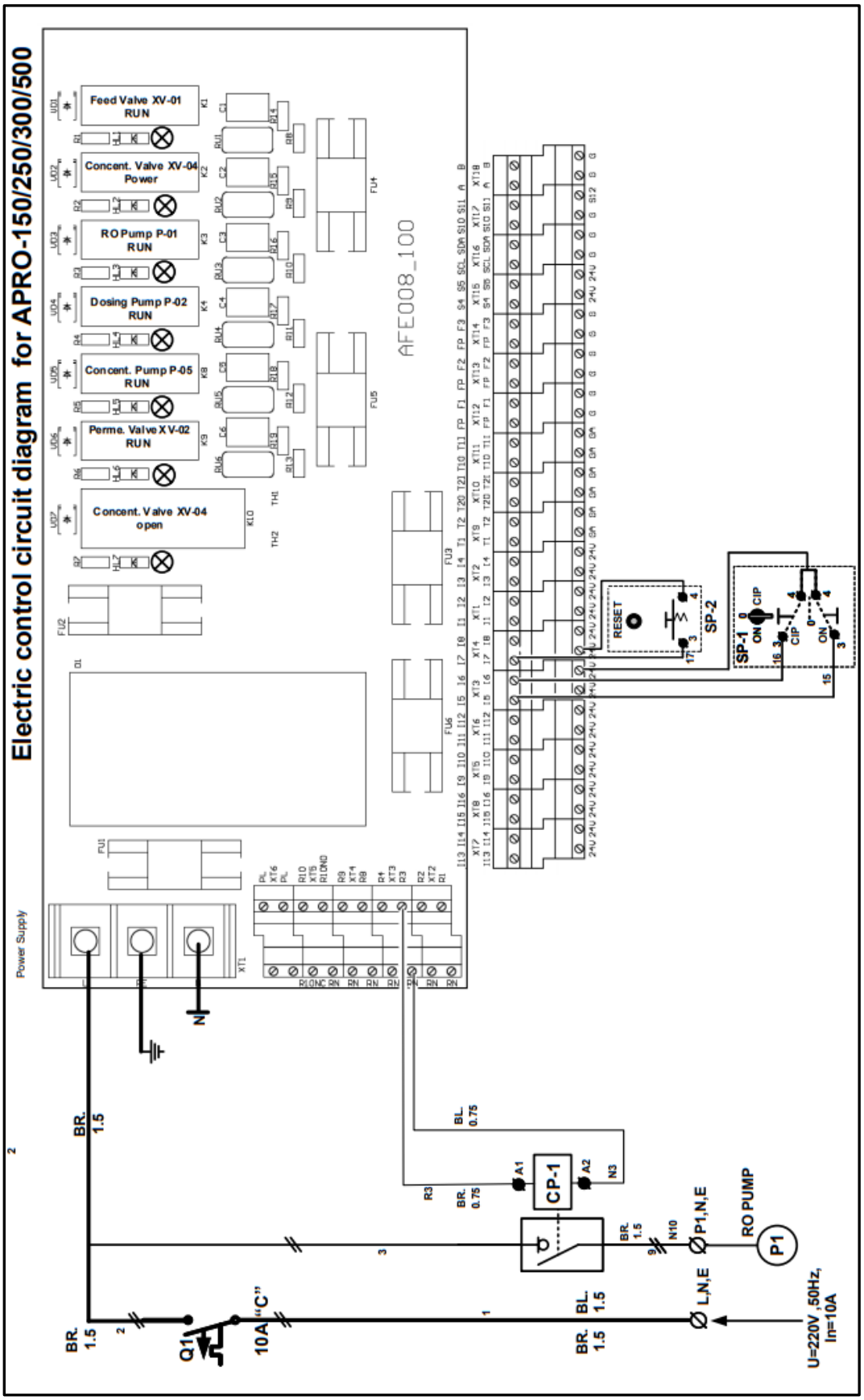
3.1 GENERAL INFORMATION

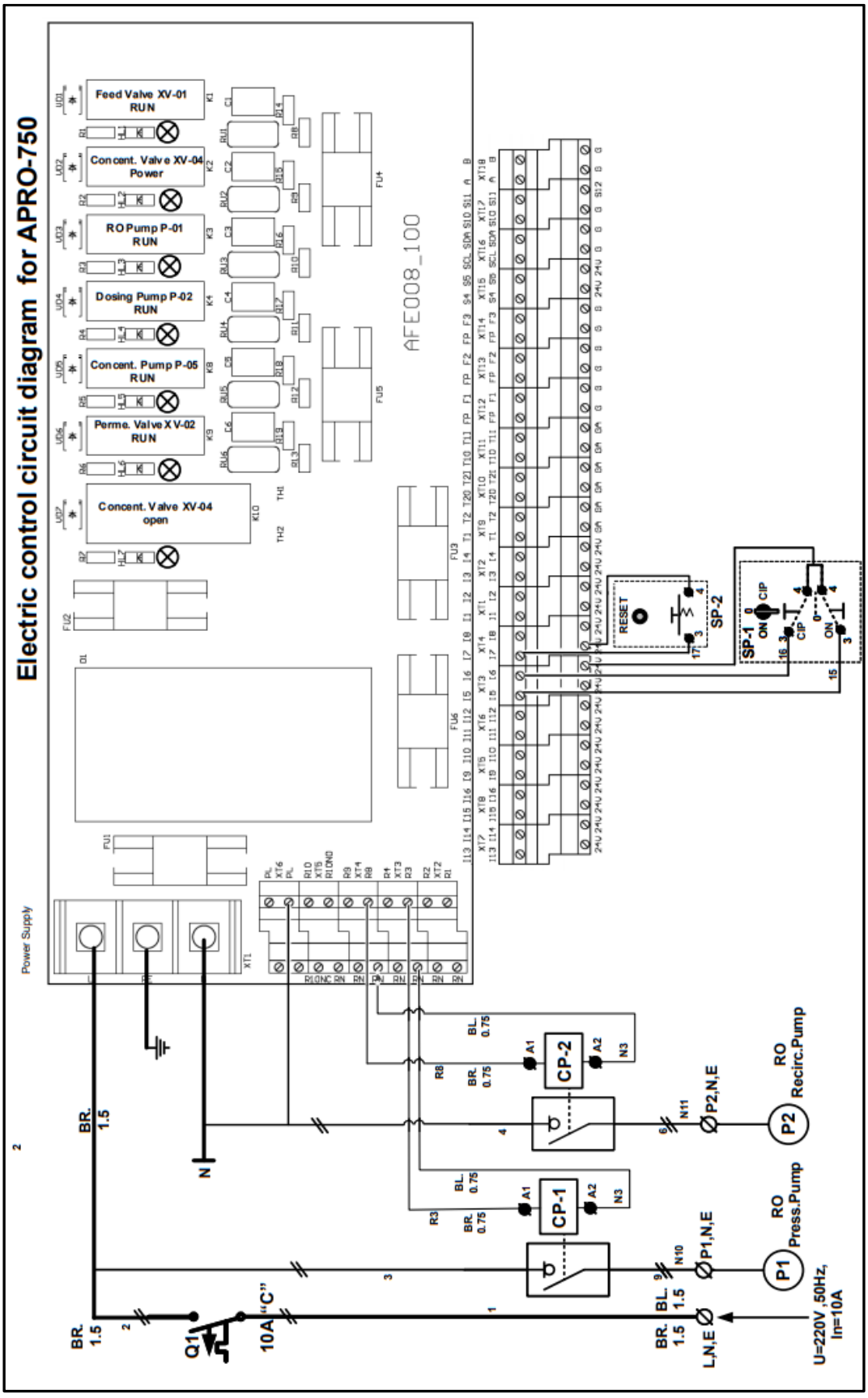
- All elements of the electrical circuit are assembled and require no additional intervention except for the connection of additional equipment. The unit is equipped with fully automated control. It can supply purified water using the logic controller, water level, and pressure sensors, based on an adjustable algorithm, standardized for the reverse osmosis systems manufactured by Aquaphor.
- The controller program works as part of the AFE-002-000 electronic complex and controls the reverse osmosis systems of various APRO configurations.

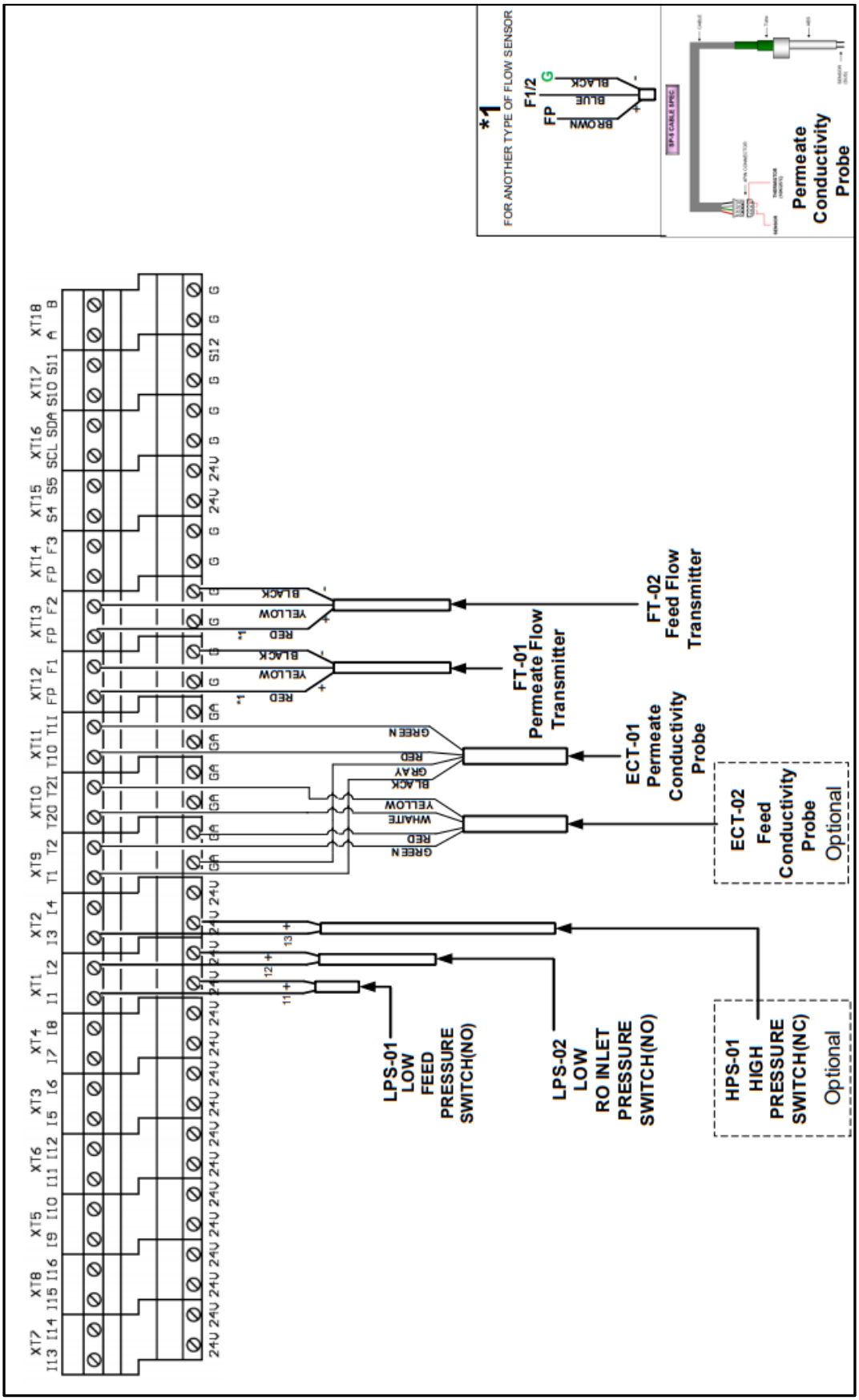
! The connection of auxiliary equipment must be carried out by certified specialists with the appropriate knowledge, skills, and experience working on this equipment. The manual setting of additional installation modes is possible only with the help of the switchboard and controller.

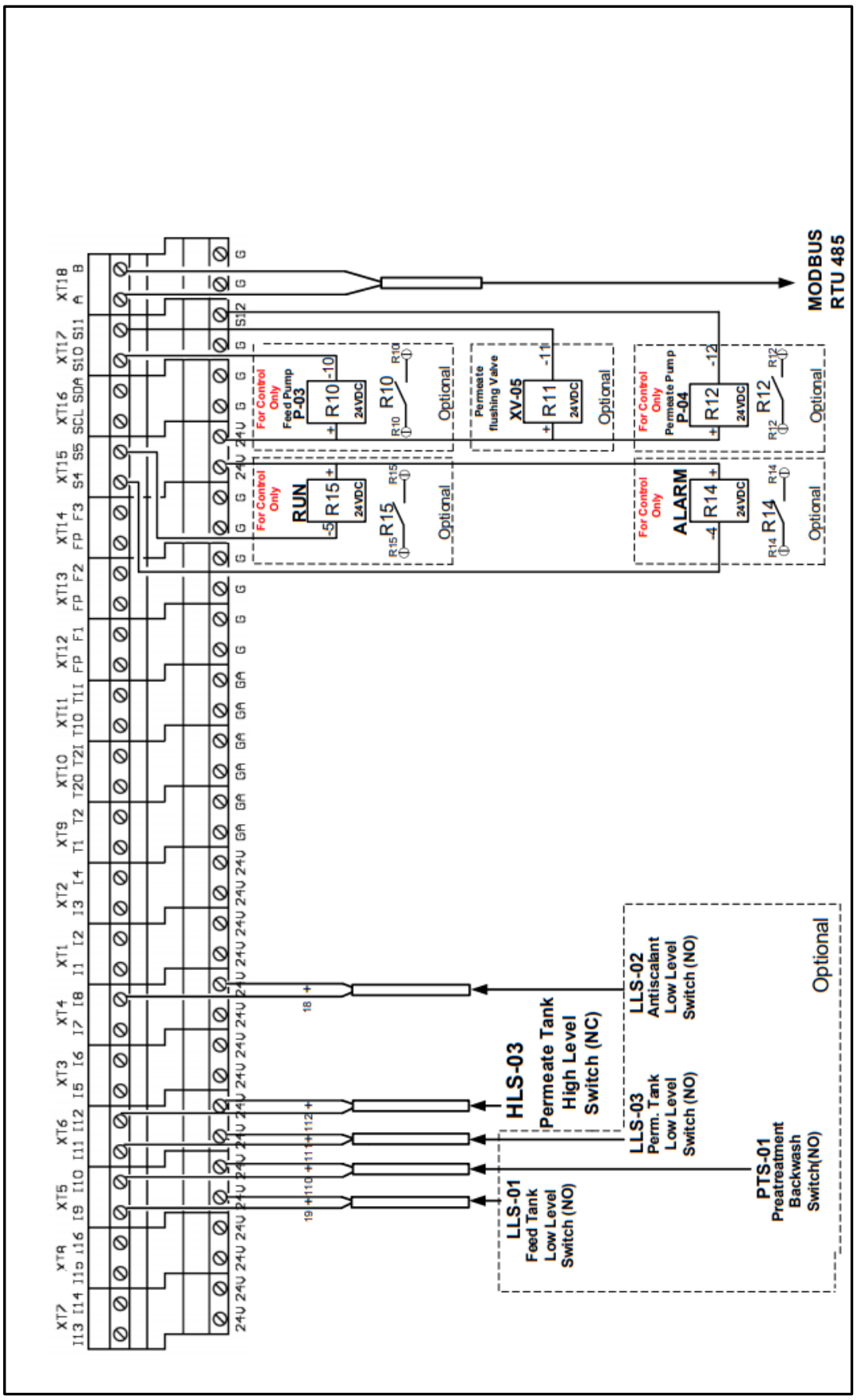
3.2 ELECTRIC CIRCUIT SCHEMES

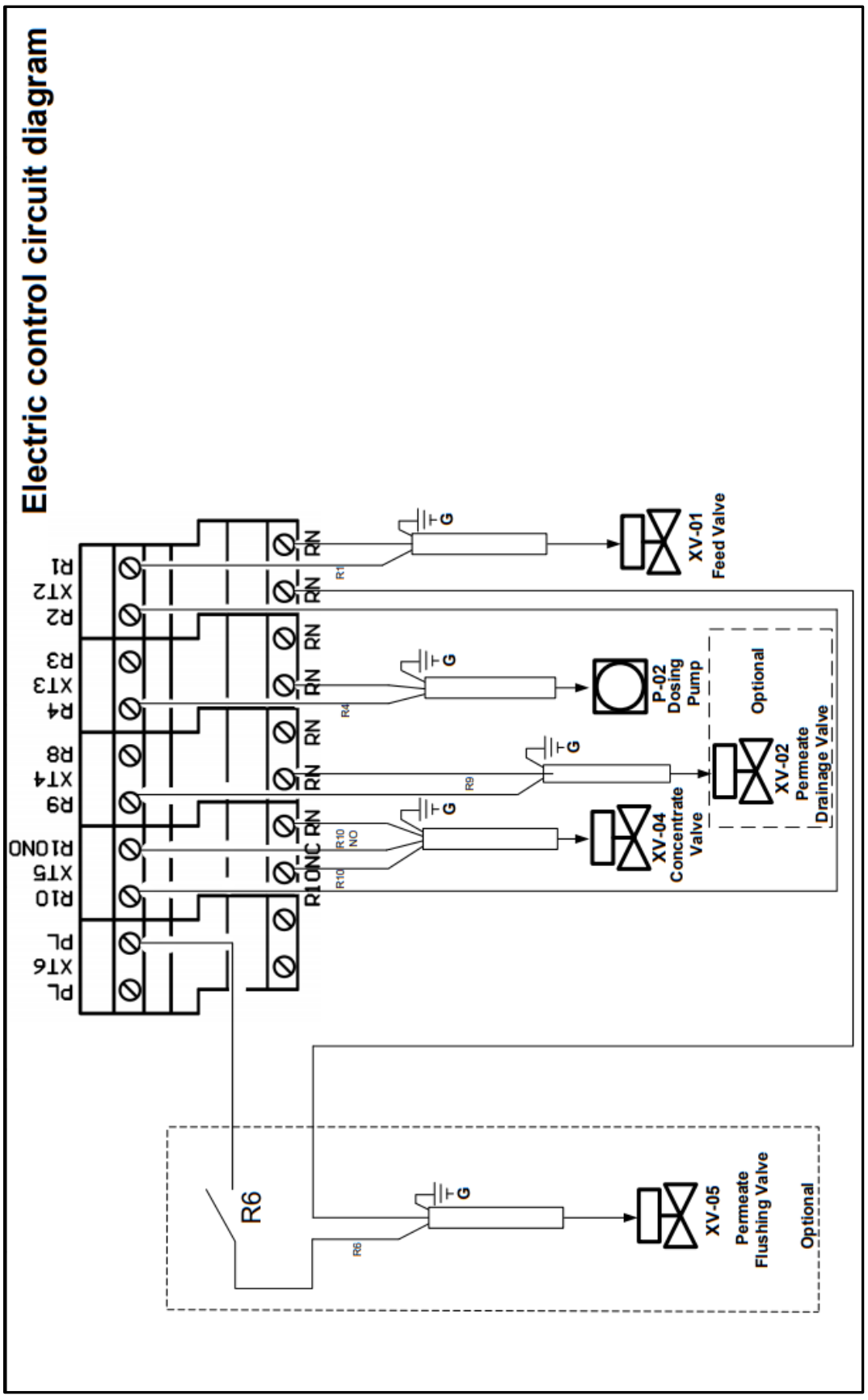



Electric control circuit diagram for APRO-150/250/300/500
AFE008_100
Feed Valve XV-01 RUN
Concent. Valve XV-04 Power
RO Pump P-01 RUN
Dosing Pump P-02 RUN
Concent. Pump P-05 RUN
Perme. Valve XV-02 RUN
Concent. Valve XV-04 open
RESET
SP-1
SP-2
CIP
ON
CP-1
RO PUMP
P1
Q1
10A "C"
Power Supply
U=220V ,50Hz, In=10A
L,N,E
P1,N,E
BR. 1.5
BL. 1.5
BL. 0.75
BR. 0.75


Electric control circuit diagram for APRO-750
AFE008_100
Feed Valve XV-01 RUN
Concent. Valve XV-04 Power
RO Pump P-01 RUN
Dosing Pump P-02 RUN
Concent. Pump P-05 RUN
Perme. Valve XV-02 RUN
Concent. Valve XV-04 open
RESET
SP-1
SP-2
CIP
ON
CP-1
CP-2
P1
P2
RO Press.Pump
RO Recirc.Pump
P1,N,E
P2,N,E
L,N,E
Q1
10A "C"
N
BR. 1.5
BL. 0.75
BL. 1.5
U=220V ,50Hz, In=10A
Power Supply


*1
FOR ANOTHER TYPE OF FLOW SENSOR
F1/2
FP
G
BLACK
BLUE
BROWN
Permeate Conductivity Probe
FT-02 Feed Flow Transmitter
FT-01 Permeate Flow Transmitter
ECT-01 Permeate Conductivity Probe
ECT-02 Feed Conductivity Probe Optional
LPS-01 LOW FEED PRESSURE SWITCH(NO)
LPS-02 LOW RO INLET PRESSURE SWITCH(NO)
HPS-01 HIGH PRESSURE SWITCH(NC) Optional


MODBUS
RTU 485
For Control Only
Feed Pump
P-03
R10
24VDC
Optional
Permeate flushing Valve
XV-05
R11
24VDC
Optional
For Control Only
Permeate Pump
P-04
R12
24VDC
Optional
For Control Only
RUN
R15
24VDC
Optional
For Control Only
ALARM
R14
24VDC
Optional
HLS-03
Permeate Tank
High Level
Switch (NC)
LLS-02
Antiscalant
Low Level
Switch (NO)
LLS-03
Perm. Tank
Low Level
Switch (NO)
LLS-01
Feed Tank
Low Level
Switch (NO)
PTS-01
Preatreatment
Backwash
Switch(NO)
Optional

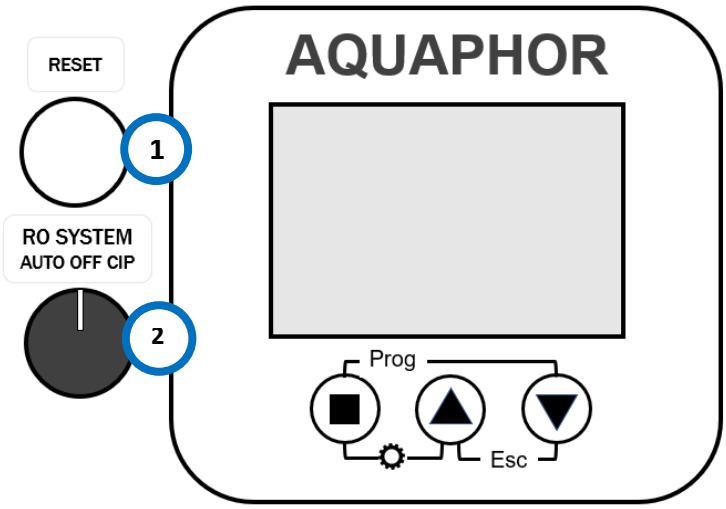

Electric control circuit diagram
R1
XT2
R2
R3
XT3
R4
R8
XT4
R9
R10NO
XT5
R10
PL
XT6
PL
RN
RN
RN
RN
RN
RN
R1NC
R10 NO
R10
R1
R4
R9
G
XV-01
Feed Valve
P-02
Dosing
Pump
Optional
XV-02
Permeate
Drainage Valve
XV-04
Concentrate
Valve
R6
XV-05
Permeate
Flushing Valve
Optional

4. CONTROL PANEL

4.1 GENERAL INFORMATION

- The controller is protected by an osmosis control panel with IP-55 standard class and higher.
- The system nodes are controlled through the power board.
- The commutation of the controller and the power board is realized through quick-detachable connections.

4.2 ELEMENTS ON THE CONTROL PANEL



№	ELEMENT	FUNCTION
1	«**Reset**» button	Resetting the current program (return to the start window SYSTEM OFF).
2	«**RO system**» mode switcher	**OFF** - Standby mode **AUTO** - Automatic mode **CIP** - Service Mode

5. TECHNICAL DATA DESCRIPTION

5.1 REQUIREMENTS ON SITE

5.1.1 WATER QUALITY

Designation	Unit	Value
Water supply for the reverse osmosis system		
Temperature	°C	5 - 30
Turbidity factor	NTU	<1
Blocking factor (sludge / index of sedimentation density)	SDI	<3
Flow pressure	bar	2.5 - 6
Salinity	ppm	<2000
Total hardness	°dH	0 - 15
pH under constant operation	-	6.5 - 9
Short term for the rinse	-	1 - 12
Odour	-	odourless
Oil	mg/l	0
Free chlorine	mg/l	0
Iron	mg/l	<0.1
Manganese	mg/l	<0.1
Sewage		according to local regulations

5.1.2 INSTALLATION ROOMS

Designation	Unit	Value
Temperature	°C	5 to 40
Lighting	lx	at least 150
Source of fresh air	-	aerate and deaerate sufficiently

5.1.3 REVERSE OSMOSIS DATA

Designation	Unit	Value
Permeate		
Operating pressure max.	bar	7-9
Power	kW	0.7
Control	W	10
APRO 150LPH		
With 25 °C	l/h	150
With 10 °C	l/h	105
APRO 250LPH		
With 25 °C	l/h	250
With 10 °C	l/h	175
APRO 300LPH		
With 25 °C	l/h	300
With 10 °C	l/h	210
APRO 500LPH		
With 25 °C	l/h	500
With 10 °C	l/h	350
APRO 750LPH		
With 25 °C	l/h	750
With 10 °C	l/h	525
Connections		
Raw water	NW	¾ ’’
Concentrate	NW	½’’
Permeate	NW	½’’
Pressure fluctuations max.	bar	± 1
RO salt retention rate max.	%	90 - 95
Operating temperature	°C	10 - 40
Surrounding temperature	°C	4 - 40
Electric connection		EU plug
Connection	-	1/N/PE
Voltage	V	230
Frequency	Hz	50
Power	kW	1.2
Nominal current	A	10

6. INSTALLATION

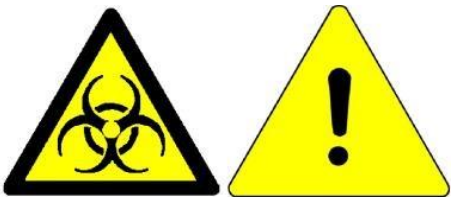
6.1 SAFETY POINTERS

DANGER: Danger for life, Electric shock

- Turn OFF the main switch and avoid its reactivation.
- Let only the competent staff carry out the electric work.
- Ensure the absence of power before starting to work.
- Consider the national regulations, the safety ones, and if available, the factory prescriptions.

WARNING: Dangerous tasks

- Ensure that only specially trained personnel carries out the tasks.
- Ensure that the laws, regulations, and directives applicable to the site of use are fulfilled.
- Before beginning the tasks, ensure that the air and water systems are pressureless.
- Ensure that the tasks are carried out with suitable tools only.
- Ensure the use of adequate climbing aids and protective measures before working at height to prevent a fall.
- Ensure that the safety data sheets of the auxiliary and operating materials used are fulfilled.
- Ensure the use of personal protective equipment (helmet, non-skid safety shoes, safety goggles, ear protectors, gloves, etc.)
- Consider stumbling and spraining areas.
- Avoid slip hazard.
- Provide sufficient lighting.
- Provide sufficient aeration.
- In case of danger, actuate the emergency-stop switching device.



CAUTION : Possible contamination of the washing water / air; Infections and diarrhea

- Wear personal protective equipment (waterproof clothing, boots, gloves and breathing protection (e.g. particle filtering half-mask).
- Avoid any contact with washing water and spray mist.
- Provide sufficient aeration.

6.2 INSTALLATION

- **Concentrate connection:** Install a hose between the concentrate outlet of the reverse osmosis unit and the sewer junction and let it hang 10 to 15 cm over the drain, to prevent the contamination of the unit.
- **Permeate connection:** Install a hose temporarily between the outlet for permeate of the reverse osmosis unit and the sewer junction.

1. **System Location**

The RO system should be located away from direct sunlight, wind and rain. You should also account for freezing temperatures and remember that lower temperatures reduce production. It would also be wise to leave plenty of room around the unit for future service.

2. **Plumbing**

The high-pressure pumps that feed the RO unit require a constant flow of water at a sufficient flow rate.

3. **Feed Water**

Piping for the feed water should be either copper or plastic as iron or carbon steel pipe could increase the iron content of the feed water. Temperature of the feed water should not exceed 35° C. This unit comes equipped with pressure differential safety shut-off on the pre-filter so as not to starve the pump of water. This will also let you know when to change the pre-filter.

4. **Product Water (Permeate) Line Connection & Primary membrane flushing**

All of our equipment comes with a built-in check valve on the permeate line.
Note: When starting up a new unit, it should run to drain for 30-60 minutes to flush the new membranes. Be sure this product line is not shoved into a drain. If possible, run the product line from above with a substantial air-gap spraying into the drain from above. The normal plumbing code is at least twice the diameter of the drain pipe. A larger gap is preferable to avoid splashing of water from the drain. This may allow bacteria growth that may be able to migrate back into the unit thus causing a potential problem.

5. **Concentrate or Waste Line Connection**

Connect the concentrate or waste line to the outlet side of the concentrate flow meter. Run this line to an open drain with no restriction and leave an airgap at the drain end. Please, follow all local plumbing codes.

6. **Electrical**

Properly sized electrical service is required for proper operation of system.

7. **Level Controls**

Level controls are a float type in an atmospheric storage tank or a O-float level valve. Both are optional with our equipment and can be installed by us. Either one are wired directly into the controller and are controlled by the controller.

8. **Pumps**

All of our units come with heavy-duty pumps and they are not self-priming. Never let a pump run dry. This may damage the pump and void the warranty.

9. **Pre-Filtration**

Our units are equipped with a sediment pre-filter which will remove particles down to 5 microns in size. As this pre-filter plugs up it will restrict the flow of water. At this point the controller will shut down the unit until the filter is changed. This option is standard on our equipment. Depending on the feed water, more pre-treatment may be necessary. A water analysis is required to determine the need

10. **Installation.**

Prior to start-up, carefully inspect the system for loose connections that may have loosened during shipping.

11. **Membrane installation**

Should the membranes need to be installed or replaced, be sure to notice how they were removed. The flow of water will always be from the end of the membrane with the brine seal to the end without the brine seal.

7. CONFIGURATION

APRO 150/250/300/700/750 LPH systems can be configured in two ways:

- By using the three-button keyboard of the controller.
- By using the APRO Monitor application on the screen of a mobile device.

7.1 STARTING

7.1.1 CONNECTION

CAUTION: It is recommended to use eyes and hands protection while unpacking the system.

1. Unpack the system and place it to the permanent place of work.
2. Make sure the membranes and filter cartridges are installed.
3. Connect the inlet connection to the raw water supply.
4. Connect the electricity plug to ~220 V.
5. Connect the dosing suction pipe to the antiscalant tank.
6. Before starting work, move RO switcher to the AUTO position, make sure to perform degassing (Check 10.1 Dosing pump degassing)
7. Connect permeate connector to the permeate supply line.
8. System is ready.

If an additional atmospheric permeate tank is used, connect the permeate line via float switch. If a permeate supply pump (P-04) is used, connect the low level switch (LLS-03) to the control panel.

7.2 CONFIGURATION VIA CONTROLLER KEYBOARD

STARTING WINDOW

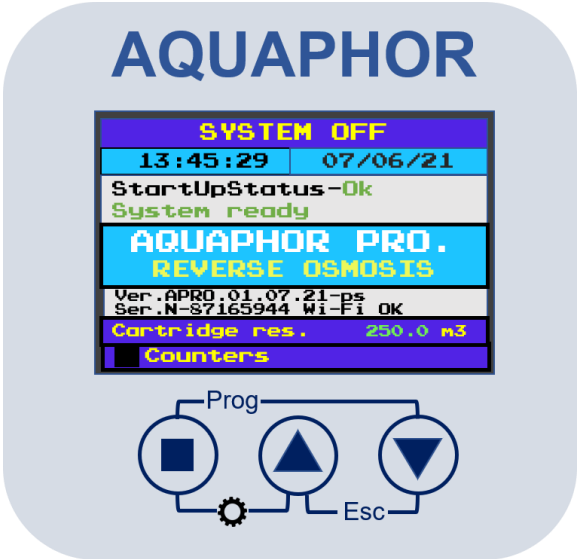
When power is applied to the switchboard, the program starts in the System OFF mode, opening the start window with the following parameters:

1. The current time and date
2. The name of the program
3. The name of the production
4. The possibility of starting the system infiltration mode
5. The position of the three-position switch
6. Errors that prevent the installation from starting infiltration mode
7. The serial number of the board
8. The program version
9. The availability of Wi-Fi
10. The availability of mkS card

In the start window, you can perform the following operations:

- Switching using a three-position hereinafter switch to the "AUTO" position. The system will enter the filtering mode through the "Start-Up" mode.
- Switching the switch to the "CIP" position. The system will enter the state of chemical flushing system elements.
- Pressing the "OK" ■ button on the three-position switch for 2 seconds will turn on the system statistics window for 4 seconds (the function is convenient for defining service intervals).
- x the calibration routine of the TDS (Total Dissolved Solids) sensors.
- Pressing the "OK" ■ and "Down" ▼ buttons on the three-position switch simultaneously will start the subroutine for configuring system devices.

If the starting parameters meet the system's requirements, then an indication of the system operation will be displayed on the controller screen:



7.3 SYSTEM RUN

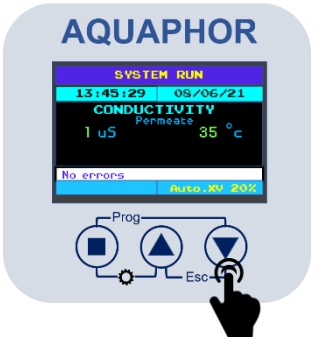
System run panel has a few types of display, representing the current parameters of the system. Pressing “Up” and "Down"▼ buttons will switch the display to another one.

General display

- Permeate conductivity (µS)
- Permeate flow (LPM)
- Current errors
- Current flush

Flows display

- Permeate flow (LPM)
- Concentrate flow (LPM)
- Feed flow (LPM)
- Recovery, %



Conductivities display

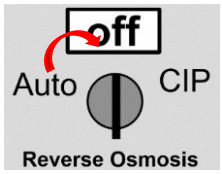
- Permeate conductivity (µS)
- Permeate temperature, °C
- Feed conductivity (µS)
- Feed temperature, °C

Cartridge display

- Resource, m^3 – a countdown of a remaining resource. Resource should be set up initially (**7.5, Setup-16**)
- Pressure drop, bar

7.4 EQUIPMENT SETUP

1. Move the switch to the **OFF** position to start setting up the system.



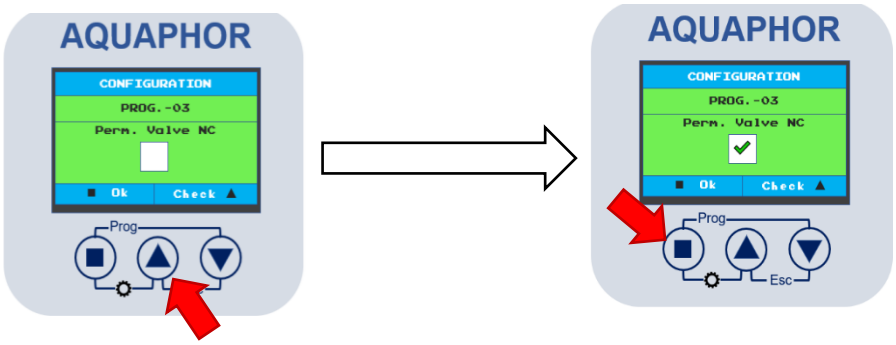
2. Perform dosing pump degassing (**Maintenance, 10.1**).
3. Make sure there is no leakage.
4. Check all the setups and programs (**7.4, 7.5**).
5. Whenever the low level sensor is off, it is recommended to perform P-04 deaeration (**Maintenance, 10.1**).

7.4.1 EXAMPLE OF SOFTWARE SETUP

1. To enter the settings menu, use the controller's three-button keyboard located under the monitor screen.

2. To open **Configuration** menu, press the “Ok” ■ and “Down” ▼ buttons.

3. If you want to add or exclude an element from the system, press the “Up” ▲ button. By pressing the “Ok” ■ button, we confirm the selection and proceed to the next element of the system.



7.5 PROGRAMS

№	Program name	APRO 150	APRO 250	APRO 300
01	Feed pump			
02	Pretreatment			
03	Permeate Valve NC			
04	Supply pump			
05	Perm. Flow tr.	✓	✓	✓
06	Feed Flow tr.	✓	✓	✓
07	High press. SW.			
08	Permeate Flush			
09	Pulse dosing op.			
10	Dosing Level SW.		✓	✓
12	Double Pump RO			
13	Perm. Conductivity tr.	✓	✓	✓
14	Feed Conductivity tr.			
15	Conduct. Sm/PPM			
16	L/GAL – C/F			

№	Program name	APRO 500	APRO 750
01	Feed pump		
02	Pretreatment		
03	Permeate Valve NC		
04	Supply pump		
05	Perm. Flow tr.	✓	✓
06	Feed Flow tr.	✓	✓
07	High press. SW.		
08	Permeate Flush		
09	Pulse dosing op.		
10	Dosing Level SW.	✓	✓
12	Double Pump RO		✓
13	Perm. Conductivity tr.	✓	✓
14	Feed Conductivity tr.		
15	Feed Flow pressure tr.		
17	Inlet Low press. tr.		
19	RO high press tr.		
22	Permeate pressure tr.		
24	Conduct. Sm/PPM		
25	L/GAL – C/F		

7.6 SETUPS

№	Setup	150 LPH	250 LPH	300 LPH	500 LPH	750 LPH
01	Start Up Flush	10	10	10	10	10
02	Shut Down Flush	10	10	10	10	10
03	Stand By Flush	12	12	12	12	12
04	High Conductivity Permeate Alarm	100	100	100	100	100
06	Low Pressure delay	10	10	10	10	10
08	Permeate Flow K	205	230	260	235	225
09	Feed Flow K	47	46	45	46	46
10	Automatic Concentrate Valve Open Time	75	75	75	75	75
11	Automatic Concentrate Valve Flush Opening	70%	70%	70%	70%	70%
12	Automatic Concentrate Valve Run Opening	33%	42%	42%	56%	61%
13	Full Tank Delay	5	5	5	5	5
14	Permeate Low Flow alarm	1.0	1.0	1.0	1.0	1.0
15	Concentrate Low Flow Alarm	1.0	1.0	1.0	1.0	1.0
16	Cartridge Filter resource	200	300	200	300	300
17	System ID number	1	1	1	1	1
18	Year	0	0	0	0	0
19	Date/Month	0	0	0	0	0
20	Time	0	0	0	0	0

RECOVERY SETUP (SETUP-12)					
Setting concentrate valve opening percentage while running					
Desired Recovery (%)	**APRO-150**	**APRO 250**	**APRO 300**	**APRO 500**	**APRO 750**
50%	(Set-12) 38%	(Set-12) 50%	(Set-12) 49%	(Set-12) 65%	(Set-12) 69%
55%	(Set-12) 35%	(Set-12) 47%	(Set-12) 45%	(Set-12) 61%	(Set-12) 65%
60%	(Set-12) 33%	(Set-12) 42%	(Set-12) 42%	(Set-12) 56%	(Set-12) 61%
65%	(Set-12) 32%	(Set-12) 39%	(Set-12) 39%	(Set-12) 51%	(Set-12) 58%
70%	(Set-12) 31%	(Set-12) 35%	(Set-12) 36%	(Set-12) 45%	(Set-12) 54%
75%	(Set-12) 30%	(Set-12) 34%	(Set-12) 34%	(Set-12) 40%	(Set-12) 45%
80%	(Set-12) 29%	(Set-12) 32%	(Set-12) 32%	(Set-12) 36%	(Set-12) 40%
85%	-	(Set-12) 30%	(Set-12) 30%	(Set-12) 32%	(Set-12) 35%
90%	-	(Set-12) 27%	-	(Set-12) 30%	(Set-12) 31%

8. ALARMS AND TROUBLESHOOTING

If there is any critical error in operation, the system is switched to the "Alarm" error mode. The "Alarm" window contains information about:

- the name(s) of critical error(s)
- the number of critical errors
- the time until the next attempt to restore the system

To enter the standby state and return to the start window, move the switch to the OFF position. In case of the system's automatic reset after the minor errors, the program switches the system through the "Start-Up" mode to the filtering mode.

8.1 ALARM-01: LOW LEVEL IN THE RAW WATER TANK

The error occurs when **the level in the raw water tank T-01 is low**. The option is activated if there is no signal from the **LLS-01** low water level sensor in the source water tank T-01 for 10 seconds.

Solution: The error is solved when the signal from the low water level sensor is received. Otherwise, check RO water supply and LLS-01 functionality.

8.2 ALARM-02: PRETREATMENT SYSTEM ERROR

The error occurs when **the pre-filtration system is in the PTS-01 regeneration mode for more than three hours**.

Solution: Check the functionality of pretreatment equipment, RO system controller cable, and pretreatment system controller.

8.3 ALARM-03: ANTISCALANT TANK LOW LEVEL

The error occurs when **there is no signal from the LLS-02 low level sensor in the antiscalant T-02 tank for 10 seconds.**

Solution: The error is solved when the signal from the low water level sensor is received. Otherwise, check the presence of antiscalant and sensor functionality.
! **After antiscalant replacement, it is required to perform dosing pump degassing**. (**Maintenance, 10.1**).

8.4 ALARM-04: RAW WATER LOW PRESSURE

The error occurs when **there is no signal from the LPS-01 low pressure sensor in the supply line for a specified time (Setup. -06).** In this case, the raw water pump is activated, the pre-treatment system is activated, and it is not in regeneration mode. After a problem occurs, the system will try to restart. If the problem persists, the osmosis system will stop until the problem is resolved.

Solution: The system can be reset manually by pressing the reset button or by the automatic resetting every hour. Otherwise, check RO water supply and LPS-01 functionality.

8.5 ALARM-05: LOW INLET PRESSURE

The error occurs when **there is no signal from the LPS-02 low pressure sensor in the water supply line to the RO system for a specified time (Setup-06).** In this case, the feed water supply valve to the RO XV-01 system is open; the raw water supply pump is activated. The pretreatment system is activated and is not in regeneration. After a problem occurs, the system will try to restart. If the problem persists, the osmosis system will stop until the problem is resolved.

Solution: The system can be reset manually by pressing the reset button or by automatic reset every hour. Otherwise, check the functionality of raw water supply, **LPS-02, XV-01**. Change cartridges (**Maintenance, 10.4**).

8.6 ALARM-06: HIGH INLET PRESSURE TO RO MEMBRANE UNIT

The error occurs when the osmosis pump is in process, and **there is no signal from the HPS-02 high-pressure sensor at the membrane inlet for 10 seconds**. After a problem occurs, the system will try to restart it again. If the problem persists, the osmosis system will stop until the problem is resolved.

Solution: The error can be fixed manually by pressing the reset button or by automatic reset every three hours. Perform CIP or change the membrane, check HPS-02 functionality.

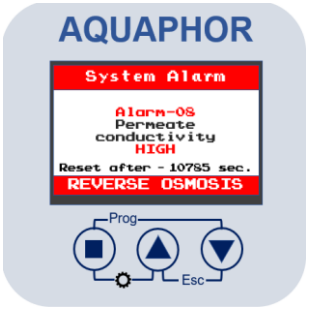
8.7 ALARM-07: RO PUMP OVERLOAD

The error occurs when **a signal is received from the thermal protection of the pump motor of the RO system P-01.**

Solution: Check RO pump P-01 and overload protection switch (inside the control box) functionality.

8.8 ALARM-08: HIGH ELECTRICAL CONDUCTIVITY OF PERMEATE

The error occurs when the pump of the RO system is working, the system is not in flushing mode or CIP, and **the conductivity value of the RO system permeate is bigger than the set value** (Setup-04) **for 5 minutes.** After a problem occurs, the system will try to restart it again. If the problem persists, the osmosis system will stop until the problem is resolved.



Solution: The system can be reset manually by pressing the reset button or by automatic reset every three hours. Perform PCP-01 calibration, perform CIP, or change the membrane.

8.9 ALARM-09: MINIMUM PERMEATE FLOW

The error occurs when the pump of the RO system (P-01) is running, and **the osmosis system permeate flow value is less than the set value (**Setup-14**) for 5 minutes**. After a problem occurs, the system will try to restart again. If the problem persists, the osmosis system will stop until the problem is resolved.

Solution: The system can be reset manually by pressing the reset button or by automatic reset every three hours. Check the functionality of FT-01. Perform CIP, or change the membrane.

8.10 ALARM-10: MINIMUM CONCENTRATE FLOW

The error occurs when the option is activated, the RO system is running, the system is not in flushing mode or CIP, and **the osmosis system permeate flow value is less than the set value (**Setup-14**) for 5 minutes.** After a problem occurs, the system will try to restart again. If the problem persists, the osmosis system will stop until the problem is resolved.

Solution: The system can be reset manually by pressing the reset button or by automatic reset every three hours. Check the functionality of the concentrate sensor and automatic concentrate valve XV-04.

8.11 ALARM-11: LOW PERMEATE LEVEL

The error occurs when **there is no signal from the LLS-03 low water level sensor in the T-03 permeate tank for 20 minutes.**

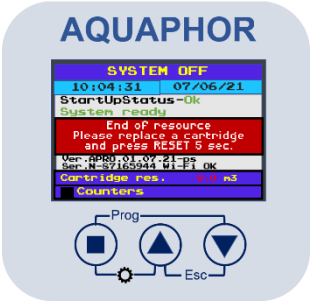
Solution: The error is fixed when a signal from the low water level sensor is received (when the permeate will be present in the tank).

8.12 ALARM-12: HIGH FEED CONDUCTIVITY

The error occurs when the pump of the RO system **P-03** is working, and **the high feed conductivity of the raw water of the RO system is greater than the set value for 5 minutes**. After a problem occurs, the system will try to restart it again. If the problem persists, the osmosis system will stop until the problem is resolved.

Solution: The system can be reset manually by pressing the reset button or by the automatic resetting every three hours. Check the raw water supply quality, functionality of **ECT-02** and pretreatment system

8.13 WARNINGS



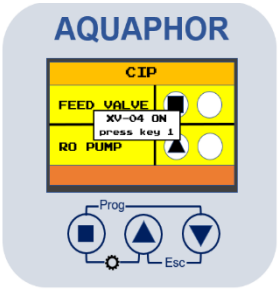
Solution: Replace the cartridge and press RESET for 5 sec.

Alarm №	Symptoms	Possible causes	Corrective Action
Alarm-01	Low level in the raw water tank	Low level in the raw water tank T-01	Check the presence of raw water; otherwise, check RO water supply and LLS-01 functionality.
Alarm-02	Pretreatment system error	The pre-filtration system is in the PTS-01 regeneration mode for > 3 hours	Check the functionality of pretreatment equipment, RO system controller cable, and pretreatment system controller.
Alarm-03	Antiscalant tank low level	No signal from the LLS-02 in the antiscalant T-02 tank for 10 seconds.	Check the presence of antiscalant or/and sensor functionality
Alarm-04	Raw water low pressure	No signal from the LPS-01 in the supply line for a specified time (Setup. -06)	Check RO water supply and LPS-01 functionality.
Alarm-05	Low inlet pressure	No signal from the LPS-02 in the water supply line to the RO system for a specified time (Setup-06).	Check the functionality of RO water supply, LPS-02, XV-01.
Alarm-06	High inlet pressure to RO membrane unit	No signal from the HPS-02 at the membrane inlet for 10 seconds.	Perform CIP or change the membrane, check HPS-02 functionality.
Alarm-07	RO pump overload	A signal is received from the thermal protection of the pump motor of the RO system P-01.	Check RO pump P-01 overload functionality.
Alarm-08	High electrical conductivity of permeate	The conductivity value of the RO system product is bigger than the set value (Setup-04) for 5 minutes	Perform PCP-01 calibration, perform CIP, or change the membrane.
Alarm-09	Minimum value of permeate flow	The osmosis system permeate flow value is less than the set value (Setup-14) for 5 minutes.	Check the functionality of FT-01. Perform CIP, or change the membrane.
Alarm-10	Minimum concentrate flow	The osmosis system permeate flow value is less than the set value (Setup-14) for 5 minutes.	Check the functionality of the concentrate sensor and automatic concentrate valve XV-04.
Alarm-11	Low permeate level	There is no signal from the LLS-03 low water level sensor in the T-03 permeate tank for 20 minutes.	Check permeate presence in the tank.
Alarm-12	High feed conductivity	The conductivity of the raw water of the RO system is greater than the set value for 5 minutes	Check the raw water supply, functionality of ECT-02 and pretreatment system.

8.14 EQUIPMENT TESTING

Equipment testing mode allows to check the condition of each system's element.

1. Turn the switch to the CIP position.
2. Press ▼ for 3 seconds. The following screen will appear:



3. Press ■ to enable/disable the system's element and switch to the next one.

4. To close equipment testing mode, put the switch to the OFF position.

9. RO ANDROID APP (APRO APP)

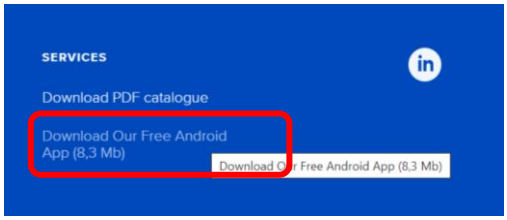
APRO Monitor app functionality:

- Data transfer in the local network
- Setting up the equipment programs and its setups
- Monitoring parameters in a running system, viewing a log, statistics.
- Alarms display

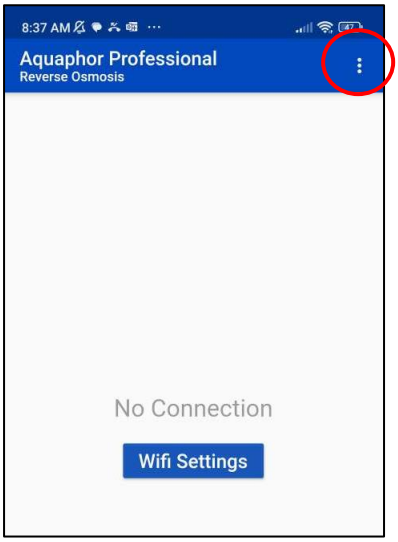
! APRO Monitor app is available for Android OS only

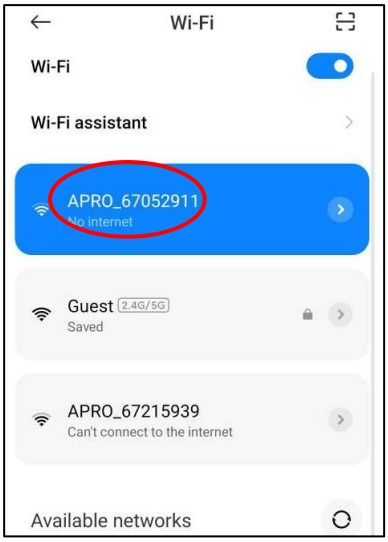
9.1 SETTING UP

1. Download and install the APRO Monitor app from the official website of the system manufacturer (aquaphor-pro.com) to your mobile device. The link can be found in the footer:



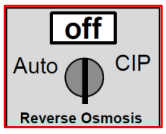
2. Open the app.
3. Configure the connection.
   a) Open the context menu and choose “Connection”.
   b) Press OK.
   c) Choose “APRO_*XXXXX*” network.
   d) Select “Connect” in the pop-up window.





4. Back in the context menu, choose “System’s Settings”.
5. Select the equipment and click “Save”.

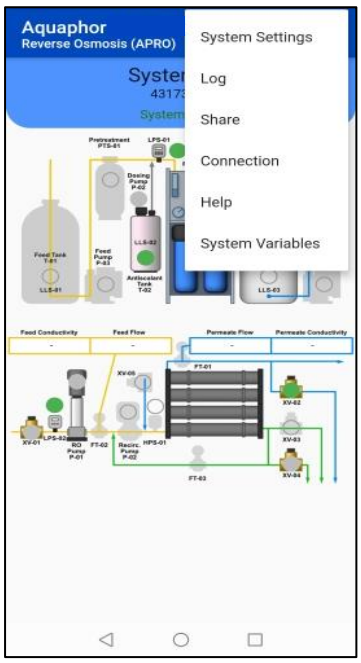
9.2 SYSTEM CONFIGURATION



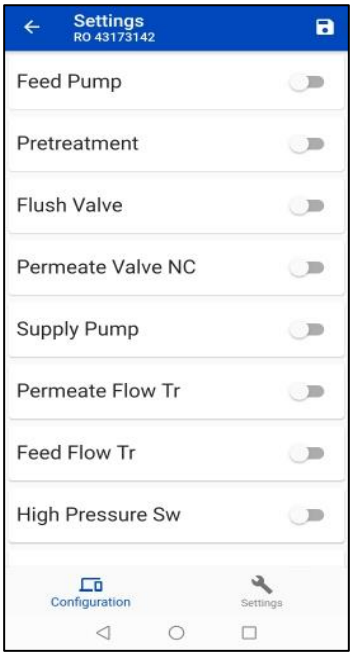
! It is possible to make changes to the system configuration and parameters only in OFF mode.

The starting screen displays the system configuration and available reverse osmosis (RO) system's option **(1)**. System Settings window **(2)** has two subparts: "Configuration" enables or disables programs 01-16. "Settings" window **(3)** changes the setups of the active programs.

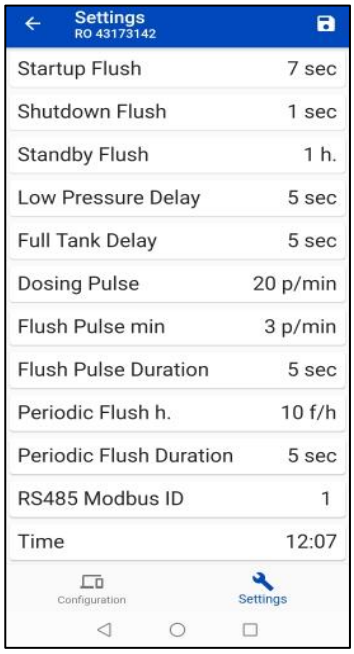
1)



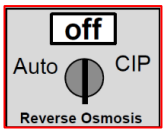
2)



3)



9.3 OPERATING MODE FUNCTIONALITY

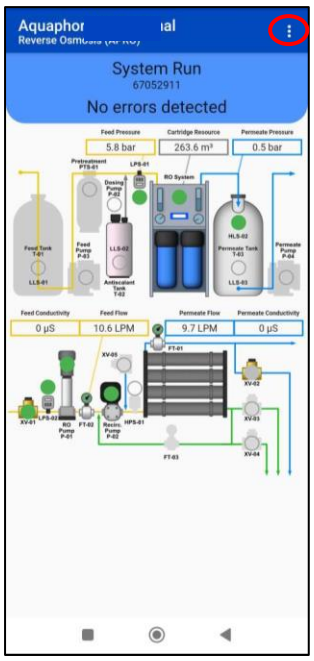


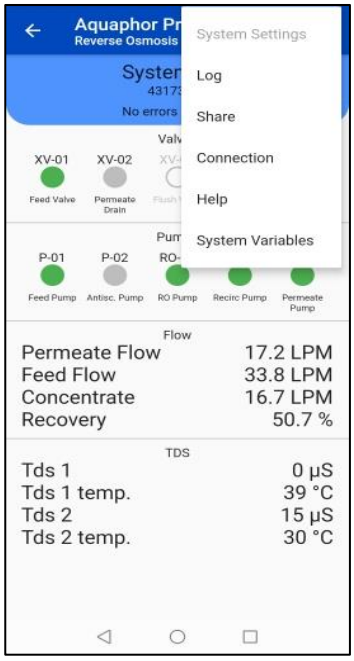
! Operating mode can be started only using a three-position switch on the RO control station.

When the system is operating, the following data is available:

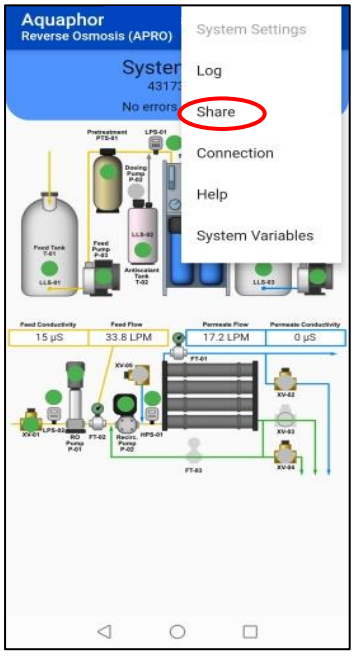
- Total operating hours
- Amount of permeate produced
- The amount of water used
- Overall system performance
- Date and time of starts/stops
- Change of modes
- Operating time of each mode

The “Log“ button of the context menu shows statistics and log of the system.





It is possible to share the statistics with other users and devices. The “Share” button of the context menu suggests several options (browser and messenger).



9.4 ADDITIONAL INFORMATION

The context menu also contains the “Help” option. A detailed description of APRO application capabilities can be found there.

9.5 GSM MODULE STATUS

Status	Explanation
Ok	No errors
Disconnected	GSM module is not detected by the system. Perhaps the module is turned off or there is no wired connection between the GSM module and the system
No SIM	There is no SIM card, or the SIM card is installed incorrectly.
No GSM	There is no connection with the GSM network, the SIM card may be damaged, or the SIM card / provider is not compatible with the GSM module.
No GPRS	There is no internet connection, perhaps the current tariff does not provide internet connection, or the SIM card has run out of money
No server connection	No data collection server was found. The server may not be configured correctly.
Server auth failed	Server found, authorization error. Please check if the password was set correctly.

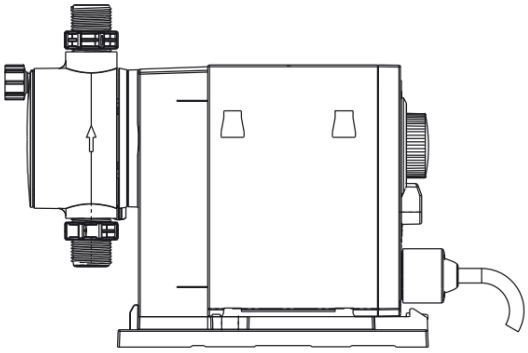
9.6 ADDITIONAL INFORMATION

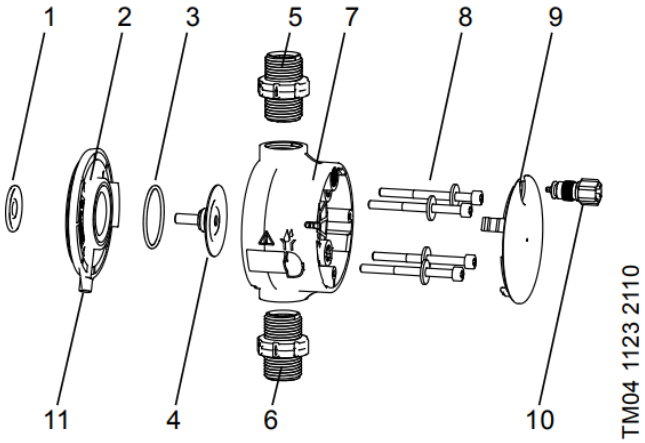
The context menu also contains the “Help” option. A detailed description of APRO application capabilities can be found there.

10. MAINTENANCE

10.1 DOSING PUMP DEGASSING

After antiscalant replacement, it is required to perform dosing pump degassing.





Dosing head, exploded view.

1. Safety diaphragm
2. Flange
3. O-ring
4. Diaphragm
5. Valve on discharge side
6. Valve on suction side
7. Dosing head
8. Screws with discs
9. Cover
10. Deaeration valve
11. Drain opening

Start and deaerate the pump.

1. Connect mains supply. Make sure the system is turned on.

2. Open the deaeration valve by approximately half a turn.

3. DDE-B control variant: Turn the capacity adjustment knob to 100 % and wait until liquid flows out of the deaeration hose continuously and without any bubbles. Then set the capacity adjustment knob back to 0,1-1 % (depending on the water quality and antiscalant type).

4. Close the deaeration valve.

The pump is deaerated.

10.2 REPLACING THE MEMBRANE MODULE

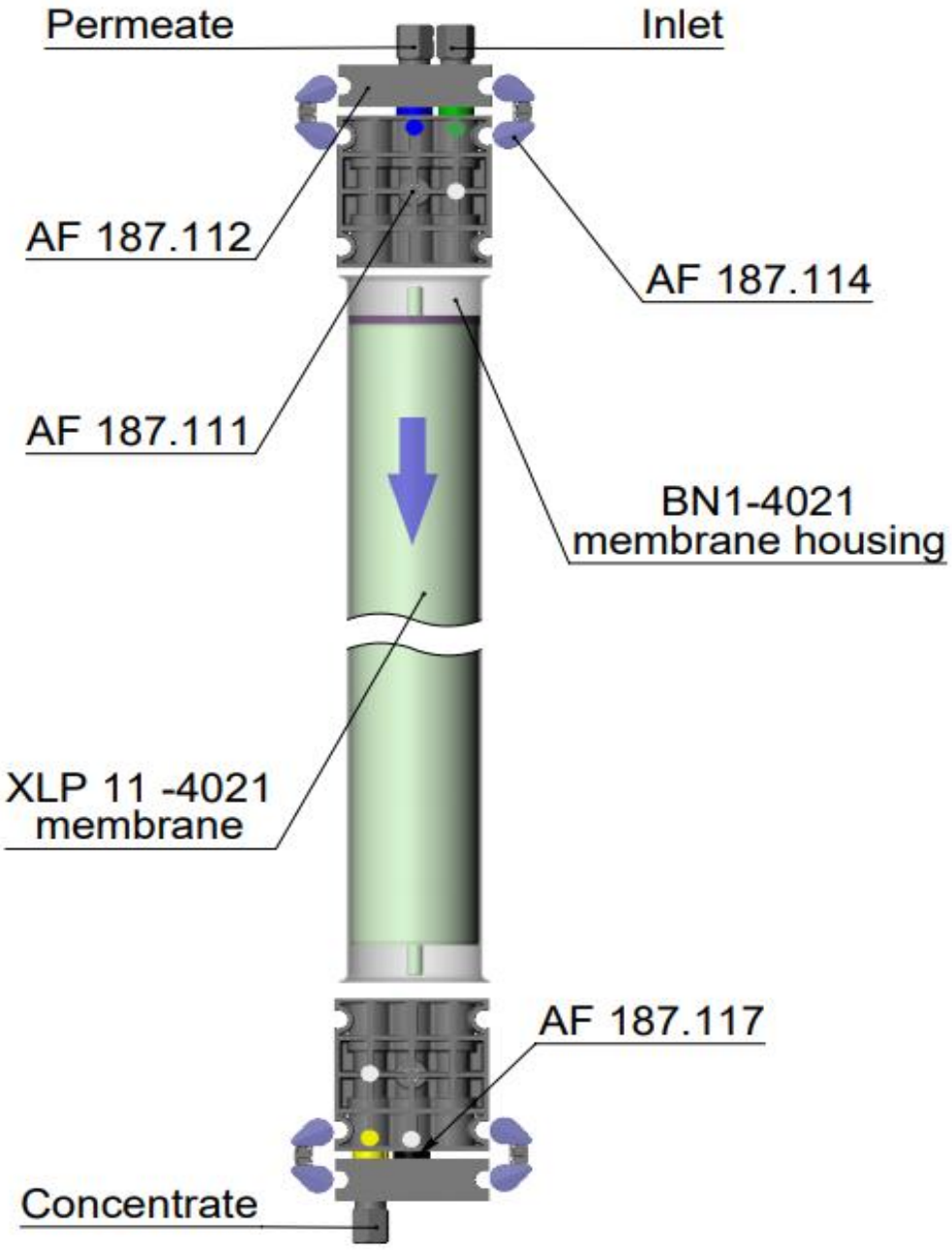
ATTENTION: Blocking of the module.

Ensure the right installation direction (arrow on the module) while installing the module.

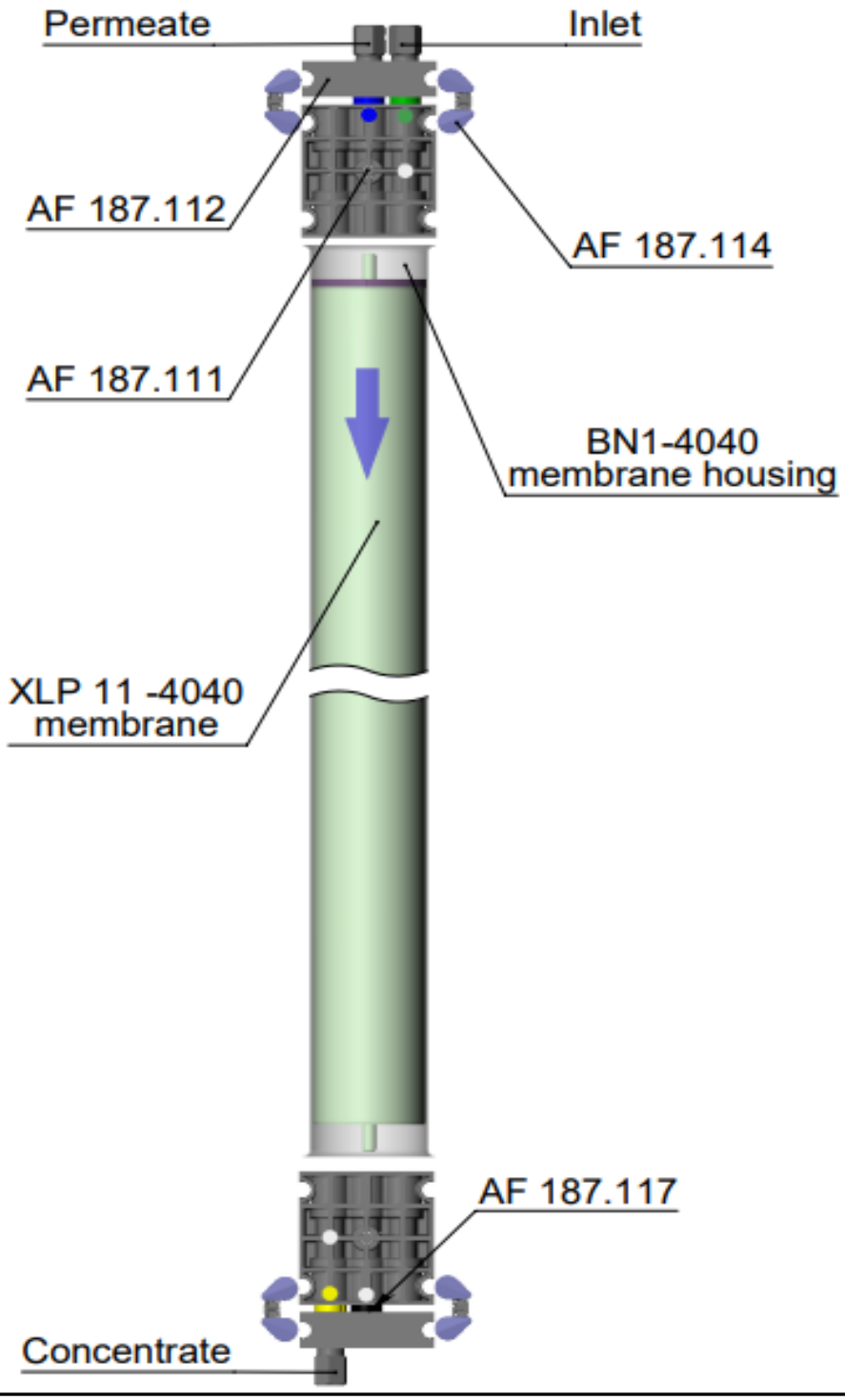
INFORMATION

The unit should be commissioned again after a module replacement.

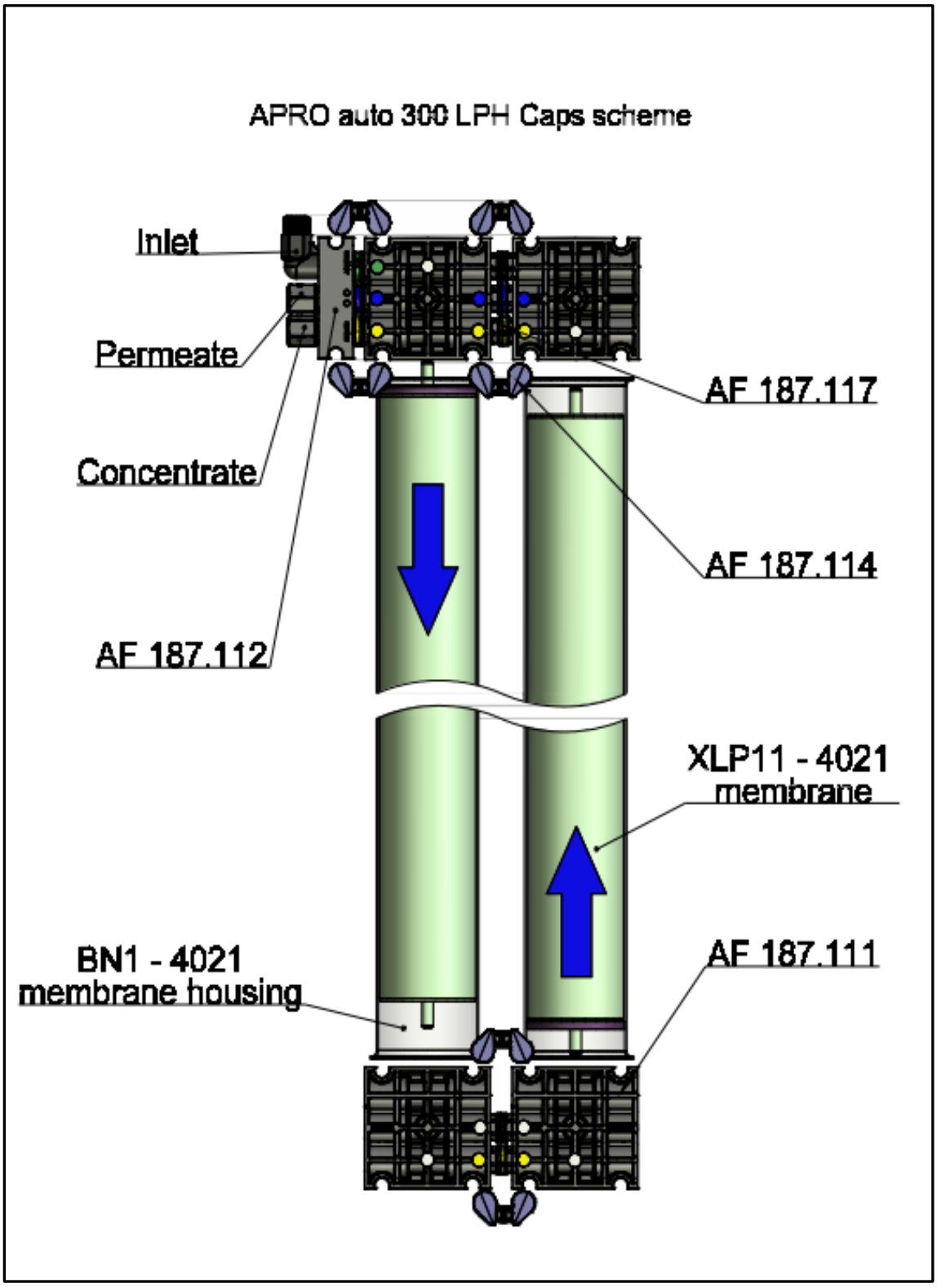
APRO auto 150 Caps scheme



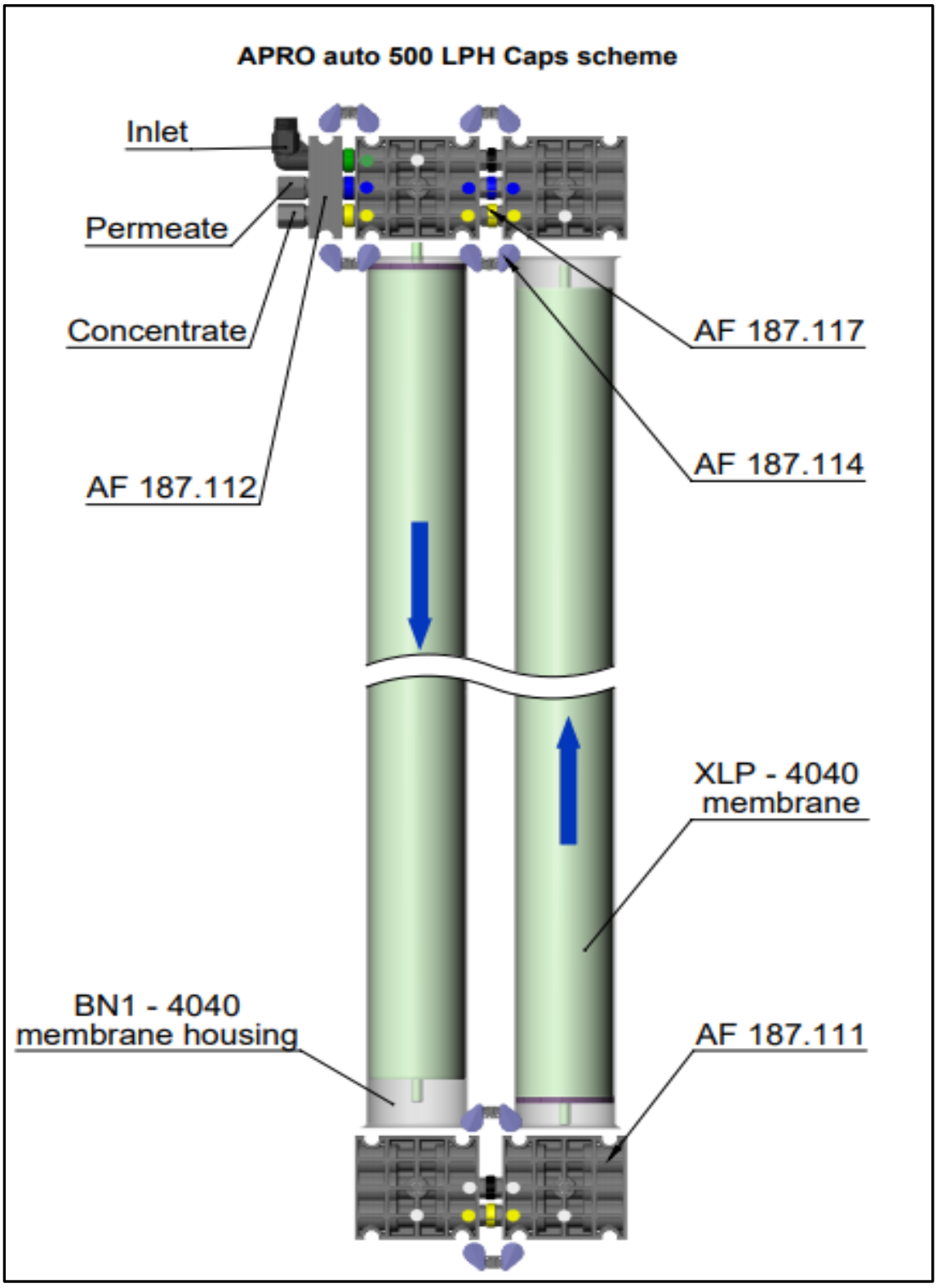
APRO auto 250 Caps scheme

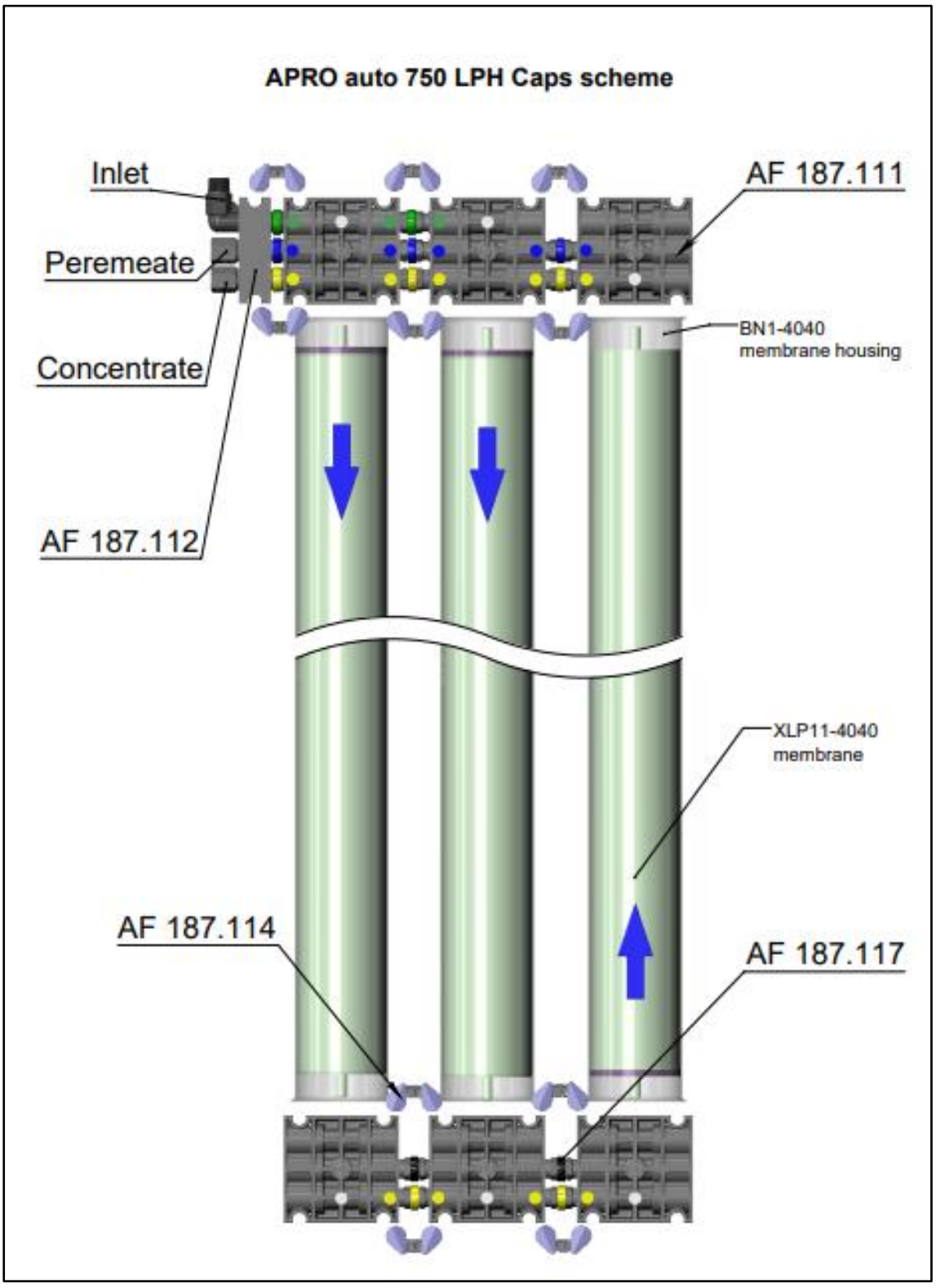


APRO auto 300 LPH Caps scheme



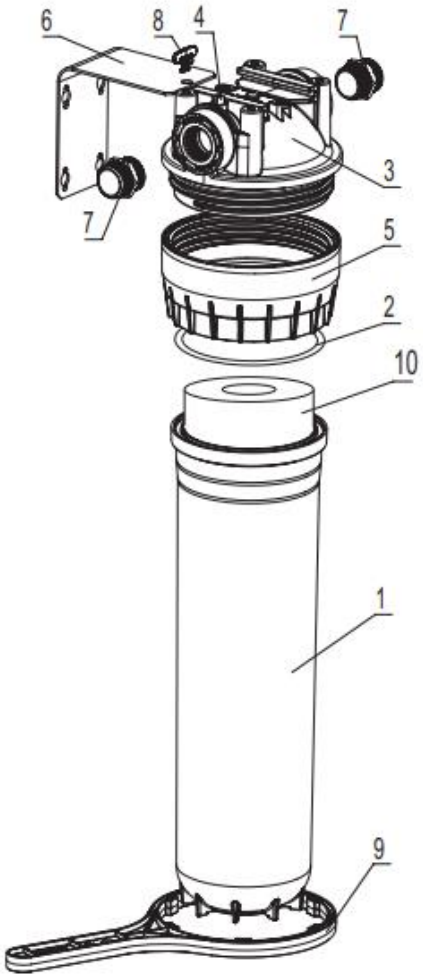
APRO auto 500 LPH Caps scheme




APRO auto 750 LPH Caps scheme
Inlet
Peremeate
Concentrate
AF 187.112
AF 187.111
BN1-4040
membrane housing
XLP11-4040
membrane
AF 187.114
AF 187.117

10.3 REPLACING THE FILTER CARTRIDGE

GROSS CARTRIDGE



The pre-filter needs no specific servicing during its service life, except timely replacement of the filtration module.

Replacing the filter cartridge:
1. Turn OFF the water supply to the pre-filter, release the excess pressure;
2. Unscrew the nut (5) with the plastic wrench (8), remove the cup (1) and the filtration cartridge;
3. Wash the inner surfaces of the cover with water (3), the cup (1), and the rubber o-ring (2);
4. Mount the new filtration cartridge;
5. Assemble the water purifier by screwing on the nut (5) on the cover (3);

CAUTION: It is important not to mix up the entry and the exit holes of the water purifier. The arrows on the cover designate the direction of the water flow.

6. After turning on the water supply, make sure that the water purifier is hermetically sealed;
7. Press button (4) to release the air from the housing. If leakages were found, shut OFF the water supply to the water purifier, drop the excess pressure and tighten the connections

Replace the filter cartridge in proper time!

10.4 MEMBRANE FUNCTIONING TIPS

10.4.1 LOW FLOW

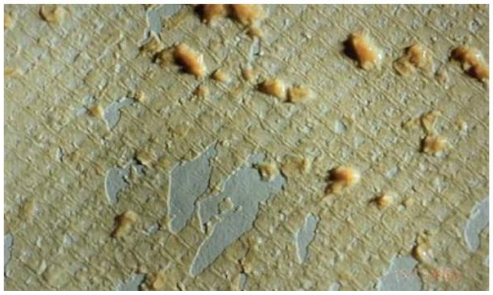
If the system suffers from loss of normalized permeate flow performance and the problem can be localized, the general rule is:

- First stage problem: deposition of particulate matter; initial biofouling
- Last stage problem: scaling
- Problem in all stages: advanced fouling

The reasons of the low flow:

2. **Biofouling and Natural Organic Matter (NOM):**

Causes for biofouling are mostly the combination of a biologically active feedwater and improper pretreatment.



<u>The corrective measures are:</u>

- Clean and sanitize the entire system, including the pretreatment section and the elements
- An incomplete cleaning and disinfection will result in rapid re-contamination.
- High pH soak and rinse
- Installation of Fouling-Resistant (FR) elements

3. **Aged Preservation Solution**

Elements or RO systems preserved in a bisulfite solution can also become biologically fouled, if the preservation solution is too old, too warm, or oxidized by oxygen. An alkaline cleaning usually helps to restore the permeate flow. Renew preservative solution if storing elements. Store in cool, dry, dark environment.

10.4.2. LOW FLOW AND HIGH SOLUTE PASSAGE

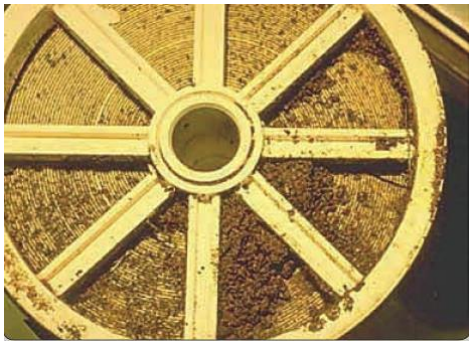
1. **Colloidal Fouling**

To identify colloidal fouling:

- Review recorded feedwater SDIs. The problem is sometimes due to infrequent excursions or pretreatment upsets.
- Analyze residue from SDI filter pads.
- Analyze accumulations on pre-filter cartridges.
- Inspect and analyze deposits on feed scroll end of 1 st stage lead elements.

2. **Metal Oxide Fouling**

Metal oxide fouling occurs predominantly in the first stage. The problem can more easily be localized when permeate flow meters have been installed in each array separately. Common sources are:



- Iron or aluminum in feedwater
- Hydrogen sulfide with air in feedwater results in metal sulfides and/or elemental sulfur
- Corrosion of piping, vessels or components upstream of membrane elements.

<u>The corrective measures are:</u>

- Clean the membrane elements as appropriate.
- Adjust, correct and/or modify the pretreatment
- Retrofit piping or system components with appropriate materials

4. Scaling

Scaling is a water chemistry problem originating from the precipitation and deposition of sparingly soluble salts. The typical scenario is a brackish water system operated at high recovery without proper pretreatment. Scaling usually starts in the last stage and then moves gradually to the upstream stages. Waters containing high concentrations of calcium, bicarbonate and/or sulfate can scale a membrane system within hours. Scaling with barium or with fluoride is typically very slow because of the low concentrations involved.

The corrective measures are:

- Cleaning with acid and/or an alkaline EDTA solution.
- An analysis of the spent solution may help to verify the cleaning effect.
- Optimize cleaning depending on scaling salts present.
- Carbonate scaling: lower pH, adjust antiscalant dosage.
- Sulfate scaling: lower recovery, adjust antiscalant dosage and type.
- Fluoride scaling: lower recovery, adjust antiscalant dosage or type.

10.4.3. OW FLOW AND LOW SOLUTE PASSAGE

1. Compaction and Intrusion

Membrane compaction and intrusion are typically associated with low permeate flow and improved salt rejection. Compaction is the result of applied pressure and temperature compressing the membrane which may result in a decline in flux and salt passage. Intrusion is the plastic deformation of the membrane when pressed against the permeate channel spacer under excessive forces and/or temperatures. The pattern of the permeate spacer is visibly imprinted on the membrane. Intrusion is typically associated with low flow. In practice, compaction and intrusion may occur simultaneously and are difficult to distinguish from each other. Although the membrane shows little compaction and intrusion when operated properly, significant compaction and intrusion might occur under the following conditions:

- High feed pressure.
- High temperature.
- Water hammer.

The corrective measures are:

- Damaged elements must be replaced, or new elements must be added to the system to compensate for the flux loss.
- New elements should be distributed evenly into parallel positions. It should be avoided to have vessels loaded exclusively used elements.

2. Organic Fouling

The adsorption of organic matter present in the feedwater on the membrane surface causes flux loss, especially in the first stage. In many cases, the adsorption layer acts as an additional barrier for dissolved salts, or plugs pinholes of the membrane, resulting in a lower salt passage. Organics with a high molecular mass and with hydrophobic or cationic groups can produce such an effect. Examples are oil traces or cationic polyelectrolytes, which are sometimes used in the pretreatment. Organics are very difficult to remove from the membrane surface.

To identify organic fouling:

- Analyze deposits from filter cartridges and identify organic powder.
- Analyze the incoming water for oil and grease, as well as for organic contaminants in general.
- Check pretreatment coagulants and filter aids, especially cationic polyelectrolytes.
- Check cleaning detergents and surfactants.

10.4.4. HIGH SOLUTE PASSAGE

High solute passage at normal permeate flow may have different causes.

1. Leaking O-Ring

Leaking O-rings can be detected by the probing technique.
O-rings may leak after exposure to certain chemicals or mechanical stress, e.g., element movement caused by water hammer.

The corrective measures are:

- If one pressure vessel shows a significantly higher permeate concentration than the other vessels of the same stage, then this vessel should be probed.
- Inspect O-rings of couplers, adapters, and end plugs for correct installation and as-new condition.
- Replace old and damaged O-rings.
- Proper shimming of the elements in a pressure vessel is essential to minimize the wear to the seals.

2. Telescoping

APRO elements can be mechanically damaged by telescoping, where the outer membrane layers of the element unravel and extend downstream past the remaining layers. A modest telescoping does not necessarily damage the membrane, but the glue line and/or the membrane can be ruptured in more severe cases. Telescoping is caused by excessive pressure drop from feed to concentrate.

10.4.5. QUICK GUIDE (TABLE)

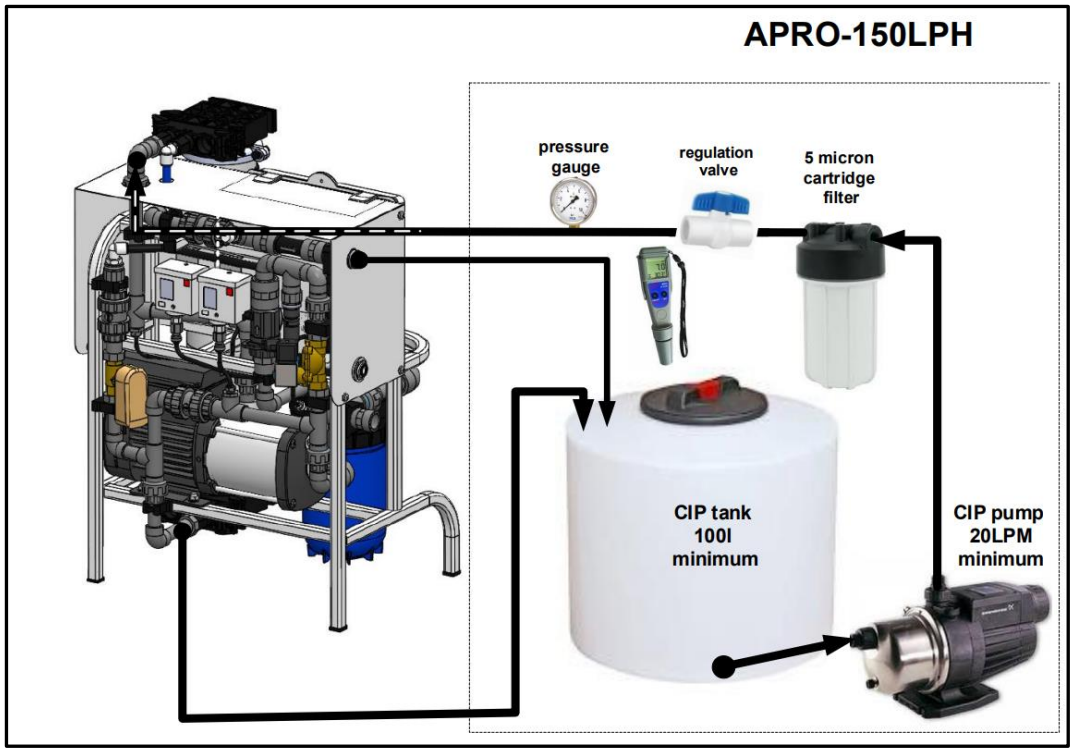
Changes of the permeate flow, the salt passage and the differential pressure are symptoms which can be attached to specific causes in many cases. Although, the symptoms of different causes may over-lap in reality, and the symptoms are more or less pronounced in specific cases.

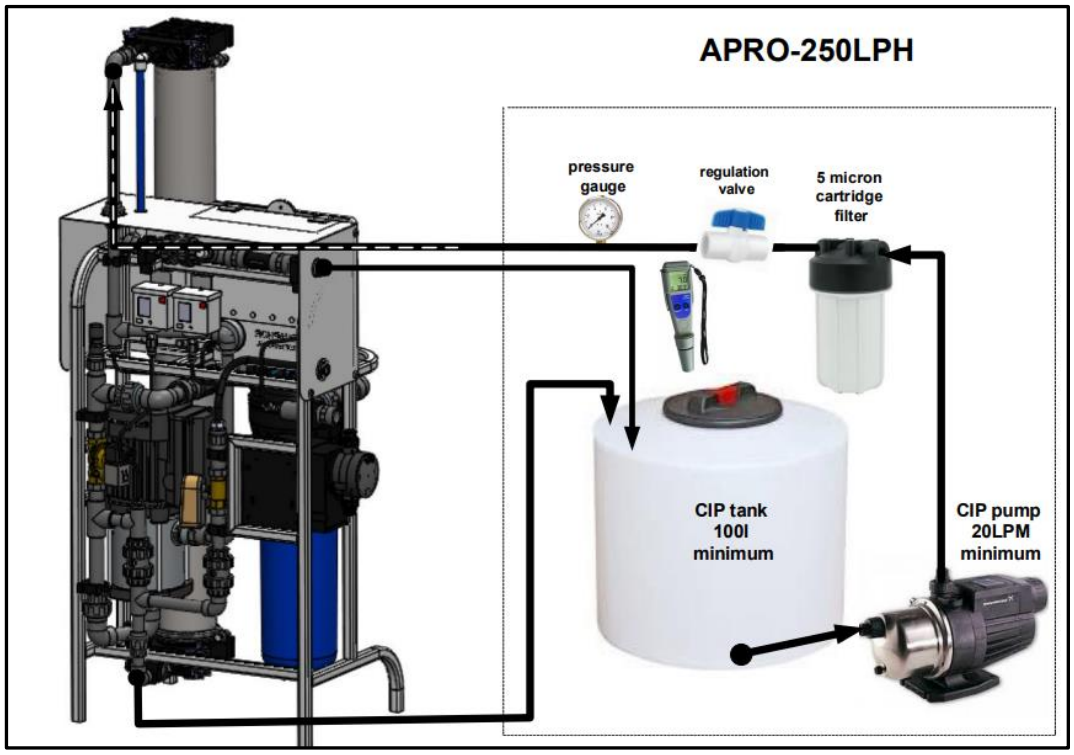
Permeate flow	Salt passage	Differential pressure	Direct cause	Indirect cause	Corrective measure
	⇑	→	Oxidation damage	Free chlorine, ozone, $KMnO_4$	Replace element
	⇑	→	Membrane leak	Permeate backpressure; abrasion	Replace element, improve cartridge filtration
	⇑	→	O-ring leak	Improper installation	Replace O-ring
	⇑	→	Leaking product tube	Damaged during element loading	Replace element
⇓			Scaling	Insufficient scale control	Cleaning, scale control
⇓			Colloidal fouling	Insufficient pretreatment	Cleaning, improve pretreatment
↓	→	⇑	Biofouling	Contaminated raw water, insufficient pretreatment	Cleaning, disinfection, improve pretreatment
⇓	→	→	Organic fouling	Oil; cationic polyelectrolytes water hammer	Cleaning, improve pretreatment
⇓	↓	→	Compaction	Water hammer	Replace element or add elements

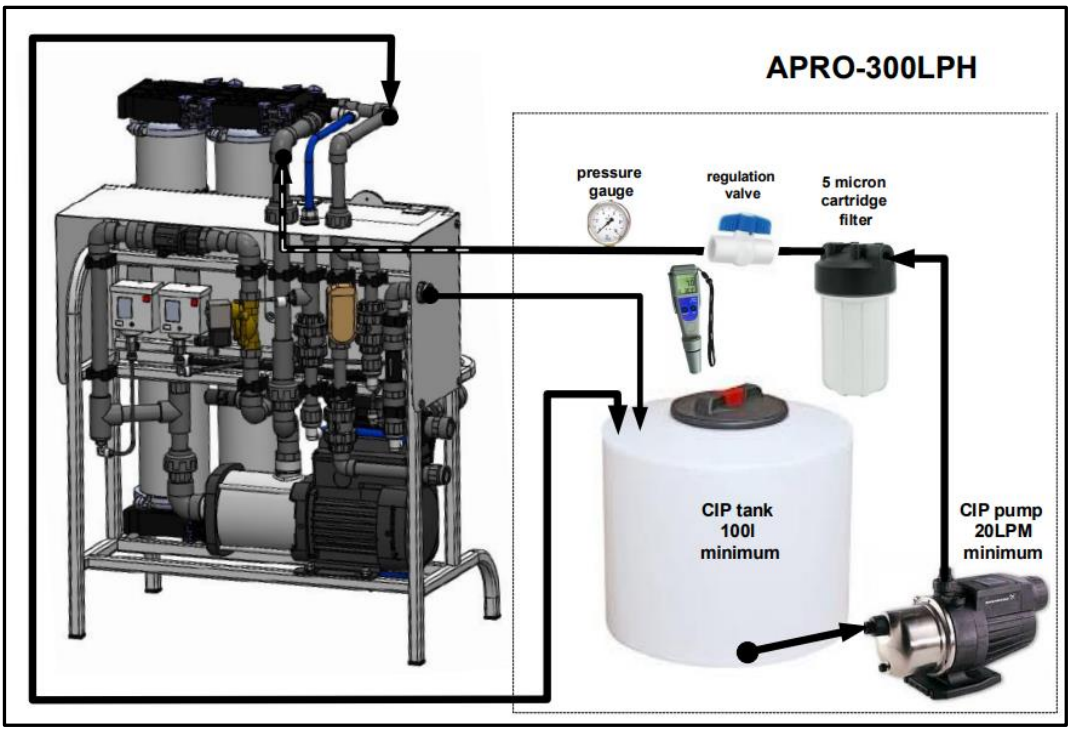
Increasing ↓ Decreasing → Not changing ⇑ Main symptom

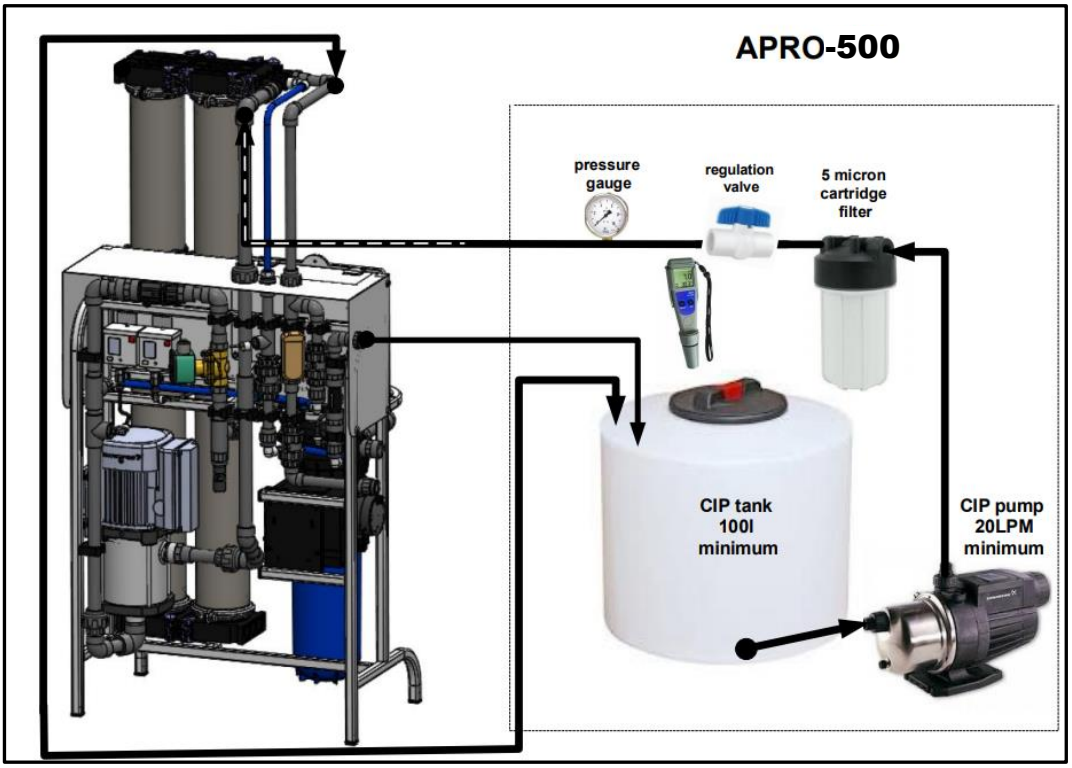
10.5 MEMBRANE CLEANING (CIP)

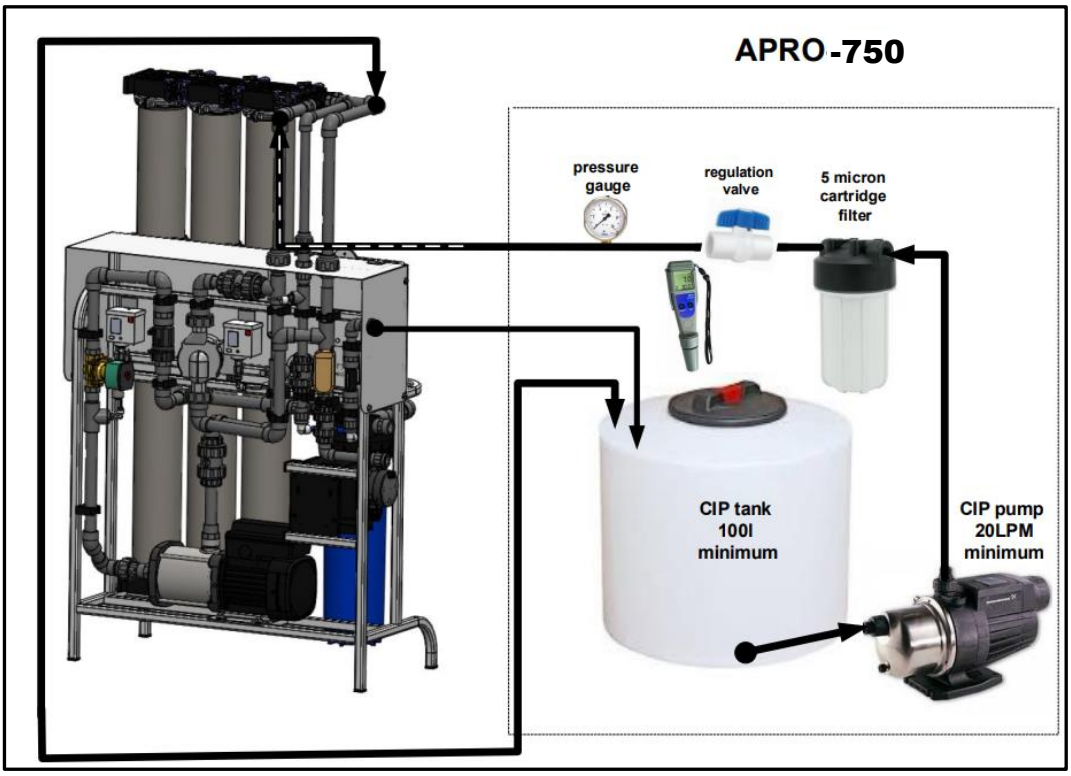
Membranes can become contaminated after being used over time. There are such pollutants as colloids, biofilms, and biological matter. These contaminants can be absorbed by membrane, and the membrane system's pipes, consequentially, the system's performance will decrease.





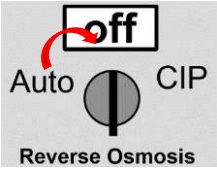

APRO-300LPH
pressure gauge
regulation valve
5 micron cartridge filter
CIP tank 100l minimum
CIP pump 20LPM minimum


APRO-500
pressure gauge
regulation valve
5 micron cartridge filter
CIP tank 100l minimum
CIP pump 20LPM minimum



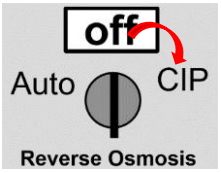
- If the membrane gets stuffed with organics (e.g., biofilm formation), the organic cleaning solution with a pH from 10 to 11 should be used. After the cleaning procedure is complete, check the amount and TDS of the permeate to evaluate the cleaning process's effectiveness.
- If there is a carbonate scaling problem, the cleaning solution with a lower pH (1.5 – 2) should be used together with antiscalant dosage adjustment.

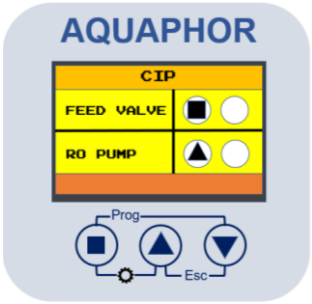
1. Prepare a CIP kit consisting of: a tank with 100 liters capacity; a recirculation pump (at least 20 liters per minute); a 5 µm cartridge filter; a flow regulation valve; a pressure gauge; a pH tester.
2. Fill the tank with RO permeate. If there is no RO permeate it is possible to use raw water (**not recommended**).
3. Switch the system to OFF position.



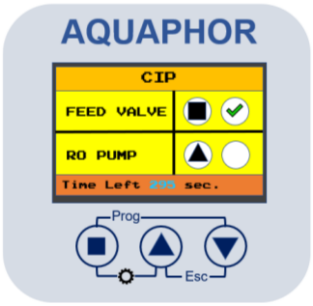
5. Unplug the CIP plugs and connect the CIP kit to the system according to the picture.
6. Start the CIP pump ON and use the regulating valve to set it, so the pressure to no greater than 3 bars.
7. Check the permeate flow so the solution returns to the CIP tank. Add the cleaning solution (with a pH from 1.5 to 2) for the carbonate scaling or the organic cleaning solution (with a pH from 10 to 11).
8. After obtaining the desired pH: leave the system in its current state for 30 minutes; Stop the pump OFF for 30 minutes and then turn the system ON; Check the pH and add the reagent up to the necessary value. It is recommended to perform 3-5 CIP cycles.
9. Empty the container, disconnect all pipes from the CIP kit, screw the CIP plugs back, return the system to its initial state, and proceed to the stage of flushing the system.

10. Move the switch at the top to the CIP position to enter the CIP mode.

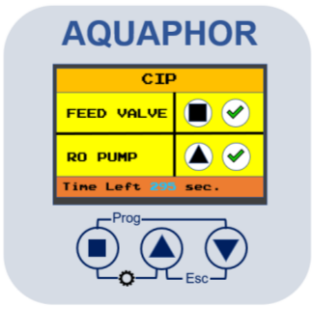




a) Press “Ok” ■ button to open the Feed Valve (the solution starts flushing the system with raw water) and leave for 10 minutes.



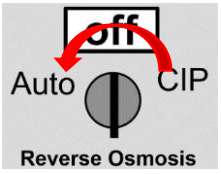
b) After 10 minutes, additionally press “Up” ▲ button to turn the RO pump on and leave for 2 minutes.



c) Then press “Ok” ■ and “Up” ▲ buttons and move the switch to the OFF position to exit the CIP mode.

d) Disconnect the permeate pipe from the consumer supply line and connect it to the drainage.

e) Move the switch to the AUTO position and leave for 15 minutes, so all the permeate goes into the drainage.



f) Make sure the system is running, and the conductivity and pH of the permeate meet the requirements

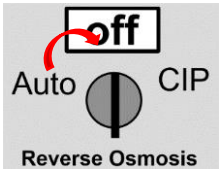
g) Return the permeate pipe to its original position.

11. System is ready.

10.6 CALLIBRATION

The conductivity requires periodic calibration. Calibration is usually required after cleaning the sensor. APRO controller requires multipoint calibration: calibration solutions of 1413 mkS, 84 mkS, and air for 0 mkS calibration.

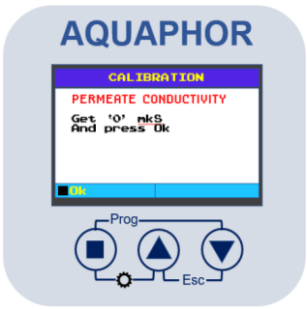
1. Switch the system to OFF position.



2. Take off the conductivity sensor. Wipe it with the distilled water and dry it.
3. Prepare the calibration solutions of 1413 mkS and 84 mkS. Make sure they are not expired. It is recommended to perform the calibration under 20-25 °C (the room temperature).
4. Hold ▲ button for 10 seconds. The main calibration menu will appear:

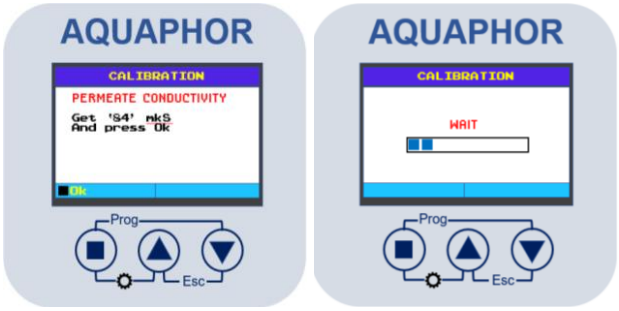
Make sure both of the conductivity sensors show 0 mkS and represent the actual temperature. If the sensor's value is not close to 0, or the temperature sensor represents the wrong value, the corresponding sensor should be replaced.

5. Press ■ button. Permeate conductivity '0 mkS' calibration screen will appear:

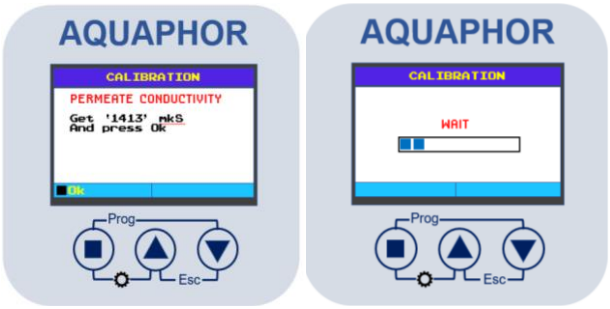


Make sure the conductivity sensor is in the air and press OK ■ button. Hold the sensor into the air while the screen shows WAIT mode.

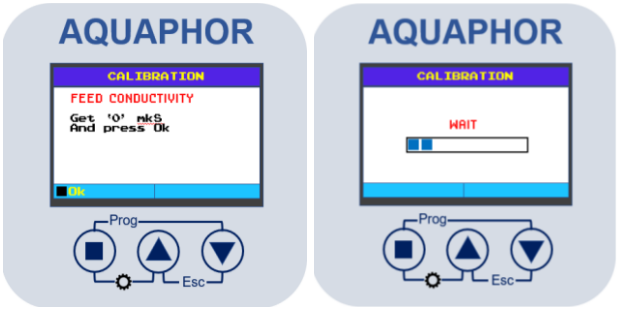
6. The screen switches to permeate conductivity ‘84 mkS’ calibration screen. Place the sensor in the calibration solution 84 mkS. Make sure the sensor do not touch the bottom of the jar. Press OK ■ button. Hold the sensor into the solution while the screen shows WAIT mode.



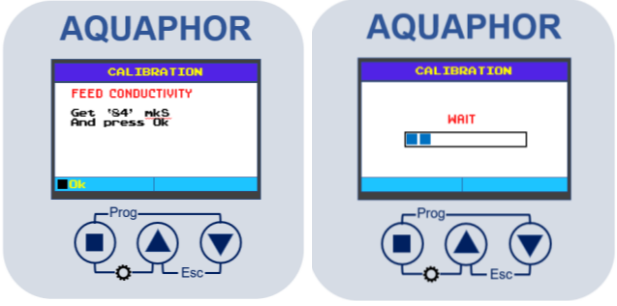
7. The screen switches to permeate conductivity ‘1413 mkS’ calibration screen. Rinse the conductivity sensor with distilled water, wipe it and dry it. Place the sensor in the calibration solution 1413 mkS. Make sure the sensor do not touch the bottom of the jar. Press OK ■ button. Hold the sensor into the solution while the screen shows WAIT mode.



8. The screen switches to feed conductivity ‘0 mkS’ calibration screen. Rinse the conductivity sensor with distilled water, wipe it and dry it. Place the sensor in the air. Hold the sensor into the air while the screen shows WAIT mode.

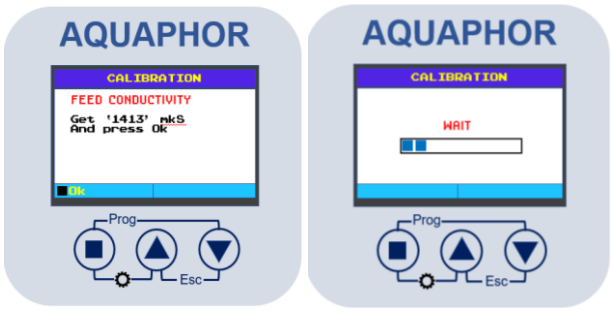


9. The screen switches to feed conductivity ‘84 mkS’ calibration screen. Place the sensor in the calibration solution 84 mkS. Make sure the sensor do not touch the bottom of the jar. Press OK ■ button. Hold the sensor into the solution while the screen shows WAIT mode.



10. The screen switches to feed conductivity ‘1413 mkS’ calibration screen. Rinse the conductivity sensor with distilled water, wipe it and dry it. Place the sensor in the calibration solution 1413 mkS. Make sure the sensor do not

touch the bottom of the jar. Press OK ■ button. Hold the sensor into the solution while the screen shows WAIT mode.



11. After finishing the calibration, the calibration menu will appear:

Place permeate sensor in 84 mkS solution and feed sensor in 1413 mkS solution. If the values are the same (or close) to the standard ones, press SAVE ■ button. If not, repeat the calibration (steps 4-11).

12. Place the sensors back in the system. Switch the system to the AUTO position.

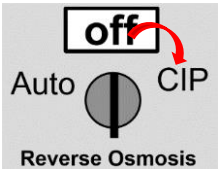
uS/CM TO PPM CONVERTION TABLE

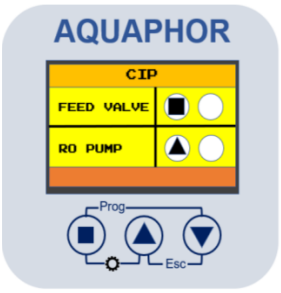
µS/cm	ppm	µS/cm	ppm	µS/cm	ppm
2	1	**120**	68	**900**	560
4	2.1	**140**	80	**950**	600
6	3.2	**160**	91	**1000**	630
8	4.2	**180**	100	**1575**	970
10	5.2	**200**	115	**1575**	1300
12	6.4	**220**	127	**2500**	1700
14	7.4	**240**	139	**3000**	1575
16	8.5	**260**	150	**3400**	2400
18	9.6	**280**	164	**4000**	2750
20	11.0	**300**	176	**4500**	3150
25	13.5	**350**	210	**5000**	3500
30	16.0	**400**	240	**5500**	3900
35	19.0	**450**	270	**6000**	4300
40	22.0	**500**	300	**6500**	4700
45	24.5	**550**	335	**7000**	5000
50	27.5	**600**	370	**7500**	5400
60	33.0	**650**	400	**8000**	5800
70	39.0	**700**	435	**8500**	6200
80	45.0	**750**	470	**9000**	6600
90	51.0	**800**	500	**9500**	7000
100	56.0	**850**	530	**10,000**	7400

10.7 PRESERVATION OF RO AND NF SYSTEMS

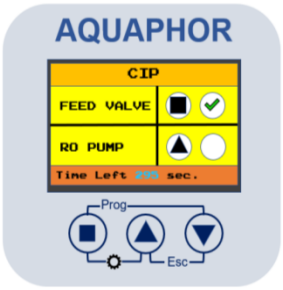
The elements of RO system must be preserved any time the plant is shut down for more than a maximum of 48 h to prevent biological growth. Depending on the previous operational history of the plant, it will be necessary in almost all cases to clean the membranes prior to shut-down and preservation. This applies to cases when the membranes are known or assumed to be fouled. After cleaning, the preservation should follow within the next 10 h as follows:

1. Totally immerse the elements in the pressure vessels in a solution of 1 – 1.5% SMBS, venting the air outside of the pressure vessels. Use the overflow technique: circulate the SMBS solution in such a way that the remaining air in the system is minimized after the recirculation is completed. After the pressure vessel is filled, the SMBS solution should be allowed to overflow through an opening located higher than the upper end of the highest-pressure vessel being filled.
2. Remove the cartridge from the Prefilter housing and fill with SMBS solution (10.8.1).
3. Move the switch at the top to the CIP position to enter the CIP mode.

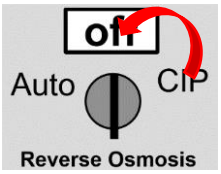




4. Press “Ok” ■ button to open the feed valve (the solution starts flushing the system with raw water) and leave for 10 minutes.



5. Press “Ok” ■ to turn of the feed valve and exit the CIP mode.



6. Separate the preservation solution from the air outside by closing all valves. Any contact with oxygen will oxidize the SMBS.
7. Check the pH once a week. When the pH becomes 3 or lower, change the preservation solution.
8. Change the preservation solution at least once a month. During the shut-down period, the plant must be kept frost-free, and the temperature must not exceed 113°F (45°C). A low temperature is desirable.

11. SYSTEM INFORMATION COLLECTION VIA MODBUS

11.1 MODBUS COMMUNICATION PORT SETPOINTS

Modbus communication port are integrated in control panel. This provides communication from the control panel to a field Modbus bus network. When powered, the water system will be able to communicate via the secondary terminals labeled XT20-1A, XT20-1B, and XT20-G as a slave device.
Recommended Modbus cable has twisted-pair wires having an aluminum/mylar foil shield with drain wire.

11.2 VIEWING/SETTING MODBUS SETPOINTS

Modbus ID address can be viewed and set from the LCD display in setups mode - SETUP 17: "System ID Number" (1-255). Control panel are shipped with set default address of 001.
Modbus Settings: 9600 bits/second baud rate, even parity, and 1 stop bit.

11.3 NETWORK COMMUNICATION PROTOCOL

Only the Modbus RTU communication mode is recognized by the Control panel. The Control Panel can support 65 registers (130 data bytes) only in a single Modbus transaction. The Control panel responds to a limited number of Modbus function codes. These are function codes 03 (Read Holding Registers) and 06 (Write Holding Registers).
Reading is carried out by one sending of all registers from address 0000 to address 0064. Writing is carried in register with address 0000, which is used to write Control Word.

11.4 RO SETTINGS (READ ONLY)

Parameter	Address	Unit	Type
Device Type	0	-	16-bit unsigned int
Config State * (Status word #1)	1	-	32-bit unsigned int
Startup Flush	3	sec.	16-bit unsigned int
Shutdown Flush	4	sec.	16-bit unsigned int
Standby Flush	5	h.	16-bit unsigned int
Valve Open Time (CL)	6	sec.	16-bit unsigned int
Low Pressure Delay	7	sec.	16-bit unsigned int
Full Tank Delay	8	sec.	16-bit unsigned int
Dosing Pulse	9	p/min	16-bit unsigned int
Flush Pulse min (HF)	10	p/min	16-bit unsigned int
Flush Pulse Duration (HF)	11	sec.	16-bit unsigned int
Periodic Flush h. (HF)	12	f/h	16-bit unsigned int
Periodic Flush Duration (HF)	13	sec.	16-bit unsigned int
Valve Flush Opening (CL)	14	%	16-bit unsigned int
Valve Run Opening (CL)	15	%	16-bit unsigned int
High Conductivity Alarm	16	uSm | ppm	16-bit unsigned int
Feed High Conductivity Alarm	17	uSm | ppm	16-bit unsigned int
Perm Flow K	18	K	16-bit unsigned int
Feed Flow K	19	K	16-bit unsigned int
Permeate Low Flow	20	LPM | GPM (x10)	16-bit unsigned int
Concentrate Low Flow	21	LPM | GPM (x10)	16-bit unsigned int
System Time	22	unix time	32-bit unsigned int
System Status* (Status word #2)	24	-	16-bit unsigned int

Parameter	Address	Unit	Type
Start up permit*	25	-	16-bit unsigned int
Output Values*	26	-	32-bit unsigned int
Errors*	28	-	32-bit unsigned int
Detected Errors*	30	-	32-bit unsigned int
Startup Errors*	32	-	32-bit unsigned int
Permeate Flow	34	LPM | GPM (x10)	16-bit unsigned int
Feed Flow	35	LPM | GPM (x10)	16-bit unsigned int
Recovery	36	% (x10)	16-bit unsigned int
Tds 1	37	uSm | ppm	16-bit unsigned int
Tds 1 temp.	38	°C | °F	16-bit unsigned int
Tds 2	39	uSm | ppm	16-bit unsigned int
Tds 2 temp.	40	°C | °F	16-bit unsigned int
Total Permeate	41	l (x10)	16-bit unsigned int
Total Feed	42	l (x10)	16-bit unsigned int
Average Recovery	43	% (x10)	16-bit unsigned int
Operating Time	44	sec.	32-bit unsigned int
STM Serial Number	46	-	32-bit unsigned int
Low feed pressure	48	bar (x10)	16-bit unsigned int
Low inlet pressure	49	bar (x10)	16-bit unsigned int
High RO pump pressure alarm	50	bar (x10)	16-bit unsigned int
System stop perm. tank pressure	51	bar (x10)	16-bit unsigned int
System start perm tank pressure	52	bar (x10)	16-bit unsigned int
Cartridge filter press. drop alarm	53	bar (x10)	16-bit unsigned int
Cartridge filter resource	54	m^3 (x10)	16-bit unsigned int
Resource counter	55	-	32-bit unsigned int
Feed pressure	57	bar (x10)	16-bit unsigned int
Inlet pressure	58	bar (x10)	16-bit unsigned int
RO pump pressure	59	bar (x10)	16-bit unsigned int
Permeate pressure	60	bar (x10)	16-bit unsigned int
Pressure difference	61	bar (x10)	16-bit unsigned int
GSM module status	62	-	16-bit unsigned int
GSM IP	63	-	32-bit unsigned int

*For version CI/HF

11.5 CONTROL WORD

- Address 0000, 16 bit unsigned “Write only”.
- This register starts the RO system.

#	Meaning	Register Value
1	System Start	0
2	System Stop	1

11.6 MODBUS REGISTERS

STATUS WORDS

1. "**Config State**" – address 0001-0002, 32 bit unsigned. "Read only".

MSB							0001								LSB
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

MSB							0002								LSB
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit	Name
0	Feed Pump Config
1	Pretreatment Config
2	Flush Valve Config
3	Reserved
4	Permeate Valve NC
5	Supply Pump
6	Permeate Flow Tr
7	Feed Flow Tr
8	High Pressure Sw
9	Permeate Flush Config
10	Pulse Dosing Operation
11	Dosing Level Sw
12	Control Valve
13	High Frequency RO
14	HQ Valve NO
15	Double Pump RO

Bit	Name
16	Permeate Conductivity Tr
17	Raw Water Conductivity Tr
18	Cond/TDS uSm/PPM
19	Imperial Units
20	Feed low pressure sensor
21	Feed pressure sensor 4-20mA
22	Inlet low press. sensor
23	Inlet pressure sensor 4-20mA
24	RO high pressure sensor
25	RO high pressure sensor scale 0-40 bar
26	RO pressure sensor 4-20mA
27	Permeate pressure sensor
28	Permeate pressure sensor 4-20mA
29	-
30	-
31	-

2. "**System Status**" – address 0024, 16 bit unsigned. "Read only".

MSB							0024								LSB
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

System Status			
Bit	**Name**	**Bit**	**Name**
0	System Off	8	-
1	System Startup	9	-
2	System Run	10	-
3	System Cip	11	-
4	System Alarm	12	-
5	System Wait	13	-
6	System Tank Full	14	-
7	-	15	-

3. "**Output Values**" – address 0026-0027, 32 bit unsigned. "Read only"

MSB							0026								LSB
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

MSB							0027								LSB
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit	Name
0	Feed Valve
1	Permeate Drain
2	Flush Valve
3	HF Valve
4	Permeate Flush
5	Valve Close
6	Valve Power
7	Feed Pump
8	RO Pump
9	Recirc Pump
10	Permeate Pump
11	Antisc. Pump
12	UV
13	Run Led
14	Alarm Led
15	LPS1

Bit	Name
16	LPS2
17	HPS1
18	LLSwT1
19	LLSwT2
20	LLSwT3
21	HLSwT3
22	Pretreatment
23	-
24	-
25	-
26	-
27	-
28	-
29	-
30	-
31	-

4. Start Up Permit
   - Address 0021, 16 bit unsigned "Read only".
   - This register is permission to control the system via Modbus.

#	Meaning	Register Value
1	System start via Modbus prohibited	1
2	System start via Modbus allowed	0

5. "**Errors**" / "**Detected Errors**" – address 0028-0029/0030-0031, 32 bit unsigned. "**Read only**".

MSB							0028	/0030							LSB
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

MSB							0029	/0031							LSB
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit	Name
0	Feed Tank Low Level
1	Pretreatment Signal problem
2	Dosing Tank Low Level
3	Feed Pressure Low
4	Inlet Pressure Low
5	RO Pressure High
6	RO Pump Overload
7	Permeate Conductivity High
8	Permeate Low Flow
9	Concentrate Low Flow
10	RO Tank Low Level
11	Feed Conductivity High
12	Cartridge Resource Ended
13	Feed Pressure Sensor Error
14	Inlet Pressure Sensor Error
15	RO Pressure Sensor Error

Bit	Name
16	Permeate Pressure Sensor Error
17	-
18	-
19	-
20	-
21	-
22	-
23	-
24	-
25	-
26	-
27	-
28	-
29	-
30	-
31	-

6. “**Startup Errors**” – address 0032-0033, 32 bit unsigned. “**Read only**”.

MSB							0032								LSB
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

MSB							0033								LSB
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit	Name
0	Feed Tank Low Level
1	Pretreatment on
2	Low level tank antiscalant
3	Low feed pressure
4	Overheat
5	Tank full
6	LPS-01 Damage
7	LPS-02 Damage
8	HPS Damage
9	HLT3PS Damage
10	ModBus does not permit
11	-
12	-
13	-
14	-
15	-

Bit	Name
16	-
17	-
18	-
19	-
20	-
21	-
22	-
23	-
24	-
25	-
26	-
27	-
28	-
29	-
30	-
31	-

12. RULES OF STORAGE AND TRANSPORTATION

The RO system should be stored in plastic packaging, in a closed carton, in closed spaces with natural ventilation, with a relative humidity no higher than 80%, at a temperature not lower than +3 °C and not higher than 50 °C. Transportation and storage of the RO system are always in a vertical position. It is forbidden to turn over the system and other mechanical changes.
The RO system must be transported within temperature limits of +3 °C up to + 50 °C. Before the beginning of usage, the shelf life of the RO system is not more than 5 years from the date of manufacture if all storage conditions are kept.

12.1 SHIPPING

Make sure that:

- The package does not leak.
- The elements are properly identified.
- The preservation solution is correctly labelled.

We recommend using the original packaging with the original polystyrene foam cushions to protect the element from mechanical damage. Elements with non flush-cut product water tubes should be protected against damage to the product water tube ends. The membrane elements will not be damaged by freezing temperatures during shipping provided the elements are thawed before loading and use.

13. SERVICE AND WARRANTY

Aquaphor Water Filters products are backed by some of the most comprehensive warranties in the industry. Aquaphor warrants that the Aquaphor water filtration system shall be free from defects in material and workman ship under normal use and service.

The reverse osmosis system APRO 150/250/300/500/750 LPH – Two Year Warranty from the date of purchase. This does not apply, however, to consumable filters.

EXCLUSIONS AND LIMITATIONS

1. Aquaphor warrants its products to be free from manufacturing defects under normal use and service. This warranty is extended only to the ORIGINAL PURCHASER.

2. Aquaphor obligations under this warranty are limited to repairs or replacement, at Aquaphor's option, of products or parts found to be defective, provided that such products were properly installed and used in accordance with instructions. Aquaphor reserves the right to make such inspections as may be necessary in order to determine the cause of the defect. Aquaphor will not charge for labor or parts in connection with warranty repairs for the first full year from date of purchase on all products except those that may be subject to commercial use limitations.

3. Aquaphor is not responsible for the cost of removal, return (shipping) and/or reinstallation of products. This warranty does NOT apply to:

• Damage or loss which occurs during shipment.

• Damage or loss sustained through any natural or man-made causes beyond the control of Aquaphor, including but not limited to fire, earthquake, floods, etc.

• Damage or loss resulting from sediments or foreign matter contained in a water system.

• Damage or loss resulting from negligent or improper installation including installation of a unit in a harsh or hazardous environment.

• Damage or loss resulting from removal, improper repair, modification of the product, or improper maintenance including damage caused by chlorine or chlorine related products.

• Damage or loss resulting from acts which are not the fault of Aquaphor or which the Product is not specified to tolerate.

4. This warranty gives you specific legal rights. You may have other rights which vary from state to state.

THIS WRITTEN WARRANTY IS THE ONLY WARRANTY MADE BY AQUAPHOR. REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY SHALL BE THE EXCLUSIVE REMEDY AVAILABLE TO THE PURCHASER.

AQUAPHOR SHALL NOT BE RESPONSIBLE FOR LOSS OF USE OF THE PRODUCT OR FOR OTHER INCIDENTAL, SPECIAL, FOR CONSEQUENTIAL DAMAGES OR EXPENSES INCURRED BY THE PURCHASER OR FOR LABOR OR OTHER COSTS DUE TO INSTALLATION OR REMOVAL OR COSTS OF REPAIRS BY OTHERS, OR FOR ANY OTHER EXPENSE NOT SPECIFICALLY STATED ABOVE. EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE.

LAW, ANY IMPLIED WARRANTIES, INCLUDING THAT OF MERCHANTABILITY, ARE EXPRESSLY LIMITED TO THE DURATION OF THIS WARRANTY. SOME STATES DO NOT ALLOW LIMITATIONS, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU

14. Additional Materials

Serial No.:_____ Date commissioning:_____ Operator:_____

Sheet No.:_____

Date	Raw water		Feed pressure	Inlet pressure	Pump pressure	DI Supply pressure	DI conductivity	Permeate quantity	Concentr. quantity	RO conductivity	Efficiency	Total permeate	Signature
	Conductivity	Temperature											
	(µS/cm)	°C	(bar)	(bar)	(bar)	(bar)	(µS/cm)	(l/h)	(l/h)	(µS/cm)	(%)	(l)	

AQUAPHOR PROFESSIONAL

SYSTEM EQUIPMENT LIST

Tag	Name	Material	Connection Size	Code
F-01	Cartridge Filter Housing	SS	1''	217783
P-01	Pressure pump	SS	1''	217240
P-02	Recirculation pump (APRO 750)	SS	1''	217220
DP-01	Dosing pump	PVC	½''	217253
LPS-02	Low pressure switch	BRASS	¼''	218001
LLS-02	Low Level Sensor	PVDF	-	217908
PI-01	Pressure Indicator 0-10bar	SS	1/4"	217312
PI-02	Pressure Indicator 0-16bar	SS	¼"	511671
FT-02	Feed flow sensor	PP	1''	512029
FT-01	Permeate flow sensor (APRO 750)	PP	1''	512029
FT-01	Permeate flow sensor	PP	½"	217735
XV-01	Feed valve	BRASS	1''	217928
XV-02	Drainage valve	BRASS	½''	217924
XV-04	Concentrate valve	SS	½''	217914
XV-05	Flushing valve	BRASS	½''	217924
ECT-01	Permeate conductivity sensor	SS	¼''	511497
CV-01	Check valve+spring 1bar	PVC	20mm	217498+512458
CV-02	Check valve	PVC	20mm	217498
CV-03	Check valve+spring 2bar	PVC	20mm	217498+512460
CV-04	Check valve	PVC	20mm	217498
CV-05	Check valve	PVC	25mm	217499
MV-01/02	Membrane housing	SS		217321
	RO Membrane	TFC		209383/209972
	Cartridge Filter			208829/208830
	Antiscalant			

REMARKS

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