

APRO-150

APRO-300

AQUAPHOR PROFESSIONAL

APRO 150/250/300/500/750 LPH

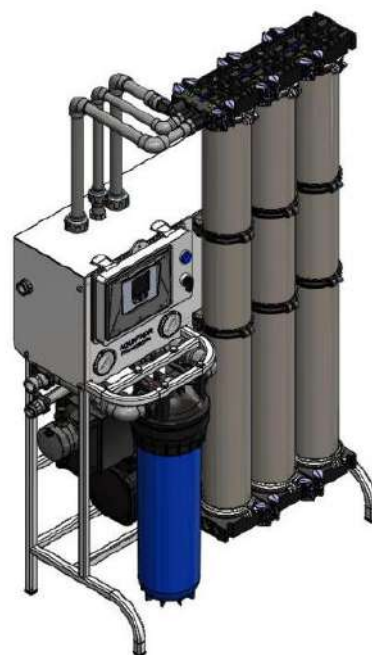
WATER PURIFICATION SYSTEM



APRO-250



APRO-500



APRO-750



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Technical modification	Revision No 2

TABLE OF CONTENTS

Table of contents	3
1. GENERAL INFORMATION.....	7
1.1 Safety	7
2. SYSTEM OVERVIEW	8
2.1 APRO-150 LPH	8
2.2 APRO-250 LPH	10
2.3 APRO-300 LPH	12
2.4 APRO-500 LPH	14
2.5 APRO-750 LPH	16
2.6 Table of system's equipment.....	18
2.7 Table of system's additional equipment.....	19
3. ELECTRIC CIRCUITS	20
3.1 General information	20
3.2 Electric circuit schemes	21
4. CONTROL PANEL	27
4.1 General information	27
4.2 Elements on the control panel	27
5. TECHNICAL DATA DESCRIPTION	28
5.1 Requirements on site	28
5.1.1 Water quality	28
5.1.2 Installation rooms	28
5.1.3 Reverse osmosis data	29
6. INSTALLATION.....	30
6.1 Safety Pointers	30
6.2 General pointers	31
6.3 Water connection	31
Installation	32
7. CONFIGURATION	33
7.1 Starting	33
7.1.1 Connection.....	33
7.2 Configuration via controller keyboard	34
Starting window.....	34
7.3 System Run	35
7.4 Equipment setup.....	36
7.4.1 Example of software setup.....	36
Program 01: FEED PUMP *OPTIONAL.....	37
Program 02: PRETREATMENT (PTS-01) *OPTIONAL	37
Program 03: PERMEATE VALVE NC (XV-02).....	37

Program 04: SUPPLY PUMP (P-04) *OPTIONAL	38
Program 05: PERMEATE FLOW TRANSMITTER (FT-01)	38
Program 06: FEED FLOW TRANSMITTER (FT-02)	38
Program 07: HIGH PRESSURE SWITCH (HPS-01) *OPTIONAL	38
Program 08: PERMEATE FLUSH *OPTIONAL	39
Program 09: PULSE DOSING *OPTIONAL	39
Program 10: DOSING LEVEL SW. (LLS-02) *OPTIONAL	39
Program 12: DOUBLE PUMP RO (P-05) *Not available for this system	39
Program 13: PERMEATE CONDUCTIVITY TRANSMITTER (ECT-01)	39
Program 14: FEED CONDUCTIVITY TRANSMITTER *OPTIONAL	40
Program 15: CONDUCT. uSM/PPM	40
Program 16: (L/GAL – C/F)	40
Program 17: GSM MODULE PORT	40
7.4 Setups	41
Setup 01: START-UP FLUSH	41
Setup 02: SHUT-DOWN FLUSH	41
Setup 03: STAND-BY FLUSH	41
Setup 04: HIGH CONDUCTIVITY PERMEATE ALARM	41
Setup 05: HIGH CONDUCTIVITY FEED WATER ALARM	42
Setup 06: LOW PRESS. DELAY	42
Setup 07: DOSING PULSE/MIN *	42
Setup 08: PERMEATE FLOW ‘k’	42
Setup 09: FEED FLOW ‘K’	42
Setup 10: AUTOMATIC CONCENTRATE VALVE OPEN TIME	43
Setup 11: AUTOMATIC CONCENTRATE VALVE FLUSH OPENING	43
Setup 12: AUTOMATIC CONCENTRATE VALVE RUN OPENING	43
Setup 13: FULL TANK DELAY	44
Setup 14: PERMEATE LOW FLOW	44
Setup 15: CONCENTRATE LOW FLOW ALARM	44
Setup 16: CARTRIDGE FILTER RESOURCE	44
Setup 17: SYSTEM ID NUMBER	45
Setup 18: YEAR	45
Setup 19: DATE/MONTH	45
Setup 20: TIME	45
8. ALARMS AND TROUBLESHOOTING	46
8.1 ALARM-01: Low level in the RAW water tank	46
8.2 ALARM-02: Pretreatment system error	46
8.3 ALARM-03: Antiscalant tank low level	47
8.4 ALARM-04: Raw water low pressure	47
8.5 ALARM-05: Low inlet pressure	47

8.6 ALARM-06: High inlet pressure to RO membrane unit	48
8.7 ALARM-07: RO pump overload	48
8.8 ALARM-08: High electrical conductivity of permeate.....	48
8.9 ALARM-09: Minimum permeate flow	49
8.10 ALARM-10: Minimum concentrate flow	49
8.11 ALARM-11: Low permeate level	49
8.12 ALARM-12: High FEED conductivity	50
8.13 WARNINGS	50
8.14 Equipment testing.....	52
9. RO ANDROID APP (APRO APP).....	53
9.1 Setting Up	53
9.2 System Configuration.....	54
9.3 Operating Mode Functionality	54
9.4 Additional Information.....	55
10. MAINTENANCE.....	56
10.1 Dosing Pump Degassing	56
10.2 Replacing The Membrane Module	57
10.3 Replacing The Filter Cartridge.....	63
GROSS cartridge	63
10.4 Yearly Check And Maintenance	64
10.4.1 Cables and Cable Connection	64
10.4.2 Automatic Concentrate Valve Flush Opening	65
10.5 Membrane Functioning Tips	66
10.5.1 Low Flow.....	66
10.5.2 Low Flow and High Solute Passage	66
10.5.3 Low Flow and low Solute Passage	67
10.5.4 High Solute Passage.....	68
10.5.5 Quick guide (table)	68
10.6 Membrane Cleaning (CIP)	69
10.7 Callibration.....	73
uS/cm to ppm conversion table	76
10.8 Preservation of RO and NF systems.....	77
11. SYSTEM INFORMATION COLLECTION VIA MODBUS.....	78
11.1 Modbus communication port setpoints	78
11.2 Viewing/Setting Modbus setpoints	78
11.3 Network Communication Protocol.....	78
11.4 RO Settings (Read Only).....	78
11.4 Control Word	79
11.5 Modbus Registers	80
Status words.....	80

12. RULES OF STORAGE AND TRANSPORTATION.....	83
12.1 Shipping	83
13. SERVICE AND WARRANTY	84
Exclusions and Limitations.....	84
14. Additional Materials.....	85
System Equipment list	87
Remarks	88

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.

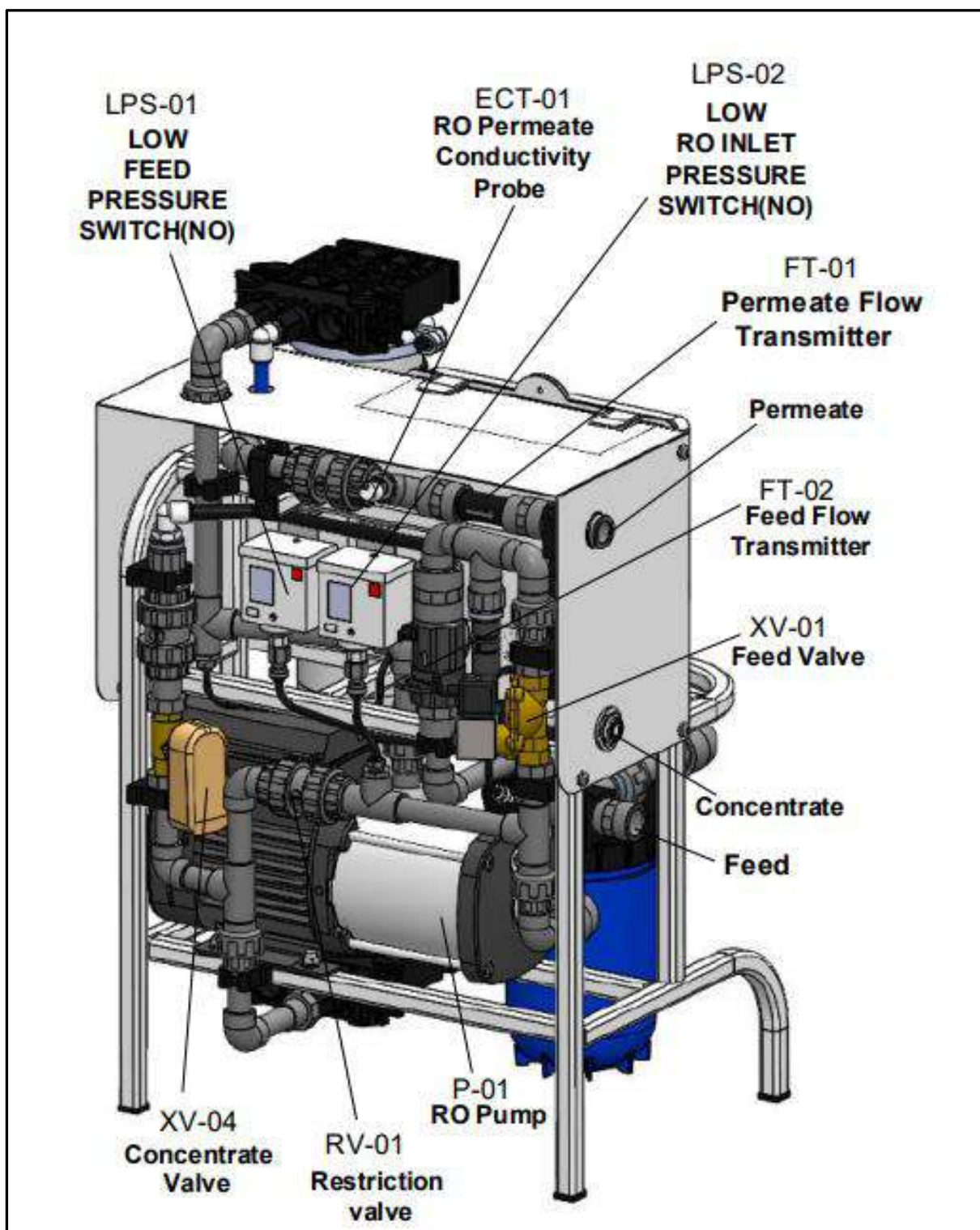


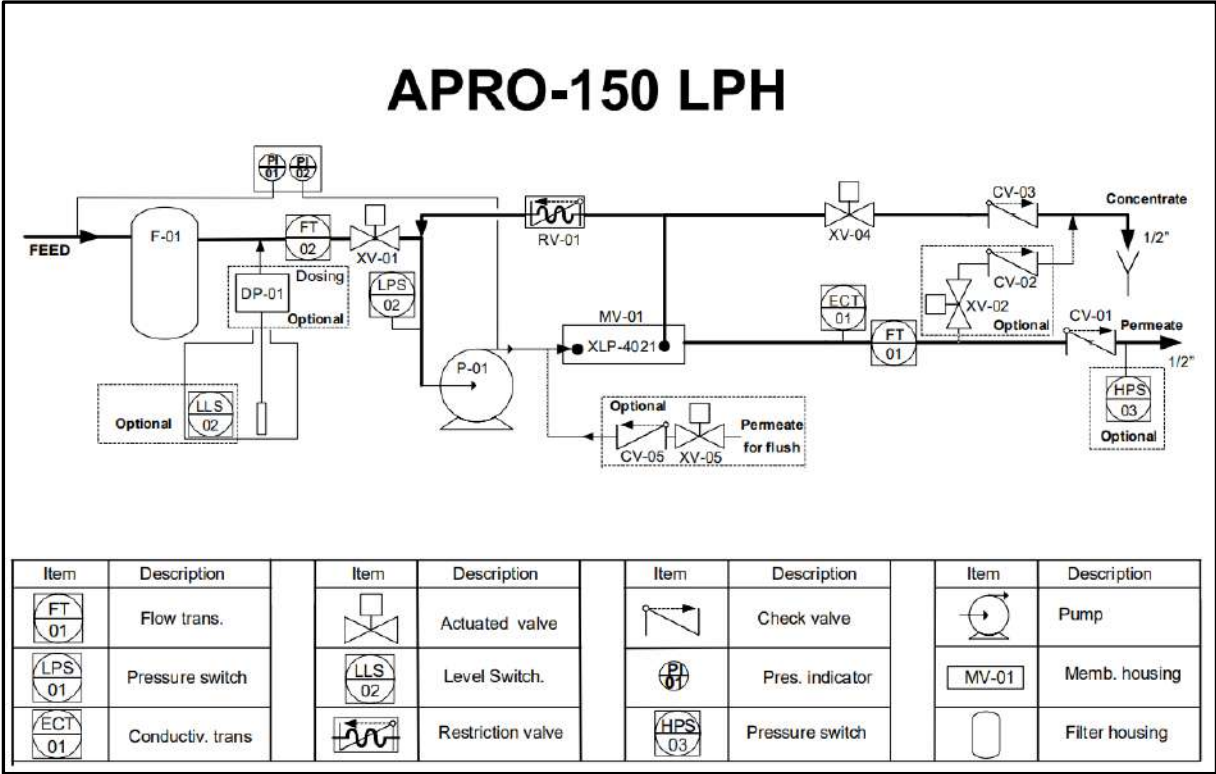
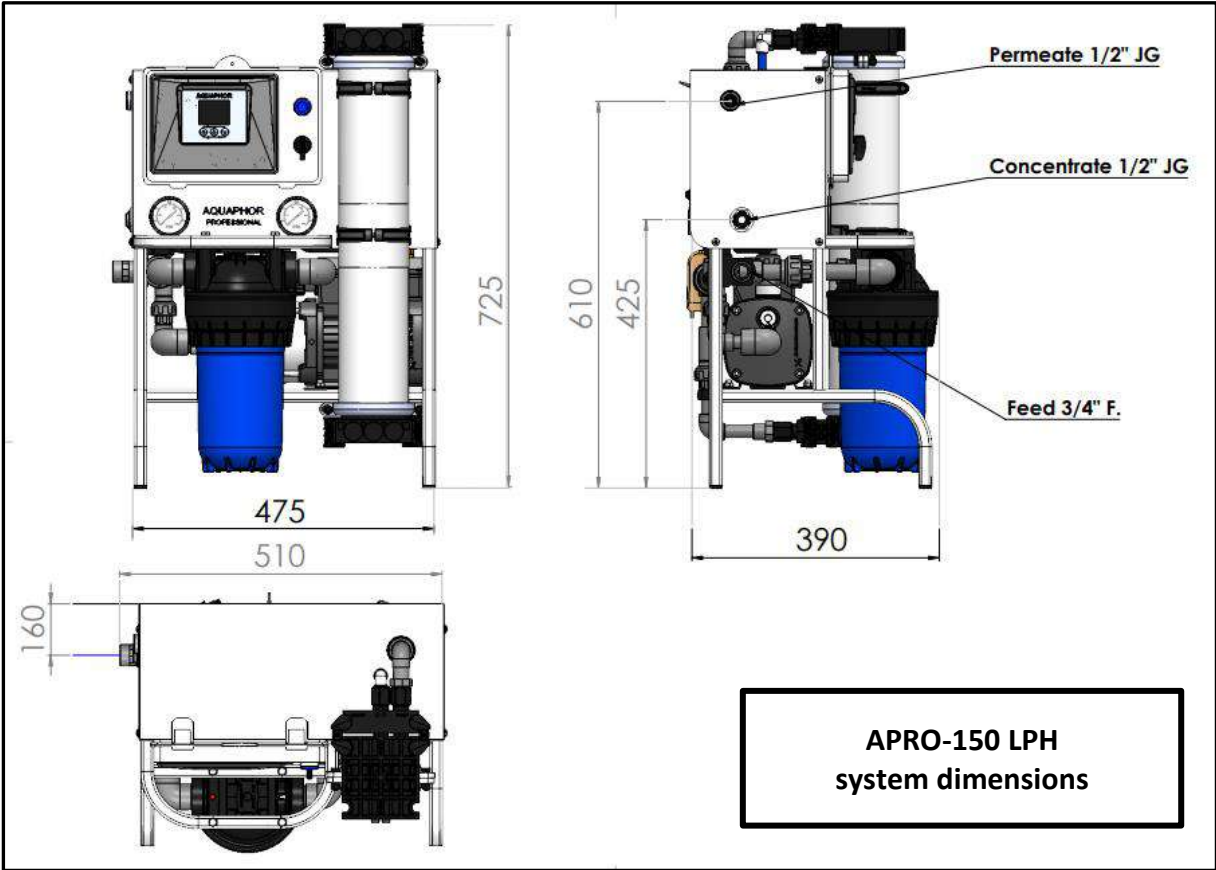
INFORMATION

Denotes application pointers and other useful information.

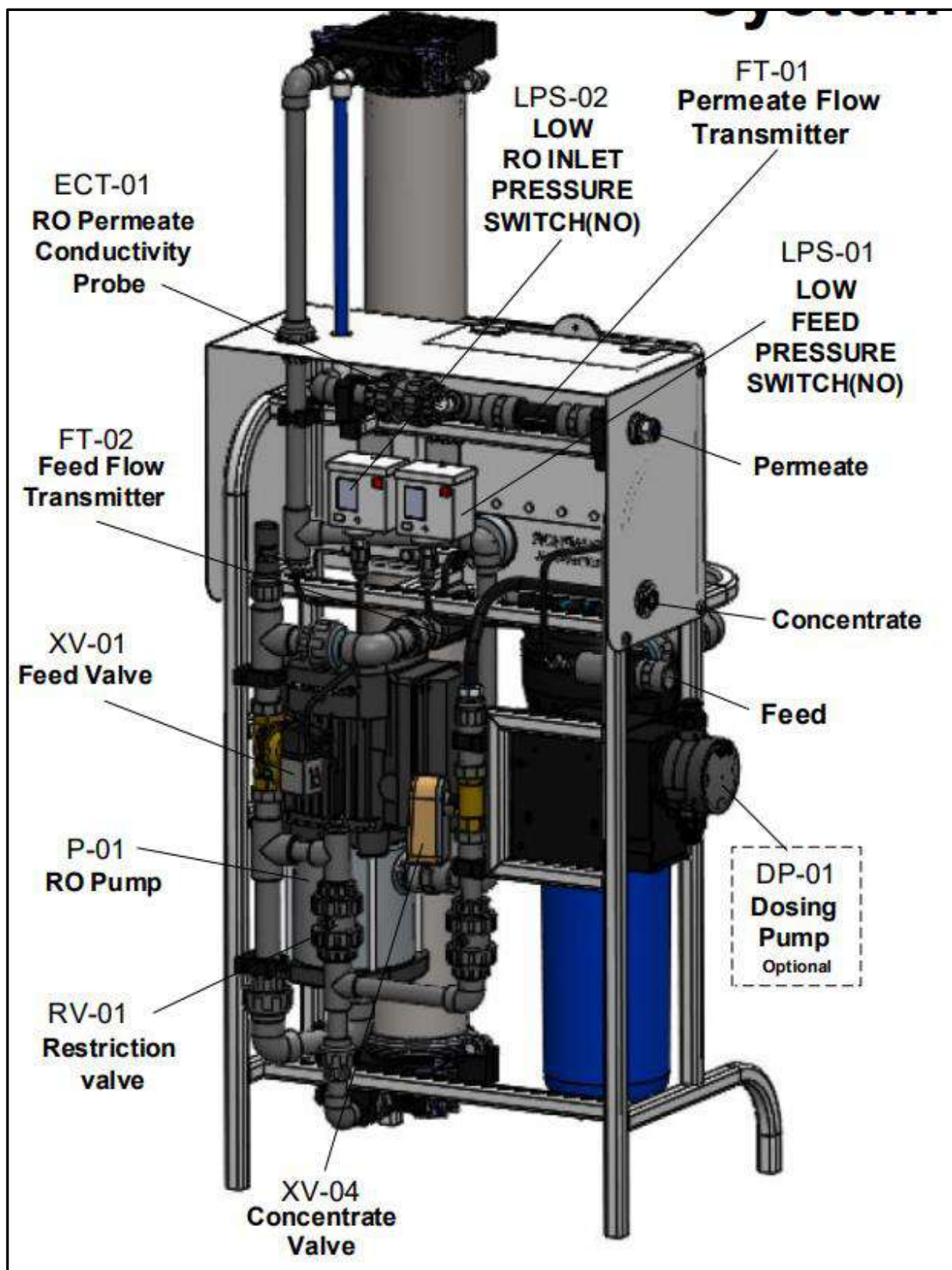
2. SYSTEM OVERVIEW

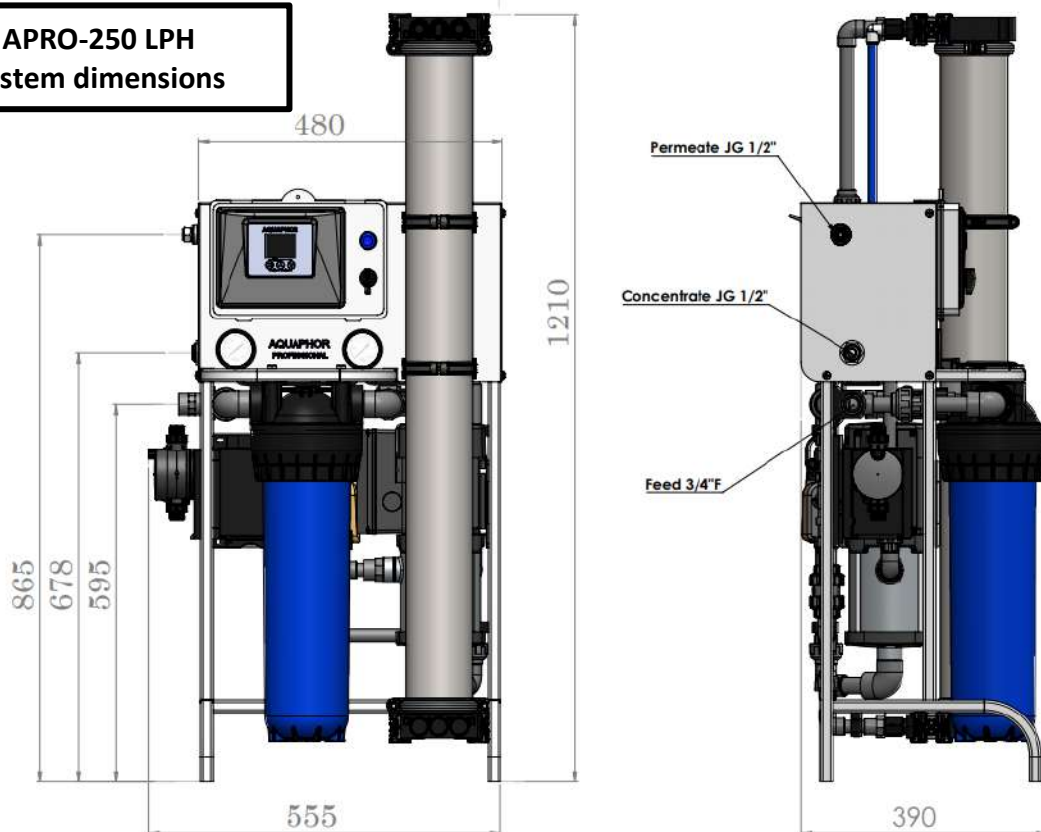
2.1 APRO-150 LPH

















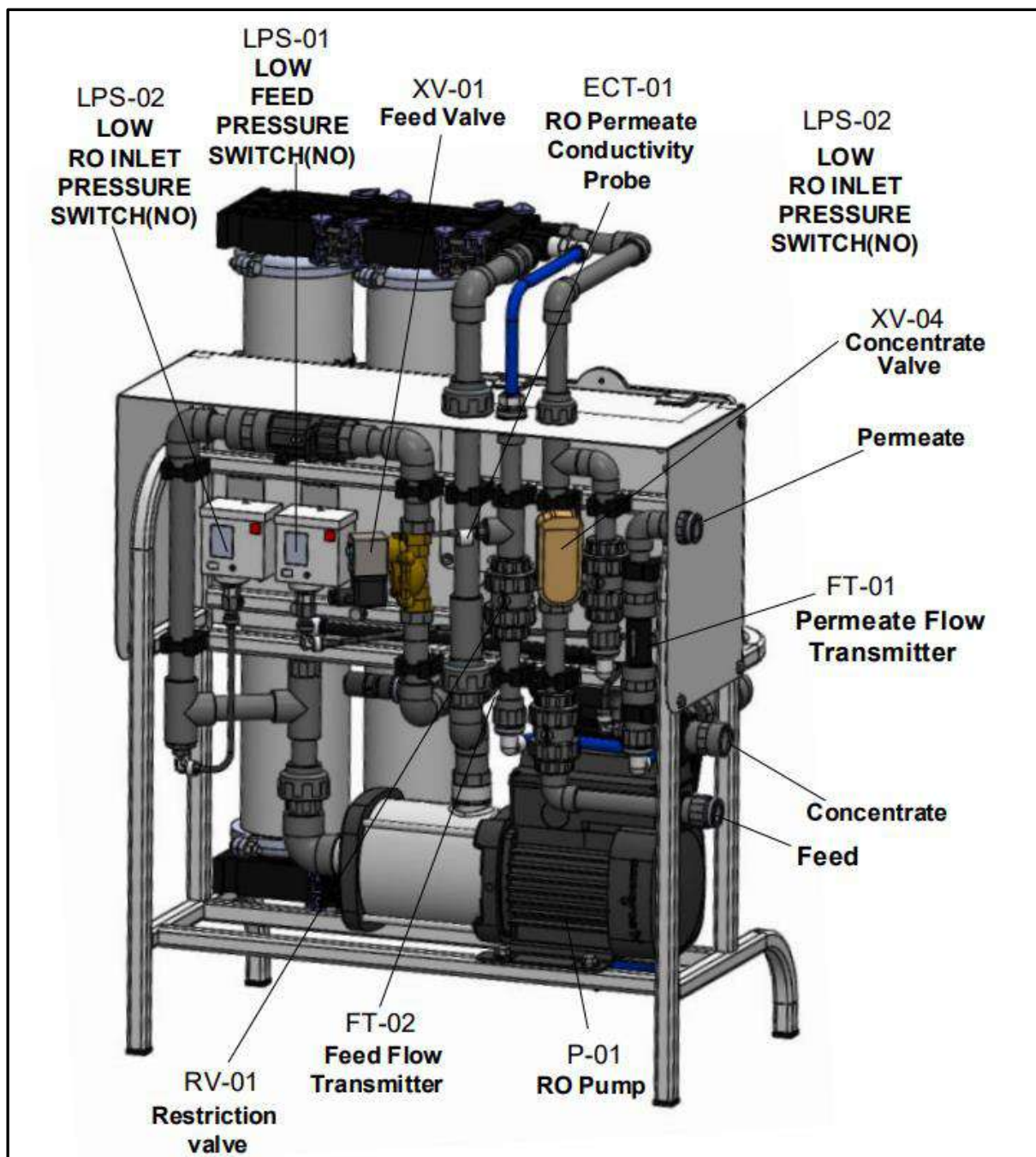
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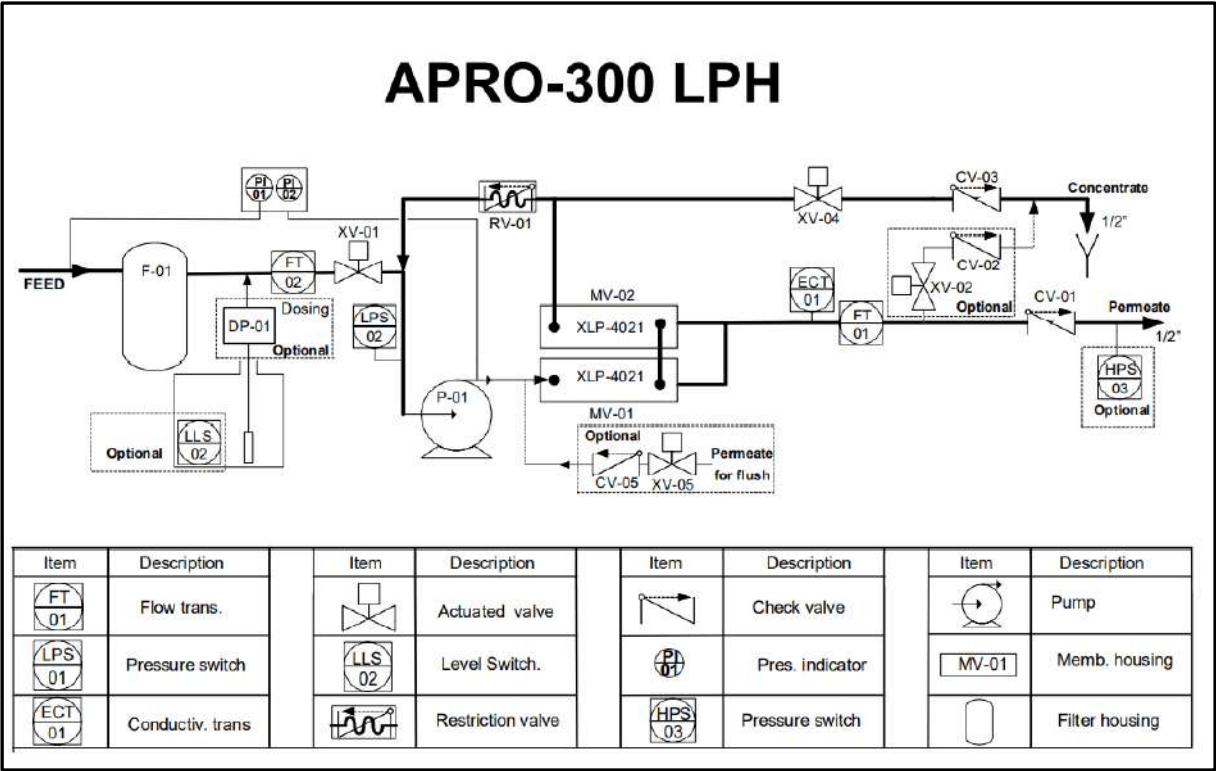
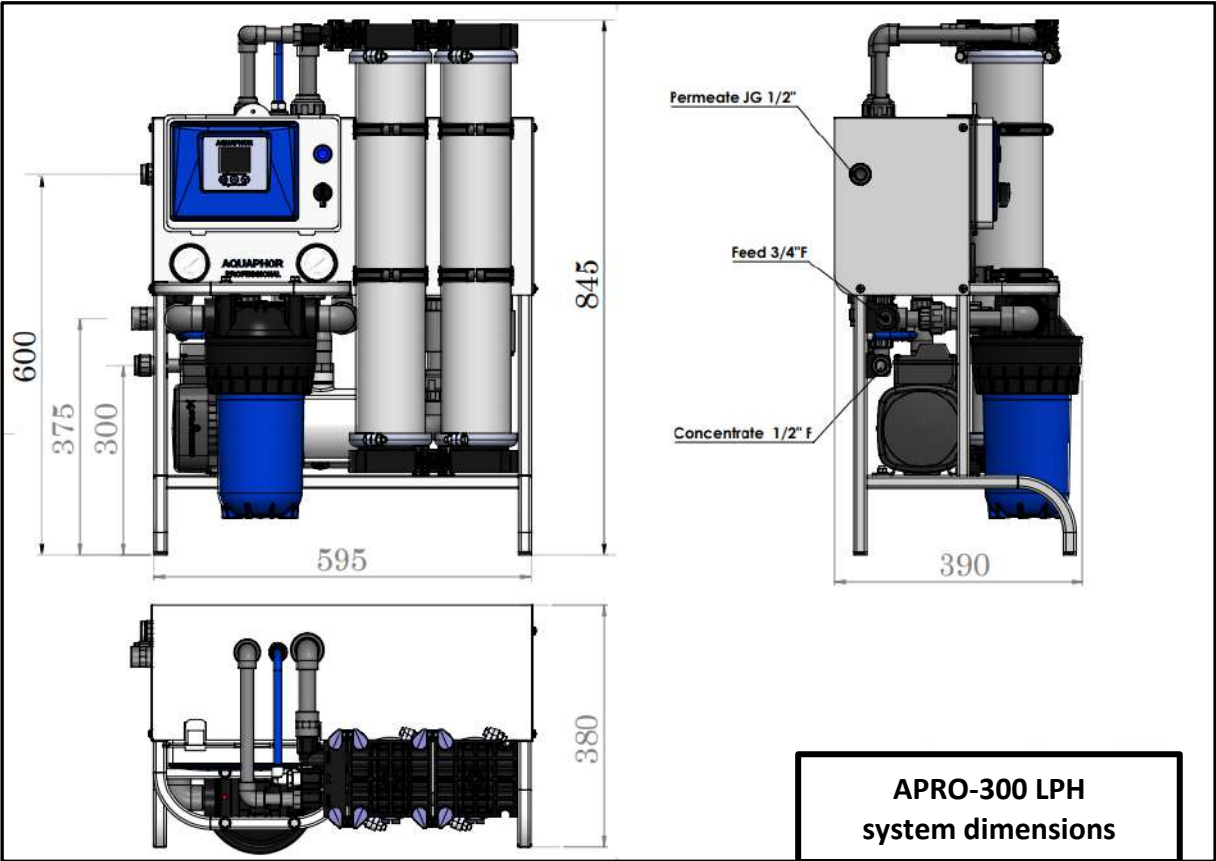




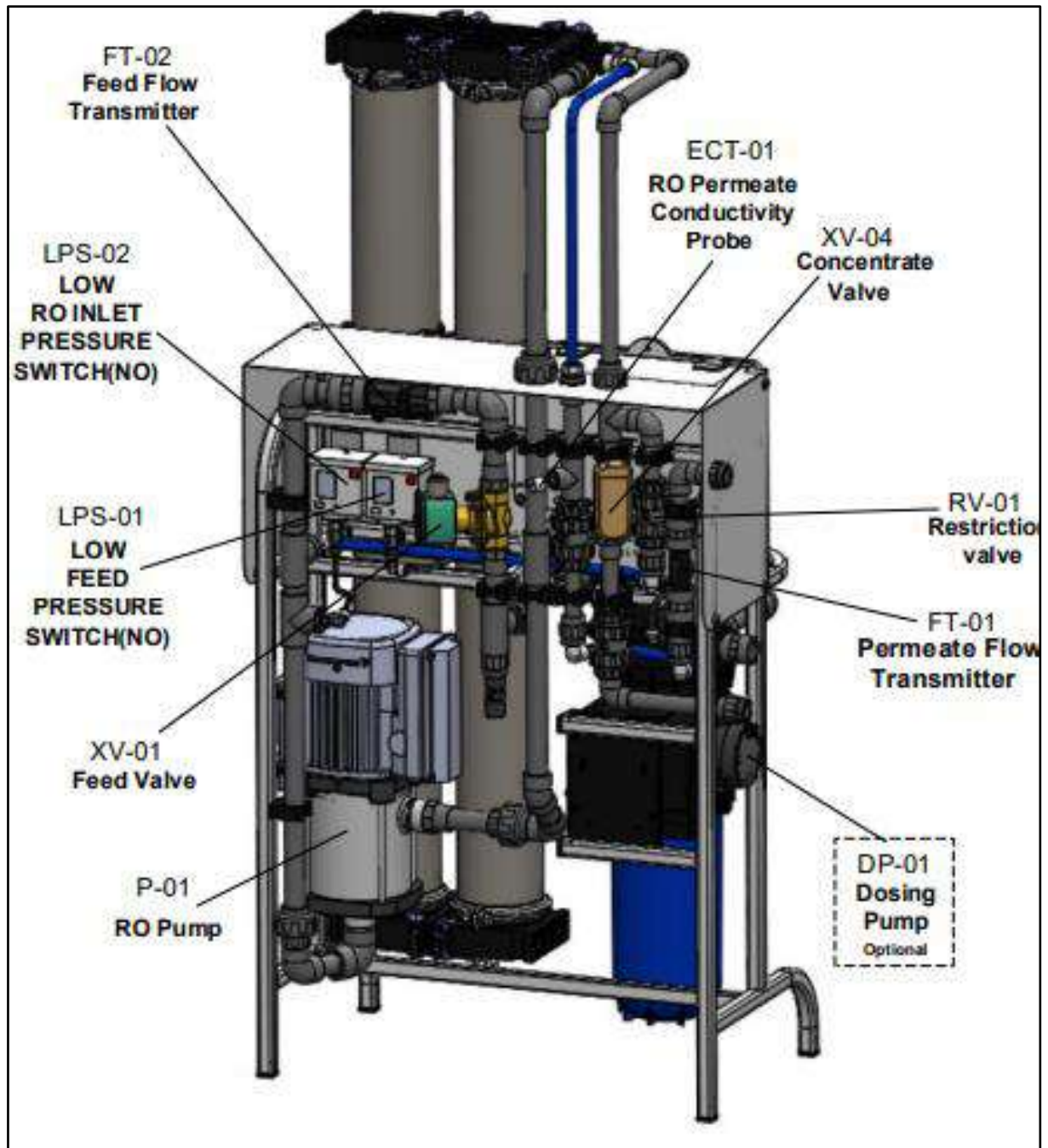
Item	Description	Item	Description	Item	Description	Item	Description
	Flow trans.		Actuated valve		Check valve		Pump
	Pressure switch		Level Switch.		Pres. indicator		Memb. housing
	Conductiv. trans		Restriction valve		Pressure switch		Filter housing

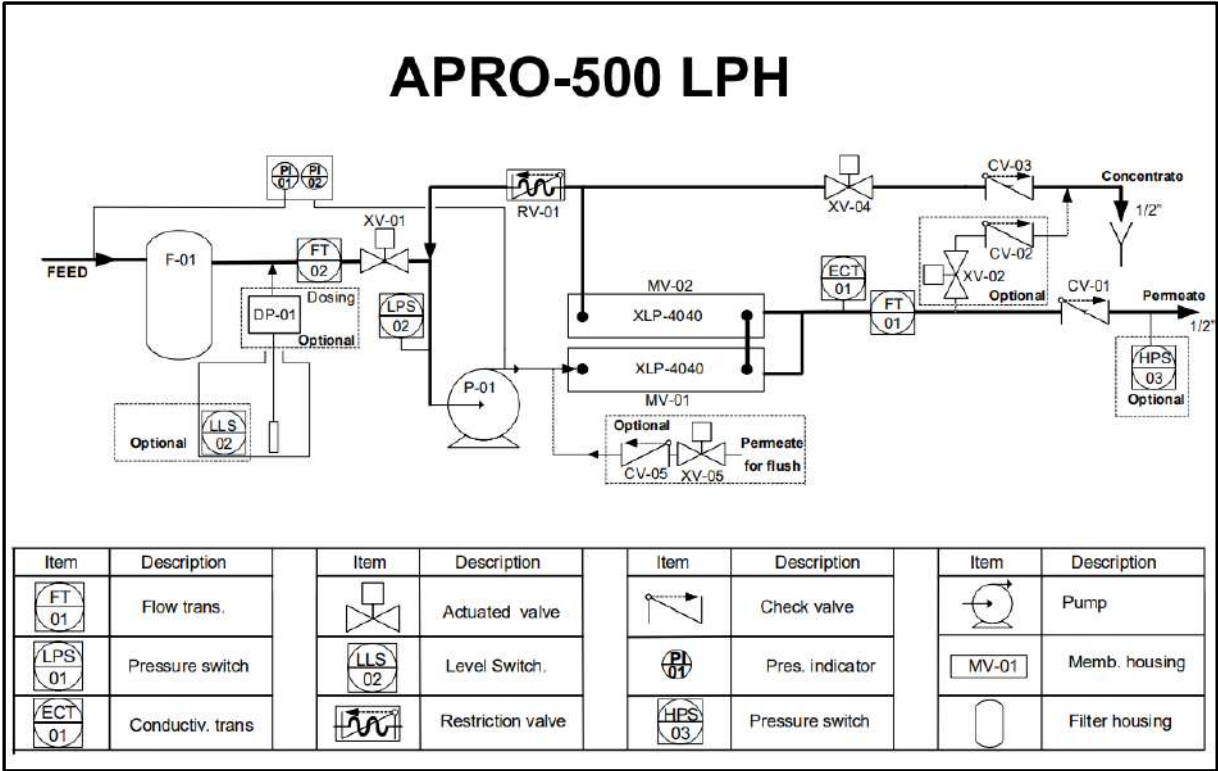
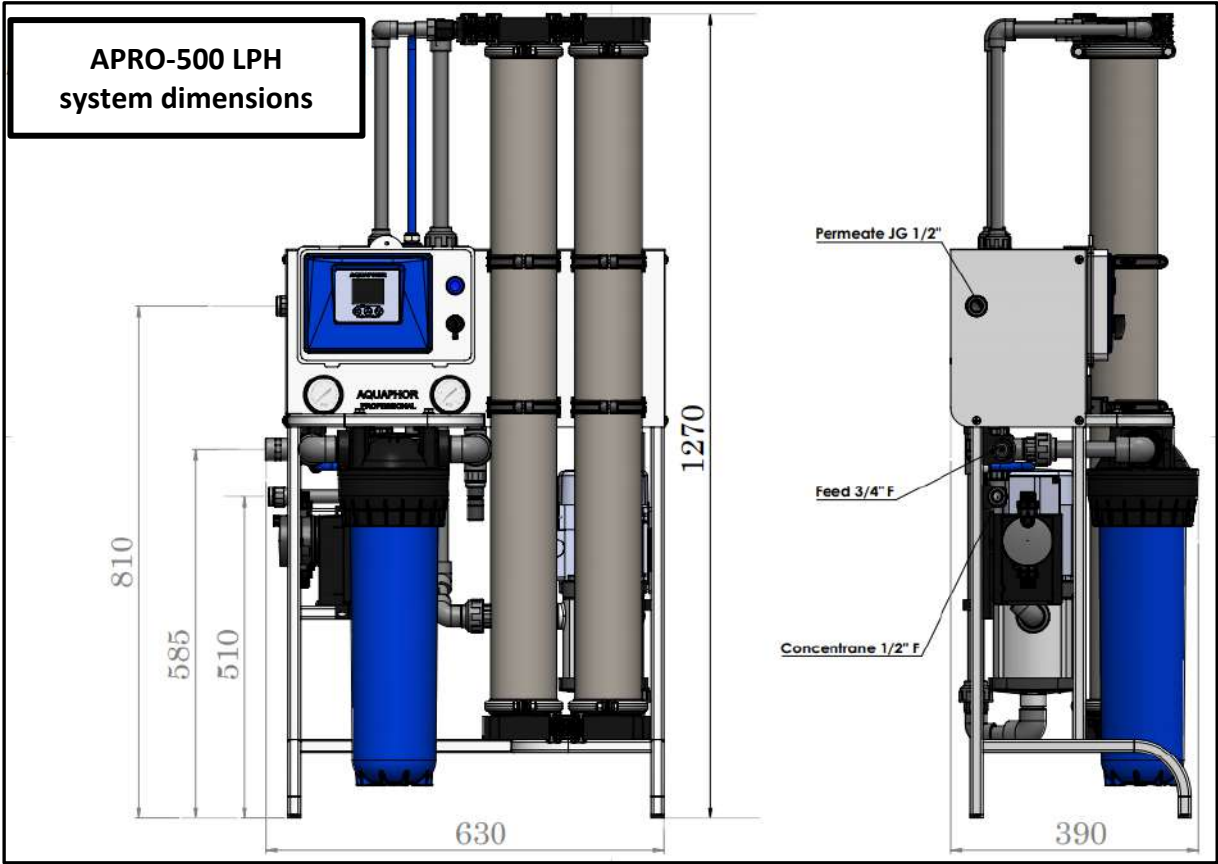
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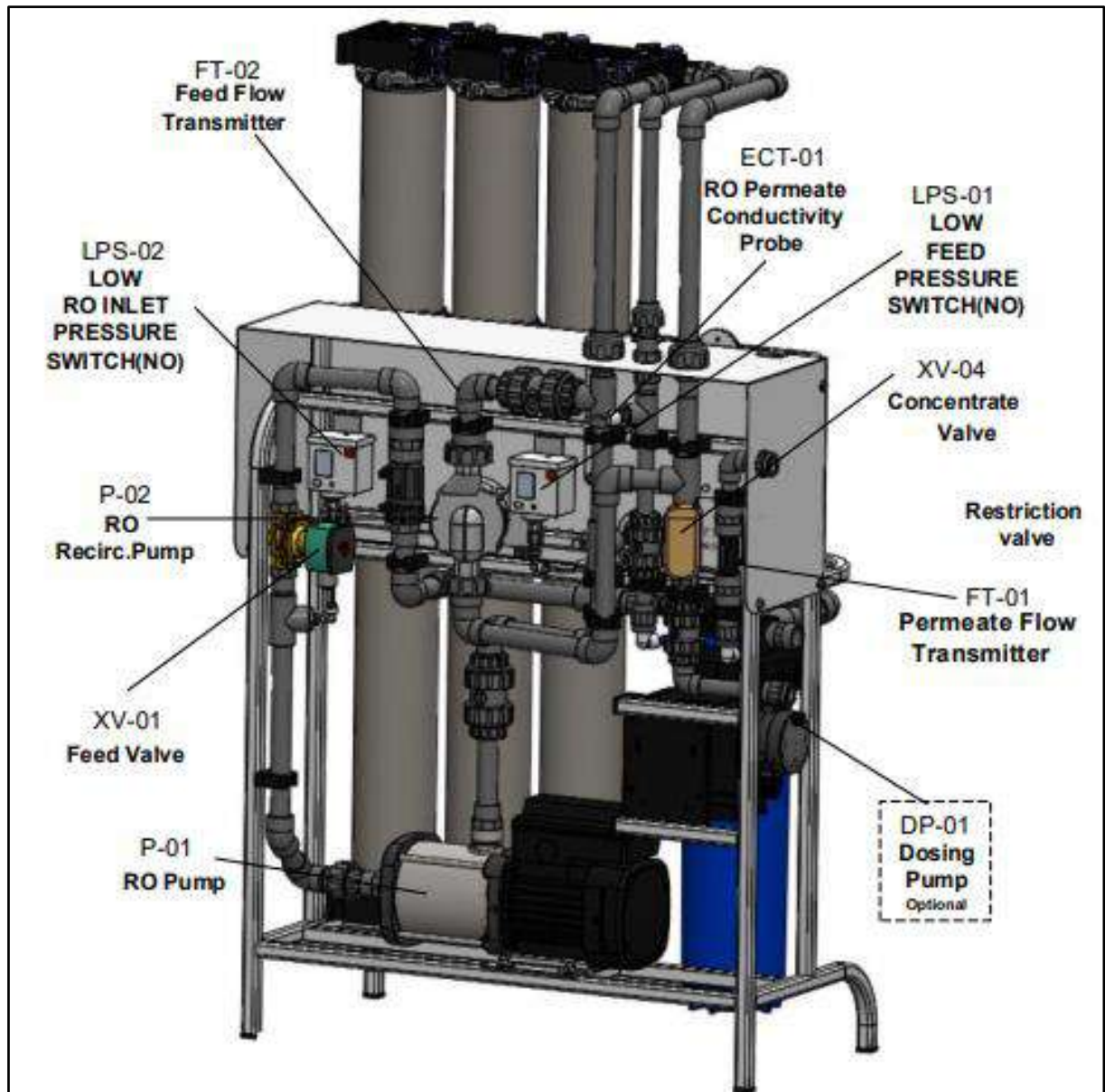


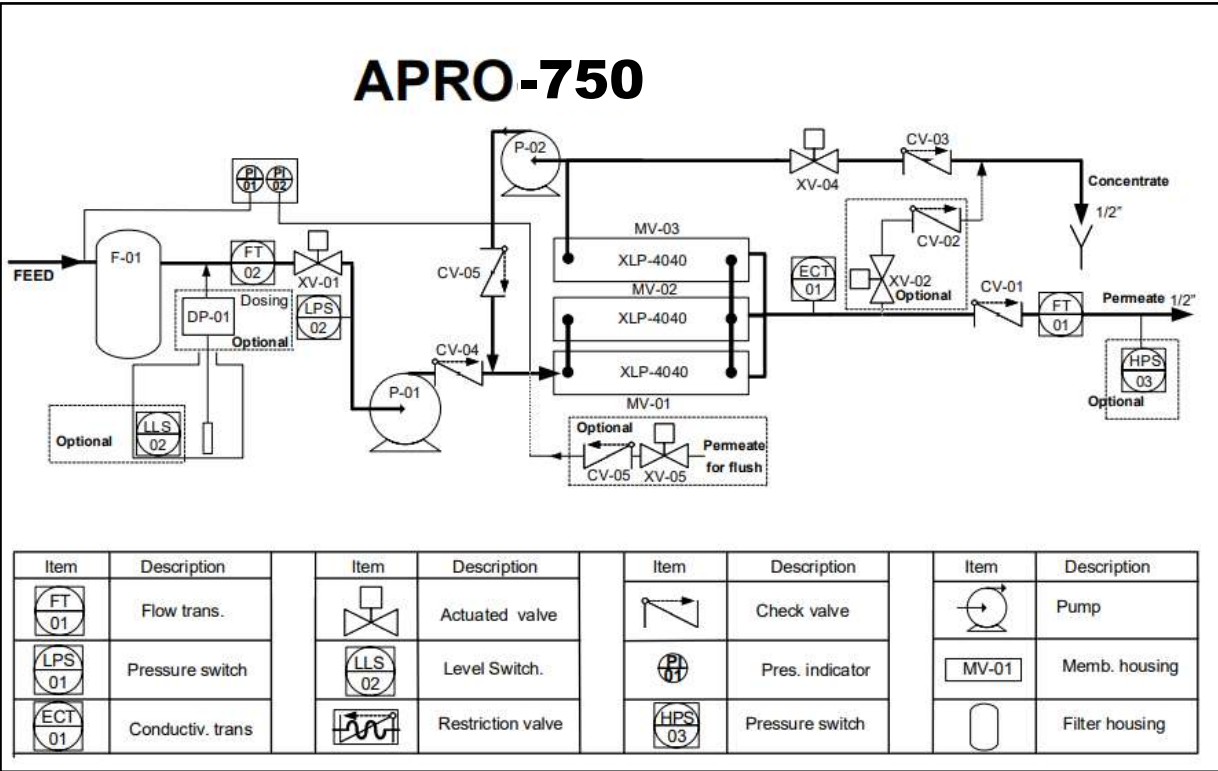
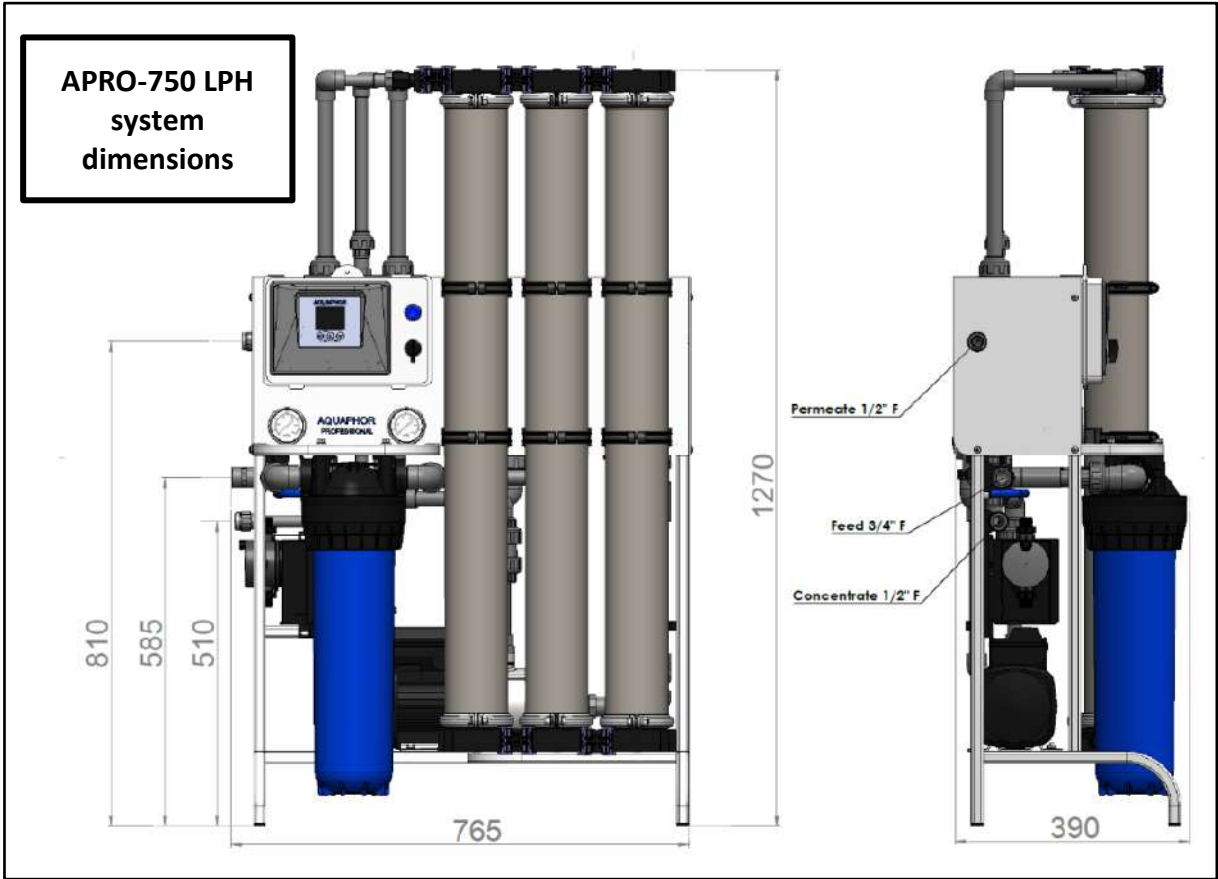
2.4 APRO-500 LPH





2.5 APRO-750 LPH

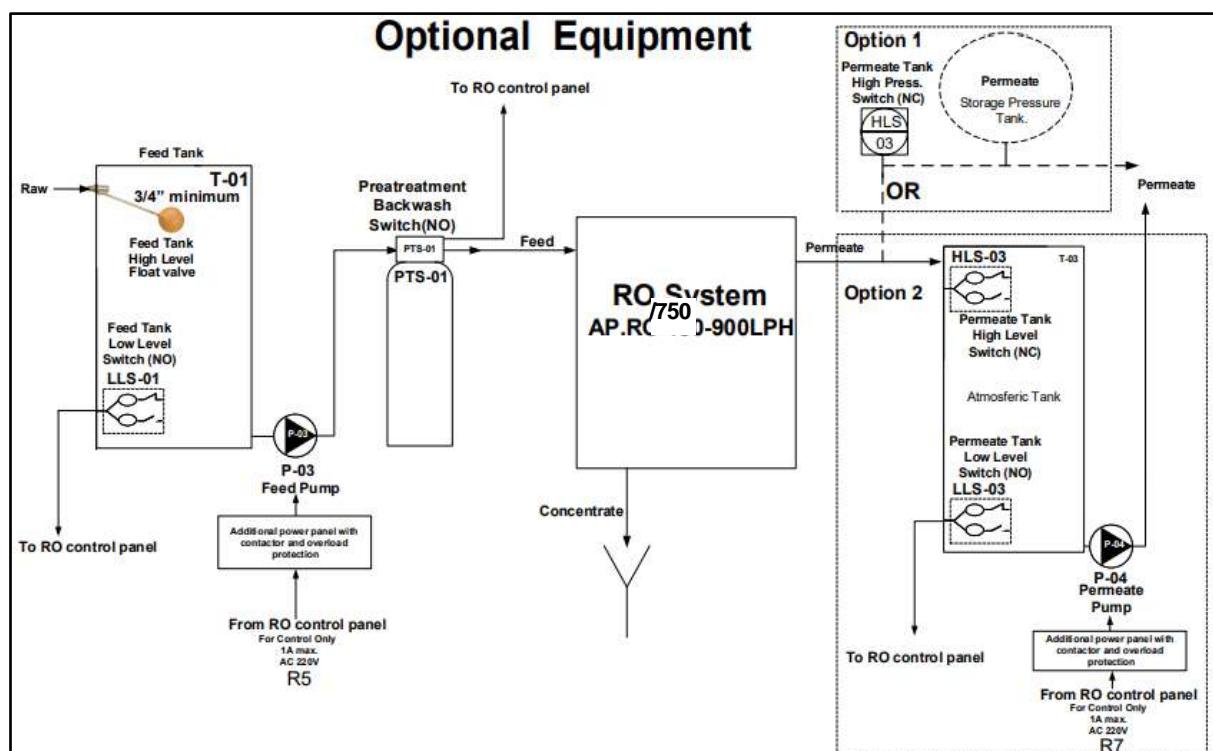




2.6 TABLE OF SYSTEM'S EQUIPMENT

Tag	Name	Function
F-01	Cartridge Filter Housing	Feed water filtration cartridge (20 mkr).
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 pack pressure valve.
CV-04	Check valve	Concentrate 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



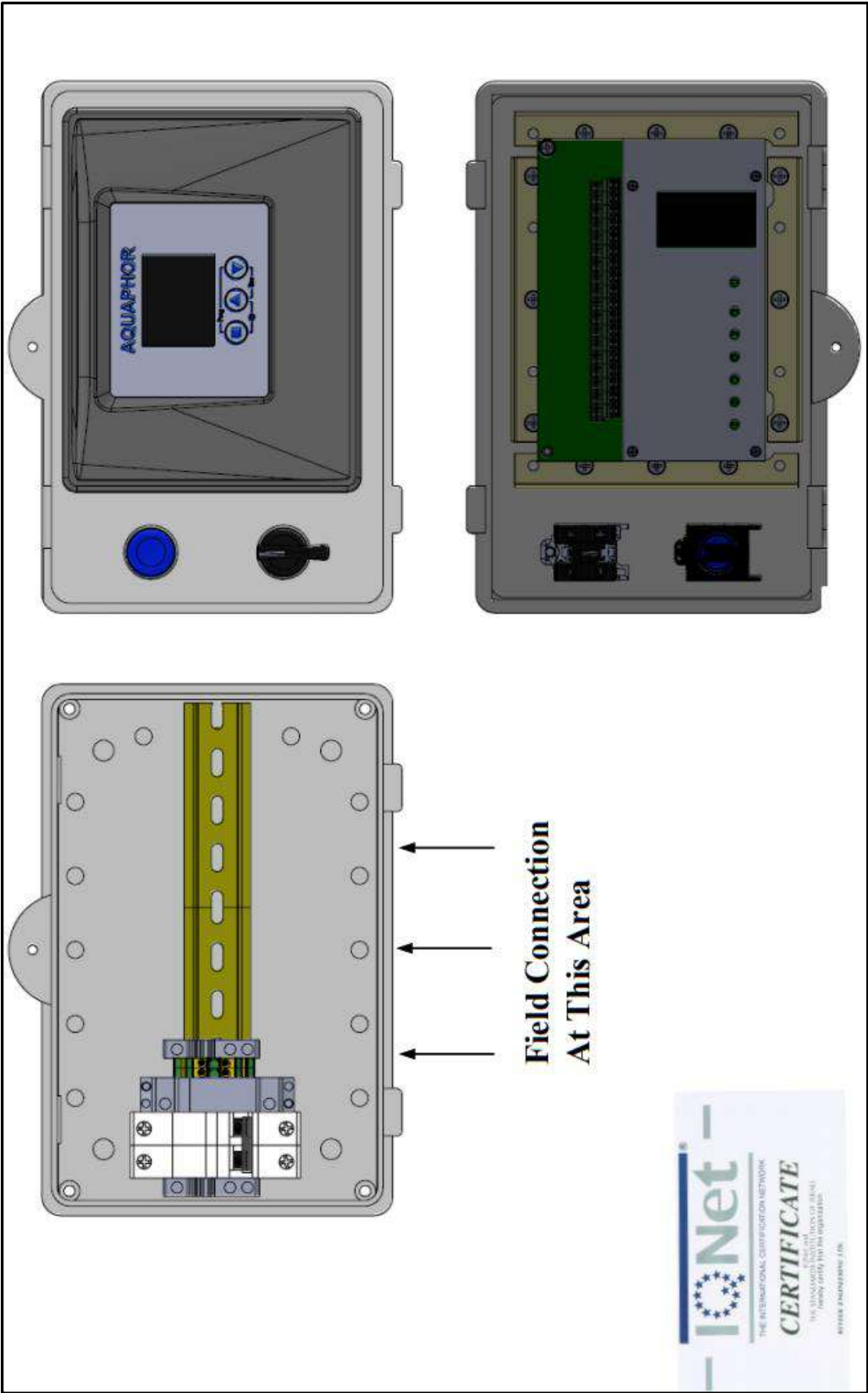
Tag	Name	Function
T-01	Cartridge Filter Housing	Feed water filtration cartridge (20 mkr).
P-01	Pressure pump	Builds up pressure and supply water to reverse osmosis membranes.
P-02	Pressure pump	Builds up pressure and supply water to reverse osmosis membranes.
DP-01	Dosing pump (optional)	Doses feed water 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

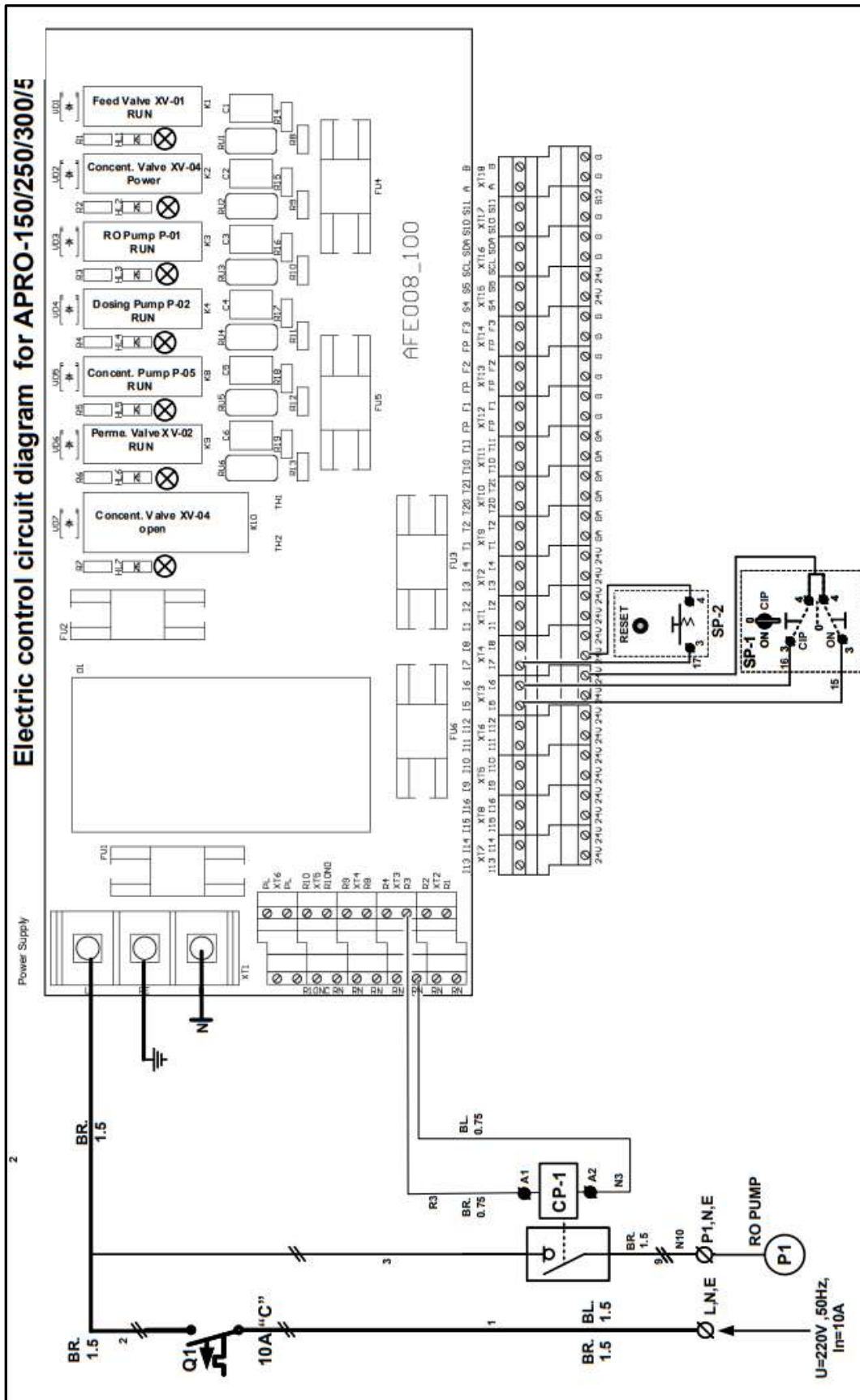
3. ELECTRIC CIRCUITS

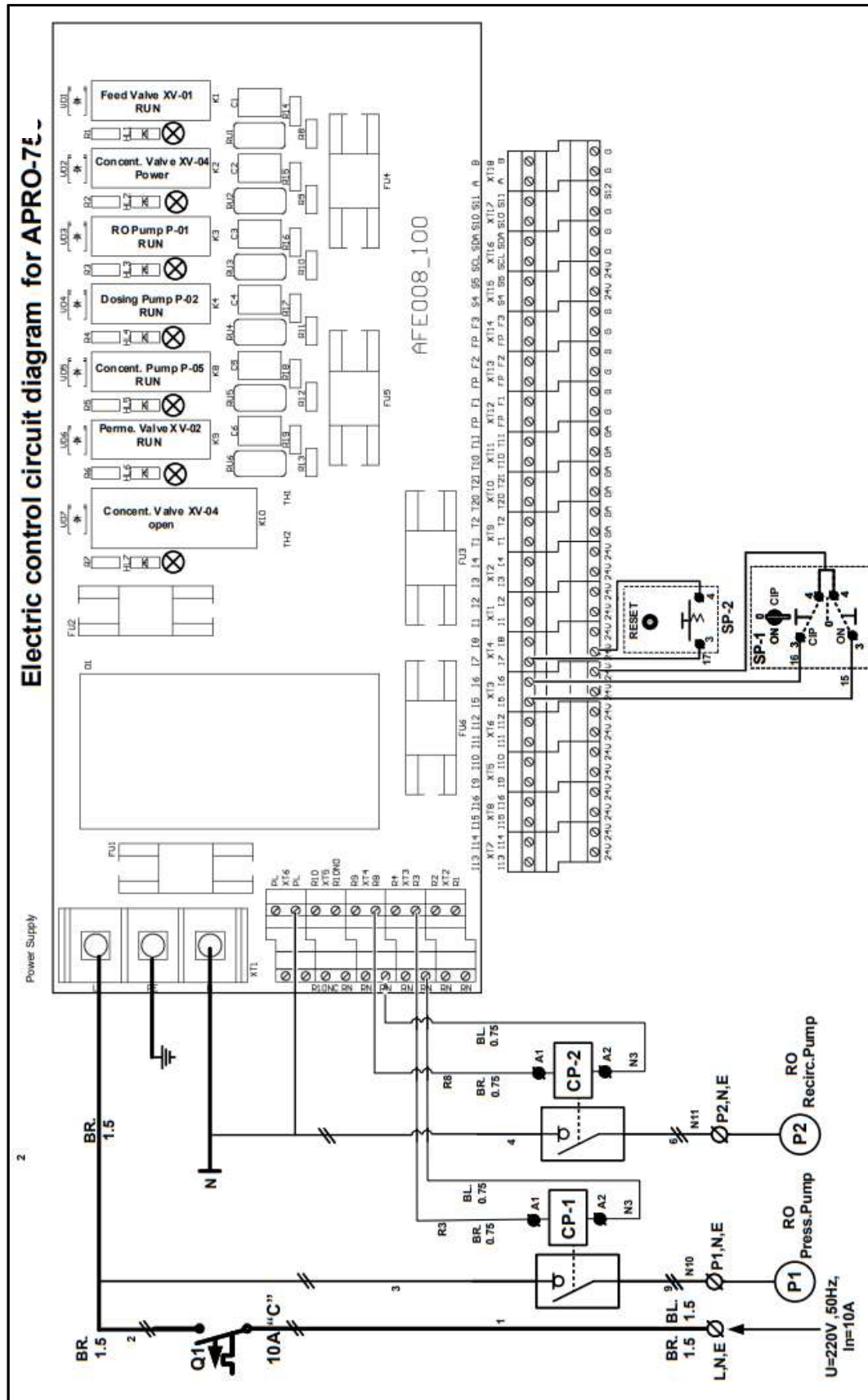
3.1 GENERAL INFORMATION

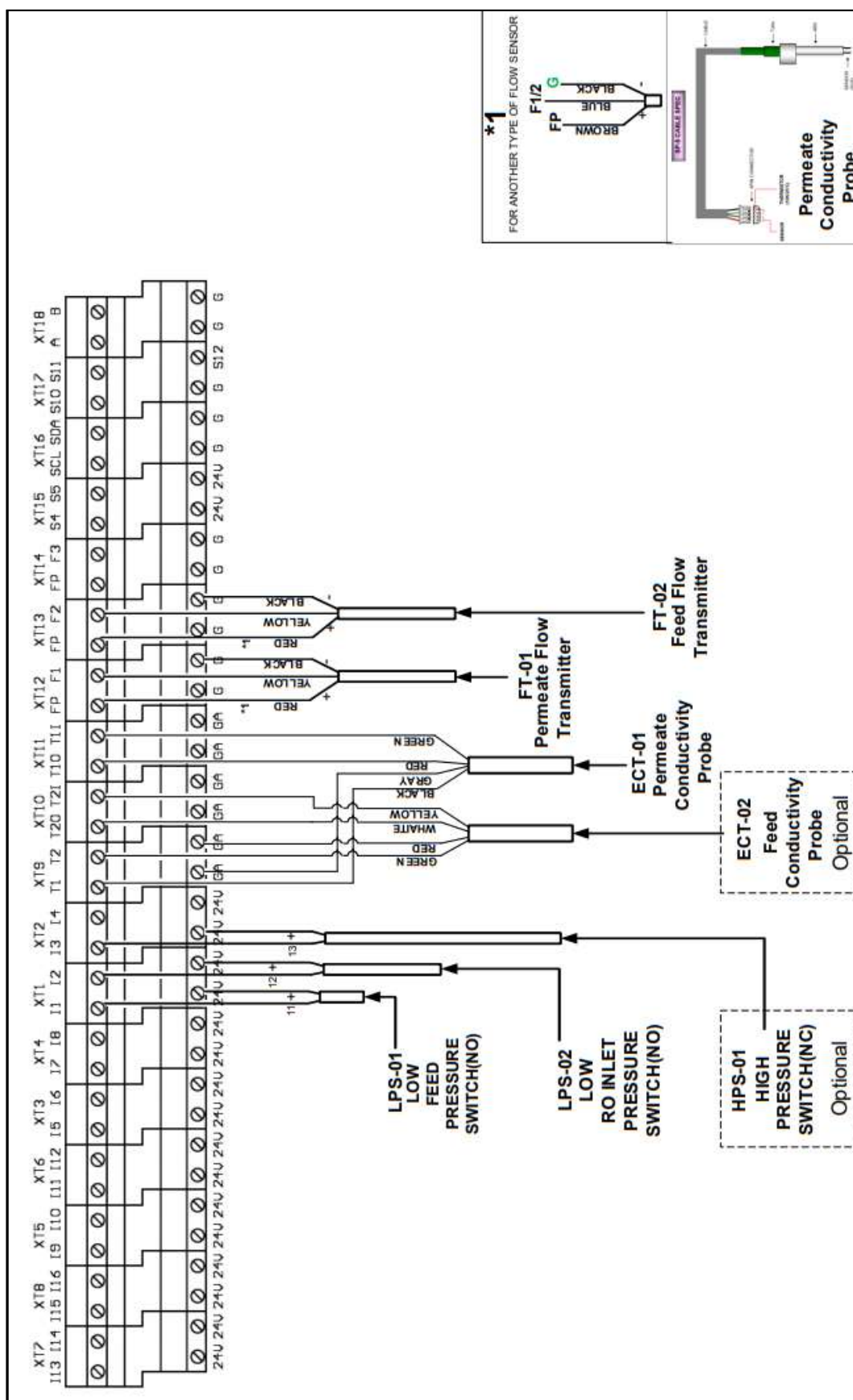
- All elements of the electrical circuit are assembled and require no additional intervention except for the connection of additional equipment. The unit is equipped with fully automated control. It can supply purified water using the logic controller, water level, and pressure sensors, based on an adjustable 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.

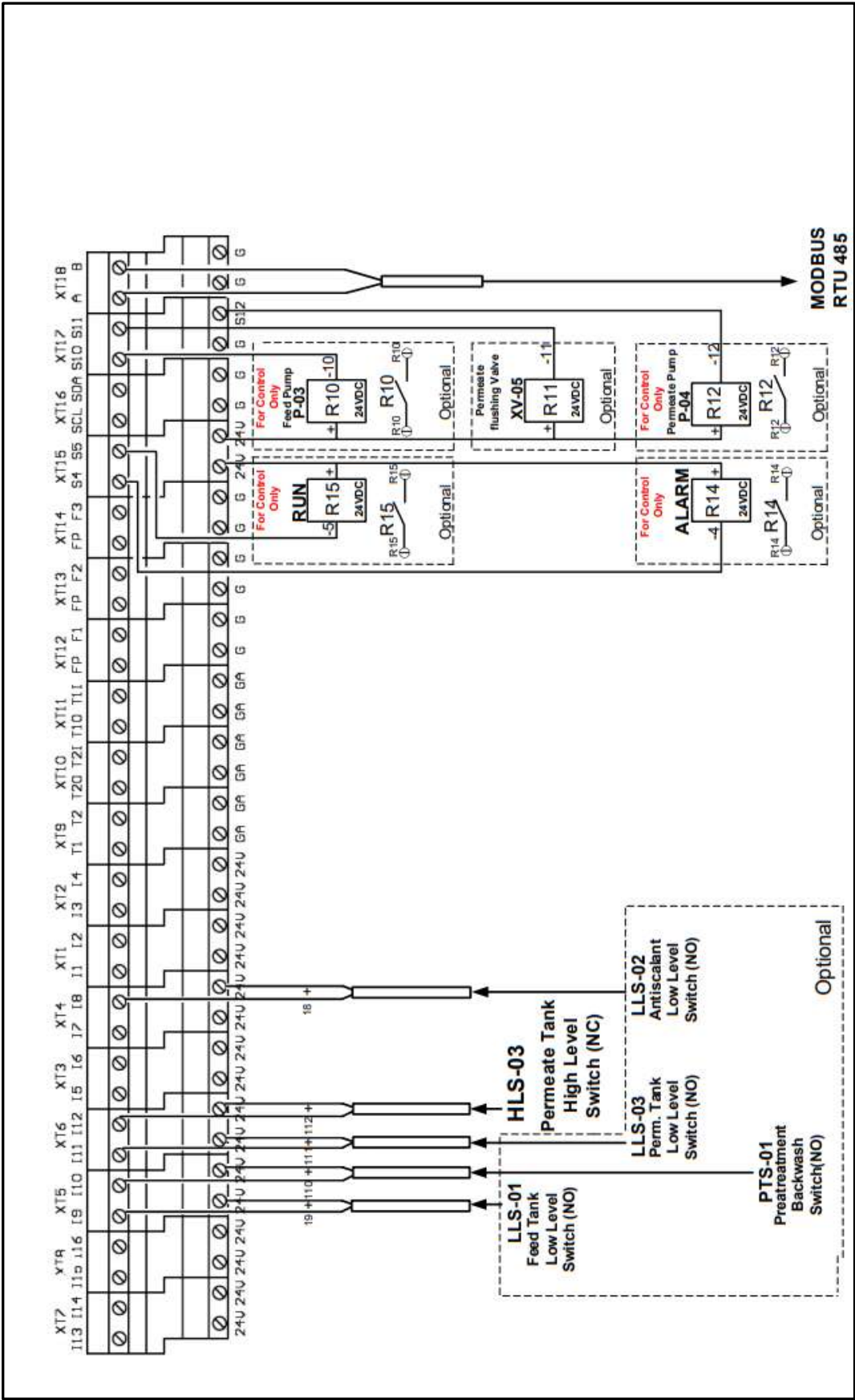
3.2 ELECTRIC CIRCUIT SCHEMES

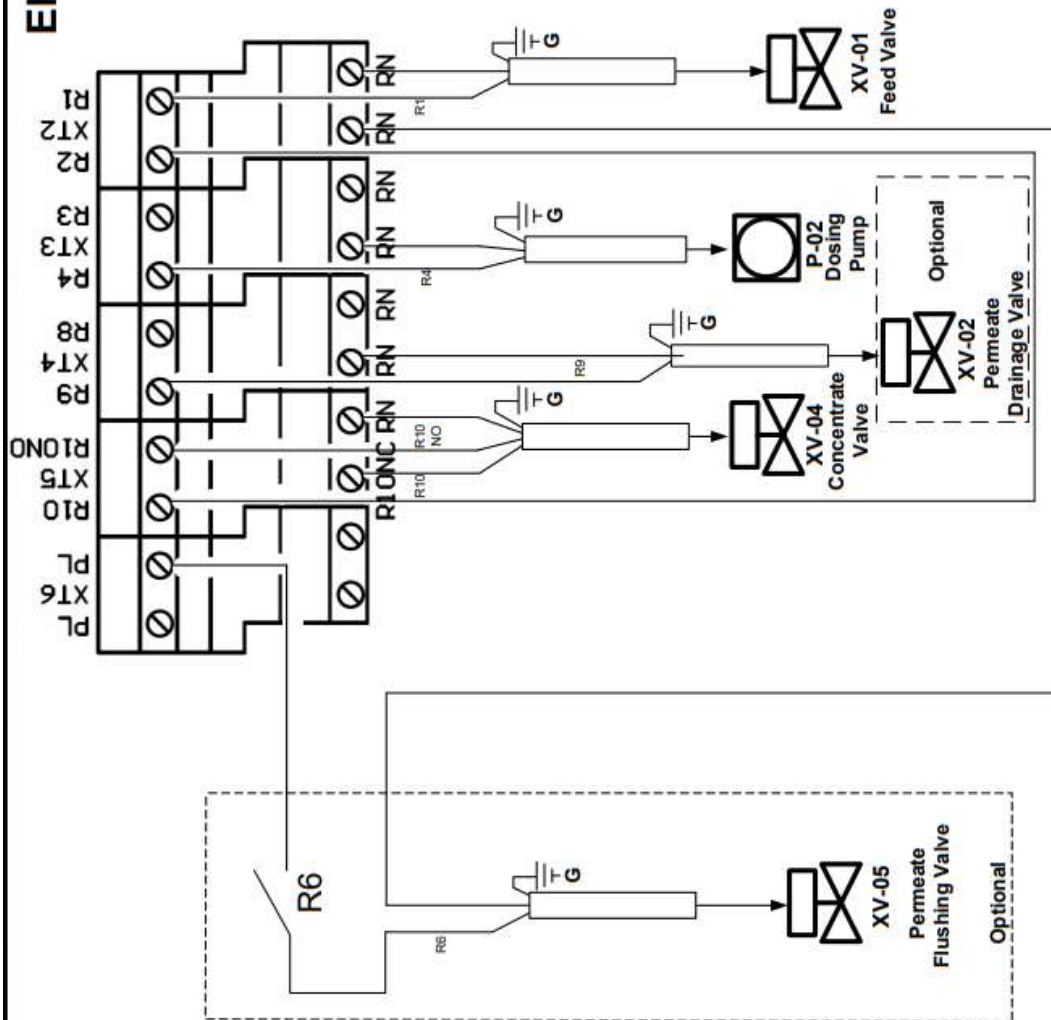










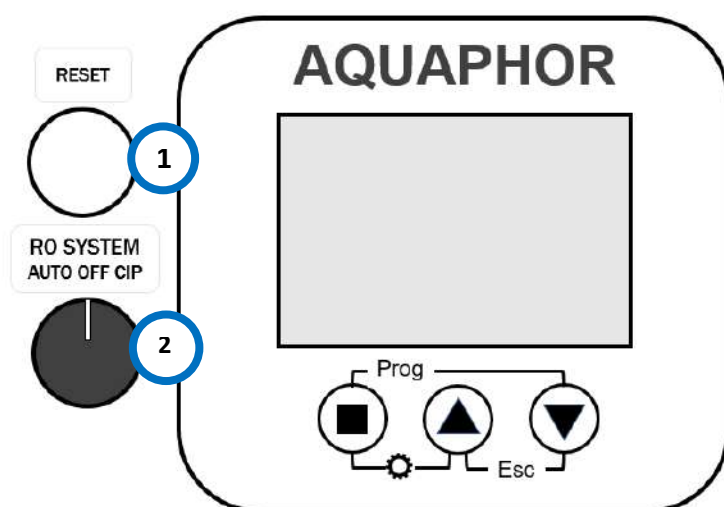


4. CONTROL PANEL

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	<1000
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

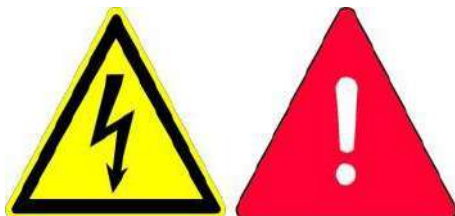
5.1.3 REVERSE OSMOSIS DATA

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	110
APRO 250LPH		
With 25 °C	l/h	250
With 10 °C	l/h	200
APRO 300LPH		
With 25 °C	l/h	300
With 10 °C	l/h	220
APRO 500LPH		
With 25 °C	l/h	500
With 10 °C	l/h	380
APRO 750LPH		
With 25 °C	l/h	750
With 10 °C	l/h	580
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 GENERAL POINTERS



ATTENTION: Contamination of the unit coming from the drain, Blocking of the module

- Do not lead the concentrate line directly in the drain, but fasten it approx. 10 - 15 cm over the drain with appropriate means.



ATTENTION: Corrosion; Destruction of the lines

- Use corrosion-resistant material for all the water lines

6.3 WATER CONNECTION

Install a pressure resistant hose between the outlet of the softening installation and the raw water connection of the reverse osmosis unit.



ATTENTION: Contamination of the unit coming from the drain, Blocking of the module

- Do not lead the concentrate line directly in the drain, but fasten it approx. 10 - 15 cm over the drain with appropriate means.

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

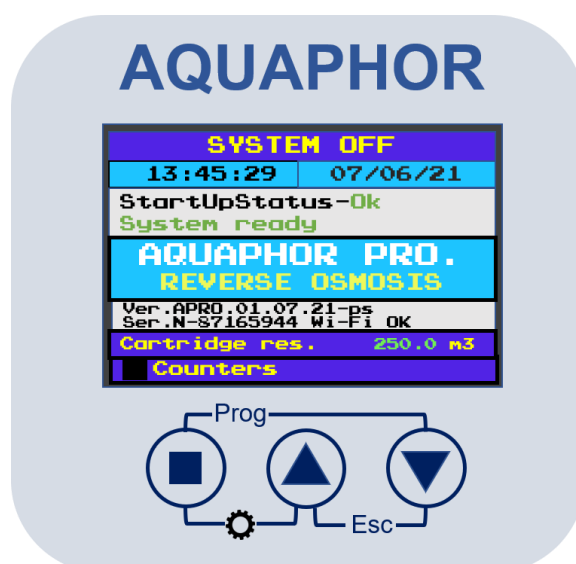
When power is applied to the switchboard, the program starts in the **System OFF** mode, opening the start window with the following parameters:

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).
- Pressing the "Up" ▲ button on the three-position switch for 5 seconds will start 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, $^{\circ}\text{C}$
- Feed conductivity (μS)
- Feed temperature, $^{\circ}\text{C}$



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

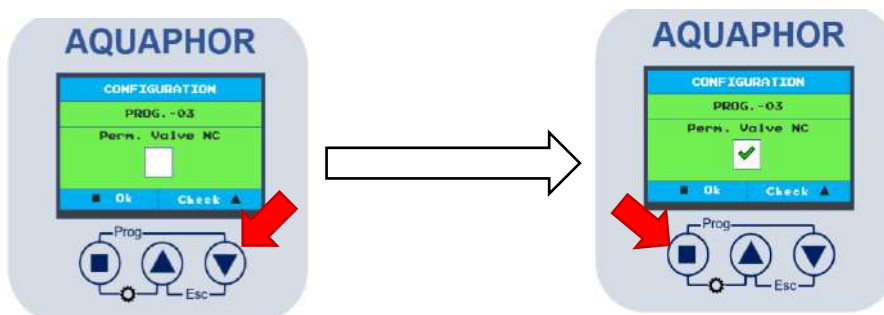
1. To enter the settings menu, use the controller's three-button keyboard located under the monitor screen.



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.



If the program is on (✓), the valve is normally closed and operating in a described way. If the program is off, the valve closes when the maximum allowed value of LLS is exceed.

PROGRAM 01: FEED PUMP *OPTIONAL

If the input water does not meet the requirements of this manual for the minimum pressure and required volume, the system can be connected to the existing water supply through the raw water supply system. For this program, a pump for raw water should be added. By default, a storage tank with raw water is also added.



The raw water pump works under the following conditions:

- The program is activated
- The three-position switch is in the "AUTO" position
- There is enough water in the storage tank.
- There is a signal from the RO system to start work

PROGRAM 02: PRETREATMENT (PTS-01) *OPTIONAL



This program turns on the water pretreatment process.

The pretreatment system (PTS-01) will carry out the regeneration according to a given program, and the results will be displayed on the controller screen. During this period, the RO system is in waiting mode.



The time of the pretreatment regeneration does not depend on the controller settings. When the pretreatment regeneration mode is activated, all RO system units turn OFF, and the raw water feed pump turns on. After finishing the regeneration process, the system continues to work automatically.

PROGRAM 03: PERMEATE VALVE NC (XV-02)



Presence of a primary permeate drainage valve (XV-02). The valve turns on when the set value of the product electrical conductivity is exceeded.



During the system operation, the drainage valve opening symbol will be displayed on the controller during the frequency reset (**the green arrow indicator should be in the right upper corner**).

PROGRAM 04: SUPPLY PUMP (P-04) *OPTIONAL



If there is a need to quickly supply a large volume of purified water quickly, a non-presurized RO water supply system can be connected (P-04). The reverse osmosis system will fill the additional tank with RO water to the specified level (LLS-03).

PROGRAM 05: PERMEATE FLOW TRANSMITTER (FT-01)



Enables/disables permeate flow sensor (FT-01).

PROGRAM 06: FEED FLOW TRANSMITTER (FT-02)



Enables/disables feed flow sensor (FT-02).

PROGRAM 07: HIGH PRESSURE SWITCH (HPS-01) *OPTIONAL



Enables/disables high pressure switch (HPS-01).

Program is not required in the current system.

PROGRAM 08: PERMEATE FLUSH *OPTIONAL



Whenever the system is in stand-by mode, enables membrane flush with permeate. Permeate is supplied by XV-05 valve.

PROGRAM 09: PULSE DOSING *OPTIONAL



Enables pulse dosing control.

Current system is lacking pulse dosing.
Program is not required.

PROGRAM 10: DOSING LEVEL SW. (LLS-02) *OPTIONAL



Enables/disables low antiscalant level switch.

PROGRAM 12: DOUBLE PUMP RO (P-05) *NOT AVAILABE FOR THIS SYSTEM



Enables concentrate recirculation pump (P-05).

PROGRAM 13: PERMEATE CONDUCTIVITY TRANSMITTER (ECT-01)



Enables RO permeate conductivity sensor (ECT-01).

PROGRAM 14: FEED CONDUCTIVITY TRANSMITTER *OPTIONAL



Enables raw water conductivity sensor (ECT-02).

PROGRAM 15: CONDUCT. μ SM/PPM



Changing the units of conductivity to μ Sm/PPM.

PROGRAM 16: (L/GAL – C/F)



Changing the units from Liters and Celsius to Gallons and Fahrenheit.

Default units are Liters and Celsius.

PROGRAM 17: GSM MODULE PORT



Enables/Disables GSM module port.

7.4 SETUPS

SETUP 01: START-UP FLUSH



Setting the start-up flush time.

SETUP 02: SHUT-DOWN FLUSH



Setting the shut-down flush time.

SETUP 03: STAND-BY FLUSH



Setting the stand-by flush period (period in hours).

SETUP 04: HIGH CONDUCTIVITY PERMEATE ALARM



Setting the point for the product conductivity limit (max value).

SETUP 05: HIGH CONDUCTIVITY FEED WATER ALARM



Setting the point for the feed conductivity limit.

SETUP 06: LOW PRESS. DELAY



Setting the delay to stop the system after a signal of low input pressure is received.

SETUP 07: DOSING PULSE/MIN *



Setting the number of pulses per minute.

Current system is lacking pulse dosing.
Setup is not required.

SETUP 08: PERMEATE FLOW 'K'



Setting the number of pulses per liter.

Note: the parameters are set by flowmeter manufacturer.

SETUP 09: FEED FLOW 'K'



Setting the number of pulses per liter.

Note: the parameters are set by flowmeter manufacturer.

SETUP 10: AUTOMATIC CONCENTRATE VALVE OPEN TIME



Setting full concentrate valve opening time (set by valve manufacturer).

Note: the time is set by valve manufacturer.

SETUP 11: AUTOMATIC CONCENTRATE VALVE FLUSH OPENING



Setting concentrate valve opening percentage during flushing process.

SETUP 12: AUTOMATIC CONCENTRATE VALVE RUN OPENING



Setting concentrate valve opening percentage while running (setting up the desired recovery of the system).

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) 34%	(Set-12) 41%	(Set-12) 41%	(Set-12) 52%	(Set-12) 73%
55%	(Set-12) 32%	(Set-12) 39%	(Set-12) 39%	(Set-12) 47%	(Set-12) 70%
60%	(Set-12) 31%	(Set-12) 35%	(Set-12) 36%	(Set-12) 41%	(Set-12) 65%
65%	(Set-12) 30%	(Set-12) 34%	(Set-12) 33%	(Set-12) 40%	(Set-12) 62%
70%	(Set-12) 29%	(Set-12) 32%	(Set-12) 32%	(Set-12) 36%	(Set-12) 55%
75%	(Set-12) 27%	(Set-12) 30%	(Set-12) 30%	(Set-12) 34%	(Set-12) 50%
80%	(Set-12) 25%	(Set-12) 28%	(Set-12) 28%	(Set-12) 31%	(Set-12) 45%
85%		(Set-12) 27%	(Set-12) 27%	(Set-12) 29%	(Set-12) 40%
90%					(Set-12) 30%

SETUP 13: FULL TANK DELAY



Setting the delay to stop the system after the full tank signal is received (HLS-03).

SETUP 14: PERMEATE LOW FLOW



Setting the minimum permeate flow signaling to stop the system (Check 8.7 Alarm-09).

This is not the absolute minimum.

SETUP 15: CONCENTRATE LOW FLOW ALARM



Setting the minimum concentrate flow.

SETUP 16: CARTRIDGE FILTER RESOURCE



Setting the volume of cartridge filter resource.

SETUP 17: SYSTEM ID NUMBER

Setting the system ID number (1-255).

SETUP 18: YEAR

Setting the year (18-50).

SETUP 19: DATE/MONTH

Setting the date (DD:MM).

SETUP 20: TIME

Setting the time (hh:mm).

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).

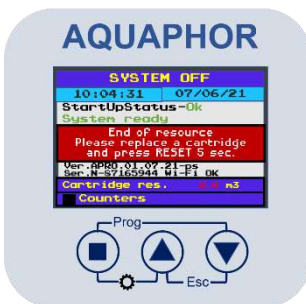
8.12 ALARM-12: HIGH FEED CONDUCTIVITY

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)

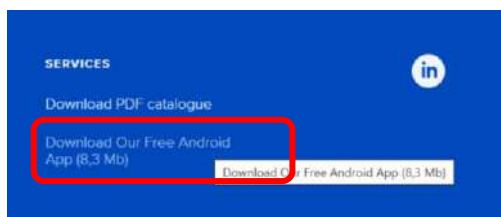
APRO Monitor app functionality:

- 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

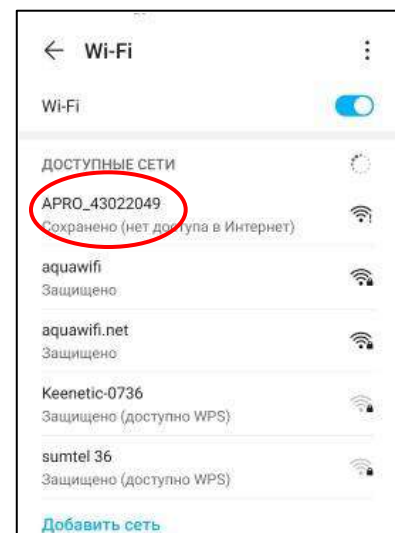
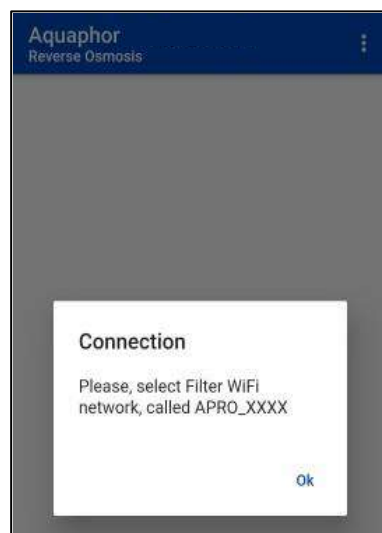
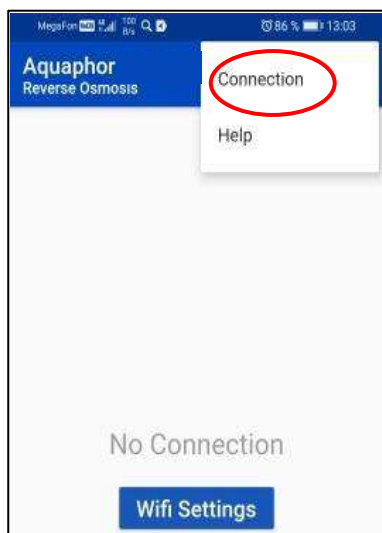
! APRO Monitor app is available for Android OS only

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:

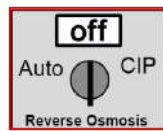


2. Open the app.
3. Configure the connection.
 - a) Open the context menu and choose “Connection”.
 - b) Press OK.
 - c) Choose “APRO_XXXX” network.
 - d) Select “Connect” in the pop-up window.



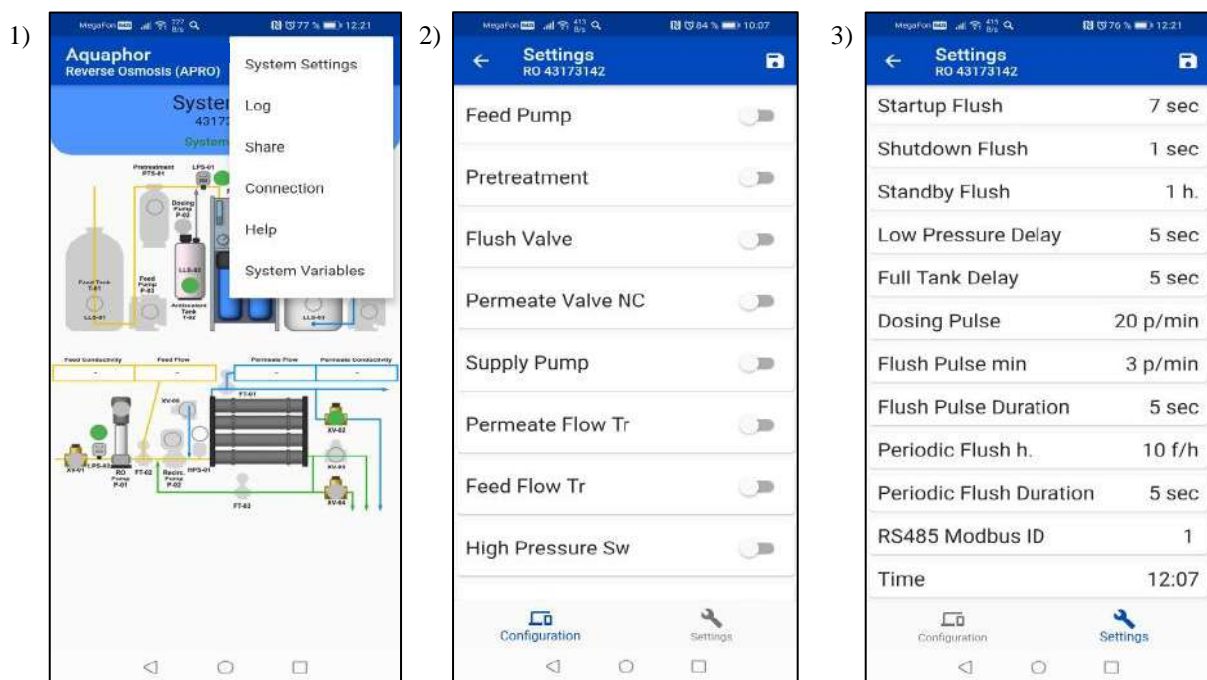
4. Back in the context menu, choose “System’s Settings”.
5. Select the equipment and click “Save”.

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 (page ... make reference to the programs part). "Settings" window (3) changes the setups (page ...) of the active programs.



9.3 OPERATING MODE FUNCTIONALITY

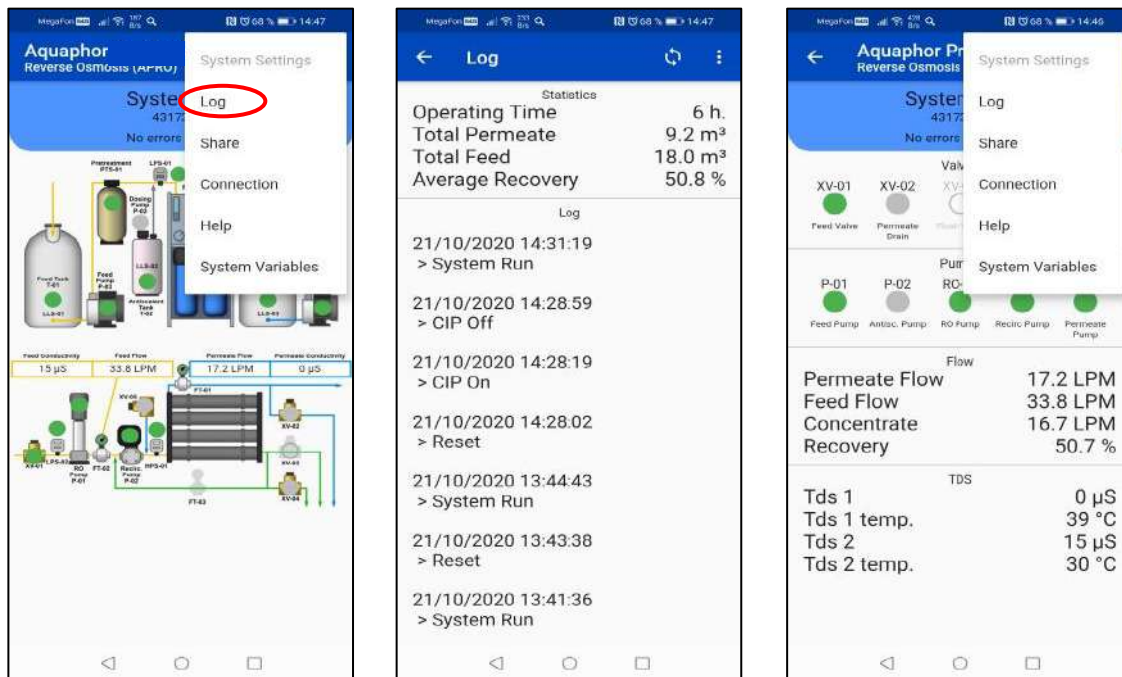


! Operating mode can be started only using a three-position switch on the RO control station.

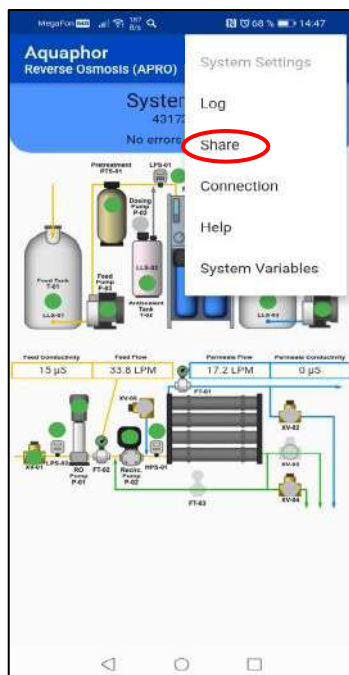
When the system is operating, the following data is available:

- 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).



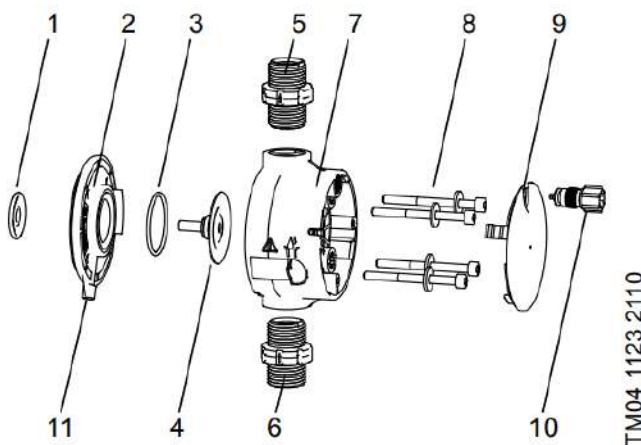
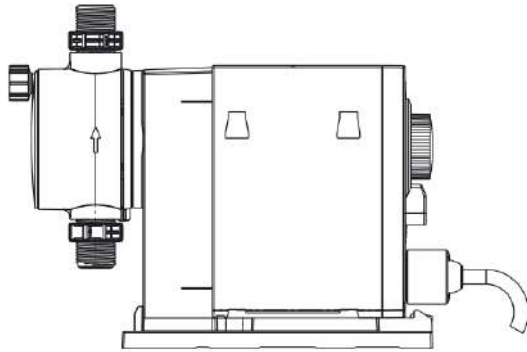
9.4 ADDITIONAL INFORMATION

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

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.

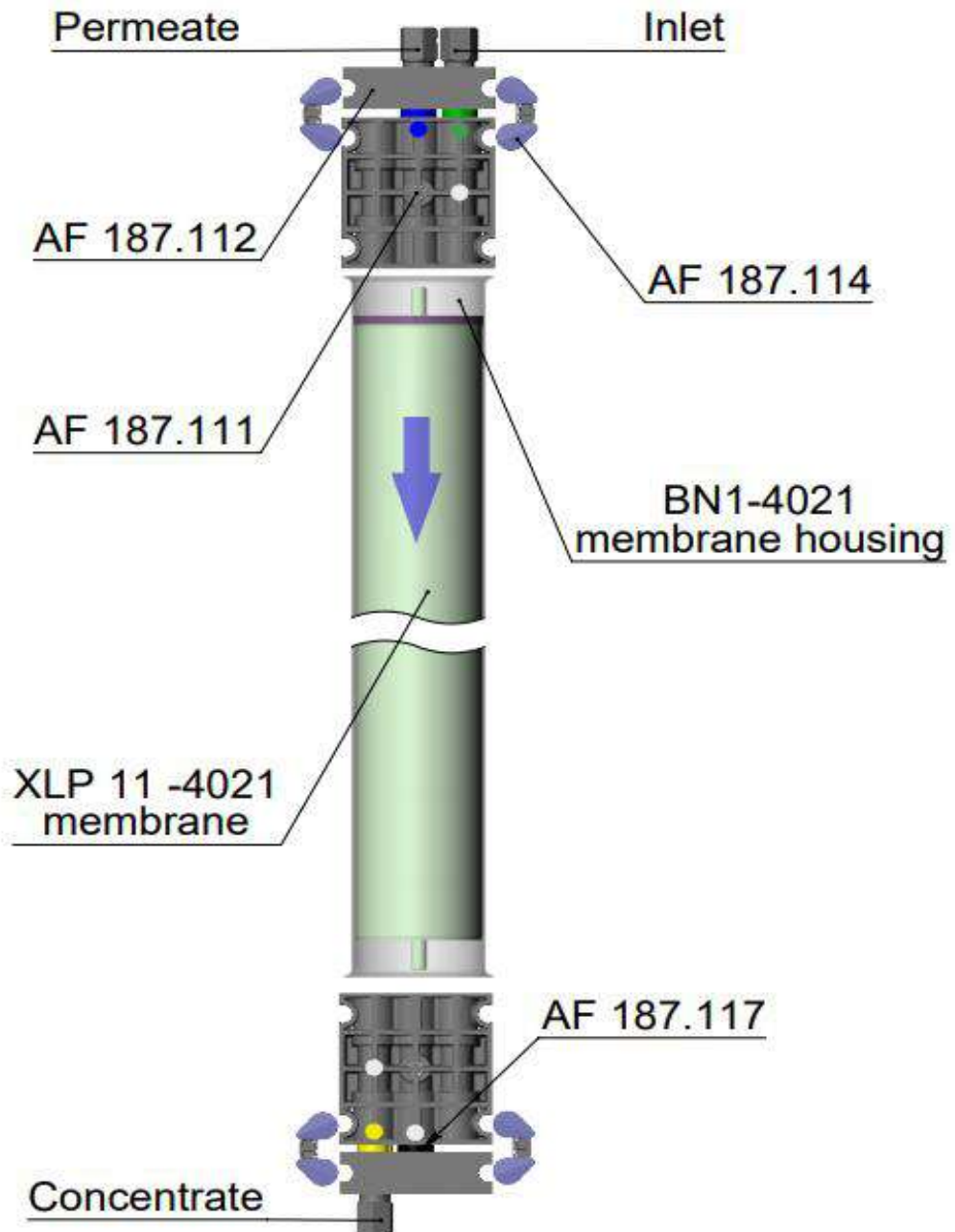
Ensure the right installation direction (arrow on the module) while installing the module.

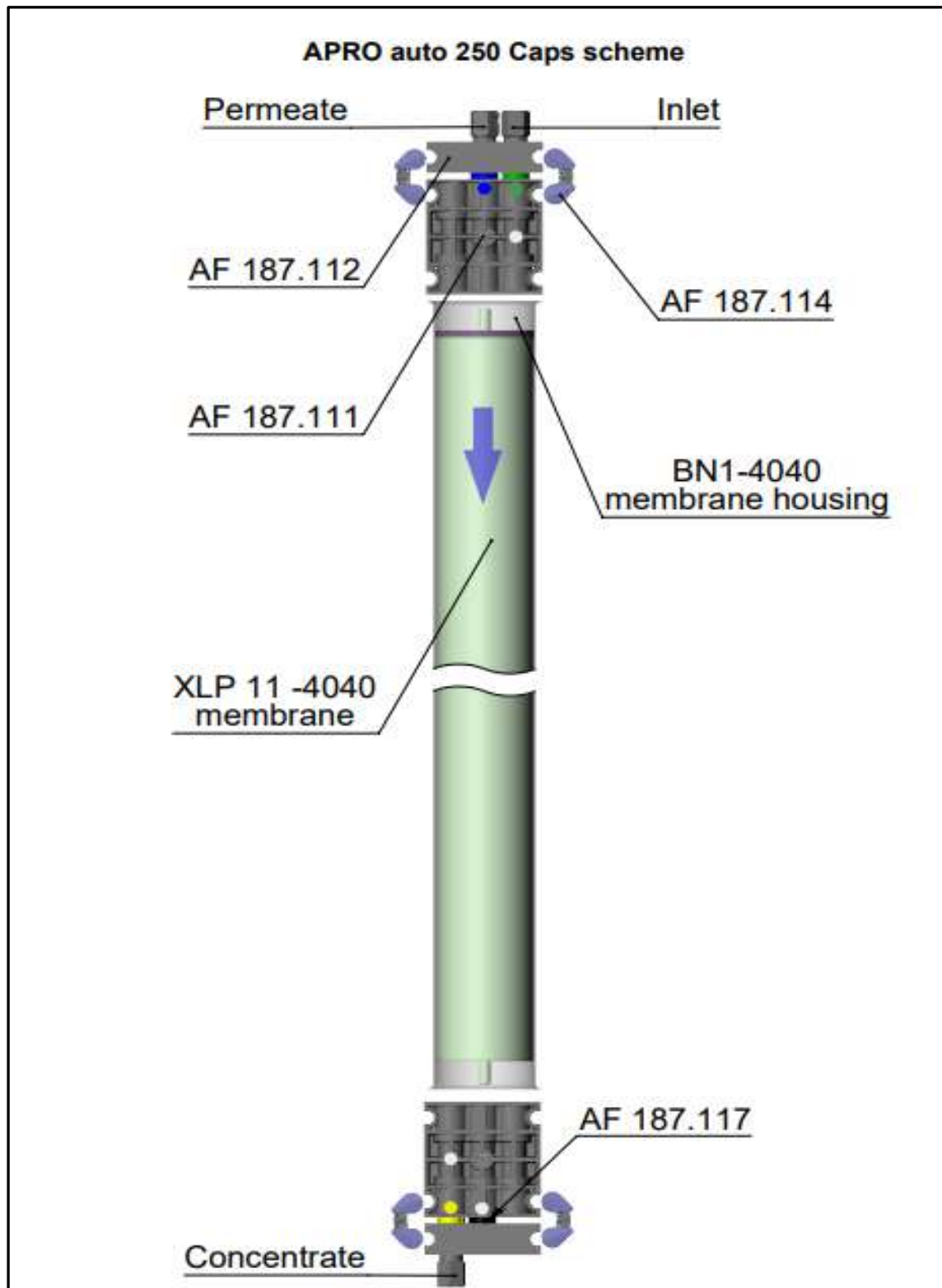


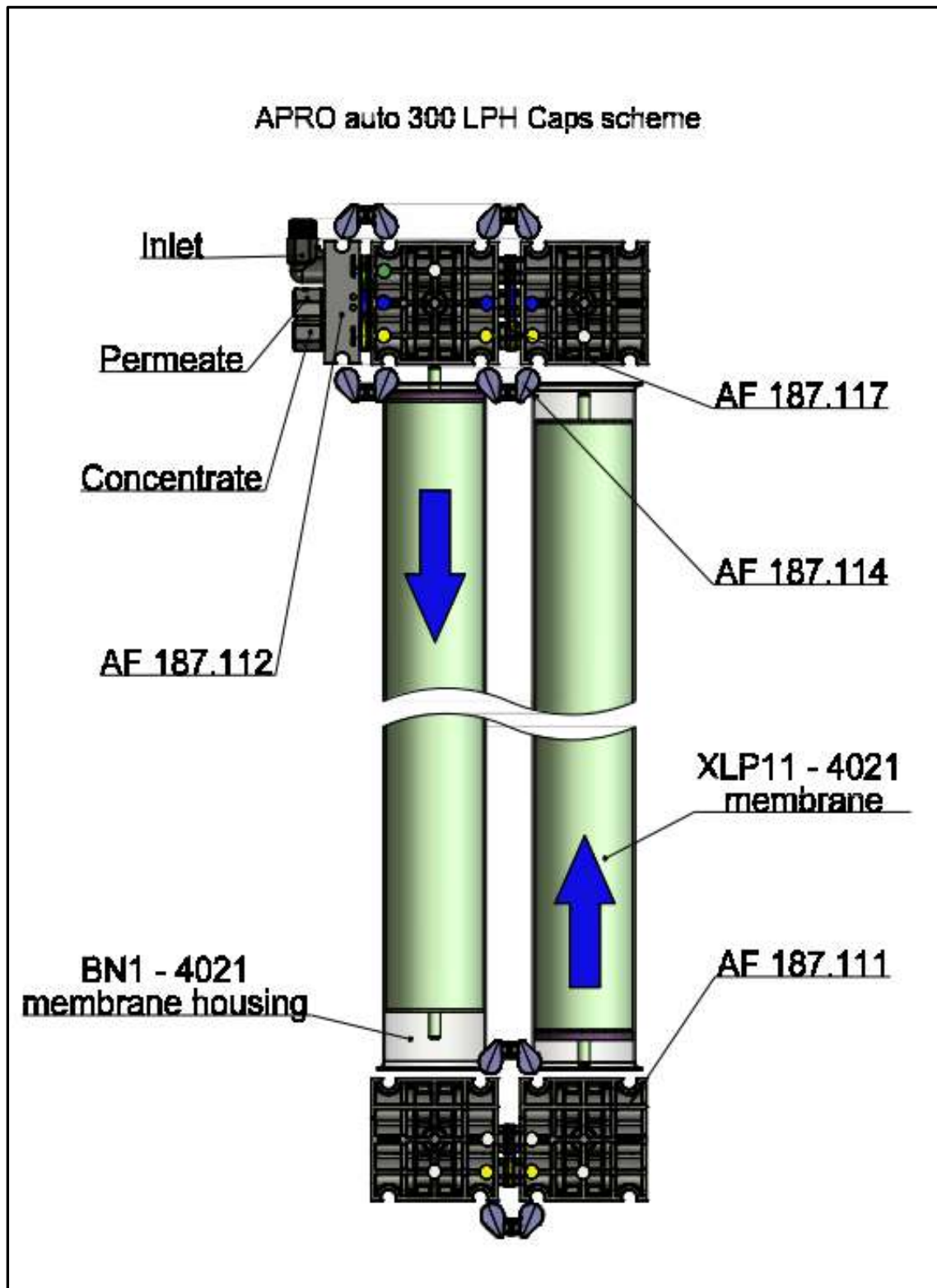
INFORMATION

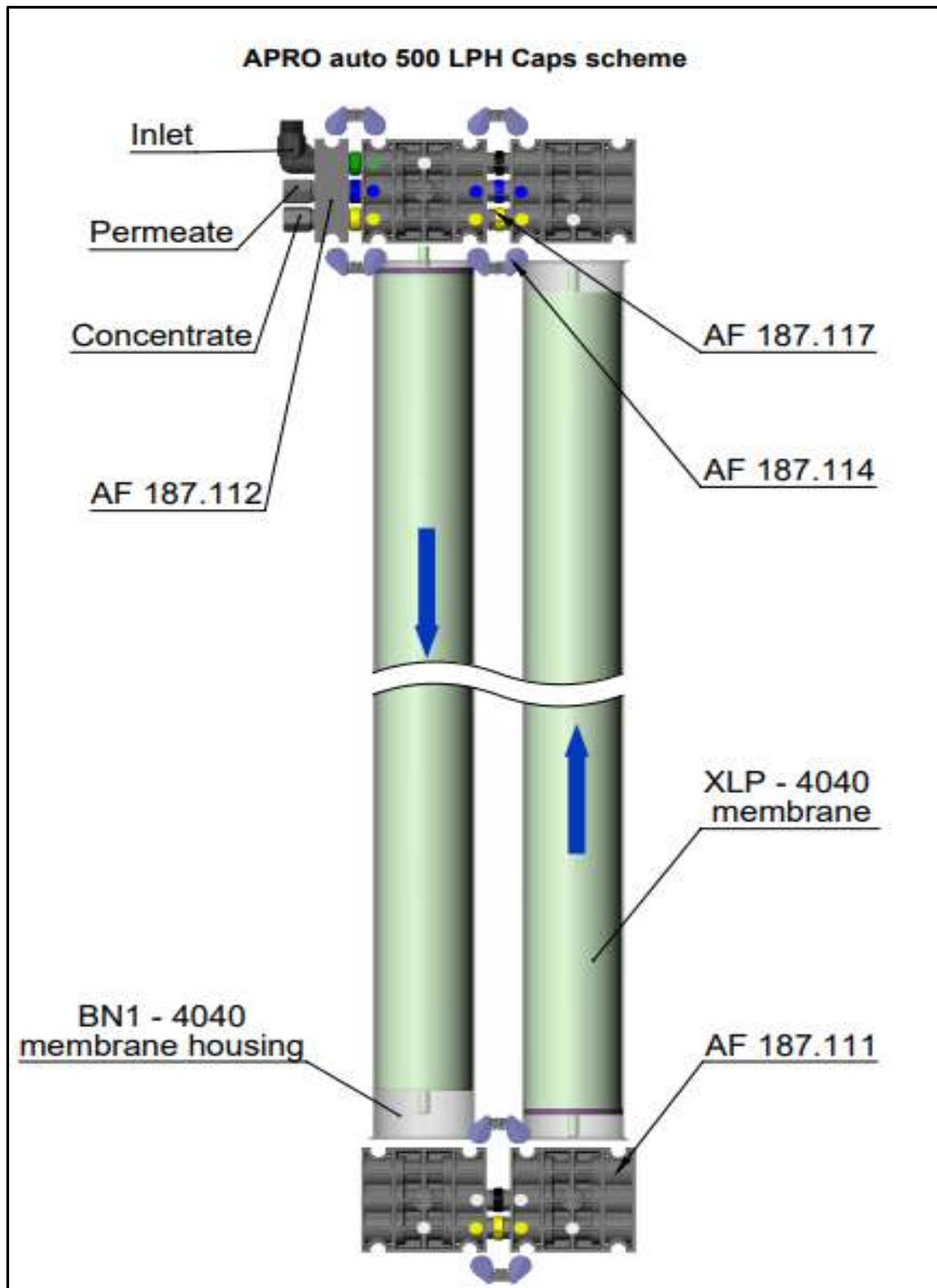
The unit should be commissioned again after a module replacement.

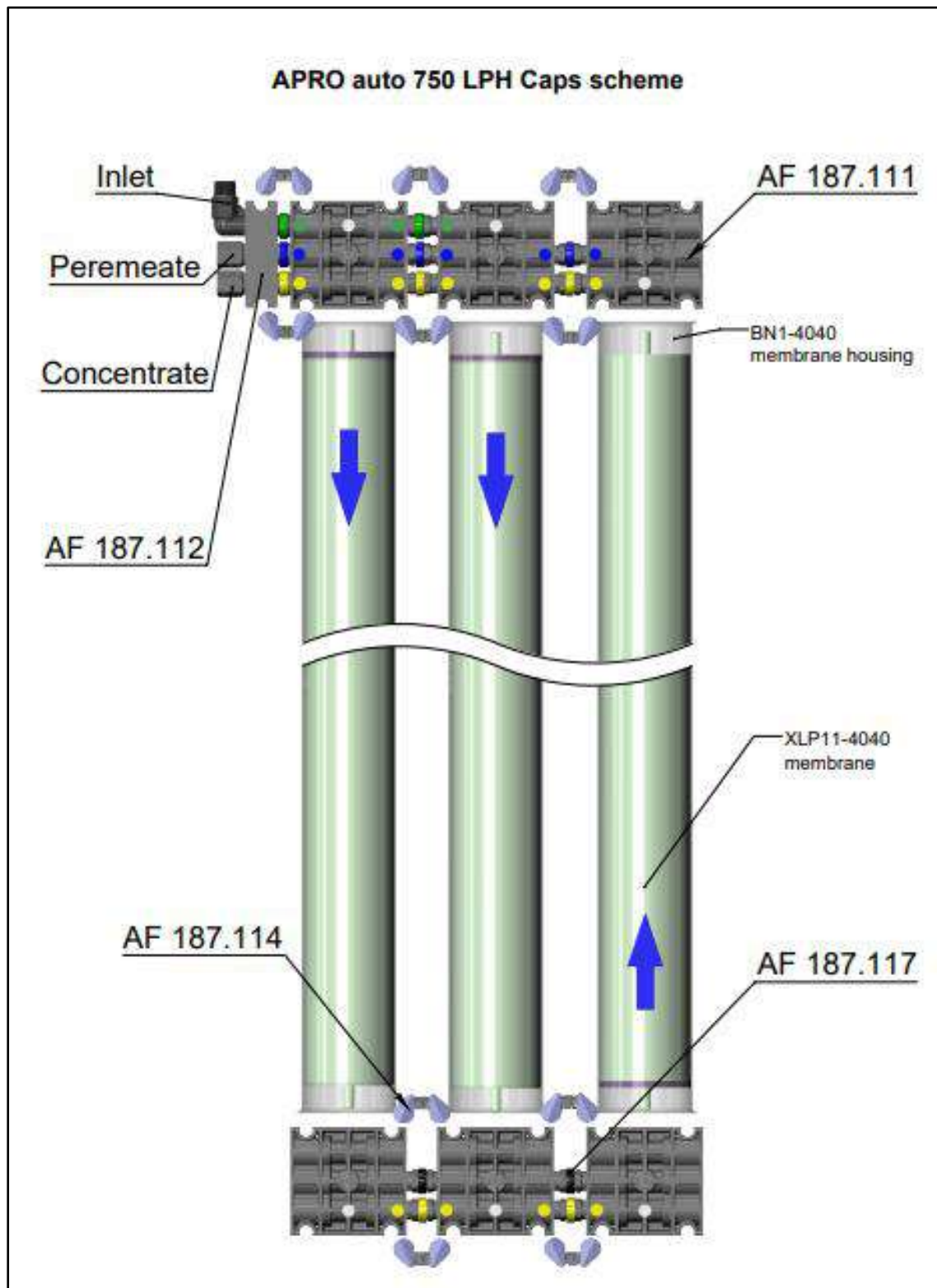
APRO auto 150 Caps scheme





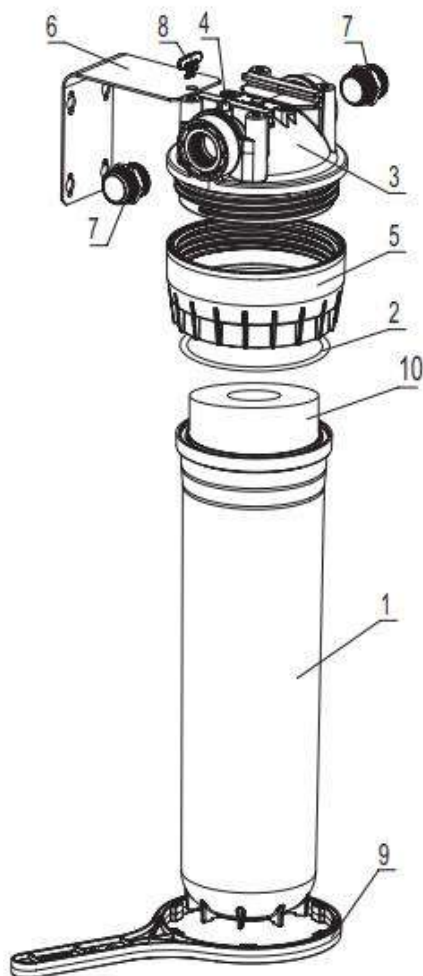






10.3 REPLACING THE FILTER CARTRIDGE

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 YEARLY CHECK AND MAINTENANCE

10.4.1 CABLES AND CABLE CONNECTION



WARNING: uncontrolled motion of the unit; danger of injury

Turn OFF the main switch and prevent the reactivation.



DANGER: Electric shock, Danger of life

- 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.



INFORMATION

Environmental influences might damage the cables and cable connections, which shall be checked periodically.

EXECUTION

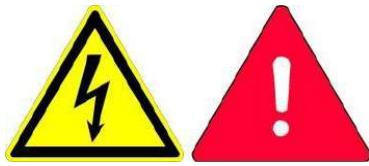
- Check the cables and cable connections.
- Check whether the cables are worn out, have fissures and damages.
- In case of wear out, fissures or damages, contact the customer service.
- Check the cable connections.
- In case of corrosion, contact the customer service.



DANGER: 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. Ø Provide sufficient aeration.

10.4.2 AUTOMATIC CONCENTRATE VALVE FLUSH OPENING



DANGER: Electric shock, Danger of life

- 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

10.5 MEMBRANE FUNCTIONING TIPS

10.5.1 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.

The corrective measures are:

- 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.

10.5.2 LOW FLOW AND HIGH SOLUTE PASSAGE

1. Colloidal Fouling

To identify colloidal fouling:

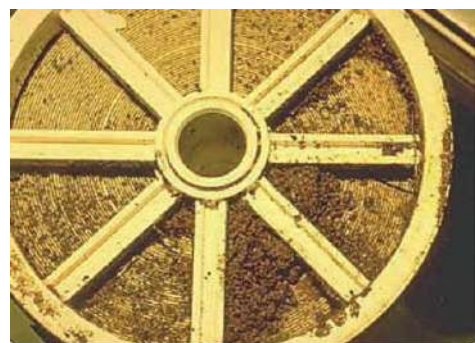
- Review recorded feedwater SDIs. The problem is sometimes due to infrequent excursions or pretreatment upsets.
- Analyze residue from SDI filter pads.
- Analyze accumulations on pre-filter cartridges.
- Inspect and analyze deposits on feed scroll end of 1 st stage lead elements.

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.



The corrective measures are:

- 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.

10.5.3 LOW 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.

10.5.4 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.

10.5.5 QUICK GUIDE (TABLE)

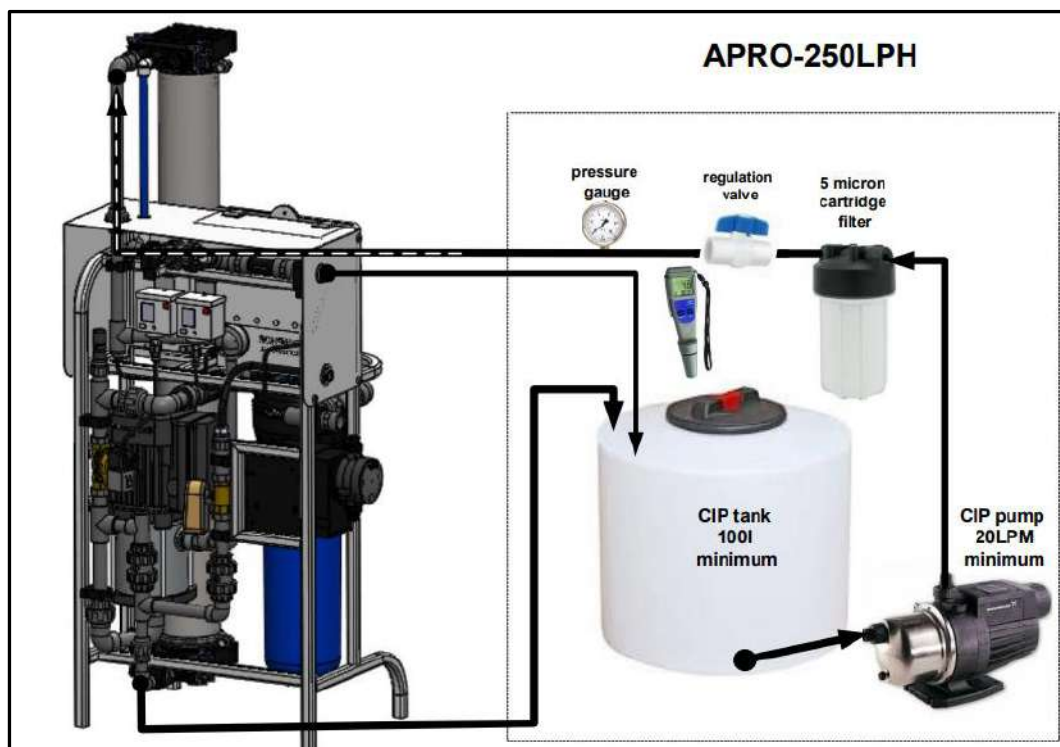
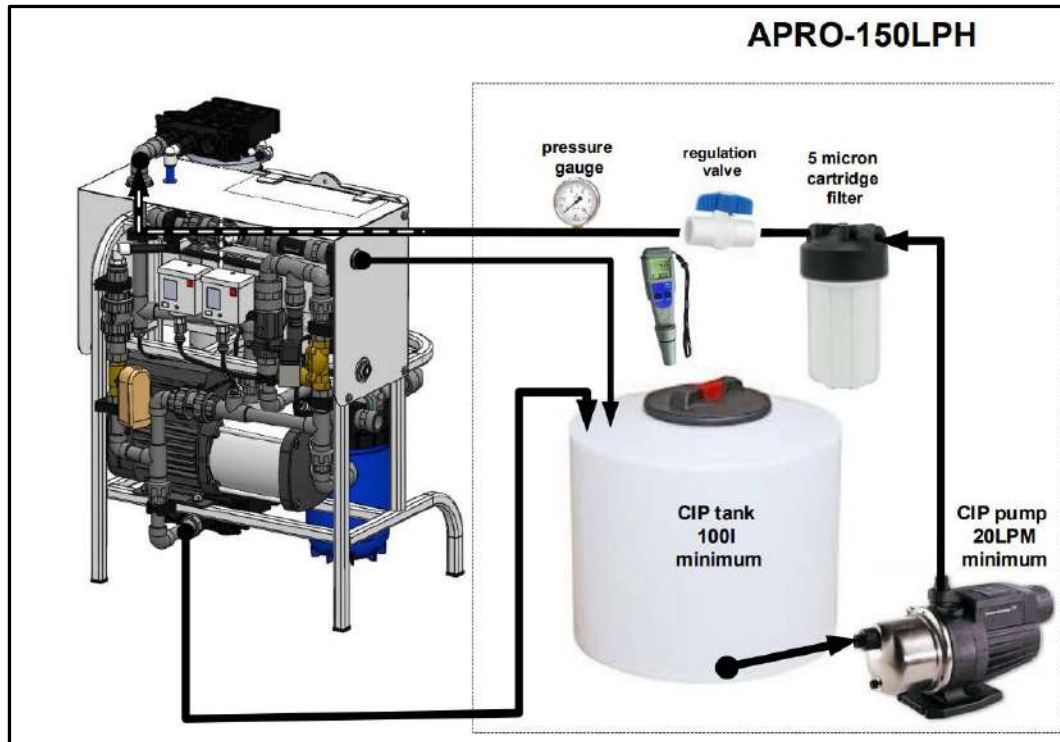
Changes of the permeate flow, the salt passage and the differential pressure are symptoms which can be attached to specific causes in many cases. Although, the symptoms of different causes may over-lap in reality, and the symptoms are more or less pronounced in specific cases.

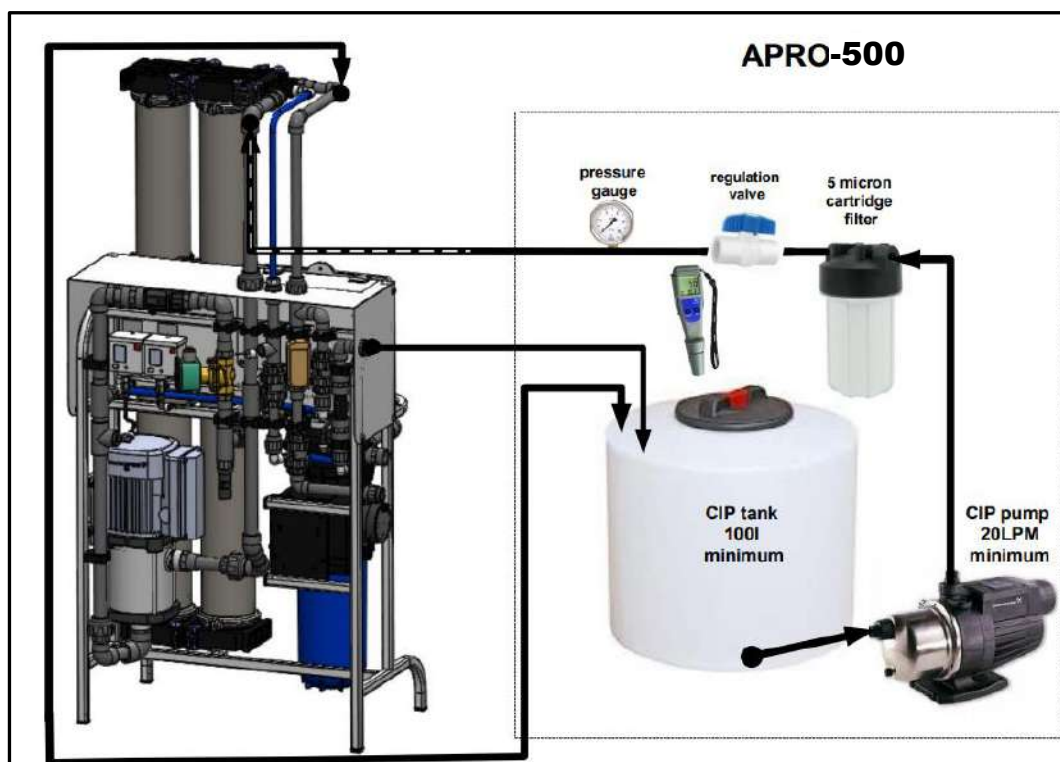
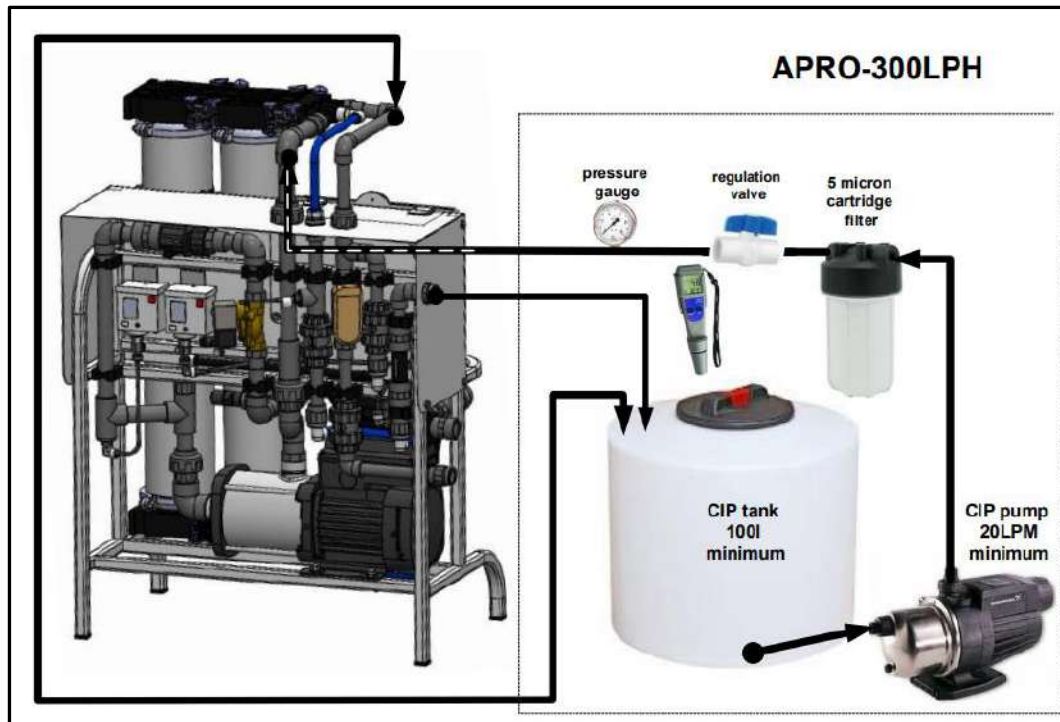
Permeate flow	Salt passage	Differential pressure	Direct cause	Indirect cause	Corrective measure
	↑	→	Oxidation damage	Free chlorine, ozone, KMnO_4	Replace element
	↑	→	Membrane leak	Permeate backpressure; abrasion	Replace element, improve cartridge filtration
	↑	→	O-ring leak	Improper installation	Replace 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

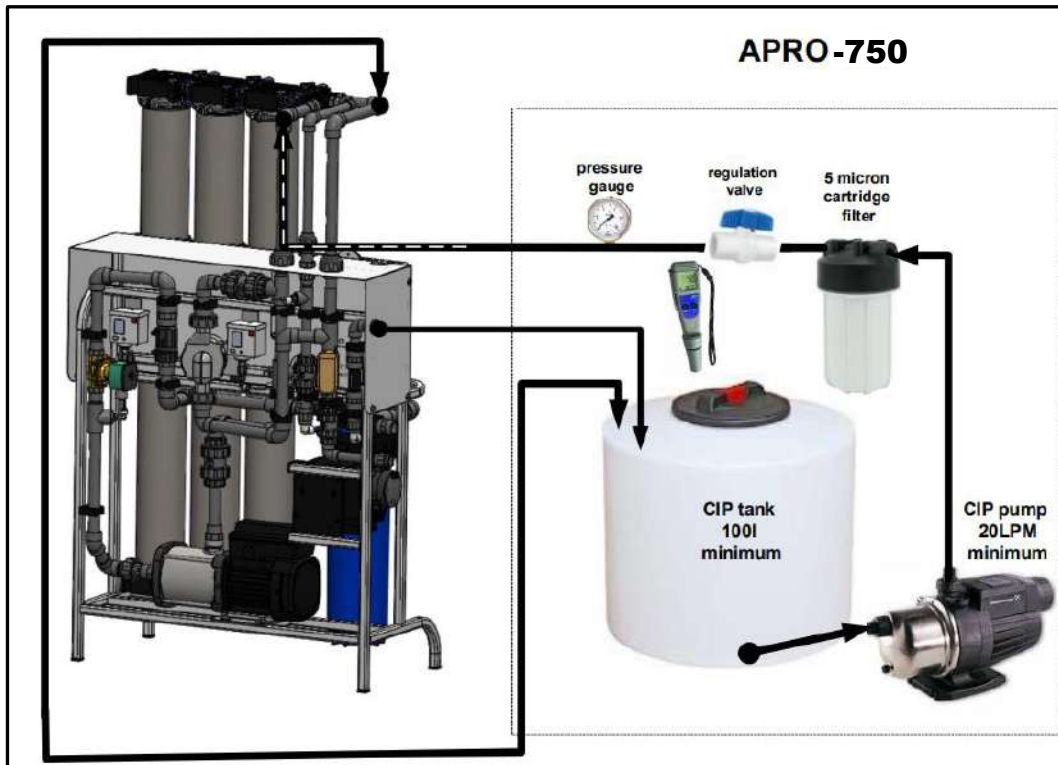
Increasing ↓ Decreasing → Not changing ↑ Main symptom

10.6 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, consequently, the system's performance will decrease.

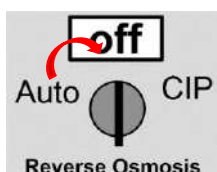






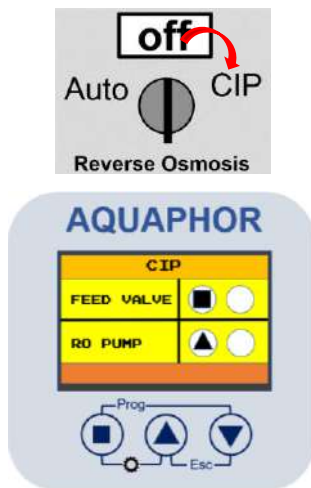
- If the membrane gets stuffed with organics (e.g., biofilm formation), the organic cleaning solution with a pH from 10 to 11 should be used. After the cleaning procedure is complete, check the amount and TDS of the permeate to evaluate the cleaning process's effectiveness.
- If there is a carbonate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



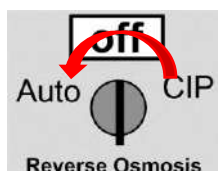
- a) Press “Ok” ■ button to open the Feed Valve (the solution starts flushing the system with raw water) and leave for 10 minutes.



- 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.

10.7 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.

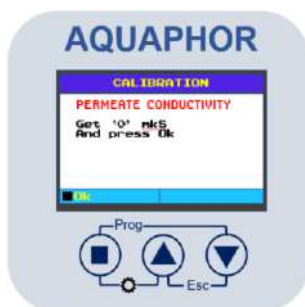


2. Take off the conductivity sensor. Wipe it with the distilled water and dry it.
3. Prepare the calibration solutions of 1413 mkS and 84 mkS. Make sure they are not expired. It is recommended to perform the calibration under 20-25 °C (the room temperature).
4. Hold ▲ button for 10 seconds. The main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

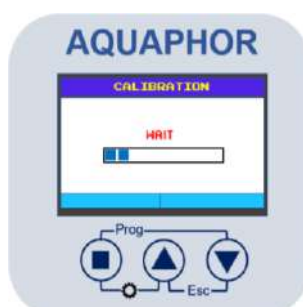



Make sure both of the conductivity sensors show 0 mkS and represent the actual temperature. If the sensor's value is not close to 0, or the temperature sensor represents the wrong value, the corresponding sensor should be replaced.

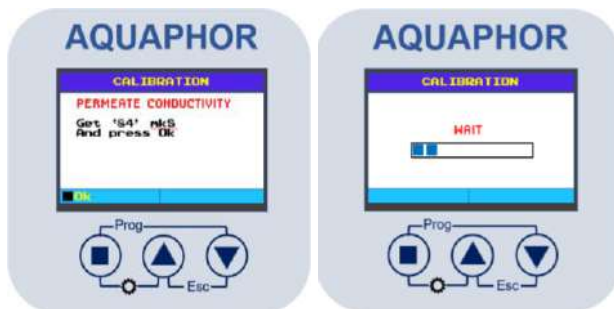
5. Press ■ button. Permeate conductivity '0 mkS' calibration screen will appear:




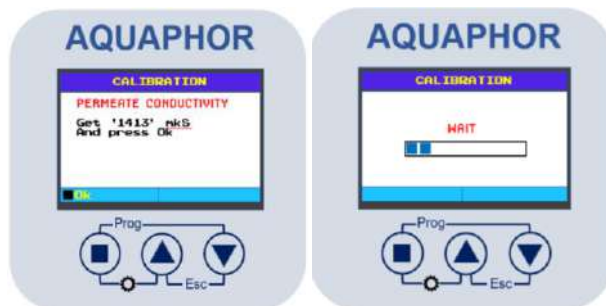
Make sure the conductivity sensor is in the air and press OK ■ button. Hold the sensor into the air while the screen shows WAIT mode.



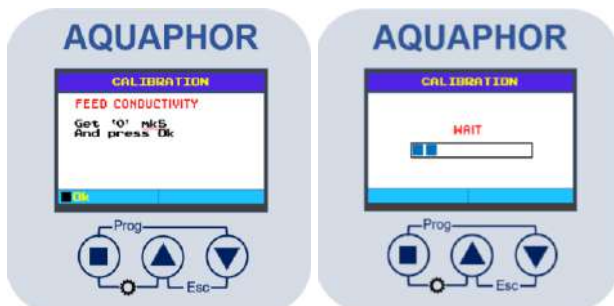
6. The screen switches to permeate conductivity '84 mkS' calibration screen. Place the sensor in the calibration solution 84 mkS. Make sure the sensor do not touch the bottom of the jar. Press OK  button. Hold the sensor into the solution while the screen shows WAIT mode.




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.

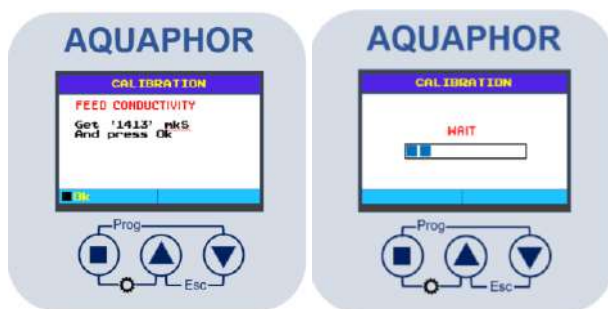


9. The screen switches to feed conductivity '84 mkS' calibration screen. Place the sensor in the calibration solution 84 mkS. Make sure the sensor do not touch the bottom of the jar. Press OK  button. Hold the sensor into the solution while the screen shows WAIT mode.




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.

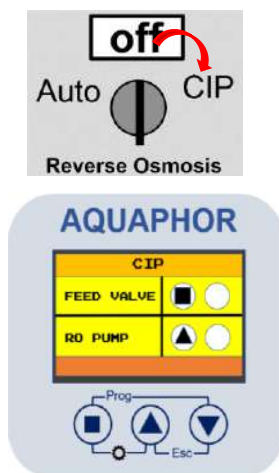
 µS/CM TO PPM CONVERSION TABLE

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

10.8 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 Viking module and fill the gap with SMBS.
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	0000	-	16-bit unsigned int
Config State * (Status word #1)	0001	-	32-bit unsigned int
Startup Flush	0003	sec.	16-bit unsigned int
Shutdown Flush	0004	sec.	16-bit unsigned int
Standby Flush	0005	h.	16-bit unsigned int
Valve Open Time (CL)	0006	sec.	16-bit unsigned int
Low Pressure Delay	0007	sec.	16-bit unsigned int
Full Tank Delay	0008	sec.	16-bit unsigned int
Dosing Pulse	0009	p/min	16-bit unsigned int
Flush Pulse min (HF)	0010	p/min	16-bit unsigned int
Flush Pulse Duration (HF)	0011	sec.	16-bit unsigned int
Periodic Flush h. (HF)	0012	f/h	16-bit unsigned int
Periodic Flush Duration (HF)	0013	sec.	16-bit unsigned int
Valve Flush Opening (CL)	0014	%	16-bit unsigned int
Valve Run Opening (CL)	0015	%	16-bit unsigned int
High Conductivity Alarm	0016	LPM	16-bit unsigned int
Feed High Conductivity Alarm	0017	LPM	16-bit unsigned int
Perm Flow K	0018	K	16-bit unsigned int
Feed Flow K	0019	K	16-bit unsigned int
Permeate Low Flow	0020	LPM (x10)	16-bit unsigned int
Concentrate Low Flow	0021	LPM (x10)	16-bit unsigned int
System Time	0022	unix time	32-bit unsigned int
System Status* (Status word #2)	0024	-	16-bit unsigned int

Parameter	Address	Unit	Type
Start up permit* (Status word #4)	0025	-	16-bit unsigned int
Output Values* (Status word #3)	0026	-	32-bit unsigned int
Errors* (Status word #5)	0028	-	32-bit unsigned int
Detected Errors* (Status word #5)	0030	-	32-bit unsigned int
Startup Errors* (Status word #6)	0032	-	32-bit unsigned int
Permeate Flow	0034	LPM GPM (x10)	16-bit unsigned int
Feed Flow	0035	LPM GPM (x10)	16-bit unsigned int
Recovery	0036	% (x10)	16-bit unsigned int
Tds 1	0037	uSm ppm	16-bit unsigned int
Tds 1 temp.	0038	°C °F	16-bit unsigned int
Tds 2	0039	uSm ppm	16-bit unsigned int
Tds 2 temp.	0040	°C °F	16-bit unsigned int
Total Permeate	0041	l (x10)	16-bit unsigned int
Total Feed	0042	l (x10)	16-bit unsigned int
Average Recovery	0043	% (x10)	16-bit unsigned int
Operating Time	0044	sec.	32-bit unsigned int
STM Serial Number	0046	-	32-bit unsigned int
Low feed pressure	0048	bar (x10)	16-bit unsigned int
Low inlet pressure	0049	bar (x10)	16-bit unsigned int
High RO pump pressure alarm	0050	bar (x10)	16-bit unsigned int
System stop perm. tank pressure	0051	bar (x10)	16-bit unsigned int
System start perm tank pressure	0052	bar (x10)	16-bit unsigned int
Cartridge filter press. drop alarm	0053	bar (x10)	16-bit unsigned int
Cartridge filter resource	0054	m ³ (x10)	16-bit unsigned int
Resource counter	0055	-	32-bit unsigned int
Feed pressure	0057	bar (x10)	16-bit unsigned int
Inlet pressure	0058	bar (x10)	16-bit unsigned int
RO pump pressure	0059	bar (x10)	16-bit unsigned int
Permeate pressure	0060	bar (x10)	16-bit unsigned int
Pressure difference	0061	bar (x10)	16-bit unsigned int
GSM module status	0062	-	16-bit unsigned int
GSM IP	0063	-	32-bit unsigned int

*For version CI/HF

11.4 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

11.5 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		Bit	Name
0	Feed Valve		16	LPS2
1	Permeate Drain		17	HPS1
2	Flush Valve		18	LLSwT1
3	HF Valve		19	LLSwT2
4	Permeate Flush		20	LLSwT3
5	Valve Close		21	HLSwT3
6	Valve Power		22	Pretreatment
7	Feed Pump		23	-
8	RO Pump		24	-
9	Recirc Pump		25	-
10	Permeate Pump		26	-
11	Antisc. Pump		27	-
12	UV		28	-
13	Run Led		29	-
14	Alarm Led		30	-
15	LPS1		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 workmanship 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.: _____

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SYSTEM EQUIPMENT LIST

Tag	Name	Material	Connection Size	Code
F-01	Cartridge Filter Housing	SS	1"	W0007320
P-01	Pressure pump	SS	1"	W0005977
P-02	Recirculation pump	SS	1"	W0007888
DP-01	Dosing pump	PVC	½"	PDDE610B
LPS-02	Low pressure switch	BRASS	¼"	W0002424
LLS-02	Low Level Sensor	PVC		W0006893
PI-01	Pressure Indicator			
PI-02	Pressure Indicator			
FT-02	Feed flow sensor	PP	1"	W0010995
FT-01	Permeate flow sensor	PP	1"	W0010995
XV-01	Feed valve	BRASS	1"	W0005579
XV-02	Drainage valve	BRASS	½"	PDHSV12B
XV-04	Concentrate valve	SS	½"	W0010075
XV-05	Flushing valve	BRASS	½"	PDHSV12B
ECT-01	Permeate conductivity sensor	SS	¼"	W0007314
CV-01	Check valve+spring 1bar	PVC	20mm	PPVVC020+W0011296
CV-02	Check valve	PVC	20mm	PPVVC020
CV-03	Check valve+spring 2bar	PVC	20mm	PPVVC020+W0011297
CV-04	Check valve	PVC	20mm	PPVVC020
CV-05	Check valve	PVC	25mm	PPVVC025
MV-01/02	Membrane housing	SS		W0007267
	RO Membrane	TFC		W0003728
	Cartridge Filter			AF15-500/H821,833
	Antiscalant PC-191			NALCOPC-191.11R

REMARKS

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