ESLI

POLLET WATER GROUP

ALFA SERIES REVERSE OSMOSIS SYSTEMS
USER MANUAL

AQUALINE®

ESLI

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These instructions for use should always be kept near the device and in an easily accessible place when necessary.

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1. INTRODUCTION

ESLİ Industrial Products Marketing Industry and Trade Limited Company has rights to change all information that exist in operating manuals without any prior notice. All informations can be changed in those operating manuals. ESLİ AQUALINE operating manuals are prepared for customers and contains important information for starting up the system in safe and maintenance the system. Operating manual must be near the system to reach easily when it is required.

1.1 ABOUT THE INSTRUCTION BOOK

There is important information for use and care of devices of the system inside the ESLİ AQUALINE ALFA SERİES REVERSE OSMOSIS SYSTEMS operating manuals. Manual must be read attentively by all responsible people for the system. Thus, the system can be carried, stored and operated safely after purchasing the system. People who are responsible for the system must act according to advice and directions otherwise, the person who did the process will be in charge.

1.2 MODEL IDENTIFICATION

ESLI AQUALINE Reverse Osmosis System is called as a figüre that is below.

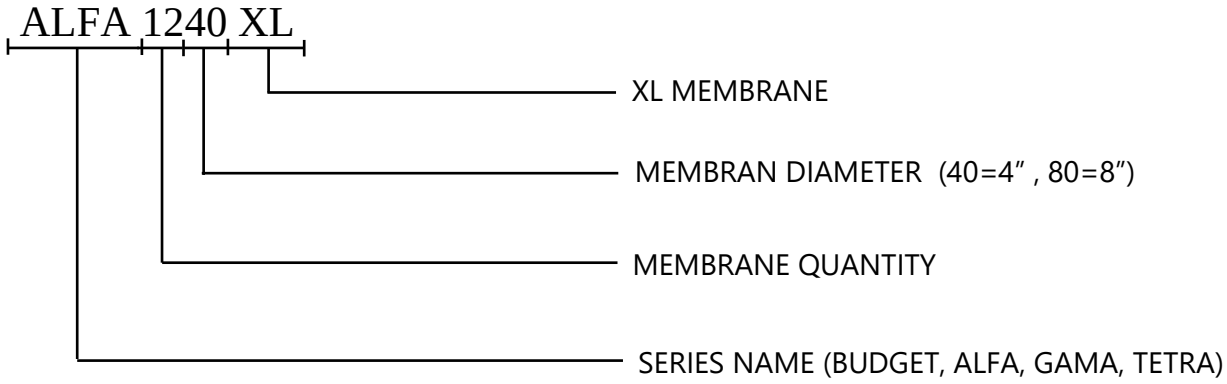


Figure 1-1: AQUALINE RO Systems Model Identification

1.3 DEFINITION OF ALFA SERIES REVERSE OSMOSIS SYSTEM

1.4 Explanation of Reverse Osmosis System

Reverse Osmosis system is called the membrane filtration process to obtain pure water applied to the water and that is applied water that a classic water treatment system can not be enough. Also, the RO system suspends all undesired minerals from the water. Membranes on the system have an important role for working principle of reverse osmosis system. Water is forced to pass through the pores on the membranes under high pressure. During the process, water molecules and some organic molecules can be passed through those pores, most of the substances in the water can not be passed through those pores and product water is excreted as permeate water. Reverse osmosis devices are popular with improved technology and automatic RO devices are able to produce. High quality with desired permeate water flow is able to be obtained with an improved RO system.

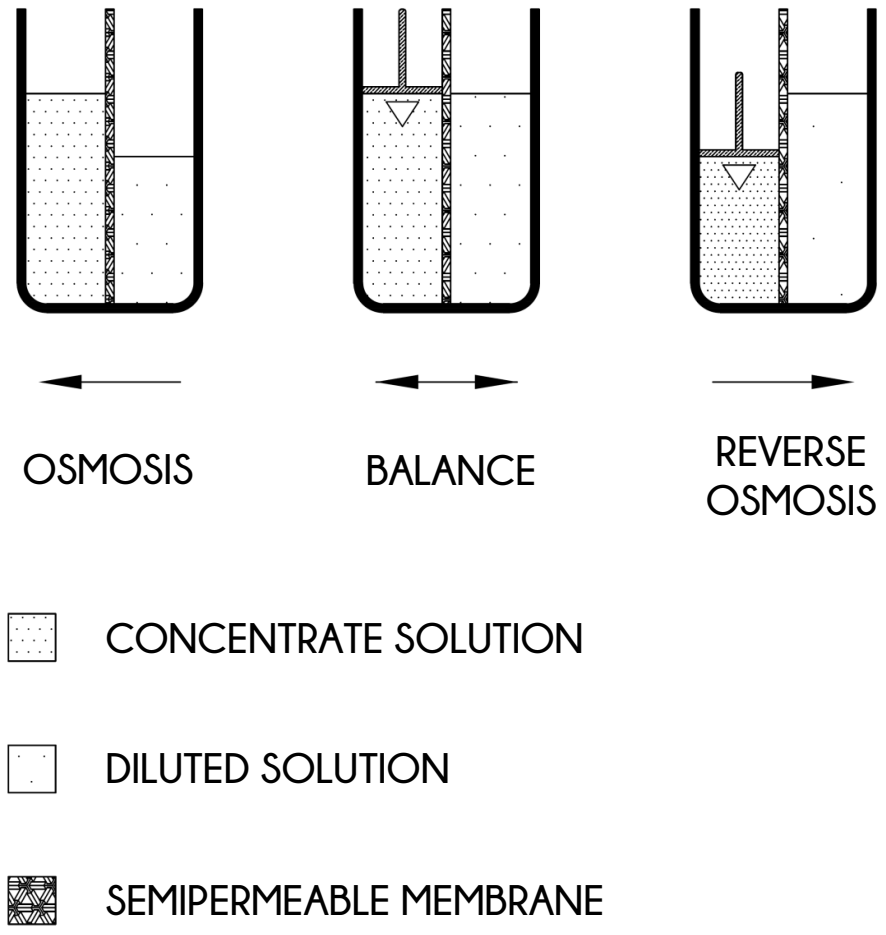


Figure 1-2: Osmosis & Reverse Osmosis Relation

1.4.1 Working Principle of Osmotic Pressure and Reverse Osmosis System

Osmotic pressure is a pressure created by water. There is an active value of any solution with a specific density to absorb the pure water that is in contact. That value is called the osmotic value of solution. The pressure that exists during the osmotic process is called osmotic pressure.

Osmosis has a significant role in the wild for the life of creatures. Understanding the principle of reverse osmosis is difficult without knowing the principle of osmosis. Osmosis is occured as vegetations sucks the water from the soil, receiving and giving water from the blood to feed the cells in the body, also works flawlessly in many places, such as separating blood from urine in the kidneys in nature. Water in the soil goes up to the plant water that is more salty with an open membrane on the plant root with osmosis despite the water pressure in the soil is less than the water pressure at the root of the tall tree. Thus, osmosis provides entrance of water from the soil to the root of tall trees. That natural phenomenon proves us there is pressure of less mineral water by comparing with the water having more minerals. Thanks to the osmotic pressure due to salty difference between water, water under the same atmospheric pressure can pass through easily the membrane that divides the creatures or cells. The law of compound vessels is not valid for this natural phenomenon that water is divided by membrane. For the RO systems, that principle uses inversely to get good quality water from bad and salty water.

1.4.2 Reverse Osmosis Membrane Qualification

Reverse osmosis system based on membrane filtration feed by the pressurized flow is parallel to the surface of membrane. Part of this flow keens on and passes through the membrane. Particles that could not pass through the membrane make concentrated solutions. This solution flows as parallel to the surface of the membrane. Hence, collapsing of dissolved minerals and particles on the membrane prevents.

Reverse osmosis membrane makes its duty against as a barrier to all dissolved salts, inorganic molecules and organic molecules with a molecular weight greater than about 100. Water molecules in the other words, molecules pass easily through the membrane create purified production flow. The efficiency of reverse osmosis system for separating dissolved salts from water molecules is between % 95 - %99.

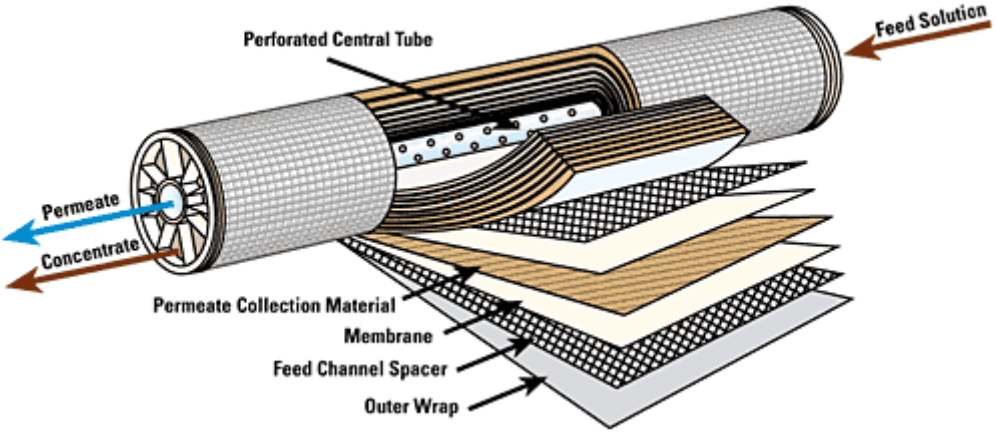


Figure 1-3: Cross Section View of Membrane

1.5 STANDARD DESIGN DATA

AQUALINE ALFA SERIES Reverse Osmosis system is designed by expert engineers with OLTREMARE SIRIO software. After entering Feed water and permeate water values on the software, reverse osmosis system design is projected. Feed water values accepted by ESLI are given below for the standard system.

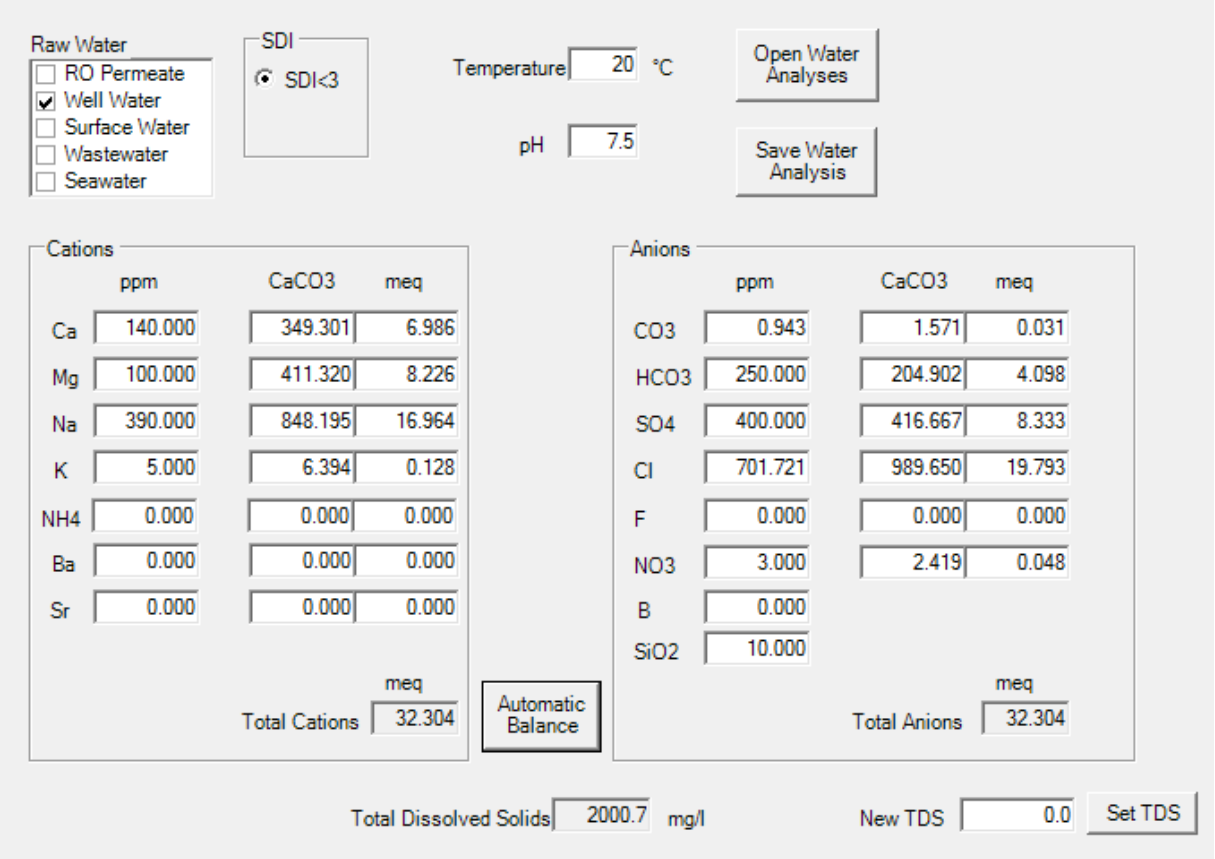


Figure 1-4: AQUALINE ALFA Series RO Systems Standart Design Data

1.6 APPLIED AREAS

- Drinking Water Production: Drinking Water Production: Main purpose of using a reverse osmosis system is obtaining drinking water. RO system is used commonly to get drinking water from water containing high salt.
- Soft Drink Industry: Fruit juices are concentrated for making their shelf life longer, carrying and stored and reducing the cost. Then they are diluted and pasteurized before selling. After that they are packaged. During the concentration of juice, it is made by vacuum evaporation and volatile flavors disappear with steam during that time but if membrane technology is used during concentration time, more qualified products will be obtained because of no loss for flavors. Also, membrane technology is used commonly for preparing soft drinks. Operating a reverse osmosis system is easier than conventional methods and more qualified water is obtained with lower cost.
- Steam Boiler Feed Water: Especially in plants that use open steam, there is low condensate. Always new feed water is given to the steam boiler in that type of steam system. Thuse, the conductivity of boiler water increases rapidly and a lot of boiler bluffs are made to reduce conductivity. Boiling water is thrown during boiler blowdown and bluffing from the boiler also means heat loss but this is not economical. Steam boiler has to be cleaned by low conductivity water prepared with reverse osmosis system instead of high conductivity water because boiler bluffs decrease 97% and cost of owner decreases.
- Steam Generator Feed Water: Water comes to steam generators is converted to steam in short time and petrifies inside the pipes of every mineral generator except water molecule in water. There is no effect for softening process for water not to petrifies because softening removes calcium and magnesium but that gives sodium molecules and many minerals to water. Minerals cause petrification which decreases the heat efficiency of generators in a short time. However, steam generator can be fed by water these are produced with reverse osmosis and purified water and problems experienced can be decreased.
- Preparing Cooling Water: Cooling waters are prepared by using reverse osmosis devices in order to increase the formation of stones and scales, product quality and

production speed in mold cooling waters For industrial establishments that make precise metal casting and precise plastic injection.

- Power Plant: In power plants, the quality of pure water under 0.1 µS/cm conductivity and the amount of Silicate (SiO2) in water should be under 0.05 mg/ t. This water purification process is usually done with reverse osmosis systems. Up to 99% of the unwanted minerals in the feed water are separated by reverse osmosis systems. After that, the water is purified by a mixed-bed demineralization system or Electro-Deionization (EDI) system.
- Textile Process Water: Softened water is often used in textile dye houses. Due to the change in the seasons for Well and Dam waters, it is impossible to obtain water as product quality in every period of the year because seasonal changes occur in the waters coming from the springs. Product waters obtained by using reverse osmosis systems are preferred in the product waters of textile dye houses, as they are minimally affected by seasonal changes.
- Chemical Industry: In some chemical industries, the low conductivity water required for the process and this water is obtained by reverse osmosis systems.
- Pharmaceutical Industry: Reverse osmosis systems are used as a pre-treatment device in the pharmaceutical industry, in the production of pure water used in the manufacture of medicines given to humans by syringe. Then, this water is used by purifying with distillation and micro-filtration methods. Dialysis machines in hospitals are fed with quality water produced with reverse osmosis devices.

2. HEALTH & SAFETY

ALL HEALTH AND SAFETY PRECAUTIONS DESCRIBED UNDER THIS SECTION MUST BE READ CAREFULLY AND ALL WARNINGS MUST BE FOLLOWED.

2.1 WARNINGS AND PRECAUTIONS ABOUT THE SYSTEM

- Δ Antiscalant dosage is so essential for membranes of RO units. Thus, If there is dosage of antiscalant for system design, won't work until finishing of dosage.
- Δ If different antiscalant from advised from ESLİ for the system, ESLİ is not responsible for damage that can be occured on the membranes.
- Δ The level and suction of antiscalant must be controlled usually.
- Δ Membranes must not be without water in the RO unit. The RO system has to be worked once and 2 hours per day for a shorter than 4 days stopping of the system. At the section of *7.2.2.1 Deactivation the System in Short-Term Stopsı* more information exists. At the section of *7.2.2.2 Deactivation the System in Long-Term Stops* the way has to be followed.
- Δ Check usually membrane entrance pressure of RO unit. If the pressure increases, will look for the reasons and will take precautions.
- Δ The conductivity of concentrated and permeate water of RO Unit has to be checked. If the conductivity increases, we will have to analyze precautions.
- Δ The flow rate of permeate water and drainage concentrated water has to be checked usually. If the flow rate increases or decreases, will have to analyze the causes and take precautions.
- Δ The shelf life of RO membranes is minimum 3 years in normal conditions. If the recovery of membranes or the efficiency cannot be increased despite chemical washes in case of clogging of membranes, membranes will have to be replaced.
- Δ It is important to work with water supply chlorine. If there is an ORP probe in the system, chlorine concentration has to be controlled when the rings of ORP alarms, and chlorine value must be under 0 ppm. If chlorine exists in the raw water, chlorine must be prevented from active carbon filtration and SBMS dosage

- Inlet and outlet valves should not close when the system works.
- System should be used just for treating brackish water and municipal water.
- Sistem devrede iken sistem drenaj hattındaki iğne vana asla kapatılmamalıdır.
- Needle valve at the drainage line must not be closed when the system works
- Reverse Osmosis Device will be shipped to your business as a package system. Linkage of feed product and drainage line that are empty on the device will be done on site. Detailed information exists at the section of *5.2.2 Hidrolik Montajı*.

2.2 HEALTH PRECAUTIONS

- Δ Fire must not be used in areas where chemicals are stored and used.
- Δ Using chemicals could be so dangerous. That's why staff should pay attention not to hurt anyone by taking precautions. Education of staff to use chemicals properly is the responsibility of the customer.
- Δ The panel cover should not be closed while the panel is energized. It can be exposed to high voltage.
- Δ Any different operation and maintenance from manual should not be done. System should be used just for water treatment.
- Δ All pipings on the system must be controlled everyday. For detecting leaks and leaks the system should be stopped and necessary precautions should be taken. Any equipment on the system line should not be disassembled due to the unknown pressure or high pressure.
- Δ Responsible staff should use protective equipment during the system maintenance. Protective clothing and equipment should be used at all times, especially the face, eyes, hands and neck should be protected. Staff should be careful not to be allowed to come into contact with the eyes, skin and clothing, and vapors should not be inhaled.
- Δ Voltage changes should be checked periodically. Electrical lines that will feed the system must be grounded; Precautions should be taken against phase change or voltage drop.
- Δ It should never be entered into a tank exposed to chemical steam or a closed area without a suitable ventilation system and accompanying personnel.
- Δ In the water treatment system, water is conditioned with the help of chemicals. Chemicals are used pre or post treatment such as chlorine, sodium metabisulfite, acid, caustic. Among the chemicals, its effect is acid burning differently from sodium metabisulfite, caustic, antiscalant, and chlorine, you should pay attention to this feature.
- Δ Energy should be cut off inside the panel before working and it should be controlled with a control pan or avometer not to bring energy to the panel. You should not

intervene with any equipment or instrument that is fed with electrical energy before cutting off energy.

- Δ System should be protected against the risk of freezing.
- Δ Main energy must be cut off, dry powder fire extinguisher should be used and water should be thrown during the fire extinguishing process.
- Δ System should be worked at the range of flow rate that is expressed in manual. Maximum work temperature is 40°C. System must not be worked over that temperature value.
- Δ Electric current should be cut off from the switch or the contact of casualty with the bare cable should be cut with a non-conductive object. In the case of an accident, first aid should be applied immediately. If there is a loss of consciousness, a burn or a fracture due to a fall, the transplant should be provided without lifting.
- Δ In every severe injury, a doctor or nurse should be called for every situation.
- Δ If the chemical is swallowed and the consciousness of the patient is good, the mouth of the patient will clear with plenty of water. It is important that the tongue of the patient should be forward and the regularity of breathing should be checked. The patient should not be attempted to be used. If there is a loss of consciousness of the patient, anything should not be given by mouth.
- Δ If there is contact with eyes, eyes should be cleared with plenty of water for 15 minutes. If there is a shock condition, tight clothes should be loosened and feet should be raised around 30 cm above (heart level) the ground.
- Δ If a person breathes the chemical vapor, the patient should be taken to fresh air immediately. If the breathing of the patient stops, artificial respiration should be applied.
- Δ Clothes that are contacted to chemicals should be taken off. Body areas that were affected by chemicals should be cleaned with plenty of water for 15 minutes.
- Δ In the case of burning, any oil or ointment should not be applied to the burned areas. If there is a flame burn and synthetic clothes are adhered to the skin, they should not be removed. Clothes were exposed to age and heat should not be removed

3. TECHNICAL SPECIFICATION

3.1 GENERAL TECHNICAL SPECIFICATIONS

In this section, technic informations are given about ALFA SERIES REVERSE OSMOSIS devices and panels on these devices

3.1.1 General Technic Informations about Alfa Series RO Devices

Standard general technical specifications of Alfa Series RO devices are expressed below.

- **Membrane Vessel** **:** It is manufactured with FRP material in FRP standard, optionally in stainless steel.
- **Membrane** **:** Membranes that are 4 inch diameter and TFC spiral winding are used in the devices
- **High Pressure Pump** **:** Rotary types with brass body vertical centrifugal high pressure pumps are used in ALFA 140 and ALFA 240 models, vertical centrifugal high pressure pump is made by SS304 stainless steel is used in ALFA 340 and ALFA 1540.
- **Chassis** **:** Chassis are made by SS304 stainless steel for Alfa 140 – Alfa 640, they are made by ST-37 carbon steel for. Also, they can be made by SS304 stainless steel for Alfa 840 – Alfa 1540 optianally.
- **Cartridge Filter** **:** There exists a 5 micron precision cartridge filter before the RO unit.
- **Piping** **:** Low and High Pressure installations are made of UPVC/Zonder pipes. Optionally, it can be made by stainless steel.
- **Otomatik Vana** **:** Automatic valves with electric actuator are used as standard
- **Control Valves** **:** There exists flow control on the pump outlet and waste water lines.
- **Pressure Switches** **:** There exist low and high pressure switches.

- **Flowmeter** **:** Permeate water and concentrated water outlet flow meters exist in all models. Also, return scratch flow meter exists additionally for between Alfa 340 – Alfa 1540 models

- **Manometer** **:** There exist manometer glycerine manometers in all models.

- **Conductometer** **:** Permeate water conductometer exists as standard in all models

- **Autoflush** **:** There exists an autoflush system as standard in all models

- **Printed Circuit Card** **:** As a standard condition, electronic control cards have alarm and condition lambs are used.

- **Electricity Supply** **:** Single-phase feed is required for Alfa 140 and Alfa 240, Three-phase feed is required for between Alfa 340 – Alfa 1540

- **Design Limits** **:** İnlet water limits are shown below for Alfa series reverse osmosis devices with standard design;

  - Inlet Water TDS : ≤ 2000 ppm
  - Inlet Water Pressure : 2-5 bar
  - Inlet Water pH : 6-8
  - Silica (SiO_2) Tolerance : Up to 25 ppm
  - Inlet Water Temperature : 10 – 30 ° C
  - Iron (Fe) Tolerance : 0,05 ppm (If ASC dosages, will be 0,2 ppm)
  - Hidrogen Sülfid Tolerance : 0 ppm (Zero)
  - Turbidity Tolerance : NTU < 1
  - Oil Grease Tolerance : 0 ppm (sıfır)
  - SDI : < 5
  - Microbiological Pollution : Must not exist.

Differences between Alfa Series RO systems are shown on the next page that is *Tablo 3-1: ALFA Series RO Systems Technical Details Table*

MODEL	FEED CAPACITY (m^3/day)	PRODUCT CAPACITY (m^3/day)	MEMBRANE SIZE (diameter x length)	MEMBRANE AMOUNT	RECOVERY (%)	ENGINE POWER (kW)
ALFA 140	10	5	4" x 40"	1	50	0,64
ALFA 140 XL	13	6,5	4" x 40" XL	1	50	0,64
ALFA 240	20	10	4" x 40"	2	50	0,64
ALFA 240 XL	25	12,5	4" x 40" XL	2	50	0,64
ALFA 340	25	15	4" x 40"	3	60	1,5
ALFA 340 XL	33,5	20	4" x 40" XL	3	60	1,5
ALFA 440	33,5	20	4" x 40"	4	60	1,5
ALFA 540	42	25	4" x 40"	5	60	2,2
ALFA 440 XL	46	27,5	4" x 40" XL	4	60	1,5
ALFA 640	50	30	4" x 40"	6	60	2,2
ALFA 540 XL	58,5	35	4" x 40" XL	5	60	2,2
ALFA 840	57,5	40	4" x 40"	8	70	2,2
ALFA 640 XL	70	42	4" x 40" XL	6	60	2,2
ALFA 940	64,5	45	4" x 40"	9	70	2,2
ALFA 1040	71,5	50	4" x 40"	10	70	2,2
ALFA 840 XL	75	52,5	4" x 40" XL	8	70	2,2
ALFA 940 XL	86	60	4" x 40" XL	9	70	3
ALFA 1240	86	60	4" x 40"	12	70	3
ALFA 1040 XL	96,5	67,5	4" x 40" XL	10	70	3
ALFA 1540	107,5	75	4" x 40"	15	70	3
ALFA 1240 XL	118	82,5	4" x 40" XL	12	70	3

Table 3-1: ALFA Series RO Systems Technical Details Table

3.1.2 Technical Information About Alfa Series Reverse Osmosis Panel

The Alfa Card Panel is used as standard for Alfa Series Reverse Osmosis devices. There is production of 3 different panels from the Alfa Card Panel. These are Alfa Plus, Siemens LOGO! And Touch Screen PLC. In the table below; information about in which equipment's working status can be observed from the panels and which processes can be controlled is given.

SPECIFICATIONS	ALFA CARD	ALFA PLUS	SIEMENS LOGO! [1]	PLC [2]
Inlet valve	✓	✓		✓
Low Pressure	✓	✓	✓	✓
High Pressure Pump	✓	✓		✓
High Pressure	✓	✓	✓	✓
Autoflush Valve	✓	✓	✓	✓
Tank Full	✓	✓	✓	✓
Alarm	✓	✓	✓	✓
Reset	✓	✓	✓	✓
Dosage Pump	✓	✓	✓	✓
Chemical Low level	✓	✓	✓	✓
Fault	✓	✓	✓	✓
pH		✓	✓	✓
ORP		✓	✓	✓
CIP ON/OFF		✓	✓	✓
CIP Tank Level		✓	✓	✓
Conductivity				✓
Instant Flow				✓
Temperature				✓

Table 3-2: Control Panels Comparison Table

[1] Operating states, faults, alarms, etc. warnings are displayed in LOGO! appears on the screen.

[2] By producing a common panel for equipment or systems located before or after the ALFA RO device, all systems can be controlled from this common panel.

3.2 SYSTEM COMPONENTS

In this section, components that make up the system. There could be little difference about the appearance for every system.

Membrane vessels; are assembled vertically for between Alfa 140 – Alfa 640 models, vessels are assembled horizontally for between Alfa 840 – Alfa 1540 models because of that differences between them.

Although the operating logic is the same as the Alfa Series, there are some differences due to capacity differences. Size and amount of some components are different due to capacity difference.

SYSTEM COMPONENTS	MODEL										
	140	240	340	440	540	640	840	940	1040	1240	1540
MANOMETER AMOUNT	5	6	7	8	7	7	7	6	7	6	7
RETURN VALVE (INCH)	-	-	½	½	½	½	½	½	½	½	½
WASTE VALVE (INCH)	½	½	½	½	½	½	1	1	1	1	1
HPP OUTLET VALVE (INCH)	½	½	¾	¾	1	1	1	1	1	1¼	1¼
INLET VALVE (INCH)	¾	¾"	¾	¾	1	1	1	1	1	1¼	1¼
AUTOFLUSH VALVE (INCH)	½	½	½	½	½	½	½	½	½	½	½
LOW PRESSURE SWITCH	SAME										
HIGH PRESSURE SWITCH	SAME										
MEMBRANE AMOUNT	1	2	3	4	5	6	8	9	10	12	15
VESSEL AMOUNT	1	2	3	4	5	6	3	3	5	4	5
CONDUCTIVITY METER	SAME										
PERMEATE WATER FLOWMETER (GPM)	2	5	5	5	10	10	10	16	16	16	20
WASTE WATER FLOW METER (GPM)	2	5	5	5	5	5	10	10	10	10	16
RETURN FLOW METER (GPM)	-	-	5	5	5	5	5	5	5	5	5

Table 3-3: Alfa Series RO Models Component Difference Table

3.2.1 System Components For Between ALFA 140 and 640 Models

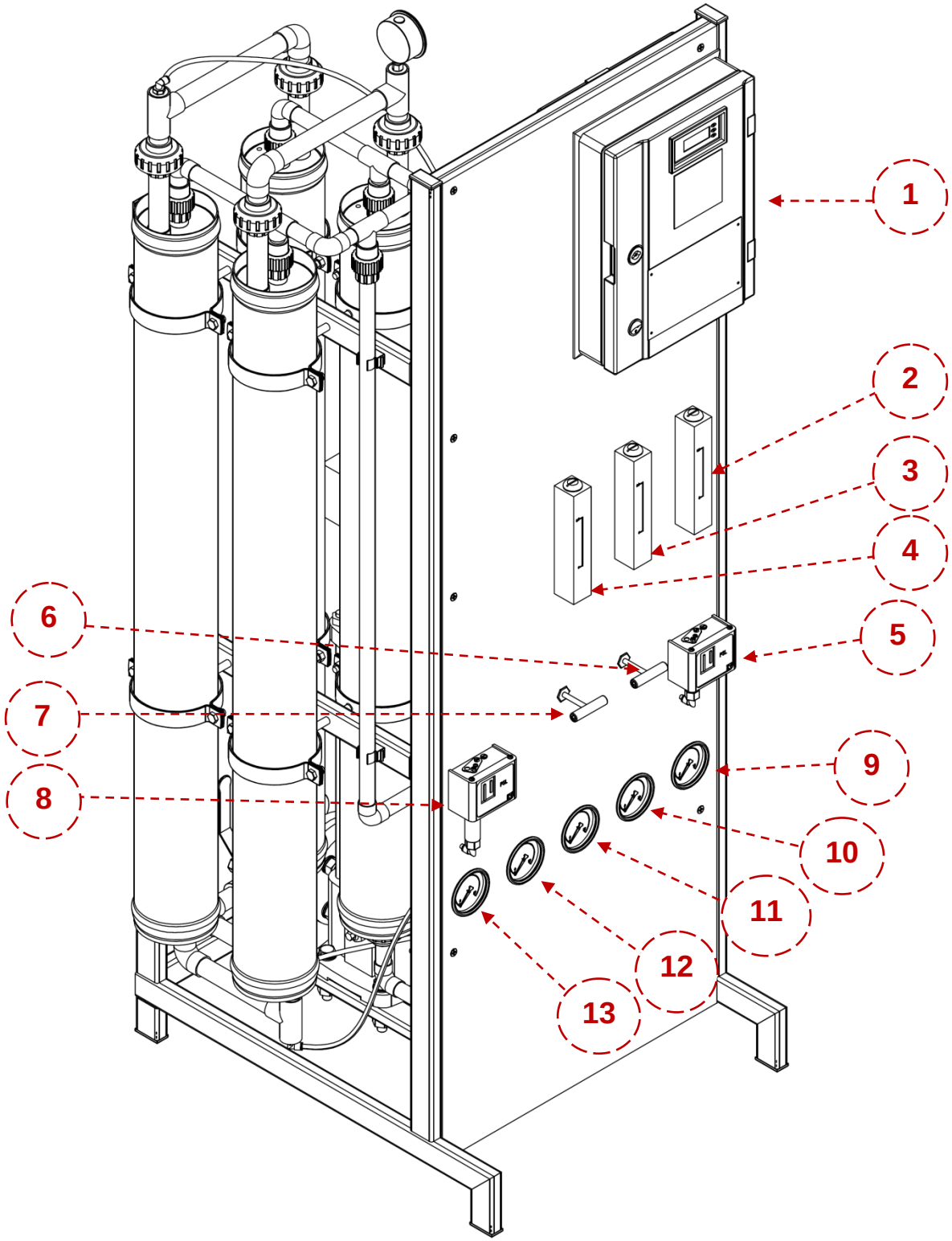


Figure 3-1: Front View of ALFA 440 Model RO Device

NO	NAME	EXPLANATION
1	CONTROL PANEL	It allows the system to be controlled both manually and automatically. Operating status, fault status, conductivity related to the system information can be seen on the control panel.
2	PERMEATE WATER FLOW METER	It shows the amount of water that system products.
3	RETURN FLOWMETER [3]	It shows the recirculation(recycling) flow in the system.
4	WASTEWATER FLOWMETER	It shows the amount of the wastewater in the system.
5	HIGH PRESSURE SWITCH	In order to prevent the system from damaging any equipment with high pressure; provides to the system to stop when the pressure rises above the set value.
6	WASTE WATER CONTROL VALVE	It is used to increase or decrease the amount of waste water from the system.
7	RETURN CONTROL VALVE [4]	It is used to increase or decrease the amount of water to be returned from the waste line to inlet of the system in order to adjust the recovery of the system.
8	LOW PRESSURE SWITCH	It stops the system when pressure value decreases under set value to prevent working of the system with low pressures or working of high pressure pump without water.
9	CARTRIDGE FILTER OUTLET MANOMETER	It shows cartridge filter outlet pressure.
10	FIRST STEP PRESSURE MANOMETER	It shows the inlet pressure of the raw water comes from a high pressure pump to the membranes in the first stage.
11	SECOND STEP PRESSURE MANOMETER [5]	It shows the inlet pressure of the concentrated waste water comes from the first stage to the membranes in the second stage.
12	THIRD STEP PRESSURE MANOMETER [6]	It shows the inlet pressure of the concentrated waste water comes from the 2.stage to the membranes in the 3. Stage.
13	WASTE WATER OUTLET MANOMETER	It shows the pressure of concentrated water goes out from the last stage of the system.

Table 3-4: System Components for between ALFA 140 – 640 Models Table 1

[3] *In all other models are available except for ALFA 140 ve 240.*
[4] *In all other models are available except for ALFA 140 ve 240.*
[5] *It is not icluede in the ALFA 140 model.*
[6] *It is not icluede in the ALFA 240 model.*

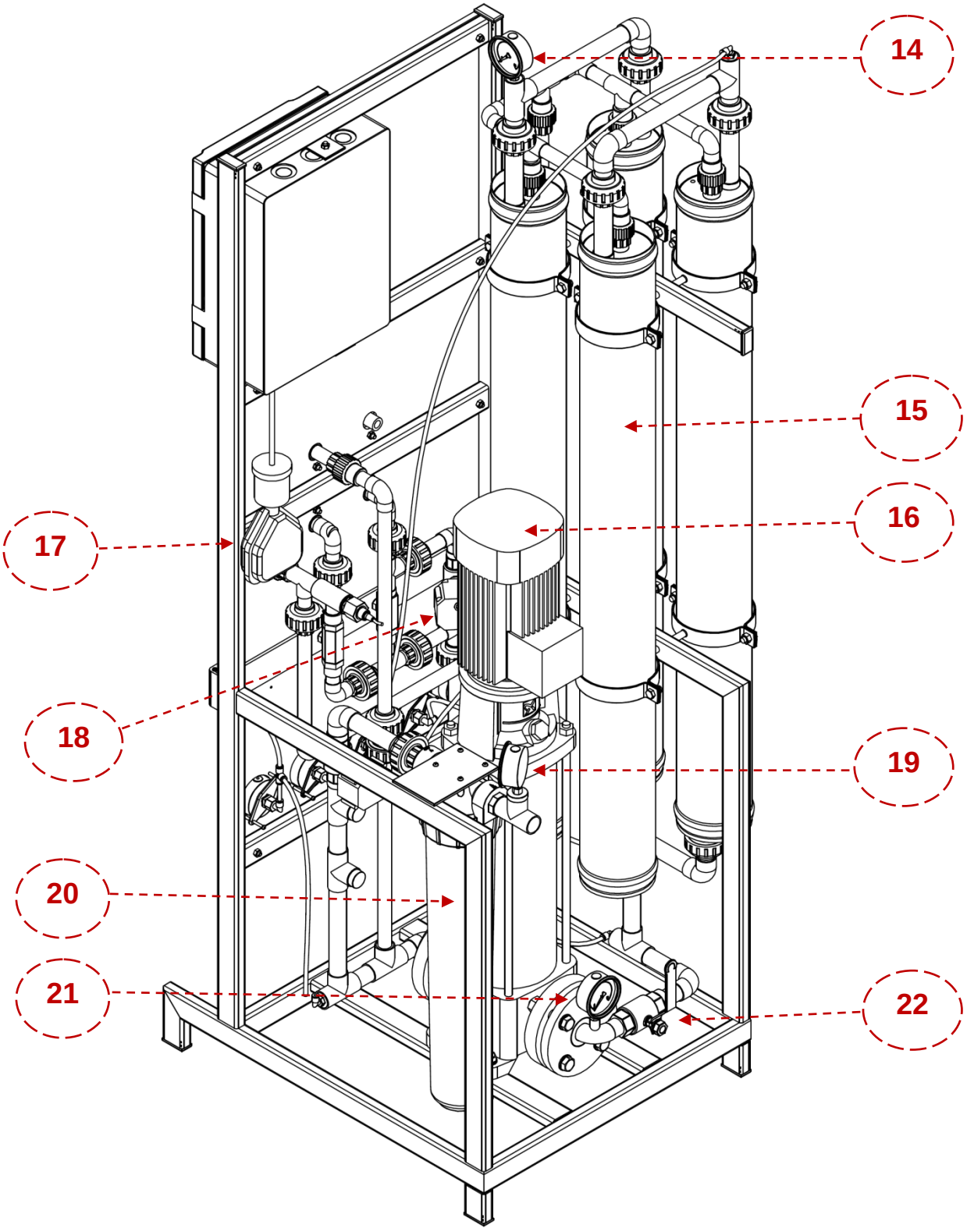


Figure 3-2: Rear View of ALFA 440 Model RO Device

NO	NAME	EXPLANATIION
14	4. STEP PRESSURE MANOMETER [7]	It shows the inlet pressure of concentrated waste water comes out from the 3. Stage to the membranes in the stage.
15	MEMBRANE VESSELS	It is the chamber where the membranes are placed.
16	HIGH PRESSURE PUMP	It provides the required pressure to pass through the membranes.
17	PERMEATE WATER TANK FLOAT [8]	It is the float placed in the permeate water tank to stop the system when the tank is full and to start the system again when the tank starts to empty.
18	AUTOFLUSH VALVE	It provides to the Belirlenen aralıklarla otomatik olarak açılarak sistemin flush yapmasını sağlar.
19	CARTRIDGE FILTER INLET MANOMETER	It shows the inlet pressure of raw water entering the cartridge filter.
20	CARTRIDGE FILTER	It is a manual filter that allows the water coming out from pre treatment to be filtered at 5 µ sensitivity.
21	HPP OUTLET MANOMETER [9]	It shows the pressure coming out from the high pressure pump.
22	HPP CONTROL VALVE [10]	It provides to increase or decrease the flow coming out of a high pressure pump and be fed directly to the membranes.

Table 3-5: System Components for between ALFA 140 – 640

[7] *Available only in ALFA 440 model*

[8] *Connections of floats are shown like made in panel. If the cable length is not enough to reach permeate water level, it could be added and extended.*

[9] *It is located on the front of the system in ALFA 140 and ALFA 240 models.*

[10] *It is located on the front of the system in ALFA 140 and ALFA 240 models.*

3.2.2 System Components for between ALFA 840 – 1540 Models

General view of the system is shown below. System view is shown as divided into two pieces on the next page.

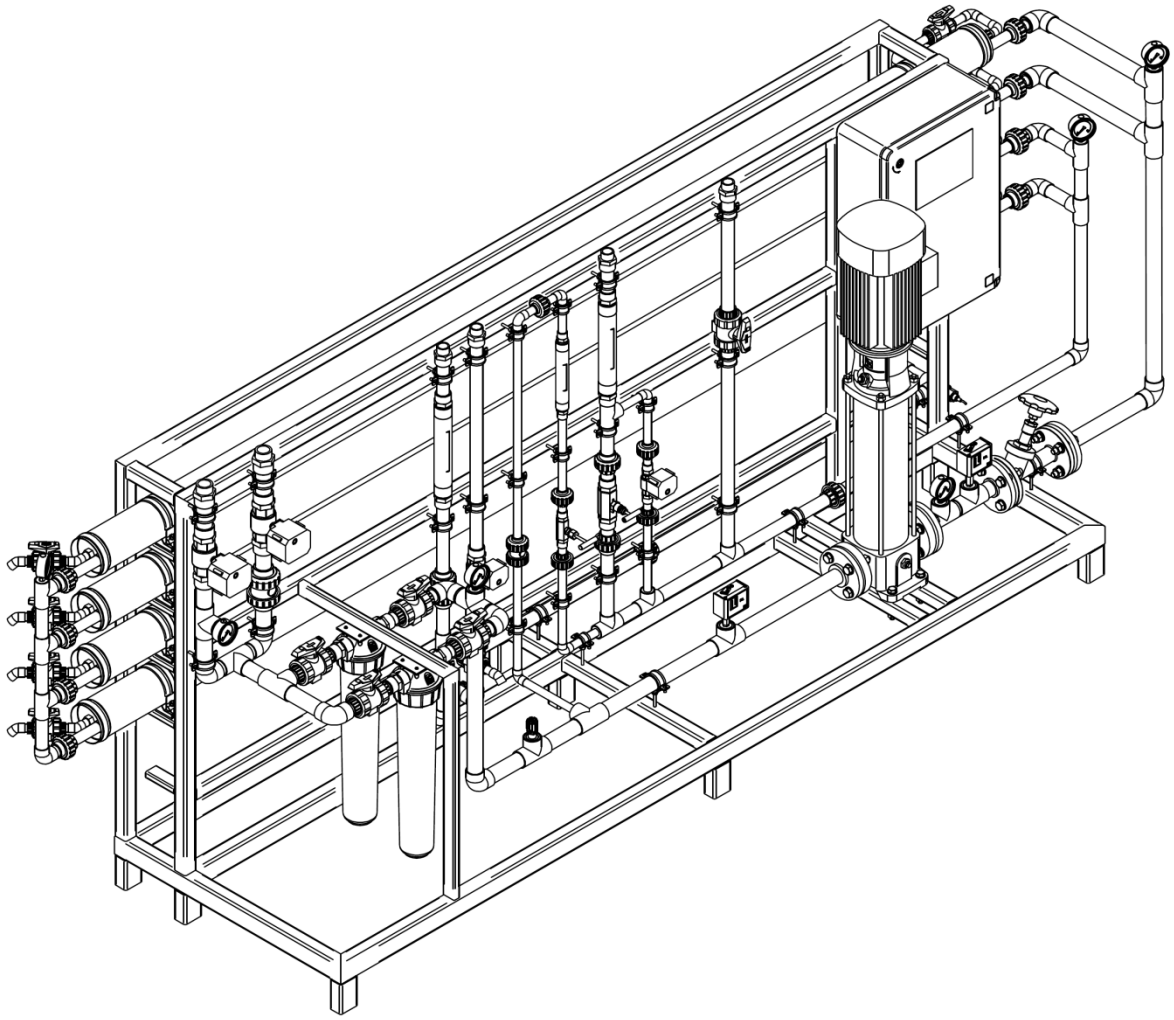


Figure 3-2: ALFA 1240 Model RO Full Perspective View

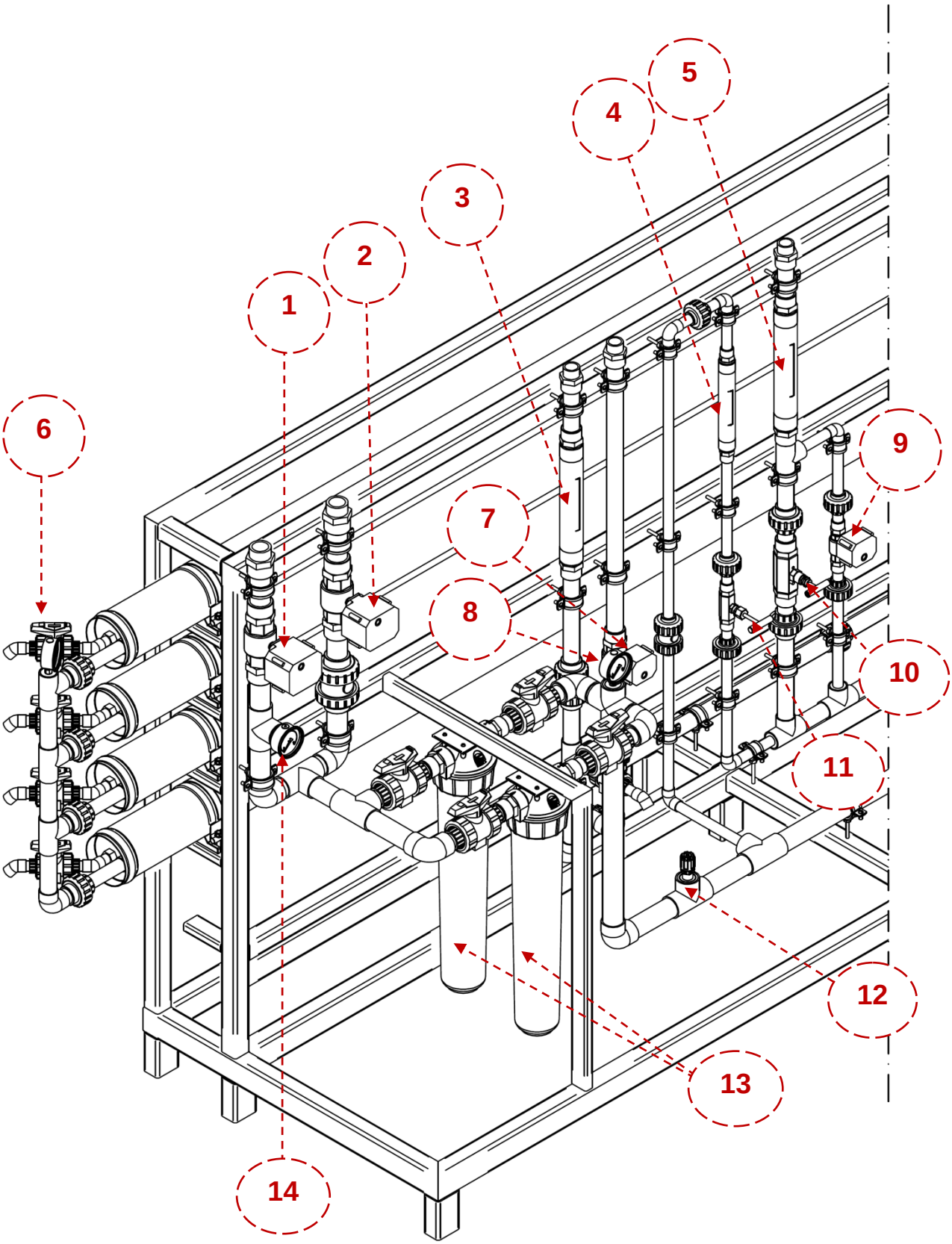


Figure 3-3: ALFA 1240 First Section Perspective View

NO	NAME	EXPLANATION
1	INLET VALVE	It is an automatic valve that controls the entrance of water to the device.
2	CIP INLET VALVE	It is automatic valve control the entrance of water to devices for the Chemical Wash or Automatic Rinse in the system uses CIP.
3	PERMEATE WATER FLOW METER	It shows the amount of permeate water product from the system.
4	RETURN FLOWMETER	It shows the recirculation (recycling) flow in the system.
5	WASTEWATER FLOW METER	It shows the amount of waste water passed through the system.
6	2. STAGE PRESSURE MANOMETER	It shows the inlet pressure of waste water come out from the 1. Stage to the membranes in 2.stage.
7	CIP TANK FILLING VALVE	It is used to fill the CIP tank when the system starts to produce water.
8	CARTRIDGE FILTER OUTLET MANOMETER	It shows cartridge filter outlet pressure.
9	AUTOFLUSH VALVE	It provides flushing at specified intervals by opening automatically.
10	WASTE WATER CONTROL VALVE	It is used to decrease or increase the waste water coming out from the system.
11	RETURN CONTROL VALVE	It is used to increase or decrease the amount of water to be returned to the inlet of the system from the waste line in order to adjust the efficiency of the system.
12	ANTISCALANT DOSAGE POINT	It is the point where antiscalant is dosaged to water.
13	CARTRIDGE FILTER	It is a manual filter that allows the water coming out from pre treatment to be filtered at 5 µ sensitivity.
14	CARTRIDGE FILTER INLET MANOMETER	It shows the pressure of the raw water entering the cartridge filter.

Figure 3-4: System Components for between ALFA 840 – 1540 Models Table 1

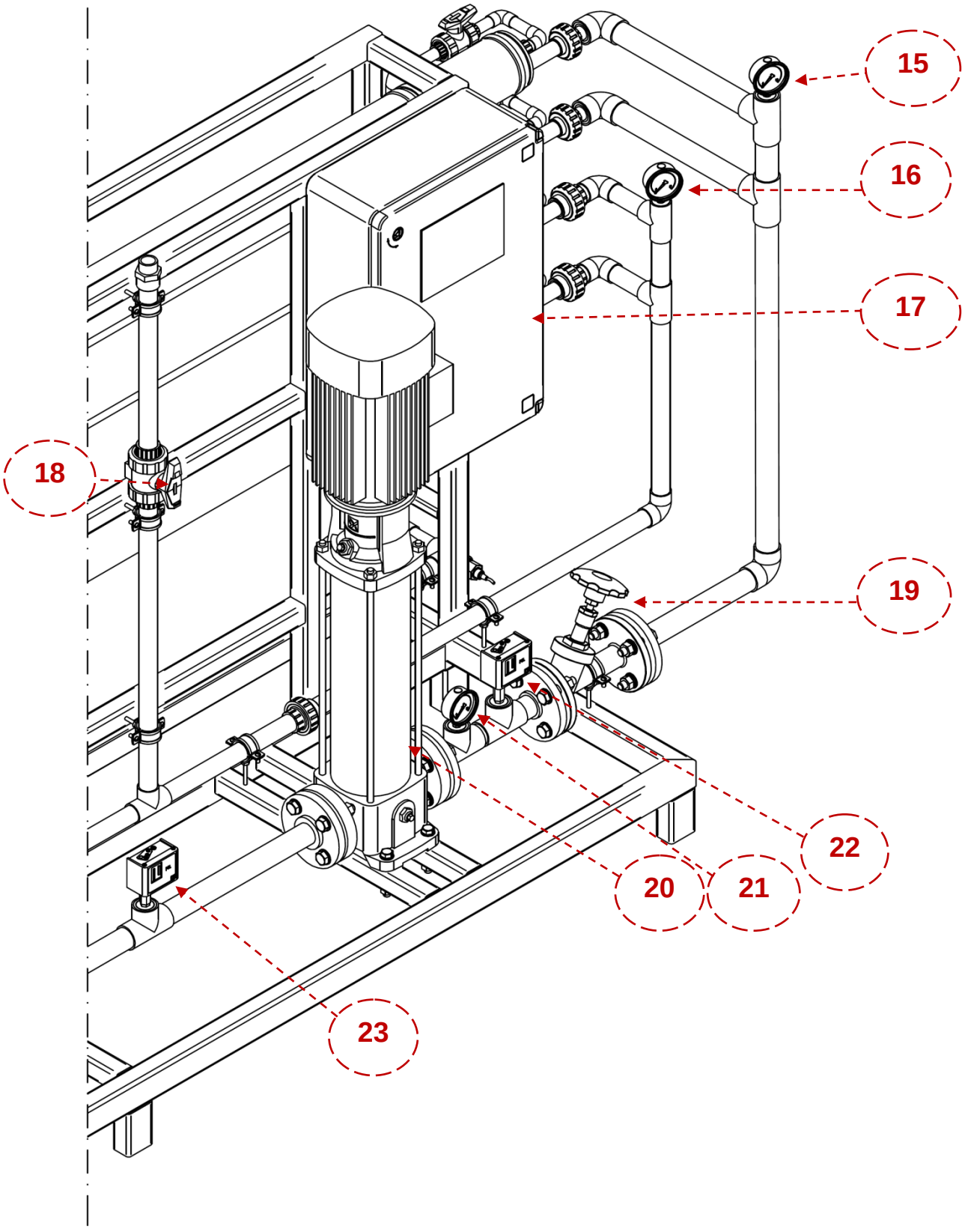


Figure 3-5: ALFA 1240 Second Stage Perspective View

NO	NAME	EXPLANATION
15	1 STAGE PRESSURE MANOMETER	It shows the inlet pressure of the raw water coming out from the high pressure pump to the membranes in the first. Stage.
16	WASTE WATER OUTLET MANOMETER	It shows the pressure of concentrated water coming out from the last stage of the system.
17	CONTROL PANEL	It allows the system to be controlled both manually and automatically. Operating status, fault status, conductivity related to the system can be viewed on the control panel.
18	CHEMICAL CLEANING TANK RETURN VALVE	It is the valve to provide the waste water again during chemical cleaning. Detailed information is explained at the section of…
19	HPP CONTROL VALVE	It is used to increase or decrease the flow of membrane feed coming out from a high pressure pump and comes in directly into the membrane.
20	HIGH PRESSURE PUMP	It provides the required pressure to pass through the membranes.
21	HPP OUTLET MANOMETER	It shows the pressure of a high pressure pump outlet.
22	HIGH PRESSURE SWITCH	It provides the system to stop when the pressure is under the set value in order to protect any equipment from the damage with high pressure.
23	LOW PRESSURE SWITCH	It allows the system to stop when the pressure is under the set value in order to work the system with low pressure or to protect the system from work without water.

Table 3-6: System Components for between ALFA 840 – 1540 Models Table 2

4. WORKING PRINCIPLE & CONTROL PANEL

4.1 WORKING PRINCIPLE

In this part, working principle of ALFA Series Reverse Osmosis systems. It could be explained in the simplest language below.

The raw water passed through the pre-treatment supplied by ESLİ AQUALINE; İT İS treated with 5 micron by entering a cartridge filter. The raw water passed through the pretreatment cartridge filter is reached to design pressure by the help of a high pressure pump. Permeate water products from the system are stored, waste water thrown to the waste line.

4.1.1 System Operation

System starts to work when operatör or responsible person gives the start command to the system. When the system started to work;

Pre treatment Works, Permeate water tank is not full and there is no alarm in the system.

I. If the feed pump Works related to osmosis, the pump will work with 3 seconds delay. If there is no connection of the feed pump to osmosis, again there will be a 3 minutes delay but there is no effect to the operation status of the feed pump.

II. Inlet valve is opened after operation of the feed pump or after 5 seconds of finishing 3 second Delay.

III. Enough amount is fed to the system after opening the ınlet valve and after a 15 seconds delay, high pressure pumps and dosage pumps work together.[11]

IV. At the end of 15 seconds delay, the auto-flush valve is opened and ıt remains open for 60 seconds. Permeate water starts to produce after closing auto-flush. Every start of hours, auto-flush is opened and and it remains open for 60 minutes. Duration of operation and waiting can be extended and shortened by the help of DIP Switch. Detailed information is explained at the section of *4.2.1.2 Setting*. System goes on

[11] *If the feed water is not enough, the system will be stopped. During that stopping time the feed pump continues to work. After 6 seconds, the inlet valve is opened again. If pressure is reached enough level, high pressure pumps, dosage pumps, and auto-flush valves start to work. If there is not enough pressure, the inlet valve will be closed after 6 seconds. After that, the inlet valve is opened again 6 seconds later. If there is not enough pressure level again, the low pressure switch led flashes gives audible warnings and the alarm led on the control panel lights continuously and keeps the system in Alarm Mode 10 minutes. After 10 minutes later, the expressed procedure is followed with the same row and the inlet valve is opened and closed 3 times again and expects to get enough pressure. If the required pressure is not obtained again, System will enter Alarm Mode for 10 minutes. If this situation is repeated 20 times, the system will be stopped completely. Low pressure switch led flashes and bip, the alarm led on the control panel lights up continuously.*

working until the system is stopped, receiving fault or for some problem related to the working principle.

4.1.2 Transition to Waiting Status of System from

System's standy, means that stop like when the stop command is given and when the factor causes this stop removes, ıt will be started again to work without operatör intervention The factors affect the system to wait;

I. Filling the permeate water tank as full.
II. Entering pre-treatment to backwash.
III. Being empty of raw water tanks.
IV. If there is a connection, cause to wait.

4.1.3 System Restart

System restart; means that the state of the system goes into standby is activated again when the holding factor ends. System will start to work again as explained at the section of *4.1.1 Sistemin Çalışması*. The factors that make the system work again are as follows;

I. By decreasing permeate water level and not being full of permeate water tanks.
II. Finishing of pre-treatment backwash.
III. Refilling of raw water tank.
IV. Except for them, cutting of signal comes from external connection causes the stop

4.1.4 SYSTEM'S STOP

System just stops when operatör or responsible staff gives a stop command. When the system is stopped;

High pressure pump and dosage pump stops at the same time and the inlet valve will be closed after 3 seconds and the feed pump will be stopped. If the operatör does not give start command, the system will never work. If the system waits for a long time, the explanation at the section of *7.2.2 Decommissioning* must be applied.

4.1.5 Stopping the System due to Malfunction

If there is a malfunction, system will stop[12]. This malfunction can be understood by both audible and visual warnings. The device should be worked again by solving the problem with operatör and resetting the device. The factors cause stop the system due to the malfunction;

I. After the signals come from low pressure and high pressure switch [13]
II. Giving low level of chemicals in chemical tank
III. When there exists electrical or mechanical faults except for the others.

4.1.6 Stopping the System with the Emergency Stop Button by

If the system must be stopped for the emergency situation, emergency stop buttons on the control panel have to be used to stop the system. When the system stops by the emergency stop button, the system will stop completely and will switch to the alarm mode. For restarting of the system. Emergency stop button has not to be pressed.

[12] *Automatic rinsing does not start in the system with CIP.*

[13] *After the low pressure or high pressure alarm, the system will run automatically every 10 minutes to check whether the specified alarms are gone, if there is no alarm, it will continue to operate.*

4.2 CONTROL PANEL

There are 4 different panels for ALFA Series Reverse Osmosis System. Information is given at the section of *3.1.2 Alfa Serisi Ters Ozmoz Panoları Hakkında Teknik Bilgiler*. Standart Alfa Panel is used for standard systems, ALFA PLUS panel and panel with LOGO and PLC is used for the system with CIP.

4.2.1 Standard ALFA Panel

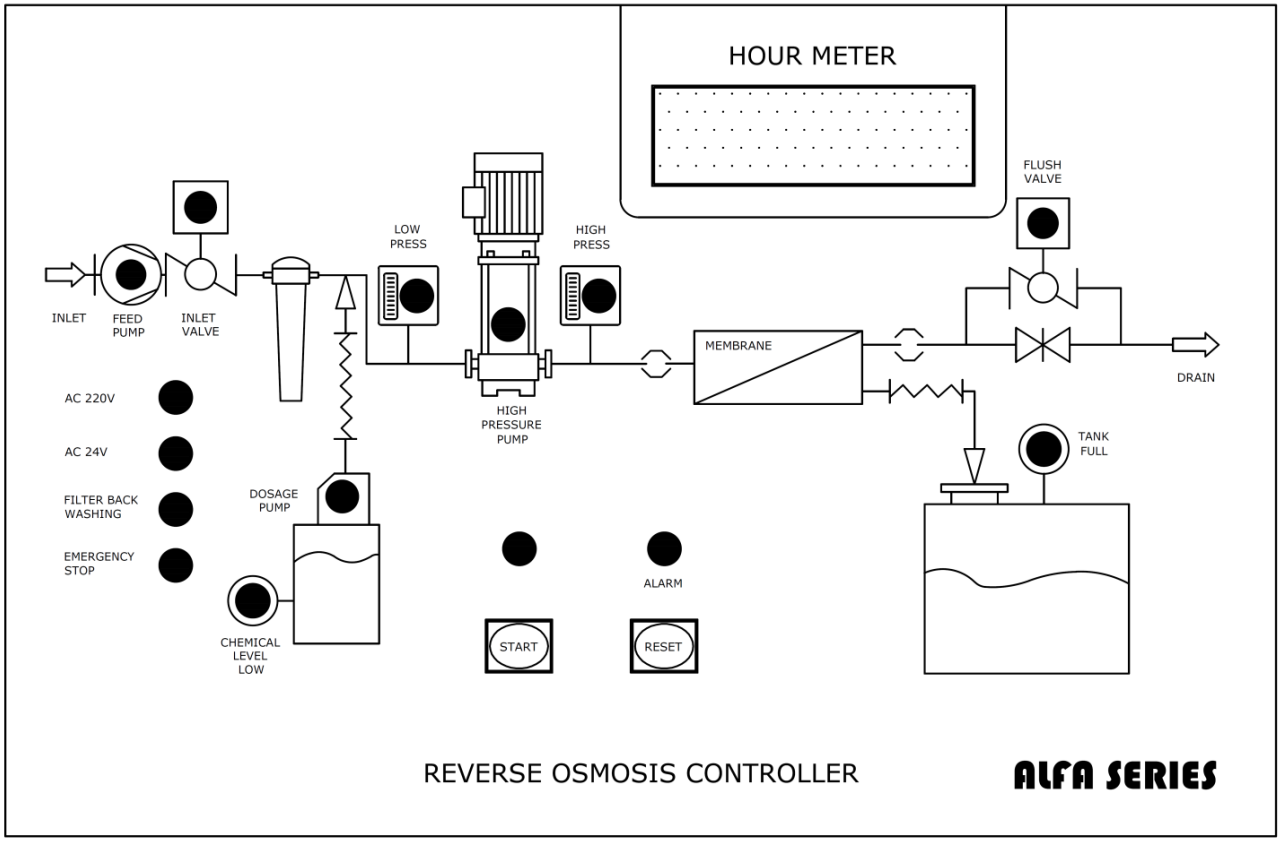


Figure 4-1: Standard ALFA Control PanEL Mimic Diagram

Operation of the system can be seen by the help of leds on the control panel. Continuous lighting of LED lights on the mimic diagram is considered normal operation. If any led of high pressure pump switch, chemical tank low level switch or any external switch is flashing, there will be a problem about the switch its led flashes. Also, for this situation, there are audible warnings and red led on led panel flashes continously. In this situation, after repairing the fault, the reset button is pressed for 3-4 seconds and it is reseted and the system continues to normal work.

4.2.1.1 Signs on the Control Panel and Their Meanings

The meaning of signs on the mimic diagram is explained at the below.

WRITTEN ON THE PANEL	MEANING	EXPLANATION
AC 220V	ALTERNATIVE CURRENT 220V	Feed, Dosage and High Pressure Pump Works with ı 220 V AC voltage. If the led of 220V is on, there is 220V on the system, If it is not, there is not 220V on the system.
AC 24V	ALTERNATIVE CURRENT 24V	The system operates with 24V AC Voltage from Autoflush relays with inlet valves on board. If the led of 24V is on, there is 24V, if it is not, there is not 24V on the system.
FILTER BACK CLEANING	BACKWASHING IN FILTER	The Pre Treatment Filter Led warns with ınly flashes, it means that filter is in cleaning. No audible warning is given. When the backwash of filters finished, the system was reactivated as explained at the section of S *4.1.1 System Operation.*
EMERGENCY STOP	EMERGENCY STOPPING	It means that the emergency stop button is pressed.
START	STARTING THE SYSTEM	It is used to restart the system. If the led of START on this button burns, it means that system is working. If it is not, the system is not working.
ALARM	ALARM	If there is a fault due to the equipment on the electronic card, led is on. Fault is reseted by the help of Reset Button after controlling the fault and repairing it.
RESET	RESET	It is used to reset the incoming.
FEED PUMP	FEED PUMP	If the led is burning, it means that the feed pump works.
INLET VALVE	INLET VALVE	If the led belongs to this valve, burns, it means that the valve is open.

Table 4-1: Standard ALFA Control Panel Mimic Diagram Explanation Table1

WRITTEN ON THE PANEL	MEANING	EXPLANATION
LOW PRESS	LOW PRESSURE	It shows that the pressure before the high pressure pump is lower than the set value and indicator led flashes.
HIGH PRESSURE PUMP	HIGH PRESSURE PUMP	It shows that a high pressure pump works and led lights as long as the pump is running.
HIGH PRESS	HIGH PRESSURE	It shows that the pressure exists on the line after the High Pressure Pump line is higher than desired pressure value and indication led flashes.
DOSAGE PUMP	DOSAGE PUMP	Led lights if the dosage pump works.
CHEMICAL LEVEL LOW	CHEMICAL LEVEL LOW	Led turns on when the level of chemicals in a chemical tank and led does not stop until a chemical supplement is added to the tank.
TANK FULL	TANK FULL	When the permeate water tank is full, the led will light on. When the permeate water goes below the upper level, the led turns off.
FLUSH VALVE	FLUSH VALVE	When the autoflush valve worked, led turns on. When this valve Works, the system flushes and after the autoflush finishes and the valve is closed, the led turns off.
HOUR METER	TIMER	When the high pressure pump starts to operate, the 6-digit counter on the LED panel starts to work, and it monitors the pump's operation time. When the pump stops, it stops on the counter. The operation time of the pump progresses in hours. For the case of power outage, the operation time is stored in hours and minutes, when the power comes back, the operation time goes on in hours and minutes.

Table 4-2: Standard ALFA Control Panel Mimic Diagram Explanation Table 2

4.2.1.2 Settings

There is just one parameter to adjust for the Standard Alfa Panel. This adjustment is the duration for Autoflush, activation and Duty Cycle. The remaining parameters are predefined on the card by the ESLI Automation Department and can not be changed by the customers.

There are 2 five DIP switches on the Alfa Card inside the Control Panel. The switch is called as SW1 is used to adjust the operation time of DIP Switch Autoflush, SW2 is used to adjust the waiting time of DIP Switch.

Adjusted time according to key position is shown below as a table.

SW1 – TO ADJUST THE AUTOFLUSH OPERATION TIME					
TIME (SEC)	1	2	3	4	5
10	OFF	OFF	OFF	OFF	OFF
20	ON	OFF	OFF	OFF	OFF
30	OFF	ON	OFF	OFF	OFF
40	OFF	OFF	ON	OFF	OFF
60	OFF	OFF	OFF	ON	OFF
120	OFF	OFF	OFF	OFF	ON

SW2 – TO ADJUST THE AUTOFLUSH WAITING TIME					
TIME (MIN)	1	2	3	4	5
30	OFF	OFF	OFF	OFF	OFF
45	ON	OFF	OFF	OFF	OFF
60	OFF	ON	OFF	OFF	OFF
75	OFF	OFF	ON	OFF	OFF
90	OFF	OFF	OFF	ON	OFF
120	OFF	OFF	OFF	OFF	ON

Table 4-3: DIP Switch Adjustment Table

Autoflush process is done for 60 seconds in every 60 minutes automatically as a standard. The time can be extended or shortened according to operating condition. The position of DIP Switches to be adh-jsuted according to Autoflush times will be as follows.

Using the table on the previous page;

For SW1, 4. Switch is upi so when its position is on, Autoflush time will be arranged as 60 seconds;

For SW2, 2. Switch is up, so when it is on, Autoflush waiting time will be arranged as 60 minutes.

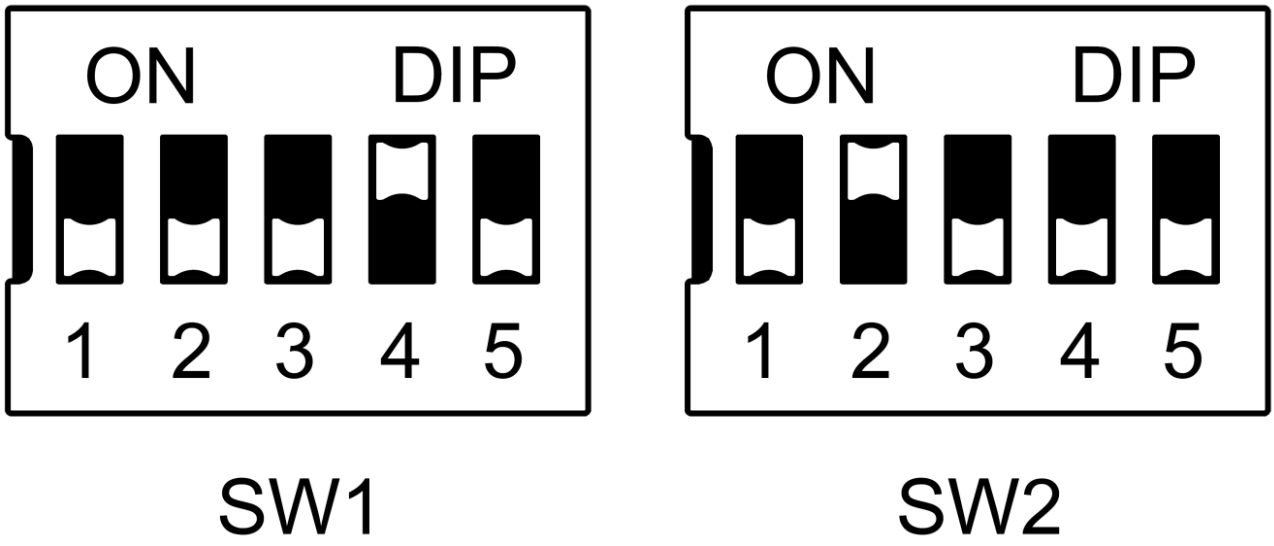


Figure 4-2: Cinque DIP Switch View

4.2.2 ALFA PLUS Panel

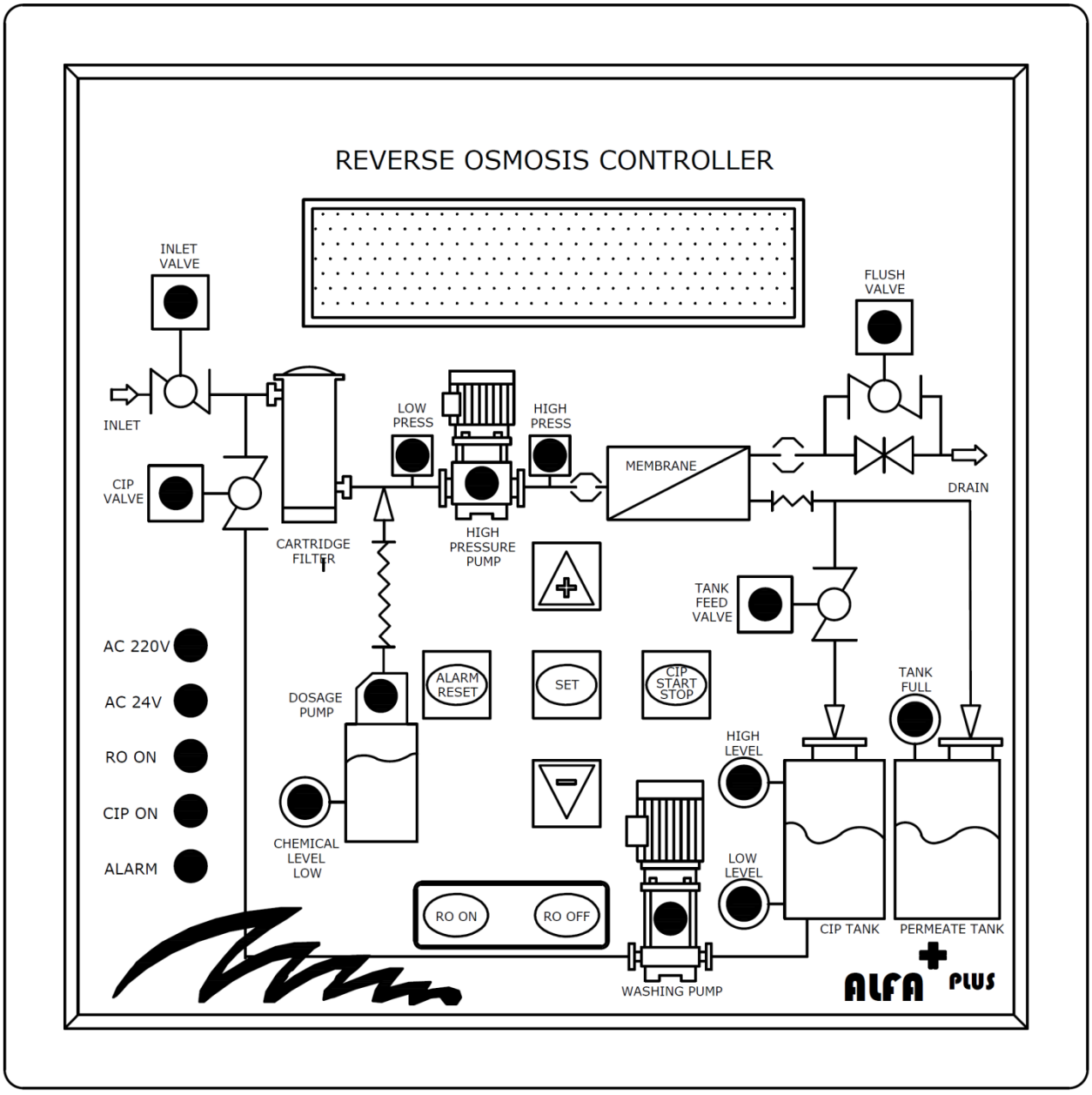


Figure 4-3: ALFA PLUS Control Panel Mimic Diagram

4.2.2.1 Signs and Their Meanings on Control Panel

WRITTEN ON THE PANEL	MEANING	EXPLANATION
AC 220V	ALTERNATIVE CURRENT 220V	Feed, Dosage and High Pressure Pump Works with ı 220 V AC voltage. If the led of 220V is on, there is 220V on the system, If it is not, there is not 220V on the system.
AC 24V	ALTERNATIVE CURRENT 24V	The system operates with 24V AC Voltage from Autoflush relays with inlet valves on board. If the led of 24V is on, there is 24V, if it is not, there is not 24V on the system.
RO ON	RO ON	*When the RO ON button is pressed, the system starts to work and the led turns on. When the RO OFF button is pressed, the system stops and the led turns off.*
CIP ON	CIP ON	*When the CIP START STOP* button is pressed, the CIP system starts to work and the led turns on. Again if the CIP START STOP button is pressed , CIP will stop and the led will turn off.
ALARM	ALARM	If there is a fault due to the equipment on the electronic card, led is on. Fault is reseted by the help of Reset Button after controlling the fault and repairing of it.
CLEANING PUMP	CLEANING PUMP	If the led lights up, it means cleaning pump Works.
INLET VALVE	INLET VALVE	If the led belonging to this valve burns, ıt means that the valve is open.
CIP VALVE	CIP VALVE	If the led of this valve turns on, it means that the valve is open.
TANK FEED VALVE	TANK FEED VALVE	If the led of this valve turns on, it means that the valve is open.

Table 4-4: ALFA PLUS Control Panel Mimic Diagram Explanation Table 1

WRITTEN ON THE PANEL	MEANING	EXPLANATION
HIGH LEVEL	HIGH LEVEL	The led turns on when the CIP tank is full. When the water in the tank goes below the upper level, the led turns off.
LOW LEVEL	LOW LEVEL	The led turns on when the CIP tank is emptied. When the water in the tank goes above the lower level, the led turns off.
LOW PRESS	LOW PRESSURE	It shows that the pressure before the high pressure pump is lower than the set value and indicator led flashes.
HIGH PRESSURE PUMP	HIGH PRESSURE PUMP	It shows that a high pressure pump works and led lights as long as the pump is running.
HIGH PRESS	HIGH PRESSURE	It shows that the pressure exists on the line after the High Pressure Pump line is higher than desired pressure value and indication led flashes.
DOSAGE PUMP	DOSAGE PUMP	Led lights if the dosage pump works.
CHEMICAL LEVEL LOW	CHEMICAL LEVEL LOW	Led turns on when the level of chemicals in a chemical tank and led does not stop until a chemical supplement is added to the tank.
TANK FULL	TANK FULL	When the permeate water tank is full, the led will light on. When the permeate water goes below the upper level, the led turns off.
FLUSH VALVE	FLUSH VALVE	When the autoflush valve worked, led turns on. When this valve Works, the system flushes and after the autoflush finishes and the valve is closed, the led turns off.

Table 4-5: ALFA PLUS Control Panel Mimic Diagram Explanation Table 2

WRITTEN ON THE PANEL	MEANING	EXPLANATION
RO ON	RO ON	It is a button to start the system.
RO OFF	RO OFF	It is a button to stop the system.
ALARM RESET	ALARM RESET	It is the button to stop or the incoming alarm.
CIP START STOP	CIP START STOP	The button is used to stop and start the CIP system.
SET	SET	It is the button that is used to save or select the process made on the screen.
(+)	(+) KEY	The button is used to move up the screen or to increase the value.
(-)	(-) KEY	The button is used to move up the screen or to increase the value.

Table 4-6: ALFA PLUS Control Panel Mimic Diagram Explanation Table 3

4.2.2.2 System Messages

There are messages on the screen showing the current operating status of osmosis as long as there is energy in the plant.

R.OSMOS DEV.DISI	There are messages on the screen showing the current operating status of osmosis as long as there is energy in the plant.
R.OSMOS DEVREDE	It shows that the RO system is working.
OTO_FL. DEVREDE	It shows that the Autoflush valve is activated.
R.OSMOS DEV.DISI D.B.S. ARIZASI	It shows that there is a fault of low pressure..[14]

[14] If the operator is not at the head of the system, the system will automatically reset itself every 10 minutes. If after 10 minutes it still continues to see a low pressure fault, it will wait another 10 minutes and then reset itself. If the pressure does not reach the desired value each time, this process will be repeated 20 times. If the user is at the beginning of the system, the alarm is reset by pressing the "RESET" button for 5 seconds.

It shows that there is a High Pressure Fault in the system. After repairing the problem, system is reseted by pressing the "RESET" button for 5 seconds.

If a high pressure pump becomes hot for any reason, the pump will exceed its nominal current and the thermal protection switch in the panel will trip.[15]

If the cleaning pump becomes hot for any reason, the pump will exceed its nominal current and the thermal protection switch in the panel will trip.

It shows that permeate water tank is full.

[15]Thermal failure messages can be removed by pressing the "START" button after the high pressure pump thermal or the cleaning pump thermal break.

OTO.DURU.DEVREDE	It shows that automatic rinsing is activated.
O.DURULAMA BITTI	It shows that automatic rinsing finished.
R.OSMOS DEV.DISI F.S.R. ARIZASI	If the order of the phases is different, this warning will appear on the screen. Phase sequence needs to be changed. System can be restarted by pressing the "RESET" button after changing the places of the phase sequence.

4.2.2.3 Settings

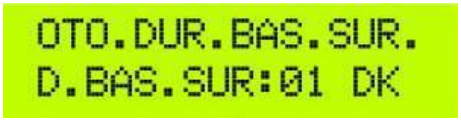
You should press the "SET" button for 3 minutes to reach the Alfa PLUS screen. Firstly, OSMOSIS SYSTEM SETTINGS PAGE appeared on the screen. You can switch between screens by pressing the SET button, the values can be changed by the help of up and down arrows on the screen we want to change. Switching between the screens can be done by pressing the SET button after changing the values. You have to wait for 5 seconds to exit from the settings page. The changes will be saved and the system goes back to the operation screen. The settings value comes on the screen after pressing the "SET" button that is shown below.

When you enter the settings page of Alfa PLUS, this message will be seen.

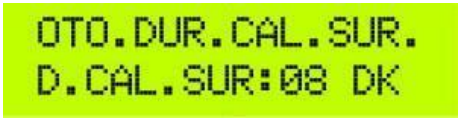
The operation time of Autoflush is adjusted after it is activated. Generally, advised time is 1 minutes.

This setting is used to determine how long the system will autoflush. Generally, the recommended time is one hour. After one hour operation time, the autoflush valve is opened, all water sent to waste and pollutants can be sent to the drainage line.

It is used to determine how long time later a high pressure pump will be activated after the system starts to work. The aim of waiting for high pressure operation; before the system is pressurized and producing water, all water is sent to the waste and contaminants that may have accumulated on the membrane and the air that may have been present in the vessel are given to the drainage line. Generally, between 30-70 seconds are enough for this process.



The water that exists in the vessels after stopping the system is the desired treated water and it contains contaminants keen on to be deposited on the membrane. During the operation of the system, water comes into the membrane with cross flow and risk of sedimentation of pollutants is low due to cross flow. But if we stop the system, the risk of sedimentation increases. That's why; When the system stops, System will be rinsed with the water in the CIP tank. The time was set to start to count after rinsing of system finishing and when the counting finished, automatic rinsing would be started. Generally, advised time is 30 minutes maximum.



How long the automatic rinsing will continue is set here. Generally, there is a lower lower float in the CIP tank and the cleaning pump stops when the water reaches a low level in the CIP Tank. Nevertheless, automatic rinsing should be applied to the systeö as a security precaution and has to learn the emptying and this value should be determined accordingly.

If the permeate water conductivity is higher than the set value of conductivity, the system waits during CONDUCTIVITY HIGH ALARM DELAY time and after that if the conductivity does not decrease, the system gives CONDUCTIVITY HIGH ALARM.

If permeate water has high conductivity, during the time set here it will wait and if the conductivity does not decrease after this period, the system will give CONDUCTIVITY HIGH ALARM.

If permeate water has low/high pH, the system waits for the time was set here and if the pH value does not increase/decrease, the system will give PH HIGH / LOW ALARM.

If permeate water has low/high ORP, the system waits for the time was set here and if the ORP value does not increase/decrease, the system will give ORP HIGH / LOW ALARM.

4.2.3 Panel with SIEMENS LOGO!

There are no led indicators on the control panel in logo controlled systems; System operation states and alarm can be seen on LOGO screen. System settings are also done on LOGO in the control panel.

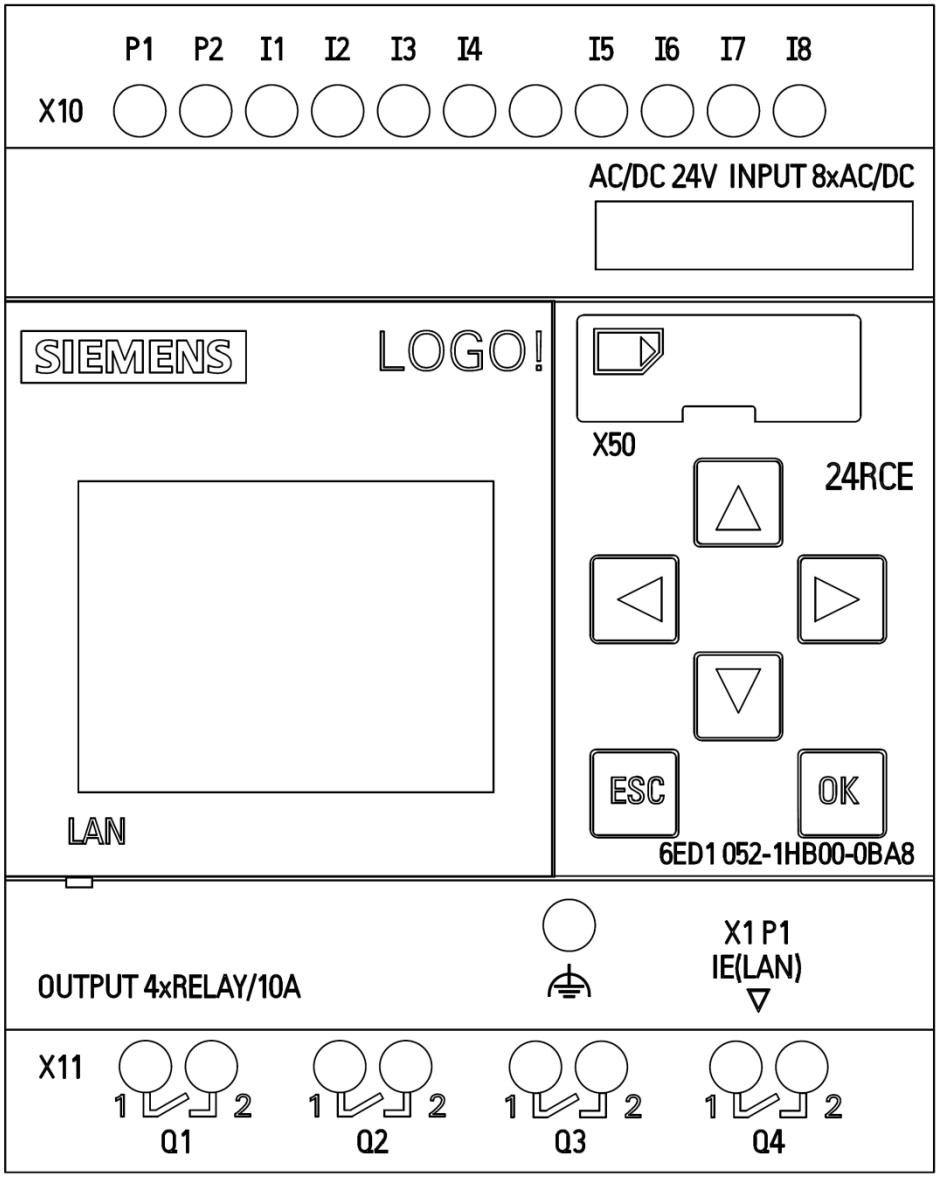
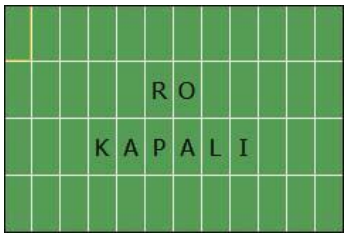
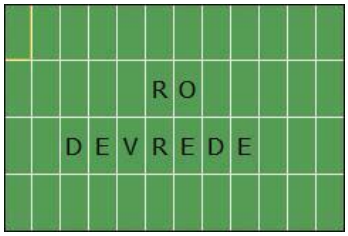


Figure 4-4: Siemens LOGO! View (24RCE Model)

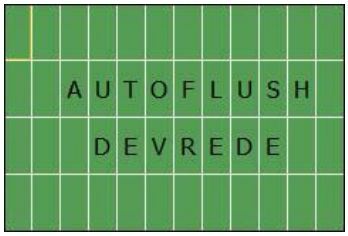
4.2.3.1 System Messages



It shows that the RO system is not activated. If the system did not start, this message is seen on the screen.



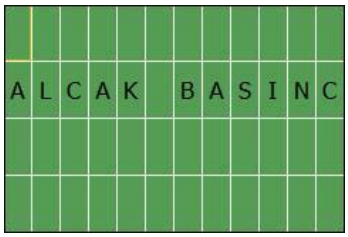
It shows that the RO system is activated.



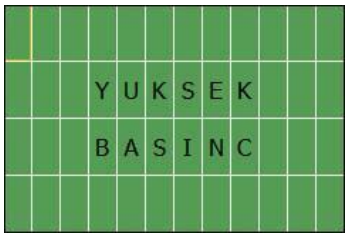
It shows that the Autoflush valve is activated.

It shows that the permeate water tank is full.

If the aumation is made to RO system will be stopped when the pretreatment units are before the RO system enters cleaning, this message is seen at that moment.

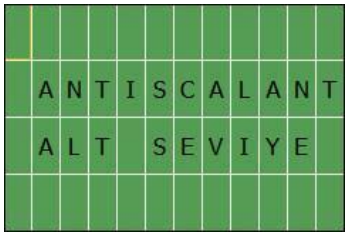


It shows that there is low pressure fault on the system.



It shows that there is a high pressure fault on the system.

When the permeate water conductivity is higher than set value, this message is seen on the screen.



When the chemical level is low in the Antiscalant tank, this message is seen on the screen.

4.2.3.2 Settings

When the Ro system is activated or not, transition between screens can be done by the help of upper and lower arrow. Screen can be transited are;

I. RO inactivated / activated[16]
II. Autoflush Set
III. Conductivity Alarm Delay
IV. If there exists one of the other system messages, this message can be also seen as 4. Message and these messages are;
    - Autoflush activated,
    - Permeate Water Tank is full,
    - RO Waiting for Filter System cleaning
    - Low Pressure
    - High Pressure
    - Permeate Water Conductivity High
    - Antiscalant Low Level

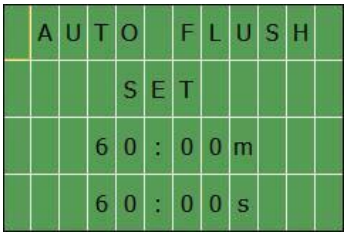
As an example, when the pre-treatment unit enters the cleaning, FILTER SYSTEM ON cleaning RO ON WAITING message is seen on the screen. Transition between the screen of RO CLOSED, AUTOFLUSH SET AND CONDUCTIVITY ALARM DELAY by presşng lower and upper arrow.

There are 2 adjustable parameters on the ALFA Panel with the LOGO controller. These are; Autoflush time adjustment and Conductivity Alarm Delay adjustment. The remaining all parameters are adjusted before by ESLI Automation Department and it could not be changed by the customer.

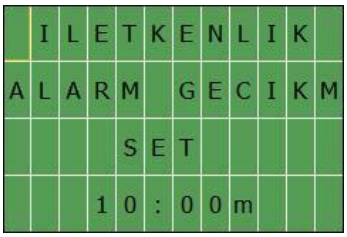
By the help of lower and upper arrow transitions the screen wants to be set could be done. When we come to the screen, it should be set and the ESC button is pressed on LOGO. When a line appears under the under values could be set on the screen, the OK button is pressed and the time values could be changed by the help of arrows. After changing the time, again have to be pressed on to the OK button and could be exited by using the ESC button and time is changed.

[16] *If RO Works at that time, Ro is on; If RO does not work, RO is off.*

The screen images could be set are shown below;



This is the page where the time of activation and inactivation of autoflush change. ESLI arranged as 60 seconds for both activation and inactivation time. as a standard. This time can be increased or decreased according to water parameters.



It is the setting page where adjust the time to transition for stopping the system when the conductivity is high.

4.2.4 PLC Control Panel with TOUCH Screen

Control of the PLC control system with touch screen is done with touch screen on the panel.

All settings can be changed by the process that is done on the screen and also the operation of the system can be viewed. Stopping, start-up etc. that are done by the operator of the system can be done on the touch screen.

You will find detailed information about the pages on the touch screen on the next page.

Caution!

This HMI screen manual is given as a sample. It may differ on seperate systems.

IN THIS USER MANUAL

OPTIONAL SHEETS ON THE TOUCH SCREEN ARE NOT SHOWN.

IF YOU HAVE OPTIONAL EQUIPMENTS / SYSTEMS IN YOUR SYSTEM

THERE WILL BE OTHER PAGES IN ADDITION TO THE PAGES SHOWN HERE ON YOUR TOUCH SCREEN.

4.2.4.1 Main Page

Figure 4-5: Touch Screen Main Page

The home page is used to switch between pages on the HMI screen.

RO PAGE button directs to the running page of the reverse osmosis system. RO system parameters such as switch positions, pressure, flow values are shown on this page. RO running page allows the user to control the system manually or automatically. Detailed information is given on the *4.2.4.2 RO Running Page*.

RO SETTINGS PAGE button directs to the settings page of the reverse osmosis system. RO system parameters are set on this page.

CIP PAGE button directs to the CIP page of the reverse osmosis system. CIP procedure is started on this page.

DOSAGE PAGE button directs to the dosage page of the reverse osmosis system. Dosage tanks and dosage pumps statuses are followed on this page.

CALIBRATION PAGE button directs to the calibration page of the reverse osmosis system. This page is used to set parameters of analog control equipment such as pressure transmitters, flowmeters, pH meter, ORP meter, etc.

ALARM PAGE button directs to the alarm page of the reverse osmosis system. This page shows past and present alarms as a list.

4.2.4.2 RO Running Page

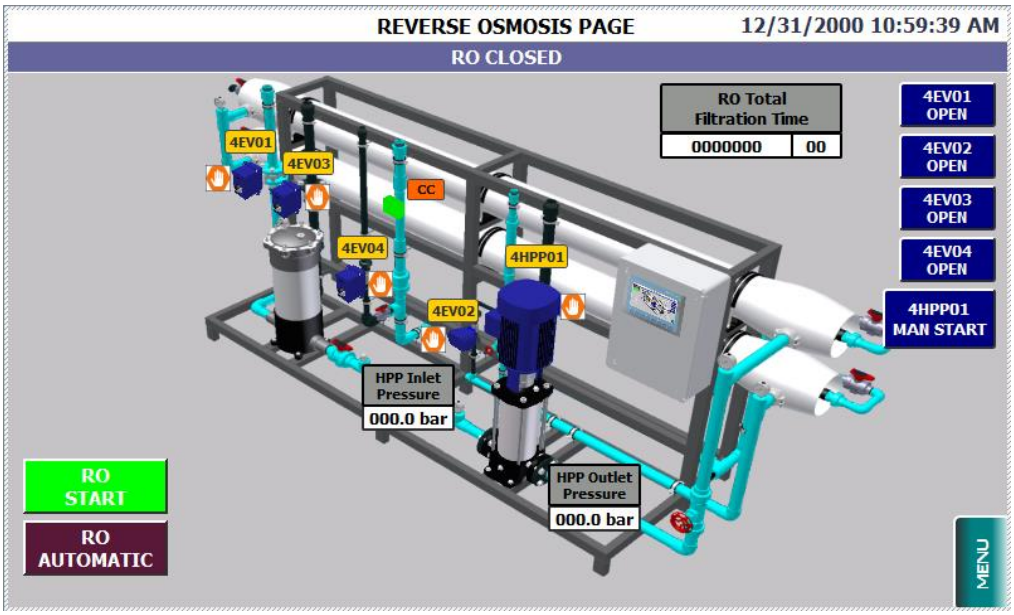


Figure 4-6: Touch Screen RO Running Page

RO running page shows the equipment of the reverse osmosis system. Control of RO running page is explained below.

4EV01 Inlet Valve

4EV02 Auto-flush Valve

4EV03 Rinsing Inlet Valve

4EV04 CIP Tank Filling Valve

4HPP01 High Pressure Pump

CC Product Conductivity Indicator

HPP Inlet Pressure displays the current pressure at the inlet of the high pressure pump.

HPP Outlet Pressure displays the current pressure at the outlet of the high pressure pump.

RO Total Running Time (Hour/Minute): Shows the total running time of RO.

RO START (STOP): Starts and stops the RO system in automatic mode.

RO AUTOMATIC (MANUAL) shows the current auto/manual status of the RO. When the system is switched into manual mode, all valves are closed and all pumps are stopped and manual control buttons appear.

4EV01 OPEN (inlet valve), **4EV02 OPEN** (auto-flush valve), **4EV03 OPEN** (rinsing inlet valve), **4EV04 OPEN** (CIP tank filling valve) buttons opens and closes the related valves in manual mode.

4HPP01 MAN START button starts & stops the high pressure pump in manual mode.

When a valve opens manually using buttons mentioned above, an hand "  " figure appears near the related equipment. Hand figure indicates that it is opened manually.

Pump and valve color codes are given below.

Green: Pump running / Valve open

Blue: Pump stops (is not running) / Valve closed

Red: Pump in failure / valve in failure (if failure present)

4.2.4.3 RO Setting Pages

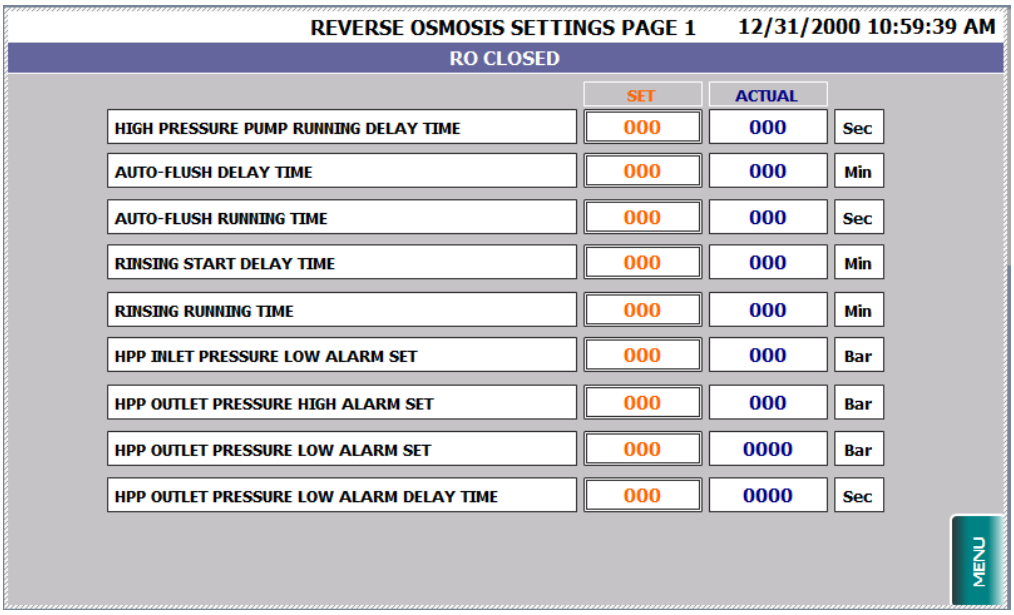


Figure 4-7: Touch Screen RO Settings Page

HIGH PRESSURE PUMP RUNNING DELAY TIME

When RO system is started, after the inlet valve (4EV01) is opened, high pressure pump starts to run after some time. This setting is the time of this delay. It is entered in seconds.

AUTO-FLUSH DELAY TIME

RO system does auto-flush for some time at every specific settable time. For example, 60 seconds of auto-flush every 60 minutes. This setting is the time of waiting time for auto-flush.

AUTO-FLUSH RUNNING TIME

RO system does auto-flush for some time at every specific settable time. For example 60 seconds of auto-flush every 60 minutes. This setting is the time of auto-flush running.

RINSING START DELAY TIME

RO system does rinsing when it stops for a reason. It counts this waiting time then goes into rinsing. It is entered in Minutes.

RINSING RUNNING TIME

RO system does rinsing when it stops for a reason. This is the time that indicates how long the system does rinsing. It is entered in Minutes.

HPP INLET PRESSURE LOW ALARM SET

It is the lower limit for pressure at the inlet of the high pressure pump. If the pressure goes down below this set point, RO system gives an alarm and stops. It is entered in Bars.

HPP OUTLET PRESSURE HIGH ALARM SET

It is the upper limit for pressure at the outlet of the high pressure pump. If the pressure exceeds this set point, RO system gives an alarm and stops. It is entered in Bars.

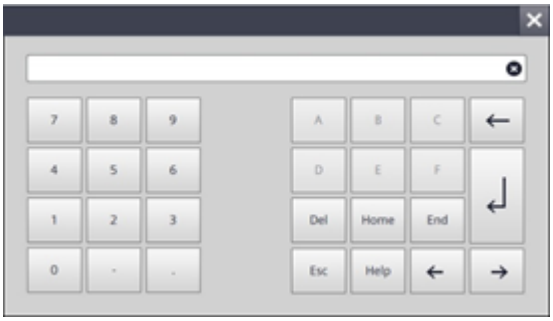
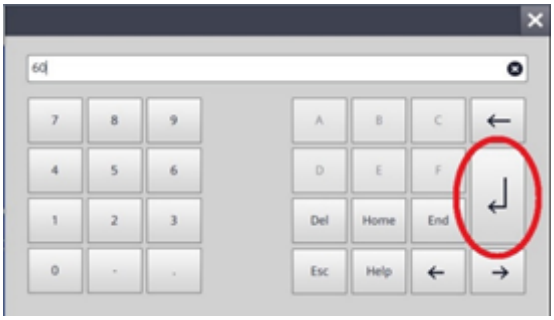
HPP OUTLET PRESSURE LOW ALARM SET

It is the lower limit for pressure at the outlet of the high pressure pump. If the pressure goes down below this set point, RO system gives an alarm after a delay time and stops. It is entered in Bars.

HPP OUTLET PRESSURE LOW ALARM DELAY TIME

It is the delay time for low pressure alarm at the outlet of the high pressure pump. If the pressure goes down below the set point along this delay time, RO system gives an alarm and stops. It is entered in Seconds.

ENTERING THE SET VALUE

-Click the box below the SET tab to enter the setpoint. The screen above appears.
-Enter the desired value using numbers.
-After entering the value press the "**ENTER**" button (shown above).

Caution!
The changes do not take place unless the "**ENTER**" button is pressed.

1) Backspace: Deletes the digit on the left of the cursor.

2) Enter: Saves the entered value.

3) Arrows: Moves the cursor to left and right.

4) Delete: Deletes the digit on the right of the cursor.

5) Dot: Types comma.

4.2.4.4 Chemical Cleaning Page

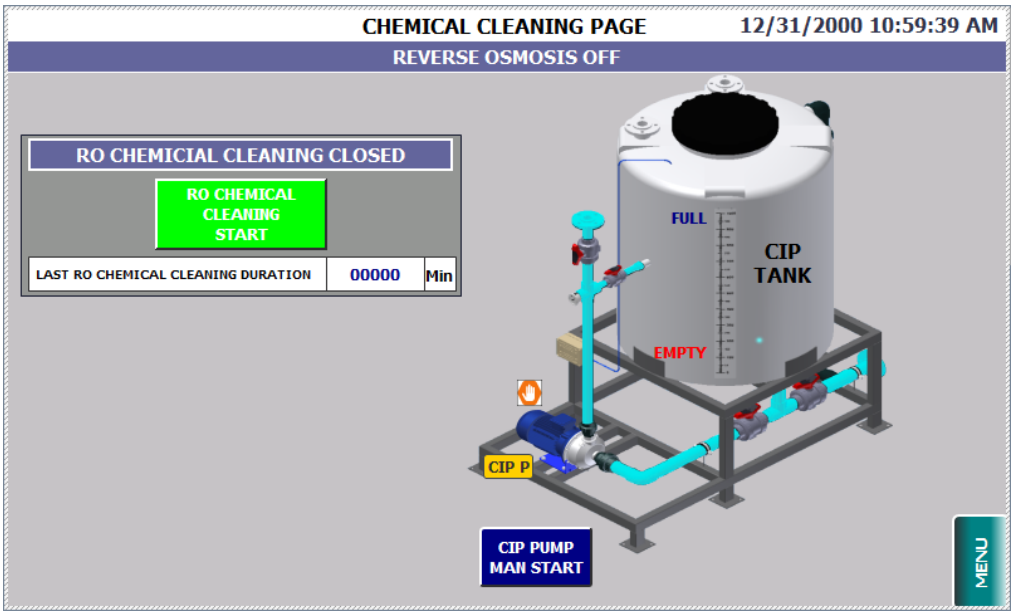


Figure 4-8: Touch Screen Chemical Cleaning Page

RO CIP Tank level switches are shown on the tank as empty and full.

CIP tank low level indicator ("**EMPTY**") appears if the signal is not received from the low level floater switch, meaning the tank is empty.

CIP tank high level indicator ("**FULL**") appears if the signal is not received from the high floater switch, meaning the tank is full.

CIP PUMP MAN START button starts & stops the washing (CIP) pump in manual mode.

RO CHEMICAL CLEANING START button starts the RO CIP (chemical cleaning). When chemical cleaning is started, the system starts the CIP pump and opens the required valves automatically. If CIP procedure is not stopped, it stops automatically in case of low level in the CIP tank.

Last RO Chemical Cleaning Duration shows the last CIP procedure duration. It resets when a new CIP procedure is started.

When a valve opens manually using buttons mentioned above, an hand "  " figure appears near the related equipment. Hand figure indicates that it is opened manually.

Pump and valve color codes are given below.

Green: Pump running / Valve open

Blue: Pump stops (is not running) / Valve closed

Red: Pump in failure / valve in failure (if failure present)

4.2.4.5 Dosage Page

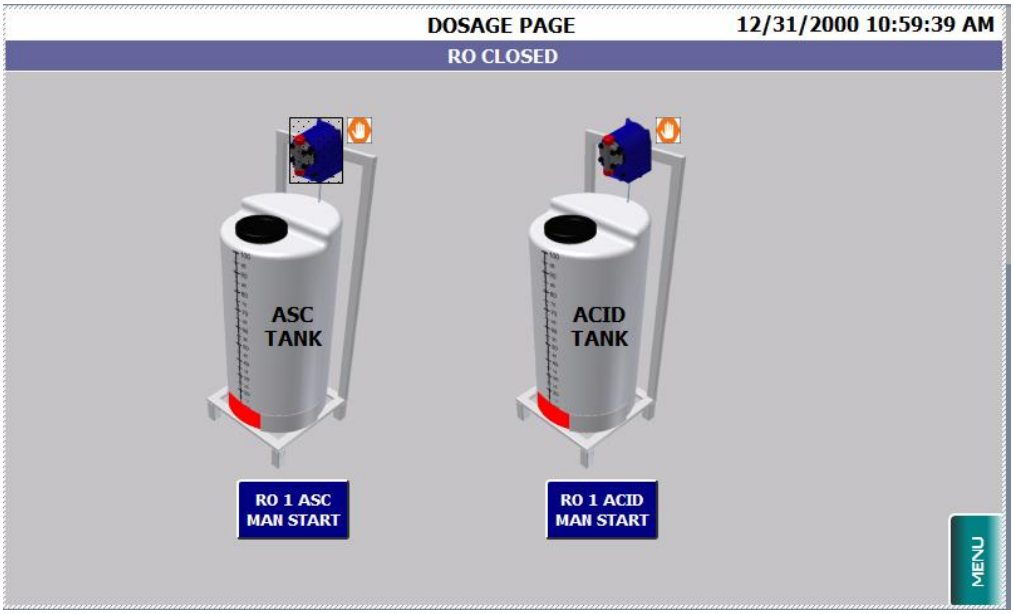


Figure 4-9: Touch Screen Dosage Page

Dosage tank low level switch is shown. It appears and flashes in red colors if the signal is not received from the switch (meaning tank is empty).

RO ASC (ACID) MAN START buttons start & stop the related dosage pump in manual mode. When a valve opens manually using buttons mentioned above, an hand "  " figure appears near the related equipment. Hand figure indicates that it is opened manually.

Pump and valve color codes are given below.

Green: Pump running / Valve open

Blue: Pump stops (is not running) / Valve closed

Red: Pump in failure / valve in failure (if failure present)

4.2.4.6 Calibration Page

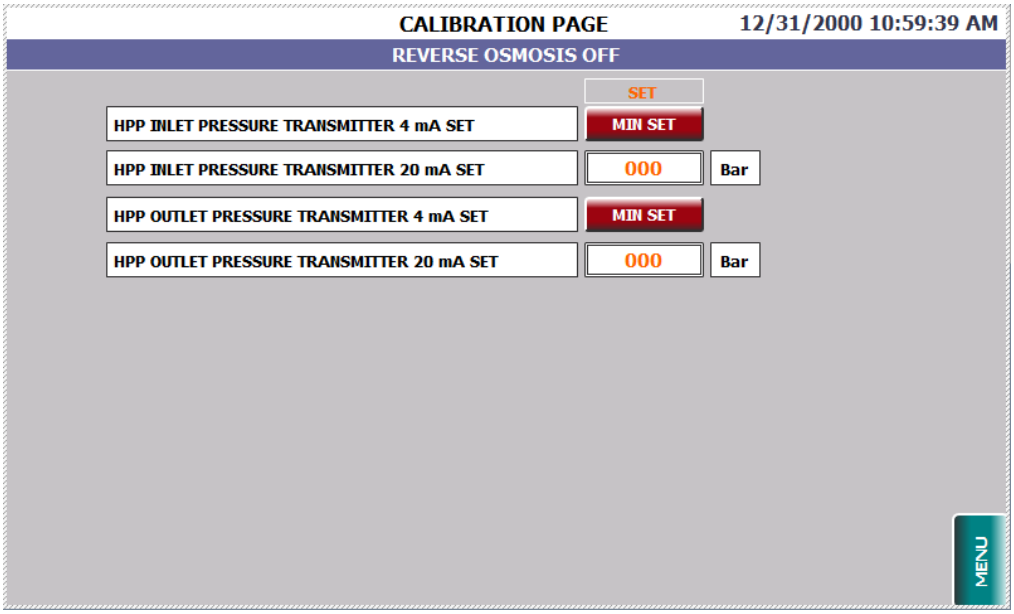


Figure 4-10: Touch Screen Calibration Page

Analog calibration page is used in order to define sensor measurement intervals in the PLC. The procedure is explained below.

PLC and sensors/analysors communication is provided via 4-20 mA current. Sensors/Analysors sends 4 mA at their minimum measurement points and sends 20 mA at their maximum measurement points. These minimum and maximum measurement points must be defined on this page.

Pressure transmitters

According to the range on the transmitter, enter the maximum point as "**...20 mA SET**" on the value box near the text.

In order to set the minimum point of the transmitter press and hold the "**MIN SET**" button near the "**...4 mA SET**" text for at least 5 seconds when there is no pressure on the line. Default value for minimum point is zero "0".

Flowmeters, conductivity meters, pH meters, ORP meters and **Turbidity meters** (if present) are connected to transmitters. Transmitters send 4-20 mA current to the PLC in the range of defined minimum and maximum measurement points. 4 mA point default values are set to zero "0". Set the MAX point as the same as the 20 mA value defined on the transmitter.

4.2.4.7 Time and Date Settings Page

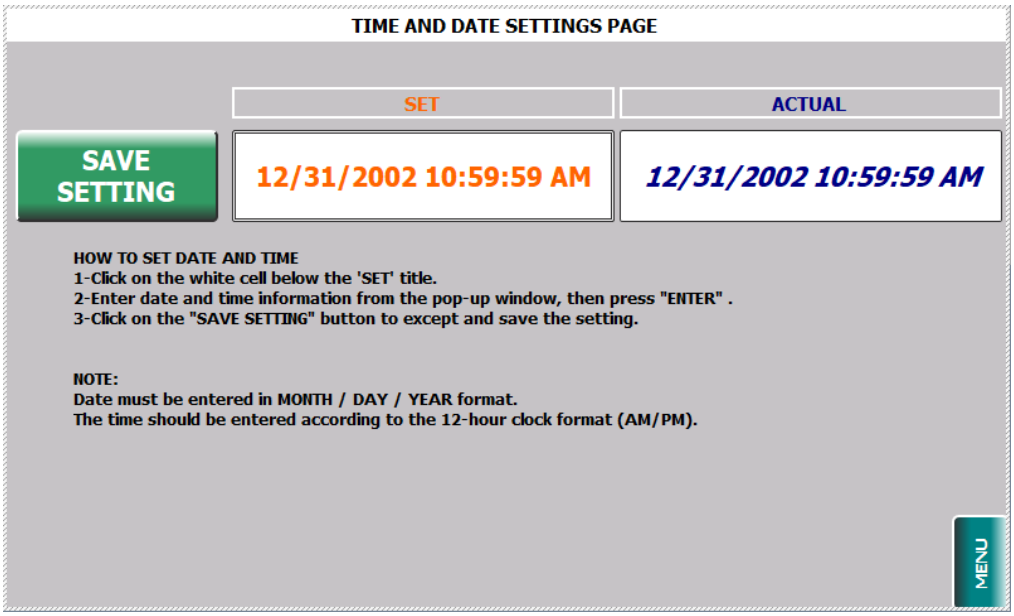


Figure 4-11: Touch Screen Time & Date Settings Page

The time and date are set in 2 steps.

1-Entering the time and date information

- Click on the date and time under the 'set date and time' title on the time settings page.

- Enter the time and date using the keyboard.
- After entering the required values, it is required to press "**ENTER**".

2-Setting the entered time and date information

- After entering the time and date as shown, press "**SAVE SETTING**" button to set.
- Value under the actual title on the left side of the screen will change, which means time and date are set.

4.2.4.8 Alarm Page

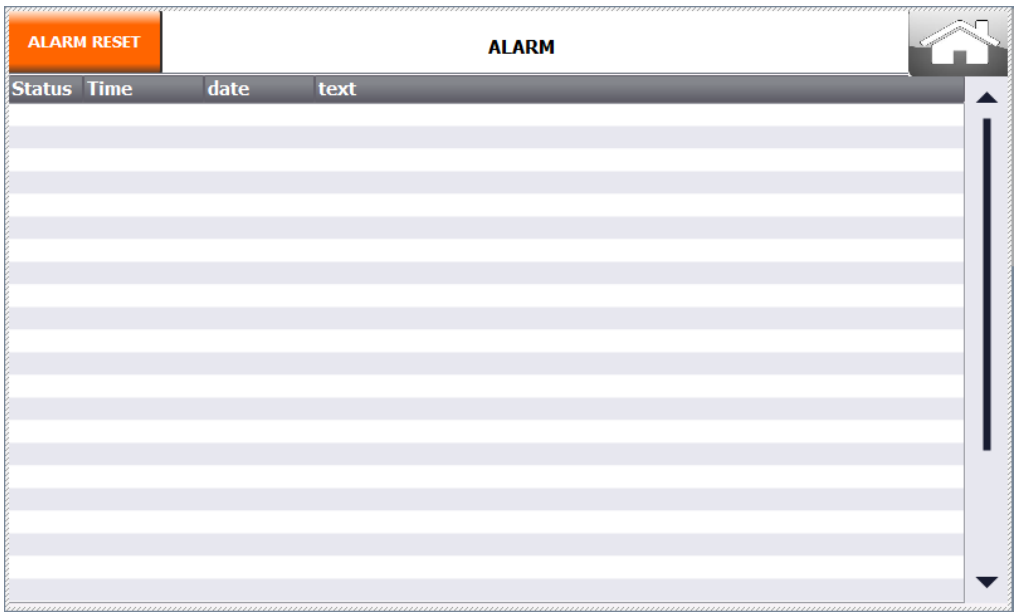


Figure 4-12: Touch Screen Alarm Page

Incoming alarms listed as text.

ALARM RESET button resets the incoming alarms when pressed.

5. TRANSPORTATION STORAGE & INSTALLATION

5.1 CARRYING STORING

There are some issues which you pay attention to during carrying and storing after the arrival of the ALFA Series Reverse Osmosis system. You should always remember that equipment may damage unless you pay attention.

- Δ Please protect the system from sliding or toppling.
- Δ You should pay attention to the weightiness of the system and use appropriate tools while carrying the system.
- Δ You should pay attention considering the system center of gravity is not in the middle and take precautions.
- Δ Devices are raised from ground 9 cm height by 6 pcs skid in order to carry by forklift.
- Δ If you want to carry the device by forklift, try not to damage the device by forks of the forklift.
- Δ Please protect from hitting the devices while carrying, otherwise the equipment of the device may damage.
- Δ Fasten up the device by a rope if you want to raise the device up by 1,5 meter and upper height.
- Δ In some cases vertical type panels must be sent with the device separately from other parts. You should carry and store the panels carefully for not to damage the panels. If you want to garner the panels you should do it vertically.

- Please try to provide that the temperature of storing or installation rooms of the systems must be minimum 4 ℃ and maximum 40 ℃.

- Please try to provide closed areas for storing the systems to protect from direct sunlight and rain. Do not store the devices in dusty environments.

- If membranes should be stored before commissioning, store in a cool and dry place protecting from direct sunlight. You can store it in a short time by minimum 4,4 ℃ and maximum 35 ℃ temperature. If you want to store it for a long time, you can keep it at 20 ℃ temperature for 12 months without releasing its original case.

- Chemicals must be stored according to appropriate storing conditions which are written in Material Safety Data Sheets (MSDS).

- You must check if there is missing or damaged equipment during delivery of the system. In any case like this, you must prepare a report with delivery company staff and proceed with it.

5.2 INSTALLATION

5.2.1 Cautions Before Installation

Cautions before installation of the system are listed below. It is strongly necessary to obey those cautions.

- Δ Please read carefully the section *2 HEALTH & SAFETY* before the installation.

- Δ Connections must be made by qualified staff. It is necessary to take occupational health and safety precautions before the installation.

- Δ You must leave a minimum 1,5 meter free area at both sides of pressure vessels to put in and remove membranes.

- Δ Installation surface must be flat.

- Δ If you want to put the systems on a base, those bases must withstand the weight of the systems.

- Δ Place where the devices will be installed must have an air conditioner. Dosage chemicals[17] must be placed in another room. That room must have an air conditioner so that you prevent the system from chemical vapour.

- Δ Enough capacity drainage must be made for concentrate water and leakage of the system.

- Δ Minimum carrying capacity of the installation place must be 1,5 times of the operating system weight.

[17] *Antiscalant chemicals are not harmful for the devices.*

5.2.2 Hydraulics Installation

Hydraulics Installation of ALFA Series Reverse Osmosis Systems, includes piping operations below:

- Between *raw water tank or pretreatment system* **and** *feed inlet of reverse osmosis device*
- Between concentrate water outlet of reverse osmosis device and drainage line of the concentrate water
- Permeate water outlet of reverse osmosis device and permeate water tank
- In systems with CIP; between CIP tank and reverse osmosis device, between *CIP overflow with CIP discharge* **and** *drainage*

According to this, you must consider cautions below during hydraulics installation;

I. You must choose fittings equipment which will be used in the installation according to the designed pressure class.

II. Connections of free feeding, permeate and drainage lines will be made on the site.

III. You must make raw water inlet connections by choosing appropriate pipe diameter and pressure class.

IV. Permeate water lines must be linked to permeate water tanks according to appropriate pipe diameter and pressure class.

V. Rear pressure of the permeate water line must be maximum 0,5 bar. If there is Ürün suyu hattı geri basıncı maksimum 0,5 bar olmalıdır. If there is a possibility of pressure more than 0,5 bar, you must link a check valve to that line. If the pressure will be more than 0,5 bar, it is advised that adding an extra tank and pressing water by this way.

VI. Permeate water connection pipe diameter, may be next larger diameter of permeate water outlet water pipe.

VII. If you must put a closing valve on permeate water line, you must put a safety valve before that.

VIII. Permeate water float switch must be connected to current permeate water tank. You can consult to electrical terminal tables in section *10 APPENDI*X

IX. Concentrate water lines must be connected to drainage with appropriate diameter pipe according to appropriate pressure class.

X. If permeate and concentrate lines have lower altitude than osmosis altitude and if there is a possibility of vacuum, you must install a vacuum breaker to those lines.

XI. In systems with CIP, overflow and discharge of cleaning tank must be connected to drainage. You must feed from an osmosis tank, returning lines of concentrate and permeate water cleaning tanks must be connected to a cleaning tank with appropriate diameter pipe according to appropriate pressure class. (CIP bulunan sistemlerde yıkama tankı taşkanı ve boşaltması drenaja bağlanmalıdır. Yıkama tankından ozmoz beslemesi yapılmalı, atık ve ürün yıkama tankı dönüş hatları uygun çapta boru ve basınç sınıfına göre yıkama tankına bağlanmalıdır.)

XII. If there are feeding-pump-before-RO and pre-filtration systems, connections must be made by checking appropriate pipe diameter and appropriate pressure class.

XIII. Consoleing should be done in a way that the weight and weight of the installation will not be placed on the system.

5.2.3 Electrical Installation

Electrical Installation of ALFA Series Reverse Osmosis Systems include electrical operations below;

- Main power connection to control panel
- If they exist, cable connections with socket
- Signal connection in filter cleaning

By this way please pay attention instructions below;

I. You must be sure that the main power switch is closed before main power feeding to the system.

II. Energy feeding line must be maximum 2 meters far from the device. If it will be longer, cable cut-view must be specified again according to new length. Enerji besleme hattı cihazdan maksimum 2 m uzakta olmalıdır. Daha uzun olacak ise kablo kesiti metraja göre kontrol edilmelidir.

III. Connections which are made to the control panel, must be made according to the scheme inside the panel. You can find standard terminal blocks' tables in sections *10.1 SINGLE PHASE ALPHA TERMINAL TABLE* ve *10.2 TRIPHASE ALPHA TERMINAL TABLE*.

IV. Main energy connection;
   - Must be connected to number 1,2 and 3 in X1 terminal blocks on mono phase (230V AC) ALFA panels[18].
   - Must be connected to number 1,2,3,4 and 5 in X1 terminal blocks on three phase (380V AC) ALFA panels.[19] You must make a correct panel phase connection. In 3-phase systems, if you make a wrong connection, Phase

[18] *1 = Phase, 2= Neutral ve 3 = Soil*

[19] *1 = R Phase, 2= S Phase, 3 = T Phase, 4 = Neutral ve 5 = Soil*

Protection Relay gives error. That is explained with details in section *6.3.6 Termik ve Motor Faz Koruma Alarmı*. Standard electrical scheme is given in section *10 APPENDIX*.

V. You must use a cable lug while connecting cables.

VI. If screwing on the panel becomes slack, heating consists on energy-existing points. Pano içerisindeki vidalamaların gevşek olması durumunda enerji olan yerlerde ısınma meydana gelecektir. Bu sebeple pano içi vida uygulamaları gevşek olmamalıdır.

VII. If you tighten the screws too much, screw jags will be damaged. So please do not tighten the screws too much.

VIII. In some cases vertical type panels may be delivered with the device. This type of panels must be installed immobilizing to the ground.

IX. The device is delivered with connected-float-switch. Permeate water level floaters must be left into the permeate water tank. If the permeate water tank is far as float-switch cable can not reach, you can extend cables.

X. You must make socket cable connections of dosage units.

XI. If there is CIP in the system, you must make socket cable connections of pump and level floater for the chemical cleaning unit.

XII. There are bridge connections on terminal blocks of L + 24 VDC (9) and Signal for Filter cleaning (10) inside the terminal block group of X2. If there is prefiltration in the system and if the osmosis system will be stopped when prefiltration starts

cleaning, you must make cleaning-signal-cable-connections by cancelling that bridge connection. Standard electric scheme is given in section *10 APPENDIX*.

5.2.4 Installation of Dosage System

5.2.4.1 Installation Between Dosage Pump and Dosage Tank

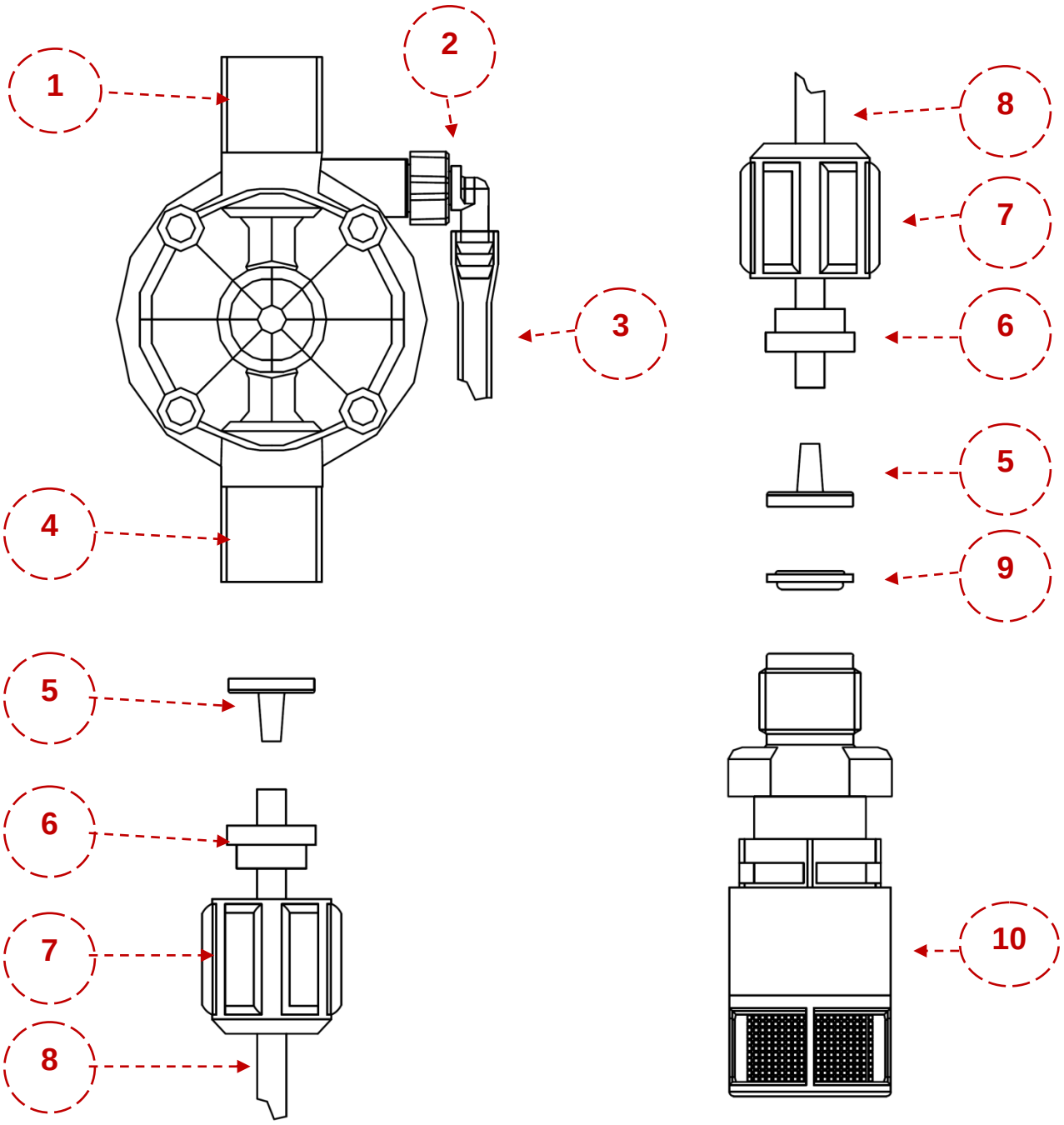


Figure 5-1: Installation Between Dosage Pump and Dosage Tank

5.2.4.2 Installation Between Dosage Pump and Dosage Point

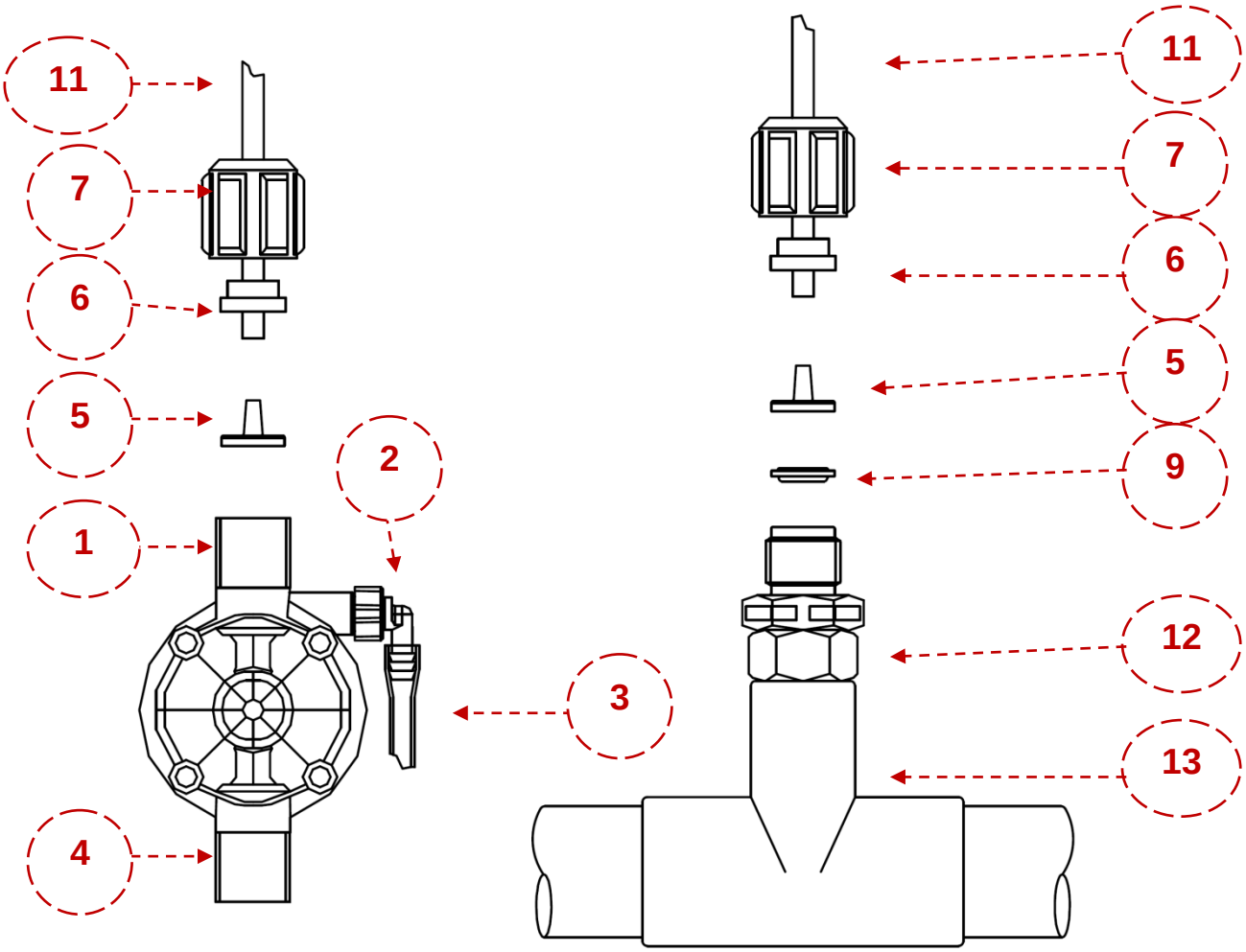


Figure 5-2: Installation Between Dosage Pump and Dosage Point

NO	NAME	DESCRIPTION
1	PRESSING VALVE	It takes chemicals (which are sucked from the dosage tank) to the injection point.
2	AIR DISCHARGE VALVE	It discharges air in the pump.
3	DISCHARGE HOSE	It is a soft and transparent hose.
4	SUCTION VALVE	It sucks the chemical from the dosage tank.
5	HOSE HOLDER	Sivri tarafı hortumun içine tamamı ile girecek şekilde monte edilir.
6	HOSE CLIP	The hose holder is brought closer to the part, preventing the hose from being pulled in and the pump not to draw air from outside
7	NUT (SOMUN)	It is the cap that allows the hose, which is compressed with a hose holder and clamp, to be combined with suction and discharge valves.
8	SUCTION HOSE	It is a soft and transparent hose.
9	PE GASKET	It prevents leakages.
10	SUCTION FILTER	It is a filter that prevents exposing the pump from particles which may cause pollution in the dosage tank. It includes a mass at its sole. Because of this, it is located at the lowest level of the chemical tank.
11	PRESSING HOSE	It is a rigid and opaque hose.
12	INJECTION FITTING	It takes the chemical which comes from the pressing valve to the injection point.
13	INJECTION POINT	The point at which the chemical is dosed.

Table 5-1: Description of the Dosage System Components

5.2.5 Membrane Loading

DO NOT LOAD MEMBRANES TO PRESSURE VESSELS IF YOU WILL NOT COMMISSION AFTER LOADING OF MEMBRANES IN A SHORT TIME. MEMBRANES ARE KEPT WITH A PROTECTION SOLUTION IN THEIR PACKING AND YOU MUST COMMISSION IN A SHORT TIME AFTER RELEASING FROM THEIR PACKING. YOU MUST ALWAYS MAKE WORK THE MEMBRANES WITH WATER OR YOU MUST ALWAYS KEEP THEM IN THEIR PROTECTION SOLUTION. OTHERWISE THERE IS RISK OF DRYING OF THE MEMBRANES. THAT AFFECTS NEGATIVELY PERFORMANCE OF THE MEMBRANES.

5.2.5.1 Rinsing

I. You must rinse the whole system (pipes, pumps, pressure vessels etc.) with clean water before loading of membranes to pressure vessels. That prevents damaging of membranes by various dirty particles, protection materials and solvent.

5.2.5.2 Preparing of Pressure Vessel

I. Release headings of pressure vessels from both sides.

II. Release all parts (o-rings, membrane head adaptor etc.) of pressure vessel headings, wash with water and put them in a clean place.

III. Check number of o-rings, adaptors and connections of headings and check that they are correct or wrong parts.

IV. Clean the dust and other particles which may damage mechanically the membrane surface from inside of the pressure vessel. cleaning with water is not enough for cleaning of pressure vessels.

V. Cover a sponge ball with a towel or fabric. Submerge that ball to a %50 – 75 glycerine-water solution. Treat the inner side of the pressure vessel with that sponge ball by a rope or PVC pipe.[20] By that way inner walls of pressure vessels are treated by glycerine and you can load membranes easier.

VI. In another way; wrap a PVC cork which has smaller diameter (3 ½ ") than pressure vessel diameter (4" for ALFA Series) by a cotton fabric[21] until it touches the inner walls of the pressure vessel. Link it to a rope which is longer than the pressure vessel and pull it through the pressure vessel. Inner walls of the pressure vessel will be glycerin that way.

VII. Mount the headings on the concentrate water side after cleaning the pressure vessel.[22] Treat the headings of pressure vessels and o-rings in the membrane head adapter with a very thin layer of silicone.

[20] *Try not to damage by pipe to the surface of the pressure vessel.*

[21] *Submerged to %50 – 75 glycerine-water solution.*

[22] *Mount the headings absolutely properly to prevent gliding of the heading gasket.*

5.2.5.3 Loading of Membranes

I. Ensure that all headings on the concentrate water side are closed.

II. Save; serial numbers of membranes, which pressure vessel they are loaded and their loading row.

III. Open package of membrane in %33 rate. By this way, contact of operators with FRP outer surface and protection solution of membranes is reduced.

IV. Push the membrane smoothly into the pressure vessel from the feeding side and remove the package while doing this. Remove the package completely when the rest becomes quarter. Avoid contacting membrane protection solutions.

V. Always load membranes from the feeding side.[23] Load membranes in arrow direction (arrow on the membrane) and avoid gliding of membrane o-ring.

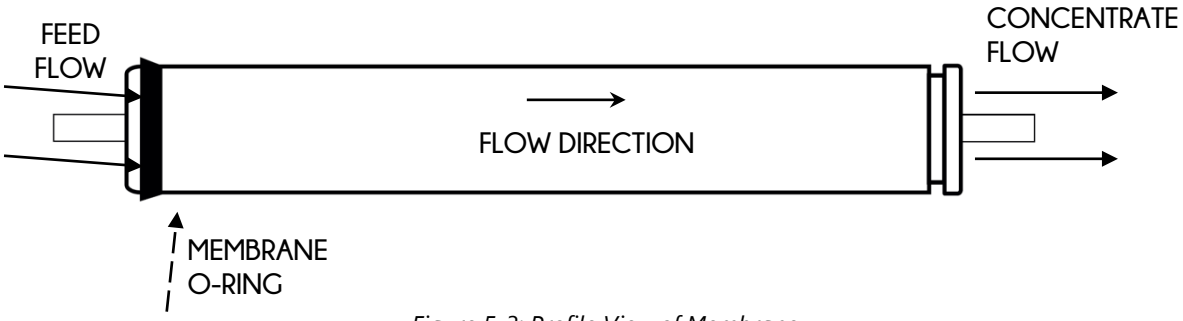


Figure 5-3: Profile View of Membrane

[23] *Feeding sides of all membranes in the system may be different.*

I. If you load membrane to a single pressure vessel, treat membrane o-ring with glycerine solution or silicone. If you load membranes to a plural pressure vessel, treat the membrane connection adapter and o-rings with silicone. After that, insert membrane connection adapter to permeate water collecting canal of first membrane and treat membrane o-ring with glycerin solution.

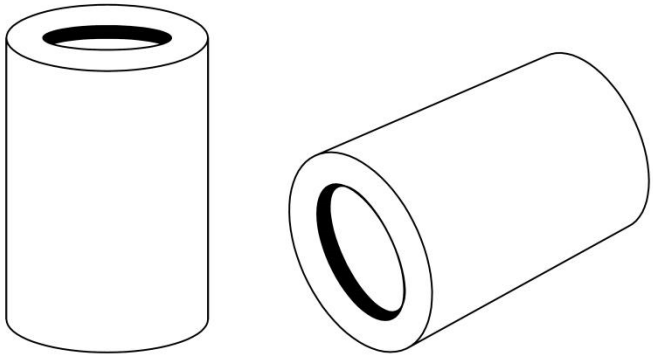


Figure 5-4: View of Membranes Connections Adapter

II. Insert next membrane to permeate water collecting canal of previous membrane[24] and load both membranes to the vessel while releasing their packages until the quarter of last membrane stays out. Finally release its package completely.

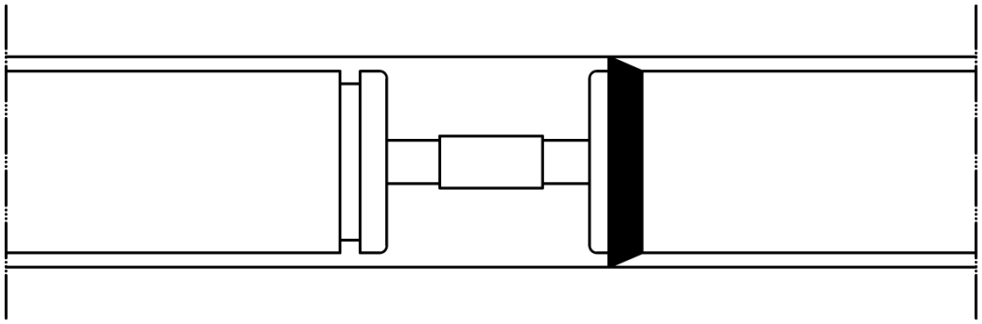


Figure 5-5: Connection of Two Membrane in the Vessel

[24]*You must lift while loading the membrane, because the interconnector may not stand to weight of membrane.*

III. Follow above steps for all membranes.

IV. After loading the last membrane; push to the last membrane and move membranes until the one on the other side touches the head of the other side.

V. After loading all membranes, mount headings on the feeding side.[25] Before mounting, lubricate the case cover and o-rings on the membrane cover adapter with a very thin layer of silicone.

5.2.6 Disassembly

If it is necessary to shut down or replace the system because of any reason, disassemble very carefully the system by following below steps:

I. Shut down electricity power from the main panel.

II. Cut electricity power which comes to the main panel and release electricity feeding cables inside the panel.

III. Close completely inlet and outlet valves to isolate the system.

IV. Remove dosage hoses in the dosage system.

V. Disassemble electricity power of dosage pumps and release them from the panel.

VI. If there are immobilizing screws on the chassis frame, disassemble them and make it movable.

VII. Remove pressure vessel headings and release membranes. Preserve membranes as WET in tanks which include protection solution.

VIII. If the system will be replaced, do it by paying attention to the center of gravity by using an appropriate crane or forklift.

IX. Disassembled equipment and lines are mounted again by following the same assembly steps.

[25] *Mount very straightly the headings to prevent gliding of the heading gasket.*

6. COMMISSIONING

6.1 CAUTIONS BEFORE COMMISSIONING

Read and apply carefully below instructions before commissioning of the assembled system.

- Δ Check all mechanical and electrical connections.
- Δ Make necessary leakage tests.
- Δ You may need a pretreatment system according to raw water quality which feeds the RO system. There may be filtration, softening or etc. systems in pretreatment. Also you can bring the water quality to intended parameters by chemical dosage. If there is pre-treatment, the Reverse Osmosis device should be stopped by receiving a signal from the pre-treatment during cleaning.[26]
- Δ Solve problems of pretreatment systems earlier. Ensure that they work properly without any problem.
- Δ Check convenience of pipes and fittings to the technical structure of the system.
- Δ Take precautions for water-hammers.
- Δ Check number and assembly of dosage systems; connections of dosage systems between them and electrical panels. Check also the convenience of dosage solution.
- Δ Check electrical connections of level floators. Ensure that signals which come to the panel are correct or not.
- Δ Check cable and analyzer connections of mounted sensors.

[26] *If the pre-treatment units entering the cleaning does not affect the feeding flow too much (for example; if one of the filters in systems with more than one filter goes into washing, sufficient flow is provided from the remaining filters), the RO system can continue to produce water without going into standby mode.*

- Check that electrical feedings of actuator or solenoid valves are made or not.
- Ensure that the airing valve of the cartridge filter works or not.
- Check numbers of cartridges on cartridge filter and convenience of assembly.
- Check cable connections of low and high pressure switches, also check convenience of set values.
- Check electrical feedings of pumps and ensure that electrical feedings are correct.
- Ensure that there is no free chlorine, suspended solids and turbidity in water which RO unit uses.
- Check that all manual and automatic valves are in the right position.
- Check that all solution tanks are full and they are not degenerated because of long time.
- Check that chemical dosage units are ready to work and their dosage settings are convenient or not.
- Check that pH, ORP and conductivity sensors are mounted correctly.
- Ensure that globe valve after high pressure pump and concentrate water setting valve is open.
- Check directions of all check-valves including permeate water check-valves.
- Check that engine connections (star or triangle) are correct or wrong according to drawings on the inner surface of caps.
- Check the motor ground connections.

6.2 COMMISSIONING STEPS

- Commissioning can be done in necessity by an authorized department after assembly and completing controls before commissioning. Also if it is necessary supervisorship service can be provided.

- Commissioning of the pump must be authorized service. Please contact the authorized service of the pump before commissioning.

- If the system is standard ALFA Series RO, analyze raw water and check that results are between standard design limits or not. If one of the results is not between those limits, please contact the ESLİ Technical Service Department before raw water feeding to the system.

- If the system is Private Manufactured ALFA Series RO, analyze raw water and check that results are between design limits which was given us. If one of the results is not between those limits, please contact the ESLİ Technical Service Department before raw water feeding to the system.

- Paying attention to raw water is soft. If the raw water is not softened, remember that antiscalant dosage must be done and contact our Technical Service Department for appropriate dosage.

- Ensure that enough flow and pressure is provided to the system.

- *Load membranes like explanation in section 5.2.5 Membrane Loading*[27]

- Switch 'main power switch' to 1 position on the left side of the panel.

- Open a completely concentrated water valve.

[27] *Membranes are loaded certainly in water flow direction.*

- Switch the high pressure setting valve to “half-open position”.

- Switch “RO ON - OFF switcher” to ON. If there is no alarm in the system, the system works normally like explained in section *4.1.1 System Operation*.

- If there is alarm in the system, check necessary controls. Read section *6.3 Possible Problems During Commissioning*.

- Discharge air which may exist in the system by air-discharging-valve on the cartridge filter, when the system works.

- Set operating parameters (flow, pressure) to design values by using concentrate and back-feed valve (if exists).

- If flow is high, you can decrease it by reducing the high pressure setting valve. If the flow is low, you can increase it by opening a high pressure setting valve.

- Check permeate water conductivity by a conductivity meter on the system. Conductivity value may be high in the first 30 minutes. Please accept the value after the first 30 minutes as real value.

- Check that manometers, flowmeters, pressure switches and other equipment work appropriate.

- Check that dosage pumps make suction or do not. Also measure that dosage pumps make theoretical dosage or do not by a measured cap. Discharge air which may exist by air-discharging-valve.

- Check that level floaters play alarm or do not.

- Check that pH sensor (if exists) reads correct or does not at the start of the system.

- Check that ORP sensor (if exists) reads correct or does not at the start of the system.

- Observe opening and closing conditions of electrical actuated valves and ensure that they open and close in the right time.

- If they exist, check pH and ORP values.

- Check that the low pressure switch stops the system in adjusted time. Please adjust it to a minimum 2 bar. You can find how to adjust pressure switches in section *6.4 ADJUSTING LOW AND HIGH PRESSURE SWITCHES*.

- Check that the high pressure switch stops the system in adjusted time. The adjusted pressure must be approximately 1 bar higher than high pressure pump outlet pressure.

- Discharge air of pumps of the system. Check their turning directions, amper values they use and compare amper values with nominal amperage value written on metal label

- Check that there is abnormal sound, vibration etc. or there is not while working on pumps.

- Check that electrical motors of pumps are overheated or not.

- Commissioning values must be written on start-up data form. This form is identification of the system. It must be filled daily and changes must be followed. You can find an example of form in section *10.3 EXAMPLE OF RO SYSTEM FOLLOWING FORM.*POSSIBLE PROBLEMS DURING COMMISSIONING

6.2.1 Low Pressure Alarm

If the feed water of the system is not enough, the system stops by playing a low pressure alarm. Possible reasons of this situation are;

- 5 micron cartridge filter may be congested at the start of the system.
- Raw water feed pumps may not be working.
- By any reason, enough water may not be coming from pretreatment.
- Low pressure switches may be out of order.
- Low pressure switch connections may be wrong. Connections must be in number 1 and 4 on the pressure switch.
- One of the valves may be closed in the system feeding the water line.
- Direction of the entry valve may be wrong.
- Low pressure set value may be wrong.

6.2.2 High Pressure Alarm

If pressure in the system is higher than the one which is adjusted, the system stops by playing a high pressure alarm. Possible reasons of this situation are;

- High pressure setting valve may be too open.
- If there are old membranes in the vessel, the membranes may be congested and they need chemical cleaning. If chemical cleaning does not become useful, membranes must be changed to new ones.
- Concentrate water lines may be congested.
- High pressure switches may be out of order.
- High pressure switch connections may be made wrong. Connections must be in number 1 and 2 on the pressure switch.

6.2.3 AC 220V Alarm

- According to the flow diagram on panel cap, if 'AC 200 volt lamp' is not green; that means any voltage that does not come to RO electronic card and glass fuse (2A) must be checked.
- Ensure that the fuse is open inside the panel.
- Check the main energy feed.

6.2.4 AC 24V Alarm

- If 'AC 24 V lamp' is not green, that means 24 Volt does not come to the system. Check that there is 220 Volt entry to the transformer in the panel and there is 24 Volt AC exit from the transformer in the panel.
- Check cable connections.

6.2.5 Chemical Tank Low Level Alarm

- If there is a dosage pump in your system, there is a terminal block behind the panel. Dosage low level edges must be connected to this terminal block. Otherwise the chemical tank plays a low level signal.
- If there is no dosage pump in your system, number 7 and 8 in X2 terminal block are bridged in standard manufacturing. Check bridged cables.
- For chemical low level connection which will be done later, remove bridged connection and connect it level sensor which is tank low level.

6.2.6 Thermic and Engine Phase Protection Alarm[28]

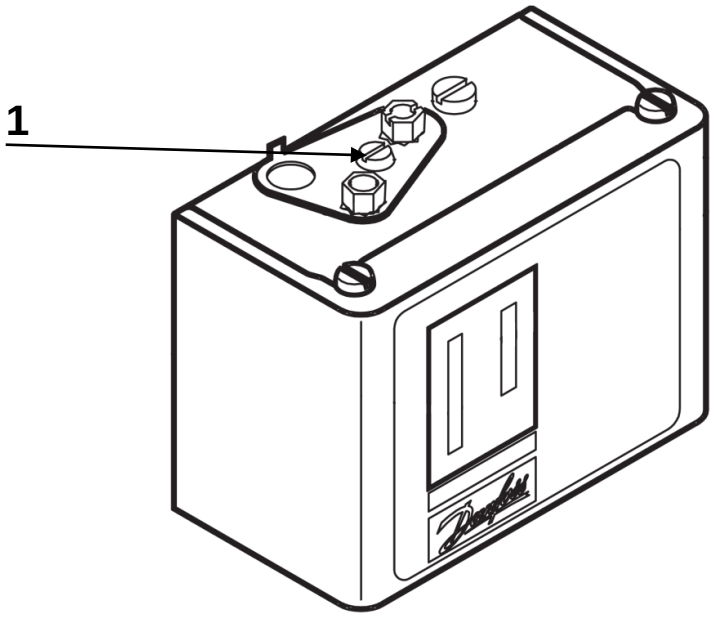
In 3 phase systems, engine direction and phase row are adjusted in standard manufacturing. When entry phase connection is made, led on the engine phase protection relay must light green. If it is necessary, phase connection direction must be changed and the correct row must be provided. Thermic adjustment must be set on appropriate current according to the engine label. If FAILURE led lamp lights, there are 2 possible reasons:

I. Phase row of panel entry is not correct. Row connection must be checked.

II. Engine protection thermic is not open, it must be opened.

[28] *It is only used in 3-phase systems.*

6.3 ADJUSTMENT OF LOW AND HIGH PRESSURE SWITCHES



I. Remove the screw (1) on the switch.

Figure 6-1: Perspective View of Pressure Switch

II. Adjust *DIFF* (4) by straight screwdriver (2), adjust *RANGE* (5) by fillister head screwdriver (3).

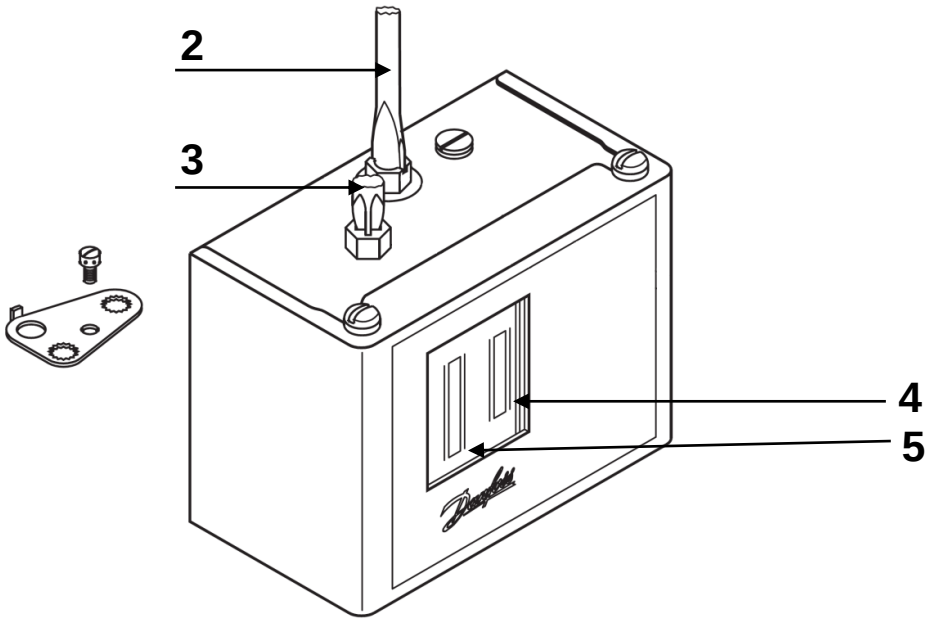


Figure 6-2: Adjustment of Pressure Switch

III. Low level switch stops the system when $System\ pressure \leq Range - Diff$

For example; If Range = 3 bar and Diff = 1 bar, when system pressure decreases 2 bar or smaller, a low level switch stops the whole system for safety. Again; Range = 4 bar and Diff = 2 bar, when system pressure decreases 2 bar or smaller, a low level switch stops the whole system for safety. If you set it as 'Diff is bigger than Range', the system never stops because of low pressure.

IV. High pressure switch stops when $Sistem\ Pressure \geq Range + Diff$

For example; If Range = 8 bar and Diff = 2 bar, when system pressure increases to 10 bar or higher, a high level switch stops the whole system for safety. Again; Range = 9 bar and Diff = 1 bar, when system pressure increases to 10 bar or higher, a high level switch stops the whole system for safety.

6.4 ADJUSTMENT OF CONDUCTIVITY METER

Conductivity meter which exists in Standard ALFA Series Reverse Osmosis, has a view like below figure. The view may differ a little because of improvements sourced by technology.

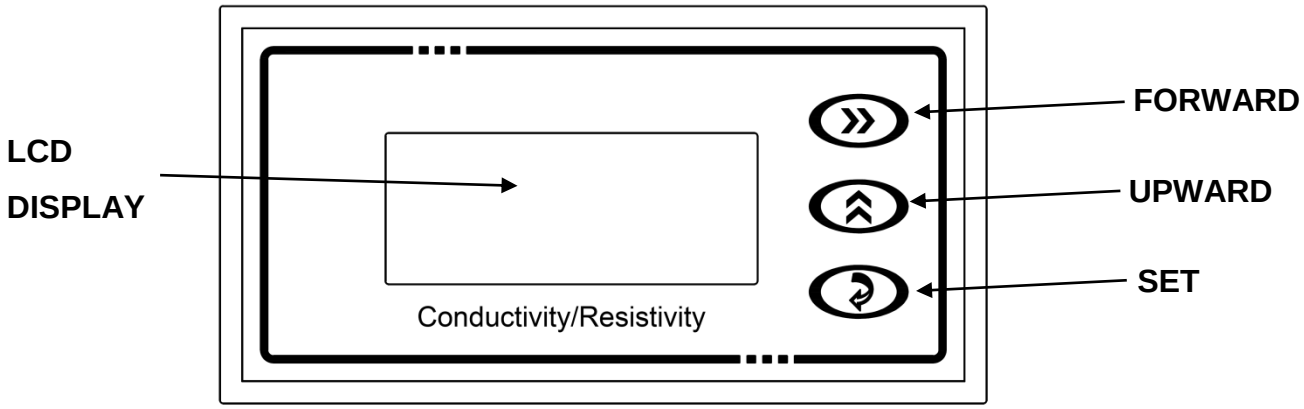


Figure 6-3: Standard Conductivity Meter Controller

When the system is fed by power, on LCD display;

You can switch between conductivity and temperature by pressing the **UPWARD** key.

You can switch between ppm and µs/cm units by pressing **SET** key.

6.4.1 Adjustment of Conductivity Meter K-Factor

I. When the device is on the conductivity meter measuring screen, press and hold the **SET** key for 3 seconds to go to the Settings page.

II. See flashing of 1.000 number on screen.[29] Press the SET key again. See flashing of only 1 digit. Choose a digit which you want to change by pressing **FORWARD** and bring the value to K-factor (which is written on a conductivity probe) by pressing **UPWARD**.

III. Press the SET button to confirm when you enter the value on the conductivity probe.

[29] *If the K-factor of the device had been changed before, you will see a changed K-factor instead of 1.000.*

6.4.2 Adjustment of Conductivity Measure Unit

I. When the device is on conductivity measure screen, press and hold **SET** button for 3 seconds to go to Settings page.

II. See flashing of 1.000 number on screen[30] Press the SET button two more times. When the word 'UNIT' word is shown on screen, choose ppm or µs/cm by using the **UPWARD** button.

III. Press **SET** button to confirm conductivity measurement unit.

6.4.3 Adjustment of Conductivity Meter Set Values

I. Press and hold the SET button for 3 seconds when you are at the conductivity measuring screen to go to the Settings page.

II. See flashing of 1.000 number on screen.[30]

III. Press the SET button 3 more times. See *Hi* word above number on the screen. This word means 'High'. If the conductivity value which passes through the probe is higher than the number on the screen, the system plays 'Conductivity High Alarm'.

IV. Choose a digit which you want to change by pressing the FORWARD button and enter the conductivity value which you want the system to play as an alarm by pressing **UPWARD**.

V. Press the **SET** button. See *Lo* word on screen. This word *Lo* means 'low'. If the conductivity value which passes through the probe is lower than the number on the screen, the system plays 'Conductivity Low Alarm'.

VI. Choose a digit which you want to change by pressing **FORWARD** and enter the conductivity value which you want the system to play alarm by pressing **UPWARD**.

VII. Press **SET** button to confirm chosen conductivity unit.

[30] *If the K-factor of the device had been changed before, you will see a changed K-factor instead of 1.000.*

6.5 ADJUSTMENT OF DOSAGE PUMPS

Adjustment of ALFA Series Reverse Osmosis devices is explained in details below. If another trademark dosage pump is used by private request, please contact ESLİ Technical Service Department and request specifically information about adjustment of that trademark pump.

Dosage pumps divide 3 categories:

I. Manual Controlled Dosage Pumps
II. ORP Controlled Dosage Pumps
III. pH Controlled Dosage Pumps

6.5.1 Manual Controlled Dosage Pumps

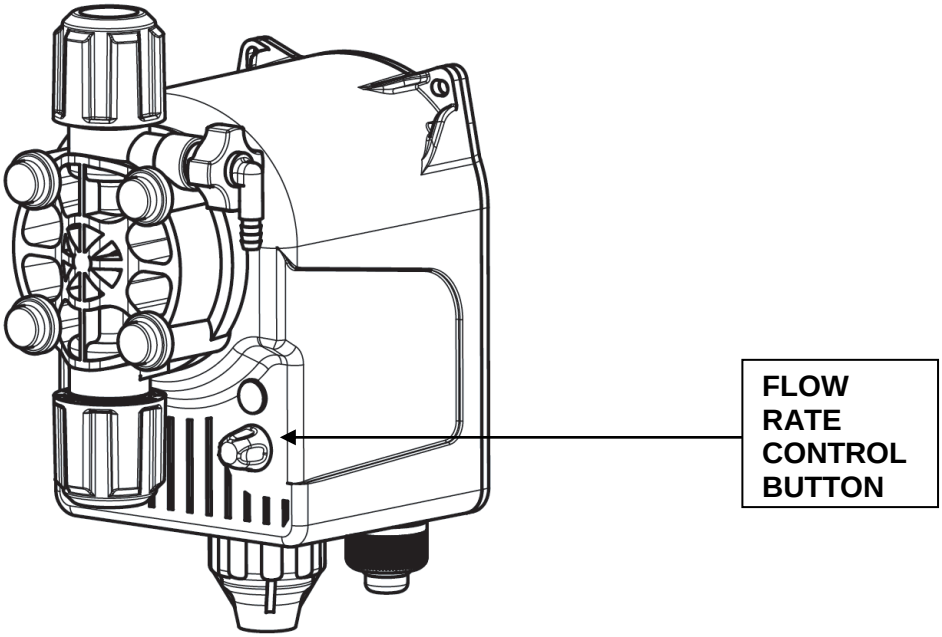


Figure 6-4: Standard Manual Controlled Dosage Pump

Manual controlled dosage pumps are constant flow analogic dosage pumps. Flow rate adjustments are made by the flow rate control button on them.

They are usually used for constant dosage amounts like antiscalant, coagulant. Manual controlled dosage pumps are often used for chlorine dosages.

Flow rate value according to the opposite pressure is written on the label of the pump. Flow rate of the pump is not the same at 1 bar opposite pressure and 10 bar opposite pressure. Pump flow rate increases by pressure decreases. Considering all these, the necessary amount which will be dosed is adjusted by bringing the control button to a value between %0 and %100.

6.5.2 ORP and pH Controlled Dosage Pumps

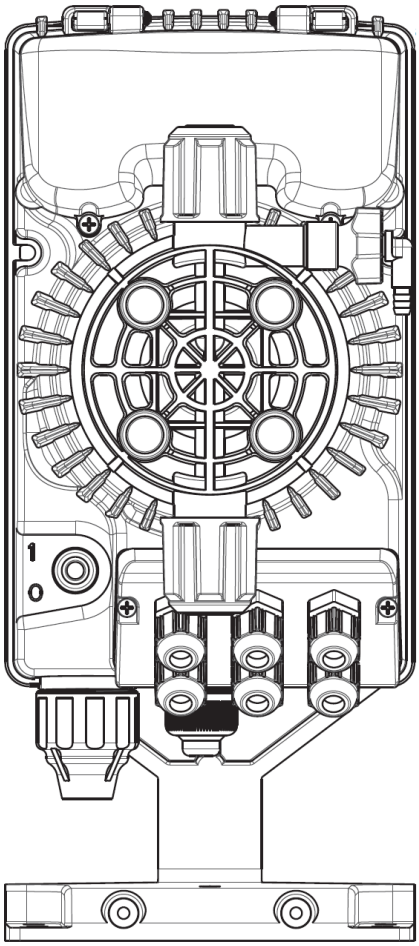


Figure 6-5: Standard pH and ORP Controlled Dosage Pump

These pumps work according to signals which come from linked probes. Acid and caustic dosages are pH controlled, SMBS and chlorine dosages are ORP controlled.

For ORP controlled pumps; dosage flow rate is adjusted automatically about to a constant mV value is caught. For pH controlled pumps; dosage flow rate is adjusted automatically about to a constant pH value is caught.

7. OPERATION & MAINTENANCE

7.1 OPERATION

The plant must be properly operated based on warnings and information written in the user manual. Although the system is fully automatic, there will be situations where operator intervention is required. For this reason, it is important to understand the operation of the plant well and to make conscious interventions.

The operator must daily fill in the form given in the SAMPLE RO SYSTEM DATA MONITORING FORM in 10.3 and be able to make comments by comparing with the previous data. If there are big differences between the membrane inlet pressure value recorded the day before and the membrane inlet pressure value the next day, the reason should be investigated. Or, an operator who sees gradually increasing wastewater conductivity over a period of 1 week should analyze this situation and investigate to find the result. Therefore, the more conscious and knowledgeable the person operating the plant is, the longer the life of the osmosis device will be. Conditions that require operator intervention are listed below,

If there is an alarm in the plant, it is checked and the alarm is resolved and the plant is restarted,

II. In case of water leakage in the fittings or the installation line, the leakage is eliminated and the plant is operated again,

III. Stopping or starting the system for any reason,

IV. Chemical cleaning of membranes,

To protect the membranes during prolonged pauses,

VI. Checking the level in chemical tanks and making chemical supplements when necessary,

VII. Apart from these, in case of any problem in the system, to contact the ESLİ Technical Service Department.

7.2 MAINTENANCE

7.2.1 Periodical Maintenance

Most of the conditions required for maintenance in the system will be detected by the current alarm mechanisms. However, when an alarm occurs; Since it will require more urgent and expensive interventions, it will be useful to routinely check the problems, whose main reasons are given below, without waiting for the alarm to occur. It is recommended to prepare a form regarding the maintenance practices and to keep a record of the notes regarding the maintenance performed in this form. Frequently encountered problems and maintenance work to be done to prevent them can be determined more easily with the help of this form.

7.2.1.1 Daily Maintenance

- Δ Check the static and dynamic elements in the plant.
- Δ Check for water leaks and if there is, fix. Write non-repaired leaks and errors in the shift book.
- Δ Make sure there is no chlorine leak by analyzing chlorine in the water at the RO unit inlet.
- Δ Check that the dosing pumps are delivering the desired amount of suction and discharge. Get your air.
- Δ Check cartridge filter inlet-outlet pressures. If the pressure difference between the inlet and outlet exceeds 0.8 bar, replace the cartridge filter.
- Δ Control product water and wastewater flow. If there is a change in baseline, investigate the causes.
- Δ Check the pressures on the manometers in the relevant parts of the system. If there is a change in pressures, investigate the causes.
- Δ Check the inlet temperature of the Reverse Osmosis device.
- Δ Check the Reverse Osmosis working efficiency.
- Δ Control chemical consumption.

7.2.1.2 Weekly Maintenance

Δ Repeat the procedures in daily care.

Δ Check the fittings. If so, troubleshoot leaks and leaks.

Δ Add the decreasing amount of chemical to chemical tanks.

Δ Check if the inside of chemical storage tanks are clean.

Δ Make sure the Datasheet on the RO is kept in order.

Δ Check that pumps and valves are working properly.

Δ Check the RO operating efficiency.

Δ Check for compressed airways. Dispose of condensed water in the drain.

Δ Clean the equipment in the device.

7.2.1.3 Monthly Maintenance

Δ Repeat the procedures in Daily and Weekly Care.

Δ Blow compressed air cleans the electrical panels.

Δ Check calibrations of pH, ORP and conductivity analyzers. If calibrations are broken, calibrate.

Δ Perform manometer pressure tests.

Δ Check the filter for signs of contamination by removing the cartridge filter.

Δ Check for signs of contamination by removing the membrane caps.

Δ Perform functional tests of the low and high pressure switches.

Δ Perform functional tests of the level switch or level switches.

Δ Check pump current values, flow rate, pressure, sound and vibration.

Δ Check that all valves in the system are fully open and closed.

7.2.1.4 Yearly Maintenance

- Repeat the process in Weekly and Monthly Maintenance.
- Check and clean the electric control assembly and devices.
- Replace defective and defective parts.
- Do the general cleaning and touch-up job.
- Fixing and leveling equipment; should be checked according to the equipment manufacturers' instructions. This should be done especially for pumps and electric motors.
- In pressure pipes; Non-destructive testing (NDT) should be carried out by notified bodies every 5 years. Some of the non-destructive testing types are x-ray, ultrasonic testing and magnetic particle testing.
- Lubricant and bearing checks of the pumps should be made, if necessary, they should be changed and / or added.
- Actuator and manual valves should be disassembled, their seals and shafts should be checked and replaced if necessary.
- If necessary, membranes should be cleaned by chemical cleaning.
- Annual system data should be reviewed and if necessary, it should be done again considering the system efficiency performance losses.

7.2.2 Decommissioning

If the system needs to be stopped for any reason, the Decommissioning Procedure must be followed. Otherwise, bacteriological growth will be observed in the pores of the membranes and will be damaged.

The CIP system must be in place during the decommissioning process. If you do not have a CIP system in the system, you can do this by installing an external CIP system.

In every conservation process; Solution printing, solution renewal, rinsing and re-commissioning should be noted by the operator by specifying the date. If available, notes about different practices or observations are recorded in the table. The schedule can be easily seen near the system and is hung in a suitable place.

7.2.2.1 Deactivation the system During Short Time Stop

Membranes must be preserved according to the Short Term Decommissioning Procedure for stops longer than 24 hours and up to 96 hours.

Short Term Decommissioning Procedure;

I. System; By rinsing with RO product water, the air in the sheath and membrane is thrown out together with the dirt in the membrane.

II. When the lids are completely filled, all valves are turned off.

III. Every 12 hours I. and II. steps are repeated.

7.2.2.2 System Deactivation During Long Time Stop

For stoppages longer than 4 days, membranes must be protected according to the Long Term Decommissioning Procedure.

Long Term Decommissioning Procedure;

I. System; By rinsing with RO product water, the air inside the sheath and membrane is thrown out together with the dirt in the membrane.

II. If there is a CIP system provided by ESLİ, the system is placed in Chemical cleaning Position.

III. Preservation Solution should be prepared in CIP tank. Sodium Metabisulfite is used as a preservation solution. The preservation solution concentration should be prepared as 2% by weight. For example; If approximately 22 kg of 95% powder SMBS chemical is added to 1000 liters of RO product water, a 2% SMBS solution by weight is prepared.

IV. The solution in the Chemical Wash Tank is mixed until it becomes a homogeneous solution.

V. Chemical cleaning is started and the system is operated until the solution in the solution tank is finished.

VI. When the solution is finished, chemical cleaning is stopped and all valves in the system are closed and the solution is cut off from contact with air. When the SMBS solution comes into contact with air (oxygen), it will oxidize the SMBS to sulphate, lowering the pH. Therefore, the pH should be checked periodically. If the pH falls below 3, the protective solution must be renewed.

VII. Ambient temperature should not be below 0 C and above 40 C.

VIII. Ambient temperature; If more than 27 C, every 15 days, if less than 27 C, every 30 days I, II, III, IV, V and VI. The solution should be renewed by repeating the steps.

7.2.2.3 Preservative Solution Rinse and System Commissioning

The protective solution must be rinsed off whenever the system in which the Long Term Disabling Procedure has been applied is desired to be reactivated. This is done by following the steps below and the system can be re-armed.

I. All valves that were first closed to activate the system are fully opened and the protective solution drained completely.

II. Power is supplied to the main board.

III. By opening the thermal protection relay on the panel of the RO high pressure pump, the pump is deactivated.

IV. The system is operated without a high pressure pump and rinsed at low pressure.

V. Air is taken with the help of the air inlet valve on the cartridge filter.

VI. By taking samples from the waste, it is observed whether the system is completely without solution. When the system is completely rinsed, the system is stopped.

VII. The high pressure pump thermal protection relay is turned off and the pump is started again.

VIII. The system is reactivated as described in section 6.2 COMMISSIONING STEPS.

7.2.3 Chemical Cleaning

The surface of RO membranes can become contaminated over time with suspended solids, colloids and precipitates. The main purpose of pre-membrane pretreatment is to minimize such contamination that can accumulate on the membrane surface. If the membranes are operated under the best operating conditions (product water flow, pressure, efficiency and pH value), the membranes will become less contaminated.

If the SDI value obtained from the pre-treatment is high, the membranes will be blocked by contamination. At the same time, wide variations in raw water properties and factors such as failure of RO cause membranes to clog.

During normal operation over time, RO membranes; Blockage may occur due to suspended or soluble substances in the water. To give an example of the pollution on the membrane;

• Calcium Carbonate Precipitate

Calcium, Barium and Strontium Sulphate Precipitate

• Metal Oxide Precipitation (Iron, Manganese, Copper, Nickel, Aluminum etc.)

• Polymerized Silica Precipitation

• Blockage Caused by Inorganic Colloids

Blockage due to Inorganic / Organic Colloid Mixture

• Clogging Caused by Natural Organic Materials

• Clogging Caused by Man-Made Organic Materials (Ex; Antiscalant)

Biological Occlusion (Bacteria, Algae, Mold, Fungus)

Pollution formation; depends on many factors such as the quality of the feed water and system efficiency. Typically, contamination progresses slowly and can damage the membrane if not addressed early. Chemical cleaning process; It is performed as routine maintenance before prolonged downtime or when clogging of membranes is observed.

Membranes; It should always be operated clean or in good condition to avoid clogging by the contaminants listed on the previous page. Permissible pollution on the membrane;

Δ If the decrease in product water flow is less than 10%

Δ If the decrease in product water quality is less than 10%

Δ If the pressure loss between feed and waste is less than 15%

Applying the Chemical Cleaning process before reaching these values will ensure that the membranes are operated in a clean condition. The values obtained after cleaning; The same values as the initial values indicate that the wash is effective.

Some operating parameters have fixed values. These; Product water flow rate is product water counter pressure, yield, temperature and inlet water conductivity. If these values are changing, these values should be fixed and then compared to baseline values to see if the membrane is clogged.

Routine control of the plant is important for early detection of membrane clogging. Performance changes due to the nature of the pollutant are shown in Table 7 1: Membrane Pollution Diagnostic Table.

RO Chemical cleaning frequency varies with each plant. The frequency of cleaning usually varies between 3 months and 12 months. If there is more than one chemical wash requirement per month, the pretreatment for RO design feeding the RO system should be reviewed. If there is a need for cleaning every three months, the functioning of the current system should be reviewed.

Membranes should be washed before heavy contamination occurs. Heavy contamination will make it difficult for the wash solution to penetrate deep into the contaminant and at the same time it will be very difficult to clean the contamination from the system. Therefore, the chemical cleaning efficiency will decrease and it will not be possible for the membrane to regain its former performance. When the membrane performance drops by 30% - 50%, it is impossible to return the membrane to its previous performance.

Systems are often washed with low and high pH solutions. This is because; Although it differs from plant to plant, it is generally that membranes are clogged with pollutants that have more than one feature.

POSSIBLE CAUSE	POSSIBLE LOCATION		PRESSURE DROP	FEED PRESSURE	CONDUCTIVITY
METAL OXIDE[31]	1. STAGE	INITIAL MEMBRANES	□	□	□
COLLOIDAL[32]	1. STAGE	INITIAL MEMBRANES	□	□	□
MINERAL[33]	LAST STAGE	LAST MEMBRANES	□	□	□
POLYMERIZED SILICA	LAST STAGE	LAST MEMBRANES	□	□	□
BIOLOGIC	IN ALL STAGE	INITIAL MEMBRANES	□	□	□
ORGANIC[34]	IN ALL STAGES		□	□	□
ANTISCALANT	AT MOST AT 2. STAGE		□	□	□
OXIDANT[35]	AT MOST AT 1. STAGE		□	□	□
HYDROLYSIS[36]	IN ALL STAGES		□	□	□
CORROSION[37]	AT MOST AT 1. STAGE		□	□	□
O-RING LEAKAGE[38]	RANDOM	GENERALLY FEED ADAPTOR	□	□	□

Table 7-1: Membrane Scaling Diagnostic

[31] *For example; Fe, Mn, Cu, Ni, Zn*
[32] *Organic and / or inorganic complexes*
[33] *For example; Ca, Mg, Ba, Sr*
[34] *Dissolved DOM*
[35] *For example; Cl2, ozone, KMnO4*
[36] *Aralığın dışındaki pH*
[37] *Carbon particles etc.*
[38] *In membrane cover or intermediate adapter*

7.2.3.1 Membrane Scaling Types

I. Calcium Carbonate Scaling

Generally, the precipitation of calcium carbonate to control because of antiscalant-dispersant or pH during acid injection for errors. Early detection to resolve the calcium carbonate water is enough to keep level 3-5 pH for 1-2 hours. More resistant to removal of calcium carbonate precipitate, such as citric acid cleaner should be used with low pH.

II. Calcium, Barium & Stronsiyum Sulfate Scaling

Sulfate to precipitate the suspension, the suspension of calcium carbonate sediment is more difficult though. Usually sulfate to precipitate; antiscalant-sulfuric acid dosage of the dispersant and the resulting implementation is more. Besides, barium and strontium sulfate precipitation is more difficult to prevent. For this reason, special precautions must be taken.

III. Calcium Phosphate Scaling

High-phosphate ratio is usually found in domestic wastewater. Calcium phosphate precipitation is used to prevent the acidic membrane washer.

IV. Metal Oxide-Hydroxide Scaling

Iron, zinc, manganese, copper and aluminum to precipitate as metals can cause oxidation of the metal oxide or metal hydroxide. Air as oxidizer, ozone, chlorine and potassium permanganate for example.

V. Polymerized silica layers

Silica is quite difficult to precipitate out of the ordinary chemicals. This chemical is used as amonyumbiflorit reason. Storage and use of such chemicals may damage equipment.

VI. Colloidal Scaling

Colloids are substances that are composed of inorganic or inorganic / organic particles that float in water and cannot be deposited by gravity. Colloidal substances usually contain one or more of iron, aluminum, silica, sulfur or organic substances.

VII. Dissolved DOM Organic Scaling

Natural organic substances (DOM), which can be found in all surface and groundwater, even rainwater, are formed as a result of complex biotic and abiotic reactions. The chemistry of these organic pollutants is very complex. Its major organic component is humic acid or fulvic acid. Dissolved DOM can be absorbed into the membrane surface, causing the membranes to clog quickly. When absorption occurs, scaling slowly begins to form in the form of a gel or cake layer.

VIII. Microbiological Scaling

Bacteria, fungi, mold etc. If there is congestion on the feed side due to organic-based pollutants, these pollutants are very difficult to remove. This blockage on the feed side prevents the entry and distribution of the washing solution. It is necessary to sterilize not only the RO system but also pretreatments, installations and dead spots to prevent additional pollution.

7.2.3.2 Considerations in the Use and Selection of Cleaning Chemicals

If the system requires chemical cleaning, the following chemicals and their uses should be considered.

- Δ Chemicals with low pH are used primarily to remove the precipitated minerals. Afterwards, chemicals with high pH should be used to remove organic substances.
- Δ In oil or biological deposits, firstly chemicals with high pH, then chemicals with low pH are used. Some detergent-added cleaning solutions are used as auxiliary substances in the removal of heavy biological and organic residues. EDTA solution can also be used to remove heavy biological and organic residues.
- Δ The cleaning process should be at the recommended temperature in order to increase the life and cleaning efficiency of the membrane.
- Δ In order to increase the life of the membrane, the contact time of the chemical and the minimum time required should be selected.
- Δ Chemicals used in membrane cleaning should not be left in contact with the membrane for a long time.
- Δ While the sensitive chemical wash pH range is 4 to 10, the strong chemical wash pH range is 2 to 12.

- Δ cleaning should be done in line with the inlet water in order not to damage the membrane. Reverse cleaning procedure can also be applied as a result of heavy contamination of the membranes. For information about this procedure, please contact ESLI Technical Service Department.
- Δ Effective cleaning method in multi-stage reverse osmosis; It is carried out by gradually cleaning the membranes by selecting the optimum cleaning speed.
- Δ After cleaning with detergent added cleaning solutions, the problem of foaming is eliminated by keeping the pH of the outlet water high during the rinsing process.
- Δ If there is biological precipitation, biocide type chemicals are used in addition to the cleaning process. Application; It is applied immediately after cleaning, weekly or during continuous service. Care should be taken that the biocide used here is compatible with the structure of the membrane and does not damage the membrane.
- Δ For safety, make sure that all equipment can withstand the pH, temperature and pressures during chemical cleaning.
- Δ For safety reasons, the chemical addition process should be done slowly to the mixing tanks containing water. Acid and caustic should not be mixed. In addition, the second solution should be added after the first cleaning solution is completely removed from the membrane.
- Δ Minimum cleaning temperature is 21 C.

7.2.3.3 Selection of Cleaning Chemical

The chemicals to be used according to the pollution to be removed are listed in the table below.

SCALING SUBSTANCE	SENSITIVE CHEMICAL CLEANING SOLUTION	STRONG CHEMICAL CLEANING SOLUTION
CALCIUM CARBONATE PRECIPITATION	1	4
$CaSO_4$, $BaSO_4$, OR $SrSO_4$, PRECIPITATION	2	4
METAL OXIDE/HYDROXIDES	1	5
INORGANIC COLLOİDAL SCALING	1	4
MIXED INORGANIC/ORGANIC SCALING	2	6
POLYMERIZED SILICA PRECIPITATION	NONE	7
BIOLOGICAL SCALING	2 OR 3	6
DOM ORGANIC SUBSTANCE	2 OR 3	6

Table 7-2: Chemical cleaning Solution Selection Chart

Solution 1:

2% by weight citric acid (C6H8O7) is used as a low pH (target pH 4) cleaning solution. These solutions are used to remove inorganic deposits (calcium carbonate, calcium sulphate, barium sulphate, strontium sulphate) and metal oxides / hydroxides (iron, manganese, nickel, copper and zinc).

Solution 2:

As a high pH (target pH 10) cleaning solution, 2% by weight STPP (sodium tripolyphosphate) (Na5P3O10) and 0.8% by weight Na-EDTA (sodium ethylenediamine tetraacetic acid salt) are used. These solutions are widely used for the removal of calcium sulphate and organic precipitates.

Solution 3:

2% by weight STPP (sodium tripolyphosphate) and 0.25% by weight Na-DDBS (Sodium dodecylbenzene sulfonate salt) (C6H5 (CH2) 12-SO3Na) solutions are used as the high pH cleaning solution (target pH 10). . These solutions are used for the removal of high organic precipitates.

Solution 4:

A 0.5% by weight hydrochloric acid (HCl) solution is widely used as a low pH (target pH 4) cleaning solution. This solution is used to remove inorganic deposits (calcium carbonate, calcium sulphate, barium sulphate, strontium sulphate) and metal oxide-hydroxides (iron, manganese, nickel, copper and zinc). HCl solution is more effective than Solution 1.

Solution 5:

1% by weight Na2S2O4 (Sodium hydrosulfite) is used as a low pH (target pH 4 to 6) cleaning solution. They are also effective in removing metal oxide / hydroxides (especially for iron precipitation) and removing small amounts of barium sulphate, calcium sulphate and strontium sulphate. Since this solution has a very strong odor, the environment should be ventilated during cleaning.

Solution 6:

NaOH (caustic) of 0.1% and SDS (sodium dodecyl sulphate) of 0.03% by weight are widely used as a high pH (target pH of 11.5) cleaning solution. Such solutions are used for the removal of organic and biological residues. SDS is detergent and may cause foaming.

Solution 7:

As a high pH (target pH of 11.5) cleaning solution, 0.1% by weight of NaOH (caustic) is used. Such solutions are used for the removal of polymerized silicas.

7.2.3.4 Preparation of Chemical Cleaning Solution

The table below; It contains information on the preparation of cleaning solutions described on the previous page. The following chemicals are prepared by adding them into 379 liters of pure water.

CLEANING SOLUTION	CHEMICALS	QUANTITY	PH	TEMPERATURE
1	Citric Acid (%100 Toz)	7,7 kg	There is no need for pH adjustment.	40 ^{0}C
2	STTP (%100 Powder) Na-EDTA (%100 Powder)	7,7kg 3,18 kg	The pH is adjusted to 10 with Sulfuric or Hydrochloric acid.	40 ^{0}C
3	STTP (%100 Powder) Na-DDBS	7,7 kg 0,1 kg	The pH is adjusted to 10 with Sulfuric or Hydrochloric acid.	40 ^{0}C
4	HCL Acid (%36 HCL)	1,78 lt	With HCL, the pH is slowly lowered to 2.5, with NaOH, the pH is slowly increased to 2.5.	35 ^{0}C
5	Sodium Hydrosulfite (%100 Toz)	3,86 kg	There is no need for pH adjustment.	35 ^{0}C
6	NaOH (%100 Powder) Or (%50 Liquid) SDS	0,38 kg 0,49 lt 0,11 kg	With NaOH, the pH is slowly increased to 11.5, with HCL the pH is slowly lowered to 11.5.	30 ^{0}C
7	NaOH (%100 Powder Or (%50 Liquid)	0,38 kg 0,49 lt	With NaOH, the pH is slowly increased to 11.5, with HCL the pH is slowly lowered to 11.5.	30 ^{0}C

Table 7-3: Chemical Cleaning Solution Preparation Table

7.2.3.5 Chemical Cleaning Steps

Before starting the chemical cleaning process, the following warnings should be considered and applied.

- Δ Before using chemicals, be sure to read their MSDS carefully.
- Δ Before starting to wash, make sure that the prepared chemical solutions are well mixed and dissolved.
- Δ It is recommended to rinse the membranes with a clean chlorine-free water (minimum 20 ° C) after chemical cleaning. Product water or deionized water can be used. During the re-commissioning of the system, the product water should be given to the drain until it is ensured that no chemicals come out of the product water.
- Δ During chemical cleaning, the maximum allowed temperature value should not be exceeded. The maximum allowable temperature and pH varies according to the membrane type.

There are 6 steps to be followed in chemical cleaning of membranes;

I. The cleaning solution is prepared.

II. The heated cleaning solution is fed into the system with the help of a pump at low flow rate and low pressure. Thus, the process water in the membranes will be thrown out. The pressure must be high enough that the system cannot produce product water or too little product water.

III. When the process water is completely discharged from the system; The prepared solution will begin to be ejected from the waste line. Thereupon, the water coming out of the waste and product line will be returned to the CIP tank with the adjustments made in the necessary valves and the temperature stabilization will be observed. The pH of the solution will be measured and pH adjustment will be made if necessary.

IV. The pump is stopped and the solution is allowed to stay in the system. Sometimes a waiting time of 1 hour is enough for the chemical wash to be effective. In case of very heavy pollution, the solutions can be kept in the system for 10-15 hours.

V. The cleaning solution in the system is rinsed with high flow rate. In this way, the pollutants separated from the membrane surface are rinsed out of the system with high flow rate.

VI. Then purge the solution present in the system by rinsing the system with product water or deionized water. Minimum rinsing temperature is 21 C.

7.2.3.6 Tips About Chemical Cleaning

Δ In cascade systems; It is recommended to wash each stage one by one. Because the pollution removed from the first stage proceeds to the second stage, and if there is any, the pollution removed from here proceeds to the next stages and reduces the cleaning efficiency.

Δ Sediment or clogging of membranes usually occurs as a result of coexistence of impurities. For example, organic, colloidal and biological contamination causes clogging of the membrane. For this reason, the selection of the first cleaning step is very important. Alkaline cleaning is recommended as the first cleaning step. If there is pollution caused by calcium carbonate or iron oxide / hydroxide, the first cleaning should be done with acid.

- Acid solutions often react with silica, organic materials (such as humic acid) and biofilm layers and can affect the performance of the membrane. Sometimes alkaline cleaning after acid cleaning can eliminate this loss of performance, but vigorous chemical cleaning is usually required. If there is colloidal, organic, biological contamination and calcium carbonate precipitation in the system, the contamination is removed by chemical cleaning in two steps. First, alkaline cleaning and then acid cleaning should be done. Organic, colloidal and biological pollution removed after alkaline cleaning will increase the efficiency of acid cleaning.

- Always measure the pH during chemical wash. PH during acid wash; If it rises more than 0.5 'unit, acid addition is required. PH when cleaning alkaline; If it falls by more than 0.5 units, caustic addition is required.

- In cases where the solution is kept in the membrane for a long time (in cases where the pollution is heavy), the solution becomes completely saturated and the pollutants can be deposited on the membrane surface again. In addition, there is a temperature drop in the waiting period and the holding process will be less effective. It is necessary to circulate the solution regularly in order to maintain the temperature (the temperature should not drop more than 5 C). If the pH decreases during this process, the pH is adjusted by adding the necessary chemicals.

- Turbidity and dark solutions should be refreshed. The chemical cleaning process is repeated with the freshly prepared cleaning solution.

8. TROUBLESHOOT

In this section, some minor problems that may occur while using Aqualine ALFA Series Reverse Osmosis devices, possible causes and solutions of these problems are discussed.

Table 8-1: Fault Rectification Table 1, Table 8-2: Fault Correction Table 2, Table 8-3: Fault Rectification Table 3, it is possible to eliminate faults. If you have applied the solution suggestions in this table against the failure but could not get a result, contact your Sales Representative.

FAULT		POSSIBLE CAUSES	POSSIBLE SOLUTIONS
RAW WATER	PUMP THERMAL FAULT	Water does not come	Make sure that water flows into the system.
		Valve is closed.	Check the valves in the system.
		Cartridge Filter is blocked	Replace the relevant cartridge filter
HIGH PRESSURE		Loss in one of the phases	Check the electrical installation and energy.
		Cable is loosed	Check the cables.
		The bearing is dispersed	Change the bearing.
CLEANING		There is a leak from the electric motor to the body	Examine the electric motor and replace the relevant parts..
		Water has entered the electric motor	Check the windings of the electric motor.
		The electric motor burned out	Check the electric motor.
LOW PRESSURE		Raw water feed pump does not work	Check the raw water feed pump.
		Cartridge filter is blocked	Replace the relevant cartridge filter.
		Cable is loosed	Check the cables.
		Cable is dislodged	
		Water does not come	Make sure that water flows into the system.
		Valve is closed	Check the valves in the system.
		Check Valve is defective	Change the check valve
		Low pressure switch setting incorrect	Adjust pressure switch.
		Low pressure switch is defective	Change pressure switch.

Table 8-1: Troubleshoot Table 1

FAULT	POSSIBLE CAUSES	POSSIBLE SOLUTIONS
HIGH PRESSURE	Membrane is blocked.	Use a chemical cleaning. If there is no result, replace the membrane with a new one.
	Needle valve over tightened	Adjust the needle valve by controlling the product water flow and high pressure.
	Cable is loosed	Check the cables.
	Cable is dislodged	
	High Pressure Pump Fault	Check the high pressure pump.
	Waste water line is blocked.	Check the concentrate water line.
	High pressure switch setting incorrect	Adjust pressure switch.
	High pressure switch is defective	Change pressure switch.
CONDUCTIVITY HIGH	Chlorine leakage to the membrane	Change the membrane
	Conductivity meter is out of calibration	Calibrate the conductivity meter.
	Conductivity meter is defective	Change conductivity meter.
	Conductivity meter probe is defective	Change conductivity meter probe.
	Cable between conductivity meter probe is loose	Check the cable
	Membrane is blocked	Use a chemical cleaning. If there is no result, replace the membrane with a new one.
	Needle valve setting incorrect	Adjust the needle valve by controlling the product water flow rate and high pressure.

Table 8-2: Troubleshoot Table 2

FAULT	POSSIBLE CAUSE	POSSIBLE SOLUTION
PH HIGH	Too much caustic dosage	Adjust the caustic dosage by looking at the pH meter.
	Product water flow is low	Check the flow rate adjustment from the adjustment valve.
	pH meter is out of calibration	Calibrate the pH meter.
	pH meter cable is loose	Change the cable.
	pH meter cable is dislodged	
	pH meter is defective	Change the pH meter.
	pH meter probe is defective	Replace the pH probe.
	Caustic concentration is high	Contact the caustic supplier.
PH LOW	Less caustic dosage	Adjust the caustic dosage by looking at the pH meter.
	Product water flow rate is high	Check the flow rate adjustment from the adjustment valve.
	pH meter is out of calibration	Calibrate the pH meter.
	pH meter cable is loose	Check the cable.
	pH meter cable is dislodged	
	pH meter is defective	Change the pH meter.
	pH meter probe is defective	Replace the pH probe.
	Caustic concentration is low	Contact the caustic supplier.

Table 8-3: Troubleshoot Table 3

FAULT	POSSIBLE CAUSE	POSSIBLE SOLUTION
DOSAGE PUMPS DO NOT WORK	Energy is not coming	Check the energy feeds by cutting the energy of the panel.
	Dosing pump burnt out	Contact your sales representative and replace it with a new one.
	Relay failure	Replace the relay.
	Contactor is out of order	Replace the contactor.
	Dosing pump fuse blown	Replace the dosage pump fuse.
DOSAGE PUMPS DO NOT DISCHARGE	Air not evacuated	Take the air in the line.
	Product water flow rate is high	Clean the suction unit.
	Dosing pump mechanism are blocked	Contact your sales representative and replace it with a new one.
	Discharge point is blocked	Clean the line.
	The hose is punctured	Change the hose
	The hose is dislodged	Check the hose connection points.
SOLUTION IS NOT DECREASING IN THE DOSING TANK	Dosing pumps not discharging	Check the dosing pumps.
VALVE DOES NOT OPEN	Energy is not coming	Check the energy feeds by cutting the energy of the panel.
	Valve coil burnt	Replace the coil with a new one.
	Actuator fault	Replace it with a new one.
	Body of valve is defective	Change the valve with a new one.
	Relay fault	Change the relay wit a new one.
	Cable is loose	Check the cables.
	Cable is dislodged	

Table 8-4: Troubleshooting Table 4

FAULT	POSSIBLE CAUSE	POSSIBLE SOLUTION
CIP TANK OVERFLOWED	CIP tank upper level switch fault	Replace the switch with a new one.
	CIP tank filling valve fault	Replace the valve with a new one.
	Chemical flushing return valve open	Close the valve.
PERMEATE WATER FLOW RATE IS LOW	Membrane is blocked	Use a chemical cleaning. If there is no result, replace the membrane with a new one.
	High Pressure Pump fault	Check the pump. Contact your sales representative and replace it with a new one.
	Needle valve setting fault	Adjust the needle valve by controlling the product water flow rate and high pressure.
	Raw water flow rate is low	Make sure that sufficient water flows into the system.
	There is a leak in the installation	Check the installation. Repair the leak point.
	There is a scaling in the pipes	Replace the blocked lines with a new one.
RO DEVICE DOES NOT ACTIVATE	Power failure problem	Check the phases and voltage from the power line coming from the network.
	Line off in power distribution board	Check the power distribution board.
	Problem with RO control board connection	Check the RO control panel electrical connection.
	RO power switch off	Set the RO power switch to the "on" position.

Table 8-5: Troubleshooting Table 5

FAULT	POSSIBLE CAUSE	POSSIBLE SOLUTION
LOW RO EFFICIENCY	Flow rate adjustment failure	Adjust the flow rates with the regulating valves.
	Water temperature low	Check the water temperature.
	Membrane feeding pressure is low	Adjust the membrane feeding pressure with the high pressure pump regulating valve.
	Membrane is blocked	Use a chemical cleaning. If there is no result, replace the membrane with a new one.
HIGH DIFFERENCES OF INLET OUTLET PRESSURE BETWEEN STAGES	Membranlar is blocked	Use a chemical cleaning. If there is no result, replace the membrane with a new one.
HIGH PRESSURE IN MOTOR PROTECTION	Ampere range not suitable	Check the amperage drawn by the motor. Make the necessary adjustments on the motor protection relay.
		Check the amperes and make sure that there are 3 phases.
	There is overheating	Please contact the Technical Service Department.

Table 8-6: Troubleshoot Table 6

9. WARRANTY CONDITIONS

9.1 SYSTEM WARRANTY CONDITIONS

- Δ There is a performance decrease of up to 10% annually in the ion removal efficiency of the membranes of reverse osmosis devices and up to 5% in the total system efficiency.
- Δ The operating conditions and settings that will affect the performance of the system should not be changed without the written approval of ESLİ and / or its authorized services.
- Δ The effect of parameters / conditions, for which ESLİ and / or its authorized services are not informed about their existence / effects, on performance are excluded from this guarantee.
- Δ The operating data of the system for which guarantee is requested; The systems will be out of warranty if they cannot be provided completely after the commissioning date.

9.2 GENERAL WARRANTY CONDITIONS

- Δ All our systems are guaranteed for 2 years against all kinds of fabrication failures. The warranty starts on the invoice date of the systems.
- Δ Under guarantee; Repair of equipment / material that malfunctions due to material, manufacturing and assembly faults is carried out by ESLI and / or its authorized services free of charge within 20 working days at the latest. The time spent in repair is added to the warranty period of the relevant material / equipment.
- Δ Under guarantee; If it is not possible to repair parts that break down due to material, manufacturing and assembly errors, the defective material / equipment is replaced with a new one. Exchange time; 10 working days for domestic supplies after it is determined that the material / equipment cannot be repaired. For international supplies, it depends on the delivery time of the supplier.

- The warranty period of the material / equipment replaced under warranty is limited to the remaining warranty period of the replaced material / equipment.

9.3 CONDITIONS ASSESSED OUTSIDE OF THE WARRANTY

- Malfunctions or damages that may occur as a result of the system inlet water acquiring characteristics different from the design values specified in the proposal accepted by the parties.

- Damage to reverse osmosis membranes due to chlorine ingress

- Using Antiscalant other than the Antiscalant specified by ESLI in the Reverse Osmosis system

- Detection of chemical dosage adjustments made outside the specified values

- Damages and failures that occur as a result of not operating the system as described in the Product Introduction and User Manual and not following the written warnings.

- Damages and failures that may occur due to low or excessive voltage, faulty electrical installation, supply with voltage different from the voltage described in the product introduction and user manual.

- Malfunctions caused by not grounding the power supply line as defined in the product introduction and user manual

- In case the shipment belongs to the customer; hitting, hitting, falling etc. damages and malfunctions that may occur due to reasons.

- By companies / persons other than ESLİ and / or its authorized services;

- Loss and theft of equipment and materials used in the system

- Damage or malfunction in devices due to force majeure such as natural disasters, lightning, fire, flood, earthquake

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11. APPENDICES

1. Appendix 1-System Data Log
2. Appendix 2-Alfa Standard Electrical Diagram
3. Appendix 3-Alfa Plus Electrical Diagram