20240701 DE

CONDAIR AT2+

Reverse osmosis unit

ASSEMBLY AND OPERATING INSTRUCTIONS

Condair AT2+ reverse osmosis unit
01/07/2024

Air humidification, dehumidification
and evaporative cooling

condair

Thank you for choosing Condair

Installation date (DD/MM/YYYY):
Commissioning date (DD/MM/YYYY):
Installation site:
Model:
Serial number:

Table of Contents

1. General Safety Instructions

1.1 Explanation of symbols and instructions

These operating instructions contain important specifications on the safe operation of the system.

These operating instructions, particularly the chapter on safety instructions, must be observed by all those who carry out work on the system. This applies to the installation company as well as the system operator. In addition, the special rules and regulations for accident prevention that apply to the usage location must be observed.

In these operating instructions, the following symbols are used to indicate personal hazards and guidance on the proper handling of the system:

DANGER!

This symbol indicates an imminent threat to personal health which may be fatal. Failure to observe these instructions may result in serious health hazards or even life-threatening injuries.

WARNING!

This symbol indicates a potential threat to personal health which may be fatal. Failure to observe these instructions may result in serious health hazards or even life-threatening injuries.

CAUTION!

This symbol indicates a potentially dangerous situation. Failure to observe these instructions may result in minor injuries or property damage.

NOTE

This symbol provides important information on the proper handling of the system. Failure to observe these instructions can lead to faults in the system or problems in the surrounding environment.

1.2 Operator obligations

The operator undertakes to ensure that all those working on the system

- are familiar with the basic health and safety and accident prevention regulations and have been instructed in the handling of the system,
- have read and understood the chapter on safety and the warnings in these operating instructions and have confirmed this by their signature, and
- have their safety-conscious work checked at regular intervals.

1.3 Personnel obligations

Prior to commencing work, all individuals who are commissioned to work on the system or carry out such work independently undertake to:

- read the chapter on safety and the warnings in these operating instructions and confirm by their signature that they have understood them.
- observe the basic health and safety and accident prevention regulations.

When operating the system, the safety instructions must be strictly observed.

1.4 Training of personnel

Only trained and instructed personnel may work on the system.

- The responsibilities of the personnel for assembly, commissioning, operation, set-up, maintenance and repair must be clearly defined.
- Personnel who have not as yet been trained may only work on the system under the supervision of an experienced co-worker.

1.5 Intended use

The system may only be used for the desalination of drinking water, well water or surface water which is free from particles and metal ions. The restrictions regarding the chemical analysis of the feed water, pressure, temperature and flow rate specified in the technical data apply.

Intended use also includes

- observance of all instructions and notes in the operating instructions
- and compliance with inspection and maintenance intervals.

Any other usage or usage beyond this is considered non-intended use. Non-intended use includes use as a

- filter
- pressure booster
- water distributor.

The manufacturer/supplier is not liable for any damage resulting from non-intended use.

1.6 Hazards when handling the equipment

- The system has been designed and manufactured in accordance with the latest technology and the recognised safety regulations.
- The system must be installed in such a way that the operating and control elements are easily accessible at all times. The floor, ceiling and walls must be level and clean.

Nevertheless, its use may pose a health hazard to the user or third parties or put their lives at risk, or cause damage to the system itself or other property. The system is only to be used for its intended use (see 1.5) and in a safe condition.

The following residual hazards exist:

Water damage

- To prevent flooding due to leakage, the installation room must be equipped with a floor drain and/or a leakage monitor with a corresponding alarm.

Electric shock

- Work on the electrical supply may only be carried out by a qualified electrician.
- Check the system's electrical equipment on a regular basis. Any loose connections or scorched cables must be removed immediately.
- The control cabinet must be kept locked at all times. Access is only allowed to authorised personnel.
- If work needs to be carried out on live parts, a second person must be called in so that they can switch off the main switch if necessary.
- Do not touch the electrical components with wet hands.
- Disconnect the system from the power supply before working on electrical system parts.

Mechanical/hydraulic energy

- Some system parts are under overpressure of up to 25 bar.
- De-pressurise the system before carrying out any repair or maintenance work!

Hygiene critical applications

- There is a risk of microbial contamination of system components if the system has not been adequately preserved. The preservation instructions must be observed.

Faults which could impair safety must be rectified immediately. This is ensured by the operator himself or an operator-commissioned company.

1.7 Protective devices and safety measures to avert hazards

1.7.1 Protective devices

- Before switching on the system, all protective devices must be properly fitted and checked to ensure they are in working order.
- Protective devices may only be removed after the machine has been switched off and secured against being switched back on.
- The required personal protective equipment for the operating personnel must be provided by the operator and worn by the operating personnel when they are working on the system.
- All existing protective devices must be checked regularly by the operator or an operator-commissioned company.

1.7.2 Informational safety measures

- The operating instructions must be kept at the usage location permanently.
- In addition to the operating instructions, the generally applicable and local regulations for accident prevention and environmental protection must be provided and observed.
- All safety and hazard notices on the system as well as the labelling of the operating and control elements must be kept in legible condition.

1.8 Safety instructions for maintenance work

- The operator must ensure that all maintenance, inspection and installation work is carried out by authorised and qualified specialist personnel who have acquired the necessary information by studying the operating instructions.
- Prior to all repair and maintenance work, the system must be switched off and secured against unintentional start-up. The procedure for shutting down the system described in the “Commissioning and Decommissioning” chapter of the technical documentation must be observed at all times.
- Before any work is started on the system’s electrical equipment, the corresponding section must be checked to ensure that it is not live. In addition, the system must be secured against being switched back on.
- Suitable protective clothing appropriate to the hazard level in question must be worn while the work is being carried out.
- Immediately after completion of work, all safety and protective devices must be reattached and/or reactivated.
- Before recommissioning the machine, the points listed in the “Commissioning and Decommissioning” chapter must be followed.

1.9 Disposal of system components and operating materials

The system components must be disposed of, if necessary also separately, in accordance with the local regulations.

1.10 Unauthorised modification and production of spare parts

- Conversion or modifications to the system are only permitted following consultation with the manufacturer.
- This also applies to PLC program changes.
- Original spare parts and manufacturer-authorised accessories are important for your safety.
- If other parts are used, the warranty becomes void and no liability is accepted for the resulting consequences.

1.11 Warranty and liability

This product incorporates the latest technical advances and has been designed, manufactured and subsequently subjected to quality control in accordance with the applicable rules of technology.

Should there nevertheless be cause for complaint, any claims for compensation against the manufacturer of this product are subject to the manufacturer’s general terms and conditions of sale and delivery. The fine filter must be replaced regularly. See section 9.3.

Warranty and liability claims for personal injury and property damage are excluded if they are attributable to one or more of the following causes:

- Non-intended use of the system
- Improper assembly, commissioning, operation and maintenance of the system
- Operating the system with defective safety devices or improperly installed or non-functioning safety and protective devices
- Non-compliance with the instructions in the operating instructions regarding transport, storage, assembly, commissioning, operation (note: the operating log should be filled in on a continuous basis), and maintenance of the system
- Unauthorised, unapproved structural changes to the system
- Unauthorised modification of the control parameters
- Inadequate monitoring of system components that are subject to wear and tear
- Improperly performed repairs
- Emergencies caused by external forces or acts of God

1.12 Safety instructions for storage

CAUTION!

The reverse osmosis unit is protected by a preservative against microbial contamination and against risk of frost down to -10°C. At room temperature (< 25°C), this preservative must be purged and replaced within 6 months at the latest.

At higher temperatures, the protection period is correspondingly shorter (3 months at 30°C). If the system has been out of operation for more than 30 days (the maximum permissible period), more preservative must be added to the system to prevent microbial contamination. In any case, the installation must be protected against direct sunlight during transport, storage and operation.

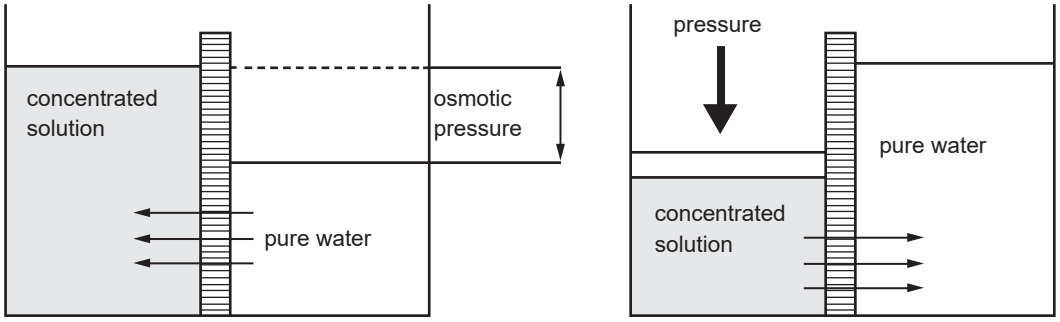
2. Principles of Reverse Osmosis Units

2.1 Principle of reverse osmosis

Osmosis is a process on which almost all natural metabolic processes are based. If you separate two solutions of different concentrations in a system through a semi-permeable membrane, the more concentrated solution always tends to dilute.

This process (osmosis) continues until osmotic equilibrium is reached. In the reverse osmosis process, the direction of the osmotic flow is reversed. For this purpose, pressure must be applied to the concentrated solution.

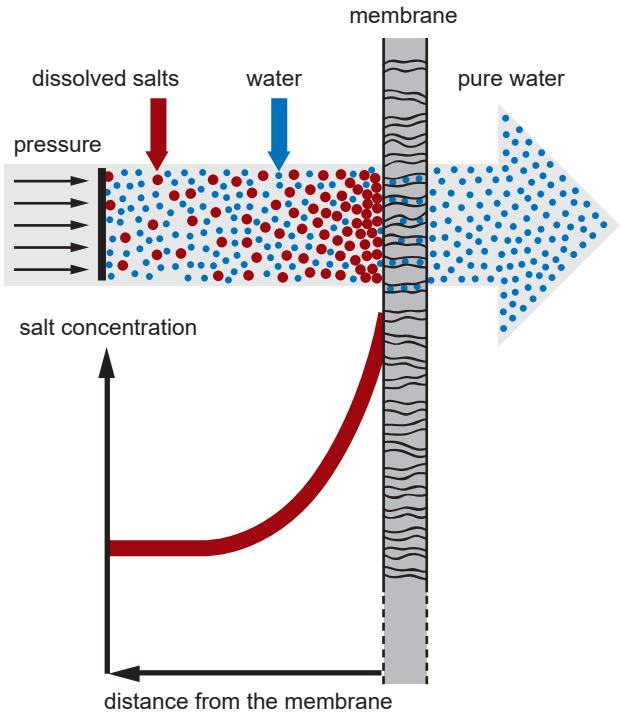
This pressure must be significantly greater than the osmotic pressure created by the natural equilibrium.



Osmosis | Reverse osmosis

Synthetic membranes are used in water treatment systems that work according to the principle of reverse osmosis. These membranes are permeable to the water molecules. The substances dissolved in the water are largely retained by the membranes. The “concentrated solution” (e.g. drinking water or process water) flows over this membrane at high pressure.

This results in the separation of this solution into a partial stream with water containing the retained substances (reject).



2.2 Calculation equations

The permeate output, the reject output and the permeate conductivity are determined by reading the corresponding measuring equipment on the system. If no indicating instruments (e.g. variable area flow meter) are present, the permeate output and the reject output are determined by manual volumetric measurement.

Feed water output = permeate output + reject output

$$\text{Yield [\%]} = \frac{\text{(permeate output [l/h])}}{\text{(feed water output [l/h])}}$$

$$\text{Reject output [l/h]} = 100 * \frac{\text{(permeate output [l/h])}}{\text{(yield [\%])}} - \text{permeate output [l/h]}$$

$$\text{Desalination rate [\%]} = 100 * \frac{\text{[1- “permeate” conductivity}}{\text{“feed water” conductivity]}}$$

Salt passage [%] = 100 - desalination rate [%]

2.3 Temperature dependency of the permeate output

The permeate output of the system depends on the feed water temperature. The nominal output indicated on the nameplate refers to the design temperature of 15°C specified in the technical data. The actual output at a given feed water temperature must be calculated using a correction factor from the following table.

The respective temperature-related permeate output is calculated according to the following calculation equation:

Permeate output [l/h] at temperature T [°C] = nominal output * correction factor

Temperature T in °C	Information	Correction factor
+10	If the actual permeate output exceeds the maximum permissible permeate output, it must be reduced by lowering the working pressure!	1.30
+9		1.28
+8		1.25
+7		1.21
+6		1.18
+5		1.15
+4		1.12
+3		1.09
+2		1.06
+1		1.03
Design temperature	Nominal output=100%	**1.00**
-1	If the actual permeate output is below the maximum permissible permeate output, it might be increased by raising the working pressure!	0.96
-2		0.92
-3		0.88
-4		0.84
-5		0.80
-6		0.77
-7		0.74
-8		0.70
-10		0.67

CAUTION!

If the system is operated at a feed water temperature higher than the design temperature, the maximum permeate output specified on the nameplate and in the technical data must not be exceeded!

2.4 Conductivity of first permeate

NOTE

After switching on the RO unit, permeate with high conductivity is produced for a short time. Therefore, when designing the peripheral system components, it must be ensured that the RO unit has a minimum running time of 30 minutes per switching operation.

3. Transport and Storage

3.1 Transport to the customer

CAUTION!

All units must be secured against slipping and falling over during transport. Allowing the unit to tip out of its fixed position is not permitted. If system parts are protruding from the base area of the pallet, such protruding parts must be protected against damage while other parts/units are being loaded.

- The transport weight corresponds to the empty weight and is specified in the technical data.
- The unit may still be damaged by extreme frost. The units are filled with a preservative/antifreeze mixture before delivery. The frost protection is effective down to -10°C.

3.2 Storage at the customer’s premises

- The maximum storage period of the original packed unit is 3 months at 20°C. The preservative must then be rinsed out and, if longer storage is desired, replenished.
- Extreme frost may damage the unit. The units are filled with a preservative/antifreeze mixture before delivery. The frost protection is effective down to -10°C.

3.3 Transport to the installation site

- Transport the unit to the intended location with care using a suitable lifting vehicle.
- Observe any specifications relating to the unit’s centre of gravity on the packaging.

4. Technical Data / Product Description

4.1 Technical data

Type AT2+		**75**	**150**	**230**	**350**	**550**
Quality of the feed water [1)]		Soft water 0°dH				
Permeate output at 7 bar	l/h	75	150	230	350	550
Permeate volume/day at 7 bar	m^3	1.8	3.6	5.5	8.4	12.7
Yield, max.	%	80				
Raw water pressure min./max.	bar	2/4				
Water temperature min./max.	°C	5/30				
Desalination rate	%	98/99				
Working pressure	bar	14–18				
Airborne noise emitted	dB (A)	<70				
Hydraulic connection						
Raw water	DN	20	20	20	20	20
Permeate	DN	20	20	20	20	20
Reject	DN	32	32	32	32	32
Electrical connection	V/Hz	230/50			3x400/50	
Max. power consumption	kW	1.1	1.1	1.1	2.2	1.5
Actual power consumption	kW	0.7	0.7	0.7	1.6	1.3
Dimensions						
Height	mm	1910	1910	1910	1910	1910
Width	mm	690	690	690	690	690
Depth	mm	760	760	760	760	760
Operating weight	kg	157	176	195	167	191

1) Limit values of the pre-treated water*

Salt content, max.	1000 mg/l
pH value	3–11
Silt density index	< 3.0
Free chlorine	< 0.1 mg/l
Total Fe, Zn, Mn	< 0.2 mg/l
CFU	< 100

2) Ratings apply at

Water temperature	15°C
Total salt content, max.	1000 mg/l
Daily operating time, max.	24 h
Ambient temperature	5–30°C

*If the limit values deviate, the ratings will change accordingly.

Type AT2+		**700**	**1000**	**1250**	**1500**	**1700**
Quality of the feed water [1)]		Soft water 0˚dH				
Permeate output at 7 bar	l/h	700	1000	1250	1500	1700
Permeate volume/day at 7 bar	m^3	16.8	24.0	30.0	36.0	40.8
Yield, max.	%	80				
Raw water pressure min./max.	bar	2/4				
Water temperature min./max.	°C	5/30				
Desalination rate	%	98/99				
Working pressure	bar	14–18				
Airborne noise emitted	dB (A)	<70				
Hydraulic connection						
Raw water	DN	20	20	20	20	20
Permeate	DN	20	20	20	20	20
Reject	DN	32	32	32	32	32
Electrical connection	V/Hz	3x400/50				
Max. power consumption	kW	2.2	2.2	2.2	2.2	2.2
Actual power consumption	kW	1.7	1.7	1.7	1.8	1.8
Dimensions						
Height	mm	1910	1910	1910	1910	1910
Width	mm	690	690	690	690	690
Depth	mm	760	760	760	760	760
Weight	kg	191	215	239	263	287

1) Limit values of the pre-treated water*

Salt content, max.	1000 mg/l
pH value	3–11
Silt density index	< 3.0
Free chlorine	< 0.1 mg/l
Total Fe, Zn, Mn	< 0.2 mg/l
CFU	< 100

2) Ratings apply at

Water temperature	15°C
Total salt content, max.	1000 mg/l
Daily operating time, max.	23 h
Ambient temperature	5–30°C

*If the limit values deviate, the ratings will change accordingly.

4.2 Application limits

The membranes are wear parts in the longer term. Their service life depends on the feed water quality and the operating conditions. In order to achieve a projected membrane service life of 3 years, the reverse osmosis units should be operated with softened water or with hard water depending on the unit type, in each case in the same quality as drinking water according to the German Drinking Water Ordinance and according to the following additional specifications:

Parameter	Unit	Limit value
Free chlorine *	mg/l	< 0.1
Total iron, zinc, manganese **	mg/l	0.2
Silicate ***	mg/l	25
Silt density index ****	-	3
pH value (operation) *****	-	3.6–9.5
pH value (cleaning)	-	2.0–12.0

The feed water must also be free of substances harmful to the membrane, such as:

- Oxidants (e.g. free chlorine, ozone, hydrogen peroxide)
- Surface-active substances (especially cationic)
- Natural organic matter (NOM)

During “softening” pre-treatment, the soft water quality should be monitored. When using antiscalant for hardness stabilisation (while at the same time stabilising e.g. iron, manganese and silicate), the exact specifications for operating the unit must be observed. If necessary, correct the pH value and/or reduce the permeate yield accordingly. When using hard water, it is to be expected that the membrane will wear out more quickly than when using softened water (“softening” pre-treatment).

* Free chlorine (oxidants) attack the plastic membrane, especially in the presence of metallic ions. This attack is irreversible and leads to a reduction in salt retention and an increase in permeate conductance. Therefore, the feed water of the RO unit should contain as little free chlorine as possible.

** Iron/manganese/zinc can be present in undissolved or dissolved form. Undissolved iron/manganese/zinc should be removed by filtration. Dissolved iron/manganese/zinc can be oxidised and then filtered out or stabilised with an antiscalant, for example. Complex iron/manganese/zinc deposits on the membranes are difficult to remove by chemical cleaning.

*** Silicate can leave solid deposits on the membrane that are difficult to remove. The maximum silicate concentration in the RO reject should not exceed 100 mg/l when using soft water, therefore only 25 mg/l are permissible, taking into account the concentration in the feed water.

**** The silt density index is a sum parameter. It provides information about the probability of deposits of finely dispersed suspended and colloidal substances on the membranes. For values > 3, the pre-treatment must be improved accordingly.

***** The pH value significantly influences the solubility of many water constituents, especially carbonates and silicates. If necessary, it must be changed to achieve a desired high permeate yield or higher permeate quality.

4.3 Product description

4.3.1 Function

The RO feed water reaches the frequency-controlled HP pump via a residual hardness monitor (optional accessory, only when using softened water) and a protective cartridge filter (grade of filtration 5 µm). This pump conveys the water at high pressure (level depends on the permeate flow being drawn and the desired permeate pressure) through the semi-permeable membranes. Water largely freed from salts passes through the membranes and forms the permeate (desired product). The retained salts are continuously discharged with the reject (drain water to the sewer).

An integrated controller monitors and controls all important functions of the RO unit during permeate production and during downtimes. It controls the HP pump so that either the permeate pressure or the permeate flow rate remains constant. Alternatively, uncontrolled operation is possible. It monitors the inlet pressure and the residual hardness of the feed water (if an optional Limitron or Testomat residual hardness monitor is present), the reject pressure and the operationally critical flows for permeate, reject and circulation, as well as the permeate conductivity. All operating, shut-down, rinsing and fault statuses are shown in plain text on the display, and faults are signalled by a red LED. A fault message can be sent to the BMS via the alarm relay. The permeate flow and the permeate conductivity can be routed to the BMS via analogue outputs. A Modbus RTU connection is built in as standard.

4.3.2 Layout

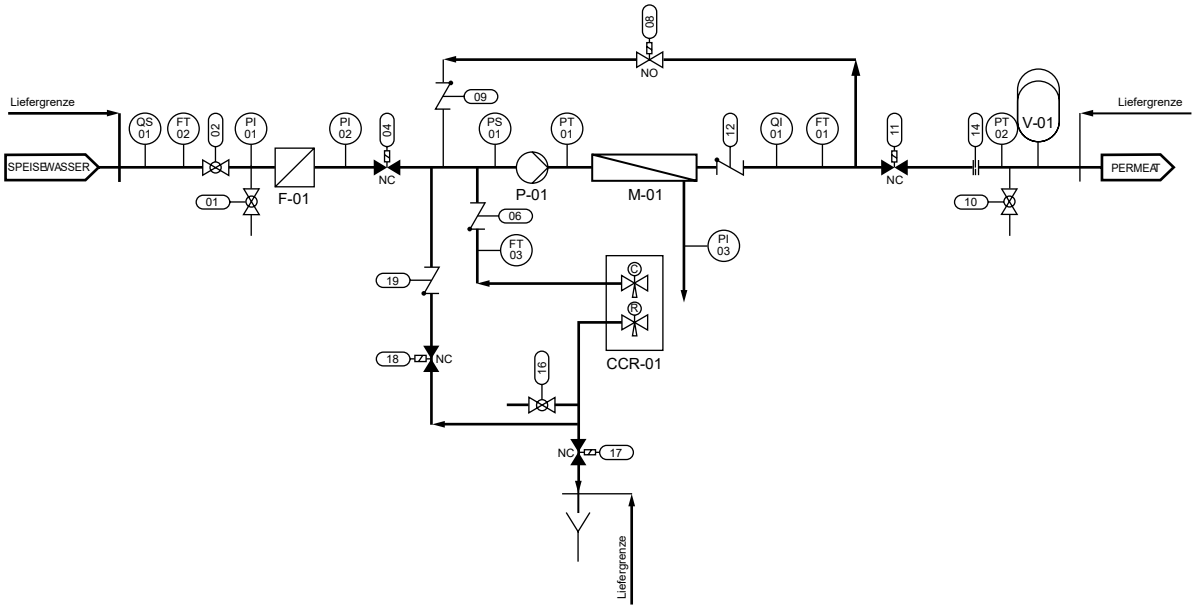
4.3.2.1 P&ID diagram

The following P&ID diagram shows the basic structure of the RO unit with explanations of the following system components:

- MSR points
- Actuators
- Hydraulic system components

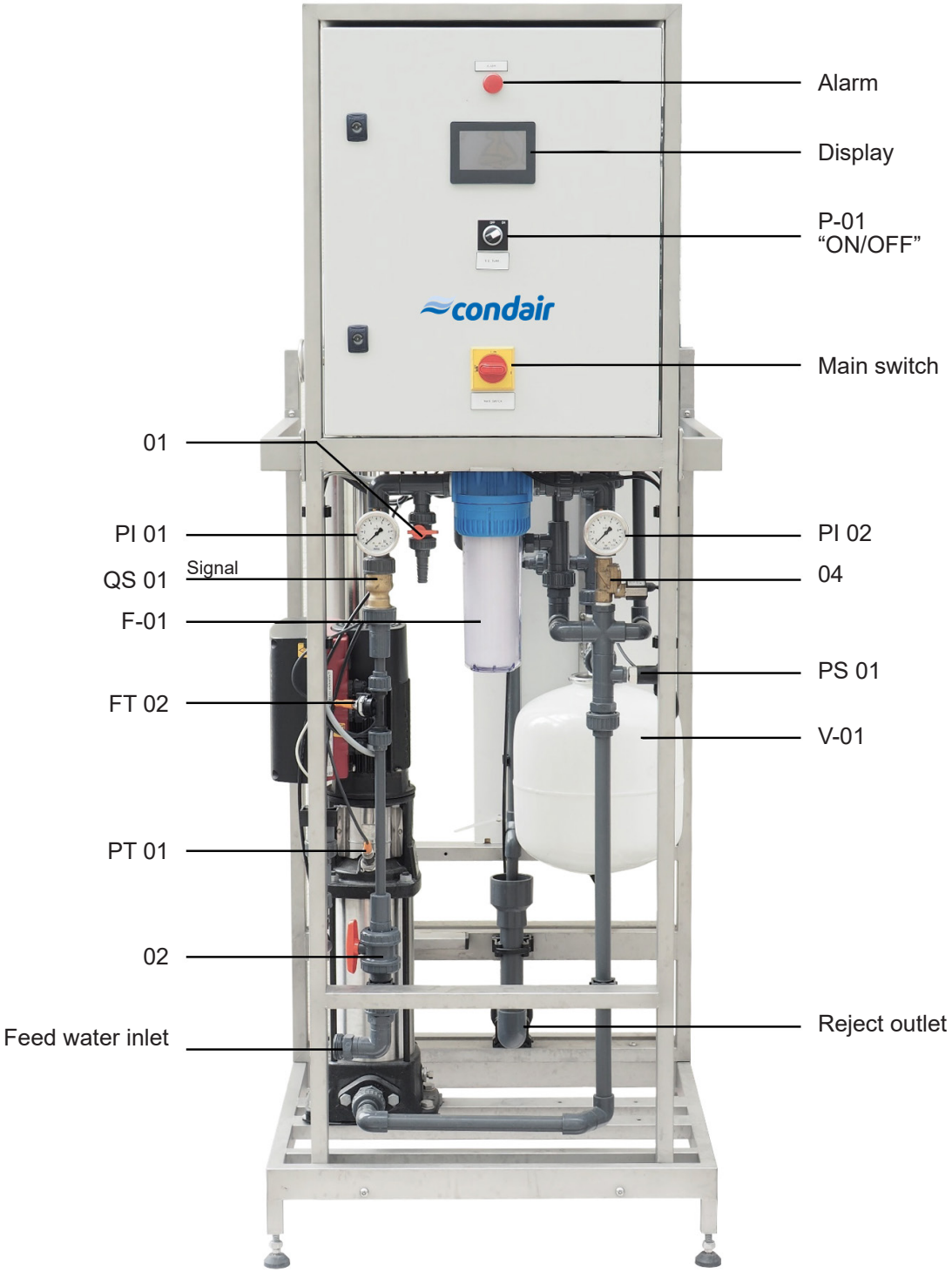
4.3.2.2 System photos

Following the P&ID diagram, the most important system components are shown in 3 labelled photos (designations with reference to the P&ID diagram).

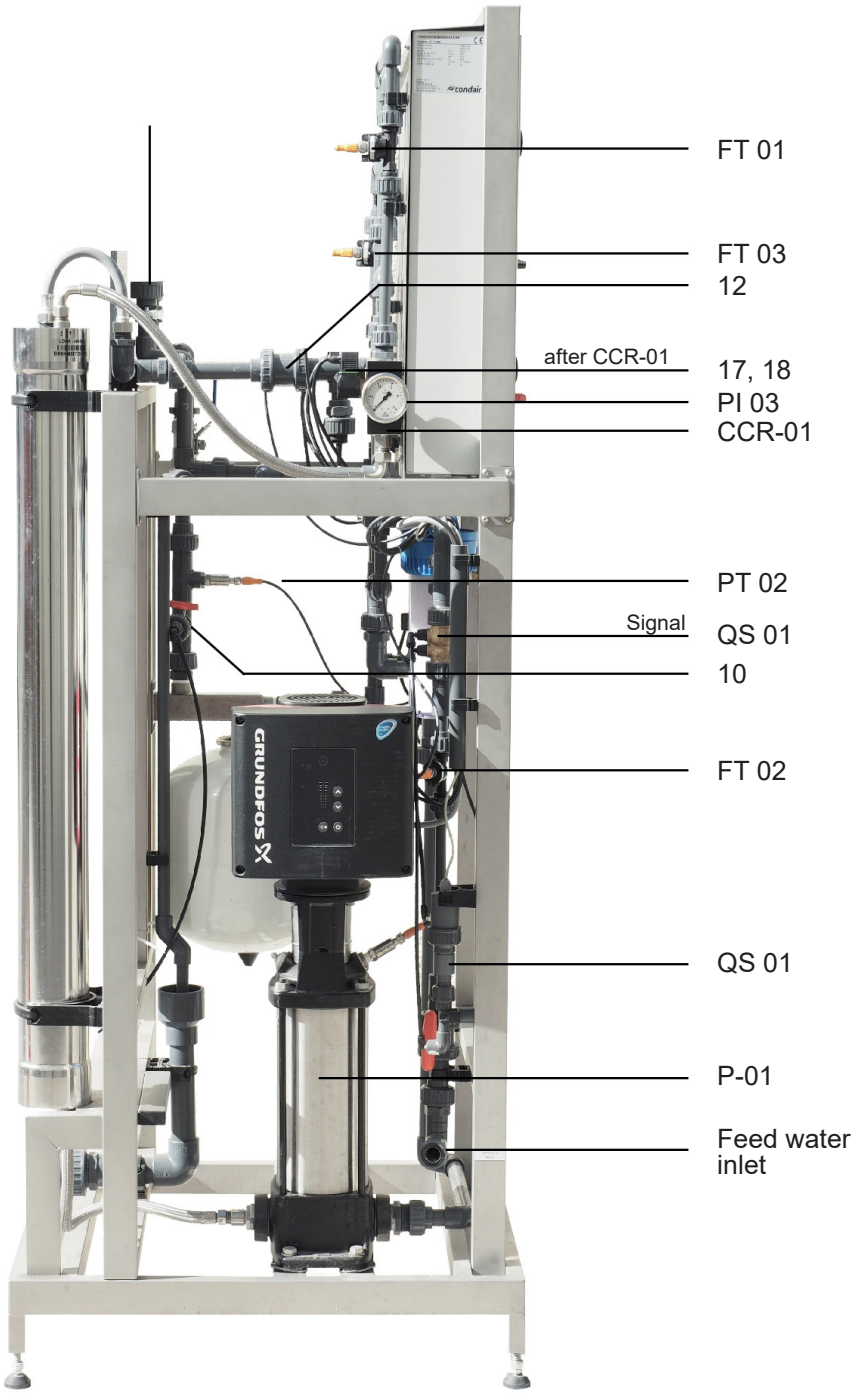


MSR point list		**Actuators**	
QS 01	Residual hardness monitor (Testomat, Limitron or similar)	01	Sampling valve for feed water
PI 01	Local display of inlet pressure before protective filter	02	Shut-off valve for feed water
PI 02	Local display of inlet pressure after protective filter	04	Solenoid valve for feed water
PI 03	Local display of reject pressure	06	Non-return valve Circulation
PS 01	Pressure switch for checking feed water pressure	08	Solenoid valve for permeate circulation NO
PT 01	Pressure transmitter for RO pump pressure	09	Non-return valve Permeate circulation
PT 02	Pressure transmitter for permeate pressure	10	Sampling valve for permeate
QI 01	Conductivity probe for permeate	11	Solenoid valve for permeate NC
FT 01	Flow transmitter for permeate	12	Non-return valve for permeate
FT 02	Flow transmitter for feed water	14	Flow control orifice
FT 03	Flow transmitter for circulation	16	Sampling valve
		17	Solenoid valve for reject NC
		18	Solenoid valve for circulation NC
		19	Non-return valve for circulation
Hydraulic system components			
F-01	Protective cartridge filter 5µm-10"	M-01	Membrane module
P-01	High-pressure pump	V-01	Membrane pressure vessel
CCR-01	Control block reject/circulation	C	Plug valve for reject
		R	Plug valve for circulation

Size 350 — front view



Size 350 — side view



5. Installation and Assembly

5.1 Installation

5.1.1 Installation site requirements

- The space required for the unit is specified in the dimensions provided in the technical data. In addition, there should be 0.8 m of space in front of the unit to allow access for operation and 1.0 m of space to the side for maintenance.
- The place of installation must meet the ambient conditions according to the technical data.
- The installation surface must be level and horizontal and have sufficient load-bearing capacity.
- The room must be well ventilated and frost-proof.
- The necessary electrical connections, as specified in the technical data, must be available on-site at a maximum distance of 1 m from the unit.
- The feed water connection must be provided with a shut-off device.
- Depending on the unit size, a control air connection must be available.
- The connection for the disposal of rinse water and reject must be installed and usable in the required cross-section.

WARNING!

To prevent flooding due to leakage, the installation site must be equipped with a floor drain and/or a leakage monitor with a corresponding alarm.

5.1.2 Installation of the unit

- Unpack the unit
- Check that the delivery is complete and has not been damaged in transit.

NOTE

Any deviations or damage must be reported to the supplier immediately.

- Transport the unit to the intended location with care using suitable lifting equipment.
- The installation is carried out on an installation surface in accordance with the requirements above.

5.2 Water connections

5.2.1 Required qualification of assembly personnel

NOTE

The water connection must be carried out by trained specialist personnel only. General directives (DIN, DVGW, SVGW, ÖKGW) and local installation regulations must be observed when installing the unit.

5.2.2 Establishing the water connections

Feed water

- Remove the sealing disc from the screw connection in the feed water inlet and keep it.
- Connect the feed water to the feed water connection through a shut-off valve.

Permeate

- Remove the sealing discs from the screw connection in the permeate outlet and keep them.
- Connect the permeate outlet line to the permeate inlet of the consumer (e.g. the humidifier).

Reject

- Remove the sealing disc from the screw connection in the reject outlet and keep it.
- Route the reject outlet line in a free-flowing drop to the free water drain along the shortest possible path. The waste water must be allowed to drain without backpressure.

NOTE

All plumbing connections must be connected while not under pressure. Do not crush or kink hoses; connect hose connections securely. The reject and drain lines must be routed to the free water drain with a drop. Sealing discs are not present in systems with flange connections.

5.3 Electrical connection

5.2.1 Required qualification of assembly personnel

DANGER!

The electrical installation must be carried out by a qualified electrician, in compliance with the installation guidelines of the VDE, utility suppliers, factory standards, etc. and in accordance with the valid country-specific regulations.

5.3.2 Control cabinet

Please refer to the appendix for the assignment of all inputs and outputs of the PLC to the terminals and the complete wiring diagram of the control cabinet.

5.3.3 Establishing the electrical connections

DANGER!

Prior to working on the electrical equipment and before starting retrofitting, maintenance, servicing or similar work, switch off the main switch of the higher-level system and secure it against being switched on again (e.g. lock it).

Clearly display a sign prohibiting switching with the following information:

"Do not switch! Work in progress!"
Location
Date
Name of the person responsible

- The internal system assemblies are already wired to the PLC upon delivery.
- The power supply to the unit must be established, checked and fused according to the specifications in the electrical wiring diagram.
- For units supplied with a mains cable/plug, a CEE AC power point fused in accordance with the system power requirements (see "Technical data") must be installed within reach of the length of the mains cable.
- For units that require a 3-phase AC supply, the power supply to the unit must be provided by the customer.

NOTE

When using a 3-phase AC supply, check the direction of rotation of the HP pump for clockwise rotation.

DANGER!

Protection class IP 65 of the PLC is only guaranteed when the cover is closed, the terminal compartment cover is closed and the cable glands are tightened.

DANGER!

We recommend routing the fault indication at the DO8 alarm output to the central building management system (BMS) either via X6/1-2 (NC) or via X6/1-3 (NO). If the fault is ignored or not acknowledged for a long period of time, this can lead to serious damage to the unit, or even a complete production stop.

Establish the following connections:

1. Power supply for the reverse osmosis unit in the control cabinet at the front of the unit. Connect the 400 volt / 50 Hz power supply to terminal block X0 (L1, L2, L3, N and PE).

2. The connections of the signals from/to external devices (from dosing pump, residual hardness monitor or UV system, to BMS) to/from the reverse osmosis unit can be carried out according to the following table:

Designation	Code desig.	Connection	Purpose
Alarm RO unit	DO 8	X6/1-2 = NO or X6/1-3 = NC	Routing the collective fault indication to the BMS
Alarm residual hardness monitor *	DI 2	X3-20/21	Residual hardness monitor (Testomat or Limitron) for soft water in the feed water line to reverse osmosis, if available
External stop *	DI 8	X3-30/31	Stop signal from a separate softening system (closing contact during regeneration) or alternatively alarm signal from a UV system, in each case if present.
Alarm for dosing pump **	DI 2	X3-20/21	Alarm signal from a dosing pump for antiscalant, if present

(*) Optional, use only when feeding in soft water

(**) Optional, use only if dosing pump for antiscalant is supplied. Electrical connection is pre-assembled and coded ex works.

6. Commissioning and Decommissioning

6.1 Commissioning

6.1.1 Qualification of commissioning personnel

CAUTION!

The unit must be commissioned by qualified specialist personnel.

NOTE

Before commissioning the unit, all screw connections must be tightened.

6.1.2 Rinsing out the preservative

WARNING!

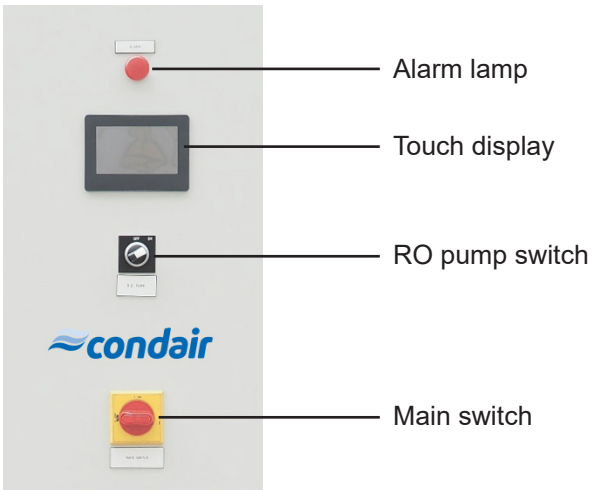
The preservative solution contains 1.5% sodium bisulfite and 20% glycerine. The rinsed-out preservative solution must be discharged into the sewage system in accordance with the locally applicable discharge regulations.

NOTE

The unit is supplied with a PLC in standby mode.

After switching on the PLC, the actuators connected to the PLC (solenoid valves for inlet, reject, circulation, permeate and permeate circulation) switch on independently.

The RO pump still remains OFF for rinsing out the preservative. It only starts when the “RO pump” rotary switch on the front panel of the PLC is set to the ON position and the PLC automatically requests pump operation.
Open the feed water inlet at the ball valve inlet



- Switch on the PLC at the red main switch.
- Inlet valve opens immediately via PLC

or
(Main menu – “Manual operation” – Inlet valve) and

rinse the system for at least 30 minutes without switching on the HP pump, using only feed water pressure.

6.1.3 Setting up automatic mode

After rinsing out the preservative, set the “HP-pump” rotary switch on the front panel of the PLC to the “ON” position. If alarm messages appeared during rinsing, they must be deleted via the main menu – alarm screen (RESET button, see chapter 7 – PLC). After that, the system is immediately in automatic mode.

6.1.4 Configuring permeate output and yield

With type AT2+ units, it is not necessary to configure the yield, as the flow rates are put into the correct proportions by self-regulating orifices. The permeate output results automatically from the consumption of permeate by a consumer. The permeate flow rate to the consumer must not exceed the nominal system output.

6.1.5 Configuring permeate outlet pressure

The permeate outlet pressure can be selected in the “Constant pressure” control mode in the range between 4 and 7 bar in the “Settings” sub-menu (set value permeate pressure).

In the “External Setpoint” control mode, the permeate outlet pressure is set by an external signal 0-10 V at input AI7 from the consumer’s control unit.

6.1.5.1 System in the “Constant pressure” control mode

The factory setting for the permeate outlet pressure is 4 bar, the membrane vessel is supplied with a charging pressure of 3.6 bar. If a different outlet pressure is desired, the charging pressure in the membrane pressure vessel must also be adjusted by increasing the gas filling according to the following table:

Permeate outlet pressure at which production is switched off in bar	**Charging pressure in the membrane pressure vessel in bar**
4.0	3.6
4.5	4.0
5.0	4.5
5.5	5.0
6.0	5.4
6.5	5.8
7.0	6.3

6.1.5.2 “External Setpoint” control mode for the permeate outlet pressure

In this control mode, the membrane vessel must be kept at a charging pressure of 3.6 bar.

6.2 Decommissioning

NOTE

If an interval rinse of “Min. 1x daily” is set in the PLC, the unit does not need to be preserved. If decommissioning with expected downtimes of > 30 days and without interval rinse is planned, the system must be treated with preservative, which must be rinsed out again during recommissioning as described in section 1.2.

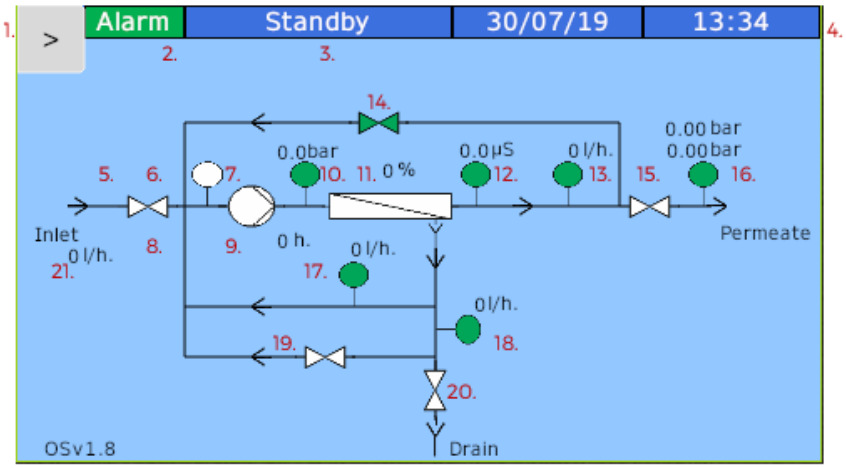
Downtime requiring decommissioning is understood to be a condition in which the unit is disconnected both from the water supply and from the power supply. If the unit remains connected to the water and power supply, then it can remain idle without any preservation if a daily interval rinse is programmed.

Information on preserving the system if downtimes of > 30 days are to be expected can be found in chapter 10.

7. PLC

7.1 Main display, Main menu

7.1.1 Main display



In this part of the display the following is displayed and controlled; items 1 to 4 are present in all displays:

1. Navigation button to access sub-menus

2. Alarm indication

Green: No alarm
Red: Alarm active

3. Actual status

“Standby”:	The unit is standing by and not producing permeate.
“Rinse before service”:	The unit rinses out the first water entering the system before going into service
“Service”:	The unit is in service and producing permeate
“Circulation”:	The unit circulates all produced permeate and reject in front of the RO pump
“Rinse after service”:	The unit rinses out the water in the module before going into standby
“Interval rinse”:	The unit rinses after a programmed period of standby

4. Actual date and time

By pressing the buttons in the sub-menu, actual time and date can be changed.

5. Residual hardness monitor (only visible when selected in the “Inputs” sub-menu)

Green: The residual hardness is below maximum
Yellow: The residual hardness monitor (Testomat or Limitron) is in alarm but not stopping the unit
Red: The residual hardness monitor (Testomat or Limitron) is in alarm and the unit is stopped

6. Actual status of the inlet valve

White: The valve is closed
Green: The valve is open

7. Actual status of the inlet pressure (pressure switch DI 1)

White: The inlet pressure is below minimum, no alarm
Green: The pressure is above minimum.
Yellow: There is a low-pressure alarm (1 or 2) but the unit is not stopped
Red: There is a low-pressure alarm (1 or 2) and the unit is stopped

8. Dosing pump (only visible when selected in the “Inputs” sub-menu)

White: The dosing pump is switched off
Green: The dosing pump is switched on
Yellow: The dosing pump is in alarm but not stopping the unit
Red: The dosing pump is in alarm and stopping the unit

9. Actual status of the RO pump with service hours

White: The RO pump is off
Green: The RO pump is running
Yellow: The RO pump is in alarm but the unit is not stopped
Red: The RO pump is in alarm and the unit is stopped

10. Actual pressure before module and status

Green: The pressure is within range
Yellow: There is a low or high-pressure alarm but the unit is not stopped
Red: There is a low or high-pressure alarm causing the unit to stop

11. Actual status and yield of the RO unit if selected

White: The RO unit is off
Green: The RO unit is running
Yellow: Warning: The RO unit is in a non-urgent alarm or needs maintenance
Red: Alarm: The RO unit is in an urgent alarm and is stopped

12. Actual permeate conductivity in µS/cm and status

Green: The conductivity is within range
Yellow: There is a low or high conductivity alarm but the unit is not stopped
Red: There is a low or high conductivity alarm causing the unit to stop

13. Actual permeate flow in l/h, and status

Green: The flow is within range
Yellow: There is a low or high flow alarm but the unit is not stopped
Red: There is a low or high flow alarm and the unit is stopped

14. Actual status of the permeate circulation valve

White: The valve is closed
Green: The valve is open

15. Actual status of the permeate outlet valve

White: The valve is closed
Green: The valve is open

16. Actual permeate pressure in bar and status

When there is a dynamic pressure setpoint, the calculated setpoint is displayed above the actual pressure.

Green: The pressure is within range
Yellow: There is a low or high-pressure alarm but the unit is not stopped
Red: There is a low or high-pressure alarm and the unit is stopped

17. Actual reject circulation flow in l/h and status

Green: The flow is within range
Yellow: There is a low or high flow alarm but the unit is not stopped
Red: There is a low or high flow alarm and the unit is stopped

18. Actual reject flow in l/h and status

Green: The flow is within range
Yellow: There is a low or high flow alarm but the unit is not stopped
Red: There is a low or high flow alarm and the unit is stopped

19. Actual status of the reject circulation valve

White: The valve is closed
Green: The valve is open

20. Actual status of the reject outlet valve

White: The valve is closed
Green: The valve is open

21. Actual inlet flow in l/h

7.1.2 Main menu

7.1.2.1 Operating principles

A ball-point pen with its tip retracted is recommended for operating the touch screen of the PLC.

Tap the > button at the top left of the screen for at least 2 seconds to open the main menu. To select sub-menus, briefly tap on one of the following options:

Main display, with status bar at the top

Current alarms

Configuration of inputs and outputs

Current value, ranges, min. and max. alarm values for operating parameters

Configuration of time parameters

Configuration of regulation parameters

Manual operation of actuators

Alarm history (history function)

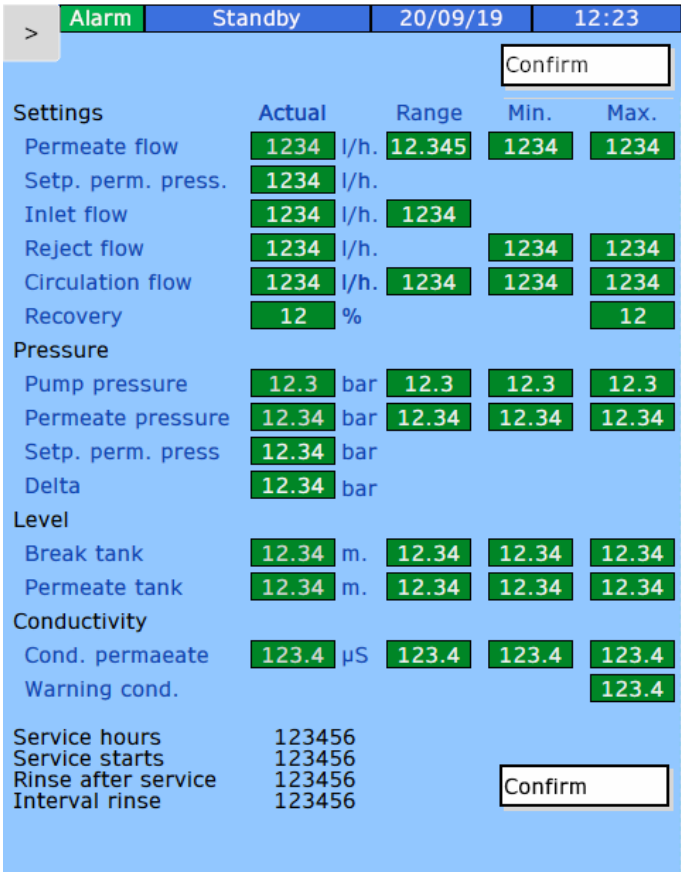
Conductivity, permeate flow and pump pressure trends

Special settings for the PLC

By tapping the  navigation buttons, further parts of the display can be shown if the page content cannot be viewed on a single screen page.

The sub-menus in which the user can configure a limited number of settings are described in more detail below.

7.1.2.2 Settings (ranges, min./max. alarm values)



Explanation of the Settings sub-menu:

Please note:

If an option is not selected, the corresponding settings are not shown on the screen. Press and hold the Confirm button for 2 seconds to permanently apply all the settings made.

The button turns green for a few seconds. Otherwise, any changes to the settings will be lost after a power failure.

Actual: Actual value of the corresponding analogue sensor

Range: Range (maximum value) of the corresponding analogue sensor1)

Min.: Minimum alarm value

Max.: Maximum alarm value

7.2 Configurable parameters

In order to ensure a meaningful control sequence, the control parameters must be correctly configured at the time of delivery from the factory. During commissioning, the technician checks all settings to ensure they are correct or adjusts them to the situation on site. Occasionally, the user has to configure individual settings. With the user password, only limited settings can be configured.

NOTE

The user password is 1111. For the menu structure, see 7.1.2 Main menu.

The following settings can be made at user level (all other parameters remain locked with the padlock icon):

Settings sub-menu (min./max. alarm values)

Permeate flow:	Permeate flow in litres per hour
Permeate pressure:	Permeate pressure in bar
Setp. perm. pressure	Permeate pressure setpoint when the system is operating in constant pressure mode
Cond. permeate:	Permeate conductivity in µS/cm

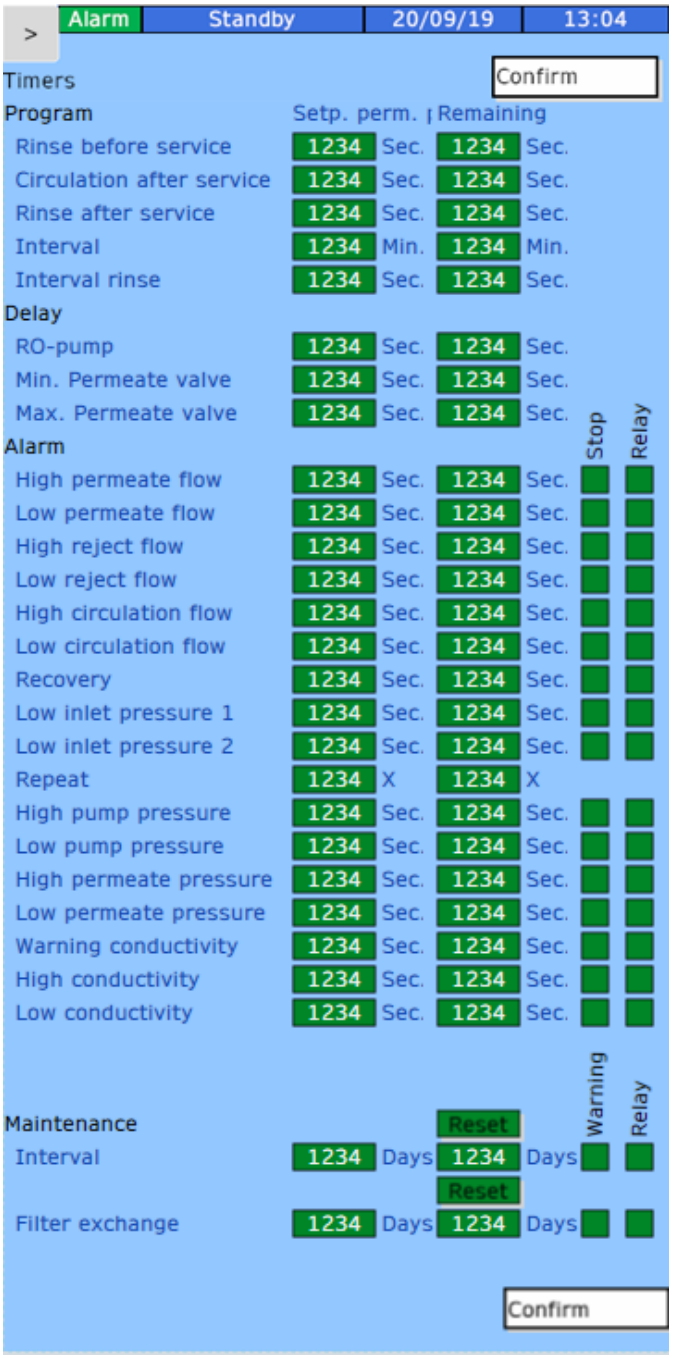
Timers sub-menu (delay times)

High permeate flow:	The alarm delay at high permeate flow during service in seconds
Low permeate flow:	The alarm delay at low permeate flow during service in seconds
High permeate pressure:	The alarm delay at high permeate pressure in seconds
Low permeate pressure:	The alarm delay at low permeate pressure in seconds
Warning conductivity:	The warning delay at high permeate conductivity during service in seconds
High conductivity:	The alarm delay at high permeate conductivity during service in seconds
Low conductivity:	The alarm delay at low permeate conductivity during service in seconds

NOTE

Please print out the following table and enter the changed values in the “Set” column!

7.1.2.1 Operating principles



Please note:

A tick in the green check box activates the function. Press and hold the button for 2 seconds to permanently apply all the settings made. The button turns green for a few seconds. Otherwise, any changes to the settings will be lost after a power failure.

Type AT2+	**75**	**150**	**230**	**350**	**550**	**700**	**1000**	**1250**	**1500**	**1700**	**Set**
Settings											
Low permeate flow l/h 1)	30				55		120				
High permeate flow l/h 2)	95	180	275	420	660	840	1200	1500	1800	2040	
Low permeate pressure (bar)	3										
High permeate pressure (bar)	7.5										
Setpoint permeate pressure (bar)	4										
Low conductivity (µS/cm)	1										
High conductivity (µS/cm)	18										
Warning conductivity (µS/cm)	14										
Timers											
Alarm delays											
High permeate flow (s) / Stop / Relay	360 / Yes / Yes										
Low permeate flow (s) / Stop / Relay	300 / No / No										
High permeate pressure (s) / Stop / Relay	30 / Yes / Yes										
Low permeate pressure (s) / Stop / Relay	180 / No / Yes										
Warning conductivity (s) / Stop / Relay	120 / No / No										
High conductivity (s) / Stop / Relay	60 / Yes / Yes										
Low conductivity (s) / Stop / Relay	120 / No / Yes										

8. Faults and Fault Elimination

8.1 General instructions

The use of high-quality individual components and the built-in safety and monitoring devices ensure a very high level of operational readiness.

Should a malfunction nevertheless occur, the fault can be easily identified and the cause eliminated using the fault table listed below.

If a serious fault occurs, contact the manufacturer (see nameplate).

WARNING!

The elimination of faults may only be carried out by qualified and instructed specialist personnel in compliance with the safety regulations in chapter 1 of these operating instructions.

Before work commences, the unit must be disconnected from the power supply and secured against being switched back on unintentionally.

All lines must be de-pressurised.

8.1.1 Reporting faults to the manufacturer

To ensure effective troubleshooting assistance, have the following pieces of information ready:

- Order number (if available)
- Item number (if available)
- Unit type
- Operating logs and maintenance logs (if available) for the last year

8.1.2 Fault indication and reset

- Red alarm LED lights up
- Fault message is displayed on the screen
- For resetting alarm messages on the PLC, please refer to the corresponding section in chapter 7 - PLC!

8.2 Fault analysis and elimination

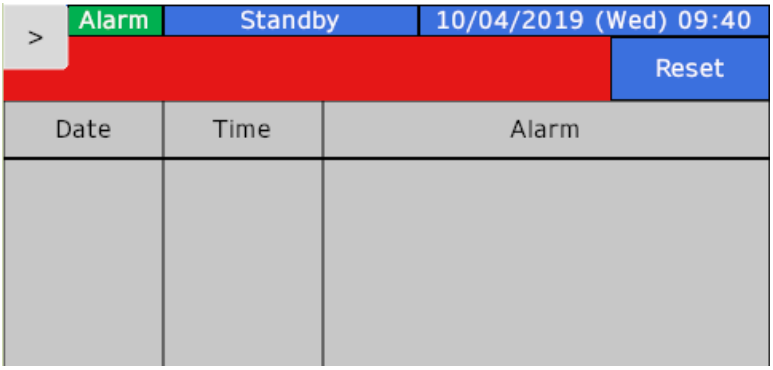
NOTE

Please read the following table with possible faults before contacting the manufacturer’s service department! All possible faults are listed in the menu of the PLC, “Alarms” sub-menu. Remedies are given below for each alarm. Faults that have already been acknowledged can be found in the menu of the PLC, “Alarm history” sub-menu, see chapter 7 - PLC!

8.2.1 Alarms

The PLC indicates a problem with the system by issuing an alarm. Depending on the alarm settings in the “Inputs” and “Timers” sub-menus, the unit can be stopped (tick the Stop box) and/or the alarm relay can be activated (tick the Stop box).

By calling up the main menu and selecting the “Alarm” sub-menu, for example, the following alarm indication appears:



Alarm	Standby	10/04/2019 (Wed) 09:40

Reset

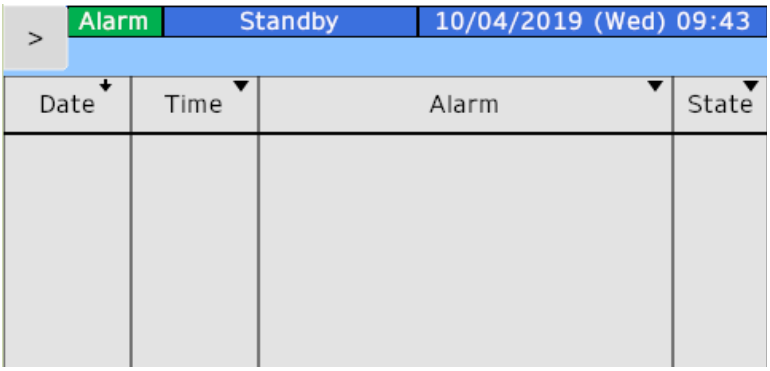
Date	Time	Alarm

When a message becomes active, the word “Alarm” in the status line changes from green to red.

Messages can be deleted by pressing the Reset button.

8.2.2 Alarm history

Press the > button and select Alarm history to activate the following display:



Alarm	Standby	10/04/2019 (Wed) 09:43

Date	Time	Alarm	State

With the buttons you can navigate through the display if the table cannot be shown on a single page.

All active (red) and already reset alarms (yellow) are displayed here with the following information:

Date: The date when the alarm occurred / was reset.
Time: The time when the alarm occurred / was reset.
Alarm: The alarm message.
State: The status of the message; “Active” or “Return” (reset)

8.2.3 Alarm causes

8.2.3.1 Power failure

The power supply has been switched off or interrupted.

Possible cause	Action
Power failure or unit switched off.	Restore the power supply and reset the alarm.

8.2.3.2 System stop

The unit is stopped by an open external contact at input DI 8.

Possible cause	Action
External contact has switched.	Depending on the function of the external device, this is not necessarily an alarm.
Broken wiring in input DI 8.	Repair wiring.

8.2.3.3 Low permeate flow

The permeate flow is below the minimum setpoint for longer than the set delay time.

Possible cause	Action
Low temperature of raw water inlet.	Lower temperature of the water means lower permeate output, check water temperature.
Membranes fouled.	Clean or replace membranes.
Wrong setting of the pressure.	Adjust pressure with circulation valve.
Wrong setting in the controls.	Adjust setting.

8.2.3.4 High permeate flow

The permeate flow is above the maximum setpoint for longer than the set delay time. Exceeding high permeate flow can damage the membranes.

Possible cause	Action
Wrong setting of in the controls.	Adjust setting.
Wrong setting of the pressure.	Adjust pressure with circulation valve.
Raw water temperature too high.	Reduce raw water temperature.
Flow rate sensor broken.	Check and/or repair sensor.

8.2.3.5 Low reject flow

The reject flow is below the minimum setpoint for longer than the set delay time. Falling below the low reject flow can damage the membranes.

Possible cause	Action
Wrong setting in the controls.	Check and/or adjust setting.
Wrong setting of the flow.	Adjust flow with the reject valve.
Membranes fouled.	Clean or replace membranes.

8.2.3.6 High reject flow

The reject flow is above the maximum setpoint for longer than the set delay time. Exceeding high reject flow can damage the membranes.

Possible cause	Action
Wrong setting in the controls.	Check and/or. adjust setting.
Wrong setting of the flow.	Adjust flow with the reject valve.
Membranes fouled.	Clean or replace membranes.
Flow rate sensor broken.	Check and/or repair sensor.

8.2.3.7 Low circulation flow

The circulation flow is below the minimum setpoint for longer than the set delay time. Too little circulation reduces the flow over the membranes and will reduce the lifetime of your membranes.

Possible cause	Action
Wrong setting in the controls.	Check and/or. adjust setting.
Wrong setting of the flow.	Adjust flow with the circulation valve.
Membranes fouled.	Clean or replace membranes.
Flow rate sensor broken.	Check and/or repair sensor.

8.2.3.8 High circulation flow

The circulation flow is above the maximum setpoint for longer than the set delay time. Too much circulation reduces the pressure before the membranes and can reduce the performance of your membranes.

Possible cause	Action
Wrong setting of in the controls.	Check and/or. adjust setting.
Wrong setting of the flow.	Adjust flow with the circulation valve.
Membranes fouled.	Clean or replace membranes.
Flow rate sensor broken.	Check and/or repair sensor.

8.2.3.9 Yield

The yield is above the maximum setpoint. (Ratio between the permeate flow and reject flow is above the maximum value for longer than the set delay time). Too high a yield can lead to fouling of the membranes after some time.

Possible cause	**Action**
Wrong setting of in the controls.	Check and/or adjust setting.
Wrong setting of the reject flow.	Adjust flow with the reject valve.
Membranes fouled.	Clean or replace membranes.
Wrong setting of the pressure.	Adjust pressure with the circulation valve.
Raw water temperature too high.	Reduce raw water temperature.

8.2.3.10 Low conductivity

The actual permeate conductivity is below the minimum setpoint for longer than the set delay time.

Possible cause	**Action**
Wrong setting in the controls.	Check and/or adjust setting.
Trapped air at the conductivity probe.	Adjust mounting of the conductivity probe to eliminate the possibility of trapped air.
Broken wiring of the probe.	Check and/or repair wiring.

8.2.3.11 Warning conductivity

The actual permeate conductivity is above the maximum setpoint for longer than the set delay time.

Possible cause	**Action**
Wrong setting in the controls.	Check and/or Adjust setting.
Membranes fouled.	Clean or replace membranes.
Internal reject leakage from reject to permeate side of the membrane.	Replace O-rings of the pressure vessel which cause the leakage.

8.2.3.12 High conductivity

The actual permeate conductivity is above the maximum setpoint for longer than the set delay time. Exceeding conductivity level means your permeate water quality does not meet your requirements.

Possible cause	**Action**
Wrong setting in the controls.	Check and/or Adjust setting.
Membranes fouled.	Clean or replace membranes.
Internal concentrate leakage from reject to permeate side of the membrane.	Replace O-rings of the pressure vessel which cause the leakage.

8.2.3.13 Low inlet pressure 1

The pressure before the RO pump is too low. The RO pump is running dry and is switched off. After a programmed delay time the pump automatically starts up again.

Possible cause	**Action**
Wrong setting in the controls.	Check and/or adjust setting.
Hand valve in the inlet line is closed.	Open the hand valve on the inlet.
Inlet solenoid valve does not open.	Repair solenoid valve or adjust settings to get valve working again.
Lack of water in the supply pipe.	Increase water supply.
Problems with the system supply.	Check the raw water pump set (if applicable).
Too high pressure loss in the pre-filtration.	Check the pre-filter at the inlet. Reduce the pressure loss or replace the filter cartridge.
Pressure switch defective.	Repair or replace switch.
Broken wiring at the pressure switch.	Check and/or repair wiring.

8.2.3.14 Low inlet pressure 2

The pressure before the RO pump is still too low after the programmed number of restarts. The RO pump is running dry and is switched off permanently.

Possible cause	**Action**
Wrong setting in the controls.	Check and/or Adjust setting.
Hand valve in the inlet line is closed.	Open the hand valve on the inlet.
Inlet solenoid valve does not open.	Repair solenoid valve or adjust settings to get valve working again.
Lack of water in the supply pipe.	Increase water supply.
Problems with the system supply.	Check the raw water pump set (if applicable).
Too high pressure loss in the pre-filtration.	Check the pre-filter at the inlet. Reduce the pressure loss or replace the filter cartridge.
Pressure switch defective.	Repair or replace switch.
Broken wiring at the pressure switch.	Check and/or repair wiring.

8.2.3.15 Low pump pressure

The pressure of the RO pump is below the minimum setpoint.

Possible cause	**Action**
Wrong setting in the controls.	Check and/or Adjust setting.
Pump problem	Check pump.
Leakage	Repair leakage.
Pressure sensor broken.	Repair or replace sensor.

8.2.3.16 High pump pressure

The pressure of the RO pump is above the maximum setpoint.

Possible cause	Action
Wrong setting in the controls.	Check and/or Adjust setting.
Membranes fouled or damaged.	Clear blockage.
Pump outlet blocked.	Replace O-rings of the pressure vessel which cause the leakage.
Pressure sensor broken.	Repair or replace sensor.

8.2.3.17 Low permeate pressure

The pressure in the permeate outlet is below the minimum setpoint.

Possible cause	Action
Wrong setting in the controls.	Check and/or adjust setting.
Pump problem	Check pump.
Permeate demand higher than production.	Check and decrease demand.
Leakage	Repair leakage.
Pressure sensor broken.	Repair or replace sensor.

8.2.3.18 High permeate pressure

The pressure in the permeate outlet is above the maximum setpoint.

Possible cause	Action
Wrong setting in the controls.	Check and/or adjust setting.
Pump doesn’t stop.	Check wiring.
Pressure sensor broken.	Repair or replace sensor.

8.2.3.19 RO pump

The alarm contact of the RO pump is open.

Possible cause	Action
The pump is blocked or broken, causing the thermal relay to trip.	Find cause or replace pump, if necessary, and reset the thermal relay.
If a frequency inverter is present, this inverter triggers an alarm.	Please refer to the converter documentation.
Broken wiring to the alarm contact of the pump.	Check and/or repair wiring.

8.2.3.20 UV unit

The alarm contact of the UV unit is open. Please refer to the manual of the UV unit.

Possible cause	Action
Malfunction of the UV unit.	Check and/or repair the UV unit.
Broken wiring to the alarm contact of the UV unit.	Check and/or repair wiring.

8.2.3.21 Limitron

The alarm contact of the Limitron residual hardness monitor is open. Please refer to the Limitron manual.

Possible cause	Action
The softener is not working properly and hardness is passing through.	Check softener and start a regeneration process.
Malfunction of the hardness monitor.	Check and/or repair the residual hardness monitor.
Broken wiring to the Limitron alarm contact.	Check and/or repair wiring.

8.2.3.22 Testomat

The alarm contact of the Testomat residual hardness monitor is open. Please refer to the Testomat manual.

Possible cause	Action
The softener is not working properly and hardness is passing through.	Check softener and start a regeneration process.
Malfunction of the residual hardness monitor.	Check and/or repair the residual hardness monitor.
Broken wiring to the Testomat alarm contact.	Check and/or repair wiring.

8.2.3.23 Dosing pump

The alarm contact of the dosing pump is open.

Possible cause	Action
Please refer to the manual of the dosing pump.	Proceed in accordance with this manual.
Broken wiring to the alarm contact of the dosing pump.	Check and/or repair wiring.

8.2.3.24 Filter exchange

Exchange the pre-filter cartridge.

8.2.3.25 Maintenance

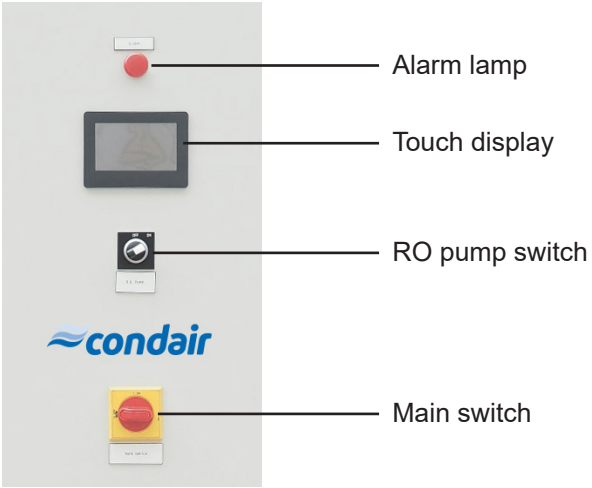
The RO unit needs periodic maintenance. Provide information to the service department.

8.3 Reject rinse

During a reject rinse, the increase in the reject flow rate causes the reject side of the membrane(s) to be flushed at a higher velocity and, due to the associated increase in shear forces, easily detachable deposits are removed and rinsed out.

A reject rinse should last at least 60 minutes and should be carried out as follows:

- Log the actual values (enter in operations log according to chapter 9)



- Switch on the PLC at the red switch, do not switch on the HP pump (switch position OFF).
- Rinse for a min. of 60 minutes
- Switch on the RO pump (switch position ON)
- Readjust the operating parameters to the setpoints
- Wait 10 minutes
- Log the actual values again (enter in operations log according to chapter 9)

NOTE

If the permeate conductivity does not improve permanently after a reject rinse, the membranes must be replaced.

9. Inspection and Maintenance

9.1 Inspection and maintenance work

9.1.1 Safety instructions

CAUTION!

The operator must ensure that all inspection, maintenance, and assembly work is carried out by authorised, qualified specialist personnel.

Prior to all repair and maintenance work, the unit must be shut down and secured against unintentional start-up.

WARNING!

Before starting work on electrical installations and equipment, the unit must be checked to ensure that it is de-energised. In addition, the unit must be secured against being switched on unintentionally.

Suitable protective clothing appropriate to the hazard level in question must be worn while the maintenance work is being carried out.

Immediately after completion of the maintenance work, all safety and protective devices must be reattached and/or reactivated.

9.1.2 General instructions

NOTE

In order to ensure the proper operation and function of the unit in the long term, regular maintenance work must be carried out and a log of the operating parameters must be kept!

The system operator is responsible for logging the operating parameters. A log sheet must be kept for logging the operating parameters, which allows for continuous documentation of the operating parameters and provides evidence of correct operation. A drop in performance or malfunctions of the RO unit can thus be detected and remedied more quickly.

It is recommended to conclude an inspection and maintenance contract with the supplier, who is qualified to carry out the regularly required maintenance work on the system. The maintenance work is documented in the designated maintenance log by the qualified person carrying out the inspection or maintenance.

9.2 Logging the operating parameters

9.2.1 List of parameters to be logged

The following parameters must be checked weekly and entered in the operations log for reverse osmosis units:

Parameter	Measuring point / remarks
Operating hours of the RO unit	Main display of PLC, No. 9, next to pump icon, in h
Residual hardness in feed water	Check with hardness test kit in feed water
Conductivity of feed water	Check with hand-held conductivity meter
Temperature of feed water	Check with hand-held conductivity meter
Fine filter inlet pressure	Inlet pressure manometer, before fine filter
Fine filter outlet pressure	Outlet pressure manometer, after fine filter
HP pump pressure = operating pressure	Main display of PLC, No. 10, to the right of pump icon, in bar
Reject pressure	Reject manometer, on reject distributor (plastic block behind front panel)
Differential pressure operating pressure — reject pressure	Δp = calculate from the read values
Permeate output	Main display of PLC, No. 13, permeate flow indicator in l/h
Reject output	Main display of PLC, No. 18, reject flow indicator in l/h
Circulation	Main display of PLC, No. 17, circulation indicator in l/h
Permeate conductivity	Main display of PLC, No. 12, permeate conductivity in µS/cm
Permeate temperature	Check with hand-held conductivity meter
Desalination rate of the RO unit	Calculation see chapter 1
Leak tightness of the system	Visual inspection of the lines, fittings and screw connections

NOTE

Slight fluctuations in the output parameters (permeate conductivity and permeate output) due to fluctuations in the feed water temperature or due to fluctuating conductivity of the feed water are normal.

WARNING!

If the desalination rate drops below 95% or the permeate output drops by approx. 10% compared to the output at commissioning, a reject rinse should be carried out in accordance with section 8.3.

9.2.2 Operations log for reverse osmosis units

Customer:_____
Unit type: _____
Order No.: _____
Commissioned on: _____

Measured variable	Unit	At commissioning	Date	Date	Date	Date	Date
Operating hours of the RO system	h						
Residual hardness in feed water	°d						
Conductivity of feed water	µS/cm						
Temperature of feed water	°C						
Fine filter inlet pressure	bar						
Fine filter outlet pressure	bar						
HP pump pressure = operating pressure	bar						
Permeate pressure	bar						
Reject pressure	bar						
Differential pressure operating pressure — reject pressure	bar						
Permeate output	l/h						
Reject output	l/h						
Circulation	l/h						
Permeate conductivity	µS/cm						
Permeate temperature	°C						
Desalination rate of the RO system	%						
Leak tightness of the system	-						

NOTE

The values at commissioning are to be recorded as a basis for the system assessment. The values are entered weekly in copies of this log sheet. If the values deviate by approx. 15% from the values at commissioning (e.g. differential pressure, permeate output, desalination rate), the supplier should be notified.

9.3 Maintenance

NOTE

Maintenance work for the system must be carried out periodically after 4000 operating hours (a warning maintenance message is sent) and for each system part separately as required, no later than the specified maintenance intervals or described situations (column “No later than as per operating hours or described situation.”)!

In the user menu you can query the operating time remaining until the next maintenance (see chapter 7 - PLC).

Operating times are defined as “Production ON” times, i.e. times when the HP pump is running. The following maintenance work must be carried out by the manufacturer’s service department:

Component	**Work to be carried out**	**At the latest after operating time or described situation**
Fine filter (part No. 2003805)	Replace filter cartridges * and clean filter housing *	■ 3 months ■ if pressure drops by 0.8 bar
Pressure switch	Function test by shutting off the feed water inlet → HP pump must switch off	■ 6 months
Sensor of residual hardness monitor * (if present)	Replace sensor with a reactivated or new sensor	■ 12 months or ■ after triggering the sensor
Conductivity measuring cell(s)	Conductivity check with hand-held conductivity meter as reference instrument, re-calibration if required.	■ at commissioning ■ 12 months ■ if the feed water quality changes
Filter mat * for control cabinet fan (if present)	Check degree of contamination and clean, if necessary	■ 1 month
	Replace filter mat	■ 6 months
HP rotary pump	Clean the fan	■ 8000 operating hours
RO membranes *	Replace the membranes	■ 3 years or ■ if the desalination rate and permeate output have dropped by more than 15% compared to the values at commissioning.

* wear part

Filter exchange log

Date of filter exchange	Unit type	Serial number	Company	Location	Signature (block capitals)

10. Preservation

10.1 General Instructions

NOTE

If the system is out of operation for more than 30 days, it must be preserved. In case of a prolonged decommissioning period: After 3 months at the latest, the preservative must be rinsed out and replaced, if necessary.

The system is recommissioned in accordance with chapter 6 of these operating instructions. Preservation is carried out with the unit switched off.

Please consult the system diagram for preservation according to section 4!

WARNING!

The preservative solution contains 1.5% sodium bisulfite and 2.5% sodium bicarbonate and, in the frost protection version, an additional 20% glycerine. The preservative solution must be discharged into the sewage system in accordance with the respective applicable discharge regulations.

10.2 Preparing the preservative

10.2.1 Preservative options

- Sodium bisulfite + sodium bicarbonate without additive: Preservative without frost protection
- Sodium bisulfite + sodium bicarbonate with added glycerine: Preservative with frost protection down to -10°C
- Ready-to-use preservative with frost protection

10.2.2 Required material

- Preservation tank with drain valve
- 3 connecting hoses
- Chemicals for preservation: Sodium bisulfite, sodium bicarbonate and glycerine
- Protective clothing (goggles, gloves, apron)

10.2.3 Connecting the preservation tank

- Switch off the RO unit
- Close feed water inlet

10.2.3.1 Units without dedicated rinse connectors

- Place the preservation tank at a higher level than the unit to ensure that the preservative solution flows freely into the RO unit.
- Close the drain valve on the preservation tank

10.2.3.1 Units without dedicated rinse connectors

- Place the preservation tank at a higher level than the unit to ensure that the preservative solution flows freely into the RO unit.
- Close the drain valve on the preservation tank
- Disconnect the permeate and reject lines at the RO unit
- Connect the preservation tank and the reject outlet of the RO unit with a hose
- Connect the preservation tank and the permeate outlet of the RO unit with a hose

10.2.3.2 Units with dedicated rinse connectors (optional)

NOTE

The dedicated rinse connectors (only available as an option) with 3-way switching valves for quickly establishing a preservation circuit are located in the feed water line, permeate line and reject outlet line.

- Place the preservation tank at a higher level than the unit to ensure that the preservative solution flows freely into the RO unit.
- Close the drain valve on the preservation tank
- Connect the preservation tank drain with the rinse connector in the inlet of the RO unit
- Connect the preservation tank to the rinse connector in the reject outlet pipe with a hose
- Connect the preservation tank and the rinse connector in the permeate line of the RO unit with a hose

10.2.4 Preparing the preservative solution

DANGER!

Risk of chemical burns!

When handling the preservation chemicals, the general accident prevention regulations and the information from the respective safety data sheet must be observed!

When pouring the chemicals into the preservation tank, wear protective clothing: Safety goggles, gloves and rubber apron

- Pour a quantity of soft water into the preservation tank according to the table at the end of the section, depending on the size of the unit.
- Check connections for leaks.
- Add sodium bicarbonate ($NaHCO_3$) to the water according to the table and dissolve while stirring,
- gradually add sodium bisulfite ($NaHSO_3$) according to the table, stirring continuously to avoid foaming.
- If frost protection is desired: Pour in glycerine according to the table while stirring and stir until the mixture is smooth
- or alternatively, pour a ready-to-use preservative with frost protection into the rinse tank.

NOTE

Slowly add the chemicals to the water while stirring continuously.

Composition of the preservative solution

Permeate output of the unit (l/h)	**Soft water supply** (l)	**Sodium bisulfite powder** (kg)	**Sodium bicarbonate** (kg)	**Glycerine** (l)
Conc. chemical only		97%		86.5%
Concentration of chemical in preservative solution		1.5% w/w	2.5% w/w	20% v/v
20–80	10	0.20	0.32	2.9
100–500	20	0.39	0.63	5.8
550–1500	50	0.97	1.6	14.5
1550–3500	100	1.93	3.1	29.0
3550–9500	200	3.87	6.25	58.0
9550–12,000	250	4.84	7.8	72.5
12,050–17,000	300	5.80	9.4	87
17,050–20,000	400	7.74	12.5	116
20,050–30,000	500	9.67	15.6	145

WARNING!

The pH value of the preservative solution is approx. 7.

10.3 Preservation steps

- Close feed water inlet
- Switch the PLC to the “OFF” operating mode.
- Fully open reject control valve and pressure control valve
- Set the 3-way ball valves to the “Rinse” position*.
- Open the drain valve on the preservation tank
- Set the PLC to the “Cleaning” or “Preservation” operating mode.

- Alternatively: Set the RO unit to an operating mode in which monitoring by connected sensors is switched off or (if such an operating mode is not provided) disconnect any connected sensors (forced stop, inlet pressure, level) and, depending on the function, provide the inputs with wire jumpers or leave them open so that uninterrupted production is established (see operating instructions of the PLC).

WARNING!

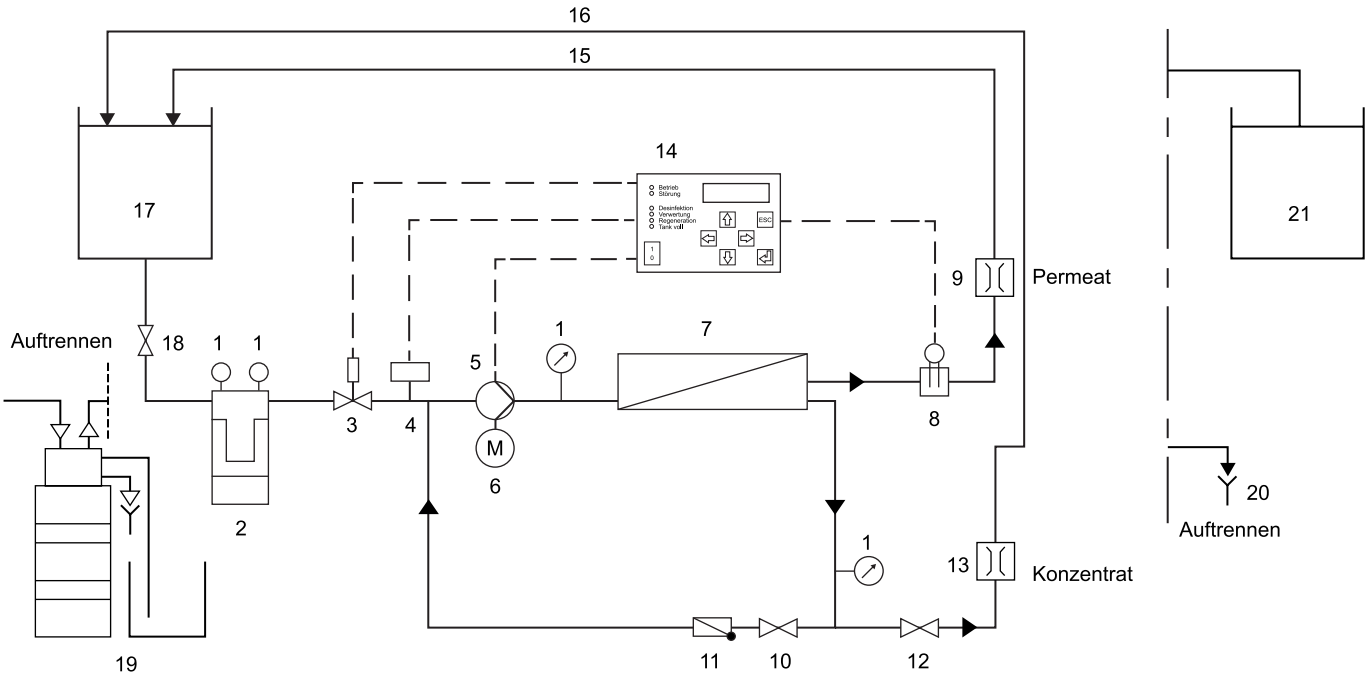
The unit runs without any safety devices. Avoid dry running of the HP pump.

- Let the preservative solution circulate for 10 min
- Switch off the PLC
- Close the drain valve on the preservation tank
- Set the 3-way ball valves to the “Service” position*.
- Disconnect hoses
- Close feed water inlet, permeate outlet and reject outlet with sealing discs
- Dispose of any preservative solution remaining in the preservation tank (see section “General instructions”).

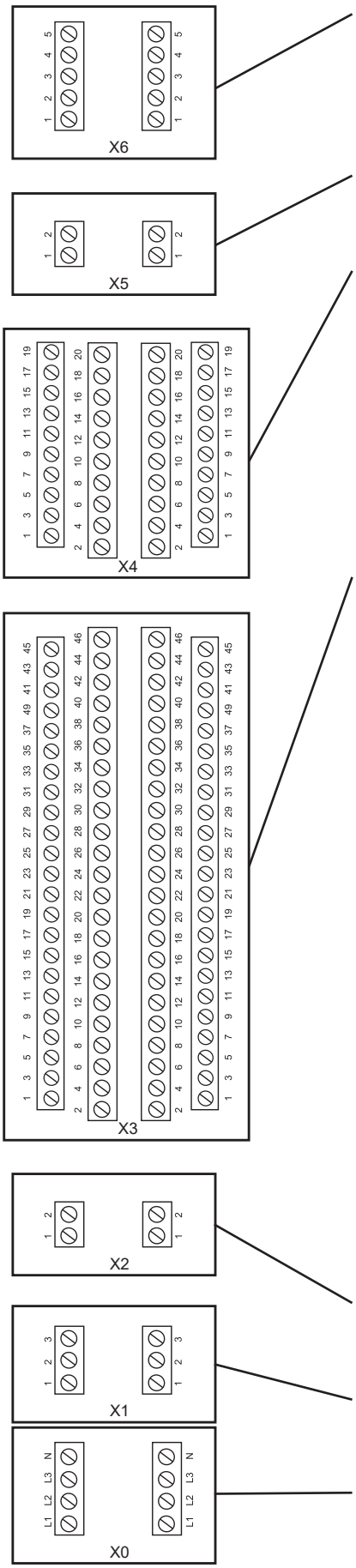
* Only in units with dedicated rinse connectors

10.4 System diagram for preservation

1 - Manometer
2 - Fine filter
3 - Solenoid valve
4 - Pressure switch
5 - Pump
6 - Motor
7 - Membrane module
8 - Measuring cell
9 - Flow meter (permeate)
10 - Pressure control valve
11 - Non-return valve
12 - Reject control valve
13 - Flow meter (reject)
14 - PLC
15 - Permeate
16 - Reject
17 - Preservation tank
18 - Drain valve
19 - Softening system
20 - Sewer connection
21 - Permeate tank



11. Wiring Diagram



Digital output

1-W, 2-NC, 3-NO Alarm		DO8
4,5	Start Testomat or start dosing pump or maintenance message	DO1

RS 485 interface

1+, 2-

Analogue inputs for sensors

1,2	Conductivity sensor, temperature	AI 6
3,4	Conductivity sensor, conductivity	
5+,6-	Permeate flow (alternative to DI 1)	AI 1
7+,8-	Feed water flow	AI 2
9+,10-	K-circulation flow	AI 3
11+,12-	Pressure before module	AI 4
13+,14-	Permeate tank level	AI 5
15,16,17	External setpoint or Inlet pressure or Break tank level	AI 7
18+,19-	Permeate pressure	AI 8

Various inputs and outputs

1 -	Start/Stop	2 - GND RO pump	DO3
3 -	Setpoint 0–10 V	4 - GND RO pump	AO1
5 -	NO	6 - C Alarm RO pump	DI 3
7,8 -	Control voltage output 24 VAC		
9+,10-	Control voltage output 24 VDC		
11,12,13	3-way permeate valve (not for AT2+)		DO4
14,15	2-way permeate valve circulation -NO-		
16,17	2-way permeate valve outlet -NO-		
18,19	Permeate flow (Impulse)		DI 1
20,21	Message from Testomat, Limitron or dosing pump		DI 2
22,23	Base level (Start)	DI 4	
24,25	Top level (Stop)	DI 5	
26,27	Alarm permeate pump	DI 6	
28,29	Inlet pressure switch	DI 7	
30,31	Ext. system stop/release or Alarm UV unit		DI 8
32,33	Solenoid valve Inlet	DO2	
34,35	Solenoid valve Reject -NO-		DO5
36,37	Solenoid valve Rinse -NO- (bypass or circulation)		DO6
38,39	Permeate pump		DO7
40 (0–10V)	, 41 (GND) Control signal, RO pump		AO2
42 (4–20mA), 43 (GND)	Conductivity output		AO3
44 (4–20mA), 45 (GND)	Permeate flow output		AO4

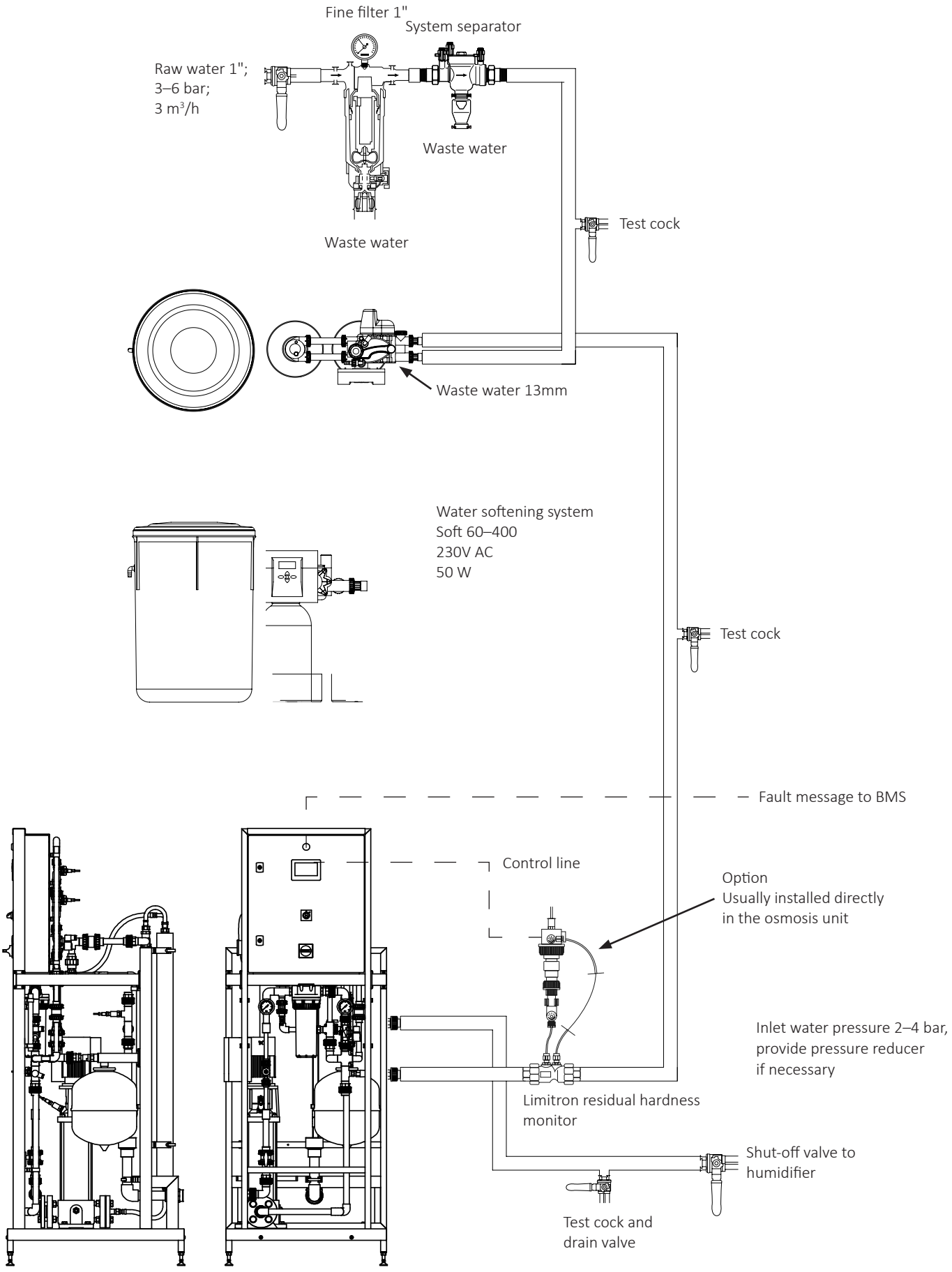
PLC supply 230 VAC

RO pump 230/400 VAC

Supply 230/400 VAC

12. Appendix

12.1 Assembly structure (diagram)



12.2 Dimensions

Condair AT2+ 75 to 1700

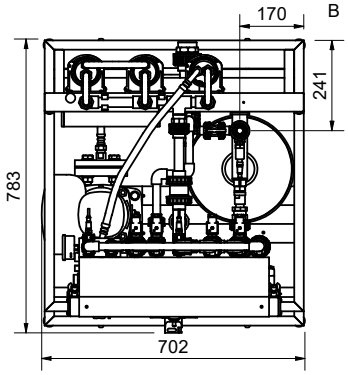
Connections:

A = Supply (PVC Ø25mm)
B = Permeate (PVC Ø25mm)
C = Waste water (PVC Ø40mm)

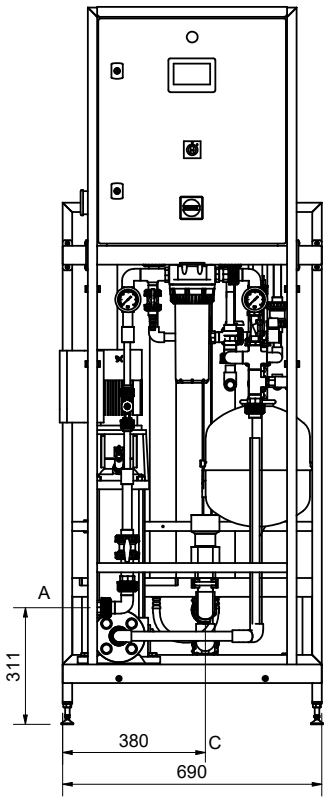
Electrical connection:

3x400V / 50Hz

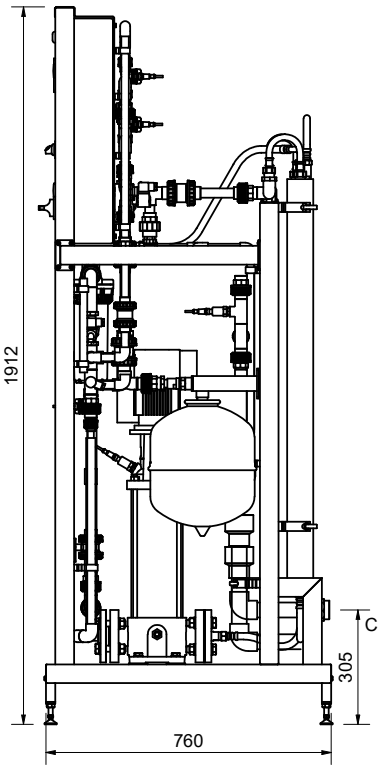
TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW



Notes

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