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CONDAIR AX

Reverse osmosis system

INSTALLATION AND OPERATING MANUAL

Condair AX reverse osmosis system
01/04/2025

Air humidification, dehumidification
and evaporative cooling

condair

Thank you for choosing Condair

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

Contents

1. General safety instructions

1.1 Explanations of symbols and instructions

This operating manual contains important information on the safe operation of the system.

This operating manual, in particular the chapter “Safety instructions” must be observed by all persons working on the system. This applies to the installation company as well as to the system operator. Moreover, the special rules and guidelines for accident prevention that apply to the location of use must also be followed.

In this operating manual, the following symbols are used to indicate hazards for persons and to ensure proper handling of the equipment:

DANGER!

This symbol indicates an imminent danger to the life and health of persons. Failure to observe these instructions results in severe adverse health effects, including life threatening injuries.

WARNING!

This symbol indicates a possible imminent danger to the life and health of persons. Failure to observe these instructions may result in severe adverse health effects, including life threatening injuries

CAUTION!

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

NOTE

This symbol provides important information on how to handle the equipment correctly. 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 only allow persons to work on the system

- who are familiar with the fundamental regulations on occupational safety and accident prevention and have been instructed in the handling of the system,
- who have read and understood the chapter on safety and the warnings in this operating manual and who have acknowledged this with their signature and
- whose safe working practices are checked at regular intervals.

The manufacturer/supplier is not liable for any damage resulting from improper use.

1.3 Personnel obligations

All persons who are commissioned to work on the system or who carry out such work independently undertake the following before commencing work:

- To read the chapter on safety and the warnings in this operating manual and to acknowledge with their signature that they have understood them.
- To observe the fundamental regulations on occupational safety and accident prevention.

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

1.4 Training of personnel

Only trained and instructed personnel must work on the system.

- The responsibilities of the personnel for assembly, commissioning, operation, set-up, maintenance and repair must be clearly defined.
- Personnel to be trained must only work on the system under the supervision of an experienced person.

1.5 Intended use

The system must only be used for the desalination of drinking water, well water or surface water that is free of particles and metallic ions. The limitations stated in the technical data regarding chemical analysis of the feed water, pressure, temperature and flow rate apply.

Intended use also includes

- compliance with all the instructions in the operating manual
- and adherence to the inspection and maintenance intervals.

Any other usage or usage beyond this is considered contrary to the intended purpose.
Non-intended use includes use as a

- filter
- pressure booster
- water distributor.

1.6 Hazards when handling the equipment

- The system has been designed and manufactured in accordance with the latest technology and recognised safety regulations.
- The system must be set up in 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 cause danger to the life or health of the user or third parties or damage to the equipment or other property. The system may only be used for its intended purpose (see 1.5) and in a perfectly safe condition.

The following residual hazards exist:

Water damage

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

Electrocution

- Ensure that work on the electrical supply is only carried out by a qualified electrician.

- Check the electrical equipment of the installation regularly. Remove loose connections and scorched cables immediately.
- The switch cabinet must be kept locked at all times. Access is only allowed to authorised personnel.
- If work on live parts is required, a second person must be called in who can switch off the main switch if necessary.
- Do not touch electrical components with wet hands.
- Disconnect the system from the power supply before working on electrical system parts.

Mechanical/Hydraulic Energy

- Some parts of the system 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 information on preservation must be observed.

Faults that may affect safety must be eliminated immediately. This is done by the operator or a company commissioned by the operator.

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 in working order.
- Protective devices may only be removed after the machine has been switched off and secured against being switched on again.
- The required personal protective equipment for the operating personnel must be provided by the operator and used by the operating personnel when working on the system.
- All protective devices in place must be checked regularly by the operator or a company commissioned by the operator.

1.7.2 Informational safety measures

- The operating manual must be kept at the system’s place of use at all times.
- In addition to the operating manual, the generally applicable and local regulations for accident prevention and environmental protection must be made available and observed.
- All safety and danger 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 assembly work is carried out by authorised, qualified technicians who have sufficiently informed themselves by studying the operating manual in detail.
- Before carrying out any repair or maintenance work, the system must be switched off and secured against being accidentally put into operation. The procedures for shutting down the system described in section “Commissioning and decommissioning” must always be observed.
- Before starting work on electrical equipment of the installation, the relevant section must be checked to ensure that it is de-energised. In addition, the system must be secured against being switched on again.
- Suitable protective clothing appropriate to the hazard must be worn during the work.
- Immediately after completion of the work, all safety and protective devices must be refitted or put into operation.
- Before recommissioning the machine, the points listed in the section “Commissioning and de-commissioning” must be followed.

1.9 Disposal of system parts and operating materials

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

1.10 Unauthorised modification and replacement parts

- Modification of or changes to the system are only permitted after consultation with the manufacturer.
- The same applies to any program modifications made to the controller.
- Original replacement parts and manufacturer-authorised accessories are important for your safety.
- If other parts are used, the warranty becomes null and void and no liability is accepted for the resulting consequences.

1.11 Warranty and liability

This product complies with the latest technology and has been designed, manufactured and subsequently subjected to quality control in accordance with the applicable codes of practice.

Should there nevertheless be cause for complaint, any claims for compensation against the manufacturer of this product shall be governed by the manufacturer’s general terms and conditions of sale and delivery.

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

- Non-intended use of the system
- Improper installation, commissioning, operation or maintenance of the system
- Operating the equipment with defective safety devices or improperly fitted or non-functioning safety and protective devices.
- Failure to observe the instructions in the operating manual with regard to transport, storage, assembly, commissioning, operation (continuous keeping of the operations log!), and maintenance of the system.
- Unauthorised, unapproved structural changes to the installation
- Unauthorised modification of the control parameters
- Inadequate monitoring of system components that are subject to wear and tear
- Repairs carried out improperly

Emergencies caused by external forces or acts of God.

1.12 Safety instructions for storage

CAUTION!

The reverse osmosis system 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 systems

2.1 Calculation equations

The permeate output, the concentrate 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 concentrate output are determined by manual volumetric measurement.

Feed water output = permeate output + concentrate output

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

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

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

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

2.2 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

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!

Permeate capacity [l/h] At temperature T[°C] = Nominal power * 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

2.3 Conductivity of first permeate

NOTE

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

3. Transport and storage

3.1 Transport to the customer

CAUTION!

During transport, all units must be secured against slipping and falling over! Tipping from a fixed position is not permitted! If parts of the equipment protrude from the base area of the pallet, then such protruding parts must not be damaged when further parts/equipment are loaded.

- The transport weight corresponds to the tare weight and can be found in the technical data.
- However, the system may be damaged by extreme frost. The units are filled with a preservative/antifreeze mixture prior to delivery.
  The frost protection is effective down to -10°C.

3.2 Storage at the customer's premises

- The maximum storage period of the system in its original packaging is 3 months at 20°C. After that, the preservative must be flushed out and, if longer storage is desired, replaced.
- The system may be damaged by extreme frost. The units are filled with a preservative/antifreeze mixture prior to delivery.
  The frost protection is effective down to -10°C.

3.1 Transport to the installation site

- Use a suitable lifting vehicle to carefully transport the unit to its intended location.
- Take note of any centre of gravity information on the packages.

4. Technical data / Product description

4.1 Technical data

Type AX		**02**	**05**	**12**	**20**	**30**	**50**
Quality of the feed water		Soft water 0˚dH					
Ratings 1)							
Permeate output at 3 bar	l/h	20	50	120	200	300	500
Permeate output at 1 bar	l/h	25	75	150	250	350	600
Yield when taking in							
- Soft water	%	40	50	70	70	75	75
- Hard water	%	35–40					
Desalination rate	%	96 / 98					
Intake pressure (min./max.)	bar	2 / 6					
Ambient and operating temperature	˚C	5 / 30					
Working pressure	bar	10					
Airborne noise emitted	dB (A)	< 70					
Hydraulic connection							
Feed water	DN	R ½" IG	DN 20				
Permeate	DN	R ½" IG	DN 15				
Concentrate (drain water)	mm	R ½" IG	d16 (hose sleeve)				
Electrical connection	V/ Hz	230/50					
Power consumption	kW	0.18	0.55				
Dimensions W x H x D							
System without membrane vessel	mm	580 x 429 x 300	800 x 461 x 360			1217 x 466 x 360	
Maximum operating weight AX	kg	65					
Membrane vessel, Ø x height	mm	270 x 580	410 x 700			610 x 1423	
Membrane vessel, Type/Capacity	l	24/24	60/55			330/328	
Membrane vessel, Empty weight approx.	kg	6	7			33	

1) Limits of the pretreated water

Salinity max.	1.000 mg/l
pH Value	3-11
Blocking index	< 3,0
Free chlorine	< 0,1 mg/l
Total Fe, Zn, Mn	< 0.2 mg/l
KBE	< 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

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 systems should be operated with softened water or with hard water according to the system type, in each case in the same quality as drinking water according to the German Drinking Water Ordinance and according to the following additional specification:

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 special specifications for the system operation 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 system 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 concentrate 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.

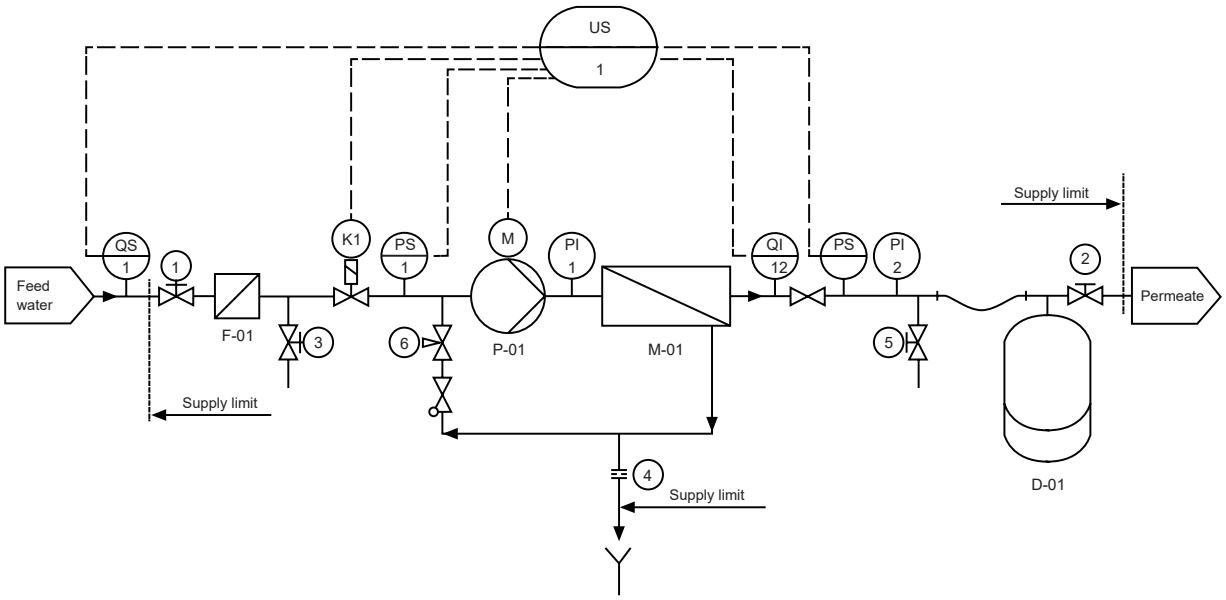
**** the silt density index is a sum parameter. It provides information about the probability of deposits of finely dispersed suspended and colloidal substances on the membranes. For values > 3, the pre-treatment must be improved accordingly.

***** 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 Layout

The following P&I diagram shows the structure of an AX reverse osmosis system:



MSR point list		Actuators	
PI 1	Local display of pump pressure and working pressure	1	Shut-off valve for feed water, manually actuated
PI 2	Local display of permeate pressure	2	Flow control orifice for permeate or shut-off valve, manually actuated
PS 1	Pressure switch for checking the water inlet pressure in the intake line	3	Sampling valve for untreated water, manually actuated
PS 2	Pressure switch to signal pressure in permeate	K 1	Solenoid valve on intake
QI 1	Conductivity probe with optional temperature sensor	4	Concentrate screen, factory setting
QS 1	Hardness monitor (optional)	5	Sampling valve for permeate, manually actuated
US 1	Local process control	6	Flow control orifice, factory standard or flow control valve (optional)
Hydraulic system components			
F-01	Protective cartridge filter 5µm-10“	M-01	Membrane module
P-01	High-pressure pump	D-01	Membrane pressure vessel

4.3.2 Function

The RO feed water reaches the 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 size of the system 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 concentrate (drain water to the sewer).

An integrated controller monitors and controls all important functions of the RO system during permeate production and during downtimes.

It controls the HP pump and records the permeate conductivity, furthermore it monitors the inlet pressure and the residual hardness of the feed water (if an optional residual hardness monitor is present), as well as the permeate pressure. All operating, shut-down, flushing 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.

5. Installation and assembly

5.1 Installation

5.1.1 Requirements of the installation site

- The space required for the unit is derived from the dimensions specified 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 comply with the ambient conditions as specified in 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.
- On site, the necessary electrical connections, as specified in the technical data, must be available 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 size of the system, a control air connection must be present.
- The connection for the disposal of rinse water and concentrates 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 corresponding alarm.

5.1.2 Installation of the system

- Unpack the system
- 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!

- Carefully transport the unit to the intended site using a suitable lifting device.
- Install the unit 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 only be carried out by trained specialist personnel. General directives (DIN, DVGW, SVGW, ÖKGW) and local installation regulations must be observed when installing the system.

5.2.2 Establishing the water connections

Feed water

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

Concentrate

- Remove the sealing disk from the screw connector in the concentrate outlet and keep it.
- Route the concentrate outlet line in a free-flowing drop to the free water drain along the shortest possible path. Drain water must be able to flow out without any backwater forming.

NOTE

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

The following applies only to systems without a membrane pressure vessel:

WARNING!

When the system is not in operation, the back pressure must not exceed 0.3 bar. The cross-section of the on-site permeate line to the consumer must not be larger by more than one rated width than the permeate outlet.

If the back pressure is > 0.3 bar and there is a risk of permeate flowing back, a non-return valve must be installed in the permeate line.

No shut-off device without a pressure relief device may be installed in the permeate line.

5.3 Electrical connection

5.2.1 Required qualification of assembly personnel

DANGER!

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

5.3.2 Establishing the electrical connections

DANGER!

Before connecting the system to the power supply, make sure that the corresponding on-site main switch is switched off.

- The internal system components are already pre-wired with the controller on delivery.
- The power supply to the system must be established, checked and fused according to the specifications in the electrical wiring diagram.
- For systems supplied with a mains cable/plug (Cable length approx. 1.5 meters), 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 systems that require a 3-phase AC supply, the power supply to the system 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.

5.3.3 Connection of external signals from and messages to BMS

Connect

- the forced stop of the residual hardness monitor
- the centralised alarm according to the electrical wiring diagram.

5.3.4 Cable list

It is recommended to use the following cable types:

Bezeichnung	Kabel Typ	Alternativ
Power supply	NYM-J 3 x 1,5	H05VV-F3 G1,5
UO high-pressure pump	NYSLYO 3 x 1	H05VV-F3 G1
Input valve	NYSLYO 4 x 1	H05VV-F3 G1
Concentrate valve (optional)	NYSLYO 4 x 1	H05VV-F3 G1
Alarm output	NYSLYO 4 x 1	H05VV-F3 G1
Pressure switch input	LIYCY 2 x 0,5	
Forced stop (for example Residual hardness analyzer)	LIYCY 2 x 0,5	
Diaphragm vessel - pressure transducer (digital)	LIYCY 2 x 0,5	
Diaphragm vessel - pressure transducer (analog)	LIYCY 3 x 0,5	
Conductivity probe with/without Temperature probe	System cable max. length 0,5m	

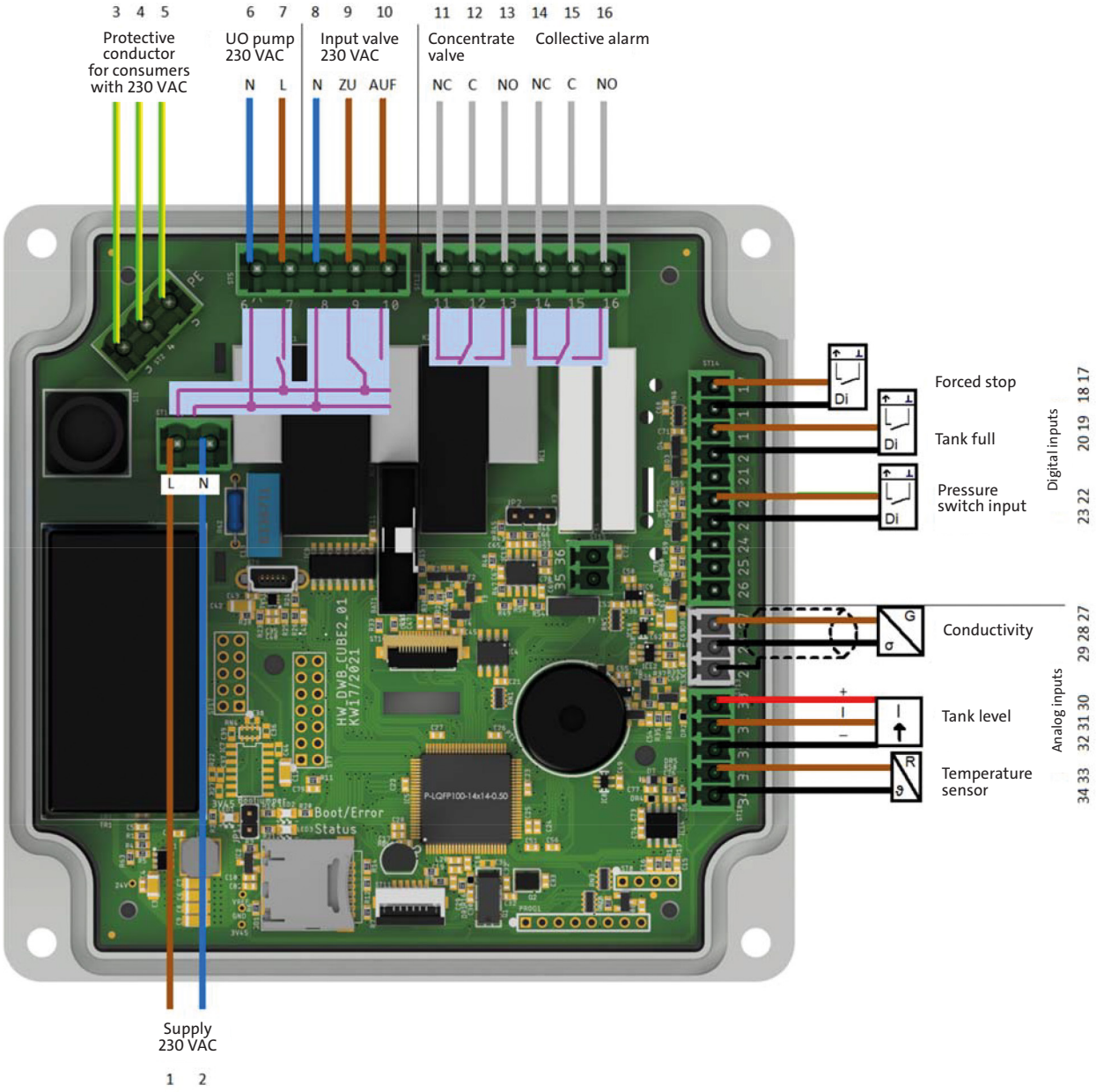
5.3.5 Terminal connection table

Kl.Nr.	Usage	Descr.	Function
1	-	L	Phase, supply 230V AC
2	-	N	Neutral conductor, supply
3	-	PE	Protective conductor
4	-	PE	Protective conductor
5	-	PE	Protective conductor
6	UO High Pressure	N	Neutral, consumer
7		Lno	Relay, normally open contact, supply switching 230V AC
8	Input solenoid valve	N	Neutral, consumer
9		Lnc	Relay, normally closed contact, supply switching 230V AC
10		Lno	Relay, normally open contact, supply switching 230V AC
11	Concentrate solenoid valve	NC	Relay, normally closed contact, potential-free
12		C	Relay, change-over contact, potential-free
13		NO	Relay, normally open contact, potential-free
14	Alarm output-Collective message	NC	Relay, normally closed contact, potential-free
15		C	Relay, change-over contact, potential-free
16		NO	Relay, normally open contact, potential-free
17	Forced stop	IN	Input for ext. potent.free NO contact against GND
18		GND	Mass
19	Diaphragm vessel pressure (digital encoder)	IN	Input for ext. potent.free NO contact against GND
20		GND	Mass
21	Pressure switch input	24V	Sensor supply +24V DC
22		MI	Multi-Input
23		0V	Mass
24	not used	24V	Sensor supply +24V DC
25		MI	Multi-Input
26		0V	Mass
27	Conductivity sensor, conductive	LF	Input LF sensor, conductive
28		0V	Mass
29		PE	Umbrella
30	Diaphragm vessel pressure (analog encoder)	24V	Sensor supply +24V DC
31		MI	Multi-Input
32		0V	Mass
33	Temperature sensor	Tp	Input temperature sensor
34		0V	Mass
35	not used	MO	Multi-Output
36		0V	Mass

Clamps on the side edge of the board:
2.5mm pitch, for single/fine stranded conductors up to 0.5mm².

Terminals in front of the relays, lower edge of the board:
5mm pitch, for single/fine stranded conductors up to 1.5mm².

When using digital encoders, no sensor supply is required.


3 4 5
Protective conductor for consumers with 230 VAC
6 7
UO pump 230 VAC
N L
8 9 10
Input valve 230 VAC
N ZU AUF
11 12 13 14 15 16
Concentrate valve
NC C NO
Collective alarm
NC C NO
PE
L N
Supply 230 VAC
1 2
Forced stop
Tank full
Pressure switch input
Digital inputs
17 18 19 20 22 23
Conductivity
Tank level
Temperature sensor
Analog inputs
27 28 29 30 31 32 33 34
Boot/Error
Status
HW_DWB_CUBE2_01
KW17/2021

6. Commissioning and decommissioning

6.1 Commissioning

6.1.1 Qualification of commissioning personnel

CAUTION!

The system must be commissioned by qualified specialist personnel.

NOTE

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

6.1.2 Flushing out the preservative

WARNING!

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

The unit is supplied with the controller set to OFF mode. After switching on the mains power, the actuators connected to the controller (pump, input valve) do not switch on independently.

- Make a temporary hose connection between the sampling valve (5 — if present) or (if necessary) between the permeate outlet and the sewage duct.
- Fully open the pump control valve (if present), pressure control valve (6 — if present), concentrate control valve (4 — if present) and permeate outlet valve (2)
- Open feed water inlet
- Switch on the main switch (if present) or switch on the power supply to the controller on site.
- Open the inlet valve via the control panel (sub-menu “Diagnostics” — Inlet valve) and flush the system for at least 30 minutes without switching on the HP pump, using only feed water pressure.
- Exit the “Diagnostics” sub-menu — the inlet valve closes again
- Remove the temporary hose connection between the sampling valve (5 — if present) or (if necessary) between the permeate outlet and the sewage duct and reconnect the connection line for permeate to the consumer.

6.1.3 Setting up automatic mode

After rinsing out the preservative, automatic operation is established in the submenu Operating mode on the control unit by selecting “Automatic operating mode”.

6.1.4 Configuring permeate output and yield

With type CaRO and CaRO ED systems, it is not necessary to configure the permeate output and yield, as the flow rates are put into the correct proportions by self-regulating orifices.

6.1.5 Setting the permeate outlet pressure

The permeate outlet pressure may be preselected in the range 1 to 3 bar at pressure switch PS 2. The factory setting is 3 bar. If a lower outlet pressure is required, the precharge pressure in the dia phragm pressure vessel must also be adjusted by inflating or deflating according to the 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
3.0	2.70
2.5	2.25
2.0	1.80
1.5	1.35
1.0	0.90

6.2 Decommissioning

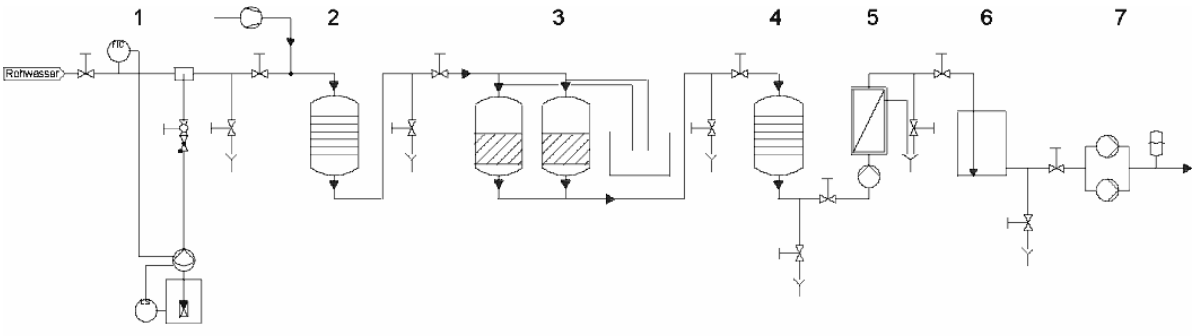
NOTE

The plant must be treated with preservative before each shutdown, which must be rinsed out again when the plant is put back into operation, as described in section 1.2. Therefore, the plant should only be taken out of service in case of expected downtimes of > 30 days.

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

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

6.3 Possible water treatment layout

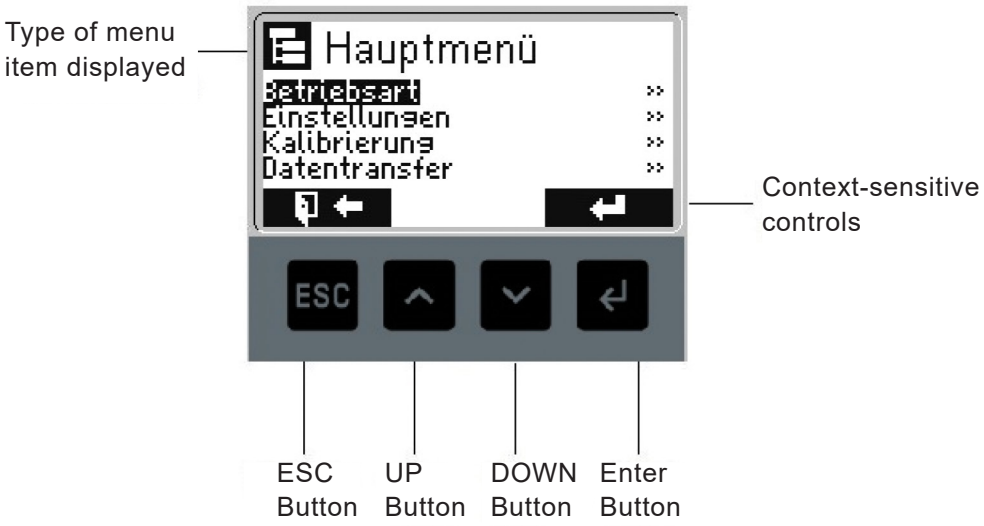


1 Dispensing system
2 Iron removal
3 Water softener
4 Activated charcoal filter
5 Reverse osmosis system
6 Permeate container
7 Pressure boosting system

7. Control Panel

7.1 Control and display element

7.1.1 Control panel



7.1.2 Context sensitive menu elements

The display shows elements that are in context to the current display content:

 Main menu or submenu of it

 Input for logical parameter, setting with UP or DOWN keys.

 Input for numerical parameter, setting with UP or DOWN keys, advancing with Enter.

 Factory setting for the parameter

 Permissible range for the parameter

7.1.3 Context sensitive controls

These elements appear in the display above the keys to which they are assigned and change intermit tently because they are related to certain menu contents:

 Back without saving with ESC key

 Input Confirm with Enter key

 Acknowledge message with ESC key

 Call up the main menu with the Enter key

 Display messages from the scrolling display with ESC key

7.1.4 Buttons

The control panel includes the following four keys:

In the main menu, a submenu can be exited with the ESC key without accepting changes, or the main menu can be exited completely.

The UP key is needed for moving up in menus.
It is also used to change parameters:
Numerical parameters → Press once = increase the value by 1.
Logical parameters → Press once = selection of the logical alternative.

The DOWN key is needed for downward movement in menus.
It is also used to change parameters:
Numerical parameters → Press once = decrease the value by 1.
Logical parameters → Press once = select the logical alternative.

The ENTER key is used to enter numerical parameters. one time to navigate one position to the right. Finally, the ENTER key temporarily saves the value, leaving the relevant sub menu. Note the „Save?“ prompt that appears later when exiting the menus.

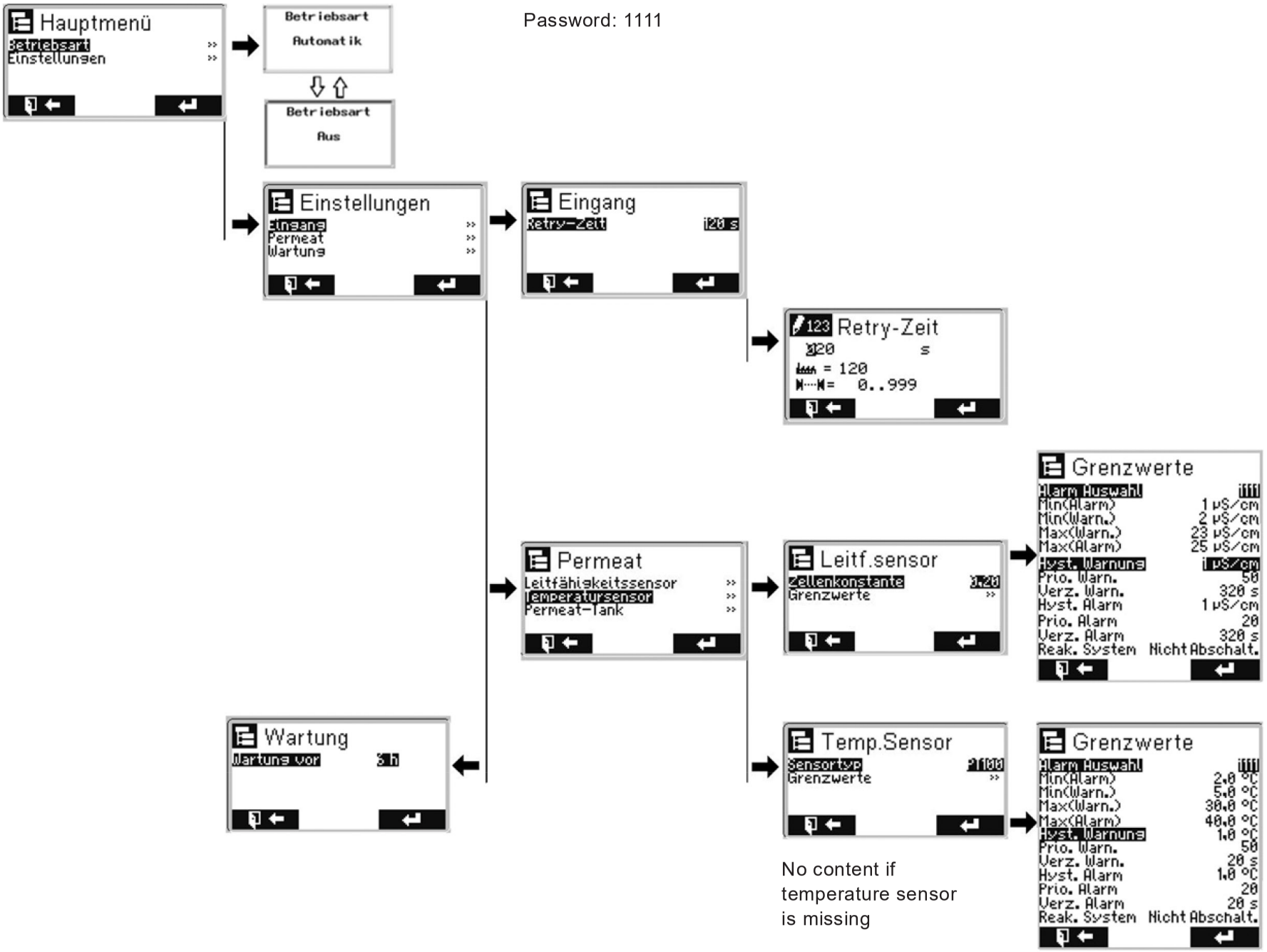
7.2 User menu

7.2.1 Overview

The user menu can be found on the following page. In the user menu, user-specific parameters can be changed which allow the system function to be adapted to the conditions in the system environment:

- Operating mode (OFF or automatic)
- Retry time
- Lower and upper limits for temperature and permeate conductivity
- Messages and system reactions when these limits are reached

Press the Enter key, the prompt for the password will appear (default password is 1111):



No content if temperature sensor is missing

No limit values are displayed if the temperature sensor is missing

7.2.2 Insulation

7.2.2/1 Retry time

Main menu → Settings → Input → Retry time

NAfter opening the inlet valve K1, a short delay time (60s are set in the factory) is active, during which the pressure must build up. If pressure has not yet built up after this delay, the inlet valve K1 is closed. After a set retry time* has elapsed (120 s are set in the factory), the inlet valve K1 is opened again and checked again to see whether pressure has built up. If the pressure has built up within the delay, the control system switches to pump startup. If the pressure has not built up again, the test for the inlet pressure is repeated until a maximum number of restart attempts (3 attempts are set in the factory) is reached, after which a low pressure alarm is triggered.

NOTE

Below is an example of how to navigate and set a parameter in the menu.

You call up the user menu by entering the user password, select with the entry Settings, then (Enter) Input, then (Enter) Retry time:

Change the numerical value for Retry time using the cursor keys !

7.2.2/2 Limit values, delays, hystereses

Limit values, delays and hystereses can be defined for triggering messages (warnings or alarms), delays and hystereses can be defined.

Main menu → Settings → Permeat → Conductivity sensor (or temperature sensor)

The limits submenu is explained below using the conductivity sensor as an example. The explanati on applies in the same way to the temperature sensor if one is present.

Under Alarm selection, select whether a message is to appear when a max value is exceeded or a min value is a message is to appear when the value falls below a min. value:

Current: Max (alarm) = 1 means: When exceeding the max. max. conductivity an alarm is displayed!

Select minimum limit values for a warning Min(Warning) or for an alarm Min(Alarm) as well as maximum limit values for a warning Max(Warning) or for an alarm Max(Alarm) for the case that these conductivity values are exceeded or undershot.

For each message (warning or alarm) it is also possible to set separately a delay, a hysteresis Hyst. and a priority Prio. can be defined. Finally, it is also possible to define a Reaction of the Reakt. System for the alarm case is possible.

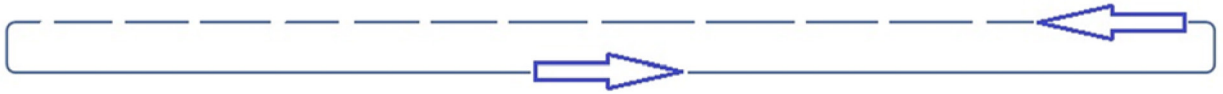
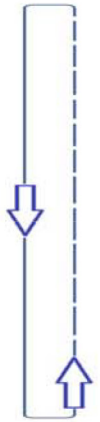
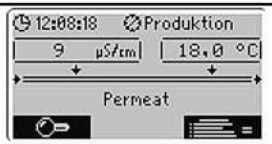
7.3 Rolling display

7.3.1 Undisturbed operation

The rolling display contains the current permeate conductivity in µS/cm, the temperature in °C if a temperature sensor is present on the LF measuring cell, and the logical states of the up to three sensors connected to the inputs of the controller Tank full ON/OFF and Inlet pressure ON/OFF.

All possible „operating states“ can be found in the following table.

Active plant elements are filled in black, inactive elements are grayed out. are grayed out.

Operating mode	OFF	Automatic sequence					
Sequence of events	Plant switched off						Rolling of the display
Operating states		Pressure test*	Warp	Production	Displacement	Tank full	
Input							
Permeate							
Concentrate**							

*If pressure is not detected after the delay time (factory setting: 60s), the input valve closes during the retry time (factory setting: 120s), only then new attempt for pressure detection, until the maximum number of restart attempts (factory setting: 3) is reached.
is reached!
**Display only appears if a concentrate valve is present!

7.3.2 Displays during pause flushing

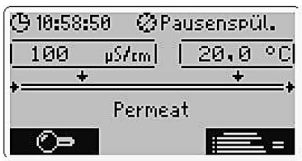
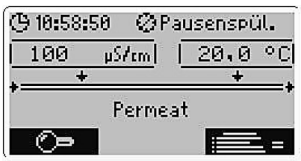
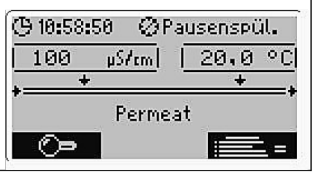
The design of the tank (without or with overflow) determines whether during a pause rinsing (this is an interval operation during production pauses due to a full tank). UO pump P-01 may be switched on. If the tank has an overflow, the P-01 HP pump is switched on, with the additionally pro duced permeate draining off via the overflow. If there is no overflow (as when using a diaphragm pressure vessel), the pause rinsing takes place without switching on the P-01 UO pump.

NOTE

The time displays in the example masks have no logical value, they are without meaning.

NOTE

The permeate tank without overflow setting is preset by default in the systems of the two AX series. The following table contains the possible displays of the AX series during pause rinsing:

	Tank type	Production	Displacement
Tank type	Permeate tank with Overflow		
Input*			
Concentrate			
Tank type	Permeate tank without Overflow		
Input*			
Concentrate			
Tank type	Independent of the Permeate Tank		
Permeate**			

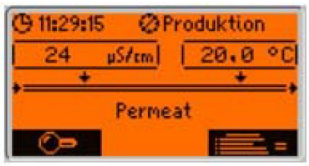
* The inlet pressure is monitored!

** No limit value monitoring for conductivity and temperature!

7.3.3 Disturbed operation

7.3.3/1 Display color scheme

In case of a warning, the background of the display appears completely in orange.



Call the cause of the warning with the ESC key under the magnifying glass icon 

In the event of an alarm, the background of the display appears completely in red.

Call the cause of the alarm with the ESC key under the magnifying glass icon 

7.3.3/2 Possible warnings

Below you will find an overview of all possible warnings:

7.3.3/3 Possible alarms

NOTE

Depending on the selection of the „Reaction system“ parameter, production is stopped or not in case of an alarm!

Below you will find an overview of all possible alarms:

Alarm acknowledgement if alarm cause persists

If an alarm is acknowledged whose cause has not been eliminated, then the alarm appears again when the delay time assigned to the alarm reason assigned to the alarm reason has expired.

7.4 Parameter

In order to ensure a sensible control process, the control parameters must be set correctly at the time of delivery from the factory. During commissioning or maintenance, the technician can use the following table to check whether the settings are correct and, if necessary, correct them or adapt them to a local situation that has changed in the meantime.

Settings	Submenu	Submenu	Submenu	Default value	Set value
Input >>	Input valve >>	Contact type		active=powered / active=not energized	
	Pressure switch >>	Contact type		occupied=active / not occupied=active	
		Alarm >>	Delay	0 s	
			Priority	20	
			React. Message	Alarm / Warning / Info / none	
			React. System	Fix Shutdown / Shutdown. / N. Shutdown.	
	max. restart			3	
	Delay. Pressure build-up			60 s	
	Retry time			120 s	
	UO pump >>	Contact type		active=powered / active=not powered	
Concentrate >>	Confi tion >>	Concentrate valve		present / n.present	
	Concentrate valve >>*	Contact type		active=powered / active=not powered	
Permeate >>	Conductivity sensor >>	Cell constant		0,2	
		Limits >>	Alarm selection	1 1 1 1	
			Min(Alarm)	1 µS/cm	
			Min(Warn)	2 µS/cm	
			Max(Warn)	23 µS/cm	
			Max(Alarm)	25 µS/cm	
			Hyst. Warn.	1 µS/cm	
			Prio. Warn.	50	
			Verz. Warn.	320 s	
			Hyst. Alarm	1 µS/cm	
			Prio. Alarm	20	
			Verz. Alarm	320 s	
			React. System	Do not switch off / Shut down	

Settings	Submenu	Submenu	Submenu	Default value	Set value
	Temperature sensor >>	Sensor type	not editable!	Display of the detected sensor type	
		Limits >>	Alarm selection	1 1 1 1	
			Min(Alarm)	2 °C	
			Min(Warning)	5 °C	
			Min(Warning)	30 °C	
				40 °C	
			Hyst. Warn.	1 °C	
			Prio. Warn.	50	
			Verz. Warn.	20 S	
			Hyst. Alarm	1 °C	
			Prio. Alarm	20	
			Verz. Alarm	20 S	
			React. System		
	Permeate-Tank >>	Sensor type		Digital / Analog	
		Area	**	**4…20 mA** / 0…20 mA	
		Current value tank empty	**	19,00 mA	
		Current value tank full	**	19,99 mA	
		Tank full***	***	**occupied=active / not occupied=active**	
		Tank type		**without overflow / with overflow**	
		Debouncing sensor	***	3 S	
		Alarm tank full >>	Delay	0 S	
			Priority	20	
			React. Message	Alarm / Warning / Info / None	
			React. System	Fix Shutdown / Shutdown / N. Shutdown.	

Settings	Submenu	Submenu	Submenu	Default value	Adjusted value
	Forced stop >>	Contact type		**occupied=active / not occupied=active**	
		Alarm >>	Delay	5 s	
			Priority	20	
			React. Message	**Alarm / Warning / Info / None**	
			React. System	**Fix Shutdown / Shutdown / N. Shutdown.**	
	Parameter >>	Pause production		300 s	
		Flush interval		24 h	
		Displacement time		30 s	
		Condemnation time		5 s	
	Rolling >>	Rolling time		4 s	
	Maintenance >>	Maintenance before			
		Maintenance done? >>	Execute = Enter!	Resetting the maintenance timer	
		Maintenance (Warn)		1400 h	
		Maintenance (alarm)		1500 h	
		Priority		0	
		React. System		Shutdown / N. Shutdown	

*Entry appears only for concentrate valve=present

**Entry appears only for tank sensor type Analogue

*** Entry appears only for tank sensor type Digital

8. Fault elimination

8.1 General information

By using high-quality individual components and due to the built-in safety and monitoring devices, a very high degree of operational reliability is achieved.

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

If serious malfunctions occur, please contact the manufacturer (see nameplate).

WARNING!

Fault elimination may only be carried out by qualified and instructed personnel in compliance with the safety regulations in chapter A of this operating manual!

Before starting work, the system must be disconnected from the power supply and secured against being switched on again unintentionally!

All lines must be de-pressurised.

8.1.1 Fault reporting to the manufacturer

To ensure effective troubleshooting, please have the following information ready:

- Order number (if available)
- Item number (if available)
- System type
- Operations logs and maintenance logs (if available) from the last year

8.1.2 Fault indication and reset

- Fault message alarm as red display
- For resetting alarm messages on the control panel, please refer to the corresponding section in chapter 7 - Control panel!

8.2 Fault analysis and elimination
8.3 Flushing the concentrate

When flushing the concentrate, the concentrate side of the membrane(s) is flushed at a higher

NOTE

Please read the following table containing possible malfunctions before contacting the manufacturer’s service department!

Fault/message	Possible causes	Remedy
Display unlit	Mains supply interrupted	Establish mains supply
	230VAC/6.3 AT fuse defective	Replace fuse concerned
	Controller defective	Replace controller
Alarm display Forced stop	Residual hardness sensor triggered (if present)	■ Check soft water quality ■ Check sensor and replace it, if required
Display shows “Low inlet pressure” although manometer shows inlet pressure in the permissible range	Feed water pressure too low	■ Check pressure differential at the softener ■ Check feed water pressure
	Filter F-01 blocked	Replace filter cartridge
	Pressure switch PS-1 defective	Replace pressure switch
	Inlet valve K-1 defective	Replace valve
Display shows “LF Perm” too high	Feed water conductivity too high → Desalination rate too low	Calculate desalination rate Target: > 97% Quick fix: Perform a flushing of concentrate, see below. After consultation with the manufacturer: ■ Clean membrane modules ■ Replace membrane modules
System does not go into production (HP pump does not run)	“Tank FULL” is displayed although permeate tank is empty	Level sensor (level switch or alternative pressure switch) defective
	Display shows “Production ON”, yet no permeate is being produced	Pump defective
Permeate output too low	Feed water temperature too low	Calculate permeate output according to chapter A
	Permeate back pressure too high	Check permeate line for height, constrictions and shut-off device
	Modules blocked	After consultation with the manufacturer: ■ Clean modules ■ Replace modules
	Pump makes grinding noises	Replace pump
Message (yellow display) Warning maintenance coming soon	Time for maintenance warning reached	Request maintenance from the manufacturer
Message (red display) Alarm Maintenance required	Time for maintenance alarm reached	Perform maintenance at short notice
Display with incomprehensible, previously unknown content → System message	Initialisation error	Notify manufacturer

speed due to the increase in the concentrate volume flow and, due to the associated increase in shear forces, easily detachable deposits are removed and flushed out.

Flushing the concentrate should last at least 60 minutes and should be carried out as follows:

- Log the actual values (enter in operations log according to chapter 9.2.2)
- Open the concentrate control valve completely or remove the concentrate screen (depending on the type of system).
- Fully open the pressure control valve (if present)
- Flush for a min. of 60 minutes
- Readjust the operating parameters to the set points
- Wait 10 minutes
- Log the actual values again (enter in operations log according to chapter H)

NOTE

If the permeate conductivity does not improve permanently after concentrate flushing, the membranes should 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 technicians.

Before carrying out any repair or maintenance work, the system must be shut down and secured against being accidentally put into operation.

WARNING!

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

Suitable protective clothing appropriate to the hazard must be worn during the maintenance work.

Immediately after completion of the maintenance work, all safety and protective devices must be refitted or put into operation.

9.1.2 General information

NOTE

In order to ensure the proper operation and function of the system 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 system 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 on 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 systems:

Parameter	Measuring point / remarks
Operating hours of the RO system	Display/menu of the control panel
Residual hardness in the feed water	Check with hardness test kit in feed water
Conductivity of feed water	Checking with hand-held conductivity meter
Temperature of feed water	Checking with hand-held conductivity meter
Fine filter inlet pressure (if present)	Manometer for fine filter inlet pressure
Fine filter outlet pressure (if present)	Manometer for fine filter outlet pressure
HP pump pressure (if present)	Manometer directly after HP pump
Operating pressure	Manometer after HP pump throttle device
Concentrate pressure (if present)	Manometer for concentrate after module
Differential pressure Operating pressure — Concentrate pressure	Δp = calculate from the read values
Permeate output	Permeate flow meter
Concentrate output	Concentrate flow meter
Concentrate recirculation (if present)	Concentrate recirculation flow meter
Permeate conductivity	Display of the control panel
Permeate temperature	Display of the control panel or measure in a sample with a hand-held conductivity meter
Desalination rate of the RO system	Calculation see chapter A
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 concentrate flush should be carried out in accordance with section 8.3.

9.2.2 Operations log for reverse osmosis systems

Customer:_____
System 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 the feed water	°d						
Conductivity of feed water	µS/cm						
Temperature of feed water	°C						
Fine filter inlet pressure (if present)	bar						
Fine filter outlet pressure (if present)	bar						
HP pump pressure (if present)	bar						
Operating pressure	bar						
Concentrate pressure (if present)	bar						
Differential pressure Operating pressure — Concentrate pressure	bar						
Permeate output	l/h						
Concentrate output	l/h						
Concentrate recirculation (if present)	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 globally after 4000 operating hours (a 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 time or described situation”)!

9.3.1 Maintenance plan for reverse osmosis systems

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

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:

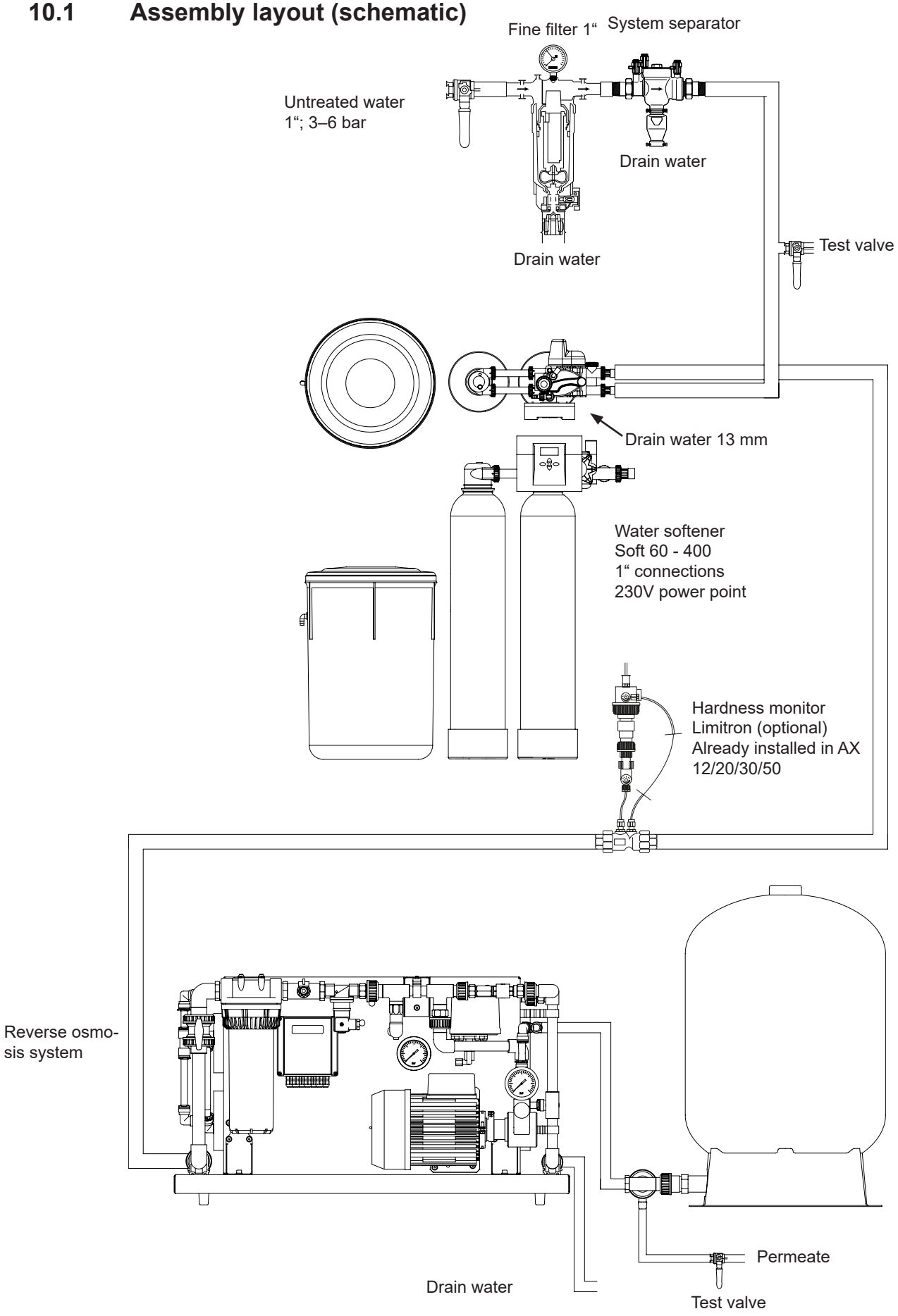
Plant section	work to be performed	At the latest after operating time or described. Situation
Fine filter	Replace filter cartridges * and Clean * filter housing	■ 2 months ■ at pressure drop of 0.5 bar
Pressure switch	Function test by shutting off the feed water inlet. →HD pump must switch off	■ 6 months
Sensor hardness control device * (if present)	Replace the sensor with a reactivated or Replace new sensor	■ 12 months respectively ■ After triggering the sensor
LF measuring cell(s)	LF check with handheld LF meter as reference instrument, Recalibration if required	■ during commissioning ■ 12 months ■ when changing the Feed water quality
Filter mat * for Control cabinet fan (if present)	Check degree of contamination and clean if necessary	■ 1 month
	Replace filter mat	■ 6 months
Rotary vane pump *, 230V/ 0,25 kW and 0,55kW (if available)	Pump replacement	■ 8000 operating hours
UO membranes *	Replacement of the membranes	■ 3 years or ■ if desalination rate and permeate capacity by more than 15% compared to the commissioning values have dropped.

Control parameters	■ Conductivity permeate (QI 1) ■ Working pressure (PI 1) ■ Total hardness feed water ■ Temperature feed water ■ pH value ■ Conductivity feed water ■ Free chlorine ■ Dissolved iron ■ Blocking index SDI	■ daily ■ daily ■ weekly ■ weekly ■ monthly ■ According to demand ■ monthly ■ According to demand ■ According to demand
Parameter setting	Control and correction of the set operating parameters	■ According to demand

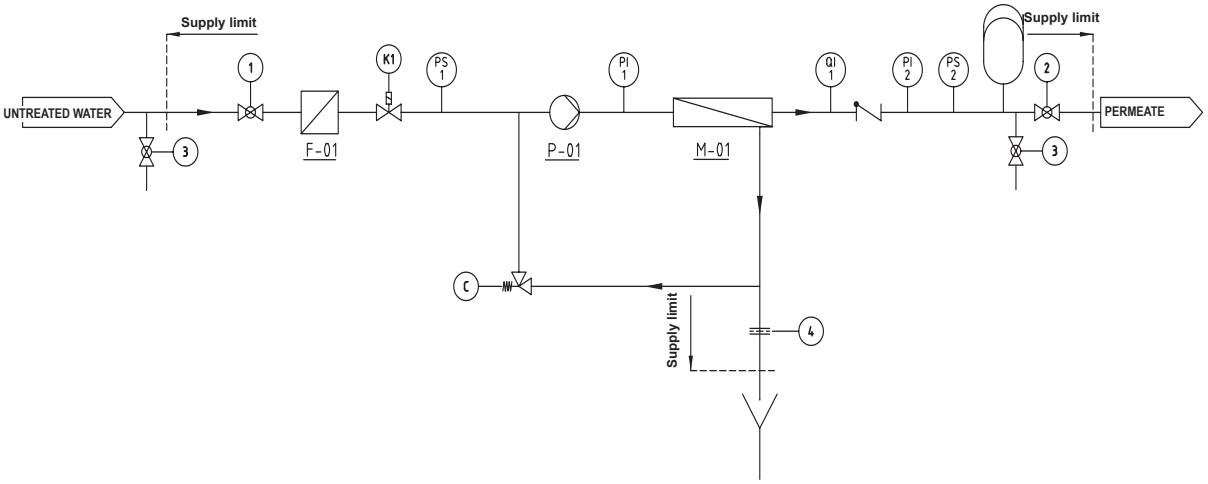
* wear part

10. Appendix

10.1 Assembly layout (schematic)



10.2 P&I diagram



MSR units and actuators

MSR point list

PI 1 Local display of pump pressure and working pressure
PI 2 Local display of permeate pressure
PS 1 Pressure switch to signal pressure loss in intake
PS 2 Pressure switch to signal pressure in permeate
QI 1 Conductivity measurement/signalling

Actuators

1 Shut-off valve for untreated water, manually actuated
2 Shut-off valve for permeate, manually actuated
3 Sampling valve for untreated water, manually actuated
K 1 Automatic valve on intake, controlled by RO controller
3 Sampling valve for permeate, manually actuated
4 Concentrate screen, factory setting
(determines the volume of concentrate drained)
C Pressure control valve, overflow valve
(sets the circulation volume)

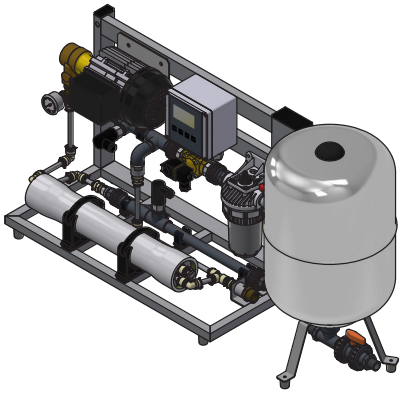
10.3 Dimensions

AX 02

Connections:

A = Input (G ½“ in)
B = Permeat (G ½“ out)
C = Drain water (G ½“ out)
D = Connection (flexible hose ½“)

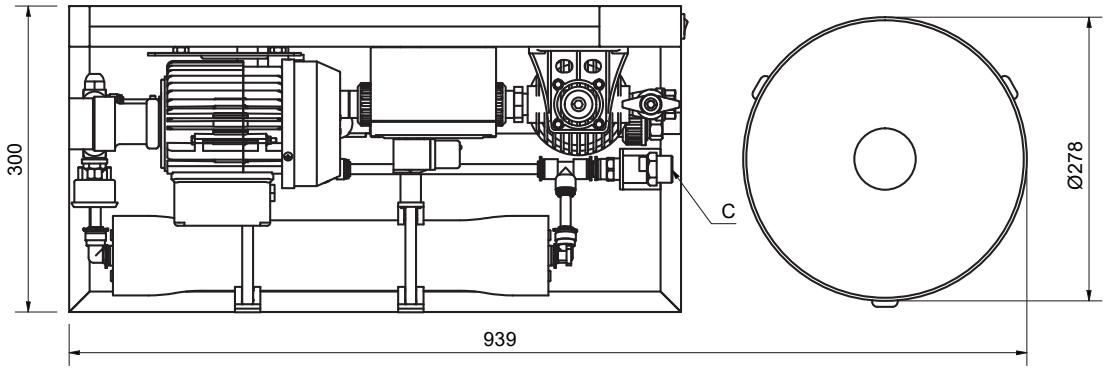
Side view



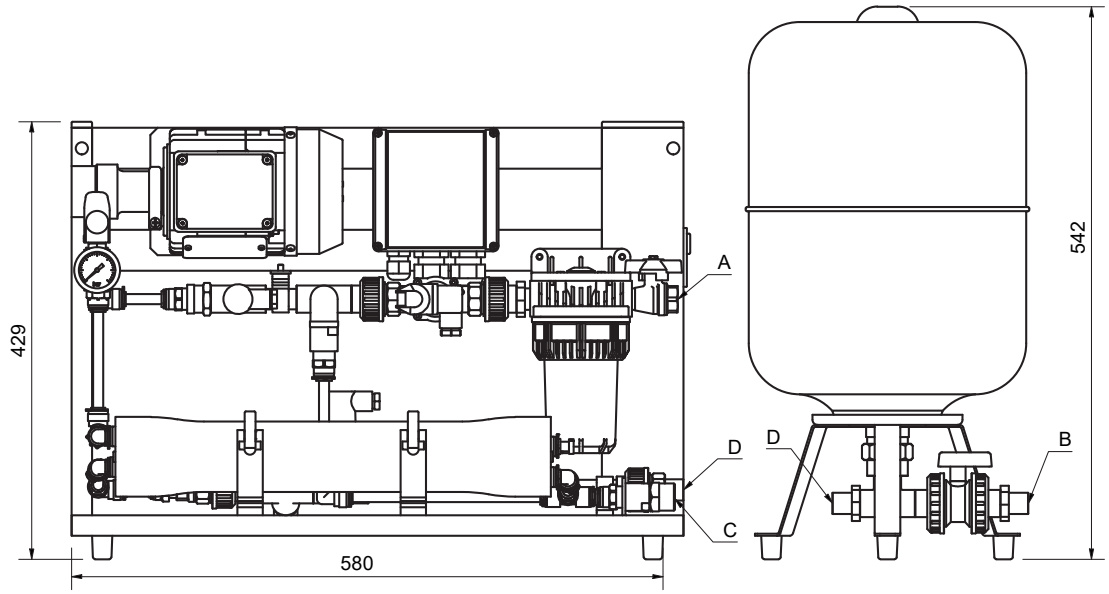
Electrical connection:

230V / 50Hz

Top view



Front view



10.4 Dimensions

AX 05, 12 and 20

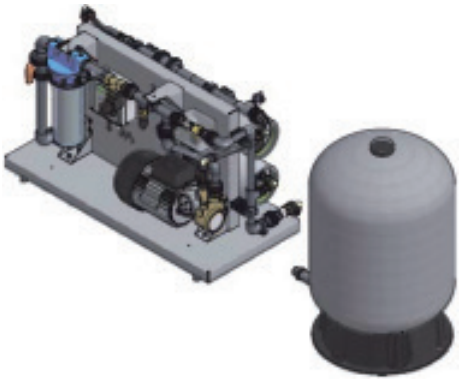
Connections:

A = Untreated water (PVC Ø 25 mm)
B = Permeate (PVC Ø 20 mm)
C = Drain water (hose sleeve Ø 16 mm)
D = Permeate connection (flexible hose)

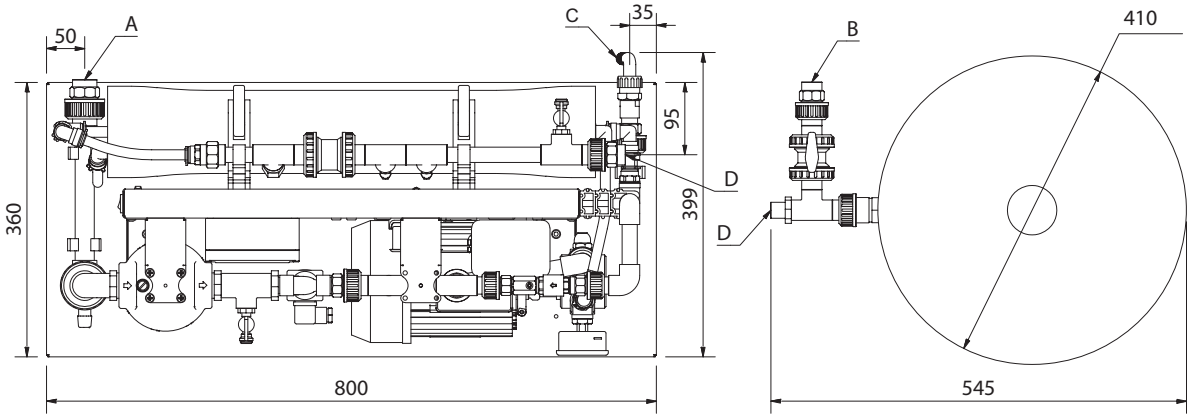
Electrical connection:

230V / 50Hz

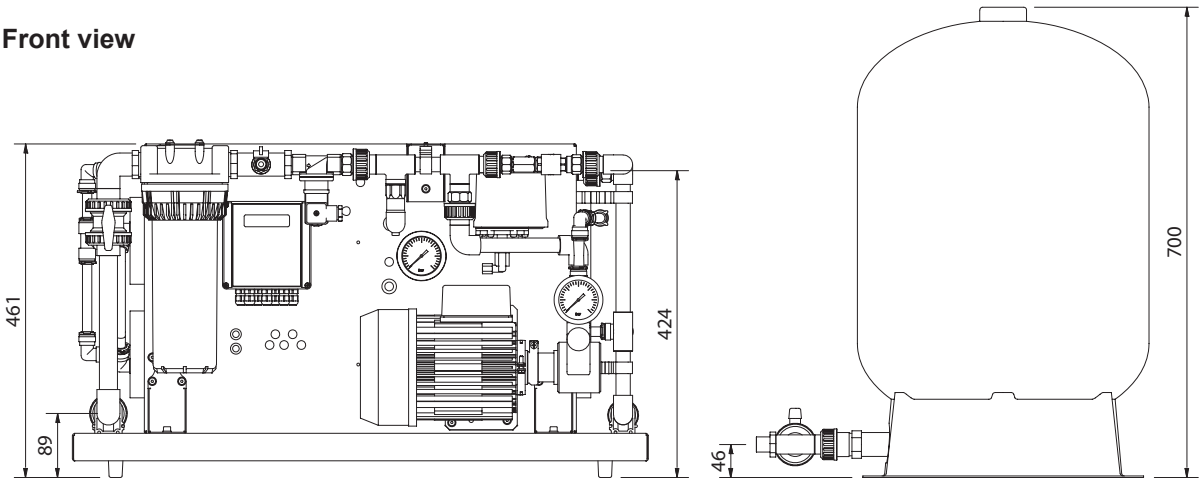
Side view



Top view



Front view



10.5 Dimensions

AX 30 and 50

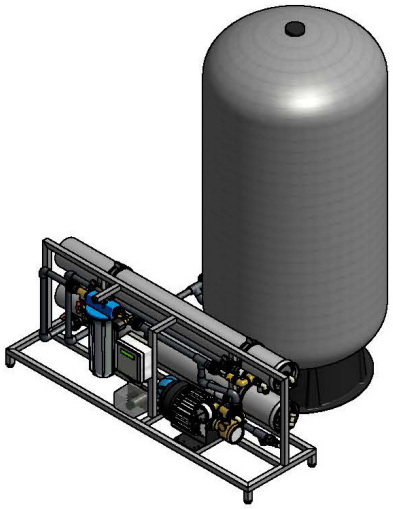
Connections:

A = Untreated water (PVC Ø 25 mm)
B = Permeate (PVC Ø 20 mm)
C = Drain water (hose sleeve Ø 16 mm)

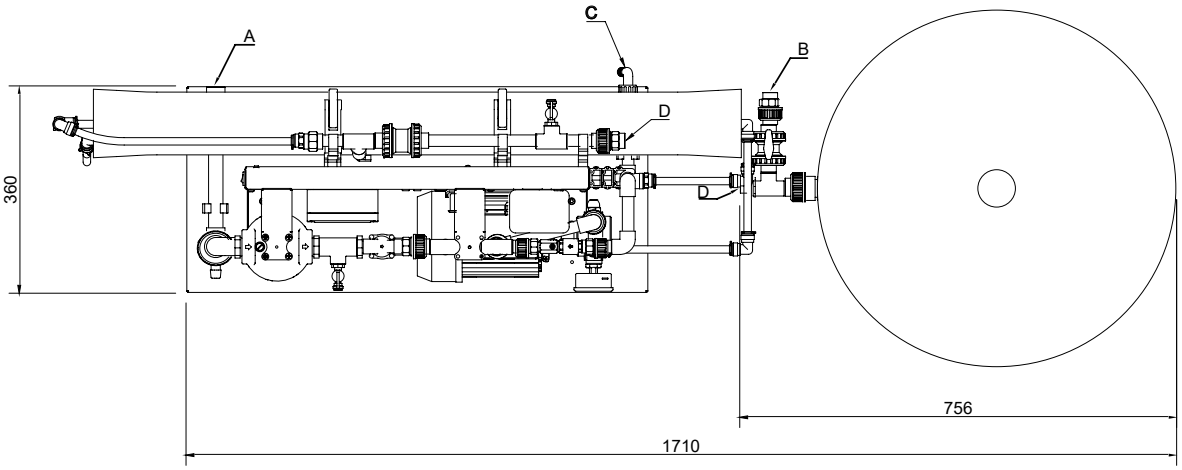
Electrical connection:

230V / 50Hz

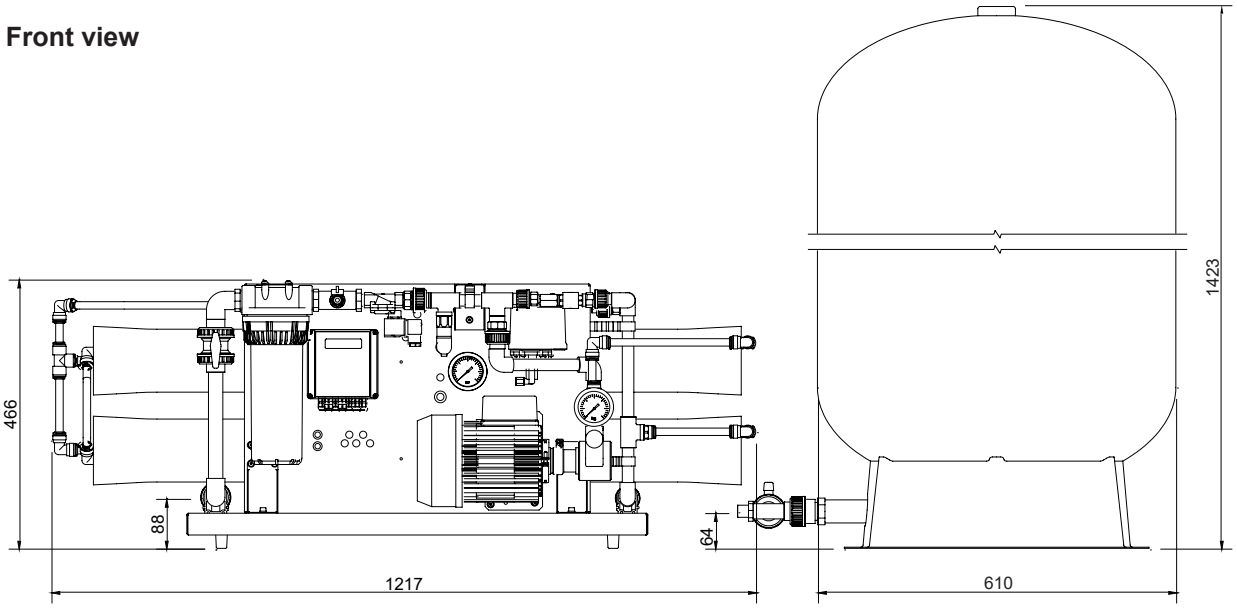
Side view



Top view



Front view



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