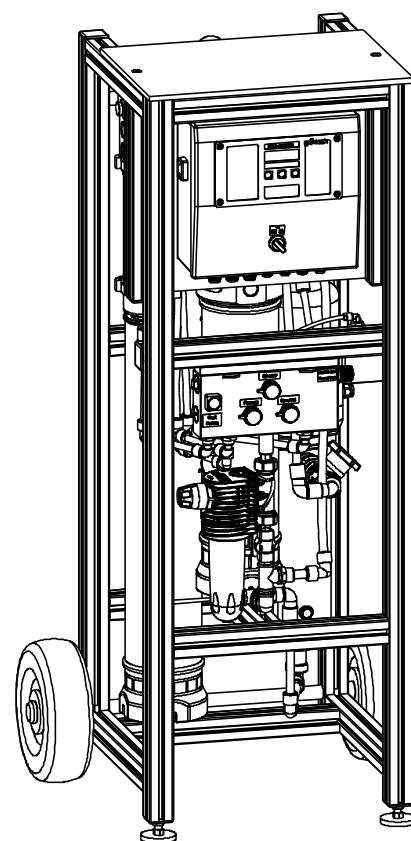


Operation Manual

Mobile reverse osmosis system

AVRO-flex 400

Starting from software version V1.33



Edition July 2020
Order no. 752 946-inter_105

Grünbeck Wasseraufbereitung GmbH

Josef-Grünbeck-Str. 1 · 89420 Hoehstaedt
GERMANY

+49 9074 41-0 · +49 9074 41-100

www.gruenbeck.com · info@gruenbeck.com



A company certified by TÜV SÜD
in accordance with DIN EN ISO 9001,
DIN EN ISO 14001 and SCC

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Responsible for contents:

Grünbeck Wasseraufbereitung GmbH

Josef-Grünbeck-Str. 1 • 89420 Hoechstädt/Germany

Tel. +49 9074 41-0 • Fax +49 9074 41-100

www.gruenbeck.com • service@gruenbeck.com

Print: Grünbeck Wasseraufbereitung GmbH

Josef-Grünbeck-Str. 1, 89420 Hoechstädt/Germany

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**EU Declaration of Conformity**

This is to certify that the system designated below meets the safety and health requirements of the applicable European guidelines in terms of its design, construction and execution.

If the system is modified in a way not approved by us, this certificate is void.

Manufacturer: Grünbeck Wasseraufbereitung GmbH
Josef-Grünbeck-Str. 1
89420 Hoechstädt/Germany

Responsible for documentation: Markus Pöpperl

System designation: Mobile reverse osmosis system

System type: AVRO-flex 400

Serial no.: Refer to type designation plate

Applicable directives: Machinery Directive (2006/42/EU)
EMC (2014/30/EU)

Applied harmonised standards,
in particular: DIN EN ISO 12100:2011-03,
DIN EN 61000-6-2:2006-03
DIN EN 61000-6-3:2011-09

Applied national standards
and technical specifications,
in particular:

Place, date and signature: Hoechstädt, 30.04.2018

i. V.

M. Pöpperl

Dipl. Ing. (FH)

Function of signatory: Head of Technical Product Design

A General

1 | Preface

Thank you for opting for a Grünbeck product. Backed by decades of experience in the area of water treatment, we provide customised solutions for all kind of processes.

Drinking water is classified as food and requires particular care. Therefore, always ensure the required hygiene when operating and maintaining systems involved in the drinking water supply. This also applies to the treatment of water for industrial use if repercussions for the drinking water cannot completely be excluded.

All Grünbeck systems and devices are made of high-quality materials. This ensures reliable operation over many years, provided you treat your water treatment systems with the required care. This operation manual assists you with important information. Therefore, please read the entire operation manual before installing, operating or maintaining the system.

Customer satisfaction is our prime objective and providing customers with qualified advice is crucial. If you have any questions concerning this system, possible extensions or general water and waste water treatment, our field staff, as well as the experts at our headquarters in Hoechststedt, are available to help you.

Advice and assistance For advice and assistance please contact your local representative (see www.gruenbeck.com) In case of emergency, please get in touch with our service hotline at +49 9074 41-444.

We can connect you with the appropriate expert more quickly if you provide the required system data. In order to have the required data handy at all times, please keep the system data (see type plate in chapter C) handy.

2 | How to use this operation manual

This operation manual is intended for the operators of our systems. It is divided into several chapters which are listed in the “Table of contents” on page 2 in alphabetical order. In order to find the specific information you are looking for, check for the corresponding chapter on page 2.

The headers and page numbers with chapter information make it easier to find your way around in the manual.

3 | General safety information

3.1 Symbols and notes Important information in this operation manual is characterised by symbols. Please pay particular attention to this information to ensure the hazard-free, safe and efficient handling of the system.



Danger! Failure to adhere to this information will cause serious or life-threatening injuries, extensive damage to property or inadmissible contamination of the drinking water.



Warning! Failure to adhere to this information may cause injuries, damage to property or contamination of the drinking water.



Attention! Failure to adhere to this information may result in damage to the system or other objects.



Note: This symbol characterises information and tips to make your work easier.



Tasks with this symbol may only be performed by Grünbeck's technical service/authorised service company or by persons expressly authorised by Grünbeck.



Tasks with this symbol may only be performed by trained and qualified electrical experts according to the VDE guidelines or according to the guidelines of a similar local institution.



Tasks with this symbol may only be performed by the local water supply companies or approved installation companies. In Germany, the installation company must be registered in an installation directory of a water company as per §12(2) AVBWasserV (German Ordinance on General Conditions for the Supply of Water).

3.2 Operating personnel

Only persons who have read and understood this operation manual are permitted to work with the system. The safety information in particular is to be strictly adhered to.

3.3 Intended use

The system may only be used for the purpose outlined in the product description (Chapter C). The instructions in this operation manual as well as the applicable local guidelines concerning drinking water protection, accident prevention and occupational safety must be adhered to.

In addition, intended use also implies that the system may only be operated when it is in proper working order. Any malfunctions must be repaired at once.

3.4 Protection from water damage



Warning! In order to properly protect the installation site from water damage:

- a. a sufficient floor drain system must be available or
- b. a safety device (refer to Chapter C "Optional accessories") must be installed.



Warning! Floor drains with discharge to a lifting system do not work in case of a power failure.

3.5 Indication of specific hazards

Danger due to electrical energy! → Do not touch electrical parts with wet hands! Unplug the mains plug before starting work on electrical parts of the system. Have qualified experts replace damaged cables immediately.

Danger due to mechanical energy! System parts may be subject to overpressure. Danger of injury and damage to property due to escaping water and unexpected movement of system parts. → Check pressure pipes regularly. Depressurise the system before starting repair or maintenance work on the system.

Hazardous to health due to contaminated drinking water! → The system may only be installed by a specialist company. The operation manual must be strictly adhered to! Ensure that there is sufficient flow. The pertinent guidelines must be followed for start-up after extended periods of standstill. Inspections and maintenance must be performed at the intervals specified!



Note: By concluding a maintenance contract, you ensure that all of the required tasks are performed on time. You may perform the interim inspections yourself.

4 | Shipping and storage



Attention! The system may be damaged by frost or high temperatures. In order to avoid damage of this kind:

Protect from frost during transportation and storage!

Do not install or store system next to objects which radiate a lot of heat.

5 | Disposal

Comply with the applicable national regulations.

5.1 Packaging

Dispose of the packaging in an environmentally sound manner.

5.2 Product



If this symbol (crossed out waste bin) is on the product, European Directive 2012/19/EU applies to this product. This means that this product and the electrical and electronic components must not be disposed of as household waste.

Dispose of electrical and electronic products or components in an environmentally sound manner.



For information on collection points for your product, contact your municipality, the public waste management authority, an authorised body for the disposal of electrical and electronic products or your waste collection service.

B Basic information

1 | Laws, regulations, standards

In the interest of good health, rules cannot be ignored when it comes to the processing of drinking water. This operation manual takes into consideration the current regulations and stipulates information that you will need for the safe operation of your water treatment system.

Among other things, the regulations stipulate that

only approved companies are permitted to make major modifications to water supply facilities

and that tests, inspections and maintenance on installed devices are to be performed at regular intervals.

2 | Water

There is no chemically pure water in nature. Even in the atmosphere, rain water absorbs various substances that change the properties of the water to a greater or lesser degree. This process continues as the water passes through the ground layers, with the result that the water is enriched with increasingly large quantities of materials. Carbon dioxide (CO₂) is particularly important here, since this substance increases the dissolving capability of the water even more. Consequently, drinking water contains quantities of dissolved sodium, potassium, calcium, magnesium, iron, manganese, copper, zinc, chlorides, fluorides, sulphates and also nitrates, nitrites, phosphates and silicates that vary greatly from location to location.

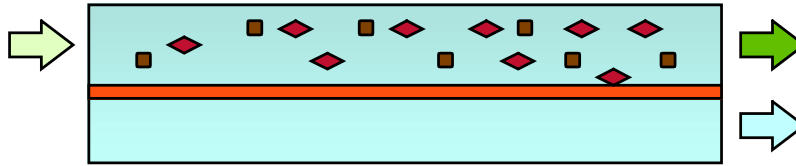
Due to dynamic substance and water cycles, harmful elements, which are only partly and only slowly biodegradable are increasingly released into nature. Over time, these elements therefore accumulate in ground and surface water. Removing them from natural water bodies again represents a particular challenge. Grünbeck rises to this challenge and aims at generating unpolluted drinking and industrial water.

The water works provide us with pure drinking water that is suitable for consumption. However, if the water is to be used for technical purposes, further treatment is frequently required.

3 | Functional principle of reverse osmosis

Principle:

Pretreated feed water



Concentrate:

Permeate

Fig. B-1: Functional principle

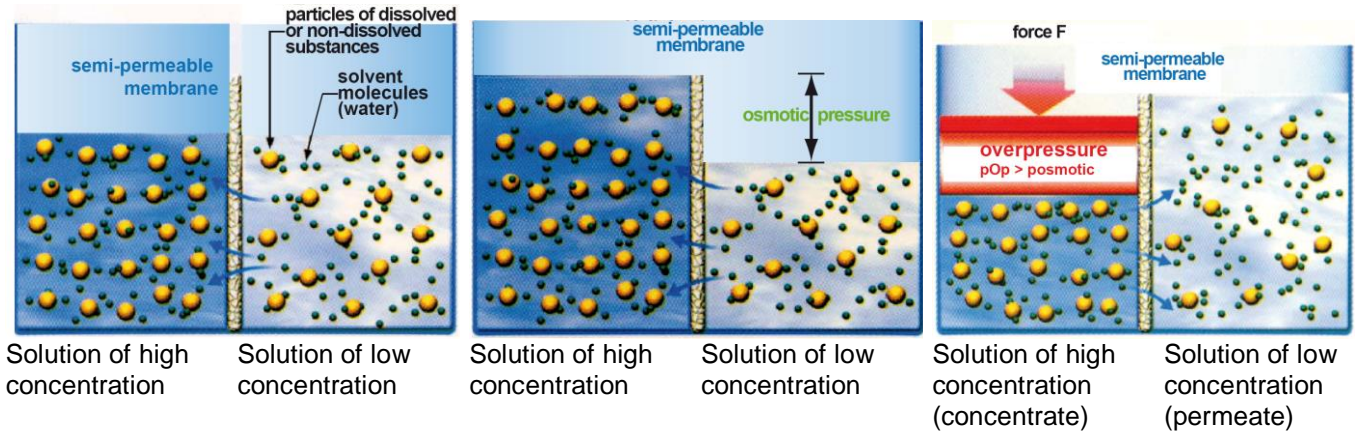


Fig. B-2: Reverse osmosis principle

In the osmosis process, watery solutions of different concentrations are separated by a semi-permeable membrane. In keeping with the law of nature, the concentrations try to equalise. On the side of the higher original concentration, the so-called "osmotic" pressure is generated. In case of reverse osmosis, this osmotic pressure is countered by a higher pressure. The consequence: the process proceeds in the reverse direction. A particular advantage of the reverse osmosis technology compared to other water treatment processes is the fact that - apart from the removal of dissolved salts - bacteria, germs, particles and dissolved organic substances are also reduced.

3.1 Functional principle of the AVRO system

AVRO is an alternative anti-scaling process to the common traditional processes of "softening" or "antiscalant dosing". Contrary to these processes, AVRO does not require any addition of auxiliary additives. The chemical composition of the generated concentrate is not modified. There is only a doubling of the concentration (standard recovery 50 %).

Hydraulically, the AVRO is installed in the concentrate pipe downstream of the membrane.

The treatment unit consists of two inert special electrodes to which a low current is applied. Seed crystals (calcium carbonate) are generated at the cathode and are permanently directed via the concentrate recirculation. The salts of the supersaturated concentrate continue to grow on these seed crystals, and they are finally washed out to the drain with the residual concentrate flow. This reliably prevents scaling (deposits of insoluble salts on the membrane). Some of the calcium carbonate remains on the cathode of the AVRO and due to increasing electrical resistance, limits the service life of the AVRO treatment unit to 3000 operating hours (permeate production) or 5 years.

C Product description

1 | Type designation plate

You may find the type designation plate at the housing of the mobile reverse osmosis system AVRO-flex 400. In order to speed up the processing of your inquiries or orders, please specify the data shown on the type designation plate of your system when contacting Grünbeck. Please copy the indicated information to the table below in order to have it handy whenever necessary.

Mobile reverse osmosis system AVRO-flex 400

Serial number:

Order number:

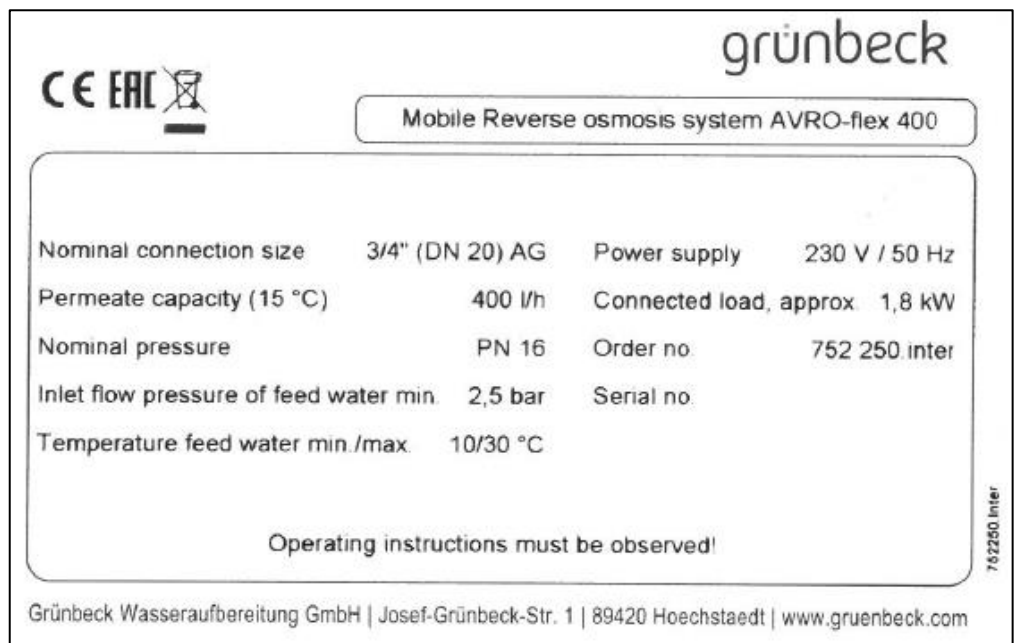


Fig. C-1: Type designation plate

2 | Functional description

Via a fine filter (filter element), the water is directed to the inlet of the feed water section. The water flows to the high-pressure pump via the inlet solenoid valve with a downstream "pressure switch for minimum pressure". By means of a control valve, the pressure generated by the high-pressure pump is reduced to the required operating pressure and the water is directed to the membrane. The membrane separates the water into the partial flows permeate and concentrate. A partial flow of the concentrate is returned to the feed water via an orifice regulating independently of pressure and thus ensures a steady flow over the membrane and increases the economic efficiency of the reverse osmosis.

At the same time, the concentrate volume flow is run via an AVRO treatment module where seed crystals are formed at a cathode due to the application of direct current. These seed crystals are then washed out with the residual concentrate and thus the reverse osmosis membrane is protected from clogging. Whenever the system is switched off or in case of disturbances, the substances retained on the membrane are flushed off by means of the inlet solenoid valve and a solenoid valve switched in parallel to the control valve for concentrate.

The hydraulic set-up of the system is designed in a way that the concentrate volume and the permeate volume are registered by means of flow sensors and are displayed in the control unit. The system recovery can also be called up in the control unit.

Downstream of the membrane, the permeate produced can be delivered into the heating system with a counter-pressure of up to 3.5 bar.



Note: If the counter-pressure on the permeate side increases, the permeate output decreases.

Filling mode:

If "filling mode" is selected via the selector switch on the controller, three waves are visible in the controller. The pressure switch is interrogated as the start criterion.

Workshop mode:

If "workshop mode" is selected via the selector switch on the controller, one wave is visible in the controller. Selection of the operating switch is used as the start criterion. After 24 hours, permeate is produced over time. The workshop mode prevents germs from infecting the system, thereby ensuring a constant permeate quality.

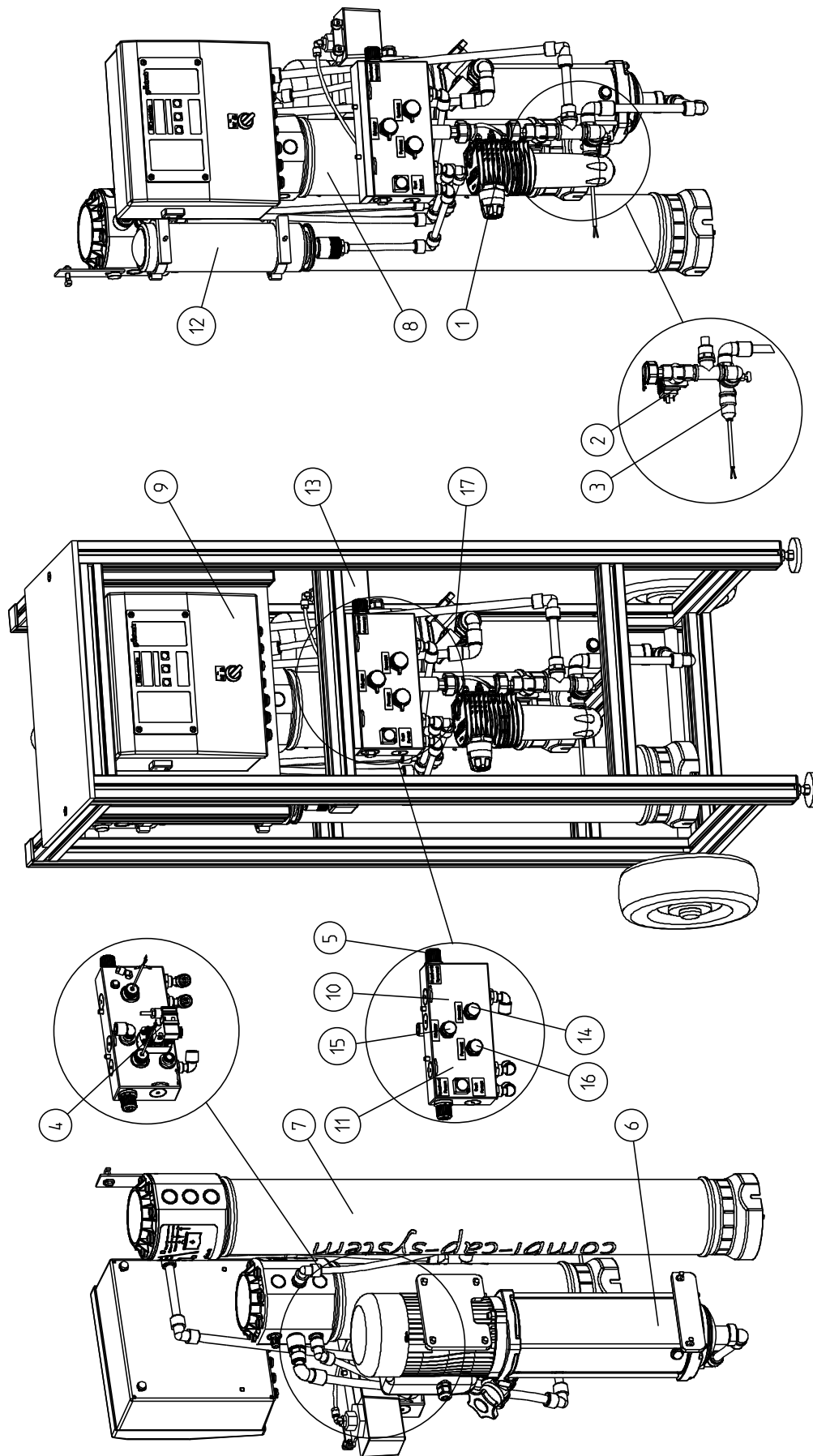


Fig. C-2: Exploded drawing of mobile reverse osmosis system AVRO-flex 400

① Fine filter incl. pressure reducer	Pressure reducer preset to 2.5 bar, incl. pressure gauge.
② Inlet solenoid valve	During the permeate production, this valve is always open. Following the system stop (tank full), the valve remains open for the programmed flushing time of the membrane. Visual indication in the control unit ⑨.
③ Pressure switch for minimum pressure of high-pressure pump.	To prevent the high-pressure pump from running dry. Switches time-delayed after the solenoid valve has opened ②. Visual indication in the control unit ⑨.
④ Flushing solenoid valve	Opens after the pressure switch "switch-off pressure" has reached the set pressure. The solenoid valve also opens in the event of system malfunctions and always in conjunction with the feed water inlet solenoid valve ②. Visual indication in the control unit ⑨.
⑤ Needle valve, concentrate	To set the feed water-dependent "concentrate" volume flow to the drain. During permeate production, this water constantly flows to the drain.
⑥ High-pressure pump	Pump unit that generates the required operating pressure for the membrane and for the filling of heating water systems.
⑦ Membrane	Reverse osmosis membrane to generate the permeate.
⑧ AVRO treatment unit	AVRO treatment unit to generate seed crystals.
⑨ Control unit	Microprocessor controller that in conjunction with the respective units, regulates the permeate production and the supply of consumers downstream.
⑩ Flow sensor, concentrate	Records the concentrate volume and sends pulses to the controller. Visual indication of the concentrate volume in the controller ⑨.
⑪ Flow sensor, permeate	Records the permeate volume and sends pulses to the controller. Visual indication of the permeate volume in the controller ⑨.
⑫ Diaphragm expansion tank	Permeate buffer to reduce the switching operations.
⑬ Pressure switch switch-off pressure	Switches the reverse osmosis on when water is required, and off again after water withdrawal ends.
⑭ Connection 3/4" (DN 20) male thread or GEKA	Concentrate to drain.
⑮ Connection 3/4" (DN 20) male thread or GEKA	Feed water.
⑯ Connection 3/4" (DN 20) male thread or GEKA	Permeate/consumer.
⑰ Control valve for operating pressure with pressure gauge	To set the operating pressure, with pressure gauge as visual indicator.

3 | Technical specifications

Table C-1: Technical specifications		Mobile reverse osmosis system AVRO-flex 400
Connection data		
Nominal connection diameter of feed water pipe		3/4" (DN 20) male thread
Nominal connection diameter of permeate outlet		3/4" (DN 20) male thread
Nominal connection diameter of concentrate outlet		3/4" (DN 20) male thread
Min. drain connection required		DN 50
Connected load, approx.	[kW]	1.8
Power supply	[V/Hz]	230/50
Protection/protection class		IP 54/I
Performance data		
Permeate output at a feed water temperature of 10 °C / 15 °C	[l/h]	340/400
Inlet flow pressure of feed water, min.	[bar]	2.5
Nominal pressure		PN 16
Salt rejection		95 - 99 %
Total salt concentration of the feed water as NaCl max.	[ppm]	1000
Concentrate volume flow (at 15 °C)	[l/h]	400 ¹⁾
Feed water volume flow (fresh water 15 °C) at a recovery of 50 %, max.	[l/h]	800
Recovery	[%]	50
Max. pressure of permeate into the heating system	[bar]	3.5
Dimensions and weights		
Dimensions (w x d x h)	[mm]	700 x 600 x 1450
Empty weight, approx.	[kg]	70
Operating weight, approx.	[kg]	80
Ambient data		
Feed water temperature, min./max.	[°C]	10/30 ²⁾
Ambient temperature, min./max.	[°C]	5/35
Order no.		752 250

¹⁾ After a water analysis, the technical service can set a higher recovery.

²⁾ If the feed water temperature is > 20 °C, special system dimensioning is required.



Note: Based on the permeate output of the reverse osmosis, a max. pressure of 3.5 bar can be reached. With increasing counter-pressure, the continuous permeate output will decrease.

4 | Intended use

The reverse osmosis system AVRO-flex 400 is designed for the demineralisation of drinking water and for the filling of heating systems / district heating networks and other systems with fully demineralised water as per the stipulations of VDI 2035, sheets 1 and 2.

If the demineralised water as per VDI 2035 is used to fill systems < 0.11°dH (0.196 °f; 0.0196 mmol/l), it may - subject to the feed water - be necessary to install a desaliQ:BA mixed bed cartridge downstream.

The continuous permeate output of the system is subject to the temperature and is defined at 15 °C. As the feed water temperature rises and falls, the permeate outputs can decrease by up to 3% per °C (falling temperature) or rise by the same amount (rising temperature).

The system is adjusted to the permeate requirements to be expected at the installation site, it is not suitable for major deviations.

The system may only be operated if all components are installed properly. Safety devices must NEVER be removed, bridged or otherwise tampered with.

Intended use of the device also implies that the information contained in this operation manual and all safety guidelines applying at the installation site be observed. Furthermore, the maintenance and inspection intervals have to be observed.

The reverse osmosis system AVRO-flex 400 is exclusively designed for use in the industrial and commercial sector.

4.1 Standstill of the system

If the system is out of operation for more than 14 days, the reverse osmosis system must be preserved by Grünbeck's technical service/ authorised service company. The maximum time, the system can remain in the preserved condition is 6 months.

In case the downtime is longer, the system must be preserved again in regular intervals by Grünbeck's technical service/authorised service company. Prior to resuming operation, the preserving agent must be flushed from the system.

5 | Application limits

With regard to the application of the mobile reverse osmosis system AVRO-flex 400, the limit values for admissible substances contained in water which are stipulated in the German Drinking Water Ordinance do represent the upper limits for the system.

- < 22° dH (39.2 °f; 3,92 mmol/l) without water analysis
- Free chlorine not detectable
- Iron < 0.10 mg/l
- Manganese < 0.05 mg/l
- Silicate < 15 mg/l
- Chlorine dioxide not detectable
- Turbidity < 1 FTU
- Colloid index < 3
- pH range 3 - 9

A water analysis is required in case of a total hardness > 22 °dH or sulphate > 500 mg/l.



Note: The permeate originating from the reverse osmosis system is not potable but requires additional treatment (blending, hardening) if it is to be used as drinking water.



Attention! In case of an admissible excess of the sulphate concentration due to geogenic conditions, the recovery with regard to the standard settings according to layout might need to be reduced.

6 | Scope of supply

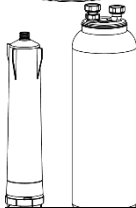
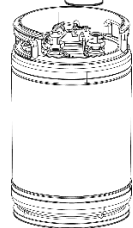
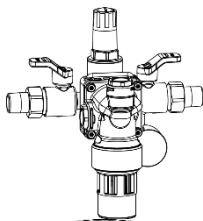
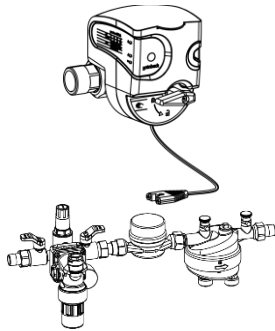
6.1 Standard equipment

- Mobile, stand-alone aluminium rack to house all aggregates and control elements.
- Microprocessor controller with LC display, voltage-free collective fault signal and voltage-free signal contact (maintenance interval, various pre-warnings), installed in a switch cabinet. Selector switch for operating modes - filling mode - workshop mode.
- Centrifugal pump made of stainless steel with motor as high pressure pump to supply the membrane, incl. control valve for operating pressure and pressure gauge.
- Adjustable pressure switch and diaphragm expansion tank to supply consumers downstream.
- Hydro distributor block for the water supply within the membrane system. Integrated valves and measuring instruments for easier system calibration.
- Fine filter with integrated pressure reducer, preset to 2.5 bar.
- Ultra-low pressure reverse osmosis membranes incl. pressure pipe.
- AVRO treatment unit, installed in a pressure pipe made of high-strength PE.
- Flow sensor to measure the volume of the system flows permeate and concentrate.
- Two pressure-resistant, metal fabric hoses and GEKA couplings.
- 3/4" double nipple for connection to a desliQ:BA mixed bed cartridge.
- Operation manual.

6.2 Optional accessories



Note: It is possible to retrofit existing systems with optional components. Please contact your local Grünbeck representative or Grünbeck's headquarters in Hoechstädt for more information.



The safety device protectliQ:A20
is a product to protect one- and two-family homes from water damage.
For more sizes, please inquire.

Order no.
126 400

Filling section thermaliQ:FB13i
For full demineralisation of water of drinking water quality for the easy and quick initial filling or make-up water feed of closed heating systems.

707 770

Filling group thermaliQ:SB13
For the protection of your drinking water according to DIN EN 1717 for the initial filling and feed of make-up water of closed heating systems.

707 750

desaliQ:BA mixed bed cartridge
Mixed bed cartridge for full demineralisation (max. 400 l/h) by means of ion exchange, installed downstream of the AVRO-flex 400.

707 450
(for larger capacities, please inquire)

desaliQ:HB4 filling cartridge 110
Full demineralisation cartridge for full demineralisation by means of ion exchange, installed downstream of the AVRO-flex 400.

707 155

Drain connection DN 50 acc. to DIN EN 1717
Connection material for DIN-compatible waste water connection DN 50

188 875

6.3 Consumables

Only use genuine consumables in order to ensure the reliable operation of the system.

	Order no.
GENO-replacement filter element with protective cylinder Packing unit: 2 pcs	103 061
Reverse osmosis membrane Packing unit: 1 pc	750 685e
AVRO treatment unit with seals Packing unit: 1 pc	720 050
Water test kit "Total hardness" Packing unit: 1 pc	170 187
Water test kit "Carbonate hardness" Packing unit: 1 pc	170 169

6.4 Wearing parts

Seals and valves are subject to a certain wear and tear. Wearing parts are listed below.



Note: Although these parts are wearing parts, we grant a limited warranty period of 6 months.

- a. Solenoid valves, control valve for concentrate, seals
- b. High-pressure pump

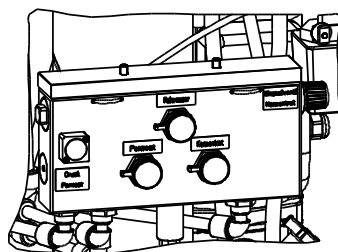


Fig. C-4: Valves

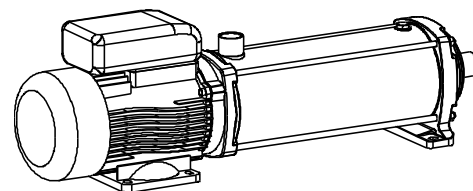


Fig. C-5: High-pressure pump

D Installation

1 | General installation instructions

The installation site must provide adequate space. A foundation of a sufficient size and adequate load carrying capacity has to be provided. The required connections must be provided prior to the installation of the system. For dimensions and connection data, please refer to table C-1.



Note: For the installation of systems with optional accessories (refer to Chapter C, item 6.3), also observe the operation manuals supplied with these components.

1.1 Water connection

Certain binding rules must always be observed when installing a mobile reverse osmosis system AVRO-flex 400. Additional recommendations are given in order to facilitate the handling of the system. The installation instructions described below are also illustrated in fig. E-2.

Binding rules



The installation of a mobile reverse osmosis system AVRO-flex 400 represents a major interference with the drinking water system. Therefore, only authorised experts may install such systems.

- Observe local installation guidelines and general regulations.
- Install a drinking water filter (e. g. pureliQ:KD) upstream of the system.
- Install a system separator upstream – not required when using a the filling section thermaliQ:FB.
- Install an activated carbon filter upstream, if required.
- Provide a drain connection (minimum DN 50) to discharge the concentrate.



Note: If the concentrate is directed to a lifting system, the delivery rate of the lifting system should at least be 800 l/h.



Warning! The installation site must have a floor drain. If no floor drain is available, an adequate safety device needs to be installed (refer to Chapter C, item 6.3 “Optional accessories”).



Warning! Floor drains that discharge to a lifting system do not work in case of a power failure.

Recommendation

If the mobile reverse osmosis system AVRO-flex 400 is not connected to the optional filling section thermaliQ:FB a sampling valve should be installed directly upstream and downstream of the mobile reverse osmosis system AVRO-flex 400. This simplifies the sampling for the regular quality control (functional check).

E Start-up



The work described below may only be performed by trained experts. We recommend having Grünbeck's technical service/authorised service company start up the system.

1 | How to connect the system to the water supply

- Connect the feed water / raw water hose to the system (refer to fig. E-1, item 3).
- Connect the permeate hose to the system and to the system to be filled (refer to fig. E-1, item 2).
- Connect the concentrate hose to the system (refer to fig. E-1, item 1). Run the hose with a gradient to the drain and connect in accordance with EN 1717 (free outlet).

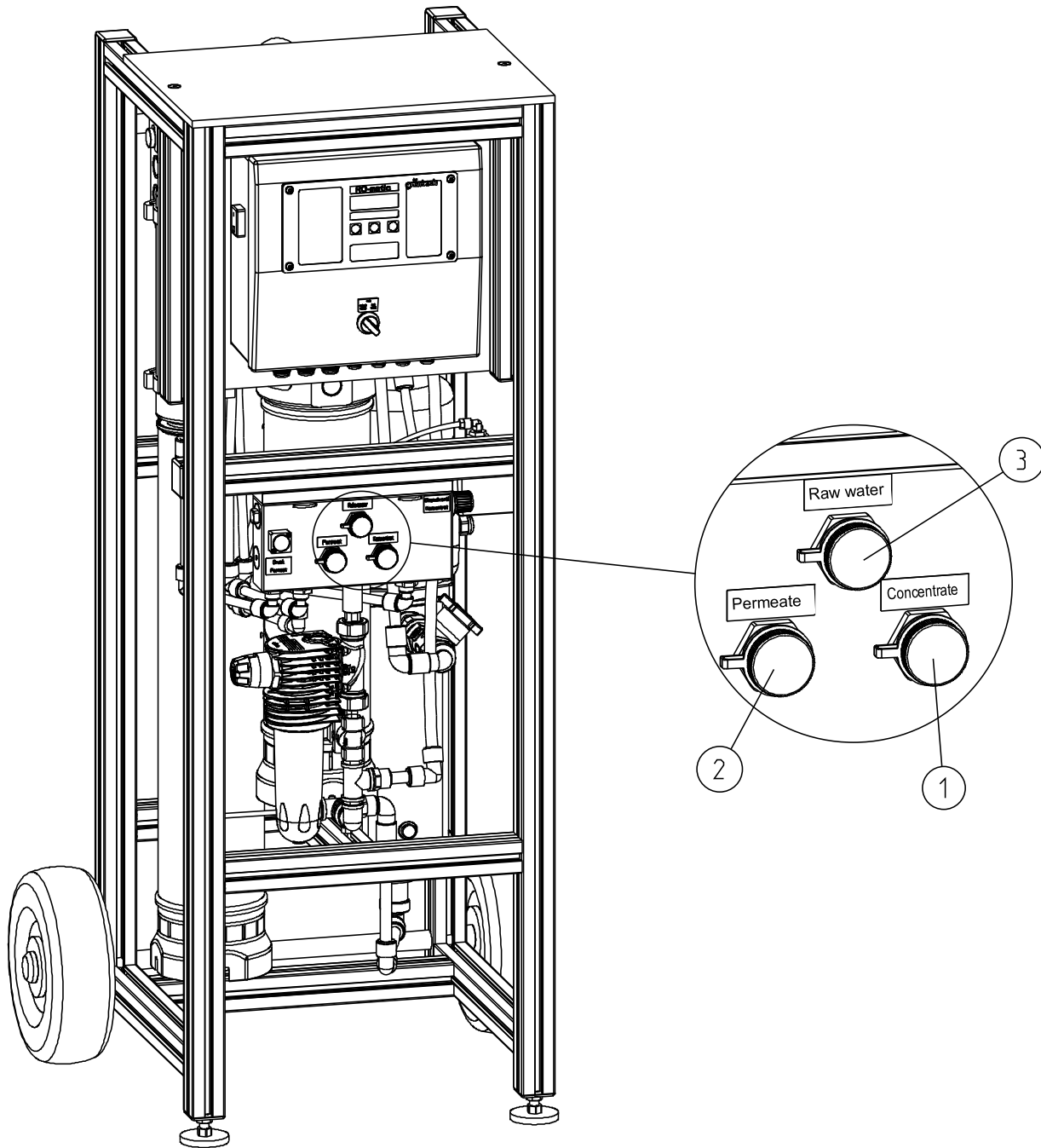


Fig. E-1: Connections of mobile reverse osmosis system AVRO-flex 400

2 | How to flush the system

For the duration of storage and transport, the membrane is protected by means of a preserving agent. This preserving agent must be flushed off before starting up the system for the first time. To do so, the concentrate hose (refer to fig. E-1, item 1) and the permeate hose (refer to fig. E-1, item 2) have to be routed to the drain.

2.1 How to flush off the preserving agent



Note: For more detailed information on the handling of the control unit, refer to Chapter F.

Switch on the mains switch and switch the operating mode selector switch to the "OFF" position.

Open both solenoid valves ("DEAERATE") via Code 113, parameter EnL: 1 and flush off the preserving agent from the system for a duration of 30 min. To do so, open parameter with P button, set ENL: 1 with ▲ button and confirm with P button.

Complete program step "DEARATE": Open parameter with P button, set EnL:0 with ▼ button and confirm with P button.

Exit the "EnL" program by simultaneously pressing the buttons ▼ and ▲.

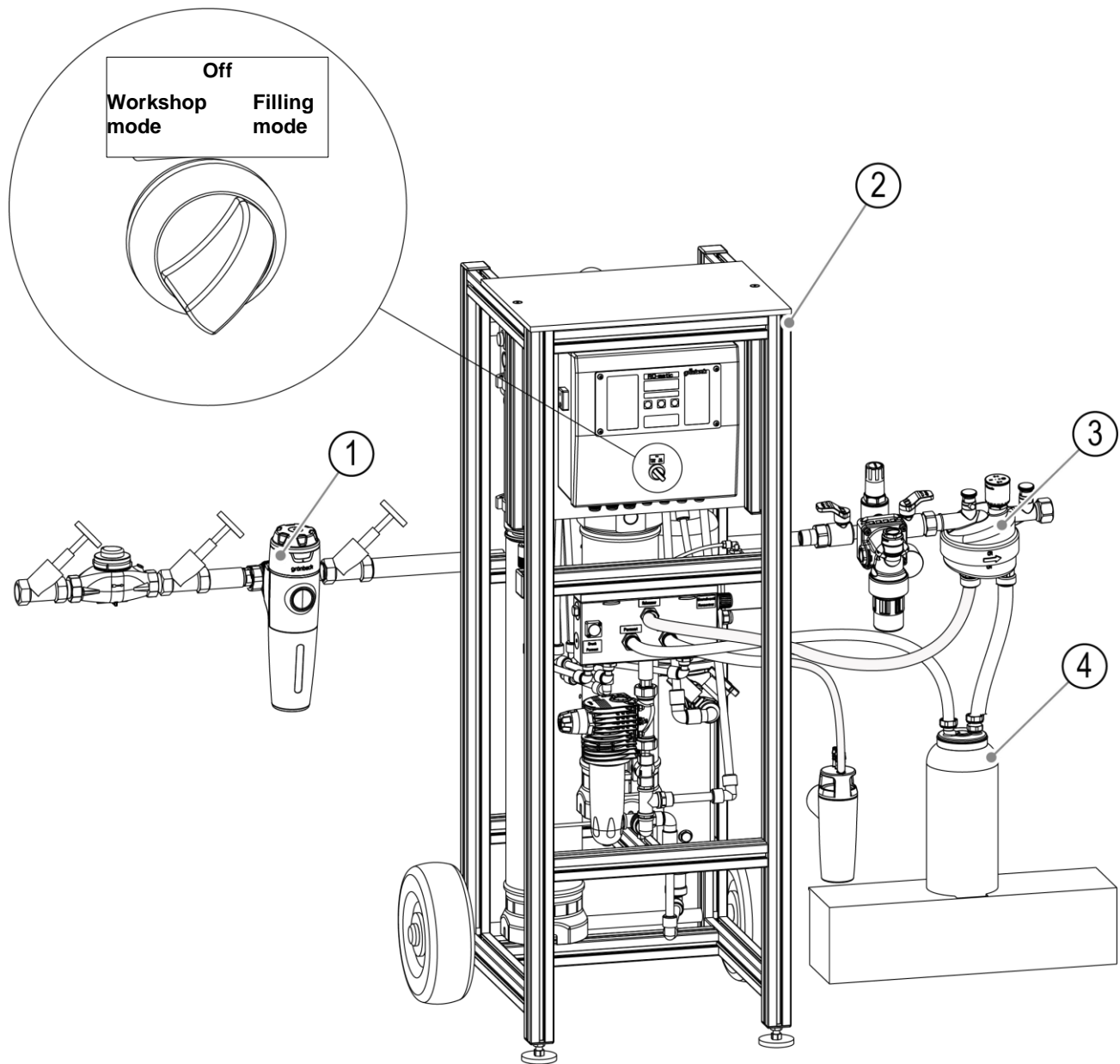
2.2 Filling mode

In filling mode (refer to fig. E-2), e.g. heating / cooling water systems, direct the hose supplied with the system from the permeate connection of the reverse osmosis system to the filling valve or to the filling section thermalIQ:FB.

The pressure switch is set to a switch-off pressure of 2.5 bar = system pressure. If a higher or lower system pressure is required, this can be set via the pressure switch (refer to fig. C-2, item 13). Then switch on the reverse osmosis system via the selector switch at the controller housing. The system produces permeate. Close the filling valve and monitor at which pressure the system switches off. Use the adjusting screws to set to the desired switch-off pressure/system pressure.



Note: Based on the permeate output of the reverse osmosis, a max. pressure of 3.5 bar can be reached. With an increasing counter-pressure, the continuous permeate output will decrease.



- ① Drinking water filter pureliQ KD (option)
- ② Mobile reverse osmosis system AVRO-flex
- ③ Filling section thermaliQ:FB (option)
- ④ Filling cartridge desaliQ:HB(option)¹⁾

Fig. E-2: Installation drawing of mobile reverse osmosis system AVRO-flex 400 - filling mode



¹⁾**Note:** If the demineralised water as per VDI 2035 is used to fill systems < 0.11°dH (0.196 °f; 0.0196 mmol/l), it may – subject to the feed water – be necessary to install a filling cartridge desaliQ:HB (order no. 707 155) downstream.

2.3 Workshop mode

To prevent damage to the membrane due to germs (bio-fouling), the mobile reverse osmosis system AVRO-flex 400 must be run in workshop mode during the entire periods of standstill (refer to fig. E-3). In this case, the permeate line as well as the concentrate line are connected as per DIN EN 1717. In the workshop mode, water is rejected for a certain time set in the controller (factory setting 15 min.) every day.



Note: The system must be connected to the power supply as well as to the water/waste water network for the entire period of standstill (transports up to 48 h excluded).



Note: If installed, the shut-off valve on the permeate side must be open!

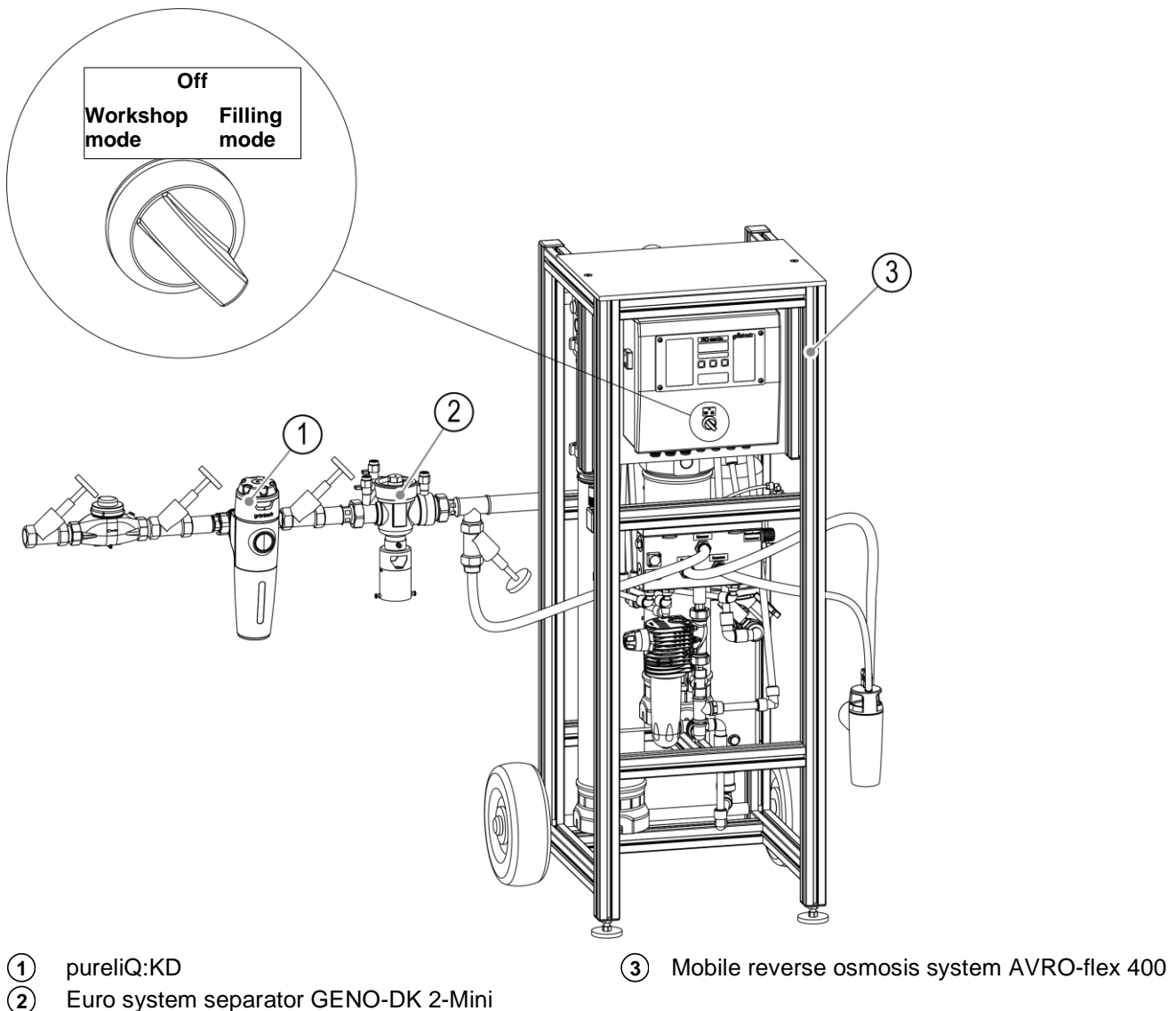


Fig. E-3: Installation drawing of mobile reverse osmosis system AVRO-flex 400 - workshop mode

F Operation (control unit)

1 | Preface



Note: Instructions in bold are absolutely essential to ensure that work can continue. All other instructions can be ignored if the value shown in the display remains unchanged.



Settings in the technical service programming level may only be performed by Grünbeck's technical service/authorised service company or by persons expressly authorised by Grünbeck.



Warning! Incorrect settings may lead to hazardous operating conditions which cause injury, health problems or damage to property.

The operation manual must be strictly adhered to! Only make the settings described there!

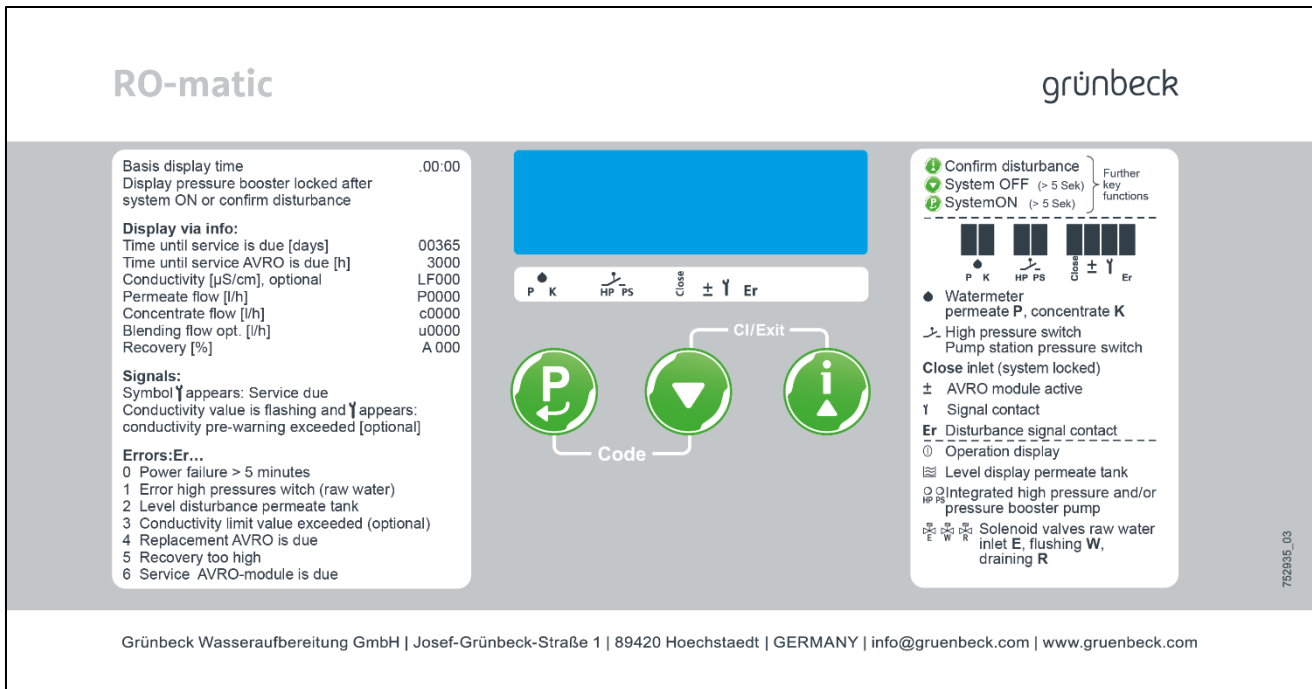







Fig. F-1: Control unit

2 | How to operate the control unit

Symbols displayed:	
	Operation indicator Appears when the system is switched on via the selector switch (workshop or filling mode)
	High-pressure pump Appears when the high-pressure pump produces permeate.
	Appears, without action/function
	Inlet solenoid valve (feed water) Appears when permeate is being produced or during system flushing.
	Flushing solenoid valve Appears when the system flushing is in progress
	Indication of operating mode Top wave: system runs in filling mode Bottom wave: system runs in workshop mode No wave: system is switched off
	Bars for water meter pulses Flash with every 5th pulse of the water meters for permeate or concentrate
	Indicates the state of the pressure switch for minimum pressure (bar appears when there is pressure) and operational release (bar appears when permeate is being delivered into the heating system)
	AVRO treatment module is active (always at the same time permeate is being delivered into the heating system)









	<p>Fig. 2 Operating panel, control unit AVRO-flex 400</p> <p>8.8.8.88</p> <ul style="list-style-type: none"> Numeric display Indicates the time and operating parameters in the Info level Indicates the parameters of the Code levels Indicates symbols in addition to the fault message
	<p>Bars for signal and fault signal contact</p> <p>Y appears when the maintenance interval has elapsed</p> <p>Er appears with all malfunctions Er0, Er1, Er4 and Er8</p>
	Flashes when the pressure switch for minimum pressure drops out during permeate production (lack of feed water pressure)

Function of buttons	
Basic function:	Extended function in programming levels:
	<ul style="list-style-type: none"> Acknowledgement of malfunctions. Access to time programming (keep button pressed > 2.5 sec).
	<ul style="list-style-type: none"> Decrease numerical value. Return to previous menu item.
	<ul style="list-style-type: none"> Increase numerical value. Go to the next menu item.
	<p>Display operating values of Info level.</p> <p>Access to the code-protected programming levels (Code request C 000).</p>
	<ul style="list-style-type: none"> Close open parameters without saving (previous value is maintained). Return to basic display time.

Operating modes selector switch		
	Workshop mode	<ul style="list-style-type: none"> When the system is switched on (symbol ) , permeate is produced for 15 minutes at the same time every day.
	Filling mode	<ul style="list-style-type: none"> When the system is switched on (symbol ) , it produces subject to the pressure switch for operational release.
	Off	

2.1 Reading the operating status

Various operating parameters can be displayed within the Info level. The Info level is accessed by pressing the ▲ button.

Button	Display	Parameters
	00:00	Basic display, time
		Pressing this button for the first time switches the system on, if still necessary!
	365	Remaining time of maintenance interval [d]
	3000	Remaining time of AVRO maintenance interval [h]
	P0200	Permeate flow [l/h]
	c0200	Concentrate flow [l/h]
	A 050	System recovery [%]
	I.200	Actual current of AVRO treatment module [mA]
	S00.00	Sum of permeate [m³] during filling mode for billing. Counter reading is deleted again in this display by the combination of buttons P and ▲ (> 5 sec).

2.2 How to set the time

Requirement:

The basic display time is currently being indicated.

1. Press button P for > 2.5 seconds. Only the hours 00: will still be displayed
2. Press P button to change the hours (value is flashing, now set the desired value with buttons ▼ or ▲ and save with the P button)
or
press ▲ button to advance to the minutes :00
3. Press P button to change the minutes (value is flashing, now set the desired value with buttons ▼ or ▲ and save with the P button)
4. Return to the basic display time by simultaneously pressing buttons ▼ and ▲

2.3 Access to the programming levels - change parameters

1. Simultaneously pressing the buttons P and ▼ (> 1 sec) causes the code request C 000 to appear.
2. Set the required code with buttons ▼ or ▲ and confirm with P button.
3. Within the programming level, select the desired parameter with buttons ▼ or ▲ and open it for editing with the P button (value starts flashing).
4. Change the parameter setting to the desired value with buttons ▼ or ▲ .
5. Save the new parameter setting with the P button (value stops flashing) or reject the change by simultaneously pressing the buttons ▼ and ▲, and close the parameter again (value stops flashing, previous setting remains saved).
6. Return to the basic display time by simultaneously pressing buttons ▼ and ▲.
7. If no button is pressed within a parameter level for more than 5 minutes, the system automatically returns to the basic display time. Any open parameters (value flashing) are closed and the previously saved value is kept.

2.4 Software version Code 999

Display	Parameters
P1.25	Software version of RO-matic controller

3 | Programming levels

3.1 Input logic Code 113

Display / factory setting	Parameters	Setting range	Comment
EHP: 2	Type of contact Pressure switch for minimum pressure (high-pressure pump)	0 ... 3	0 = Normally open contact (NOC) 1 = Normally closed contact (NCC) 2 = NOC with automatic restart ¹⁾ 3 = NCC with automatic restart ¹⁾
EPS: 1	Type of contact PS pressure switch	0 ... 1	0 = NOC (setting for systems <u>without</u> pressure switch) 1 = NCC (setting for systems <u>with</u> pressure switch)
EnL: 0	Flush system (inlet and flushing solenoid valves)	0 ... 1	1 = Open solenoid valves (only possible if the system is switched off) 0 = Close solenoid valves again

¹⁾ If error Er 1 occurs during ongoing permeate production (pressure switch minimum pressure of high-pressure pump), the system attempts a restart at the following intervals:

5 ... 10 ... 20 ... 40 ... 80 ... 160 minutes


If sufficient pressure is present, permeate is produced until the pressure switch for operational release responds and the error is acknowledged automatically.

During the wait time between the start attempts, the symbol **P** is flashing in the display.

3.2 System parameters Code 290

Display / factory setting	Parameters	Setting range	Comment
5. 2	Reaction to return of power for error Er 0 (power failure > 5 minutes)	0 ... 2	0 = Irrespective of whether the system was switched on or off prior to the power failure, it remains switched off after power is restored and error Er 0 is emitted (symbol ⓘ is still switched on) 1 = Error Er 0 is deactivated 2 = After power is restored, the system is switched on or off like prior to the power failure, and error Er 0 is emitted
D. 15	Run time of workshop mode [minutes]	15 ... 99	In workshop mode, permeate is produced for this time at a 24 h interval after the system is switched on. Operation is irrespective of the status of the pressure switch for operational release.
E. 0	Reserved function	0 ... 1	0 = Factory setting

3.3 Reference values / times Code 302

Display / factory setting	Parameters	Setting range	Comment
1. 2	Operating mode AVRO-flex 400	Display only	
2,0000	Reference value permeate flow [l/h]	0 ... 9999	 Note: The parameters 2. and 3. must be measured and gauged while the high-pressure pump is running.
3,0000	Reference value concentrate flow [l/h]	0 ... 9999	
6. 5.0	Duration of flushing [minutes]	0 ... 99.9	Inlet (feed water) and flushing solenoid valves.
7. 3	System run-down time [seconds]	1 ... 99	After pressure switch for minimum pressure responds = operational release.
9. 5	Start-up delay of high-pressure pump [seconds]	3 ... 99	After inlet solenoid valve opens.
A. 3	Delay time of pressure switch of high-pressure pump [seconds]	3 ... 99	
b. 000	Duration of maintenance interval [days]	0 ... 365	0 = Service interval deactivated. Acknowledgement of the maintenance interval (bar above the "screw wrench" symbol) by reprogramming of the maintenance interval.
d. 40	Minimum AVRO treatment current [mA]	0 200	Treatment current is requested at the end of the permeate production. In case the threshold programmed there is undershot, Er4 is emitted.
E. 3000	AVRO maintenance interval [h]	0.3000	Acknowledgement of the maintenance interval by reprogramming the value.
F. 03	Delay time of PS pump after start of permeate production [sec]	1 99	Without function in case of AVRO-flex 300
G. 0.0	Flushing delay after activation of pressure switch for operational release [minutes]	0.0 99.9	Filling mode: If the pressure switch has responded uninterrupted this long, the system flushes. If the pressure switch drops out, the permeate production starts.


3.4 Error memory / water volumes Code 245

Display	Parameters	Comment
1.Er_x ... 9.Er_y	Error memory of the 9 most recent errors	1.Er_ = most recent error 9.Er_ = least recent error ▼
A.0372	Operating time [hours] in workshop mode	Time during which the HP pump is operating in workshop mode.
b.0231	Run time filling mode [days]	
c.0097 d. 00	Run time HP pump [hours]	Filling mode c = thousands ... ones d = ten thousands
E.0068 F. 00	No function	No function No function
G.0103 H. 00	Permeate volume produced so far [m ³]	G = thousands ... ones H = ten thousands
I.0085 L. 00	Concentrate volume produced so far [m ³]	I = thousands ... ones L = ten thousands

3.5 Diagnosis Code 653

In this code of the customer service programming level, it is possible to request the states of the inputs and to switch the outputs separately.

Access requirement: System is switched off via ▼ button.

E.PA:	Motor protection switch of high-pressure pump	Physical state of the input signals: 0 = no voltage applied 1 = 24 VDC voltage applied
E.Pb:	Switch for workshop mode	
E.Pc:	Switch for filling mode	
E.HP:	Pressure switch for minimum pressure of high-pressure pump	
E.PS:0	Pressure switch System ON - Filling mode	
E.CL:	Input always 1 Motor protection switch PS pump	
A.St:0	Voltage-free fault signal contact	Physical state of the output signals: 0 = output switched off 1 = output switched on  Attention! Make sure there is an inflow of water when switching the pumps - risk of running dry!
A.YE:0	Inlet solenoid valve	
A.YS:0	Flushing solenoid valve	
A.Yr:0	Reserved	
A.HP:0	High-pressure pump	
A.PS:0	No function	
A.PF:0	Voltage-free signal contact	

5 | Operation of reverse osmosis system AVRO-flex 400

5.1 How to set the system recovery

A certain part of the feed water must be rejected in order to prevent the membrane from clogging due to scaling. The ratio of the produced permeate volume to the feed water volume is called recovery.

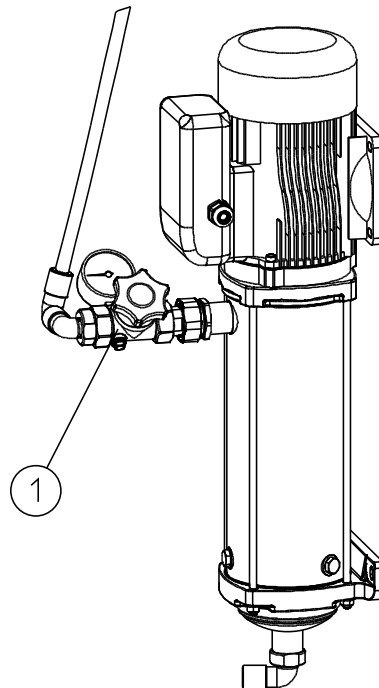
5.1.1 How to set the permeate volume

Switch on the system via the ▲ button at the control unit.

With the control valve for the operating pressure (refer to fig. F-3, item 1), throttle the high-pressure pump in a way that the system-specific permeate flow of 400 l/h is attained.



Note: The current permeate flow can be displayed via the controller (refer to Chapter F, paragraph 2.1 “Reading the operating status”).



① Control valve for operating pressure

Fig. F-3: Control valve for operating pressure at the high-pressure pump

5.1.2 How to set the concentrate volume

Set the concentrate flow at the concentrate needle valve (refer to fig. F-4, item 1).

To safeguard against the valve changing its position, it features a safety screw which is centrally located at the green cap.

The concentrate flow in a standard system has to be set in a way, that a recovery of 50 % is attained (400 l/h of permeate flow, 400 l/h of concentrate flow).



Note: The current concentrate flow and the recovery can be displayed via the controller (refer to Chapter F, paragraph 2.1 “Reading the operating status”).



Attention! If the set recovery is not met, scaling (precipitation of dissolved salts) occurs on the reverse osmosis membrane.

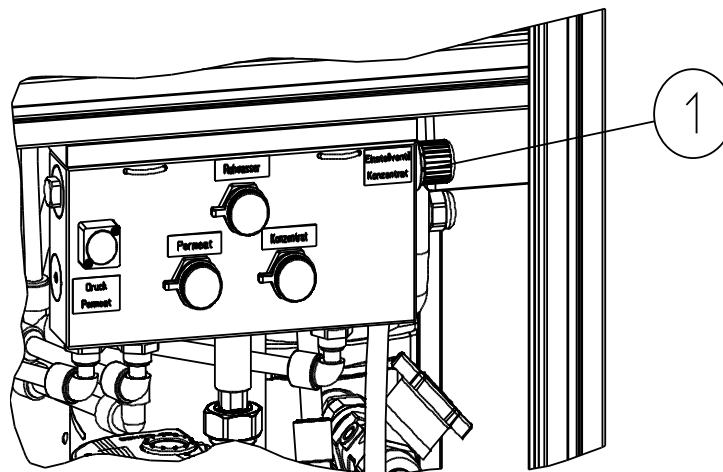


Fig. F-4: Needle valve, concentrate

Example for the calculation of the recovery

$$\text{Recovery [\%]} = \frac{\text{Permeate flow [l/h]} \times 100\%}{\text{Permeate flow [l/h]} + \text{Concentrate flow [l/h]}}$$

$$\text{Concentrate flow [l/h]} = \frac{\text{Permeate flow [l/h]} \times 100}{\text{Concentrate recovery [\%]}} - \text{Permeate flow [l/h]}$$

G Troubleshooting

Even carefully designed and manufactured technical systems that are operated properly, may experience malfunctions. Table G-1 provides an overview of possible problems that may occur during the operation of the systems and indicates the causes and their elimination.

The systems are equipped with an error detection and reporting system. If an error message is displayed:

1. Press P button (= acknowledge malfunction).
2. Watch the display.
If the message reappears, compare it with table G-1.
3. If necessary, notify Grünbeck's technical service.



Note: The technical service definitely must be notified (refer to gruenbeck.de) in case of malfunctions that cannot be remedied with the information given in table G-1! When contacting the technical service, please indicate the system designation, serial number and the error message displayed.

Table G-1: Troubleshooting

This is what you observe	This is the cause	This is what to do
Water quality deteriorated by 50 %.	Membrane clogged.	Replace or flush the membrane ¹⁾ .
	Feed water values deteriorated.	Check feed water values.
Solenoid valve does not open .	Coil defective or fuse F1 blown on circuit board.	Replace coil or fuse T1A.
Solenoid valve does not close .	Valve contaminated.	Clean valve.
Bar appears in the display above Symbol Close.	<ul style="list-style-type: none"> • High-pressure pump: Thermostat contact has responded, pump has overheated. • Upstream hardness monitoring or water treatment locks the system. 	<ul style="list-style-type: none"> • Wait until the pump has cooled down again, the system will then automatically continue to produce. • Inspect system installed upstream.
Bar appears in the display above screw wrench symbol (without further indications of a malfunction).	Service interval has elapsed.	Have maintenance performed.

Continuation Table G-1: Troubleshooting		
This is what you observe	This is the cause	This is what to do
Er 0	Power failure > 5 minutes Refer to Chapter F / paragraph 3.2 / parameter A: Depending on the setting, the system either continues to run or remains switched off.	Check power supply for failures.
Er 1	Pressure drop at pressure switch for minimum pressure of high-pressure pump: Refer to Chapter F / paragraph 3.1 / parameter EHP: Depending on the setting, the system has previously undertaken 6 unsuccessful start attempts.	Restore primary pressure of feed water.
Er 4	Minimum AVRO treatment current undershot.	Have the AVRO treatment module replaced immediately by Grünbeck's technical service/authorised service company. The malfunction can be acknowledged once and a maximum of 5 m ³ of permeate can still be produced.
Er 5	System recovery too high: Recovery was above 60 % for more than 1 h	Gauge and reset the system.
Er 6	AVRO maintenance interval has elapsed.	Notify Grünbeck's technical service/authorised service company to have the AVRO treatment module replaced promptly.
Er 7	No function	
Er 8	Motor protection switch of high-pressure pump has responded.	Notify Grünbeck's technical service/authorised service company to have the high-pressure pump checked and replaced, if necessary
Er 9	In workshop mode, a shut-off valve is closed on the permeate side.	Open shut-off valve and acknowledge malfunction.

¹⁾ Separate flushing instructions for membranes are available for authorised service personnel, order no. 700 950.

H Maintenance and care

1 | Basic information

In order to guarantee the reliable function of the systems over a long period of time, some maintenance work has to be performed at regular intervals. All regulations and guidelines which apply at the installation site must be strictly adhered to.

- Check the quality and the system volume flows every day.
- Maintenance has to be performed by Grünbeck's technical service/authorised service company or by a specialised company. Maintenance is subject to the load but at the latest has to be performed once a year.
- An operation log and the corresponding test log must be kept in order to document the maintenance work performed.



Note: By concluding a maintenance contract you ensure that all maintenance work will be performed in due time.

The maintenance work performed must be documented in the checklist, refer to appendix "Operation log".

2 | Inspection (functional check)

You may perform the daily inspections yourself.

Please refer to the following summary for the tasks to be performed within the framework of an inspection.

Summary: Inspection work

- Read the recovery



Note: Minor deviations are normal and cannot be prevented technically. In case of considerable deviations from the standard, notify Grünbeck's technical service.

- Take the remaining time of the AVRO treatment unit's maintenance interval into consideration (refer to Chapter F, paragraph 2.1). If the remaining time is < 100 hours, notify Grünbeck's technical service/authorised service company to have the treatment module replaced.
- Take the remaining time of the maintenance interval [d] into consideration (refer to Chapter F - paragraph 2.1 "Reading the operating state"). In case the remaining time of the maintenance interval is < 30 days, inform Grünbeck's technical service about the impending service.

- Check the system's tightness to the drain. Solenoid valves are not tightened, visible in the display (refer to fig. F-2, items 9 and 10). In this state, no water must creep to the drain.



Note: Leaky solenoid valves will cause the system to consume more water. The recovery will be reduced.

3 | Maintenance



According to DIN EN 806-5, maintenance work at the systems may only be performed by Grünbeck's technical service/authorised service company or an approved specialist company.

For this kind of systems, an operation log - a checklist has to be kept. In this operation log, the customer service technician records all maintenance and repair work performed. In case of malfunctions, this log helps to identify possible sources of error. In addition, the log documents the proper system maintenance.



Note: Make sure that all maintenance work is recorded in the operation log as well as in the corresponding test log.

Summary: Maintenance work

- Replace the filter element.
- If necessary, replace the filter element of the activated carbon filter.
- Check the permeate quality; flush or replace the membrane, if necessary. So-called flushing instructions (order no. 700 950) are available for authorised service personnel.
- Replacement of AVRO treatment unit, if necessary (limit value: 3000 h or 5 years)
- Solenoid valves – check function, clean if necessary.
- Check the flow volumes and recalibrate the water meters.
- Check the state of the entire system and check the entire system for tightness.
- Mechanical resp. electrical functional and performance check of all aggregates (pumps, valves).
- Prepare a written maintenance log on the state and function of the system and the maintenance work performed, incl. evaluation and assessment of the operating values and water analysis results.



Note: The maintenance work performed must be documented in the checklist, refer to appendix "Operation log".

3.1 Operation log

The operation log is located in Chapter H, paragraph 4 of this operation manual. When starting up the system, make sure to record all data on the cover sheet of the operation log and fill in the first column of the checklist.

The customer service technician will fill in a column of the check list whenever maintenance is performed. This document provides evidence of proper maintenance.

4 | Operation log

Customer

Name:

Address:.....

.....

.....

Mobile reverse osmosis system AVRO-flex 400

Order no. 752 250

Serial number

.....

Maintenance work on mobile reverse osmosis system AVRO-flex 400 Checklist

Please enter measured values. Confirm checks with OK or enter repair work performed.

<input type="checkbox"/> Maintenance performed without replacement of module	<input type="checkbox"/> Maintenance performed with replacement of module Module no.	<input type="checkbox"/> Maintenance performed with replacement of AVRO treatment module Treatment module no.
---	---	--

Measured values

Water volumes and water qualities **before** the replacement of the module / **after** the replacement of the module or in case of maintenance

Pump pressure [bar] before/after	Conductivity [µS/cm] before/after	Total hardness [°dH] before/after	Carbonate hardness: [°KH]	Temperature [°C] before/after	Volume flow [l/h] before/after	Recovery [%] before/after
/						
Feed water	/	/		/	/	
Permeate	/	/		/	/	
Concentrate	/	/		/	/	

	Confirmation	Remarks
Water meter reading upstream of the system [m³]		
Inlet water pressure (2.5 - 4 bar) checked		
Filter elements replaced (incl. activated carbon)		
Settings of electronics checked		
Water meter configured (code 302, par. 2 + 3) [l/h]		
Run time in workshop mode (code 290, par. d) [min.]		
AVRO treatment current (Chapter F, 2.1) [mA]		
Operating period in workshop mode (code 245, par. A) [h]		
Run time in filling mode (code 245, par. b) [T]		
Run time of high-pressure pump (code 245, par. c/d) [h]		
No function (code 245, par. E/F) [h]		
Permeate volume produced (code 245, par. G/H) [m³]		
Concentrate volume generated (Code 245, par. I/L) [m³]		
Error memory (code 245, par. 1..9) [Er]		

**Maintenance work on mobile reverse osmosis system AVRO-flex 400
Checklist**

Please enter measured values. Confirm checks with OK or enter repair work performed.

<input type="checkbox"/> Maintenance performed without replacement of module	<input type="checkbox"/> Maintenance performed with replacement of module Module no.	<input type="checkbox"/> Maintenance performed with replacement of AVRO treatment module Treatment module no.
---	---	--

Measured values

Water volumes and water qualities **before** the replacement of the module / **after** the replacement of the module or in case of maintenance

Pump pressure [bar] before/after	Conductivity [µS/cm] before/after	Total hardness [°dH] before/after	Carbonate hardness: [°KH]	Temperature [°C] before/after	Volume flow [l/h] before/after	Recovery [%] before/after
/						
Feed water	/	/		/	/	
Permeate	/	/		/	/	
Concentrate	/	/		/	/% /%

	Confirmation	Remarks
Water meter reading upstream of the system [m³]		
Inlet water pressure (2.5 - 4 bar) checked		
Filter elements replaced (including activated carbon)		
Settings of electronics checked		
Water meter configured (code 302, par. 2 + 3) [l/h]		
Run time in workshop mode (code 290, par. d) [min.]		
AVRO treatment current (Chapter F, 2.1) [mA]		
Operating period in workshop mode (code 245, par. A) [h]		
Run time in filling mode (code 245, par. b) [T]		
Run time of high-pressure pump (code 245, par. c/d) [h]		
No function (code 245, par. E/F) [h]		
Permeate volume produced (code 245, par. G/H) [m³]		
Concentrate volume generated (Code 245, par. I/L) [m³]		
Error memory (code 245, par. 1..9) [Er]		

Maintenance work on mobile reverse osmosis system AVRO-flex 400 Checklist

Please enter measured values. Confirm checks with OK or enter repair work performed.

<input type="checkbox"/> Maintenance performed without replacement of module	<input type="checkbox"/> Maintenance performed with replacement of module Module no.	<input type="checkbox"/> Maintenance performed with replacement of AVRO treatment module Treatment module no.
---	---	--

Measured values

Water volumes and water qualities **before** the replacement of the module / **after** the replacement of the module or in case of maintenance

Pump pressure [bar] before/after	Conductivity [µS/cm] before/after	Total hardness [°dH] before/after	Carbonate hardness: [°KH]	Temperature [°C] before/after	Volume flow [l/h] before/after	Recovery [%] before/after
/	/	/		/	/	
Feed water	/	/		/	/	
Permeate	/	/		/	/	
Concentrate	/	/		/	/% /%

	Confirmation	Remarks
Water meter reading upstream of the system [m³]		
Inlet water pressure (2.5 - 4 bar) checked		
Filter elements replaced (including activated carbon)		
Settings of electronics checked		
Water meter configured (code 302, par. 2 + 3) [l/h]		
Run time in workshop mode (code 290, par. d) [min.]		
AVRO treatment current (Chapter F, 2.1) [mA]		
Operating period in workshop mode (code 245, par. A) [h]		
Run time in filling mode (code 245, par. b) [T]		
Run time of high-pressure pump (code 245, par. c/d) [h]		
No function (code 245, par. E/F) [h]		
Permeate volume produced (code 245, par. G/H) [m³]		
Concentrate volume generated (Code 245, par. I/L) [m³]		
Error memory (code 245, par. 1..9) [Er]		

	Confirmation	Remarks
All electrical lines checked for external damage		
All hoses and connections checked for external damage		
Inlet solenoid valve checked for tightness - cleaned, if necessary		
Pressure switch of high-pressure pump checked for function		
Pressure switch - switching hysteresis		
Pressure booster checked/adjusted		
Visual check of the control unit		
System checked for tightness		

Miscellaneous

Remarks:

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Start-up technician / CS technician:

Company:

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Work time certificate (no.).....

Date/signature