



Reverse Osmosis Water Treatment System

Use, Maintenance, Care Instructions

Implementation Standards: CB/T19249--2003

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I. Reverse Osmosis Device Overview

This manual is intended to help users install and use this equipment correctly so that the equipment can achieve the best operating effect and the longest service life. Therefore, please take some time to read this manual carefully before installing and using this equipment.

1.1 Reverse Osmosis Principles, Terms and Definitions

1 Reverse osmosis principle

It uses membrane separation to remove soluble solids, organic matter, colloids and bacteria in water. Raw water is sent to and passed through the reverse osmosis membrane at a certain pressure. The water passes through the tiny pores on the membrane and is collected to obtain pure water. The impurities in the water are dissolved in the retentate and discharged. RO can remove more than 96% of soluble solids, more than 99% of organic matter, colloids and bacteria in raw water.

2 Reverse osmosis membrane element

The basic usage unit is composed of reverse osmosis membrane that meets the standard requirements.

3 Reverse osmosis membrane module

A composite component that assembles the reverse osmosis membrane element with other components such as the shell according to certain technical requirements.

4 Reverse osmosis

The process in which an external pressure higher than the osmotic pressure of the solution is applied to the raw water side of the membrane, allowing only water and certain components in the solution to selectively pass through, while other substances cannot pass through and are retained on the membrane surface.

5 Salt rejection

A value indicating the desalination efficiency of the equipment.

6 Recovery

The value of the equipment's efficiency in utilizing raw water.

7 Permeat

The water with lower salt content obtained after being treated by the equipment.

8 Concentrate

Water with concentrated salt content after being treated by the equipment

9 Cartridge filter

The filter, which is composed of a microfiltration element with a filtration accuracy less than or equal to 5μm, is installed in front of the reverse osmosis membrane to ensure that the water quality entering the reverse osmosis membrane meets the specified requirements.

1.2 Product categories and models

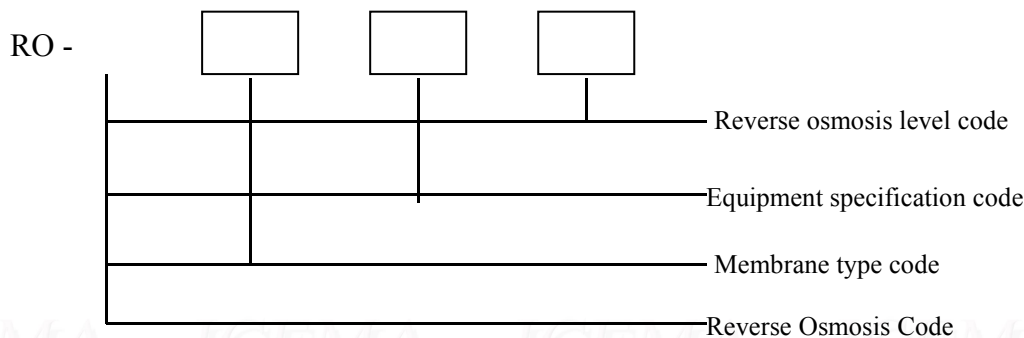
1 Product Categories

The equipment is divided into three categories according to the daily water output m³/d (measured in 24 hours, 25°C water temperature, the same below):

- a) Small equipment daily water production ≤ 100 m³/d;
- b) Medium-sized equipment: daily water output 100-1000 m³/d;
- c) Large equipment daily water production ≥ 1000 m³/d.

2 Product Model

The product model is composed of the English initials RO of reverse osmosis, the type code of the membrane, the specification code of the equipment, and the number of reverse osmosis stages:



2.1 Reverse osmosis membrane type code:

J----Roll film; B----Plate membrane; Z----Hollow membrane; G----Tubular membrane。

Equipment specification code:

S----Small equipment; M----Medium equipment; L----Large equipment

Reverse osmosis level code (expressed in Arabic numerals):

1----First level reverse osmosis; 2----Secondary reverse osmosis; 3----Three-stage reverse osmosis

2.2 Model examples:

RO-JSI Meaning: A small-scale reverse osmosis water treatment equipment consisting of a spiral reverse osmosis membrane

2.3 Require:

a)Reverse osmosis water treatment equipment performance indicators

b)Desalination rate: The desalination rate of the equipment is $\geq 95\%$ (except for special requirements of the user)

c)Raw water recovery rate:

1)Small equipment raw water recovery rate $\geq 30\%$;

2)Raw water recovery rate of medium-sized equipment $\geq 50\%$;

3)Type equipment raw water recovery rate $\geq 70\%$;

The design flow rate of this equipment is 1T/h, and the design capacity of this equipment is to produce 1 ton of pure water per hour. The production capacity of this equipment is set when the raw water temperature is 25°C. If the raw water temperature is higher or lower than this temperature in actual operation, its production capacity will change to a certain extent. For every 1 degree drop in temperature, the water output will drop by 3%. Of course, changes in other raw water conditions will affect the water quality and quality of the product.

II.Reverse osmosis water conditions

This RO machine should operate under the following water inlet conditions. It is very important to check that your raw water is within this limit. RO water inlet conditions that do not meet this standard will cause permanent and unrecoverable contamination and damage to the membrane components. Therefore, contamination and damage caused by this situation are not within the warranty scope of the system.

1. Minimum raw water pressure: 0.3Mpa
2. Minimum water supply flow: 2.5T/H
3. Water temperature: 4°C--45°C
4. PH range: 4--9
5. Hardness <17mg/L (calculated as CaCO₃)
6. Turbidity: SDI <5

7. Total dissolved solids content: TDS <1000mg/L

8. The raw water must meet the following requirements:

Iron: <0.1mg/L

Organic matter: <1mg/L

The raw water hardness must be below 17 mg/L. To meet this requirement, it is recommended to install a suitable softener or antiscalant dosing device before the reverse osmosis system. Damage to the reverse osmosis membrane caused by scaling due to excessive raw water hardness is not covered by the warranty.

9. Raw water temperature and water output. The rated water output of the equipment is set under the assumption that the raw water temperature is 25°C. The water output of the reverse osmosis system decreases as the raw water temperature decreases. Under normal circumstances, the water output will decrease by 3% for every 1°C decrease in water temperature.

II. How to use reverse osmosis water treatment system correctly

3.1 Reverse Osmosis Production Process

Raw water pump — Multi-media filter — Activated carbon filter — Softener — Security filter — High-pressure pump — Reverse osmosis — Pure water tank

3.2 Impact of raw water quality changes on reverse osmosis

We should frequently analyze the raw water quality, observe the changes in water quality, and see whether the RO membrane inlet water quality meets the index. Exceeding the standard of water quality has a far-reaching impact on reverse osmosis. If the water quality exceeds the standard, a suitable reverse osmosis treatment process must be used to treat it to meet the RO membrane inlet water index. Therefore, the reverse osmosis treatment process we currently select is adapted to the raw water quality standard currently provided. It is necessary to frequently analyze the raw water quality and deal with problems in a timely manner. Therefore, changes in raw water quality are directly related to the normal operation of reverse osmosis.

3.3 Maintenance work during RO membrane shutdown

The reverse osmosis operating system should be turned on once every two days to prevent bacterial contamination of the RO membrane. If the system is shut down for too long, antibacterial agents should be added, and winterization should be done in winter, otherwise permanent damage to the membrane will occur.

3.4 Reverse osmosis device maintenance and equipment troubleshooting

1 Replacement of the filter element of the security filter

The filter element of the security filter is a spray-melt filter element made of polypropylene. The replacement of the spray-melt filter element depends on the raw water conditions:

- (1) The SDI in the effluent water quality exceeds the standard
- (2) The inlet and outlet pressure difference reaches a certain level, generally 0.5KG

Recommendation: The filter element must be removed for inspection and cleaning every ten days. The filter element replacement cycle depends on the quality of the incoming water, generally 3-6 months.

2 Reverse Osmosis Membrane

If the pre-treatment is appropriate, the water quality entering the RO membrane meets the requirements, and the equipment is used according to the operating instructions, the life of the membrane can reach 2-3 years.

However, with the formation of pollutants such as scale and bacteria, the water output and water quality will gradually decrease:

- (1) If the water production gradually decreases by 5% not due to factors such as temperature and pressure, it means that the reverse osmosis membrane needs to be chemically cleaned.
- (2) When the quality of the produced water gradually declines and exceeds the relevant standards (excluding factors such as changes in raw water), it means that the reverse osmosis membrane needs to be chemically cleaned.
- (3) Chemical cleaning must be carried out by professionals or under the guidance of professionals. For relevant technical issues, please refer to the appendix.
- (4) The temperature of the equipment installation site should be between 4°C and 45°C. If the equipment is shut down for a long time, protective fluid should be added to the system. The initial addition of protective fluid should be done by professionals or under the guidance of professionals.

IV.Reverse Osmosis Device Instructions

4.1 Multi-media filter instruction manual

1 Multi-media filter equipment parameters

Name	Technical Parameters	Qty.	Origin	Key Features
Multi-media filter	Specifications: $\phi 400 \times 1650 \text{mm}$ Packing volume: 0.15m ³ Flow rate: 2.5m ³ /h Main material: 304 Packing: refined quartz sand Pipe material: 304	1	ICEMA	Remove mechanical and other impurities

2 Multi-media filter function

The raw water contains very fine dust, humus, starch, cellulose, bacteria, algae and other microorganisms. These impurities form colloidal particles in a sol state with water. Due to Brownian motion and electrostatic repulsion, they show sedimentation and aggregation stability. They usually cannot be removed by natural gravity sedimentation. The water can be removed by passing through a sand filter, thereby reducing the turbidity of the water and improving its clarity.

3 Cleaning of Multi-Media Filters

After the multi-media filter works continuously (depending on the actual situation), a large amount of mechanical impurities such as fine dust, humus, starch, cellulose, bacteria, algae and other microorganisms are deposited in the filter material. These impurities form colloidal particles in a sol state with water and should be removed in time. The method is to backwash first and then wash forward, and wash repeatedly.

4.2 Activated carbon filter instruction manual

1 Activated carbon filter equipment parameters

Name	Technical Parameters	Qty.	Origin	Key Features
Activated carbon filter	Specifications: $\phi 400 \times 1650 \text{mm}$ Packing volume: 0.15m ³ Flow rate: 2.5m ³ /h Main body material: 304 Packing: high-quality fruit shell activated carbon Pipe material: 304	1	ICEMA	Remove residual chlorine, bacteria, organic matter and other impurities

2 Activated Carbon Filter Function

In addition to the requirement of $SDI \leq 5$, the reverse osmosis water inlet also has another water inlet index of residual chlorine < 0.1 mg/L. The activated carbon filter has two main functions: 1. Adsorb some organic matter in the water, with an adsorption rate of about 60%;

Adsorb residual chlorine in the water. It is difficult to remove inorganic colloids, organic colloids, soluble organic polymer impurities and residual chlorine with a particle size of about 10-20 angstroms in the sand filter. In order to further purify the raw water and make it meet the reverse osmosis water inlet index, an activated carbon filter is designed in the process flow.

The reason why activated carbon can be used to adsorb organic matter with a particle size of about tens of angstroms is that its structure has a large number of micropores and particle gaps with an average pore size of 20-50 angstroms.

This structural feature of activated carbon enables its surface adsorption area to reach 500--2000 m²/g. Since the molecular diameter of general organic matter is slightly smaller than 20-50 angstroms, activated carbon has a strong adsorption effect on organic matter. In addition, activated carbon has a strong dechlorination ability.

In this process, it is not adsorption, but because residual chlorine has a strong oxidizing property, residual chlorine reacts with carbon to generate carbon dioxide and -1 valence chloride ions, so only a small amount of carbon is lost, so activated carbon dechlorination can be used for a long time. Activated carbon not only has the above functions, but also can remove odor and pigments in water and improve the clarity of water.

After a period of use, the adsorption capacity of activated carbon decreases and needs to be replaced. Therefore, after the raw water passes through the activated carbon filter, it can greatly improve the water quality and reduce the pollution to the reverse osmosis membrane. The treated water quality can meet the reverse osmosis inlet water quality requirements.

3 Cleaning of activated carbon filters

After the activated carbon filter has been working continuously (depending on the actual situation), a large amount of organic matter and other impurities are deposited in the filter material. These impurities form colloidal particles in a sol state with water and should be removed in time by backwashing first and then forward washing, and repeated cleaning is required until the water is clear.

4.3 Security filter user manual

1 Softener equipment parameters

Name	Technical Parameters	Qty.	Origin	Key Features
Softener	Specifications: $\phi 350 \times 1650 \text{mm}$ Packing volume: 0.10 cubic Flow rate: 2.5m ³ /h Main body material: 304 Packing: cationic resin Pipe material: 304	1	ICEMA	Adsorb calcium and magnesium ions in water to prevent reverse osmosis membrane scaling

2 Softener function

The softener is equipped with strong acidic cationic resin. When in operation, water enters from the top and flows out from the bottom. When the equipment stops running for regeneration, the regeneration liquid enters from the bottom, and the regeneration waste liquid is discharged from the middle drain port, thus completing the regeneration of the non-top pressure countercurrent regeneration softener.

In the process, the softener mainly exchanges calcium and magnesium ions in the water through the sodium type resin group, absorbs the metal calcium and magnesium ions in the water, and exchanges sodium ions, thereby achieving the purpose of removing the hardness of the water.

Key Features:

1. The water supply condition is stable, the service life is long, and salt needs to be added regularly.
2. High efficiency, low energy consumption, and economical operating costs.
3. The equipment has a compact and reasonable structure, convenient operation and maintenance, small footprint, and saves investment.
4. It is easy to use, install, debug, and operate, and the performance of the control components is stable, which can solve the worries of users.

4.4 Security filter user manual

1 Security filter equipment parameters

Name	Technical Parameters	Qty.	Origin	Key Features
Security Filters	Specification: $\phi 230$ Filter element material: PP Water treatment capacity: 2.5m ³ /h Main body material: stainless steel Pipe material: 304	1	ICEMA	Remove fine particles

2 Security filter function

The main function of the security filter is to further intercept the fine particles that may leak from the activated carbon filter to prevent damage to the mechanical seal of the high-pressure pump and scratches on the surface of the reverse osmosis membrane. The filter used in this security filter has a filtration accuracy of 5 μ m.

V.How to start the reverse osmosis operating system

5.1 Preparation before startup

Before the RO device is turned on, it is necessary to check whether the pre-treated effluent reaches the RO device water inlet indication, otherwise the equipment shall not be put into operation.

Under any circumstances, the ambient temperature of the RO device cannot be lower than 5°C and higher than 40°C, and the water temperature should be controlled at 20-25°C.

Check whether each pipeline is connected according to the process requirements, whether the electrical circuit is complete, and whether the wiring is reliable. Open and check whether the relevant valves such as the "concentrated water pressure regulating valve" are unobstructed, as well as the relevant ball valves in the pipeline (each cleaning valve and sampling valve are in the closed state) to ensure the unobstructed pipeline from the water inlet to the reverse osmosis outlet.

Check whether the rotating parts of each water pump are flexible and the direction is correct. If any abnormality is found, necessary measures should be taken to deal with it.

Open the safety filter to vent and close it if water overflows.

5.2 Pre-processing instructions

Cleaning of multi-media filters, cleaning of activated carbon filters.

5.3 Reverse Osmosis Host Instructions

5.3.1 Automatically start the machine

- a. Boot steps
- b. Turn the two-position selector switch to automatic.
- c. Turn on the main power switch of the RO device.
- d. Make sure the filter is in operation to ensure smooth water flow.
- e. Enter the main interface and click on the automatic start on the main interface on the touch screen, indicating that the system has entered the automatic operation state. The system will automatically start and stop according to the high and low water tanks.

Shutdown steps

Clicking the automatic stop button on the main interface of the touch screen indicates that the system has entered the automatic stop state.

- a. 5.3.2 Manual startup
- b. a. Turn the two-position selector switch to manual
- c. b. Enter the manual operation interface
- d. c. Click manual start
- e. d. Click the raw water pump on the touch screen. The icon changes from red to green, indicating that the raw water pump has started.
- f. e. Click the high-pressure pump on the touch screen. The icon changes from red to green, indicating that the high-pressure pump has started.
- g. The equipment enters the operation stage

Shutdown steps

- a. Click the high-pressure pump on the touch screen. The icon changes from green to red, indicating that the high-pressure pump has stopped.
- b. Click the flushing solenoid valve on the touch screen. The icon changes from red to green, indicating that the flushing solenoid valve has started.
- c. After 30 seconds, click the flushing solenoid valve on the touch screen. The icon changes from green to green, indicating that the flushing solenoid valve has been closed.
- d. Click the raw water pump on the touch screen. The icon changes from green to red, indicating that the raw water pump has stopped.
- e. The equipment enters the stop state

VI. How to shut down the RO system

1 System automatic operation mode

When the system is shut down or restarted after a power outage, click Auto Start to indicate that the system has entered automatic operation. The system will automatically start and stop according to the level of the water tank.

2 Automatic startup conditions

- a. When the pure water tank reaches a low liquid level, the reverse osmosis will automatically start.
- b. When the raw water tank reaches a high liquid level, the reverse osmosis will automatically start.

3 Automatic shutdown conditions

The system shutdown is divided into manual system shutdown and shutdown when the shutdown conditions are met.

1. Manual system stop: If you need to stop the system due to special circumstances, press "Stop" and the system will stop.
2. The system will automatically shut down when the shutdown conditions are met.
 - a. When the pure water tank reaches a high liquid level, the reverse osmosis machine will automatically shut down.
 - b. When the raw water tank reaches low liquid level, the reverse osmosis will automatically shut down.

4 Alarm processing

The buzzer beeping in the system indicates that the system has an unexpected misoperation. You can enter the alarm page, click Reset, and then click the reset button next to the touch screen to release the alarm.

Low pressure alarm: When the water inlet is less than 0.5KG, low pressure protection occurs, the system shuts down, and then the buzzer alarms.

Solution: Check the valve to see if the water inlet solenoid valve cannot be opened, or the operating valve is closed before the first-level water inlet low pressure protection, resulting in low pressure protection.

Open the corresponding valve.

Replace the PP filter element of the security filter to ensure normal operation.

VII. Equipment operation control point

1. Antiscalcing agents and flocculants must be added on time. Equipment damage caused by stopping the use of agents without permission is not covered by the warranty.

2. It is strictly forbidden to adjust the valve at will. Equipment damage caused by improper operation without the manufacturer's permission is not covered by the warranty.
3. The water pipe is a PVC pipe, which is strictly prohibited to be stepped on.
4. Continuous operation of the equipment will reduce the use time of the membrane
5. The operating pressure of the equipment must be within the set range.
6. The equipment cannot be stopped for more than 2 days. It must be turned on for 30 minutes every day during the stop period. If the equipment is stopped for a long time (more than 10 days), the equipment must be added with protective liquid, otherwise the service life of the membrane will be reduced. Especially in winter, the temperature is too low and the membrane may be damaged. The resin must be soaked in water. If it needs to be stopped, contact the manufacturer for relevant matters.

X.Operation record form

Equipment operating consumables are

No.	Name	Specifications	Cycle	Remark
1	Antiscalant	MDC708/MDC220	Depending on actual situation	
3	Quartz sand	SiO ₂	12 months	
4	Activated carbon	Nutshell	6-12 months	
5	PP cotton	20 inches	15-30 days	Security filter
7	Membrane	4040	1-3 years	

XI.Reverse osmosis device maintenance and equipment troubleshooting

10.1 Common faults and solutions of RO system

No.	Fault	Reason	Treatment measures
1	The switch is turned on, but the device does not move	<ol style="list-style-type: none"> 1. Electrical circuit failure, such as fuse, Wire falling off 2. Thermal protection element not reset after protection 3. Water circuit underpressure 	<ol style="list-style-type: none"> 1. Check the fuse and wiring 2. Reset the thermal protection element 3. Check the water circuit to ensure the water supply pressure, Press the reset button
2	After the device is started, the water inlet solenoid valve does not open	<ol style="list-style-type: none"> 1. The wiring is disconnected. 2. The solenoid valve has an internal fault. 	<ol style="list-style-type: none"> 1. Check the wiring 2. Disassemble the solenoid valve, repair or replace
3	The pump operates but does not reach the rated pressure and flow	<ol style="list-style-type: none"> 1. Pump reverses 2. The filter element of the safety filter is dirty. 3. There is air in the pump. 4. The flushing solenoid valve is open 	<ol style="list-style-type: none"> 1. Reconnect the wires 2. Clean or replace the filter element 3. Remove the air from the pump 4. Adjust the pressure after flushing is complete
4	System pressure increases and pump noise becomes louder	<ol style="list-style-type: none"> 1. Insufficient raw water flow 2. The raw water flow is unstable and has vortices 	<ol style="list-style-type: none"> 1. Check the raw water pump and pipeline 2. Check if there is any leakage in the pipeline
5	Solenoid valve does not close after flushing	<ol style="list-style-type: none"> 1. Solenoid valve control element and circuit failure 2. Solenoid valve mechanical failure 	<ol style="list-style-type: none"> 1. Check or replace components and circuits 2. Disassemble the solenoid valve, repair or replace
6	Undervoltage shutdown	<ol style="list-style-type: none"> 1. Insufficient raw water supply 2. Safety filter element is clogged 3. Improper pressure adjustment, causing underpressure during automatic flushing 	<ol style="list-style-type: none"> 1. Check whether the raw water pump and pre-treatment are working. 2. Clean and replace the filter element 3. Adjust the system pressure to the optimal state to keep the post-filtration pressure above 20psi
7	Concentrate water pressure does not reach the rated value	<ol style="list-style-type: none"> 1. Foreign matter is clogged in the pressure hose 2. The flushing solenoid valve is not completely closed 	<ol style="list-style-type: none"> 1. Check and clear the pipes 2. Remove air 3. Replace the pressure gauge
8	The pressure is sufficient, but the pressure gauge shows insufficient	<ol style="list-style-type: none"> 1. Foreign matter is blocking the pressure hose 2. There is air in the hose 3. Pressure gauge is faulty 	<ol style="list-style-type: none"> 1. Check and clear the pipes 2. Remove air 3. Replace the pressure gauge
9	The pressure before and after the membrane is too high	<ol style="list-style-type: none"> 1. Membrane pollution and blockage 	<ol style="list-style-type: none"> 1. Chemical cleaning according to technical requirements
10	The water quality deteriorates	<ol style="list-style-type: none"> 1. Membrane pollution and scaling 2. Membrane joint seal aging and failure 3. Membrane perforation 	<ol style="list-style-type: none"> 1. Perform chemical cleaning according to technical requirements 2. Replace O-rings 3. Replace membranes
11	The output decreases	<ol style="list-style-type: none"> 1. Membrane fouling and scaling 2. Water temperature changes 	<ol style="list-style-type: none"> 1. Chemical cleaning according to technical requirements

8.2 Troubleshooting and Chemical Cleaning Checklist

Troubleshooting and Chemical Cleaning Checklist

Fault			Position	Reason	Verify	Treatment methods
Concentrated water	Pure water flow	Pressure drop				
Normal to increased	Decrease	Normal to increasing	Mainly in the first paragraph	Metal oxides contaminate the membrane	Analyze metal oxides in cleaning fluid	Improve pretreatment to remove metal oxides, clean with acidic cleaning solution
Normal to increased	Decrease	Increasing	Mainly in the first paragraph	Colloid contamination	Test SDI in raw water	Optimize pretreatment to remove colloidal substances, clean the membrane with anionic cleaning solution with high pH value
Increased	Decrease	Increasing	Mainly in the last paragraph	Scaling (SiO ₂ , CaSO ₄ , BaSO ₄ , CaCO ₃)	Analyze metal ions in cleaning fluid, check LSI index and CaSO ₄ , BaSO ₄ and SiO ₂ solubility in removal fluid	Add acidic additives and anti-scaling to reduce recovery rate, clean with alkaline cleaning solution
Normal to increased	Decrease	Normal to increasing	Any paragraph	Biological contamination	Test bacteria count in pure water and removal fluid	Add sodium bisulfite, lower pH value and continuously add sodium bisulfite, formaldehyde sterilization, add chlorine to remove chlorine; replace filter element
Decreased or slightly increased	Increase	Normal	All paragraphs	Organic contamination	Destructive test	Add activated carbon or other pretreatment, clean the membrane with high pH cleaning solution
Increased	Increase	Decreasing	The first level is the most serious	Free chlorine oxidation	Analyze chlorine in raw water; perform destructive test on membrane	Check chlorination equipment and dechlorination system
Increased	Normal to increase	Decreasing	The first level is the most serious	Crystalline material wears the membrane	Perform microscopic solid analysis of raw water and	Improve pretreatment, check all filters

					perform destructive test	
Increased	Normal to increase	Decreasing	Any paragraph	O-ring leakage Seal leakage	Test	Replace O-rings, repair or replace membranes
Concentrated water	Pure water flow	Decreasing	All paragraphs	Recovery rate is too high	Check flow and pressure according to design requirements	Reduce recovery rate, check softener

