# Installation, Operation and Maintenance Manual

## Wall Mounted Commercial Reverse Osmosis Systems

## Series PWR2511

**PURE WATER**

⚠ **CAUTION: Please read the entire manual before proceeding with the installation and startup. Your failure to follow any attached instructions or operating parameters may lead to the product's failure, which can cause property damage and/or personal injury.**

- **Do not use where the water is microbiologically unsafe.**
- **Pretreatment must be sufficient to eliminate chemicals that would attack the membrane materials.**
- **Always turn off the unit, shut off the feed water, and disconnect the electrical power when working on the unit.**
- **Never allow the pump to run dry.**
- **Never start the pump with the reject valve closed.**
- **Never allow the unit to freeze or operate with a feed water temperature above 100°F.**

**Save manual for future reference.**

Please refer to Section 6 of this manual for operating parameters according to your specific feed water Silt Density Index (SDI). For all other settings according to your specific feed water quality, please contact your Watts representative. A chemical analysis of the feed water should be conducted prior to the initial sizing and selection of this system.

## Notes

Changes in operating variables are beyond the control of Watts. The end user is responsible for the safe operation of this equipment. The suitability of the product water for any specific application is the responsibility of the end user.

Successful long-term performance of an RO system depends on proper operation and maintenance of the system. This includes the initial system startup and operational startups and shutdowns. Prevention of fouling or scaling of the membranes is not only a matter of system design, but also a matter of proper operation. Record keeping and data normalization are required in order to know the actual system performance and to enable corrective measures when necessary. Complete and accurate records are also required in case of a system performance warranty claim.

Changes in the operating parameters of an RO system can be caused by changes in the feed water or can be a sign of trouble. Maintaining an operation and maintenance log is crucial in diagnosing and preventing system problems. For your reference, a typical log sheet is included in this manual.

Series PWR2511

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**Note:** Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system.

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# I. Introduction

The separation of dissolved solids and water using RO membranes is a pressure driven temperature dependent process. The membrane material is designed to be as permeable to water as possible, while maintaining the ability to reject dissolved solids.

The main system design parameters require the following:

- Internal flows across the membrane surface must be high enough to prevent settling of fine suspended solids on the membrane surface.
- The concentration of each dissolved ionic species must not exceed the limits of solubility anywhere in the system.
- Pre-treatment must be sufficient to eliminate chemicals that would attack the membrane materials.

## A. Specifications

| | PWR25111011 | PWR25112011 | PWR25113011 | PWR25113021 |
|---|---|---|---|---|
| Maximum Productivity (gallons per day) | 150 | 250 | 600 | 1200 |
| Quality (membrane rejection) | 98 % | 98 % | 98 % | 98 % |
| Recovery (user adjustable) | 15 - 75 % | 15 - 75% | 15 - 75 % | 30 - 75 % |
| Membrane Size | 2.5" x 14" | 2.5" x 21" | 2.5" x 40" | 2.5" x 40" |
| Number Of Membranes | 1 | 1 | 1 | 2 |
| Dimensions W x H x D (approximate inches) | 22 x 32 x 12 | | 22 x 52 x 12 | |
| Prefilter (system ships with one 5 micron cartridge) | 10" | | | |
| Feed Water Connection | ½" NPT | | | |
| Product Water Connection (tubing OD) | ⅜" | | | |
| Reject Water Connection (tubing OD) | ⅜" | | | |
| Feed Water Required (maximum) | 2.4 gpm | | | |
| Feed Water Pressure (minimum) | 20psi | | | |
| Drain Required (maximum) | 2.4 gpm | | | |
| Electrical Requirement | 120 VAC 60 Hz 8 amps | | | |
| Motor Horse Power | ½ | | | |
| Shipping Weight (estimated pounds) | 50 | 50 | 60 | 70 |

**Notes:**

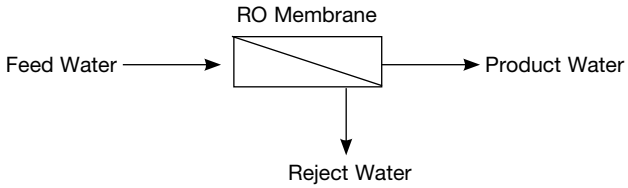
- Maximum production based on a feed water of 77°F, SDI < 3, 1000 ppm TDS, and pH 8.

Individual membrane productivity may vary (± 15%). May be operated on other feed waters with reduced capacity.

- Percent Rejection is based on membrane manufactures specifications; overall system percent rejection may be less.

## B. RO Overview

Reverse osmosis systems utilize semipermeable membrane elements to separate the feed water into two streams. The pressurized feed water is separated into purified (product) water and concentrate (reject) water. The impurities contained in the feed water are carried to drain by the reject water. It is critical to maintain adequate reject flow in order to prevent membrane scaling and/or fouling.




## C. Pretreatment

The RO feed water must be pretreated in order to prevent membrane damage and/or fouling. Proper pretreatment is essential for reliable operation of any RO system.

Pretreatment requirements vary depending on the nature of the feed water. Pretreatment equipment is sold separately. The most common forms of pretreatment are described below.

**Media Filter -** Used to remove large suspended solids (sediment) from the feed water. Backwashing the media removes the trapped particles. Backwash can be initiated by time or differential pressure.

**Water Softener -** Used to remove calcium and magnesium from the feed water in order to prevent hardness scaling. The potential for hardness scaling is predicted by the Langelier Saturation Index (LSI). The LSI should be zero or negative throughout the unit unless approved antiscalents are used. Softening is the preferred method of controlling hardness scale.

**Carbon Filter -** Used to remove chlorine and organics from the feed water. Free chlorine will cause rapid irreversible damage to the membranes.

*The residual free chlorine present in most municipal water supplies will damage the thin film composite structure of the membranes used in this unit. Carbon filtration or sodium bisulfite injection should be used to completely remove the free chlorine residual.*

**Chemical Injection -** Typically used to feed antiscalant, coagulant, or bisulfite into the feed water or to adjust the feed water pH.

**Prefilter Cartridge -** Used to remove smaller suspended solids and trap any particles that may be generated by the other pretreatment. The cartridge(s) should be replaced when the pressure drop across the housing increases 5 - 10 psig over the clean cartridge pressure drop. The effect of suspended solids is measured by the silt density index (SDI) test. An SDI of five (5) or less is specified by most membrane manufacturers and three (3) or less is recommended.

**Iron & Manganese -** Iron should be removed to less than 0.1 ppm. Manganese should be removed to less than 0.05 ppm. Special media filters and/or chemical treatment is commonly used.

**pH** - The pH is often lowered to reduce the scaling potential. If the feed water has zero hardness, the pH can be raised to eliminate CO2.

**Silica:** Reported on the analysis as SiO2. Silica forms a coating on membrane surfaces when the concentration exceeds its solubility. Additionally, the solubility is highly pH and temperature dependent. Silica fouling can be prevented with chemical injection and/or reduction in recovery.

# II. Controls, Indicators, and Components (See Figure 1)

Ⓐ On / Off Switch – Turns the unit on and off.

Ⓑ Product Pressure Switch – Automatically turns the unit on and off based on the product water pressure.

Ⓒ Reject Control Valve - Controls the amount of reject flow.

Ⓓ Reject Recycle Control Valve – Controls the amount of recycle flow.

Ⓔ Prefilter Pressure Gauges - Indicate the inlet and outlet pressures of the prefilter. The difference between these two gauges is the prefilter differential pressure.

Ⓕ Pump Discharge Pressure Gauge - Indicates the membrane feed pressure.

Ⓖ Reject Flow Meter - Indicates the reject flow rate in gallons per minute (gpm).

Ⓗ Product Flow Meter - Indicates the product flow rate in gallons per minute (gpm).

Ⓘ Prefilter Housing - Contains the RO prefilter.

Ⓙ Automatic Inlet Valve - Opens when pump is on and closes when the pump is off.

Ⓚ RO Feed Pump - Pressurizes the RO feed water.

Ⓛ RO Membrane Vessel(s) - Contains the RO membrane(s).

Ⓜ Low-pressure indicator.

# III. Operation

## A. Installation

1. Proper pretreatment must be determined and installed prior to the RO system.
2. The water supply and pretreatment equipment should be sufficient to provide a minimum of 20-psig at the maximum feed flow.
3. An electrical receptacle with a ground fault interrupt (GFI) is highly recommended.
4. Responsibility for meeting local electrical and plumbing codes lies with the owner / operator.
5. Install indoors in an area protected from freezing. Space allowances for the removal of the membranes from the pressure vessels should be provided.

## B. Plumbing Connections

**Note: It is the responsibility of the end user to ensure that the installation is done according to local codes and regulations.**

1. Connect the pretreated feed water line to the inlet valve (Figure # 1 item J). A feed water shutoff valve should be located within 10 feet of the system.
2. Temporarily connect the product water outlet to a drain. The product outlet is located on top of the product flow meter. The product water line should never be restricted. Membrane and/or system damage may occur if the product line is blocked.
3. Connect the reject water outlet to a drain. The reject outlet is located on top of the reject flow meter. The reject drain line should never be restricted. Membrane and/or system damage may occur if the reject drain line is blocked. An air gap must be located between the end of the drain line and the drain. The use of a standpipe or other open drain satisfies most state and local codes and allows for visual inspection and sampling.
4. If a bladder tank is used for product water storage then the product pressure switch (Figure #1 item B) needs to be connected. Install a tee and tube fitting in the inlet piping of the bladder tank and connect the tank to the pressure switch using poly tubing. A check valve should be installed between the RO unit and this tee.

## C. Electrical

**Note: It is the responsibility of the end user to ensure that the installation is done according to local codes and regulations.**

1. Make sure the on / off switch is in the off position (Figure # 1 item A).
2. Plug the unit into a standard 120 volt 3 prong outlet. An outlet protected with a ground fault interrupt (GFI) is recommended.

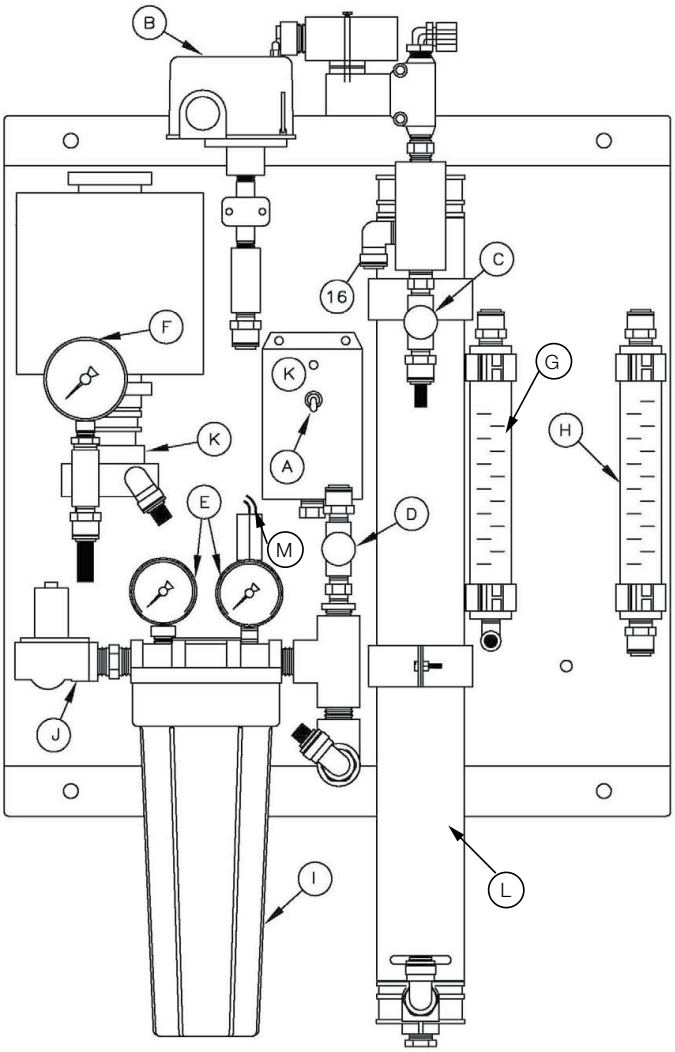



**Figure 1**

## D. Startup

1. Verify that the pretreatment equipment is installed and working properly. Verify that no free chlorine is present in the feed water.
2. Verify that the on / off switch is in the off position.
3. Install a 10" five micron filter cartridge in the prefilter housing.
4. Open the reject control valve completely (Figure # 1 item C) by turning it counterclockwise.
5. Close the reject recycle control valve (Figure # 1 item D) completely by turning it clockwise.
6. Open the feed water shutoff valve installed in step III-B-1 above.
7. Move the controller on/off switch to the on position.
8. Allow the unit to run for 15 – 30 minutes to flush the preservative from the membrane(s).
9. Adjust the reject control valves (Figure # 1 items C & D) until the desired flows are achieved. Closing the reject valve increases the product flow and decreases the reject flow. Opening the reject recycle valve decreases both the reject and product flow. See the flow rate guidelines and temperature correction table in the appendix to determine the flow rates for different operating temperatures. **Do not exceed 200psi on the pump discharge gauge (Figure #1 item F).**
10. Allow the product water to flow to drain for 30 minutes.
11. Turn off the system and connect the product line to the point of use. The product water line should never be restricted. Membrane and/or system damage may occur if the product line is blocked.
12. Restart the system and record the initial operating data using the log sheet.

## E. Control Function

1. When the on / off switch is in the on position, the inlet valve opens and the pump runs. If the product pressure switch is used then the pump will cycle based on the product water pressure. The switch is factory set to cut off at 40psi and cut on at 20psi. Instructions for adjusting the cut off and cut on pressures are located on the inside cover of the switch.
2. If the water pressure feeding the pump drops below 5psi for more than 5 seconds, the pump will turn off and the amber light on the control box will turn on. The controller will automatically reset after 30 minutes and the pump will turn back on. Cycle the on / off switch to manually reset a low-pressure shutdown.
3. **Autoflush –** This is a feature that provides increased reject flow at startup and for 2 minutes every hour. The timer is preprogrammed at the factory and should not be adjusted.

## F. Operation and Maintenance Log

| DATE | PRODUCT GPM | REJECT GPM | PUMP DISCHARGE PRESSURE | FEED TDS PPM | PRODUCT TDS PPM | FEED WATER TEMP | FEED WATER HARDNESS | FEED WATER CHLORINE LEVEL | PRE FILTER INLET PRESSURE | PRE FILTER OUTLET PRESSURE | REMARKS |
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**Note: Change the prefilter when the differential pressure increases by 5 - 10psi over the clean differential pressure.**
**Clean the RO membrane(s) when the product flow drops by 15% or more. (See appendix)**

## G. Troubleshooting

### RO Membrane Troubleshooting Guide

| SYMPTOMS | | | | | | |
|---|---|---|---|---|---|---|
| SALT PASSAGE | PERMEATE FLOW | PRESSURE DROP | LOCATION | POSSIBLE CAUSES | VERIFICATION | CORRECTIVE ACTION |
| Normal to increased | Decreased | Normal to increased | Predominantly first stage | Metal oxide | Analysis of metal ions in cleaning solution. | Improved pretreatment to remove metals. Cleaning with acid cleaners. |
| Normal to increased | Decreased | Normal to increased | Predominantly first stage | Colloidal fouling | SDI measurement of feed/ X-ray diffraction analysis of cleaning sol. residue. | Optimize pretreatment system for colloid removal. Clean with high pH, anionic detergent formulation. |
| Increased | Decreased | Increased | Predominantly last stage | Scaling ($CaSO_4$, $CaSO_3$, $BaSO_4$, $SiO_2$) | Analysis of metal ions in cleaning sol. Check LSI of reject. Calculate maximum solubility for $CaSO_4$, $BaSO_4$, $SiO_2$ in reject analysis. | Increase acid addition and scale inhibitor for $CaSO_3$ and $CaSO_4$. Reduce recovery. Clean with an acid formulation for $CaCO_3$, $CaSO_4$ and $BaSO_4$. |
| Normal to moderate increase | Decreased | Normal to moderate increase | Can occur in any stage | Biological fouling | Bacteria count in permeate and reject. Slime in pipes and vessels. | Shock dosage of sodium bisulfite. Continuous feed of low conc. bisulfite at reduced pH. Peracetic acid sterilization. Clean with alkaline anionic surfactant. Chlorine dosage upstream with dechlorination. Replace cartridge filters. |
| Decreased or moderately increased | Decreased | Normal | All stages | Organic fouling | Destructive testing, e.g. IR reflection analysis. | Optimization of pretreatment system (e.g. coagulation process.) Resin/ activated carbon treatment. Clean with high pH detergent. |
| Increased | Increased | Decreased | Most severe in the first stage | Chlorine oxidant attack | Chlorine analysis of feed. Destructive element test. | Check chlorine feed equipment and dechlorination equipment. |
| Increased | Increased | Decreased | Most severe in the first stage | Abrasion of membrane by crystalline material | Microscopic solids analysis of feed. Destructive element test. | Improved pretreatment. Check all filters for media leakage. |
| Increased | Normal to increased | Decreased | At random | O-ring leaks, End or side seal glue leaks. | Probe test. Vacuum test. Colloidal material passage. | Replace O-rings. Repair or replace elements. |
| Increased | Normal to low | Decreased | All stages | Conversion too high. | Check flows and pressures against design guidelines | Reduce conversion rate. Calibrate sensors. Increase analysis and data collection. |

## RO System Troubleshooting

| PROBLEM | CORRECTIVE ACTION |
|---|---|
| **General** | |
| **High Product Water TDS** | |
| Membrane frozen, high temp, or backpressure. | Replace membrane. |
| Membrane attack by chlorine Carbon pre-filter may be exhausted. | Replace filter and membrane. |
| Product seal on end cap. Determine if seal or O-ring is bad. | Replace as needed. |
| **No Product Water or Not Enough Product Water** | |
| Feed water shut off. | Turn on feed water. |
| Low feed pressure. Feed pressure must be at least 20psi. | Consider booster pump. |
| Pre-filter cartridge clogged. | Replace pre-filter cartridge. |
| Membrane fouled. | Determine and correct cause; replace or clean membrane. |
| Product check valve stuck. | Clean or replace check valve. |
| Low pump discharge pressure | Adjust reject valve or replace pump |
| Low feed water temperature | Increase membrane feed pressure or heat the feed water. |

# IV. Replacement Parts List

A list of common replacement parts is provided below. Contact your dealer for replacement parts assistance.

| ITEM NUMBER | DESCRIPTION |
|---|---|
| 1 | Pre filter housing 10" |
| 2 | RO membrane pressure vessel 2½" x 14" SS |
| 3 | RO membrane pressure vessel 2½" x 21" SS |
| 4 | RO membrane pressure vessel 2½" x 40" SS |
| 5 | Pressure gauge, 2", 0-100psi, dry, bottom mount |
| 6 | Pressure gauge, 2", 0-100psi, dry, back mount |
| 7 | Pressure gauge, 2½", 0-400psi, LF |
| 8 | Flow meter 0.1 – 1.0 gpm |
| 9 | Flow meter 0.2 – 2.0 gpm |
| 10 | Product pressure switch |
| 11 | Product pressure switch with auto / off lever |
| 12 | Motor 0.5 HP single phase 120 volt |
| 13 | Pump 140 GPH carbonator with relief valve |
| 14 | Low-pressure controller |
| 15 | Low-pressure switch, ¼" MPT, 3 – 40psi |
| 16 | Reject & recycle brass needle valve |
| 17 | Inlet solenoid valve, ½", 120 volt coil |
| 18 | 2½" x 14" RO membrane |
| 19 | 2½" x 21" RO membrane |
| 20 | 2½" x 40" RO membrane |
| 21 | Prefilter cartridge, 10", 5 micron |
| 22 | Product check valve, SS |

# V. Membrane Replacement

1. Turn off the system and close the feed water shutoff valve.
2. Disconnect the tubing from the pressure vessel.
3. Remove the retaining "U" pins from the pressure vessels.
4. Push the old membrane out of the vessel in the direction of the feed flow
5. Record the serial numbers of the new membranes.
6. Lightly lubricate the brine seals on the new membranes with clean water.
7. Install the new membranes in the direction of flow with the brine seal end going in last.
8. Lightly lubricate the end cap internal and external O-rings with glycerin.
9. Install the end caps and secure them with the "U" pins.
10. Reconnect the tubing to the pressure vessel.
11. Verify that all retaining "U" pins are installed.
12. Follow the start up procedure in section III-D.


# VI. Appendix

The following tables are intended as a guide to determining the flow rates for the PWR2511 series RO systems. All flows are in gallons per minute (GPM).

**Nominal flows for systems operating at 50% recovery.**

| MODEL NUMBER | PWR25111011 | PWR25112011 | PWR25113011 | PWR25113021 |
|---|---|---|---|---|
| **Product** | 0.10 | 0.17 | 0.41 | 0.83 |
| **Reject** | 0.10 | 0.17 | 0.41 | 0.83 |

## Temperature Correction Factors

| °C | °F | CORRECTION FACTOR |
|---|---|---|
| 30 | 86 | 1.16 |
| 29 | 84.2 | 1.13 |
| 28 | 82.4 | 1.09 |
| 27 | 80.6 | 1.06 |
| 26 | 78.8 | 1.03 |
| 25 | 77 | 1.00 |
| 24 | 75.2 | 0.97 |
| 23 | 73.4 | 0.94 |
| 22 | 71.6 | 0.92 |
| 21 | 69.8 | 0.89 |
| 20 | 68 | 0.86 |
| 19 | 66.2 | 0.84 |
| 18 | 64.4 | 0.81 |
| 17 | 62.6 | 0.79 |
| 16 | 60.8 | 0.77 |
| 15 | 59 | 0.74 |
| 14 | 57.2 | 0.72 |
| 13 | 55.4 | 0.70 |
| 12 | 53.6 | 0.68 |
| 11 | 51.8 | 0.66 |
| 10 | 50 | 0.64 |
| 9 | 48.2 | 0.62 |
| 8 | 46.4 | 0.61 |
| 7 | 44.6 | 0.59 |
| 6 | 42.8 | 0.57 |
| 5 | 41 | 0.55 |

Multiply the nominal product flow at 25° C by the temperature correction factor to determine the flow at various other temperatures.

**CALIFORNIA PROPOSITION 65 WARNING**

**WARNING:** This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

(California law requires this warning to be given to customers in the State of California.)

**For more information: www.watts.com/prop65**

**LIMITED WARRANTY:** Certain Watts Pure Water products come with a limited warranty from Watts Regulator Co. Other products may have no warranty or are covered by the original manufacturer's warranty only. For specific product warranty information, please visit www.watts.com or the published literature that comes with your product. Any remedies stated in such warranties are exclusive and are the only remedies for breach of warranty. **EXCEPT FOR THE APPLICABLE PRODUCT WARRANTY, IF ANY, WATTS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED. TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, WATTS HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND IN NO EVENT SHALL WATTS BE LIABLE, IN CONTRACT, TORT, STRICT LIABILITY OR UNDER ANY OTHER LEGAL THEORY, FOR INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR PROPERTY DAMAGE, REGARDLESS OF WHETHER IT WAS INFORMED ABOUT THE POSSIBILITY OF SUCH DAMAGES.**

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