Better Water, Inc.
698 Swan Dr. Smyrna, TN 37167
Ph. (615) 355-6063

Water System Information
For Manual

Customer	Date Installed
Address	Rated RO Flow
City	Rated Pre-Treatment Flow
State Zip	RO Serial #
RO Model	RO Pump Pressure
RO Product Flow	RO Membrane Pressure
RO Reject Flow	RO Reject Pressure
RO Recirc. Flow	RO Product Pressure
# Of Membranes	Membrane Array
Membrane Manuf.	Membrane Model
RO Membrane #1 Serial Number	RO Membrane #2 Serial Number
RO Membrane #3 Serial Number	RO Membrane #4 Serial Number
	Voltage Amp Phase
RO Pump Model	Pump Serial #
RO Motor Model	Motor Serial #
RO Height RO Depth	RO Width
Ultrafilter Model	Post Treat. Model
UF # of Membranes N/A	Post Treat. # of Membranes
UF Serial #	Post Treat. Serial #
Bi-Carb Model	Divert-Drain Model
Bi-Carb Serial #	Divert-Drain Serial #

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IT IS UNSAFE TO START USING THIS DEVICE WITHOUT FIRST READING AND UNDERSTANDING THIS MANUAL IN ITS ENTIRETY

OPERATOR'S INSTRUCTIONS

FOR

REVERSE OSMOSIS MACHINE

Model: BW-_____

Serial Number:_____

ADDRESS: _____
_____
_____

IMPORTANT DOCUMENT
PLEASE SAFEGUARD

ORIGINAL

DATE: _____

REVISED
December 22, 2003
(RO1232manA.doc)

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USER ASSISTANCE INFORMATION

Assistance is available: Monday through Friday (excluding holidays), 7:30 am to 4:00 pm Central Time. Call: 615-355-6063 and follow the telephone prompts.

Emergency assistance is available after normal operating hours (including holidays). **Before** calling for emergency assistance, please:

- **check** the electrical power connections, fuses, and/or circuit breakers.
- **check** the inlet water connections and flow.
- **press** the alarm reset button.
- **check** the operator's trouble-shooting guide.

If this fails to correct the problem **and an emergency hemodialysis treatment situation exists,** please call: 615-355-6063, **ext: 01**. (You will enter the directory of on-call cell phone numbers, please copy all numbers, and then call the most appropriate one)

Table of Contents

WARNINGS and **CAUTIONS**

WARNING: It is unsafe to operate this device without first reading and understanding the **entire** Operator's Instruction Manual.

WARNING: Misuse or improper operation of this device could result in serious injury, death, or other serious reactions to a patient undergoing hemodialysis treatment.

WARNING: Misuse, improper use or handling of chemical disinfectants and chemical cleaning solutions could result in serious injury or even death. You must comply with the information contained in the Material Safety Data Sheet (MSDS) for the chemical being used and follow the procedural steps in this Operator's Instruction Manual

CAUTION: Improper operation of this device could result in a low or no-flow alarm on the hemodialysis machine.

CAUTION: Misuse or improper operation of this device will void any warranty.

INTRODUCTION

Your Better Water Reverse Osmosis (RO) Machine is a computer-aided design, custom built, and of the utmost quality. With proper operation, maintenance and care, this device should give you years of reliable service.

Before you start using this device, you must read and understand this manual in its entirety. This manual of Operator's Instructions describes in considerable detail all of the steps and procedures required to **safely** operate this device.

It is **unsafe** to operate this device without a basic understanding of water treatment and a thorough understanding of the contents of this manual.

Your RO was designed and built to your specifications and consideration for the information that has been provided to us on the current tap water conditions at your site of operation.

There is not a Reverse Osmosis Machine on the market that is a panacea for all water treatment requirements. The RO cannot do the job alone; therefore, one must understand that changing tap water conditions require monitoring.

Incoming tap water **contaminants, temperature, pH, pressure and flow-rates** have a **direct impact** on the **quality** and **quantity** of the Reverse Osmosis Machine **output**.

You must be aware of changing tap water conditions. This can be easily accomplished with good, two-way communications with your municipal drinking water supplier and with routine testing of the tap water provided to you.

To emphasize the importance of water treatment and proper use of water treatment equipment used for hemodialysis, the following is quoted from Health and Human Services Publication FDA 89-4234,

"Numerous reports have documented that use of inadequately treated water for hemodialysis poses a severe threat to the health and safety of the hemodialysis patient. Despite this, water treatment and water quality are often neglected areas of hemodialysis. A major reason for this neglect is that water treatment is a technically complex subject which is not generally a part of the education and training of clinical staff in hemodialysis facilities."

We, at Better Water, Inc., highly recommend the use of this very informative and self-teaching publication in your training programs.

Once the device has been delivered to you, "it is the **responsibility** of the **Medical Director** to ensure that the [device] is operated, monitored, and maintained in such a manner so as to satisfy all applicable standards for which the water may be used". (Quoted from HHS Publication FDA 89-4234).

Please keep this manual readily available for each of your operators to use.

DESCRIPTION

Your Reverse Osmosis (RO) Machine is a computer aided design, _____-membrane, _____array device that is pressurized by a stainless steel submersible pump and motor that are contained in a stainless steel cylinder. Based upon your specifications and consideration for the tap water data that was provided to us, your RO was custom designed and built to exacting standards and Good Manufacturing Practices outlined by the FDA.

Your RO is a device that uses a membrane separation process for removing solvent (contaminants) from solution (tap water). To best describe the process, the following is a quote from Health and Human Services Publication FDA 89-4234:

"In order to use reverse osmosis as a water purification process, the feed [tap] water is pressurized on one side of a semi permeable membrane. The pressure must be high enough to exceed the osmotic pressure to cause reverse osmotic flow of water. If the membrane is highly permeable to water, but essentially impermeable to dissolved solutes [contaminants], pure water crosses the membrane and is known as product water. As product water crosses the membrane, the concentration of dissolved impurities increases in the remaining feed water (a condition known as concentration polarization) and, as a consequence, the osmotic pressure increases. A point is reached at which the applied pressure is no longer able to overcome the osmotic pressure and no further flow of product water occurs. Moreover, if the applied pressure is increased in an attempt to gain more product water, a point is reached at which the membrane becomes fouled by precipitated salts and other undissolved material from the water. Therefore, there is a limit to the fraction of feed water which can be recovered as pure water and reverse osmosis units are operated in a configuration where only a portion of the feed water passes through the membrane with the remainder being directed to drain (cross-flow configuration). The water flowing to drain contains concentrated solutes and other insoluble materials, such as bacteria, endotoxin and particles, and is referred to as the **reject stream**. Typically, the product water to feed water ratio is of the order of 25 to 50% for purification of water for hemodialysis by reverse osmosis".

Your RO is the most important and costly component in your water treatment system. With appropriate pretreatment of the tap water, proper cleaning and disinfection, the RO life can be prolonged for several years.

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IMPORTANT DATA
&
CHECK POINTS PRIOR TO INSTALLATION

1. **Tap Water Requirements** (Critical Factors):

   a). **Pressure**: 40 psi **(Minimum)**; 90 psi (Maximum). The minimum pressure must be maintained with water flowing at the maximum required flow-rate.

   b). **Flow-rate:** _____ gpm (gallons-per-minute) **Minimum.**

   c). **Chlorine/Chloramines:** <0.1 ppm.

   d). **Silt Density Index (SDI)**: <5.

   e). **Turbidity**: <1 NTU.

   f). **Hardness:** <2 gpg (grains-per-gallon) or 34.2 ppm (parts-per- million).

   g). **Temperature:** 70-85 degrees Fahrenheit (optimum: 77 degrees Fahrenheit or 25 degrees centigrade).

2. **Electrical Requirements:** Must be in compliance with all applicable governing codes and ordinances.

   a). _____ volts AC, **60** Hz, _____-phase.

   b). The circuit must be protected by a _____ amp circuit breaker.

3. **Drain Requirement:** A suitable floor drain that will comply with codes and ordinances that will accept a flow-rate of 10 gpm.

4. **Floor Space:** An area measured 48" x 48" that will support 250 pounds is required to provide sufficient space for installation and operation of this device.

5. **Machine Specifications:**

a). Model/Serial Number: BW-_____.

b). Number of Membrane Vessels: _____

c). Number of Membranes per Vessel: One

d). Membranes:

Membrane Manufacturer_____Membrane Model_____

#1 s/n _____
#2 s/n _____
#3 s/n _____
#4 s/n _____

e). Membrane Array: _____

f). Pump: Teel model #_____ s/n_____.

g). Pump Motor: Teel model #_____ s/n_____.

h). Dimensions:

Height:____" Width: ____" Depth: ____" Weight: Approximately 250 lbs

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REVERSE OSMOSIS MACHINE START-UP PROCEDURES

We have built your Reverse Osmosis Machine (RO) to be extremely user friendly. To start the RO, the operator must change the position of only one switch. However, we have found that some people like to touch an area that is identified "WET PAINT", and we have found that some people like to move switches, because switches are there to be moved. Before you change the position of the one switch required to start the RO, please perform the following preliminary steps.

To start the Reverse Osmosis Machine (RO):

1. Check the RO CONTROL PANEL:

   a). All alarm lights should be **OFF** and **NO** audible alarm should be sounding. If any one or more of the alarm lights are **ON** and/or an audible alarm is sounding, **PRESS** the Alarm **RESET** button. All alarm lights should go out and audible alarms should stop sounding.

WARNING
Disinfectants can
cause serious injury
or death to patients
undergoing hemodialysis
treatment.

   b). The keyed, **OPERATE-DISINFECT** switch should be in the **OPERATE** position. **If this switch is in the DISINFECT position,** you **MUST** verify that the RO does **NOT** contain any disinfecting solution **BEFORE** proceeding to the next step.

   c). The **OPERATE-DISINFECT-OFF** switch should be in the **OPERATE** position. If the switch is in the **DISINFECT or OFF** position, see step 1b and the warning above.

d). If you must reset the switches listed above, the alarm lights will illuminate and the audible alarm will sound, **PRESS** the Alarm **RESET** button to return the alarms to normal.

2. Now you are ready to start the RO: Simply move the **OPERATE-FLUSH** switch from **FLUSH** to the **OPERATE** position. The rest is automatic.

a). The Purge cycles will commence.

NOTE: After approximately 30 seconds the RO pump will start, and at the same time, the Water Quality Alarm will begin to sound. This is a normal function to advise you that the first water produced by the RO is being routed to drain until the quality equals the set-point on the Water Quality Monitor. This purge cycles may take approximately **two minutes.**

b). After the Purge Cycles have completed, the R.O. should be operating within the parameters as listed below:

1). Pump pressure should read: **150-200** psi.

2). Membrane pressure should read: **100-150** psi.

3). Reject Pressure should read: **50-100** psi.

4). Product Pressure should read: **0 (zero)** on tank feed systems, and **20-70** psi on direct feed systems.

5). The Product Flow Meter should read: _____ **(+/- 15%)**.

6). The Reject Flow Meter should read: _____ **(+/- 15%)**.

7). The Recirculation Flow Meter should read: _____ **(+/- 15%)**.

8). The water quality should be above the set-point (90%).

3. If your RO is not within the design specifications listed above, go the section titled: Reverse Osmosis Machine - Operator Adjustments.

4. Perform a thorough quality assurance check of your entire water treatment system including pretreatment, primary treatment, post treatment, and distribution.

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REVERSE OSMOSIS MACHINE SHUT-DOWN PROCEDURES

After the hemodialysis day is over, you will find it very easy to shut-down your RO by changing the setting on only **one switch.**

To shut-down the Reverse Osmosis Machine (RO):

NOTE: The RO is not completely turned-off. It is placed into an idle or standby mode that is called the FLUSH Mode.

1. Ensure there are no further requirements for water for hemodialysis or other systems used in your facility.

2. Move the **OPERATE-FLUSH** switch from the **OPERATE** to the **FLUSH** position, and the RO will enter into an automatic and scheduled Flush program. The amber, Flush light will come on when the R.O. actually starts-up and goes into flush at the pre-determined time, or when manually cycled into the flush mode by the 24 hr. timer.

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REVERSE OSMOSIS MACHINE ADJUSTING PROCEDURES

On occasion, your RO may require adjustments that can be performed by **qualified operators**. There are many factors that can affect the performance of the RO. If minor adjustments to the RO do not produce the desired results, you must investigate changes in the tap water feeding the RO. Tap water pH, temperature, pressure, TDS, and flow changes can cause a **drastic** reduction in the RO performance. **In worst case situations,** changes to the tap water can create conditions the RO cannot handle without augmentation.

CAUTION: Only **qualified** RO operators should make adjustments to the RO.

CAUTION: The inlet water temperature must be **70-85** degrees Fahrenheit with **77°F being optimum**. The temperature must be measured while the RO is running. The RO inlet water pressure must be >39 psi while flowing at a rate of ____ gpm **(minimum)**.

CAUTION: While making adjustments, the RO must be running with **no** alarm conditions indicated.

PREPARATION: Before making any adjustments, read this entire section and pay close attention to cautions, notes, and items marked important.

1. **Product Flow Adjustment*: NOTE:** This adjustment affects both the Product Flow and the Reject Flow. Peak RO efficiency is obtained when the Product Flow and the Reject Flow are the same.

   a). On the front panel of the RO, locate the "T-Handle" on the Reject/ Product Regulating Valve.

b). Slowly, turn the "T-Handle" on the Reject/Product Regulating Valve clockwise or counterclockwise, as required, to balance **(as close as possible)** the Reject and the Product Flows.

c). After the Reject and Product Flows have been balanced, perform a Quality Assurance Check on the RO to insure all pressures and flows are within design specifications.

2. **Reject Flow Adjustment *:** Same as Product Flow Adjustment. See paragraph 1a, b, & c above.

3. **Recirculation Flow Adjustment*:**

a). On the front panel of the RO, locate the "T-Handle" to the Recirculation Regulating Valve.

b). Slowly, turn the "T-Handle" on the Recirculation Regulating Valve clockwise or counterclockwise, as required, to adjust the Recirculation Flow to design specifications.

c). After the Recirculation Flow has been adjusted, perform a Quality Assurance Check on the RO to insure all pressures and flows are within design specifications.

4. **Pump Pressure Adjustment*:** There are **no** requirements to adjust the Pump Pressure. The Pump Pressure Gauge is used solely to monitor Pump performance. Please refer to the Membrane Pressure Adjustment below.

5. **Membrane Pressure Adjustment*: NOTE:** This adjustment affects both the Pump Pressure and the Membrane Pressure.

a). Read paragraph 4 above.

b). Locate the **"Pump/Membrane Adj."** valve**:** On the right-hand side of the RO and located at the top of the stainless steel, Pump/ Motor housing, you will find a stainless steel valve with a yellow, lever-type handle used to adjust the Membrane Pressure.

IMPORTANT NOTE: Only minute adjustments to the **"Pump/ Membrane Adj."** valve are required to achieve the desired results. If you make abrupt adjustments, the RO may enter into an alarm condition.

c). This is a delicate adjustment. **Very slowly**, move the Yellow handle on the Membrane Adjustment Valve **left to decrease** or **right to increase** the Membrane Pressure to design specifications.

d). After adjusting the Membrane Pressure, perform a Quality Assurance Check on the RO to insure all pressures and flows are within design specifications.

6. **Reject Pressure Adjustment*:** There are **no** requirements to adjust the Reject Pressure. The Reject Pressure Gauge is used solely to monitor the pressure drop across the membrane.

7. **Product Pressure Adjustment*:** There are no requirements to adjust the Product Pressure on a Tank Feed system. If installed, the Product Pressure Gauge is for any possible Feed System changes in the future.

8. **Product Pressure Adjustment for Direct Feed Systems:** Product pressure should be adjusted only when there are no requirements for R.O. water. Locate the pressure by-pass T-handle at the end of the distribution loop. To increase product pressure, turn T-handle clockwise. Maximum product pressure is 70 psi. To decrease product pressure, turn the T-handle counter-clockwise. Minimum 20 psi.

NOTE: Product pressure must be 10 psi greater than feed water/5 micron filter out pressure to the R.O. Adjustments on feed water pressure may be required before attempting to adjust product pressure.

*** If you are unsure of any adjusting procedure, please call our Assistance phone number, we will gladly discuss the situation, and if necessary, talk you through the procedure.**

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REVERSE OSMOSIS MACHINE DISINFECTING PROCEDURE

Your RO comes to you with new, proprietary Thin Film Material membranes that should not be disinfected for a period of six-weeks after initial installation. After the initial break-in period of six-weeks, it is recommended that you routinely disinfect the membranes every 30 days with an approved disinfectant that will not degrade the membranes or the components of the RO. Based on your specification for Renalin disinfectant, your RO was built with components that will tolerate paracetic acid type disinfectants. The membranes will not tolerate sodium hypochlorite (bleach).

WARNING

Disinfectants can cause serious harm or death. Wear protective clothing and face protection.

This procedure covers the mechanical steps required to disinfect the Reverse Osmosis Machine. The preparation of the disinfecting solution must be in accordance with specification established for the selected disinfectant. The disinfectant must be handled in accordance with its Material Safety Data Sheet (MSDS).

CAUTION

This procedure should be performed by well trained and qualified people.

1. **Preparation**: **Before performing the disinfection procedure, read the entire procedure.**

   a). Rinse the inside of the Disinfect Tank with RO Product water and drain thoroughly.

b). Add the predetermined quantity of RO Product water (approx. 20 gallons) to the Disinfect Tank. **DO NOT ADD THE DISINFECTANT AT THIS TIME.**

2. In accordance with the following procedures, place the RO into the **DISINFECT** mode:

a). Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position.

b). Turn the keyed, **OPERATE-DISINFECT** switch to the **DISINFECT** position. **REMOVE AND PROTECT THE KEY**.

c). Turn the **OPERATE-FLUSH** switch to the **OPERATE** position.

3. In accordance with the following steps, connect the Disinfect Tank to the RO:

a). Properly identify and connect the **Disinfectant Feed Line** (bottom line on the Disinfect Tank) to the **RO Disinfect/Clean Valve** (Yellow Handle Valve, located at the bottom left side of the RO and labeled **DISINFECT/CLEAN** Valve).

b). On the Disinfect Tank, properly identify and **OPEN** the **Disinfect Feed Valve** (located on the bottom, front of the Disinfect Tank).

c). **OPEN** the **RO Disinfect/Clean Valve** (Yellow Handle Valve located at the bottom left side of the RO and labeled DIS**INFECT/ CLEAN** Valve).

d). Disconnect the **RO Drain Line** from the drain, and connect it to either of the Disinfect Tank top ports.

e). Disconnect the **RO Product (permeate) line** from the Storage Tank, and connect it to the remaining **port located at the top of the Disinfect Tank**.

NOTE: On a Direct Feed system, proceed with steps a-d. Before proceeding to step f, ensure that the disinfectant of choice is compatible with water contact materials, as well as the Dialysis Machine. Also ensure that all post R.O. filters are removed, and D.I. tanks are by-passed. The product/permeate line should

remain connected to the loop. Disconnect the loop return line from the R.O. and connect it to either of the disinfect tank top ports.

CAUTION

If the lines are not connected properly
and the valves are not open,
the RO pump will be damaged.

f). Double-check your work. **DO NOT ADD THE DISINFECTANT**.

4. Using the following procedure, check the disinfecting system for leaks.

For safety reasons, this step is performed without the disinfecting chemical.

CAUTION

Upon pump start,
there must be an
immediate flow into
the top of the
disinfect tank.

a). Turn the **OPERATE-DISINFECT-OFF** switch to the **DISINFECT** position.

b). **IMPORTANT:** Check for an **immediate** flow into the top of the Disinfect Tank. If there is no flow, **immediately** turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position and check the RO **DISINFECT/CLEAN VALVE** and the **DISINFECT FEED VALVE** on the Disinfect tank. **BOTH** valves must be **OPEN**.

c). Allow the water to flow for one to two minutes and check for leaks.

d). Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position.

WARNING

Before proceeding, don appropriate protective clothing and face protection.

IF NO LEAKS WERE FOUND, add the predetermined quantity of chemical disinfectant to the water in the Disinfect Tank. Do NOT close the lid to the Disinfect Tank.

5. In accordance with the following procedures, disinfect the RO:

   a). Turn the **OPERATE-DISINFECT-OFF** switch to the **DISINFECT** position. The RO pump will start, and disinfecting solution will circulate throughout the RO and **immediately** return to the Disinfect Tank.

   b). **CAUTION: There must be an immediate flow return to the Disinfect Tank. IF NOT, immediately, turn the OPERATE-DISINFECT-OFF switch to the OFF position AND RECHECK the steps in paragraph 4a, b, c, d, and e.**

   c). Close the lid on the Disinfect Tank.

   d). **IMPORTANT**: Allow the RO to run in the **DISINFECT** mode for 10-15 minutes. **A longer period of time can cause the pump to overheat.**

   e). Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position. The RO pump will shut-down, and all power will be disconnected from the control panel.

   f). Place a **WARNING** placard on the RO Control Panel stating the, "**RO contains disinfectant DO NOT OPERATE".**

   g). While wearing protective face shields and protective clothing, carefully perform the following steps to remove the Disinfect Tank and lines.

1.On the RO, close the RO **DISINFECT/CLEAN** Valve.

2. On the Disinfect Tank, close the **DISINFECT FEED** Valve.

WARNING: **All lines from the Disinfect Tank to the RO contain disinfecting solution, and when each one is disconnected from the RO, the solution will drain from the line; therefore, you must use a disposable container to catch the solution or hold the line in a position to cause the solution to flow to the Disinfect Tank.**

3. Disconnect the RO Drain line and return it to drain.

4. Disconnect the RO Product (permeate) line and connect it to **DRAIN**. On Direct Feed systems, the R.O. product line will remain connected to the distribution loop.

5. Disconnect the Disinfect Feed Line from the RO **DISINFECT/CLEAN** Valve.

5a. On Direct Feed systems, connect the loop return line to drain.

6. In accordance with approved methods and procedures, dispose of the remaining disinfecting solution.

7. Allow the disinfecting solution to stand or dwell in the RO for the specified period of time for the disinfectant used.

8. Alert the nursing supervisor; the RO contains a disinfectant.

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REMOVING DISINFECTANT FROM THE REVERSE OSMOSIS MACHINE.

WARNING

ALL RO lines contain disinfectant.
Wear protective clothing and face protection.

1. Ensure the disinfectant has been allowed to stand or dwell for the specified time.

2. Ensure the RO Product (permeate) line is connected to **drain**. Secure the line. (On Direct Feed systems, the product line should remain connected to the distribution loop.)

3. Ensure the RO Reject (drain) line is connected to **drain**. (On Direct Feed systems, ensure that the loop return line is connected to the drain.)

4. Ensure the RO **DISINFECT/CLEAN** Valve is closed.

5. Ensure the **OPERATE-FLUSH** switch is in the **OPERATE** position.

6. Insert the key into the **OPERATE-DISINFECT** switch and turn it to the **OPERATE** position.

7. Turn the **OPERATE-DISINFECT-OFF** switch to the **OPERATE** position and **PRESS** the alarm **RESET** to reset the alarms.

   a). The Purge cycles will begin.

   b). After approximately 30 seconds, the RO pump will start.

   c). The product water will be routed to drain.

   d). The Water Quality Alarm will sound.

8. Allow the RO to operate in this configuration for a **minimum** of **two hours**, or until the disinfectant is rinsed clear.

9. After the two-hour time period and by using an approved reagent, check for residual disinfectant. If residual disinfectant is detected, allow the RO to run and retest every 30 minutes until no residual disinfectant is detectable.

10. Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position.

11. Allow the RO to stand idle for **30 minutes**.

12. After the 30 minute, idle period, turn the **OPERATE-DISINFECT-OFF** switch to the **OPERATE** position and **PRESS** the alarm **RESET** to reset the alarms.

13. Allow the RO to run for another 10 minutes (**minimum**).

14. Check the RO product water for residual disinfectant. This test is for a phenomenon known as **"disinfectant rebound"**. If disinfectant is detected, continue the run-test procedure until no residual disinfectant is detectable.

15. When no residual disinfectant is detectable:

a). Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position.
b). Reconnect the RO Product (permeate) line to its normal operate position.

1. On Direct Feed systems, reconnect the loop return line to the R.O.

c). Remove the **WARNING** placard from the RO.
d). Advise the Nursing Supervisor that the disinfectant has been removed from the RO and no residual disinfectant is detectable.

16. **Before the next hemodialysis treatment, have a second, knowledgeable person verify the absence of residual disinfectant.**

17. Perform a Quality Assurance Check on the RO. Begin normal operation.

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REVERSE OSMOSIS MACHINE MEMBRANE CLEANING PROCEDURES

On occasion, your RO Membranes will require cleaning with chemical cleaners to regain maximum performance. The membrane cleaning procedure is almost identical to the RO disinfecting procedure with the exception: there is no stand or dwell time for the chemical cleaning solution.

Membrane fouling is **indicated** when:

- The Product Flow **decreases** and the Reject Flow **increases**, and the two cannot be adjusted to design specifications.

- The Pump Pressure **increases**, the Membrane Pressure **increases**, and the Reject Pressure **decreases** and cannot be adjusted to design specifications.

- The Quality Monitor indicates a continuous **decline** in water quality.

NOTE: Other factors, such as changes in the tap water pH, TDS, temperature, and/or pressure can cause **drastic** changes in the overall performance of the RO.

WARNING

Chemical cleaners can cause serious injury or death.

This procedure covers the mechanical steps required to clean the Reverse Osmosis Machine Membranes. The preparation of the chemical cleaning solution must be in accordance with the specifications established for the selected cleaning chemical. The cleaning chemical must be handled in accordance with its **M**aterial **S**afety **D**ata **S**heet (MSDS).

CAUTION

This procedure should be performed by well trained and qualified people.

1. **Preparation:** **Before cleaning the membranes, read this entire procedure from beginning to end.**

a). Rinse the inside of the Disinfect/Cleaning Tank with RO Product water and drain thoroughly.

b). Add the predetermined quantity of RO Product water to the Cleaning Tank. **DO NOT ADD THE CLEANING CHEMICAL AT THIS TIME**.

2. In accordance with the following procedure, place the RO into the DISINFECT **(Clean)** mode.

a). Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position.

b). Turn the keyed, **OPERATE-DISINFECT** switch to the **DISINFECT (Clean)** position. **REMOVE AND PROTECT THE KEY.**

c). Turn the **OPERATE-FLUSH** switch to the **OPERATE** position.

3. In accordance with the following steps, connect the Disinfect/Cleaning Tank to the RO:

a). Properly identify and connect the Disinfectant (Cleaner) Line (bottom line on the Disinfect/Cleaning Tank) to the RO **DISINFECT/CLEAN** Valve (Yellow Handle Valve, located at the bottom left side of the RO and labeled **DISINFECT/CLEAN** Valve).

b). On the Disinfect/Cleaning Tank, properly identify and **OPEN** the **DISINFECT/CLEAN FEED** Valve (located on the bottom, front of the Disinfect/ Cleaner Tank.

c). **OPEN** the RO Disinfect/Clean Valve (Yellow Handle Valve located at the bottom left side of the RO and labeled **DISINFECT/CLEAN** Valve).

d). Disconnect the RO Drain Line from the drain, and connect it to either of the Disinfect/Clean Tank top ports.

e). Disconnect the RO Product (permeate) line from its normal operate position, and connect it to the remaining port located at the top of the Disinfect/ Clean Tank.

CAUTION

If the lines are not connected properly
and the valves are not open,
the RO pump will be damaged.

f). **Double-check** your work. **DO NOT ADD THE CHEMICAL CLEANER.**

4. Using the following procedure, check the cleaning system for leaks.

For **safety** reasons, this step is performed without the cleaning chemical.

CAUTION

Upon pump start,
there must be an
immediate flow into
the top of the
Disinfect/Cleaning Tank

a). Turn the **OPERATE-DISINFECT-OFF** switch to the **DISINFECT (Clean)** position and **PRESS** the alarm **RESET** to reset the alarms.

b). **IMPORTANT:** Check for an **immediate** flow into the top of the Disinfect/ Cleaning Tank. If there is no flow, **immediately** turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position and check the RO

DISINFECT/ CLEAN Valve and the **DISINFECT/CLEANING** Valve on the Disinfect/ Cleaning Tank. **BOTH** valves must be **OPEN**.

c). Allow the water to flow for one to two minutes and check for leaks.

d). Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position.

WARNING

Before proceeding, don appropriate protective clothing and face protection.

IF NO LEAKS WERE FOUND, add the predetermined quantity of chemical cleaner to the water in the Disinfect/Cleaning Tank. Do **NOT** close the lid to the Disinfect/Cleaner Tank.

5. In accordance with the following procedures, clean the RO membranes:

a). Turn the **OPERATE-DISINFECT-OFF** switch to the **DISINFECT (Clean)** position and **PRESS** the alarm **RESET** to reset the alarms. The RO pump will start, and cleaning solution will circulate throughout the RO and immediately return to the Disinfect/Cleaning Tank.

b). **CAUTION:** There must be an **immediate** flow return to the Disinfect/ Cleaner Tank. If **NOT**, **immediately**, turn the **OPERATE-DISINFECT- OFF** switch to the **OFF** position **AND RECHECK** the steps in paragraph 4a, b, c, d, and e.

c). Close the lid on the Disinfect/Cleaning Tank.

d). **IMPORTANT:** Allow the RO to run in the **DISINFECT** (Clean) mode for 10-15 minutes. A longer period of time can cause the pump to **overheat.**

e). Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position. The RO pump will shut-down, and all power will be disconnected from the control panel.

f). While wearing protective face shields and protective clothing, carefully perform the following steps to remove the Disinfect/Cleaning Tank and lines from the RO.

1. On the RO, **close** the RO Disinfect/Clean Valve.

2. On the Disinfect/Cleaning Tank, **close** the **DISINFECT/CLEAN FEED** Valve.

WARNING: All lines from the Disinfect/Cleaning Tank to the RO contain cleaning solution. When each line is disconnected, the solution will drain from the line; therefore, you must use a disposable container to catch the solution, or you must hold the end of the line in an elevated position to cause the solution to flow to the Disinfect/Cleaning Tank.

3. Disconnect the RO Drain line from the Disinfect/Cleaning Tank and return it to **DRAIN**

4. Disconnect the RO Product (permeate) line from the Disinfect/ Cleaning Tank and connect it to **DRAIN**.

5. Disconnect the Disinfect/Cleaning Line from the RO **DISINFECT/CLEAN** Valve.

6. In accordance with approved methods and procedures, dispose of the remaining cleaning solution.

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REMOVING CHEMICAL CLEANING SOLUTION FROM THE REVERSE OSMOSIS MACHINE

WARNING

ALL RO lines contain cleaning solution.
Wear protective clothing and face protection.

1. Ensure the RO Product (permeate) line is connected to **DRAIN.** Secure the line.

2. Ensure the RO Reject (drain) line is connected to drain.

3. Ensure the RO **DISINFECT/CLEAN** Valve is **closed**.

4. Ensure the **OPERATE-FLUSH** switch is in the **OPERATE** position.

5. Insert the key into the **OPERATE-DISINFECT** switch and turn it to the **OPERATE** position.

6. Turn the **OPERATE-DISINFECT-OFF** switch to the **OPERATE** position and **PRESS** the alarm **RESET** to reset the alarms.

   a). The Purge cycles will begin.

   b). After approximately 30 seconds, the RO pump will start.

   c). The product water will be routed to drain.

d). The Water Quality Alarm will sound. You may silence the alarm by pressing the alarm mute switch. The alarm will re-sound in 30 seconds if the R.O. alarm condition still exists.

7. Allow the RO to operate in this configuration for a **minimum of two hours**.

8. After the two-hour rinse period, check for residual cleaning chemicals by performing a pH test of the tap water feeding the RO and the RO Product water. The Product pH should be within one point of the tap water pH. If residual cleaning chemicals are detected, continue the rinse program for an additional 30 minutes and retest. Continue the rinse-test procedure until no cleaning chemicals are detected.

9. Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position.

10. Allow the RO to stand idle for **30 minutes**.

11. After the 30 minute, idle period, turn the **OPERATE-DISINFECT-OFF** switch to the **OPERATE** position and **PRESS** the alarm **RESET** to reset the alarms.

12. Allow the RO to run for another **10 minutes (minimum)**.

13. Perform the pH test for residual cleaning chemicals. This test is for a phenomenon known as "rebound". If cleaning chemicals are detected, continue the run-test procedure until no residual cleaning chemicals are detectable.

14. When no residual cleaning chemicals are detectable:

a). Turn the **OPERATE-DISINFECT-OFF** switch to the **OFF** position.

b). Reconnect the RO Product (permeate) line to its normal operate position.

c). Advise the Nursing Supervisor that the RO Membranes have been cleaned, and the cleaning chemicals have been rinsed from the RO.

15. **Before the next hemodialysis treatment,** have a second, knowledgeable person verify the absence of residual cleaning chemicals.

16. Perform a Quality Assurance Check on the RO and begin normal operations.

TROUBLE-SHOOTING GUIDE

This section of the Operator's Manual is a guide only for operators. It is not all inclusive for RO repair technicians. This guide should aid operators with reminders and routine trouble-shooting tasks. For any problem outside the confines of this guide, call for technical assistance. See page 2.

PROBLEM: The RO will not start.

CORRECTIVE ACTION:

1. Is the water level in the storage tank above the **#2** float switch?

   - If **yes**, this is a normal condition. When the water level drops below the **#2** float switch, the RO should start.

   - If **no**, proceed.

2. Press the Alarm **RESET** button; all alarm lights should go out and the audible alarm should be silenced and the RO should start.

3. Check the position of the RO switches:

   a). **OPERATE-FLUSH** switch should be in the **OPERATE** position.

   b). **OPERATE-DISINFECT** switch should be in the **OPERATE** position.

   c). **OPERATE-DISINFECT-OFF** switch should be in the **OPERATE** position.

   d). **TANK-OFF-DIRECT** switch should be in the **TANK** position.

4. Check the RO fuses and/or circuit breakers.

5. The R.O. is equipped with a pre-treatment interlock, which will not allow the R.O. to run when any piece of equipment is in regeneration. If there is pre-treatment in regeneration, it must be allowed to complete this cycle on its own before the R.O. unit may be started.

6. If steps **1**, **2**, **3**, **4**, & **5** do not correct the problem; call for assistance - see page #**2**.

PROBLEM: The RO has shut-down for no apparent reason and there are no alarms indicated.

CORRECTIVE ACTION:

1. Is there electrical power to other pieces of water treatment equipment?

   - If **yes**, check the RO circuit breakers AND circuit breakers that supply power to the RO.

2. The R.O. unit is equipped with an pre-treatment interlock, which will not allow the R.O. to run when any piece of pre-treatment is in regeneration. If there is pre-treatment in regeneration, it must be allowed to complete this cycle on its own before the R.O. unit may be started.

3. If this does not correct the problem, call for technical support. See page 2.

PROBLEM: The RO has shut-down and there are alarm indications.

CORRECTIVE ACTION:

1. Note the alarm that is indicated on the Control Panel.

2. Press the alarm reset button. If this corrects the problem, perform a Quality Assurance Check on the RO.

3. If this does not correct the problem, call for technical support. See page 2.

PROBLEM: When the tank is full, the RO will not shut off.

CORRECTIVE ACTION:

1. Check the **TANK-OFF-DIRECT** switch. It should be in the **TANK** position.

2. Check the top float switch located inside the storage tank.

3. If this does not correct the problem, call for technical support. See page 2.

PROBLEM: The RO Product water is continuously flowing to drain.

CORRECTIVE ACTION:

1. Check the Water Quality Monitor Set-Points.

2. Perform a Quality Assurance Check on the RO.

3. If this does not correct the problem, call for technical support. See page 2.

PROBLEM: The RO Audible alarm is sounding, but there are no alarm light indications.

CORRECTIVE ACTION:

1. Check the alarm light bulbs.

2. If this does not correct the problem, call for technical support. See page 2.

For any problem exceeding the operator's ability to correct, call for technical support. See page 2.

SUMMARY

Daily RO Start-up:

1. Move the **OPERATE-FLUSH** switch from the **FLUSH** to the O**PERATE** position.

2. Perform a Quality Assurance Check on the RO.

3. Perform a complete Quality Assurance Check on the entire water treatment system.

Daily RO Shut-down:

1. Ensure there are no requirements for treated water for hemodialysis.

2. Move the **OPERATE-FLUSH** switch from the **OPERATE** to the **FLUSH** position.

RO Disinfection and/or RO Membrane Cleaning: The procedure **cannot be summarized**. Follow the detailed steps outlined for each procedure.