The Water Company

OPERATING AND MAINTENANCE MANUAL

BRO-12 000
2000 l/hr
Reverse Osmosis Unit

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1 Introduction

This operating and maintenance manual outlines a general overview, operation, maintenance and troubleshooting details vital to the sustained performance and understanding of your system.

NOTE Before operating or servicing this system, this operating and maintenance manual must be read and fully understood. Keep it and other associated information regarding this system safe for future use.

2 Safety Precautions

2.1 General Safety Precautions

The system should be operated and maintained by trained personnel. Personnel must comply with this manual as well as the safety measures listed by their own employer. Water Purification Solutions cannot be held liable for any damages, injury or even death that may result from use of this system.

2.2 Safety Headings

The safety section of this manual outlines various safety headings throughout the manuals' text and are identified and defined as below:

NOTE: Indicates statements that provide further information and clarification.
CAUTION: Indicated statements that are used to identify conditions or practices that could result in equipment or property damage.
WARNING: Indicates statements that are used to identify conditions or practices that could result in injury or loss of life. Failure to follow these warnings could result in serious injury or even death.

3. Labelling

Do not remove any labelling of the system. These labels are used to warn against potential hazards as well as identify components.

4. General Plant Description

4.1 Purpose

To reduce dissolved salt content of raw water for later use.

4.2 Principle Process

Reverse Osmosis (RO) is a form of high pressure hyper filtration where dissolved solids are removed from the supply stream to produce treated water (permeate) and waste water (concentrate). This is a continuous process running at a fixed flow rate.

4.3 Process Flow

Water is fed from a municipal supply line to a media and cartridge filters before being pumped through the reverse osmosis (RO) stage of the system where the dissolved salt content is reduced. The treated water (permeate) is fed into a holding tank and the concentrate to drain.

5. Process Description

5.1 Pre-Filtration

Raw water is fed through a pressurised line into the water treatment system. The filtration stage of the system consists of a cartridge filter in which suspended matter larger than 5 micron is removed. A solenoid valve is used to shut off the supply line when the holding tank has reached its top level or when the system is turned off.

5.2 Reverse Osmosis (RO)

Pre-filtered water is fed to the RO system by means of the vertical centrifugal pump. The pump is controlled by the following parameters, namely:

- Product tank high level, indicated by a float level switch.
- Raw supply tank low level, indicated by a float level switch.
- Low pressure condition, indicated by the pressure switch.
- Timer unit contact.

The RO system generates two steams of water, a purified stream (permeate) is directed to the product tank, while the concentrated stream is directed to the drain. A ball valve on the concentrate line allows for manual flushing of the RO system.

Pressure indicators are fitted at strategic points to illustrate the systems operating pressure. Flow rate through the system can be monitored by the in-line rotameters on the permeate and concentrate lines.

En route to the product tank, permeate passes a conductivity probe, which reads conductivity of the product water.

6 Technical Data

6.1 Equipment Details

Reverse Osmosis Pump	Tag Qty Model Duty Power	P-01 1 CDLF4-12 $2m^2$/hr @ 14.4 bar 2.2kW
Cartridge Filter	Tag Qty Material Dimensions Elements	CF-1 2 Polypropylene Ø 4.5” x 20” L 5 µm, Glass Blown
Solenoid Valve	Tag Qty Model Actuated	SV-1 1 1.1/4” F BSP Electrically, 220V AV
Solenoid Valve	Tag Qty Model Actuated	SV-02 1 1.3/4” F BSP Electrically, 220V AV
Reverse Osmosis Vessel	Tag Qty Model Port Position Element	RO-1 8 4”, 1 Element, 300 PSI Same Side Port LP21-4040
Rotameter	Tag Qty Range Thread	FLM-1 2 0.25 – 2m3/hr ½” F BSP
Pressure Switch	Tag Qty Range Actuated	PS-01 1 -0.5 - 6 bar Electrically, 250V AC
Pressure Indicator	Tag Qty Model Range	PI-1 1 ¼” BSP, Bottom Entry 0-15 bar
Pressure Indicator	Tag Qty Model Range	PI-2 & 3 2 ¼” BSP, Rear Entry 0-25 bar
Conductivity Meter	Tag Qty Model Range	Conductivity Meter 1 CM-230 0-199.9µS/cm

6.2 Operating Parameters

Cartridge Filtration

Service Flow Rate :	2 m3 /hr
Max Operating Pressure :	6 bar
Element :	5 Micron (Ø4.5” x 20” L)
Replacement Intervals :	When required (Minimum once a month)

Reverse Osmosis

Service Flow Rate :	1m3 /hr
Flush Frequency :	30 seconds
Flush Period :	Every hour
Max Operating Pressure :	20 bar
Element :	LP21-4040
Replacement intervals :	When required

7. System Requirements

7.1 Plumbing

System connections are as follows:

- From raw supply to system inlet: 1.1/4"PVC
- From permeate outlet product tank: 1“PVC
- From concentrate outlet to drain: 1” PVC

NOTE: Ensure the diameter of pipeline can supply adequate flow with minimal head loss relative to pipe length.

NOTE: All municipal drain connections should not be connected together in a closed drain with any backpressure. i.e. drainage must be free flowing.

NOTE: The Brine from the RO has a high mineral content and should be delivered to drain or evaporation dam.

NOTE: We recommend that a qualified plumber installs the plumbing lines to and from the system

WARNING: The plumbing of this system is constantly under pressure during operation. Incorrect installation or operation of the system could result in serious injury or even death

7.2 Electrical

The electrical supply required for the plant is 230V (stable), 20A, 50Hz, single phase with Neutral and Earth.

NOTE: We recommend that a qualified electrician installs the electrical supply to the system.

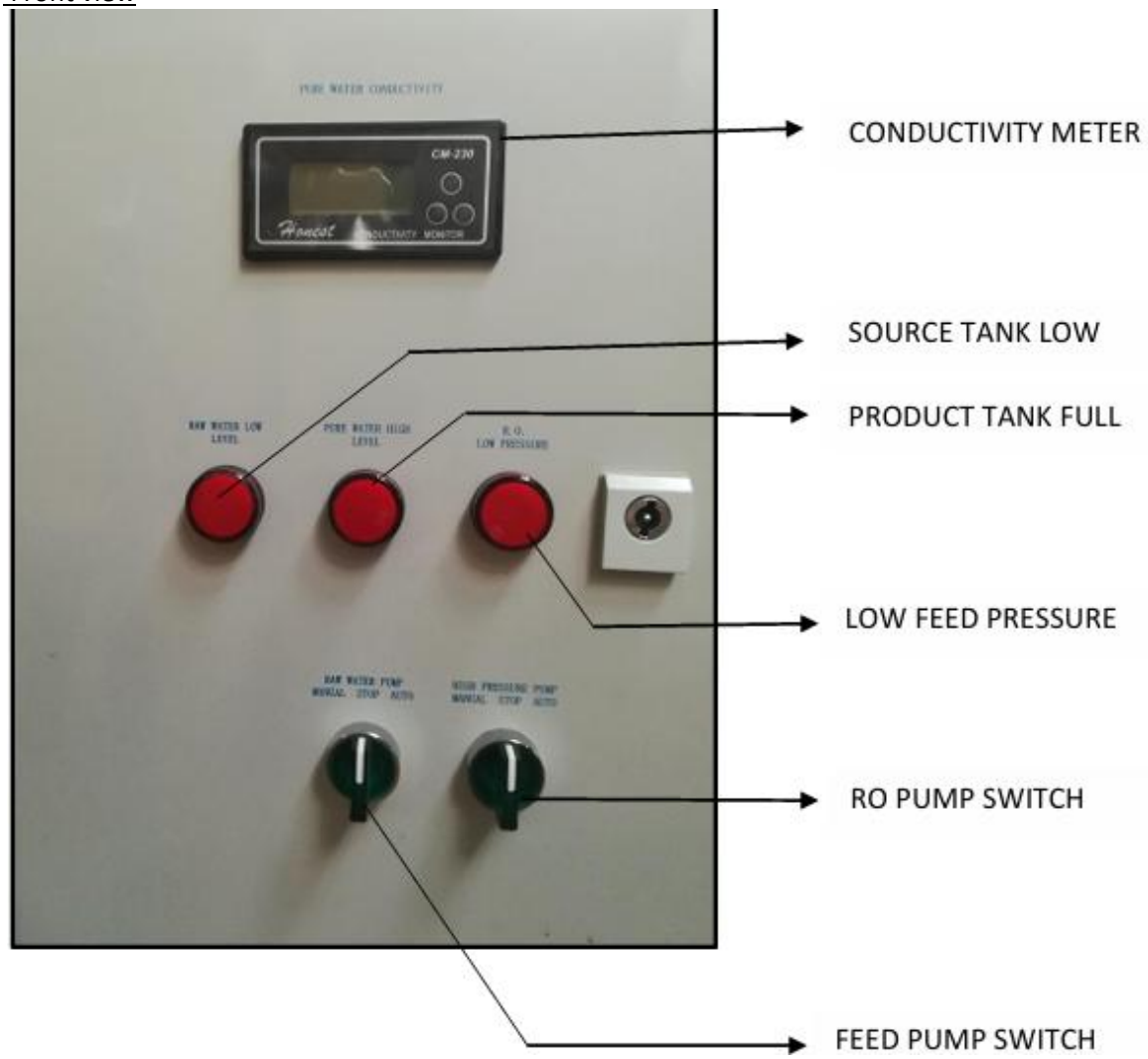
WARNING: To reduce the risk of electrical shock, the incoming electrical supply must include a protective earth connection. Electrical shock can result in serious injury or even death. Ensure the system is isolated from the supply before any electrical work commences.

WARNING: Incorrect installation of the electrical supply can result in serious damage to the equipment but can also result in serious injury or even death

8. Operating Procedures

8.1 Panel Overview

Front view



- "PRODUCT TANK FULL" Illuminates when the high level switch in the product tank is actuated. i.e. the product tank has reached its full level.
- "SOURCE TANK LOW" Illuminates when the high level switch in the source tank is actuated. i.e. the source tank is empty.
- "LOW PRESSURE" Illuminates when the pressure switch in the inlet is actuated. i.e. there is not enough pressure in the inlet.
- "RO PUMP RUNNING" Illuminates when the RO pump (P-1) is running.
- "RO PUMP SWITCH" Used to select which mode the RO pump runs:
  - When the switch is turned to the left, "MANUAL" is selected
  - When the switch is in the middle and "OFF" is selected
  - When the switch is in the right and "AUTO" is selected

8.2. Full System Start Up

A full system start up is performed when the system has been shut down for an extended period of time or after commissioning.

- Ensure all supply valves from the raw supply are open.
- Ensure the “RO PUMP SWITCH” is in the “OFF” position.
- Ensure the isolator switch is in the “ON” position
- Open the electrical enclosure and ensure the circuit breaker is in the “ON” position.
- Switch the “RO PUMP SWITCH” to the “ON” position.

NOTE: The pump will only start if the level switches are in the correct orientation, i.e. product tank is empty and there is sufficient supply pressure.

- Regulate the control valve, MV-1, (just after pump) to allow a slow flow.
- Allow the RO system to purge all air for about 30 seconds before closing the flush valve (MV-3).
- Regulate the concentrate control valves, MV-1 & 2, to allow a concentrate flow of around 13.3 l/min and a permeate flow of around 3.3 l/min. Confirm with rotameters (FLM-1 &2).

NOTE: Do not regulate the control valves (MV-1 & MV-2) when the RO flush valve (MV-3) is open.

- Confirm RO pressure (PI-1, 2 & 3) and flows (FLM-1 & 2). Ensure the correct flow and pressures as noted at last plant shut down, operating parameters (Please refer to 6.2 Operating Parameters).

8.3. Full System Shut Down

A full system shut down is performed if the plant is to be shut down for a period of three weeks or longer.

- Record all system operating parameters.
- Switch the “RO PUMP” selector switch from “AUTO” to “OFF”.
- Isolate the water treatment system by adhering to the following valve sequence:
  - CV-1 – Closed
  - CV-2 – Regulated
- Open the electrical enclosure and ensure the circuit breaker is in the “OFF” position.

9. Maintenance Information

9.1. Plant Operator Log Sheet

The water treatment system has been designed to the function with minimum input from the operator. However, it is strongly recommended that a daily log of important system parameters and activities is kept. These records are of utmost importance for gauging the systems long term efficiency as well as being a vital key in speeding up the troubleshooting, in the event of failure.

Review the log sheet on a regular basis for changes in operating parameters, water qualities etc. Regular monitoring of the system can bring imminent failures to light before stoppages result. Any abnormal conditions should be attended to or reported immediately.

Changes in raw water quality must be monitored on a regular basis to maintain acceptable treated water quality. It may be necessary to adjust operating flows and pressures.

9.2. Maintenance Tasks

Daily

- Maintain the system in a clean and tidy condition.
- Inspect the system for any leaks. If any, seal / repair them accordingly.
- Monitor the system for any abnormal conditions such as excessive noise, vibration or heat. If any present it should be reported and attended to immediately.
- Check and adjust flow rates as per operating parameters.
- Check operating parameters and complete Daily Operator Checklist.

Monthly

- Replace cartridge filter element.

3-5 Years

- Replace Reverse Osmosis membrane or when required due to fouling

9.3. Cartridge Filter – Element Replacement Procedure

The cartridge filter (CF-1) has a 5 micron nominal pore size. This element will be required to be replaced periodically as the filter blinds with filtered matter. The filter element should be replaced every four weeks or if the flow rate continues to deteriorate with the control valve (MV-1) completely open.

9.4. RO Element Replacement

- Switch the “RO PUMP” selector switch from “AUTO” to “OFF”.
- Ensure that the supply water is isolated from the cartridge filter.
- Release any trapped pressure by pressing the air release valve on top of the housing before attempting to open.
- Use the housing spanner supplied to open the housing by turning the spanner in a clockwise manner. Once loosen turn the rest by hand.
- Dispose of the used element. Replace with a new element, ensuring that the elements bottom port is securely placed in the bottom port of the housing.
- Secure the housing by turning in an anti-clockwise manner.
- Reconnect the filter to the raw water supply.
- Switch the “RO PUMP” selector switch “OFF” to “AUTO”.

NOTE: Bleed off any trapped air by pressing the air release valve on top of the housing during start up

9.5. Recommended Spares List

The following spares holding are recommended for minimizing downtime of the plant in the event of failure as well as during the maintenance period.

Description	Qty
RO Feed Pump – P-1 – CDLF4-12T, 2.2kW, 1~, 230V	1
Membranes – LP21-4040	1

9.6. Troubleshooting Guide

PUMPS		
Symptom	Possible Cause	Possible Solution
RO pump, not starting / running	High water level in T-1, FLS-1 activated	Confirm high level in T-1
	Power Supply	Check circuit breaker switch
		Check power supply to system
		Faulty relays
RO pump running but no pressure	Check water supply	Bleed pump
Switched to auto but pump not switching off on timer	Timer disconnected	Press timer into socket, check wire connection
	Timer unit malfunction	Repair or replace timer
Switched to Manual or Auto but pump does not start	Electrical supply fault	Check supply state
	Circuit Breaker tripped	Reset circuit breaker
	Thermal protection not reset	Reset thermal protection
	Low water pressure	Increase feed pressure or decrease flow to RO
Pump gets extremely noisy during operation	Insufficient feed flow	Check supply pressure, check pipes and pre-filter for blockages.
Misc. System		
Symptom	Possible Cause	Possible Solution
Switched to Manual or Auto but inlet valve does not open	Valve disconnected	Check connection
	Valve malfunction	Repair or replace valve
Tank indicators light when tank is not empty/full	Float switches incorrectly setup	Check float switch configuration
Check supply pressure	Insufficient feed pressure	Check supply pressure
	Pre-filter cartridge blocked	Clean or replace pre-filter

REVERSE OSMOSIS		
Symptom	Possible Cause	Possible Solution
RO, Low operating pressure (PI2)	Perforated Membrane	Flush and clean the membrane element
	Power supply	Confirm voltage
	RO flush valve	RO check that flush valve MV 3 is closed
RO, Low permeate flow rate (FLM-2)	Low operating pressure	See possible causes for low pressure above
	Dirty or fouled membrane elements	Flush and clean the membrane elements
	Membrane elements installed backwards or damaged concentrate seal	Install membrane elements in the direction of fluid flow. Flush and clean the machine immediately.
	Flow meter inaccurate	Check the flow rate manually with a stop watch and calibrated container
	Concentrate valve plugged	Remove the concentrate valve and /or disassemble the plumbing. Clean the valve
RO, Low concentrate flow rate, normal or higher than normal pressure	Flow meter inaccurate	Check the flow rate manually with a stop watch and calibrated container
	Dirty concentrate valve	Disassemble and clean plumbing to the valve
Pressure does not drop when concentrate valve is opened	Inaccurate pressure gauge	Recalibrate the gauge as required
RO, High operating pressure	Restricted or reduced flow rate	See the possible causes for low permeate rate above
		Refer to the control values on daily operator sheet (9.1 Plant Operator log sheet).
	Restricted flow after pump outlet	Check for blockage of the concentrate flow at the inlets and outlets of the membrane element housings
RO, Excessive pressure drop [exceeding max ΔP]	Telescoped membrane element covering	Ensure that the anti telescoping device is located properly on the membrane

(high primary pressure – low final pressure)	membrane element housing outlet port	element
	Severely fouled or dirty membrane elements	Flush the system, then clean it with detergent.
	Dirty or fouled membrane elements	Flush and clean the membrane elements
RO, High permeate conductivity	O ring seal broken or damaged	Replace the O-ring, check the sealing surfaces on the O ring groove interconnectors and end caps. Replaced damaged parts.
	Change in incoming water quality	Open the concentrate valve and flush. Test the water for pH, Hardness, TDS and iron content. A water analysis should be sent to WPS for review.

Appendix A: Electrical Diagram