



RODI SYSTEM

*Equipment Operation & Maintenance Manuals
And Drawings*

BURT PROCESS EQUIPMENT

RO-DI System O & M Manual

Prepared for:
The College of William and Mary
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Table of Contents

SECTION 1

System Description	1.0
Operating Procedure	1.1
Routine Maintenance	1.2
Recommended Spare Parts	1.3
Troubleshooting Guide	1.4
BPE Product Warranty &	1.5

SECTION 2

<u>Component O&M Manuals</u>	2.0
ALLEN BRADLEY 20AD014A3AYNANC0 Powerflex Drive (REFER TO CD)	
ALLEN BRADLEY 1747-L551 PLC Processor (REFER TO CD)	
ALLEN BRADLEY 2711P-T620A Color Touch Pane (REFER TO CD)	
AQUA AZUL AAGI-100 Ultraviolet Sanitizer	
ASAHI 252700594115M2 3-Way Ball Valve Double	
CRANE FAW2510-MM2 Multimedia Filter	
CRANE FAW2510-AC12 Carbon Filter	
CRANE STA9000-90K14 Duplex Softener	
CRANE EPRO-4500 Reverse Osmosis System	
FLECK 2510 Filter Multiport Valve / Controller	
FLECK 9000 Twin-Alternating Softener Multiport Valve / Controller	
GRUNDFOS CRN20-4 Vertical Centrifugal Pump	
GRUNDFOS 15BMQE05A-110 EZ Boost Booster Pump System	
McMASTER CARR 45265K61 Backflow Preventer	
RESINTECH MBD-15SC Mixed Bed Ion Exchange Resin	
SIGNET 3-2450-5U Pressure Transmitter	
SIGNET 3-2819-1 Conductivity Sensor	
SIGNET P51530 Rotor-X Paddlewheel Flow Sensor	
SIGNET 3-8550-1P Flow Transmitter	
SIGNET 3-8850-1P Monitor Cond/ Res Monitor	
SIGNET 3-8860-AC Controller Cond/Res Controller	
SIMTECH RBPFM208 2" Back Pressure Regulator	
SHELCO 4FOS2-316-222-2F-P-ML-S 2" Loop Filter Housing	
TOWERHILL 6625-83007-01 Thermostatic Mixing Valve	
VAREC 210B21TFFOP00202 Varec Relief Valve	

SECTION 3

B-Size Prints

RODI SYSTEM P&ID	1016536-PID
HIGH PURITY WATER SYSTEM	1016536-RODI
PRETREATMENT SUB-ASSEMBLY	1016536-Pretreat
DISTRIBUTION PUMP SUB-ASSEMBLY	1016536-Pump
DISTRIBUTION LOOP TANK	1016536-Tank
DISTRIBUTION TANK SUB-ASSEMBLY	1016536-Tank Ass'y
DISTRIB LOOP MIXED BED-UV-FILTER	1016536-MB-UV-FILT
RODI WATER SYSTEM SCHEMATIC (1 of 6)	1016536-EL01
RODI WATER SYSTEM SCHEMATIC (2 of 6)	1016536-EL02
RODI WATER SYSTEM SCHEMATIC (3 of 6)	1016536-EL03
RODI WATER SYSTEM SCHEMATIC (4 of 6)	1016536-EL04
RODI WATER SYSTEM PANEL (5 of 6)	1016536-EL05
RODI WATER SYSTEM PANEL BOM (6 of 6)	1016536-EL06

1.0 System Description

The RODI system supplied to William and Mary College will produce water suitable for use in laboratory applications. The system is comprised of two main parts; reverse osmosis (RO)/ pre-treatment, distribution. The RO/pre-treat side of the system consists of a multi-media filter, carbon filter, water softener, 5 micron particle filter and RO unit. The main function of the pre-treatment equipment is to condition the water before it is fed to the RO unit. The multi-media filter removes sediment from the water and the carbon filter removes chlorine and organics. The water softener contains sodium cation exchange resin and exchanges sodium Na^+ ions for hard ions (eg. Ca^{2+} , Mg^{2+} , ect) in the feed water. A final 5-micron filter acts as a resin trap to catch resin that may have escaped from the softener.

The RO unit is capable of producing 3 gallons per minute (4500GPD) of water at a resistivity of about 0.5 MOhm. The operation is monitored by percent reject, which is determined by measuring the conductivity of the feed and permeate water.

The RO water is fed to a 500 gallon cone bottom polypropylene storage tank. The tank is equipped pressure transmitter for sensing the tank liquid level. The tank also includes a vent filter to prevent bacteria from entering as the tank breathes, and a pressure/vacuum relief valve.

The distribution pump skid includes two stainless steel booster pumps connected in parallel, which alternate based on a user defined time. The water from the pump skid is sent to a 254nm UV unit for bacteria destruction. The UV is located on a Skid along with two 4 round x 20", 0.2-micron final filter housings. The filters remove bacteria destroyed by the UV before the water is sent to the distribution loop.

The water is continuously circulated through the distribution loop and passes through a backpressure regulating valve before entering the storage tank.

The system control panel is located on the pump skid and provides power to the system components. System alarms such as high/low tank level and low RO % reject will be indicated on the control panel. System parameters may also adjusted at the control panel.

1.1 Operation Procedure

The system supplied is designed for automatic operation, with a minimum amount of operator interaction. Regular maintenance is required, and should be performed as outlined elsewhere in this manual.

The operator should read this entire manual prior to installation and system start-up is attempted.

1. Insure that the UV lamps are properly installed and sealed per the manufacturer's instructions.
2. Insure that the mixed bed DI resin bottles are properly loaded and sealed.
3. Insure that all filter and chlorine removal cartridges are clean and properly loaded.
4. Enable the system by turning the panel power switch to the "ON" position.
5. Confirm that both resistivity cells are properly calibrated and appropriate alarm set points are established per the manufacturer's instructions.
6. Enable the city water feed by opening the primary ball valve.
7. Enable the RO system by flipping the toggle switch on the remote RO panel. *Note: When operating the system for the first time and after every RO membrane replacement, the RO product water line should be disconnected from the primary polishing loop and allowed to run to drain for a minimum of one (1) hour to insure that all traces of preservative are removed from the membrane.*
8. Adjust the RO reject valve until the appropriate 3gpm product water flow rate is achieved. *Note: Do not exceed the recommended product flow rate or membrane fouling may occur.*
9. Once an ample supply of make-up water has accumulated in the storage tank, the recirculation pump can be enabled by turning the switch to the "ON" position.
10. Set the loop flow rate by adjusting the manual pressure regulating valve located on the pump skid.
11. Allow the system to operate automatically and follow regular maintenance procedures as outlined in this manual.

1.2 Routine Maintenance

CAUTION: Before performing any maintenance or repairs on the Pure Water System, be sure to disconnect all electrical connections.

Routine Maintenance will include:

1. Replacement of the tank vent filter on a monthly basis.
2. Replacement of cartridge filters when pressure drop exceeds 10% as compared to start-up value.
3. Replacement of chlorine removal carbon filter when breakthrough chlorine tests reveal any residual chlorine. The carbon filter cartridge should be changed at least every six months regardless of test results.
4. Replacement of RO membrane when differential pressure increases by more than 10 psi as compared to start-up value. *It is not recommended to clean the RO membrane because dangerous chemicals and cumbersome cleaning equipment are required.*
5. Replacement of both UV lamps after every 7,500 hours of use, or one year, whichever occurs first.
6. Inspection and cleaning of quartz UV lamp sleeves once per year.

****Refer to each component's specific Operation and Maintenance Manual for complete maintenance and care instructions.***

1.3 Recommended Spare Parts

COMPONENT	DESCRIPTION	PART NO.	QTY.
ALLEN BRADLEY Complete	Powerflex Drive	20AD014A3AYNANC0	2
	PLC Processor	1474-L551	1
	Color Touch Panel	2711P-T6C20A	1
AQUA AZUL AAGI-100 (Refer to Manual For Complete Spare Parts List)	UV Replacement Bulb 60" 254nm	L-1-804-N	4
ASAHI 252700594115M2 3-Way Ball Valve Double Extra Limit Switch	3-Way Ball Valve Double Extra Limit Switch	252700594115M2	1
CRANE EPRO 4500 Reverse Osmosis System	Prefilter 2.75" X 20", 5 Micron	PFC02A	1
	Prefilter Housing 5" D X 23" H	HPO01	1
	Concentrate Control Valve ¾"	BLV12	1
	Concentrate Pressure Gauge 0-300psi	DGO02	1
	Inlet Solenoid Valve	GCV075C	1
	Element Housing Clamp 4"	CH-9PW	2
	RO Membrane Cold Water	ETT74	3
	Permeate Flow Meter	DFO06	1
	Concentrate Flow Meter	DFO06	1
	Recycle Flow Meter	DFO05	1
	Low Pressure Switch	DBO24	1
	Recycle Valve	BLV14	1
	Pump Throttle Valve	GLV10	1
CRANE Complete	Fleck Valve	2510	1
	Water Softener	9000	1
GF SIGNET Complete	Pressure Transmitter	3-2450-5U	1
	Conductivity Sensor	3-2819-1	4
	Rotor-X Paddlewheel Flow Sensor	P51530	2
	Flow Transmitter	3-8550-1P	2
	Monitor Cond/Res Monitor	3-8850-1P	1
	Controller Cond/Res Controller	3-8860-AC	1
GRUNDFOS Complete(Refer to Manual for Spare Parts List)	Vertical Centrifugal Pump	CRN20-4	2
	EZ Boost Booster Pump System	15BMQE05A-110	2

McMASTER CARR Complete	Backflow Preventer	45265K61	1
SHELCO	Filter Cartridge	MAP0.22-10-S3S	1
SHELCO	Loop Final Filter Cartridges	MAS0.22-20-S3S	8
SIMTECH Complete	Back Pressure Regulator	RBPFM208	1
TOWERHILL Complete	Thermostatic Mixing Valve	6625-83007-01	1
VAREC Complete	Relief Valve	210B21TFFOP00202	1

**Always include pump serial number when ordering spare parts.*

***This is a Recommended Spare Parts List. Component O & M's contain detailed parts lists for specific parts. Refer to Section 2 for complete lists.*

The above parts should be kept on hand at all times to minimize down time and avoid difficulties. See each component's O&M Manual for installation instructions.

1.4 Troubleshooting Guide

PROBLEM	SYMPTOM	REMEDY
EXCESSIVE RO PUMP PRESSURE: <u><i>RO Pump Pressure should not exceed 200 PSI.</i></u>	Constant high pressures may indicate blockage or severe membrane fouling. Pressures in excess of those shown will reduce the useful life of the membranes and system components and may cause a hazardous situation resulting in injury or death.	Check RO Pump pressure weekly or more often if use warrants and adjust or clean as indicated.
PUMP CYCLES ON AND OFF:	Pump cycles on and off every few seconds.	A defective pressure switch could cause the pump to cycle rapidly on all models. Check for leaks in the product line. If there is a pressure tank in the line, be sure it is properly pressurized.
RO UNIT:	Not making enough water.	Reject ratio too low.
		Product flow controller restriction.
		Product line blocked.
		Pressure too low.
		TDS too high.
		Membrane fouled.
		Pre-filter plugged.
	Making too much water.	O-ring by-pass on membranes.
		Chlorine damage to membranes.
		Temperature increase.
		Reverse flow through membrane (causing a rupture in the membrane).
	Permeate TDS too high; (Possible Reasons:)	O-ring by-pass in ROMAS.
		Chlorine damage to membranes.
Membrane fouling.		
Ruptured membrane.		
Increase in feed water TDS.		
		High pH in feed water (over 9.0).
LOOP DISTRIBUTION PUMP:		
<i>-Motor fails to start or run at full speed.</i>	Start capacitor failed-1 phase motor. (Motor hums)	Replace start capacitor.
	Power loss.	Replace bad fuse or reset circuit breaker (check for correct fuse/breaker size).

	Incorrect Voltage (Voltage must be within $\pm 10\%$ of motor rated voltage. Example: Rated voltage 230 volts Range: 207-253 volts)	1) Check incoming voltage, contact power company. 2) Verify that the voltage of the motor matches the power supply voltage. 3) Check wire size from main switch to motor.
	Defective wire or connections.	Replace defective wires, tighten and clean connections
	Grounded motor.	Have motor rewound with new windings or replace motor.
	Wired for incorrect voltage.	Check motor wiring diagram for proper voltage.
-Pump Leaks. -Pump Leaks cont.	Worn mechanical seal due to abrasive liquid/corrosion.	1) Replace seal with materials compatible with liquid pumped. See section 2 for component O & M. 2) Install filter on inlet line.
	Lack of water - carbon seal on mechanical seal face overheats and wears rapidly or cracks.	1) Replace mechanical seal and O-ring. 2) Verify inlet pressure, minimum pressure on inlet gauge is 2 PSIG.
	Inlet pressure too high.	1) Check pressure rating of mechanical seal (100 or 250 PSI). 2) Reduce inlet pressure.
	Misalignment of mechanical seal.	1) Check for a bent motor shaft. 2) Clean seal and seal seat area in the inlet housing.
	Worn or pinched o-ring seals.	Replace the seals.
	Cracked weld on discharge/pump housing, stainless steel models.	Replace discharge/pump housing.
-Pump Operates, But Delivers Little or No Water.	Incorrect rotation on 3 phase motor	Interchange any two incoming power leads to the motor.
	Low line voltage.	(See above motor section)
	Air locked pump.	Fill pump & inlet pipe with water - jog motor on and off several times. Refill with water. Repeat procedure several times to remove all air.
	Suction lift too high - maximum suction lift is 5 feet.	Reduce suction lift.
	Worn or plugged impellers.	1) Replace rotating assembly, o-ring, and mechanical seal. 2) Clean clogged impeller, install filter on inlet.
	Inadequate inlet pressure.	Minimum pressure on the inlet side of booster pump is 2 PSIG.
	Diameter of suction/discharge pipe is too small.	1) Size of inlet pipe should be at least equal to the threaded inlet size in the pipe inlet housing. 2) Calculate friction losses for the discharge pipe. Replace undersized piping. For assistance contact Webtrol Maintenance @ 314/ 631-9200.

	Broken Shaft.	1) If motor shaft is broken replace motor. 2) If pump shaft is broken replace rotating assembly, o-ring, and mechanical seal.
	Defective or plugged strainer.	Clean, repair or replace as required.
	Wired for incorrect voltage.	Check motor wiring diagram for proper voltage. <i>See component O & M in section 2.</i>
-Excessive Noise While Pump is Operating.	Cavitations (<i>noise like gravel in pump</i>)	1) Increase size of inlet line, 2) Reduce flow rate-GPM, 3) Too viscous (liquid is too thick) maximum viscosity is 80 centipoises (CPS).
	Pump not secured to firm foundation.	Bolt down to secure and rigid base.
	Noisy motor.	1) Ensure that motor fan is clear 2) Remove motor from pump. If noise persists check for smooth bearing operation. Replace bad bearings/or motor.
	Wired for incorrect voltage.	Check motor wiring diagram for proper voltage. <i>See component O & M in section 2 for details.</i>
	Insufficient supply voltage.	Check incoming voltage, contact power company.
	5 hp (-1) pump models, bearing properly not loaded.	Motor should be below pump, when mounted in vertical position. (<i>See figure 7 in component O & M.</i>)
UV LAMPS:		
-Low UV output.	Dirty quartz sleeve.	Remove and clean quartz sleeve.
	Old or broken quartz sleeve.	Replace quartz sleeve.
	Old UV lamps.	Replace UV lamps.
	Water or condensation inside quartz sleeve.	Remove quartz sleeve and dry internal quartz.
-UV lamp our or will not light.	Bad UV lamp.	Replace UV lamp.
	Defective lamp ballast.	Replace ballast.
-Leak at quartz nipple.	Defective or cracked o-ring.	Replace o-ring.
	O-ring not seated properly.	Replace o-ring.
	Quartz sleeve cracked.	Replace quartz sleeve.
-Low UV transmission.	Dirty, cloudy or high mineral content or water.	Install pre-filter or demineralizer.

1.5 BPE Product Warranty

MINIMUM ORDER:

The minimum order acceptable is \$25.00 net billing.

PRICES:

Prices are based on standard domestic packaging and do not include special export packaging or other requirements. **ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE.**

CREDIT INFORMATION:

Open account billing is extended to firms with established credit ratings. Please request a credit application. Any account not approved by our Credit Department may order C.O.D. or by credit card.

TERMS:

Net (30) days.

DELIVERY:

We are staffed to handle most orders promptly from our large inventory. **ALL SHIPMENTS WILL BE F.O.B. OUR PLANT UNLESS OTHERWISE SPECIFIED.**

RETURNS AND CLAIMS:

CLAIMS FOR SHORTAGE MUST BE MADE WITHIN TEN (10) DAYS AFTER RECEIPT OF GOODS. Claims for goods damaged or lost in transit should be filed with the carrier. **RETURNS WILL NOT BE ACCEPTED WITHOUT OUR WRITTEN PERMISSION.**

TECHNICAL INFORMATION:

Information on corrosion, pressures, and temperatures may be used as a guide and as a basis for recommendations and should not be interpreted as a guarantee. To be certain of results, materials should be tested under actual service conditions.

LIMITED PRODUCT WARRANTY

All **products not manufactured by Burt Process Equipment** carry the original manufacturer's warranty. Copies are available on request. All **products manufactured by Burt Process Equipment will be free of defects** in material and workmanship for a period of (90) days from date of shipment from Burt Process Equipment. If found to be defective by us, we will **repair or replace the nonconforming parts or goods at our option**, or return the purchase price, at our option. Notice of a defective product must be given to Burt Process Equipment in writing immediately upon the discovery of such defect and include a copy showing proof of purchase. Burt Process Equipment will not be liable for special or consequential damages in any claim, suit or proceedings arising under this warranty, nor will Burt Process Equipment accept any liability for claims for labor, loss of profit, repairs or other expenses incidental to replacement. **The product warranty expressed above is our only warranty** and may not be verbally changed or modified by any representative of Burt Process Equipment. The offer to repair or replace nonconforming goods within warranty does not cover defects caused by shipping damages, damages caused by improper use of installation, or by the buyers attempt to use products beyond their mechanical, thermal or electrical capacity.

All freight costs incurred in shipping parts to or from Burt Process Equipment or to the manufacture if necessary, are at the expense of the customer.