PuROmax™

HP, LP, XL, And TS
Operation Manual

LP-2800
2,800 GPD
1.9 GPM

LP-5000
5,.000 GPD
3.47 GPM

LP-17000
17,000 GPD
11.87 GPM

LP-20
28,500 GPD
20 GPM

Table Of Contents

Important

Please read entire manual before proceeding with the installation and startup:

- Do not use where the water is microbiologically unsafe.
- 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 or run the pump with the concentrate (drain) valve closed.
- Never operate the unit with the product or drain line closed or with any back pressure from external valve.
- All units are designed for use with atmospheric tank. Additional parts are require for use with pressure tanks.
- Never allow the unit to freeze or operate with a feed water temperature above 100 degrees F.
- Never bypass the low pressure switch. Doing so will allow the pump to run dry and void warranty.
- Always check and follow local plumbing and electrical codes.
- Units are designed for indoor use only.
- Make sure to check operating parameters of your specific unit.
- All units require timely and proper maintained to insure proper function.
- Maximum production based on a feed water of 77 degrees F, SDI <3, and tds of 500 ppm (XL,LP) or 2,000 ppm (HP). Individual membrane production may vary +/- 15% and may have reduced efficiency with other feed water parameters.
- Performance is based on manufacture specifications and may vary.

Notes

PuROMax offers many standard units. These units are not made for every type water supply. As a rule of thumb XL and LP units are made to function on TDS under 1500 ppm and the production is based on 500 ppm NaCi. All HP units are designed to function on tds over 1500 ppm and production is based on 2,000 ppm Naci. FSHS Inc. will custom engineer any size reverse osmosis unit up to 400 gpm. FSHS Inc. offers a reverse osmosis design form. Completing the form and providing a ion breakdown of the water will insure proper performance and long life. FSHS Inc. can not guarantee the life or performance of the unit and or membrane with a complete design for and ion analysis.

Changes in operating conditions are beyond the control of FSHS Inc. The operating engineer, end user, or the installing water treatment dealer is responsible for the safe operation of this equipment. No claims are made of the quality of the quality of the product water and is the responsibility of the operating engineer, end user, or the water treatment dealer. All service should be preformed by a qualified water treatment dealer. Failure to properly maintain this unit or the use of any aftermarket parts not approved by FSHS Inc. will void its warranty.

Changes in the operation parameters of the RO system can be caused by changes in the feed water. To insure the system operates correctly and to prevent membrane failure a operation log should be kept. Properly tracking the feed water conditions and RO performance can help insure log term performance and prevent system failure.

PuROMax™

Light Commercial Units

Standard Features

* NSF Certified Membrane
* Stainless Steel Membrane Housing
* Procon Pump
* TDS Monitor for Product and Feed
* Low Pressure Safety Cut Off
* High Pressure Cut Off Switch
* Product and Drain Flow Meters
* Stainless Steel Drain Valve
* 2" x 20" Sediment Pre Filter
* Inlet Solenoid Valve
* SS Operating Pressure Gauge
* Comprehensive Warranty
* Easy to Install and Maintain
* Aluminum Frame

Unit	LP-500	LP-800	LP-1000
Membrane Part #	PM-2521-BLF	PM-2540-TL	PM-4021-BLF
Membrane Size	2.5 x 21	2.5 x 40	4 x 21
GPD	525	800	1000
Production GPM	.36	.55	.72
Rejection GPM	.80	.61	.94
Total GPM	1.16	1.16	1.66
Recovery	31%	47%	43%
Operating PSI	150	150	150
Motor Horse Power	1/3	1/3	1/3
Volts	115	115	115
Amps	375W	375W	375W
Connection Feed	3/4”	3/4”	3/4”
Connection Product	3/8”	3/8”	3/8”
Pump Model	112A070F11BA170	112A070F11BA170	112A100F11BA170
Pre-Filter Size	2x20	2x20	2x20
Dimension WxDxH	20x13x26	20x13x48	20x13x26
Approximate Unit Weight	30	40	43

Optional Features

- Auto Flush
- Waste Recycle
- Pre Filter Gauge
- Control Panel
- Crating
- Powder Coating
  (custom colors)

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LP-100

PuROMax™

XL Industrial Reverse Osmosis Units

Standard Features

* Low Energy BLF Membrane
* Stainless Steel Membrane Housing
* Pedrollo Stainless Steel Pump
* TDS Monitor for Product and Feed
* Smart Low Pressure Low Flow Controller
* Product and Drain Flow Meters
* Stainless Steel Drain Valve
* 2" x 20" Sediment Pre Filter
* SS Inlet Solenoid Valve
* SS Operating Pressure Gauge
* Comprehensive Warranty
* Easy to Install and Maintain
* Aluminum Frame

XL Units are based on 500 ppm properly pre-treated water at 90 psig operating pressure and 77degree water.

With a inlet pressure of 40 psi @ 5 GPM.

Unit	XL-2000	XL-4000
Membrane size Part #	1 4x40 low pressure PM-4040-BLF	2 4x40 Low Pressure PM-4040-BLF
GPD	2000	4000
Production GPM	1.38	2.77
Rejection GPM	4.16	2.77
Total GPM	5.54	5.54
Recovery	25%	50%
Operating PSI	90	90
Motor Horse Power	0.5	0.5
Volts	115	115
Amps	9	9
Connection Feed	3/4”	3/4”
Connection Product	1/2”	1/2”
Pump Model	Pedrollo	Pedrollo
Pre-Filter Size	4.25 x 10	4.25 x 10
Dimensions WxDxH	18x18x50	25x18x50
Approximate Unit Weight	62 lbs.	83 lbs.
Approximate Ship Weight	109 lbs.	130 lbs.

Optional Features

- Auto Flush
- Waste Recycle
- Pre Filter Gauge
- Control Panel
- Crating
- Powder Coating (custom colors)

TS-
Coming Soon

PuROMax™

Single Membrane Industrial Reverse Osmosis Units

Standard Features

* NSF Certified Membrane on LP-2800
* Stainless Steel Membrane Housing
* Gould's Multi Stage SS Centrifugal Pump
* TDS Monitor for Product and Feed
* Low Pressure Safety Cut Off
* Product and Drain Flow Meters
* Stainless Steel Drain Valve
* 2" x 20" Sediment Pre Filter
* Inlet Solenoid Valve
* SS Operating Pressure Gauge
* Comprehensive Warranty
* Easy to Install and Maintain
* Aluminum Frame

Low Pressure Units are based on 500 ppm properly pre-treated water at 115 psig operating pressure and 77degree water.

High Pressure Units are based on 2000 ppm properly pre-treated water at 225 psig operating pressure and 77degree water.

Unit	LP-2800	HP-2200
Membrane size Part #	1 4x40 low pressure PM-4040-BLF	1 4x40 high pressure PM-4040-BE
GPD	2800	2200
Production GPM	2	1.52
Rejection GPM	6	3.48
Total GPM	8	5
Recovery	25%	30%
Operating PSI	115	225
Motor Horse Power	.5	1
Volts	115/230	115/230
Amps	10.8/5.4	16.2/8.1
Connection Feed	3/4”	3/4”
Connection Product	1/2”	1/2”
Pump Model	7GBS05FS	7GBS10FS
Pre-Filter Size	2x20	2x20
Dimensions WxDxH	18x23x55	18x23x55
Approximate Unit Weight	120 lbs.	120 lbs.

Optional Features

- Auto Flush
- Waste Recycle
- Pre Filter Gauge
- Control Panel
- Crating
- Powder Coating (custom colors)

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PuROMax™

Dual Membrane Industrial Reverse Osmosis Units

Standard Features

* 2 NSF Certified Membranes on LP-5000
* Stainless Steel Membrane Housing
* Gould's Multi Stage SS Centrifugal Pump
* TDS Monitor for Product and Feed
* Low Pressure Safety Cut Off
* Product and Drain Flow Meters
* Stainless Steel Drain Valve
* 2" x 20" Sediment Pre Filter
* Inlet Solenoid Valve
* SS Operating Pressure Gauge
* Comprehensive Warranty
* Easy to Install and Maintain
* Aluminum Frame

Low Pressure Units are based on 500 ppm properly pre-treated water at 115 psig operating pressure and 77degree water.

High Pressure Units are based on 2000 ppm properly pre-treated water at 225 psig operating pressure and 77degree water.

Unit	LP-5000	HP-4400
Membrane size Part #	2 4x40 low pressure PM-4040-BLF	2 4x40 high pressure PM-4040-BE
GPD	5000	4400
Production GPM	3.95	3
Rejection GPM	3.95	7
Total GPM	7.91	10
Recovery	50%	30%
Operating PSI	115	225
Motor Horse Power	.5	1.5
Volts	115/230	115/230
Amps	10.8/5.4	21.4/10.7
Connection Feed	3/4”	3/4”
Connection Product	3/4”	1/2”
Pump Model	7GBS05FS	10GBS15FS
Pre-Filter Size	2x20	2x20
Dimensions WxDxH	22x23x65	22x23x65
Approximate Unit Weight	130 lbs.	130 lbs.

Optional Features

- Auto Flush
- Waste Recycle
- Pre Filter Gauge
- Control Panel
- Crating
- Powder Coating (custom colors)

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PuROMax™

Triple Membrane Industrial Reverse Osmosis Units

Standard Features

* 3 NSF Certified Membranes on LP-7500
* Stainless Steel Membrane Housing
* Gould's Multi Stage SS Centrifugal Pump
* TDS Monitor for Product and Feed
* Low Pressure Safety Cut Off
* Product and Drain Flow Meters
* Stainless Steel Drain Valve
* 4.25" x 20" Sediment Pre Filter
* Inlet Solenoid Valve
* SS Operating Pressure Gauge
* Comprehensive Warranty
* Easy to Install and Maintain
* Aluminum Frame
* Control Panel & Auto Flush Standard on HP6600

Low Pressure Units are based on 500 ppm properly pre-treated water at 115 psig operating pressure and 77degree water.

High Pressure Units are based on 2000 ppm properly pre-treated water at 225 psig operating pressure and 77degree water.

Unit	LP-7500	HP-6600
Membrane size Part #	3 4x40 low pressure PM-4040-BLF	3 4x40 high pressure PM-4040-BE
GPD	7500	6600
Production GPM	5.2	4.56
Rejection GPM	6.8	5.44
Total GPM	12	10
Recovery	43%	45%
Operating PSI	115	225
Motor Horse Power	1.5	1.5
Volts	115/230	115/230
Amps	21.4/10.7	21.4/10.7
Connection Feed	1”	1”
Connection Product	3/4”	3/4”
Pump Model	10GBS15FS	10GBS15FS
Pre-Filter Size	4.25x20	4.25x20
Dimensions WxDxH	22x23x64	22x23x64
Approximate Unit Weight	130 lbs.	140 lbs.

Optional Features

- Auto Flush
- Waste Recycle
- Pre Filter Gauge
- Control Panel
- Crating
- Powder Coating (custom colors)

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PuROMax™

Quad Membrane Industrial Reverse

Standard Features

* 4 NSF Certified Membranes on LP-11500
* Stainless Steel Membrane Housing
* Gould's Multi Stage SS Centrifugal Pump
* TDS Monitor for Product and Feed
* Low Pressure Safety Cut Off
* Product and Drain Flow Meters
* Stainless Steel Drain Valve
* 4.25" x 20" Sediment Pre Filter
* Inlet Solenoid Valve
* SS Operating Pressure Gauge
* Comprehensive Warranty
* Easy to Install and Maintain
* Aluminum Frame
* Control Panel
* Auto Flush

Low Pressure Units are based on 500 ppm properly pre-treated water at 115 psig operating pressure and 77degree water.

High Pressure Units are based on 2000 ppm properly pre-treated water at 225 psig operating pressure and 77degree water.

Unit	LP-11500	HP-8800
Membrane size Part #	4 4x40 low pressure PM-4040-BLF	4 4x40 high pressure PM-4040-BE
GPD	11500	8800
Production GPM	7.63	6.1
Rejection GPM	7.63	7.89
Total GPM	15	14
Recovery	50%	43%
Operating PSI	115	225
Motor Horse Power	1.5	3
Volts	230	230
Amps	10.7	
Connection Feed	1”	1”
Connection Product	3/4”	3/4”
Pump Model	18GBS15FS	18GBS30FS
Pre-Filter Size	4.25x20	4.25x20
Dimensions WxDxH	26x28x64	26x28x64
Approximate Unit Weight	150 lbs.	160 lbs.

Optional Features

- Waste Recycle
- Pre Filter Gauge
- Crating
- Powder Coating
  (custom colors)

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PuROMax™

Multi Membrane Industrial Reverse Osmosis Unit

Standard Features

* 6 NSF Certified Membranes
* Stainless Steel Membrane Housing
* Gould's Multi Stage SS Centrifugal Pump
* TDS Monitor for Product and Feed
* Low Pressure Safety Cut Off
* Product and Drain Flow Meters
* Stainless Steel Drain Valve
* 4.25" x 20" Sediment Pre Filters
* Inlet Solenoid Valve
* SS Operating Pressure Gauge
* Comprehensive Warranty
* Easy to Install and Maintain
* Aluminum Frame
* Control Panel
* Auto Flush
* Crating on Units Shipped

Unit	LP-17000
Membrane Size Part #	6 4x40 low pressure PM-4040-BLF
GPD	17000
Production GPM	11.97
Rejection GPM	13.01
Total GPM	25
Recovery	47%
Operating PSI	115
Motor Horse Power	3
Volts	230
Amps	10.7
Connection Feed	1”
Connection Product	1”
Pump Model	25GBS30FS
Pre-Filter Size	4.25x20
Dimensions WxDxH	36x30x74
Approximate Unit Weight	170 lbs.

LP-17,000
6 Membrane Unit
17,000 GPD

Optional Features

- Waste Recycle
- Pre Filter Gauge
- Powder Coating
  (custom colors)

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PuROMax™

Multi Membrane Industrial Reverse Osmosis Unit

Standard Features

* 10 NSF Certified Membranes
* Stainless Steel Membrane Housing
* Gould's Multi Stage SS Centrifugal Pump
* TDS Monitor for Product and Feed
* Low Pressure Safety Cut Off
* Product and Drain Flow Meters
* Stainless Steel Drain Valve
* 2 4.25" x 20" Sediment Pre Filters
* Inlet Solenoid Valve
* SS Operating Pressure Gauge
* Comprehensive Warranty
* Easy to Install and Maintain
* Aluminum Frame
* Control Panel
* Auto Flush
* Crating on Units Shipped

Production based on properly pre treated feed water at 1500 ppm and 77 degrees F. You must provide a complete water analysis to insure production and warranty/

Unit	LP-20	LP-40
Membrane Size Part #	10 4x40 low pressure PM-4040-BLF	8 8x40 low pressure PM-8040-BLF
GPD	28500	57,000
Production GPM	19.79	39.58 3:1
Rejection GPM	19.79	39.58
Total GPM	39.58	79.16
Recovery	50%	50%
Operating PSI	115	115
Motor Horse Power	5	10
Volts	230	230
Amps		
Connection Feed	2”	2 1/2”
Connection Product	1”	2”
Pump Model	4SVB2J5DO	
Pre-Filter Size	2 4.25x20	1 WB
Dimensions WxDxH	109x35x60	109x35x60
Approx. Unit Weight	210 lbs.	380 lbs.

LP-20

LP-40

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What is Reverse Osmosis

The article below is provided by the Water Quality Association.

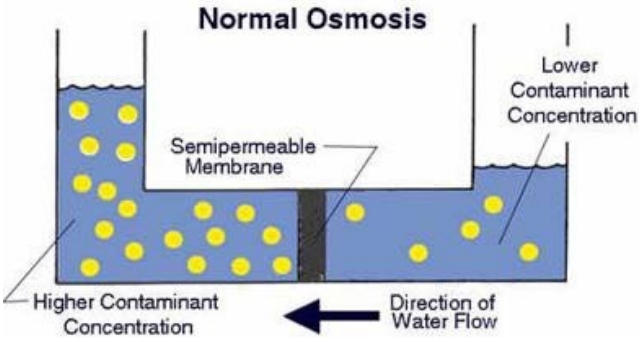
Anyone who has been through a high school science class will likely be familiar with the term osmosis. The process was first described by a French Scientist in 1748, who noted that water spontaneously diffused through a pig bladder membrane into alcohol. Over 200 years later, a modification of this process known as reverse osmosis allows people throughout the world to affordably convert undesirable water into water that is virtually free of health or aesthetic contaminants. Reverse osmosis systems can be found providing treated water from the kitchen counter in a private residence to installations used in manned spacecraft.

Reverse Osmosis is a technology that is found virtually anywhere pure water is needed; common uses include:

- Drinking Water
- Ice-Making
- Car Wash
- Rinse Water
- Biomedical Applications
- Laboratory Applications
- Photography
- Pharmaceutical Production and Removal
- Kidney Dialysis
- Chemical Processes
- Cosmetics
- Animal Feed
- Hatcheries
- Restaurants
- Greenhouses
- Metal Plating Applications
- Waste Water Treatment
- Boiler Water
- Battery Water
- Syrup Production
- Semiconductor Production
- Hemodialysis

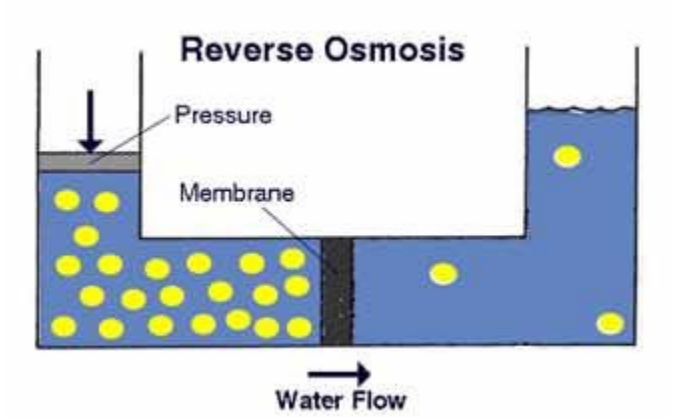
How Reverse Osmosis Works

A semi permeable membrane, like the membrane of a cell wall or a bladder, is selective about what it allows to pass through, and what it prevents from passing. These membranes in general pass water very easily because of its small molecular size; but also prevent many other contaminants from passing by trapping them. Water will typically be present on both sides of the membrane, with each side having a different concentration of dissolved minerals. Since the water I the less concentrated solution seeks to dilute the more concentrated solution, water will pass through the membrane from the lower concentration side to the greater concentration side. Eventually, osmotic pressure (seen in the diagram below as the pressure created by the difference in water levels) will counter the diffusion process exactly, and an equilibrium will form.



What is Reverse Osmosis

The process of reverse osmosis forces water with a greater concentration of contaminants (the source water) into a tank containing water with an extremely low concentration of contaminants (the processed water). High water pressure on the source side is used to "reverse" the natural osmotic process, with the semi-permeable membrane still permitting the passage of water while rejecting most of the other contaminants. The specific process through which this occurs is called ion exclusion, in which a concentration of ions at the membrane surface from a barrier that allows other water molecules to pass through while excluding other substances.

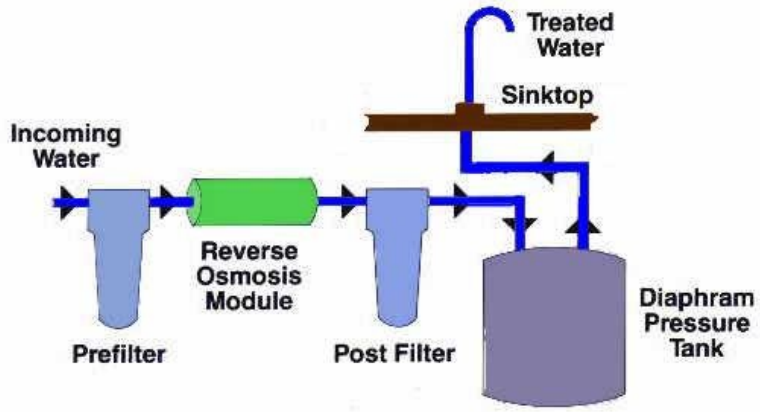


Semi permeable membranes have come a long way from the natural pig bladders used in the earlier osmosis experiments. Before the 1960's, these membranes were too inefficient, expensive, and unreliable for practical applications outside the laboratory. Modern advances in synthetic materials have generally solved these problems, allowing membranes to become highly efficient at rejecting contaminants, and making them tough enough to withstand the greater pressures necessary for efficient operation.

Even with these advances, the "reject" water on the source side of a Reverse Osmosis (RO) system must be periodically flushed in order to keep it from becoming so concentrated that it forms a scale on the membrane itself. RO systems also typically require a carbon pre filter for the reduction of chlorine, which can damage an RO membrane; and a sediment pre filter is always required to ensure that fine suspended materials in the source water do not permanently clog the membrane. Hardness reduction, either through the use of water softening for residential units or chemical softening for industrial use, may also be desirable in hard water areas.

Low Pressure (Residential) Systems

Low pressure RO systems generally refer to those systems with a water feed pressure of less than 100 psig. These are the typical countertop or under sink residential systems that rely primarily on the natural water pressure to make the reverse osmosis process function; a typical system is shown schematically below.



What is Reverse Osmosis

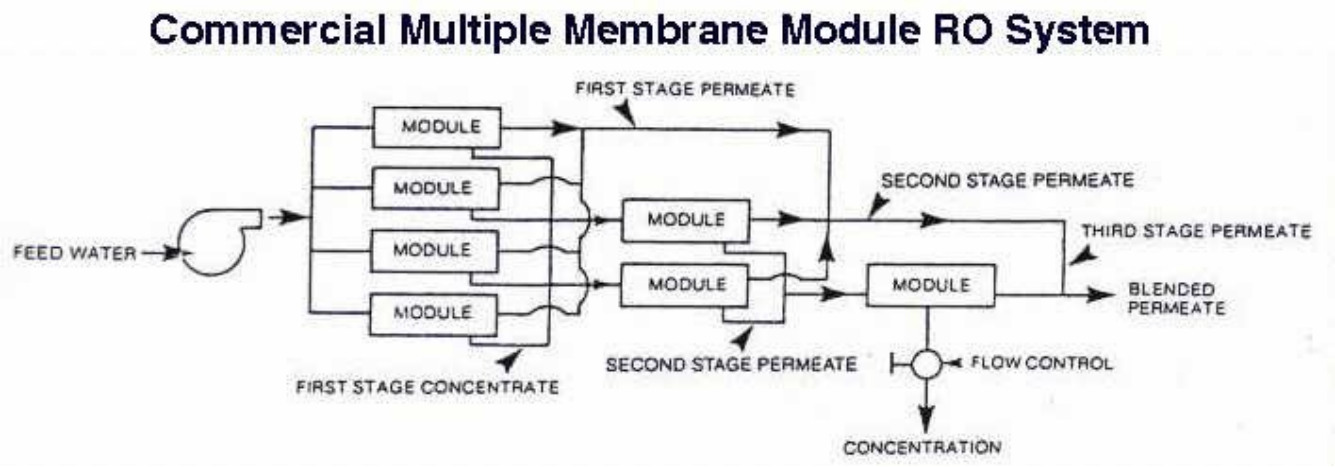
Countertop units typically have an unpressurized storage tank; Under sink units typically have a pressurized accumulator storage tank where the water pressure tends to increase as the tank fills. This pressurized system provides sufficient pressure to move the water from the under sink storage tank to the faucet. Unfortunately, this also creates a back pressure against the membrane, which can decrease its efficiency. Some units overcome this by using unpressurized tanks with a pump to get the treated water where it is needed.

Low pressure units typically provide between 2 and 15 gallons per day of water, with an efficiency of 2-4 gallons of reject water per gallon of treated water. Water purity can be as high as 95 percent. These systems can be highly affordable, with countertop units starting at about US $150, and under sink units starting at about US $500. These units produce water for a cost as low as ten cents per gallon once maintenance and water costs are factored in. Maintenance usually requires replacing any pre- or post filters (typically one to four times per year); and the reverse osmosis cartridge once every two to three years, depending on usage. Look for the WQA Gold Seal (S-300) to find products that have been successfully tested to industry performance standards; and to Certified Water Specialists (CWS I-VI), Certified Sales Representatives (CSR), and Certified Installers (CI) for advice on your water needs, and equipment installation.

High Pressure (Commercial/Industrial) Systems

High pressure systems typically operate at pressures between 100 and 1000 psig, depending on the membranes chosen and the water being treated. These systems are usually used in industrial or commercial applications where large volumes of treated water are required at a high level of purity.

Most commercial and industrial systems use multiple membranes arranged in parallel to provide the required quantity of water. The processed water from the first stage of treatment can then be passed through additional membrane modules to achieve greater levels of treatment for the finished water. The reject water can also be directed into successive membrane modules for greater efficiency (see diagram below), though flushing will still be required when concentrations reach a level where fouling is likely to occur.



High pressure industrial units typically provide from 10 gallons to thousands of gallons per day of water with an efficiency of 1-9 gallons of reject water per gallon of treated water. Water purity can be as high as 95 percent. These systems tend to be larger and more complicated than low pressure systems, and this is reflected in their costs, which range from US $1000 through tens of thousands of dollars for a large, multi-module unit capable of providing desalinated drinking water for a resort facility or water bottling plant.

What is Reverse Osmosis

What Reverse Osmosis Treats

Reverse osmosis can treat for a wide variety of health and aesthetic contaminants. Effectively designed, RO equipment can treat for a wide variety of aesthetic contaminants that cause unpleasant taste, color, and odor problems like a salty or soda taste caused by chlorides or sulfates.

RO can also be effective for treating health contaminants like arsenic, asbestos, atrazine (herbicides/pesticides). fluoride, lead, mercury, nitrate, and radium. When using appropriate carbon pre filtering (commonly included with most RO systems), additional treatment can also be provided for such "volatile" contaminants as benzene, trichloroethylene, trihalomethanes, and radon. Some RO equipment is also capable of treating for biological contaminants like Cryptosporidium. The Water Quality Association (WQA) cautions, however, that while RO membranes typically remove virtually all known microorganisms and most other health contaminants, design considerations may prevent a unit from offering foolproof protection when incorporated into a consumer drinking water system.

When looking for a product to treat for a given health contaminant, care should be used to find products that have been tested successfully for such purposes at a quality testing laboratory.

Conclusion

Reverse osmosis is a relatively new, but very effective, application of an established scientific process. Whether it is used to meet the needs of a typical family of four, or the needs of an industrial operation requiring thousands of gallons per day, it can be a cost effective to provide the required quantity of highly treated water. With continual advances in system and membrane design that boost efficiency and reliability, RO can be expected to play a major role in water treatment for years to come.

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Pretreatment

Feed water for any R/O system must be pretreated to prevent system damage and/or membrane fouling. It is essential to properly pretreat the feed water for reliable and accurate operation. Pretreatment requirements will vary depending on the nature of the feed water. Pretreatment is not included. FSHS reverse osmosis systems are supplied with a sediment pre-filter intended to provide 5 micron pre-filtration prior to the reverse osmosis system membranes. It is recommended that the pre-filter cartridge be checked periodically. Although once a month is a recommended interval between filter cartridge changes, the filter should be checked whenever feed water conditions change, previous experience dictates that more frequent changes are required, or if the pressure drops across the pre-filter exceeds 15 psi. If the pre filter becomes clogged and water flow to the pump is reduced or interrupted, pump hammering will occur. This will damage the pump and/or reduce the performance of the system. A water analysis should be done for every unit. Water conditions vary and some containments such as chlorine and Iron will damage membrane and will not be covered under manufacturers warranty. Please see membrane specifications for more information. Listed are some common types of pretreatment.

Chemical Injection
Chemical injection is typically used to feed anti-scalant, coagulants, bisulfate, and calcite into feed water to protect the membrane or the product water to adjust ph.

Water Softener
Water softeners are used to remove calcium and magnesium from the feed water in order to prevent membrane 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 anti-scalents are used.

Carbon Filter
Carbon filters are used to remove chlorine and some organics from the feed water. Free chlorine will cause rapid damage to the membranes.

Media Filters
Media filters are used to remove larger suspended solids from the feed water. Backwashing the media removes the trapped particles and rinses them away.

Please Note

- The effects of suspended solids is measured by the Silt Density Index (SDI). An SDI or less than 3 is recommended.
- Iron and manganese should be completely removed from the feed steam for any RO unit.
- Silica (SiO_2) forms a coating on the membrane surface when the concentration exceeds solubility. This will cause membrane fouling and chemical injection may be necessary.
- Providing a complete RO design form with an ion breakdown of the feed water will help determine what pre-treatment may be necessary.
- Pretreatment is sold separately, please consult a qualified OEM or water treatment specialist to insure proper capacities and flow rates.
- Membranes have a PH operating range of 2-11 and may lower the ph of the product water. Proper ph adjustment may be necessary of the product water.

ELECTRICAL

All motors on the FSHS units are open drip-proof (ODP) type unless specified otherwise. Single-phase motors are supplied on most models. The standard motors are 60 Hz, but 50 Hz motors are supplied as requested. Voltage will be either 110V or 220V (for 60 Hz and most 50 Hz frequencies) or 190V (for some 50 Hz models). Refer to the systems specifications on the motor and data sheet for the particular electrical requirements of a given model. The voltage will be specified in the model or part number by the last 2 digits. For example XX-XXXX-XX-110 would be 110v. Also all 110v systems are equipped with a cord unless ordered otherwise. Voltage is consistent cross all system. If the voltage is 110v then the pump, solenoids, and control box (if equipped) is the same voltage. Changes to the voltage in the field are not covered under any warranty. For help please contact your local distributer.

Insure that the electrical circuit supplying the system is compatible with the requirements of the specific FSHS R/O unit. The system should also be plugged or wired into a float switch that will turn the unit on and off. For models LP-100, LP-500, LP-800, and LP-1000 they are equipped with a high pressure switch. This allows them to turn off when a pressure tank is full. For all other models a high pressure switch must be added at time of order. Incoming power connections on units without a control box should be made through the low pressure safety switch. This is a gray switch located on the side of the unit. (wire diagram 1 page). If your unit is equipped with a control panel, power is connected to the control box terminals in the back of the control box (wire diagram 2). You should always consult a qualified electrician. It is the responsibility of the installer to insure all codes are met.

PUMP

The pumps supplied with the PuROMax LP-100, LP-500, LP-800, and LP-1000 reverse osmosis systems are positive displacement rotary vain pumps. These pumps are small and sometimes can be noisy. Due to the nature of the rotary vain pump additional pre filtration may be requires as small debris and or sand will damage the pump. On all other PuROMax commercial units are equipped with a multistage centrifugal type pump. It is essential that the following guidelines be followed:

1. The pump must NEVER be run dry. Operating the pump without sufficient feed water will cause damage to the pump and will void the warranty.

2. ALWAYS feed the pump with filtered water. Loss of performance and damage can result from sediment and debris in the feed water.

3. Pump performance may vary depending on inlet pressure. All PuROMax units are based on a 35 psi inlet pressure at its total gpm usage. Inlet pressure higher than 35 psi may cause the pump to run “right of the curve”. This means it will pump more water than expected and may pull more amps and overheat. If this occurs your system may require a inlet pressure regulator.

START-UP

The following start-up procedure should be performed to ensure proper operation of the system:

1. Attach feed water pipe to the inlet of the FSHS system . Plumbing should be installed in a manner, which ensures that smooth and sufficient flow of feed water can be maintained. Inlet size is base on the unit and is listed in the specifications.

2. Connect permeate and concentrate plumbing to the unit. Special care must be taken on the permeate line to ensure that back pressure on the membrane does not result. Fill RO completely with water before starting. All PuROMax units are equipped with a low pressure switch on the side of the unit. Switch specifications are placed between the contact to keep the unit from running, but allow the unit to fill with water. Once the unit is filled with water you can remove this to start the unit.

3. Turn the machine on by connecting the electrical cord to the electrical supply or on control box units press the green power button on the front of the system. Allow the system to run for about three minutes with the concentrate valve fully open and the recycle valve, if equipped, fully closed to purge air from the system. The concentrate (drain) valve is usually shipped fully open. In some cases this may need to be closed slightly to keep the unit from going into low pressure fault or hammering.

4. Turn the concentrate control valve until the correct pressure is displayed on the concentrate pressure gauge. Refer to the System Specifications of your unit for the correct concentrate pressure for your unit. Most units have a SS valve located on the left side of the unit. The XL-2000 and XL-4000 have a control knob on the front of the drain flow meter.

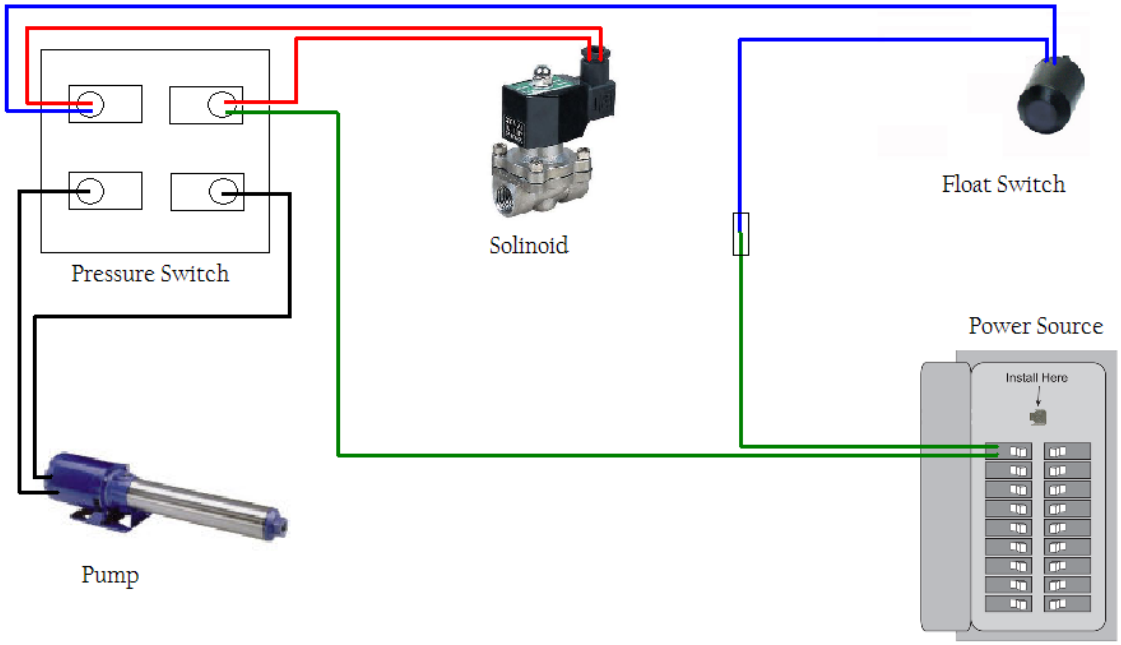
5. Discard the permeate water from the first 15 minutes of system operation to ensure that all the bactericide and preservatives have been flushed from the membrane. Slowly open recycle valve (if equipped). If feed water TDS is extremely low or if multiple membranes are included in the system, higher recovery may be achieved.
NEVER EXCEED 75% RECOVERY! Premature element fouling usually occurs at high recovery rates.

NOTE: As the recycle valve is opened, the pressure will drop. This can be compensated for, by further adjustment of the control valve.

6. Connect the permeate line to the point-of-use. Again, no back pressure must exist on the permeate line.

7. Insure that the water flow through the system ceases when the system is turned off. This will prevent premature fouling of the reverse osmosis membrane.
8. Verify that the system is producing the correct amount of product and drain, taking into consideration correction factors on pages 45 and 46.

Wiring Diagram 1
With out control box



SERIES 75 CONTROLLER
For LP and HP units up to LP-11500

Specifications

Power	120VAC- 240VAC, 50/60 Hz, +10/-15%, 2.5 watts Input power is auto selected.
Inputs:	3 switch inputs, selectable normally open or normally closed
Outputs:	RO pump 1HP max
	Inlet solenoid 5A

OPERATION

When the power switch is turned ON, the center status LED will flash Green, the inlet valve will OPEN and the RO pump will START. The center LED will be solid Green for normal run.

Under normal operation the RO unit will run until: (A) the storage tank is full (left status LED Amber) or (B) Pre-treat lockout has occurred (center status LED Flashing Green). When A or B has cleared, after a time delay, the RO unit will restart, and the status LED will return to Green. Switch setting 3 selects a 2 second or 15 minute tank full restart time delay.

Upon an alarm signal for Pressure Fault, the left status LED will flash Red, the RO pump will stop and the inlet valve will close and the RO pump will turn OFF.

If switch 1 and 2 are in the OFF Position (disabled), the left status LED will be a steady RED and the RO will not restart until the Power Switch has been manually cycled OFF then ON to reset the unit.

If switch 1 is in the ON Position (auto reset), every 60 minutes the RO will start and stop again if a pressure fault continues.

If switch 2 is in the ON Position (pressure fault retry), the RO will attempt to restart after 30 seconds, then 5 minutes, then 30 minutes. If the pressure alarm has not cleared after the third try, the RO unit will remain off until manually reset.

If switch 1 and 2 are in the ON Position, after a pressure fault condition, the RO unit will continually attempt to restart after each 60 minute cycle, until the pressure switch input has cleared.

If switch 5 is in the OFF position, Flush is disabled, in the ON position, Flush is enabled.

If switch 6 is in the OFF position, the unit will flush on Tank Full. In the ON position, flush is every 24 hours elapsed time. Flush time is 5 minutes. The Amber Flush LED with flash.

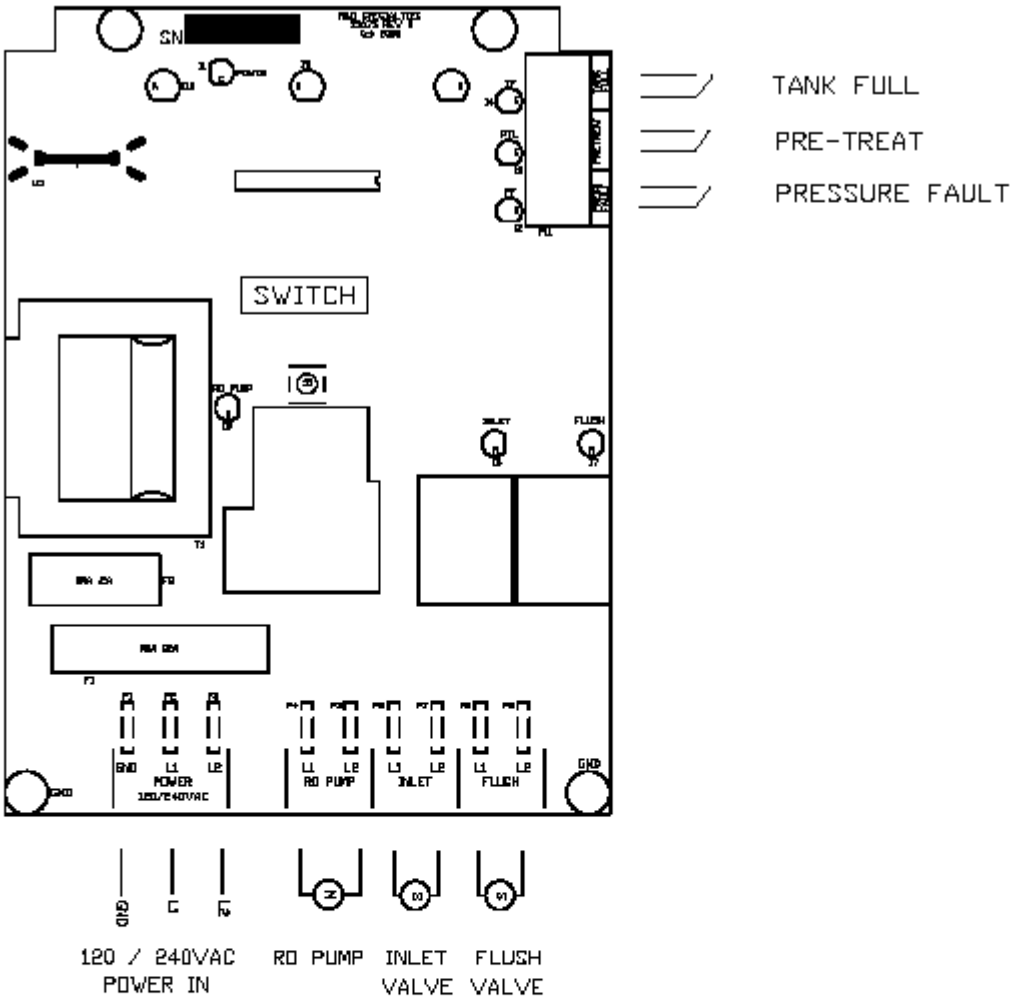
Switch 4 is for switch inputs. OFF is for N.O. contacts. ON is for N.C. contacts.

Installation

1. The RO pump motor or motor starter and the solenoid valves must be of the same voltage 120 or 240 volt.
2. Confirm that the (3) input signals - pressure switch, tank level switch and pre-treat switch are all of the same configuration, normally open or normally closed.
3. Confirm the desired switch settings for your operation. The switches are factory set to the OFF Position: Auto Reset (disabled), Pressure Fault Retry (disabled), Tank Full restart time delay (2 seconds), Input contact type (NC, open to operate). If you desire to change any switch functions, move that switch to the ON Position. [See Table 1, Switch Selection].
4. Wire to the controller as follows:
   A. Remove the enclosure cover.
   B. Mark and drill necessary electrical entry holes in the empty enclosure.
   C. Terminate necessary wiring to the Quick Connect terminals as required (See Fig. 1). Each terminal is labeled for the proper connection. Terminals P1-P9 are high voltage for power, motor, inlet and flush solenoid. Utilize proper 3 conductor wire size for the appliance. ***CAUTION:*** The controller is rated for maximum 20 amp total load. Terminal strip P11is dry contact for input signals from tank full, pressure fault and pre-treat lockout. Use small gauge 2 conductor cable for these wire connections.
5. Position and mount the enclosure in the desired location.
6. Connect all wiring to the appropriate appliances (Do not connect to the power source at this time).
7. Reassemble the enclosure, be sure to coil and leave some slack wire inside the enclosure.
8. Connect the power wire 120- 240 volt to its source.
9. Proceed to push the power switch ON and test the completed unit as necessary.
10. Notice the status LED to confirm system status.

SERIES 75 CONTROLLER

For LP and HP units up to LP-11500



SWITCH	OFF POSITION	ON POSITION
1	AUTO RESET DISABLED	AUTO RESET ENABLED
2	RETRIES DISABLED	RETRIES ENABLED
3	2 SEC RESTART	15 MIN RESTART
4	N.O. SWITCHES	N.C. SWITCHES
5	FLUSH OFF	FLUSH ON
6	FLUSH TF	FLUSH ET

Table 1

NOTES:

ALL SWITCH INPUTS MUST BE DRY CONTACT ONLY! IF VOLTAGE IS APPLIED TO THESE INPUTS, DAMAGE TO THE CONTROLLER WILL RESULT.

FOR POWER WITH NEUTRAL AND HOT LEADS, L1 IS HOT AND L2 IS NEUTRAL

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

INTRODUCTION

The R & D Specialties Series 150 controller is a state of the art control system for commercial and industrial reverse osmosis systems. The Series 150 combines features that have not previously been available in one compact unit.

The Series 150 is a microprocessor controlled system that can monitor pressure and level switches. A TDS / Conductivity monitor/controller with programmable Set points is an integral part of the Series 150. The Series 150 displays system status and sensor and switch input status on an easy to read backlit display. User programmable Set points are provided that allow fast and easy adjustment of system parameters.

SPECIFICATIONS

Power:
120/240 VAC -15+10%, 50/60Hz, 25Watts

Environment:
-22°F to 140°F, 0-95% RH, non condensing

Enclosure:
8" X 6" X 4" (203mm X 152mm X 102mm) NEMA 4X

Display:
2 line X 20 character, alphanumeric backlit LCD

Front Panel:
Overlay with LCD window, alarm lamp, 7 key membrane switch

Switch Inputs, Dry Contact:
- Pressure fault
- Pre-treat lockout
- Tank full high
- Tank full low

Relay Outputs:

RO pump relay	120/240VAC, 1HP
Inlet valve relay	120/240VAC, 5A
Flush valve relay	120/240VAC, 5A

Relays supply same output voltage as board power(120 or 240 VAC)

Cell:
TDS / Conductivity cell with digital display, standard range, 0-250PPM or uS.
Other ranges available:50, 100, 500, 1000, 2500, 5000. Wetted parts ABS and 316SS, 3/4" NPT, 300 PSI max.

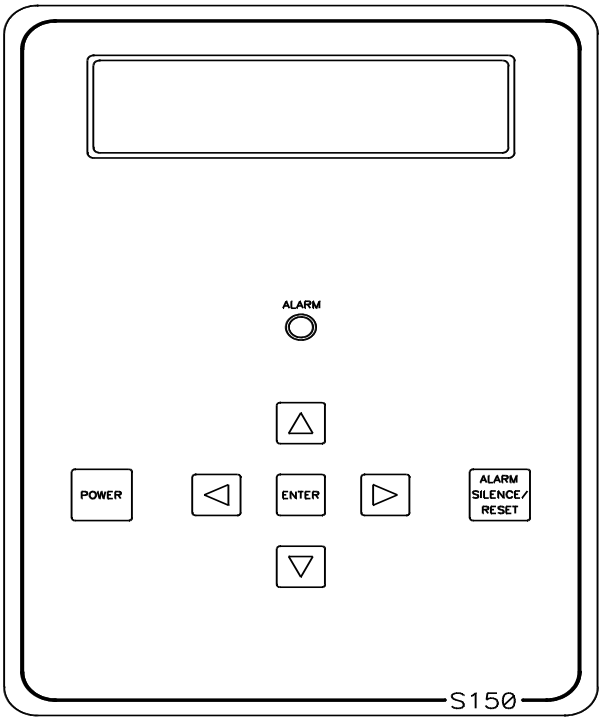
Optional I/O expander:

Auxiliary/divert/boost relay	120/240VAC, 1HP
Divert/alarm relay	120/240VAC, 5A

Tank low switch input, dry contact

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

FRONT PANEL CONTROLS AND INDICATORS



DISPLAY - Shows status of system.

ALARM LAMP - Flashes when fault causes an RO system shut down. On steady when a Set point is exceeded that does not cause an RO system shut down.

POWER KEY - Places controller in operating or standby mode.

LEFT ARROW KEY - Scrolls through Set points starting with first Set point.

RIGHT ARROW KEY - Scrolls through Set points starting with last Set point.

UP ARROW KEY - Increases value of Set point.

DOWN ARROW KEY - Decreases value of Set point

ENTER KEY - Confirms entry of new Set point value

ALARM SILENCE/RESET KEY - Push once for alarm silence and twice to reset system after a shut down has occurred.

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

INSTALLATION

Physical Installation

Mount the Series 150 in a convenient location on the RO equipment using the four mounting ears provided with the unit or the optional panel mounting bracket.

NOTE: All terminals on the board are labeled.

Terminal Strip, Jumper and Adjustment Locations

Refer to figure 2 for the location of all terminal strips and connectors. Figure 2 also shows all jumper and adjustment locations. Figure 3 shows a sample wiring diagram.

Power Wiring

Refer to figure 2-3 for terminal strip and jumper locations. Before applying power to the unit, verify that the voltage jumpers are configured correctly for the voltage that will power the unit. The voltage jumpers are located below the transformer. For 120VAC operation, there should be a wire jumper installed between P2 and P3 and a second wire jumper installed between P4 and P5. For 240VAC operation, a single wire jumper should be installed between P3 and P4.

AC power for the unit is connected to terminal strip P1. Connect the ground wire of the AC power to the terminal labeled GND. For AC power with a neutral and hot wire, the hot wire connects to L1 and the neutral wire connects to L2. For AC power with 2 hot wires, either wire can connect to L1 and L2. On AC power with 2 hot wires, the wire jumper between P6 and P7 should be removed and a fuse (GMA 1/4A) installed in F2.

Pump and Valve Relay Outputs

The Series 150 supplies relay outputs to control the RO pump and solenoid valves. NOTE: The relays output the same voltage as the AC power to the board. If the pump and solenoids operate on different voltages, a contactor will need to be supplied to operate the pump.

RO Pump Wiring

The RO pump connects to the L1 and L2 RO pump terminals of P1. This output can operate 120/240VAC motors up to 1HP directly. For motors larger than 1HP or 3 phase motors, this output can be used to operate a contactor.

Inlet and Flush Valve Wiring

The inlet and flush valves must operate at the same voltage as supplied to the board. These outputs can supply 5A maximum and are not designed to operate pump motors directly. If these outputs are to be used to operate a boost or flush pump, the output should be used to operate a contactor. The inlet valve connects to the L1 and L2 inlet terminals of P1. The flush valve connects to the L1 and L2 flush terminals of P1.

TDS / Conductivity Cell Wiring

For accurate TDS / Conductivity readings, the cell should be installed in a tee fitting where a continuous flow of water passes over the cell and no air can be trapped around the cell. Refer to figure 5 for example installation. The cell is connected with 5 wires to terminal strip P10. Connect each colored wire to the terminal labeled with the same color.

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

Switch Inputs

Switch inputs are connected to P9. The connections for these inputs are not polarity sensitive and can be connected to either terminal. The switch inputs should be dry contact closures only. **NOTE:** Applying voltage to these terminals will damage the controller. The switches can be either normally open or normally closed in any combination. The switch connected to an input that is configured as normally open must be open for the unit to run. The switch connected to an input that is configured as normally closed must be closed for the unit to run. The Switch Select Set point allows each input to be configured as normally open or normally closed. The Switch Select Set point is defaulted to 0 which programs all inputs as normally open. This means that all switch inputs must be open for the unit to run. Table 1 lists the values used to program the Set point to configure the inputs.

TABLE 1

Select the type of switch used for each input and put that number in the value column. Add the values and program the total in the Switch Select Set point. For example, if the pressure fault and tank low inputs were normally closed and all others normally open, the value programmed in the Switch Select Set point would be 17(1 + 16)

Pressure Fault Switch

On systems where a low feed pressure shut down is required, a feed pressure switch can be connected to the pressure fault input of P9. If a high pump pressure shut down is required, a high pressure switch can be connected to this input. If both low feed pressure and high pump pressure shut down are required, both switches can be connected to this input. Both switches must be either normally open or normally closed to operate properly.

Pre-treat Switch

In systems with pretreatment, a pre-treat lockout switch can be connected to the pre-treat input of P9. This switch should operate when the pretreatment device is out of service. NOTE: The output from the pretreatment device must be a dry contact and must not supply voltage

Tank Full Switch

In systems with a single tank level switch for controlling the RO pump, the level switch connects to the tank full high input of P9. If dual level switches are used for controlling the RO pump, the upper level switch connects to the tank full high input of P9 and the lower level switch connects to the tank full low input of P9.

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

I/O Expander Board

If the optional I/O expander board is installed, 2 additional relay outputs and 1 additional switch input are provided. Refer to figure 4 for the location of terminal strips, jumpers and wiring for this board. AC power for the relays is connected to the L1 and L2 power terminals of P1. Relay 1 is connected to this power input and will supply the same voltage. This relay is rated for 120/240VAC at 1HP maximum. Relay 1 can be configured to supply a dry contact by connecting a jumper wire between the L1 and L2 power terminals of P1. NOTE: If Relay 1 is configured as a dry contact, Relay 2 must be configured as a dry contact also. If Relay 1 is configured to supply voltage, Relay 2 can be selected to supply voltage, 120/240, 5A maximum, or as a dry contact output. Jumpers J1-J4 are used to select the relay 2 output type. To output voltage, a wire jumper is installed between J1 and J4 and a second wire jumper is installed between J2 and J3. For a contact closure output, a single wire jumper is installed between J3 and J4. The 2 relay outputs can be selected to operate as an auxiliary pump output, a divert output or an alarm output by programming the Expander Mode Set point. Table 2 shows the values used to program the relay outputs.

TABLE 2

Auxiliary Pump

If the Expander Mode Set point is programmed to 0 or 1, relay 1 operates as an auxiliary pump output. This output is energized when the tank low input is not active. This output will supply power or a contact closure determined by the connections L1 and L2 of the terminal strip P1.

Boost Pump

If the Expander Mode Set point is programmed to 3 or 4, relay 1 operates as a boost pump output. This output is energized when the inlet solenoid output is active. This output will supply power or a contact closure determined by the connections L1 and L2 of the terminal strip P1.

Divert Output

If the Expander Mode Set point is programmed to 0 or 3, relay 2 operates as a divert relay and will operate whenever the unit is in the divert mode. This output will supply voltage or provide a contact closure based on the configuration of relay 1 and on the position of jumpers J1-J4. If the Expander Mode Set point is programmed to 2, relay 1 operates as a divert relay and will operate whenever the unit is in the divert mode. This output will supply power or a contact closure determined by the connections L1 and L2 of the terminal strip P1.

Alarm Output

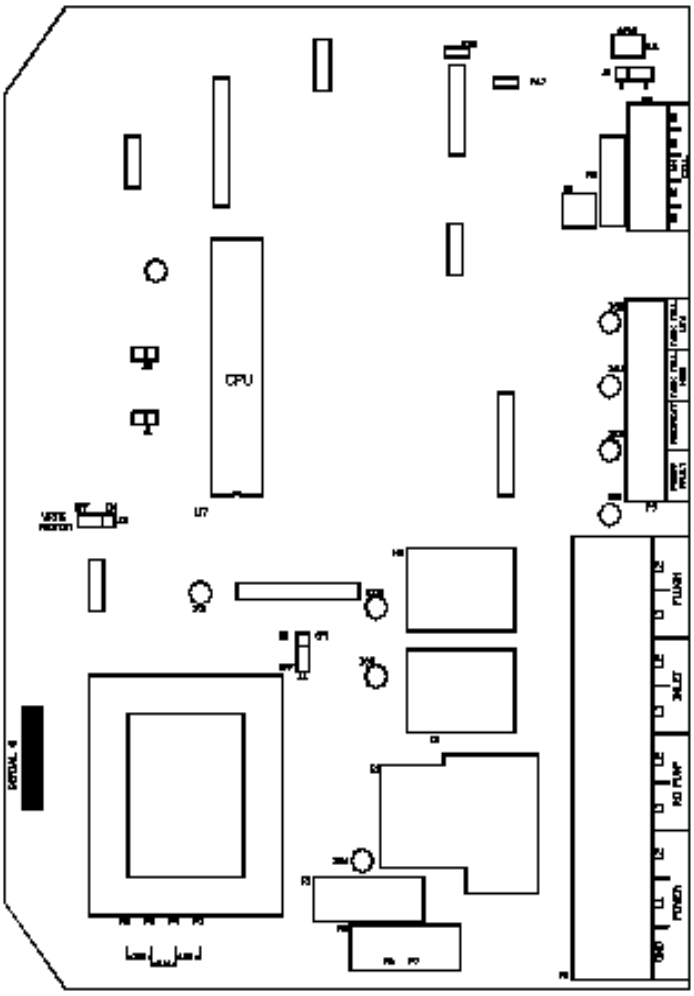
If the Expander Mode Set point is programmed to 1, 2 or 4, relay 2 operates as an alarm relay. When an alarm or warning is active, this relay will supply voltage or provide a contact closure based on the configuration of relay 1 and the position of jumpers J1-J4.

Tank Low Switch

A tank low switch input can be connected to the tank low input of P2 on the expander board. This input will provide a tank low warning on the unit and if the expander is programmed to provide an auxiliary pump output, will provide low tank level protection for this pump.

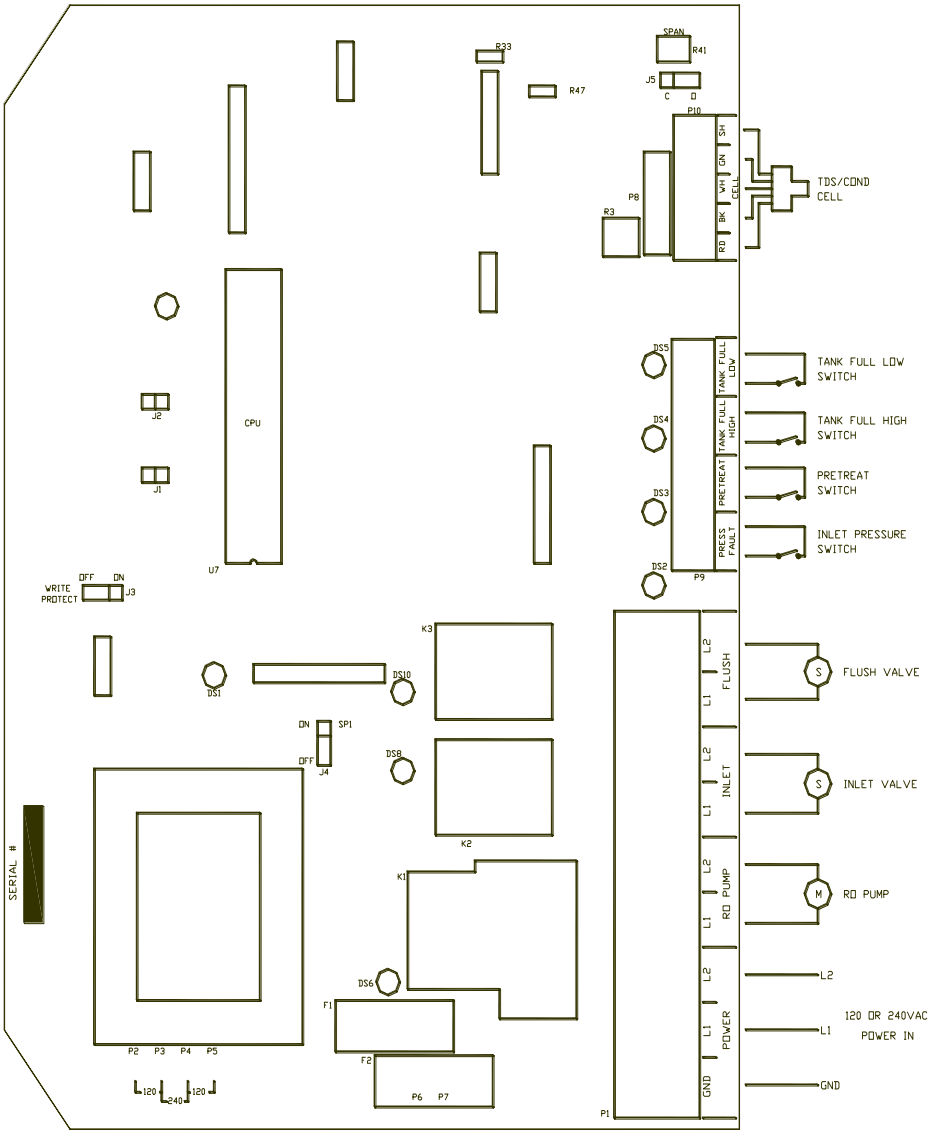
SERIES 150 CONTROLLER

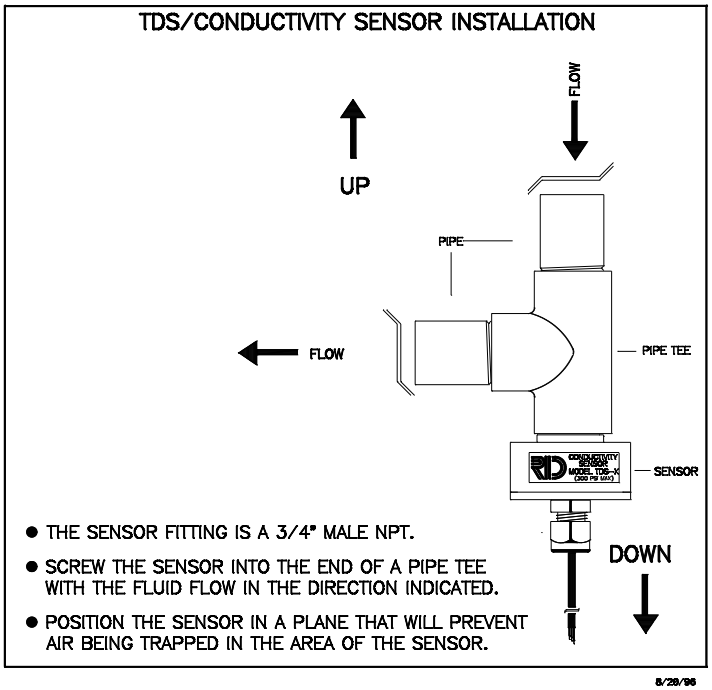
For LP and HP LP-11500 to LP-20



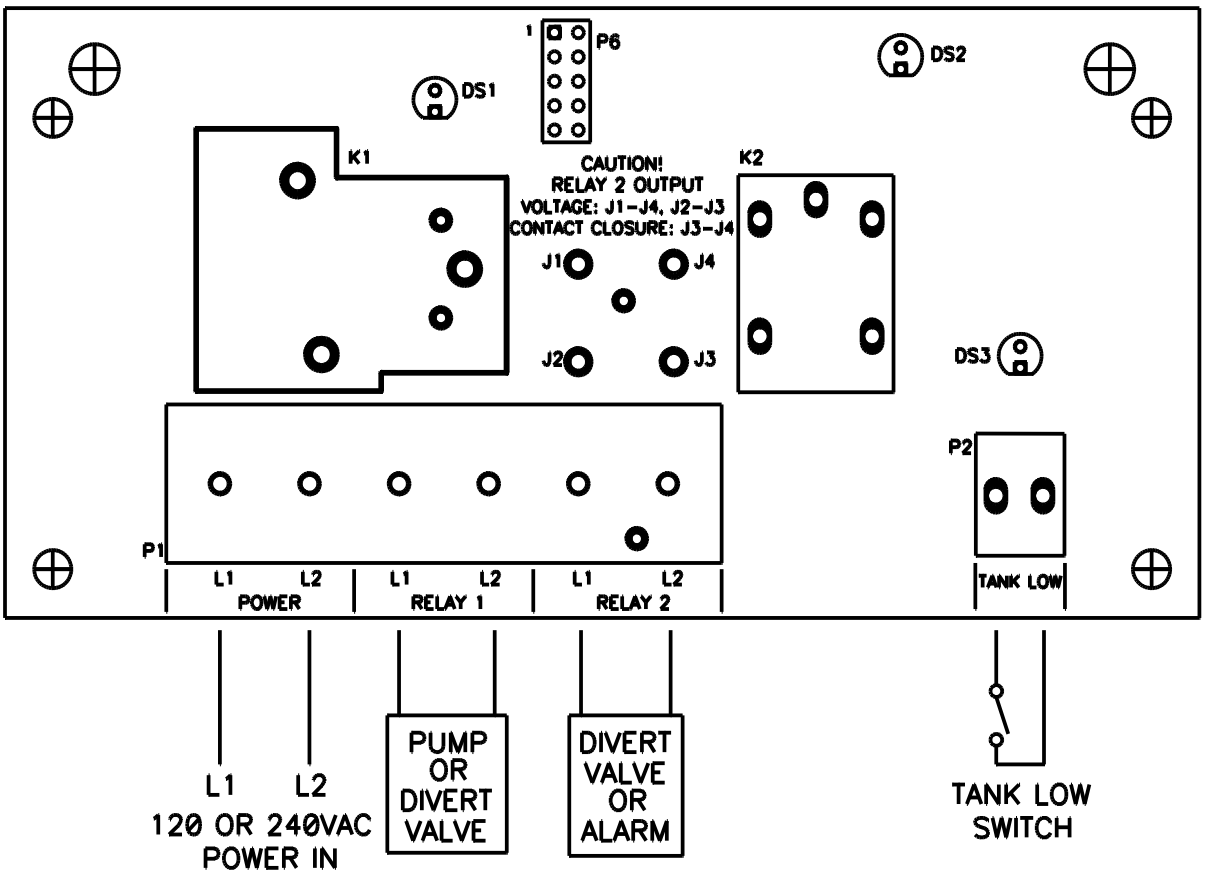
SERIES 150 CONTROLLER

For LP and HP LP-11500 to LP-20





SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20



STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
TDS / Cond Limit	When this value is met or exceeded, the alarm lamp will light and high TDS / Cond uS or PPM will show on the display. To disable, set to 0.	0-999	100
TDS / Cond Delay	When the limit Set point is exceeded, no alarm will be given until this time has seconds expired.	0-999	30
TDS / Cond Shtdwn	Once a TDS / Cond alarm is active, if the time in this exceeded, a TDS / Cond shut minutes down will occur. To disable, set to 0.	0-99	0

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

SETPOINT	DESCRIPTION	RANGE	DEFAULT
RO Start Delay	The amount of time between the inlet valve opening and the RO pump start.	0-99 seconds	5
Press Fault Delay	The time a pressure fault must be active before a pressure fault shut down occurs.	0-99 seconds	5
Auto Reset	When a pressure fault shut down is active, the system will attempt to restart after this delay. If set to 0, system must be manually reset.	0-99 minutes	60
Alarm Silence	If the audible alarm is silenced, after this delay, the alarm will resound. If set to 0, the alarm will remain silenced.	0-99 minutes	0
TF Restart Delay	When a tank full condition clears, the system will restart after this delay.	0-99 sec/min	5
TF Restart	Selects whether the tank full restart delay is in seconds or minutes. 0=seconds, 1=minutes.	0-1	0
TFO Time	The amount of time that a tank full override lasts.	0-9 minutes	5
Tank Lo Restart	When a tank low condition clears, the auxiliary pump will restart after this delay.	0-99 Minutes	15
Flush Type	Selects the type of flush. Set to 0 to disable flush.	0-8	0
Flush Time	The length of time a membrane flush cycle will last when flush is active.	0-99 minutes	5
Flush Interval	The interval between flush cycles. Only valid with op hour, elapsed time or off flush types.	0-99 hours	24
Flush Mode	Selects if the inlet and RO pump relays operate during flush.	0-3	0
Maximum Hours	If the current operating hours exceed this limit, the operating hours warning will occur. To disable, set to 0.	0-65000 hours	0
Current Hours	Current number of hours of RO system operation.	0-65000	0
Expander Mode	Selects how the relays on the I/O expander board operate.	0-4	0
Temp Offset	Allows adjustment of temperature reading by +-5 degrees.	-5 - +5	0
Temp UOM	Selects display of temperature in °F or °C	0-1	0

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

SETPOINT	DESCRIPTION	RANGE	DEFAULT
Switch Select	Selects if switch inputs are normally open or normally closed.	0-32	0
TDS / Cond UOM	Selects display of water quality in uS or PPM NOTE: If this Set point is changed, the unit must be recalibrated.	0-1	0
TDS / Cond Range	Selects range of TDS / Conductivity monitor 0-50, 1-100, 2-250, 3-500, 4-1000, 5-2500 6-5000 NOTE: If this Set point is changed, the unit must be recalibrated and may require some components be changed.	0-6	2

TO DISPLAY OR CHANGE SETPOINTS

Refer to figure 1 for the location of the keys used to display or change the Set points and figure 2 for the location of the write protect jumper, J3. For the unit to be able to accept a change in a Set point, the shorting jumper must be in the off position (center and left pins).

NOTE: Set points cannot be changed if the write protect jumper is in the ON position.

Use the Left and Right arrow keys to display the Set points. Each press of an arrow key will advance the display to the next Set point. The Left arrow key starts with the beginning Set point and the Right arrow key starts with the last Set point.

The Up and Down arrow keys are used to increment or decrement the Set point value. The value will change by 1 count each time a key is pressed. If the key is pressed and held for ~1 second, the Set point value will change at a fast rate. When the key is released, the fast rate will be reset. Pressing both the Up and Down arrow keys together will reset the Set point value to 0.

Pressing the Alarm Silence/Reset key at any time will cancel the operation and return the display to the main screen.

To accept the new Set point value, press the Enter key.

The unit will beep twice if the change is accepted. If the write protect jumper is on, the unit will show WRITE PROTECTED on the display and one long beep will sound.

When finished changing Set points, the write protect jumper should be placed in the on position (center and right pins).

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

SYSTEM OPERATION
General Operation

The unit has 2 modes of operation, a standby mode and an operating mode. In the standby mode, the unit is effectively off. All outputs are turned off and the display shows STANDBY. In the operating mode, the unit operates automatically. All inputs are monitored and the outputs are controlled accordingly. Pressing the Power key will toggle the unit from standby to operate or from operate to standby. If power is removed from the unit, when power is reapplied, the unit will restart in the mode it was in when power was removed.

Display

The display is a 2 line x 20 character backlit liquid crystal display. System operating status and sensor readings are shown on this display. Set point information is also shown on this display.

Operating Status Messages

The operating status of the unit is shown on the top line of the display. The following list describes the items shown for the operating status.

STANDBY - The unit is in the standby mode.

DELAY 99 - The unit is in the RO start delay. The number is the seconds remaining before the RO pump starts.

OPERATING - The RO unit is operating.

TANK FULL - The unit is shut down due to a tank full condition.

TANK FULL 99 - The unit is shut down due to a tank full condition. If the number is blinking, the tank full high switch has cleared, but the tank full low switch is still active. If the number is on steady, both tank level switches have cleared and the delay is counting down.

PRETREAT - The unit is shut down due to a pre-treat lockout condition.

PRESS FAULT - The unit is shut down due to a pressure fault condition.

MEMB FLUSH 99 - Membrane flush is active. The number is the minutes remaining in the flush cycle.

TDS / Conductivity

The TDS / Conductivity is shown on the top line after the unit operating status. When the unit is offline because of a shut down condition, the reading is replaced with >----= If the reading is over range, the reading is shown as >^^^^=.

Operating Hours

The current operating hours are shown on the bottom line.

Temperature

The current water temperature is shown on the bottom line after the operating hours. When the unit is offline because of a shut down condition, the reading is replaced with >---=.

Warning Messages

Warning messages are also shown on the second line. If any warnings are active, the active warnings will alternate with the normal displays for the bottom line. The following lists the warning messages.

HI TDS / Cond - The TDS / Conductivity reading has exceeded the programmed limit.

TANK LOW - The tank low input is active.

TANK LOW 99 - The tank low input has cleared, but the tank low restart delay is active. The number is the minutes left in the delay.

OP HOURS EXCEEDED - The current operating hours have exceeded the programmed limit.

Tank Full Operation

The unit can be operated with 1 or 2 level switches. With 1 level switch, the switch is connected to the tank full high input. When this switch has been active for 5 seconds, the unit will shut down on tank full. TANK FULL will show on the display. When the tank full condition clears, the display will show TANK FULL 99. The number is the tank full restart time and the unit will restart when this delay times out.

For 2 level switch operation, the upper switch is connected to the tank full high input and the lower switch is connected to the tank full low input. When both switches are clear, the RO unit will run. The RO unit will continue to run when the water level rises and the lower switch becomes active. When the upper switch becomes active, after the 5 second delay, the RO unit will shut down. TANK FULL will show on the display. When the tank level drops and the upper level switch clears, the display will show TANK FULL 99 and the RO unit will remain off. The number is the tank full restart time and the number will blink until the lower level switch clears. When the lower level switch clears, the number will remain steady and the RO will restart when the delay times out.

Tank Full Restart

The tank full restart is the delay before the RO unit starts when a tank full condition clears. This delay can be in minutes or in seconds. The TF Restart Set point selects seconds or minutes.

Tank Full Override

A timed tank full override can be initiated when the RO unit is shut down due to a tank full condition. Pressing the Alarm Silence/Reset key for 3 seconds during a tank full condition will enable the tank full override. The RO will start and TF OVERRIDE 9 will show on the display. The number is the minutes remaining in the override timer. When the override times out, the unit will return to the tank full shut down condition.

Pressure Fault

If the pressure fault input becomes active and stays active for the delay programmed in the PF Delay Set point, the unit will shut down for a pressure fault. The display will show PRESS FAULT, the alarm lamp will flash and the audible alarm will sound. The pressure fault can be cleared by pressing the Alarm Silence/Reset key twice.

Auto Reset

If a pressure fault shut down occurs and the Auto Reset Set point is programmed to 0, the unit will remain shut down until manually reset. If the Auto Reset Set point is programmed to a value greater than 0, the unit will automatically clear the pressure fault and attempt to restart after this delay times out.

Alarm Silence

When a shut down occurs that causes the audible alarm to sound, the alarm can be silenced by pressing the Alarm Silence/Reset key once. The alarm will remain silenced if the Alarm Silence Set point is programmed to 0. If the Alarm Silence Set point is programmed to a value greater than 0, the alarm will resound after this delay times out. Pressing the Alarm Silence/Reset key will silence the alarm and reset this delay.

Pre-treat

If the pre-treat input becomes active and stays active for 2 seconds, the unit will shut down in a pre-treat lockout condition. PRETREAT will show on the display and the unit will remain shut down as long as the pre-treat input is active.

Membrane Flush

If the Flush Type Set point is programmed to 0, flush is disabled. If membrane flush is desired, several types of flush are available. When the unit enters a flush cycle, the flush relay will activate. The flush cycle will last for the time programmed in the Flush Time Set point. Table 3 shows the value that must be programmed in the Flush Type Set point for each type of flush.

TABLE 3

TANK FULL - The RO unit will flush each time a tank full condition occurs.

OPERATING HOURS - A flush will occur when the RO pump has operated for the number of hours programmed in the Flush Interval Set point.

ELAPSED TIME - A flush will occur after the number of hours programmed in the Flush Interval Set point has passed.

OFF HOURS - A flush will occur when the RO has been shut down due to a tank full condition for the number of hours programmed in the Flush Interval Set point.

RO START/STOP - A flush will occur each time the RO starts or stops.

The tank full flush can be combined with any of the 3 interval flush types. A manual flush can be initiated by pressing the Alarm Silence/ Reset key for 3 seconds.

Flush Mode

The Flush Mode Set point can be used to control the operation of the inlet valve and RO pump during flush. Each can be independently programmed to operate during flush. Table 4 shows the values to program into the Flush Mode Set point to control the operation of the inlet and RO outputs during flush.

FLUSH MODE	RO PUMP	INLET VALVE
0	OFF	CLOSED
1	OFF	OPEN
2	ON	CLOSED
3	ON	OPEN

TABLE 4

High TDS / Conductivity Warning/Alarm

If the TDS / Conductivity reading exceeds the limit programmed the TDS / Cond Limit Set point for the delay programmed in the TDS / Cond Delay Set point, the alarm lamp will light and the HI TDS / Cond warning message will show on the display. This warning will clear when the TDS / Conductivity drops below the Set point. If the TDS / Cond Shutdown Set point is programmed to 0, the unit will continue to operate. Otherwise, once a high TDS / Cond warning occurs, after the time programmed in this set point, the RO unit will shut down and the alarm will sound. The alarm can be cleared by pressing the Alarm Silence/Reset key twice. NOTE: the auto reset function is not active for this shut down.

Operating Hours Exceeded

If the current hours exceed the limit programmed in the Maximum Hours Set point, the alarm lamp will light and the OP HOURS EXCEEDED warning message will be shown. This warning can be cleared by programming the current hours to 0 or by increasing the maximum hours limit.

I/O Expander

The I/O Expander board adds 2 relays and 1 switch input. The operation and programming of the 2 relays is described in the installation section.

Auxiliary Output

Relay 1 can be used to control a repressurization pump when relay 1 of the expander board is configured to operate an aux relay. In this mode, this relay will be energized as long as the tank low input is not active. When energized, the relay supplies power to the repressurization pump.

Tank Low

When the tank low input has been active for 5 seconds, the auxiliary output will turn off. The alarm lamp will light and the TANK LOW warning message will show on the display. When the tank low condition clears, the TANK LOW 99 warning message is displayed. The number is the delay in minutes before the auxiliary relay will energize.

For boost pump operation, when the tank low input has been active for 5 seconds, the boost pump output will turn off, the RO unit will shutdown, the alarm lamp will flash and the audible alarm will sound. TANK LOW shutdown message will show on the display. When the tank low condition clears, the TANK LOW 99 shutdown message is displayed. The number is the delay before the RO unit will restart. The shutdown can be manually reset by pressing the Alarm Silence/Reset button twice.

Boost Pump Output

Relay 1 can be used to control a boost pump when the expander board is configured to operate relay 1 as a boost pump relay. This relay will operate the same as the inlet solenoid relay. This option is used to directly operate a boost pump up to 1HP.

Divert Output

When relay 1 or relay 2 has been programmed to operate as a divert relay, the relay will energize when the TDS / Conductivity exceeds the TDS / Cond Limit Set point. This will occur as soon as the reading exceeds the limit, there is no delay. When the reading drops below the limit and stays below the limit continuously for 5 seconds, the divert relay will turn off.

Alarm Output

When relay 2 has been programmed to operate as an alarm relay, the relay will energize whenever a warning or alarm condition occurs. The relay will remain energized as long as the warning/alarm condition is active.

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

ADJUSTMENTS

TDS / Conductivity Calibration

Refer to figure 2 for adjustment location. To calibrate the TDS / Conductivity, place the cell in a known standard solution. Adjust the span adjustment for the correct reading. If the cell is installed, the unit can be calibrated by taking a sample of the permeate water and testing it with a known, good meter. Adjust the span control until the reading matches the meter. NOTE: If the TDS / Cond range is changed, the unit must be recalibrated AND some components may need to be changed.

Display Adjustment

The display contrast can be adjusted for best viewing by adjusting control R3. This control is located toward the upper right corner of the board, just to the left of the cell connector.

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

TROUBLESHOOTING

CAUTION: Hazardous voltages are present when power is applied to the unit. Care should be taken when troubleshooting any of the input power or output circuits. When disconnecting or connecting any board or accessory, be sure power is turned off at the disconnect.

Before contacting R & D Specialties for technical help, verify the programming of all Set points, check the display and check the status of all lights and indicators. The more information available when you contact us, the easier it will be to determine the source of the problem. NOTE: Phone support is only available from 8AM to 5PM Central Standard Time, -6 GMT.

System Inoperative

Is the yellow CPU active LED blinking? If no, is the green power LED, DS1 Lit? If no, is the fuse OK? If no, replace the fuse. If yes, with a voltmeter, verify power is applied to the power terminals L1 and L2. If power is applied to the power terminals and the above checks are OK, the board is probably defective and should be replaced. If no power is applied to the board, check the power wiring to the system.

Display Blank

Is the green power LED, DS1 lit? If no, refer to the system inoperative section. If yes, is the CPU active LED, DS9 blinking? If no, replace the board. If yes, adjust the display contrast adjustment, R3. Is the display still blank? If yes, replace the board.

Inlet Valve Will Not Operate

Is the system in standby? If no, are any shut down conditions active? If no, is the inlet LED, DS8 lit? If no, replace the board. If yes, with a voltmeter, verify if there is power on the inlet terminals. Is there power? If no, replace the board. If yes, check the valve and wiring.

RO Pump Will Not Operate

Is the system in standby? If no, are any shut down conditions active? If no, is the RO LED, DS6 lit?
If no, replace the board. If yes, with a voltmeter, verify if there is power on the RO pump terminals. Is there power? If no, replace the board. If yes, check the pump and wiring.

Unit Not Flushing or Not Flushing Correctly

Verify that flush is enabled and what type of flush is selected. Is flush enabled? If no, enable flush. If yes, press the Alarm Silence /Reset key for 3 seconds. Does the unit show flush on the display? If no, replace the board. If yes, is the flush LED, DS10 lit. If no, replace the board. If yes, with a voltmeter, verify if there is power on the flush terminals. Is there power? If no, replace the board. If yes, check the valve and wiring.

No or Incorrect TDS / Conductivity Reading

Is sensor wired correctly? If no, correct wiring. If yes, is sensor installed as described in the installation section? If no, install correctly. If yes, verify correct TDS / Conductivity range. Range correct? If no, correct range. If yes, calibrate unit. Does unit calibrate OK? If no, disconnect green and white wires of sensor. Does reading show 0? If no, replace board. If yes, reconnect wires and remove sensor from piping and dry. Does reading show 0? If no, replace cell. If yes, short pins of cell together. Does reading show >^^^=? If no, replace board.

TDS / CONDUCTIVITY EXPANDER

Installation / Wiring

The TDS / Conductivity expander board allows a 2nd TDS / Conductivity to be monitored and displayed by the Series 150 controller. The expander board is mounted on the main board to the left of the connector for the 1st cell. Figure 6 shows the wiring and adjustment information for the expander.

SERIES 150 CONTROLLER
For LP and HP LP-11500 to LP-20

Set points

When the expander is installed, 3 additional set points are provided to allow features of the expander to be changed. Refer to the Displaying or Changing Set points section of the manual on page 14 for information on changing the set points. The additional set points are listed below.

SETPOINT	DESCRIPTION	RANGE	DEFAULT
C2 Range	Selects range of TDS / Conductivity monitor 0-50, 1-100, 2-250, 3-500, 4-1000, 5-2500 6-5000 NOTE: If this Set point is changed, the unit must be recalibrated and range components may need to be changed.	0-6	2
C2 Limit	When this value is met or exceeded, the alarm lamp will light and high TDS / Cond uS or PPM will show on the display. To disable, set to 0.	0-999	100
% Rej	If the 2nd TDS / Conductivity is used to monitor feed water, programming this set point to1 allows the % rejection to be displayed.	0-1	0

Operation

When the TDS / Conductivity expander is installed, the reading will be shown on line 2 and will alternate every 3 to 4 seconds with the hours and temperature. If the % rejection display is enabled, it will be shown on line 2 with the 2nd TDS / Conductivity reading.

If the C2 limit is enabled, and the 2nd TDS / Conductivity reading exceeds the limit programmed the C2 Limit Set point for the delay programmed in the TDS / Cond Delay Set point, the alarm lamp will light and the HI TDS / Cond 2 warning message will show on the display. This warning will clear when the 2nd TDS / Conductivity drops below the Set point.

Calibration

Refer to figure 6 for adjustment location. To calibrate the 2nd TDS / Conductivity, place the cell in a known standard solution. Adjust the span adjustment for the correct reading. If the cell is installed, the unit can be calibrated by taking a sample of the water and testing it with a known, good meter. Adjust the span control until the reading matches the meter.

PuROMax Membrane Replacement

1. Turn off the system and close the feed water shutoff valve.
2. Disconnect power from the system and verify again that the feed water is off.
3. Disconnect the membrane feed line from the membrane housing cap, Note that the feed is always the outside of the two ports.
4. Remove the clamp bolts from the vessel the hold the cap to the stainless steal vessel. One fiberglass vessels remove retaining ring or plate,
5. Remove cap from vessel using caution that you do not crack the cap or damage the o rings.
6. Remove membrane from vessel. Take note of the placement of the brine seal when removing the membrane. The new membrane and seal must go in the same direction as the old one came out. This should be with the open part of the brine seal towards the end of the vessel where the feed is connected. On units with multiple membranes the placement alternates. If a membrane is put inn upside down or with the brine seal in the wrong position it could damage the membrane and the system itself.
7. Inspect the o rings of both vessel caps and replace it there are signs of excessive wear or cracking. Lightly lubricate o rings.
8. Record the model number and serial number of the new membrane before placing in system.
9. Insert new membrane. The new membrane and seal must go in the same direction as the old one came out. This should be with the open part of the brine seal towards the end of the vessel where the feed is connected. On units with multiple membranes the placement alternates. If a membrane is put inn upside down or with the brine seal in the wrong position it could damage the membrane and the system itself.
10. Install end caps that were removed attaching the clamp bolts from the vessel the hold the cap to the stainless steal vessel. One fiberglass vessels remove retaining ring or plate,
11. Install membrane feed hoses. Always check lines for signs of excessive wear or cracking and replace if necessary.
12. Follow the startup procedure in section

PuROMax Commercial RO Troubleshooting

Issue	Cause	Corrective action			
RO unit is not making enough water	Low water temperature	adjust temperature - see temperature chart			
	Low water supply pressure	Check pre filters and replace if necessary			
	Membranes are fouled	Clean or replace membranes if necessary			
	Low pump pressure	Pressure can be adjusted using the drain control vale. Also if pump is damaged and not building any pressure then replace			
	Feed water TDS is to high	Production will vary based on TDS. See TDS correction chart			
RO unit is making too much water.	O-Ring Bypass	Remove membrane and inspect all o-rings to be sure it is sealing correctly. If damaged o-ring is found replace. Also make sure the brine seal is at the end of the membrane where the water enters.			
	Chlorine damage	Replace membrane and remove chlorine			
	Increased water temperature	As temperature increases it is normal to see an increase in production.			
	Membrane tear due to reverse flow	check to make sure a check valve is in place and working correctly to avoid reverse flow on the product and replace membrane.			
TDS of product water is too high	O-Ring Bypass	See above			
	Chlorine damage	See above			
	Membrane fouled	Clean or replace membranes if necessary			
	Membrane tear due to reverse flow	See above			
RO unit hammers or show LP fault with control box unit	Restricted feed water	Check pre filters and replace if necessary			
	Low flow feed water	All PuROMax units are based on the total gpm required at 35 psi. Make sure your supply is feeding sufficient flow. Additional feed or larger feed pump may be required			
	Drain control is open too far	The drain control valve may need to be adjusted to maintain the system operating pressure.			

PuROMax Commercial RO Troubleshooting

Issue	Cause	Corrective action
RO unit is running but has no product water	Instruments are not working correctly	Check product line and replace instruments if necessary
	Blockage in product line	Check and correct
	Auto Flush solenoid stuck open	check flow and verify valve is closing correctly. Replace if necessary
RO Pump overheats	Unit with multistage pumps can run 60 degrees over ambient	make sure unit is properly ventilated. Move if necessary
	Running right of the curve	Check to verify that the total pump outlet does not exceed the total GPM of the unit base on the units spec page. Units that pump excessive amounts of water will overheat and draw over amps.
	Incorrect voltage	Check to verify that a clean constant voltage the system call for and correct if necessary.
RO pump is pumping too much water. (Running right of the curve)	High feed pressure	All PuROMax systems are based on a 35 psi inlet pressure. If the inlet pressure exceeds this it may cause the pump to pump more water than expected. A pressure regulator may be required to maintain a 35 psi inlet pressure.
	Open drain valve	The drain valve for the unit may need to be adjusted to the systems rated pressure. If the valve is open too far the system will waste more water than projected.
RO pump is Leaking between the pump and motor	Run Dry	Replace shaft seal on pump. Also verify low pressure switch is functioning correctly.
RO pump turns slow	improper voltage	Usually the motor is set for 220v and the supplied power is 110v. Correct pump to proper voltage. Also not that the entire system operates on the same voltage. If the system is set up for 220v and you only have 110v the system will not function correctly unless all electric items are changed.
Unit has water flow but does not run	Initial start up	Remove paper between contact of low pressure switch
Pump runs but no water	Improper wiring	make sure on units without control box that the source power is connected to the top two terminals of the low pressure switch with the solenoid valve

Temperature & Pressure Correction

Temperature of the feed water and the net driving pressure across the element must be taken into account before comparing or evaluating the performance of a membrane element or a reverse osmosis system.

Temperature Correction Factor

The water temperature is one of the key factors in the performance of the reverse osmosis membrane element. The higher the temperature, the more the product flow, and vice versa. All reverse osmosis membrane elements and systems are rated at 77° Fahrenheit (25° Celsius). To find the membrane permeate rate at a different temperature, follow these steps:

Find the temperature correction factor (TCF) from the below table. Divide the rated permeate flow at 77° Fahrenheit by the temperature correction factor. The result is the permeate flow at the desired temperature.

EXAMPLE
QUESTION: For a thin-film membrane permeate rated at 1800 gallons per day at 77° Fahrenheit, what is the actual permeate rate at 59° Fahrenheit?
ANSWER: Temperature correction factor (from below table) for 59°F = 1.47
Permeate flow at 59 degrees Fahrenheit = 1800 ÷ 1.47 = 1224 gallons/day

Feed Water Temperature °C	°F	TCF for Thin Film	TCF for CTA/CAB
1	33.8	3.64	2.23
2	35.6	3.23	2.15
3	37.4	3.03	2.08
4	39.2	2.78	2.00
5	41	2.58	1.93
6	42.8	2.38	1.87
7	44.6	2.22	1.80
8	46.4	2.11	1.74
9	48.2	2.00	1.68
10	50	1.89	1.63
11	51.8	1.78	1.57
12	53.6	1.68	1.52
13	55.4	1.61	1.47
14	57.2	1.54	1.42
15	59	1.47	1.38
16	60.8	1.39	1.33
17	62.6	1.34	1.29
18	64.4	1.29	1.25
19	66.2	1.24	1.21
20	68	1.19	1.17
21	69.8	1.15	1.13
22	71.6	1.11	1.10
23	73.4	1.08	1.06
24	75.2	1.04	1.03
25	77	1.00	1.00

Feed Water Temperature °C	°F	TCF for Thin Film	TCF for CTA/CAB
26	78.8	0.97	0.97
27	80.6	0.94	0.94
28	82.4	0.91	0.91
29	84.2	0.88	0.89
30	86	0.85	0.86
31	87.8	0.83	0.83
32	89.6	0.80	0.81
33	91.4	0.77	0.79
34	93.2	0.75	0.76
35	95	0.73	0.74
36	96.8	0.71	0.72
37	98.4	0.69	0.71
38	100.4	0.67	0.68
39	102.2	0.65	0.66
40	104	0.63	0.65
41	105.8	0.61	
42	107.6	0.60	
43	109.4	0.58	
44	111.2	0.56	
45	113	0.54	
46	114.8	0.53	
47	116.6	0.51	
48	118.4	0.49	
49	120.2	0.47	
50	122	0.46	

Temperature & Pressure Correction

Net Pressure Correction

The higher the net pressure on a membrane element, the higher the permeate rate. A rough value of osmotic pressure of water can be calculated roughly by the following rule:

Osmotic pressure (PSI) = Total Dissolved Solids / 100

To estimate the effect of net pressure, follow these steps:

1. Calculate the net pressure at which the membrane element is rated (P_r)
   P_r = Rated pressure - Osmotic pressure of test solution

2. Calculate the net pressure under operating conditions (P_{op})
   P_{op} = Average applied pressure - Average osmotic pressure of the feed water

3. Expected permeate flow at operating conditions = (Rated permeate flow) x P_{op} / (P_r)

EXAMPLE

QUESTION:
For a thin-film membrane, 4 × 40" membrane element, using a 2000 ppm, sodium chloride solution at 225 psi and 77 degrees Fahrenheit, the permeate rate is 1800 gallons/day. What is the permeate rate at 150 psi, feed water with 1000 TDS and temperature of 59 degrees Fahrenheit?

ANSWER:
From the above example for the temperature correction, the permeate rate at 59 degrees Fahrenheit is 1224 gallons/day.

Using the steps above, the effect of net pressure is:
1224 x (150 - 10) / (225 - 20) = 1224 x (140) / (205) = 835.9 gallons/day

NOTE

When designing a system additional detailed calculations are necessary to take into account the effect of pressure drop and variation in total dissolved solids (TDS) throughout the system. Please contact us if you require further information.

Industrial R/O Test Data					
Serial #:					
	Units	Sample	Before Install	After Install	Service
Permeate Rate	GPM	1			
Concentrate Rate	GPM	1			
Recovery		50%			
Inlet Pressure	PSI	50			
Membrane Pressure	PSI	115			
Feed TDS	PPM	500			
Well or Municipal		Municipal			
Iron	PPB	0.02			
Hardness	PPM	0			
Permeate TDS	PPM	10			
Water Temp.	F	77			
Rejection		98%			
Low Pressure		Y			
Solenoid		Y			
Pump Model #		7GBS10			
Pump Serial #					
Membrane size	Style	4x40 GE			
TDS Monitor		Y			
Recycle Valve		NA			
Pre & Post Pressure Gauge		NA			
Customer Name		FSHS Inc			
Test Date		10/1/2005			
Install Date		10/13/2005			
Tested By		Jeremy Greene			
Remarks					
Y is yes for function NA is used for not equipped					

The industrial R/O data sheet should be filled out before and after install. Any units that wish to be returned for service or repair must have a completed test data sheet for review.

SIX MONTH LIMITED WARRANTY

FSHS, Inc., warranties your commercial/ industrial Reverse Osmosis system, to be free of defects in material and workmanship, for a period of (6) six months, under normal use, within normal operating conditions. To resolve any warranty problems, you must **first** contact your local dealer, they in turn will contact the factory. Upon proof of purchase, ***FSHS, Inc.***, will repair or replace, at the factory, the defective part or unit, and return it to your local dealer. Freight to and from the factory is to be paid by the buyer.

The Pre and Post filter cartridges, if any, are warrantied for manufacturers defects only and not for taste and odor problems. The membrane is warrantied separately as stated below.

All parts, such as pumps, motors, electrical parts and flow meters, shall be warrantied by the manufacturer of these parts.

MEMBRANE LIMITED WARRANTY

The **REVERSE OSMOSIS MEMBRANE** will be warranted for a six month period. Warranty begins from the date of purchase from the manufacturer. Membrane is warranted against defects when used under standard operating conditions.

Membranes must be kept moist at all times. Defective membranes must be returned in a sealed bag and kept moist with an appropriate preservative solution or R.O. water. **Membranes returned dry, opened, or improperly packaged can not be evaluated for warranty and will be returned to the sender at your expense.**

Low Pressure Membrane	**NSF Certified**	**RE4040-BLF**
NaCl Solution,	PPM*	500
Applied Pressure**,	psig	100
Operating Temperature,	°F (°C)	77° (25°)
Permeate Recovery		15%
pH Range		6.5-7.0
Maximum Supply	PPM	2500

High Pressure Membrane	**NSF Certified RE4040-TE**	
NaCl Solution,	PPM	2,000
Applied Pressure	psig	225
Operating Temperature,	°F (°C)	77° (25°)
Permeate Recovery		15%
pH Range		6.5-7.0
Maximum Supply	PPM	6,000

Application Data

Maximum Operating Temperature,	°F (°C)	113° (45°)
Feed water pH Range		3.0-10.0
Maximum Feed water Turbidity	NTU	1.0
Maximum Feed water SDI	(15 mins)	5.0
Maximum Chlorine Concentration	PPM	<0.1
Iron	PPM	<0.01
Hardness	GPG	<10

THERE ARE NO OTHER WARRANTIES EITHER EXPRESSED OR IMPLIED AND THERE IS NO LIABILITY FOR CONSEQUENTIAL DAMAGES OF ANY NATURE OR KIND.