Village Marine-PW 3000

Part Number: 95-0027

Pure Water Series

PW 8,000-20,000 GPD

Installation, Operation & Maintenance

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climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
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LIST OF TABLES

The following are the types of flags used in this technical manual. They designate safety related items and important operational instructions and should be given special attention when they appear in the text:

WARNING Text formatted in this manner concerns an operating procedure or practice that, if not strictly observed, can result in injury to personnel or loss of life.

CAUTION Text formatted in this manner concerns an operating procedure or practice that, if not strictly observed, can result in damage to or destruction of equipment.

NOTE Text formatted in this manner concerns an operating procedure or condition that warrants special attention.

1.0 SYSTEM DESCRIPTION

The Village Marine Tec. (VMT) Seawater Desalinator is a single-pass purification system that uses reverse osmosis (RO) as its method of seawater desalination. This unit produces potable (drinking) quality water with salt concentrations of < 500 ppm by removing approximately 99% of the dissolved salt in seawater.

This manual covers the following models: PW3000, PW4000, PW5000, PW6000, PW7000, PW8000, PW10000, PW12000, PW16000 and PW20000. The principle of operation is the same for all models. Specific differences are noted, where applicable.

1.1 SPECIFICATIONS

1.1.1 PERFORMANCE CHARACTERISTICS

Parameter	**Specification**
Raw water temperature range:	1-40°C (33-108ºF)
Design RO element pressure:	800 psi
Max. RO element pressure:	1000 psi
Max. feedwater residual chlorine:	< 0.1 ppm
pH range (short term for cleaning):	4-10 (3-11)
Membrane type:	Thin film composite
Nominal product water production: (2)	
• PW-3000	2.1 gpm
• PW-4000	2.8 gpm
• PW-5000	3.5 gpm
• PW-6000	4.2 gpm
• PW-7000	4.9 gpm
• PW-8000	5.6 gpm
• PW-10000	6.9 gpm
• PW-12000	8.3 gpm
• PW-16000	11.1 gpm
• PW-20000	13.9 gpm

(2) Raw water temperatures less than 25°C (77ºF) will result in less than rated product water output. Conversely, higher raw water temperatures will result in higher than rated output.

Table 1.0 - Performance Specification

1.1.2 PHYSICAL CHARACTERISTICS

	PW3000-5000	PW6000	PW7000-12000	PW16000-20000
Length	84"	84"	84"	84”
Width	34"	44"	48"	52”
Height	35"	35"	35"	43”

Table 1.1 - Unit Dimensions

	PW3000	PW4000	PW5000	PW6000	PW7000
Weight	800 LB	900 LB	1000 LB	1050 LB	1500 LB

	PW8000	PW10000	PW12000	PW16000	PW20000
Weight	1600 LB	1800 LB	1900 LB	2200 LB	2250 LB

Table 1.2 – Unit Weights

1.1.3 UTILITY REQUIREMENTS

See the nameplate attached to top of the unit for power requirements.

	PW3000	PW4000	PW5000	PW6000	PW7000
Motor HP	10	10	15	15	15

	PW8000	PW10000	PW12000	PW16000	PW20000
Motor HP	20	20	25	25	30

Table 1.3 – HP Pump Horsepower

Utility	Connection	Design Pressure Minimum (psi)	Design Pressure Maximum (psi)
Raw water inlet	1 ½” ANSI Flange	0	50
Reject discharge*	1 ½” ANSI Flange	0	15
Product water discharge	1” ANSI Flange	0	15
Flush water inlet	1 ½” NPT	20	50

* Vacuum condition at shutdown is not acceptable, syphon breaker may be reqd.

Table 1.4 - Utility Requirements

Unit	Raw water inlet (gpm)	Reject discharge (gpm)	Product water discharge (gpm)
PW-3000	14	12	2.1
PW-4000	14	11	2.8
PW-5000	20	16	3.5
PW-6000	20	16	4.2
PW-7000	20	15	4.9
PW-8000	24	19	5.6
PW-10000	30	23	6.9
PW-12000	36	28	8.3
PW-16000	36	26	10.4
PW-20000	43	29	13.9

Table 1.5 – Nominal Design Flow

1.1.4 ENVIRONMENTAL REQUIREMENTS

Parameter	Specification
Ambient temperature:	1-40°C (33-108ºF)
List (permanent):	15º
Trim (fore and aft):	+ 30º
Pitch:	± 10º (6 sec cycle)
Roll:	± 30º (12 sec cycle)

Table 1.6 - Nominal Operating Conditions

1.2 EQUIPMENT REQUIRED FOR OPERATION

1.2.1 CONSUMABLES

The following is the normal quantity of equipment consumed during 6 months of standard unit operation:

NOTE

Only Village Marine Tec approved filters and chemicals should be used.

Description	QTY		VMT Part No.
	PW3000-6000	PW7000-20000	
Cleaning Chemical #1, 25 lbs	2	3	85-0045
Cleaning Chemical #2, 25 lbs	2	3	85-0048
Preservative Chemical #3, 25 lbs	1	1	85-0049
Filter, 100 ft^2, 5 Micron	6	6	33-5100
Filter, 100 ft^2, 20 Micron	6	6	33-2100
Flushing Filter	2	2	See Parts Dwg
Oil, HP Pump, Quart	20	20	85-0050
LP Pump Mech Seal Kit	1	1	90-0108
HP Pump Service Kits	1	1	See Pump Manual

Table 1.7 - Consumables

1.2.2 TEST EQUIPMENT

The following table lists the basic equipment recommended to perform most types of verification testing and system maintenance. The salinity meter allows the operator to perform routine sampling of the RO membranes:

Description	VMT Part No.
Kit, pH Test, 0-14 (10 strips):	90-0135
Meter, Handheld Analog, 0-5000 ppm:	40-5000
10X Range Extender for Analog Meter:	40-5001
Alternate Digital Handheld meter, 0-1000 ppm:	99-1990
Solution, Calibration, 300 ppm:	90-1300
Solution, Calibration, 30,000 ppm:	90-1301

Table 1.8 - Recommended Test Equipment

2.0 PREPARATION FOR USE, INSTALLATION AND INITIAL ADJUSTMENT

2.1 UNPACKING AND HANDLING

Remove unit from shipping crate and inspect for shipping damage.

CAUTION
Do not allow unit or any components to be exposed to freezing temperatures. If it is anticipated that the unit may be exposed to freezing temperature, please contact VMT in advance for technical assistance.

2.2 LOCATION

The RO unit should be installed in a dry, sheltered location protected from direct weather. Some type of drainage should be provided beneath the RO unit to allow standing water to drain when performing maintenance or repair (see system diagram in Section 9.0 for skid size, interface locations and minimum maintenance envelope requirements).

For units without a pressurized feed, it is recommended that the RO unit be mounted in a location below the vessel's waterline. This will ensure a flooded suction to the unit at all times.

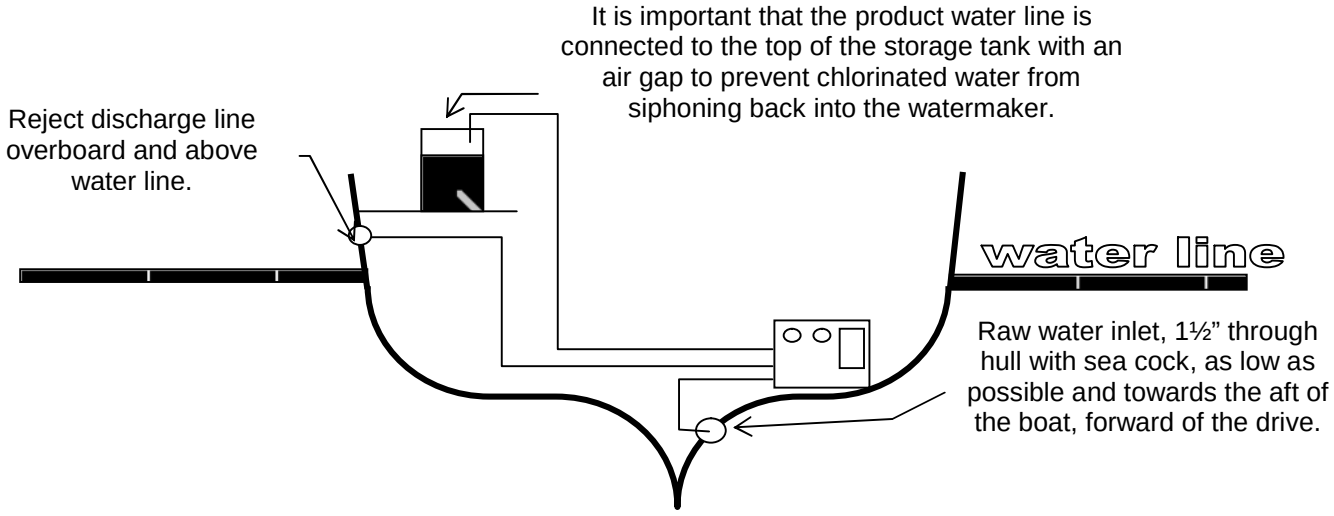


Figure 2.0 - Recommended Installation (Below Water Line without Pressurized Feed)

If it is not possible to mount the watermaker below the water line, the boost pump can lift to a maximum height of 15 feet (5 feet for 50 Hz units) above the water line with the boost pump removed from the frame and installed below the RO frame near the through hull. A check valve might be required in the suction line to maintain adequate system priming. Locating the system any more than 15 feet above the water line requires installation of external pumps to maintain a pressurized feed.

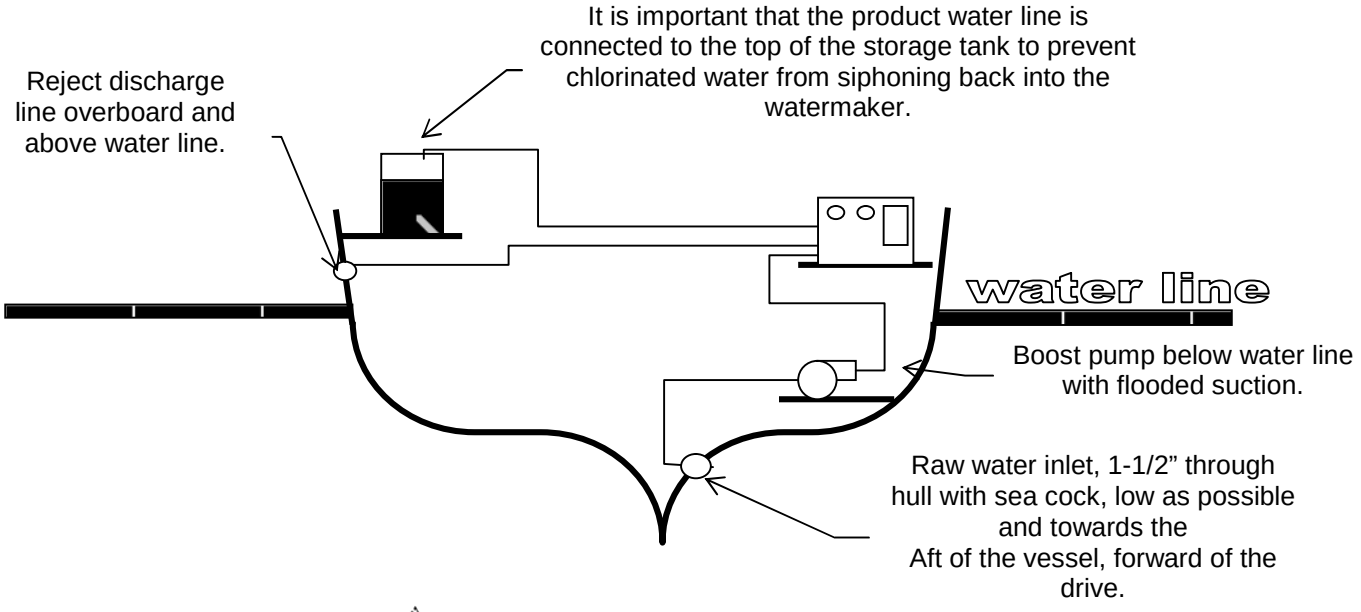


Figure 2.1 - Proper Installation
(Above Water Line)

Since every installation is unique, the mounting instructions are provided for guidance only. It is recommended that you use your own discretion as to the exact method of mounting and placement of any mounting bolts.

1) Place the RO unit in an appropriate location and use existing holes or drill new holes for a minimum of four point mounting by studs or bolts. Mount the RO unit securely making sure that the base of the unit is continuously supported.

2) Make the following plumbing connections to the RO unit's piping interfaces (refer to Section 9.0 for the exact piping interface locations):

   a) Connect the raw water supply (1½" flange connection inlet) to a clean seawater source.

CAUTION

Inlet and discharge interconnecting lines should be constructed of a NON-FERROUS material. Examples of some suitable materials are PVC, copper-nickel, 316 stainless steel pipe or a reinforced non-collapsing hose. Ferrous piping produces rust that will irreversibly foul the membrane and void the RO unit warranty.

NOTE

Avoid connecting the inlet piping to any water line that services any other piece of equipment. Air could be drawn through the RO unit causing damage to the RO unit's pumps.

b) Connect the reject discharge 1½" flanged connection to an unobstructed line connected to an appropriate drain. If the reject is discharged overboard, the discharge port should be above the waterline. On above waterline installations where the reject goes down more that 10 feet to its outlet, install a vacuum breaker or vent to prevent any negative pressure or vacuum situation at shutdown.

CAUTION

The use of galvanized steel for product piping should be avoided as small amounts of rust may form that can be drawn back into the RO when the system is off.

c) Connect the product water discharge 1" flanged connection to an unobstructed line that is connected to the TOP of the product water storage tank. If the storage tank water is chlorinated, a check valve or air gap should be installed in the product line as a precaution to prevent chlorine damage of the RO membranes. The air gap is often accomplished by teeing the product connection to a tank vent or tank fill line of suitable size.

d) Connect the flush water inlet to the pressurized fresh water system on the vessel. Do not exceed 50 psi pressure.

CAUTION

Exposing the membranes to chlorinated water may cause irreversible damage and will void the RO unit warranty, so use the carbon flush filter supplied.

3) Connect the following RO unit's electrical interfaces:

NOTE

Strictly observe all applicable electrical codes and regulations governing the installation and wiring of electrical equipment. Typical codes specify the type and size of conduit, wire diameter and class of wire insulation depending upon the amperage and environment. The power supply should always be of a greater service rating than the requirements of the RO unit. This will assure proper voltage even if power supply voltage is slightly less than required. Never connect the RO unit to a line that services another electrical device. The RO unit should have its own dedicated power supply and breaker.

WARNING

Disconnect electrical power to RO unit and the power source before connecting to RO unit interface. Failure to do so can cause serious injury or death to personnel.

a) Connect the correct voltage/power supply to the three-phase or single phase supply point in the Motor Starter Box. Correct high pressure pump rotation is clockwise when viewing the motor fan (or counter-clockwise when viewing from the shaft and pulley end. Correct rotation for the low pressure boost pump is clockwise when viewing the motor fan.

IMPORTANT NOTE

Three phase power supplies will spin the motors and pumps either rotation direction, depending on the phase sequence of the three hot power legs. It is very important not to rotate the low pressure pump backwards. Even “bumping” the motor for one second can cause significant damage. The high pressure pump will not be damaged from running backwards. Either use a phase meter to determine the rotation, or use the high pressure pump only to check rotation and adjust the input power legs accordingly prior to checking the low pressure pump. If the low pressure pump is inadvertently “bumped” backwards, open the pump and check the impellor is secured on the motor shaft and spins freely prior to starting it again.

b) Connect a suitable ground to the RO unit skid (as determined by the specifics of your installation).

3.0 GENERAL THEORY OF OPERATION

3.1 REVERSE OSMOSIS THEORY

Reverse osmosis, like many other practical scientific methods, has been developed from processes first observed in nature. Osmosis is a naturally occurring phenomenon in which a semi-permeable membrane separates a pure and a concentrated solution (a semi-permeable membrane is defined as one that preferentially passes a particular substance). Every fluid has an inherent potential that is directly related to the type and amount of solids in solution. This potential, referred to as osmotic pressure, increases in proportion to relative concentration of a solution. A concentrated solution, therefore, has an osmotic pressure that is higher than that of a pure solution.

In an osmotic system, the less concentrated solution will attempt to equalize the concentrations of both solutions by migrating across the semi-permeable membrane. When enough pure solution migrates across the membrane such that the inherent potential difference between the solutions is no longer higher than the osmotic pressure of the membrane, the purer solution will stop flowing. If the pressure on the concentrated solution is increased to above the osmotic pressure, fluid flow will be reversed. This condition, called Reverse Osmosis, can be established by artificially pressurizing the more concentrated solution using a high pressure pump. In this type of system, the concentrated solution (normally referred to as feedwater) will become more concentrated as pure water flows out of solution and across the membrane to the permeate side. Discounting the effects of feedwater temperature and salinity, the operating pressure normally required to produce significant amounts of pure water is at least twice the osmotic pressure of the membrane being used.

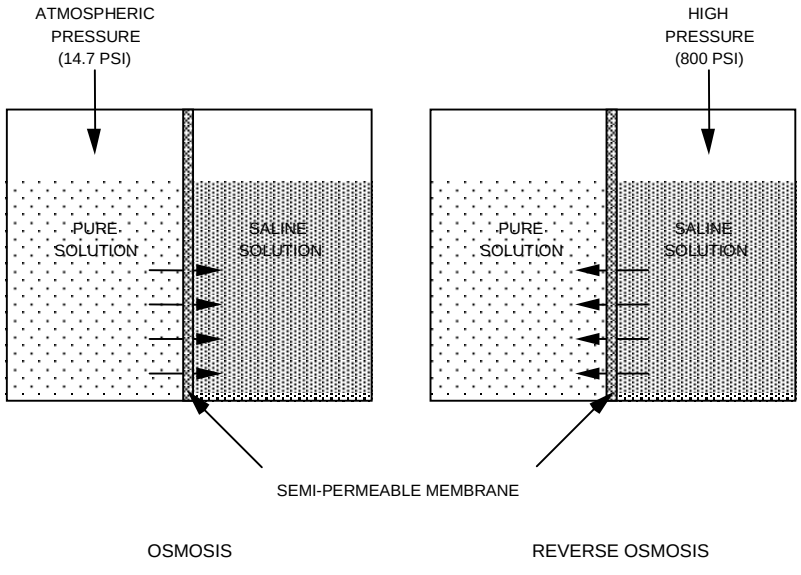


Figure 3.0 - Simple (Reverse) Osmotic System

3.2 APPLICATION OF REVERSE OSMOSIS

Seawater contains many kinds of solids dissolved in solution. The most prevalent is common table salt (sodium chloride). Other minerals that may be present in solution are substances that usually contain various compounds of calcium and sulfate. The sum of all of the solids dissolved in a particular sample of water is referred to as *Total Dissolved Solids* or TDS. Seawater normally averages 32,000 to 35,000 ppm (parts per million) TDS although variations of 5000 ppm are common in various parts of the world. The fundamental goal any desalination process is a significant reduction in the amount of dissolved solids in water.

In a Reverse Osmosis desalination system, most of the dissolved solids do not pass through the membrane but are instead carried along the membrane surface. This rejected water, referred to as *brine*, becomes increasingly more concentrated as it flows along the surface of the membranes and is eventually piped to drain. The product water that flows through the membrane is referred to as *permeate*. The percentage of feedwater converted to permeate is called the *recovery rate* and is normally somewhere between 20% and 30%. For example, a unit with a 29% recovery rate will produce 29 gallons of permeate for every 100 gallons of feedwater with the remaining 71 gallons discharged to waste as brine. A higher than optimal recovery rate (which can be obtained by increasing the back pressure on the unit above the recommended range) results in greatly increased membrane fouling rates and a significant decrease in the operational life of the membranes.

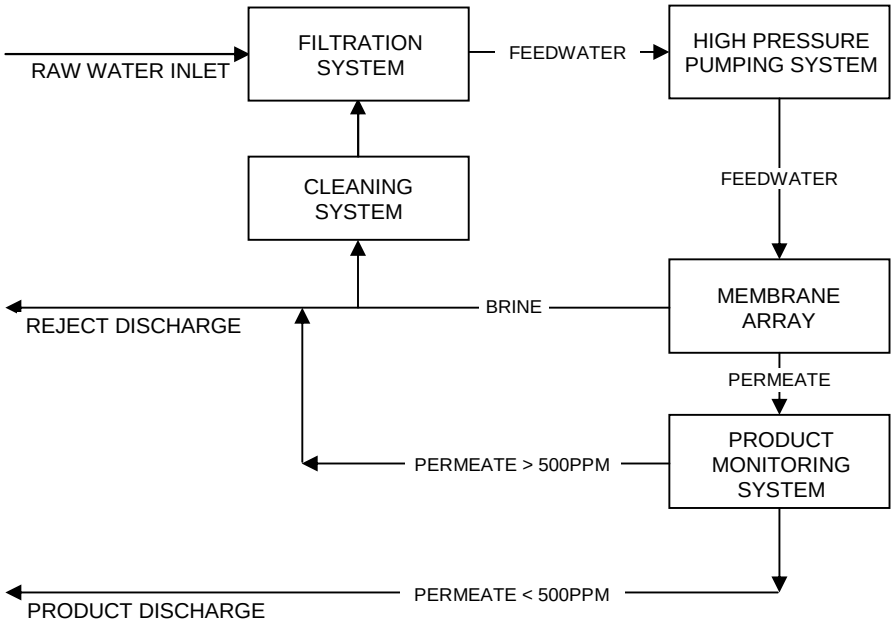


Figure 3.1 - Simplified Schematic of an RO System

It should be noted that no system is capable of removing all of the dissolved solids from seawater. The system is actually designed to reject approximately 99% of the TDS or, in other words, to allow 1% of the 35,000 ppm TDS in the seawater to pass into the product water. This yields water of less than 500 ppm, the recommended TDS for drinking water. A system such as this is said to have a *salt passage* percentage of 1% or a *salt rejection* of 99%.

3.3 PRODUCT WATER QUALITY STANDARDS

This RO unit will produce permeate (product water) with a quality of < 500 ppm TDS and in accordance with World Health Organization (WHO) standards for drinking water. General specifications for acceptable drinking water quality are as follows:

Constituent Ion/Molecule	**Maximum Limits (ppm)**
Nitrate	10
Fluorine	.1
Sulfate	100
Magnesium	30
Calcium	75
Calcium Carbonate	100
Iron	.1
Manganese	.05
Total Dissolved Solids	500
Turbidity	5
Oil	.1
Detergents (anionic)	.2
Phenols	.001
Bacteria - E Coli (per 100 ml)	0

Table 3.0 - Drinking Water Standards

3.4 FACTORS AFFECTING PERMEATE PRODUCTION

3.4.1 VARIATIONS IN TEMPERATURE, PRESSURE AND SALINITY

The following table illustrates how the quality and quantity of permeate produced in by RO system is affected by changes in temperature, salinity and pressure:

With constant....	And increasing....	Permeate	
		TDS	Capacity
Salinity and Pressure	Temperature	Increases	Increases
Temperature and Pressure	Salinity	Increases	Decreases
Temperature and Salinity	Pressure	Decreases	Increases

Table 3.1 - Factors Affecting Permeate Quality

NOTE

If feedwater salt concentration decreases, the product water flow rate should not be allowed to increase more than 20% above rated flow. Reject pressure will need to be lowered to maintain rated flow in brackish water or fresh water applications.

The RO system can be adjusted to maintain a constant permeate output when feedwater salinity is below nominal (near river mouths or in estuaries). The operator can do this by controlling system pressure manually via the back pressure regulator valve, V3, located in the system brine piping. For long pump life and low membrane fouling, VMT recommends that 800 psi is not exceeded except in situations of extreme low temperature feed water.

CAUTION

Operating the unit at more than 120% of rated capacity in low salinity water can damage the membranes and will void the RO unit warranty.

3.4.2 TEMPERATURE CORRECTION FACTOR

As previously described, the output capacity of any RO unit is highly dependent on feedwater temperature. In order to quantify this relationship, theoretical data has been utilized to develop Temperature Correction Factors (TCF) to compensate measured flowrate to calculated flowrate at 25°C/77°F. This allows the operator to establish the baseline flow for a given temperature, allowing more accurate troubleshooting. The procedure for calculating the temperature compensated flow is as follows:

1) Measure raw water temperature and determine the corresponding correction factor from Table 3.2 based on the measured temperature.
2) Note the actual product flow rate at the *Product Flow* meter. Multiply the actual product flow meter flow rate by the correction factor from Table 3.2 to give theoretical temperature compensated flow under standard conditions (25°C).

Example:

Raw water temp:	15°C
TCF:	1.47
Actual product flow:	113.5 (gph)
Calculation:	113.5 x 1.47 = 167 (gph)
Temperature Corrected flow:	167 (gph)

(167 gph is the normal flow for a PW4000)

°C	Factor	°C	Factor	°F	Factor	°F	Factor
1	3.64	26	0.97	34	3.47	84	0.88
2	3.23	26	0.94	36	3.18	86	0.82
3	3.03	28	0.91	38	3.18	88	0.79
4	2.78	29	0.88	40	2.68	90	0.79
5	2.58	30	0.85	42	2.47	92	0.77
6	2.38	31	0.83	44	2.29	94	0.75
7	2.22	32	0.80	46	2.14	96	0.73
8	2.11	33	0.77	48	2.01	98	0.70
9	2.00	34	0.75	50	1.88	100	0.68
10	1.89	35	0.73	52	1.77	102	0.65
11	1.78	36	0.71	54	1.68	104	0.63
12	1.68	37	0.69	56	1.59	106	0.61
13	1.61	38	0.67	58	1.51	108	0.59
14	1.54	39	0.65	60	1.44	110	0.57
15	1.47	40	0.63	62	1.36	112	0.55
16	1.39	41	0.61	64	1.30	114	0.53
17	1.34	42	0.60	66	1.24	116	0.51
18	1.29	43	0.58	68	1.17	118	0.49
19	1.24	44	0.56	70	1.12	120	0.47
20	1.19	45	0.54	72	1.08	122	0.45
21	1.15	46	0.53	74	1.05		
22	1.11	47	0.51	76	1.02		
23	1.08	48	0.49	78	1.00		
24	1.04	49	0.47	80	0.93		
25	1.00	50	0.46	82	0.90		

Table 3.2 - Temperature Correction Factors (TCF)

3.5 OPERATIONAL DESCRIPTION

3.5.1 FILTRATION SYSTEM

Seawater supplied to the intake of the Village Marine RO desalination unit will initially flow through the **raw water strainer, ST1,** which removes large particulate matter. Once through the strainer, the raw water is supplied to the **low pressure boost pump, P1,** which raises the pressure of the water in order to provide enough positive feed pressure to flow through the filtration system and into the suction of the high pressure pump.

For units equipped with a (optional) **Media Filtration System**:

- When a unit operates in areas where the raw water source of high turbidity or organic materials, VMT recommends installing a **media filtration system (IMF)**. The media pump and filter, is installed upstream of the watermaker and will remove particles as small as 25 microns in diameter. The filtration media is comprised a multiple layers of specific materials that are specifically designed to remove suspended particulate matter from the raw water stream. The benefit is to significantly reduce the cleaning and replacement frequency for the micron filters. When the media filter is fully loaded (indicated by high filter differential pressure), the operator initiates a backwash cleaning cycle designed to flush trapped particulate matter out of the filter and into the system drain. Please see the IMF manual or IMF bulletin for further details.

The raw water next passes through the **micron filter array, F1 & F2,** which is designed to reduce raw water turbidity to a nominal 5 microns in diameter. The micron filter array consists of one 20 micron filter cartridge and one 5 micron filter cartridge.

Each filter housing contains one (1) filter element with an effective filtering area of 100 ft^2 and is equipped with an integral **air/oil separator** bleed. Bleed is continuously discharged to the reject header and overboard.

The discharge pressure from the filter housings is monitored by a **pressure gauge, PG1,** and **pressure switch, PS1,** that allow the operator to determine when the filter elements require cleaning or replacement.

3.5.2 REVERSE OSMOSIS SYSTEM

The clean and filtered raw water (now referred to as *feedwater*) is supplied to the inlet of the **high pressure pump, P2**. This pump raises feedwater pressure to 800 psi, the nominal pressure required for optimal system recovery. The pressurized feedwater

then flows directly into the **membrane array**. The membrane array is an arrangement of fiberglass pressure vessels each containing a RO membrane element.

The pressurized feedwater flows along the membrane elements where reverse osmosis takes place (see Section 3.1). The feedwater flow is divided into two streams - the high purity product stream (referred to as the *permeate*) and the increasingly concentrated reject stream (referred to as the *brine* or *reject*).

After exiting the membrane array, the brine (which contains higher concentrations of salts) flows through the **back pressure regulator valve, V3**. This manually adjustable valve is used to control the back pressure through the membrane array. After passing through the back pressure regulator, the brine flows through the **reject flow meter, FM1** and exits the RO unit.

3.5.3 PRODUCT MONITORING SYSTEM

The product water stream (or permeate) flows past a conductivity sensor, which provides a signal to the water quality monitor. Depending on the concentration of total of dissolved solids (TDS) in the permeate stream, the following occurs:

If permeate TDS is > 500 ppm, indicating poor quality water, a signal is sent to close the **2-way product diversion valve, V6**. This causes permeate system pressure to rise until it equals the activation set point of the **permeate relief valve, V7**. With the relief valve open, the poor quality water is diverted to the reject stream and away from your storage tanks. A **product pressure gauge, PG3** is supplied to enable accurate adjustment of the product relief valve to about 40 psi in most installations.

If the permeate has < 500 ppm TDS, indicating good quality (drinking) water, a signal is sent to open the product diversion valve. The relief valve then shuts allowing the permeate to pass through the **product flow meter, FM2** and then on to the potable water storage tank(s).

3.5.4 MEMBRANE CLEANING SYSTEM

This RO unit includes a membrane cleaning system which provides a means for removing performance degrading organic foulants and scale deposits from the RO membranes (occurs approximately every 30 – 90 days during constant use). By using the filter housings as cleaning solution tanks, the pumps, a cleaning valve **V5,** and a high pressure bypass valve **V4**, the membranes can be chemically cleaned in place. Complete information and cleaning procedures can be found in Section 5.5.

3.6 WATER QUALITY MONITOR

The Water Quality Monitor (MON) monitors and displays permeate salinity, temperature and accumulated unit operating hours. It also provides operational mode control of the system product valve.

3.6.1 PUSHBUTTONS

- Temperature – allows the operator to display permeate temperature (as opposed to the normal permeate salinity display). By changing a jumper located on the back of the monitor, the temperature can be displayed in ºF or ºC.
- Salinity Alarm Set Point – allows the operator to display and vary (via a control knob located on the back of the monitor) the salinity alarm set point.
- Mode – allows the operator to bypass the normal automatic operation and manually close the product valve (called DUMP mode, used, for instance, during cleaning).

3.6.2 DISPLAYS AND LIGHTS

- Normal Operation – a green light is illuminated when the product valve is energized and permeate is flowing through the product valve.
- Dump/Cleaning – a yellow light is illuminated when the product valve is de-energized and the product valve is closed.
- Salinity Alarm – a red, flashing light indicates that permeate quality is above the salinity set point.

3.7 CONTROLS AND INSTRUMENTATION

The following table provides a brief description of each individual component along with an explanation of its function. It is intended as a supplement to the more detailed information contained in Section 9.0 – System/Equipment Drawings and Diagrams.

Call Out	Description	Function
F1	20 Micron Pre-filter	Filters particles $\geq$ 20 microns in diameter.
F2	5 Micron Pre-filter	Filters particles $\geq$ 5 microns in diameter.

FM1	Reject Water Flow Meter	Indicates the amount of reject water discharged from the RO unit.
FM2	Product Water Flow Meter	Indicates the amount of permeate produced by the RO unit.
MON	Water Quality Monitor	See Section 3.6 for detailed description.
MS1	LP Pump Magnetic Starter	Provides ON/OFF control of LP pump.
MS2	HP Pump Magnetic Starter	Provides ON/OFF control of HP pump.
P1	Low Pressure (LP) Boost Pump	Pressurizes raw water to supply the cartridge filters, F1 and F2.
P2	High Pressure (HP) Pump	Pressurizes feed water to supply the membrane array at proper (high) pressure.
PG1	Pre-Filter Pressure Gauge	Indicates cartridge filter inlet and discharge pressure.
PG2	High Pressure Gauge	Indicates membrane array discharge (brine side) pressure.
PG3	Product Water Pressure	Indicates membrane array (permeate side) discharge pressure.
PS1	Low Pressure Switch	Will shut down pumps if the pressure is below setpoint.
SR1	Product Conductivity Sensor	Conductivity probe provides signal to water monitor (MON).
ST1	Raw Water Strainer	Removes large particulate matter from the raw water stream to prevent system fouling.
SW1	LP Boost Pump Start Pushbutton	Allows operator to START the LP boost pump.
SW2	LP Boost Pump Stop Pushbutton	Allows operator to STOP the LP boost pump.
SW3	HP Pump Start Pushbutton	Allows operator to START the HP pump.
SW4	HP Pump Stop Pushbutton	Allows operator to STOP the HP pump.
V1	Filter Gauge Selector Valve	Allows operator to select and read filter array inlet or discharge pressure on the gauge.

V3	HP Regulating Valve	Maintains and controls system back pressure.
V4	HP Bypass Valve	Allows operator to bypass the HP Regulating Valve during start-up, shutdown and cleaning.
V5	Cleaning Valve	Used to re-circulate the brine during cleaning and preservation procedures.
V6	Product Diversion Valve	Based on its salinity, directs permeate to either the potable water tank(s) or to drain.
V7	Product Water Relief Valve	Discharges product water when Product Diversion Valve is closed. Typical setting 40 psi.
V8	Filter Bleed Check Valve	Prevents reject flow from back flowing through the filter housings into the feed water stream.
V9	Trim Valve	Adjust to get quiet operation at regulator
V10	Flush Valve	3-way feedwater valve used to flush system

Table 3.3 - Instrumentation and Controls

4.0 OPERATION

4.1 START-UP PROCEDURE

NOTE

The HP Pump should rotate in the counter-clockwise direction (when facing the protruding end of the shaft).

1) Check the HP pump oil level by observing sight gauge located on the pump.

2) On initial start up, check the drive belt tension by removing the belt guard. See Section 5.4 for detailed procedure.

WARNING

De-energize (lock out or disconnect) the electrical supply to RO unit before attempting to check or adjust drive belt tension. Serious injury to personnel can result if the RO unit is started while checking drive belt tension.

3) Open the raw saltwater supply to the unit. On pressurized feed systems, water may now be flowing through the watermaker.

4) On initial start up, check the tightness of all lines and fittings.

5) If equipped with an IMF or other media filter, backwash and rinse media filter as required for initial startup or after long periods of standby. With fresh fill of media, multiple backwash and rinse sequences will be required. See IMF manual.

6) Place the RO unit's valves and switches in the positions shown in Table 4.0.

ID	Description	Position
V3	HP Regulating Valve	Factory set to 800 psi
V4	High Pressure Bypass Valve	Cleaning (open)
V5	Cleaning Valve	Normal Flow
V10	Flush Valve	Seawater Feed

Table 4.0 - Valve/Switch Line Up - Initial Start-up

CAUTION

Failure to open the *High Pressure Bypass Valve* (which is required to bleed any entrapped air) can result in hydraulic shock to the system.

6) Verify electrical power is supplied to the RO unit.

CAUTION

The low pressure (LP) boost pump should not be started if the feed system pressure as read on the inlet side of the *Pre-filter Pressure* gauge is more than 40 psi. Operate with only the HP pump if feed pressure is in excess of 40 psi to avoid overpressure to the feed water system components.

7) Start the pumps in turn, feed pump (if equipped), boost pump and then the HP pump. At least 10 psi must be indicated on the discharge side of the *Pre-filter Pressure* gauge.

8) Inspect all plumbing connections in the unit for leakage. Temperature variations during shipment may cause plumbing connections to seep when initially started on-site. Secure the unit and repair any leaks prior to proceeding. Once the leaks have been repaired, open the raw water source and re-start the unit.

9) When flow through the reject discharge flow meter appears to be free of air bubbles, place the *High Pressure Bypass Valve, V4,* in the *closed* position by slowly turning the handle in the clockwise direction.

NOTE

When the *High Pressure Bypass Valve* is closed, the salinity of the initial permeate produced may be temporarily high and will probably be enough to temporarily energize the salinity alarm.

10) Observe the system pressure on the discharge side of the *RO Membrane Array Pressure* gauge. For seawater applications, indicated pressure should be preset to 800 psi. If the indication is other than 800 psi, adjust the nut on top of the back pressure regulator valve, V3, using a wrench until the discharge side of the *RO Membrane Array Pressure* gauge indicates 800 psi. In conjunction with adjustment of the regulator, adjust the trim valve, V9, to find the quietest operating point.

WARNING

Pressure, as indicated on the inlet side of the *RO Membrane Array* gauge, should never exceed 1000 psi.

NOTE

The system pressure required to produce equivalent amounts of permeate is lower for fresh water sources (approximately 200 psi) and brackish water sources (approximately 400 psi) than for seawater applications. Reduce system pressure as necessary to maintain system output at no more than 120% of rated capacity.

11) Normally, during start-up using seawater, the Salinity alarm (red) will remain lit for approximately 2 minutes. When the product water quality drops below 500 ppm TDS, the green lamp will light. The water quality monitor will then open the product diversion valve, which will direct the product water to the product water flow meter. If the green lamp does not light within 10 minutes, sample the product water from the pressure vessel sample valves and confirm with a handheld salinity meter.

12) Observe the *Product Flow* meter. This flow meter indicates, in gallons per minute (gpm), the product water flow rate. Record the product flow after 5 hours of operation (use the sample log sheet provided in Figure 5.1). This indication will provide the baseline used to determine RO membrane cleaning requirements. Normally, a drop of 10-15% in the temperature corrected product water production rate indicates the need for RO membrane cleaning (see Section 3.4 for a more detailed information concerning variations in product flow).

13) Observe the *Reject Flow* meter. This flow meter indicates, in gallons per minute (gpm) the reject flow rate from the RO array. Record the reject flow after the first 5 hours of operation (use the sample log sheet provided in Figure 5.1).

4.2 SHUTDOWN PROCEDURES

4.2.1 SHUTDOWN PROCEDURE (SHORT TERM)

1) Release the pressure from the system by turning the *High Pressure Bypass Valve, V4,* counter-clockwise to the *Cleaning* (open) position.

2) Secure the HP pump by pressing the red *HP PUMP STOP* button located on the front panel.

3) If required, secure the LP boost pump by pressing the red *LP PUMP STOP* button located on the front panel.

4) Secure the feedwater system by closing a feedwater valve upstream of the water maker or by turning the Flush Valve, V10, to the midway position. If the anticipated shutdown period will be 24 hours or more, flush the system as per Section 4.3 - Flushing Procedure.

4.2.2 SHUTDOWN PROCEDURE (EXTENDED)

Since bacteria and biologic growth increases significantly the longer stagnant water is in contact with the membranes, the fresh flushing procedure (Section 4.3) should be used whenever the unit will be secured for more than 1 or 2 days. Although they do not attack the membranes or other system components directly, high concentrations of biological matter can block enough of the product water channels to cause a reduction of as much as 40% of the total system capacity.

CAUTION
Failure to follow the extended shutdown procedure can result in irreversible fouling to the RO membranes.

Bacterial contamination can be avoided by following the following procedures:

- Flush the RO unit with **non-chlorinated** fresh water for 2 - 4 minutes.
- Reflush the RO unit for 2 - 4 minutes every 7 days.
- Or, Pickle the RO unit with a preservative solution. Refresh the preservative every 3 months. Follow the preservation instructions provided in Section 5.6.

4.3 FRESH WATER FLUSH PROCEDURE

Note: Fresh flushing water should pass through the carbon flush filter supplied on the PW unit so it is **non-chlorinated**. Exposing the membranes to chlorinated water may cause irreversible membrane damage. The carbon filter element should be changed once per year or after 50 flushes. It is designed to remove normal concentrations of free chlorine (0.5 to 1.0 ppm). Do not flush with shock-chlorinated water. Once the watermaker is shut off and isolated, the flush procedure is:

1) Make sure the *HP Bypass Valve*, V4, is in the counterclockwise (open) position.

2) Turn the Flush Valve, V10, to the flush position to bring freshwater to the feed of the watermaker.

3) Start the LP boost pump.

4) Once you have observed fresh water flow through *Reject Flow* meter, run the system for an additional 2 to 4 minutes. For greater flushing flow, start the HP pump as well.

5) Secure the pumps. Return the Flush Valve, V10, to midway position, isolating the watermaker.

5.0 MAINTENANCE INSTRUCTIONS

5.1 GENERAL

The service life of most of the system equipment is directly related to the raw water inlet conditions. Improper maintenance will also significantly reduce the life expectancy of the major unit components (such as the membranes, filters and pumps) as well as the reliability of the unit as a whole. Under normal conditions, and with proper maintenance, a reverse osmosis membrane (which is the major consumable item) should have an effective service life somewhere between 1 to 2 years heavy use.

	Daily	Weekly	Monthly	Quarterly	Semi-Annually	Annually	As Required	Labor Hours (approximate)
Clean and inspect strainer basket		•						0.3
Clean and inspect micron filter(s)							•	0.5
Replace filter(s)							•	0.5
Clean membranes							•	4.0
Replace membranes							•	2.0
Inspect pump drive belt			•					1.0
Check pump oil level	•							0.1
Change pump oil(1)			•					1.0
Lubricate pump motors					•			1.0
Backflush media filter(2)							•	0.3

(1) After first 50 hours and every 500 hours thereafter

(2) For units equipped with the optional media filtration system.

Figure 5.0 - Maintenance Task Chart

5.2 RAW WATER STRAINER INSPECTION

1) Isolate the raw water supply and open the strainer housing.

2) Remove the screen from the strainer bowl. Remove any debris from screen and inspect the screen closely for damage. Replace as required.

3) Check the sealing gasket or o-ring is in good condition, and keeping the seal in place install the screen and reclose the strainer housing hand tight. Start the RO and check for leaks.

5.3 FILTER ELEMENT CLEANING OR REPLACEMENT

The filter elements should be replaced when the discharge side of the pressure gauge drops below 5 psi or the differential pressure is 20 psi. Each PW3000-20000 employs a filter array consisting of one (1) 20 micron, 100 ft^2 filter in series with one (1) 5 micron, 100 ft^2 filter. VMT filters can be washed and re-used 2-3 times provided it is not contaminated with oil or organic growth.

Description	**Qty**	**VMT Part #**
Micron filter, 20 micron, 100 ft^2	1	33-2100
Micron filter, 5 micron, 100 ft^2	1	33-5100
O-ring, filter lid, 100 ft^2	2	30-0405
Filter, complete assembly, 100 ft^2	2	30-4353

Table 5.0 - Filter Tank Parts List.

CAUTION

VMT filter cartridges are specifically designed for RO applications and constructed with an oil attractive polypropylene. Use of non-approved cartridges will void the RO unit warranty.

Replace the filter element(s) using the following procedure:

1) Secure the RO unit. Close the raw water supply (external) to RO unit.

2) Loosen and remove the bolts or wing-nuts that hold the filter tank lid in place. Remove the tank lid.

3) Remove the filter element. If required, first break the filter seal by rocking the filter from side to side.

4) The filter element may be cleaned by flushing it with water to remove foreign matter from the filter pleats. If the filter element appears oil-fouled or is damaged in any way, discard it and install a new element.

5) Reinstall the filter element. Be sure to install the filter element with the end marked "TOP" upwards. Ensure a proper seal by pressing the filter element down into place until it reaches the bottom and is fully seated.

6) Reinstall the filter tank lid. Tighten the bolts or nuts.

7) After the filter element has been changed, operate the RO unit and check for leaks.

5.4 DRIVE BELT INSPECTION AND REPLACEMENT

Proper adjustment of the HP pump drive belt(s) is essential for proper operation of the system. The drive belt(s) should be inspected for cracking, fraying and excessive wear. Replace the belts immediately it the inspection indicates that the belt(s) are damaged.

WARNING

Disconnect electrical supply to RO unit before attempting to check. Serious injury to personnel can result if RO unit is started when checking drive belt.

1) Remove the mounting screws that hold the left front panel in place and remove the panel.

2) Inspect drive belt carefully for wear and proper tension. The belt should deflect approximately ½ " when a force of 6-9 lbs is applied at a point halfway between the pulleys. Remember that cogged drive belts are never kept as tight as V drive belts, and overtightened belts will create a squealing sound and can damage bearings. Adjust the base plate as required to obtain proper belt tension.

3) If the drive belt is damaged or shows any evidence of excessive wear, replace the drive belt:

   a) Locate the HP pump's mounting nuts on the adjustable pump base. Loosen the nuts to relax the belt tension.

   b) Remove the old drive belt and install new one ensuring they are properly positioned in the pulleys.

c) Check the drive belt tension. Adjust the base plate as required to obtain proper belt tension.

(d) Be sure to properly align the pump and motor pulleys using a straight edge (at a minimum). After the belt has been sufficiently tightened and aligned, secure the HP pump by tightening the pump mounting nuts.

4) Replace the side panel on the RO unit

5.5 RO MEMBRANE CLEANING

This section is designed to guide the operator in the periodic chemical cleaning of RO membrane elements used in the PW3000-20000 unit. The basic procedure for all cleaning and preservative treatments is the same - a specific chemical solution is circulated through the system for a pre-determined length of time.

	PW3000-6000	**PW7000-20000**
Cleaning Chemical #1	5 to 15 lbs (8 to 25 cups)	6 to 20 lbs (10 to 33 cups)
Cleaning Chemical #2	4 to 12 lbs (7 to 20 cups)	5 to 15 lbs (8 to 25 cups)
Preservative Chemical #3	4 lbs (6 cups)	5 lbs (8 cups)

Table 5.1 - Chemical Requirements

There is a large variance in the required amount of chemical due to several factors. If RO product water is used to flush the unit prior to cleaning, the quantity required will be on the lower side. If the fresh water flush is done with dock or city water that is hard, then the required amount will rise. If the unit is significantly fouled, the quantity also rises. The key is to use only enough chemical to achieve the desired pH (pH 11 for #1 and pH 3 for #2). Extreme pH will damage the membranes, so do not exceed the recommendations. For the first cleaning of a system, use the lower quantities and measure the pH after circulating as described below. Keep adding chemical as needed until the cleaning solution maintains the desired pH level. Keep a record of the total chemical needed, so that on subsequent cleanings the correct amount can be used without the needed pH measurements and adjustments.

5.5.1 CLEANING CHEMICALS

The alkaline detergent (Cleaning Chemical #1) is used to remove biological matter and grime from the surface of the RO membranes. The acid cleaner (Cleaning Chemical #2) is used to remove mineral scale deposits.

CAUTION

The use of chemicals or cleaning methods other than those outlined below will void the RO unit warranty. Non-ionic surfactants for membrane cleaning or other chemicals not approved in writing by VMT will void the RO unit warranty.

5.5.2 WHEN TO CLEAN

During normal operations, mineral scale and biological matter will foul the RO membranes. These deposits build up over time and will eventually cause a loss of product water output, salt rejection capability, or both. The RO elements should be cleaned whenever the temperature corrected product water output drops by 10-15% from the initial baseline established during the first hours of operation with new membranes. Prior to cleaning the membranes, verify that any reduction in product output is not the result of a corresponding variation in raw water inlet temperature or salinity. See Section 3.4 for more detailed information.

NOTE

Product water output of the system is dependent upon feedwater temperature, RO feed pressure and feedwater salinity. Reductions in product water output due to these factors are normal and may not indicate the need for membrane cleaning. See Section 3.4 for more detail.

Use the following procedure to clean the RO elements:

1) Flush the watermaker per section 4.3, so it is filled with fresh water, not seawater.

2) Dissolve the appropriate amount of Cleaning Chemical #1 (see Table 5.1) in a pail of fresh water. Make sure that that the chemical is completely dissolved (use warm water if necessary).

NOTE

Cleaning Chemical #1 is an alkaline detergent. Use appropriate safety precautions.

3) Verify the *High Pressure Bypass Valve, V4,* is in its *Cleaning* (open) position.

4) Place the Cleaning Valve, V5, in the *Cleaning Flow* position.

5) Remove the filter elements from both filter tanks and replace the 5 micron filter with a dedicated cleaning filter (5 micron). A dedicated cleaning filter should be used to prevent fouling of the operational filters. When the cleaning process is

complete the dedicated cleaning filter can be cleaned and set aside until the next membrane cleaning is required. Pour the chemical solution into the empty 20 micron filter housing and the 5 micron housing (drain water first as necessary) and reinstall the filter housing lids.

6) Start the LP boost pump.

7) Start the HP pump. At least 0 psi must be indicated on the discharge side of the *Pre-filter Pressure* gauge. Temporarily cracking open the flush valve will boost the cleaning loop pressure if required.

   a) After the chemical solution has circulated for 3 minutes, secure the pumps, release any loop pressure by momentarily moving the cleaning valve, V5, to the normal position and back to cleaning. Take a sample from the cleaning loop from the filter tank drain valve or by opening the tank lid. Measure the pH of the sample using a pH meter or test kit VMT# 90-0135.

   b) If the pH < 11 then add 10% more of the cleaning solution. Repeat this step until the pH = 11.

   c) Once a pH = 11 can be maintained start the LP and HP pumps and allow the cleaning solution to circulate for an additional 30-40 minutes.

8) Secure the HP and LP pumps.

9) Place the Cleaning valve, V5, in the *Normal Flow* position.

10) Open raw water supply to the RO unit external to the unit and make sure the Flushing Valve, V10, is turned to the Normal, seawater position.

11) Start the LP boost pump and HP pump. Allow both pumps to run for 5 minutes to flush the chemical solution from the unit.

12) Secure the HP pump and the LP boost pump.

13) Flush the watermaker, so it is filled with fresh water, not seawater.

14) Dissolve the appropriate amount of Cleaning Chemical #2 (see Table 5.1) in a pail of fresh water. Make sure that that the chemical is completely dissolved (use warm water if necessary).

NOTE
Cleaning Chemical #2 is an acid used for mineral scale removal. Use appropriate safety precautions when handling.

15) Place the Cleaning Valve, V5, in the *Cleaning Flow* position.

16) Remove the lid from the 20 micron filter tank, pour the cleaning solution into the tank (drain water first as necessary) and replace the lid.

17) Start the LP boost pump.

18) Start the HP pump. At least 0 psi must be indicated on the discharge side of the *Pre-filter Pressure* gauge, PG1. Temporarily cracking open the flush valve will boost the cleaning loop pressure if required.

    a) After the chemical solution has circulated for 3 minutes, secure the boost pump, release any loop pressure by momentarily moving the cleaning valve, V5, to the normal position and back to cleaning. Take a sample from the cleaning loop from the filter tank drain valve or by opening the tank lid. Measure the pH of the sample using test kit VMT# 90-0135.

    b) If the pH > 3 add 10% more of the cleaning solution. Repeat this step until the pH < 3.

    c) Once a pH of less then 3 can be maintained replace the filter tank lid, start the LP and HP pumps and allow the cleaning solution to circulate for an additional 30-40 minutes.

19) Secure the HP and LP pumps.

20) Place the Cleaning valve in the *Normal Flow* position.

21) Open raw water supply to the RO unit (external to the unit).

22) Start the LP boost pump and HP pump. Allow both pumps to run for 5 minutes to flush the chemical solution from the unit.

23) Secure the HP pump and the LP boost pump.

24) Close raw water supply to RO unit (external to the unit).

25) Remove, set aside and retain the cleaning filter for future use. Replace the operational 20 and 5 micron filter elements in the filter housings and replace both housing lids.

26) Place the unit back into service using the procedure contained in Section 4.1 - Start-up Procedure.

5.6 RO ELEMENT PRESERVATION / PICKLING

During periods when the RO unit is to be shut down for an extended period of time, it is necessary to circulate a preservative solution through the membranes to prevent the growth of biological organisms. Use the following procedure to preserve the RO elements:

1) Secure the raw water supply to RO unit (external to the unit).

2) Dissolve the appropriate amount of Cleaning Chemical #3 (see Table 5.1) in a pail of **non-chlorinated** product water. Make sure that that the chemical is completely dissolved (use warm water if necessary).

NOTE
Preservative Chemical #3 is a food-grade preservative. See warning label on package and observe all safety precautions on label.

3) Flush the watermaker, so it is filled with fresh water, not seawater (see section 4.3)

4) Make sure the *High Pressure Bypass Valve* is in the *Cleaning* (open) position.

5) Place the *Cleaning Valve* in the *Cleaning Flow* position.

6) Remove one of the filter housing lids (draining water as necessary) and pour in the preservative solution prepared in step #1. Reinstall the lid. Leave the filters elements in place.

7) Start the LP boost pump.

8) Start the HP pump. At least 0 psi must be indicated on the discharge side of the *Pre-filter Pressure* gauge. Temporarily cracking open the flush valve will boost the cleaning loop pressure if required. Allow the chemical solution to circulate for 10 minutes.

9) Secure the LP and HP pumps.

10) The system is now properly conditioned and may be left idle for an extended period of time. This preservation procedure (including the fresh flush to remove old pickling solution) should be repeated at least every 3 months during the shutdown. In colder climates the interval between preservation cycles may be extended to 6 months.

5.7 RESTARTING UNIT AFTER PRESERVATION

Restart unit using the procedure contained in Section 4.1 - Start-up Procedure. Use the MODE button on the Water Quality Monitor to light the DUMP lamp for the first 15 minutes of production to make sure all preservative is flushed clear prior to filling the fresh water tanks.

5.8 HIGH PRESSURE PUMP OIL CHANGE

See equipment literature in back of this manual for instructions for changing the oil on your particular pump.

5.9 MOTOR LUBRICATION

Locate the grease fittings on the electric motor. Use a clean cloth to wipe this fitting clean. If applicable, remove any caps. Free the drain hole of any hard grease (use a piece of wire if necessary). Add 2-3 strokes of grease using a low pressure grease gun (see Table 5.2 for grease type).

Location	**Type**
High pressure pump oil	VMT pump oil #85-0050
High pressure pump motor grease	Shell Oil Dolium R Texaco Premium RB Exxon Mobil PolyrexEM Chevron SRI
O-rings & gaskets	Glycerin or silicone lubricant

Table 5.2 - Lubrication Requirements

5.10 INSPECTION LOG

Figure 5.2 depicts a sample operation log for the PW3000-20000 RO unit. The operator of the RO unit should establish a program for entering the required data on a regular basis. Maintaining accurate operational data is the first, and most important, step in determining preventative maintenance requirements and reducing system downtime. The data maintained in the log must be provided by the Purchaser to make any RO element warranty claim. Figure 5.3 depicts a sample discrepancy report that may be used for reporting and tracking problems with the RO unit.

Date	Total Operating Hours	PG1, Pre-filter Inlet Pressure	PG1, Pre-filter Discharge Pressure	PG2 RO Array Discharge Pressure	FM1, Reject Flow	FM2 Product Flow	Product Water TDS (ppm)	Water Temp, (°C)	Comments

Figure 5.1 - Sample Operational Log

COMMENT/DISCREPANCY REPORT

Village Marine Tec.
RO Desalinator Model PW-3000 to PW-20000

Plant No: _____ Date: _____
Log Task No: _____ Time: _____
System Affected: _____ Technician : _____

Comment/Discrepancy:

_____
_____
_____
_____
_____
_____
_____
_____
_____

Corrective Action:

_____
_____
_____
_____

Action Taken:

_____
_____
_____
_____
_____

Date Completed: _____
Printed Name: _____
Signature: _____

Figure 5.2 - Sample Discrepancy Report

6.0 PRESSURE VESSEL AND MEMBRANES

6.1 PRESSURE VESSEL DISASSEMBLY

NOTE
It is not necessary to remove a pressure vessel from the RO unit for disassembly.

1) Disconnect all plumbing connections from the pressure vessel to be disassembled.

2) Remove the bolts holding each end plug in place with an Allen wrench. Place a mark on each end plug removed and its corresponding collar. This will ensure proper orientation during assembly.

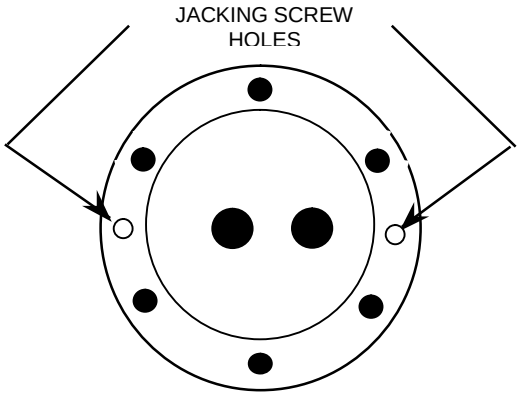


Figure 6.0 - Pressure Vessel End Plug

3) Locate the jacking screws on opposite sides of the end cap (see Figure 6.0). Screw in the correct size bolt until the end cap is pulled off. There are also prying slots on either side of the end plug to assist in removal.

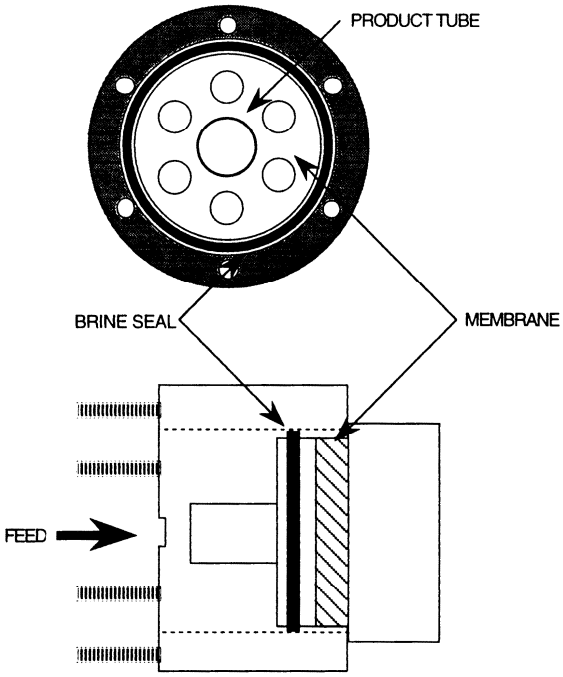


Figure 6.1 - Brine Seal Orientation

4) Note which end of the pressure vessel the brine seal is visible from. This is the feed end of the pressure vessel. When reinstalling the RO membrane, the brine seal must be located at the feed end of the pressure vessel. Note the feed flow direction marked by a sticker on the outside of the pressure vessel, or trace the flow direction from the high pressure pump to confirm the high pressure flow direction. See Figure 6.1.

CAUTION

Never force a membrane out of a pressure vessel by applying pressure on the product water tube (center tube) as this will damage the membrane. If the membrane is difficult to remove, use a length of 2" plastic pipe to apply pressure on the protected end of membrane.

5) Whenever possible, remove the membrane from the discharge end of the pressure vessel (opposite the brine seal). This is accomplished by pushing on the membrane from the feed end of the pressure vessel until it is visible at the discharge end. Then grasp the protruding membrane and pull it out of pressure vessel. Place the membrane in a clean area.

6) Remove the product water o-rings and end plug o-ring from each end plug for inspection. The product water o-rings are internal o-rings located inside the center hole in the end cap.

6.2 PRESSURE VESSEL ASSEMBLY

1) Clean all parts thoroughly. Inspect the o-rings on all fittings. Replace any parts that are damaged.

NOTE
Do not apply Teflon tape or other sealant to straight thread fittings such as those used on HP hose assemblies and their adapters.

2) Install the product water and end plug o-rings onto the end plugs. Lubricate the o-rings and entrances to the pressure vessel with glycerin or silicone lubricant. Locate the discharge end of pressure vessel. Install the end plug into the discharge end making sure to align the end plug holes and the mounting holes on the pressure vessel while paying particular attention to the reference mark (see Section 6.3.1, Step 2). Apply pressure to the end plug until screws can be threaded into the collars. If the end plug will not slide into the pressure vessel sufficiently, see Figure 6.2 for an installation aid. Install and hand tighten the screws.

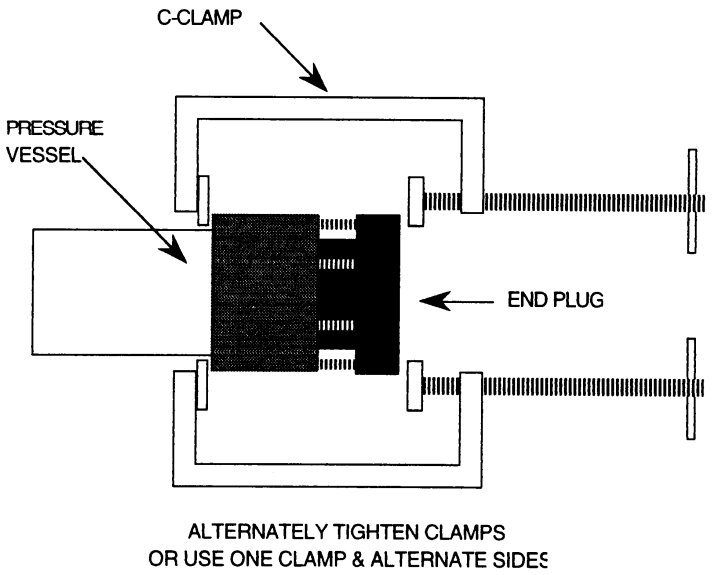


Figure 6.2 - End Plug Installation Aid

3) Lubricate the brine seal and product water tubes of RO membrane with glycerin or silicone lubricant. Do not use a petroleum based lubricant. Orient the membrane such that the end without the brine seal enters the feed end of the pressure vessel first. Slide the membrane into the pressure vessel until

resistance is felt. Continue to apply moderate pressure until the product water tube seats in the end plug.

4) Install the remaining end plug making sure to align the end plug holes with the mounting holes on the pressure vessel while paying particular attention to the reference mark (see Section 6.3.1, Step 2). Apply moderate pressure to the end plug until the screws can be threaded into the collar. If the end plug will not slide into the pressure vessel sufficiently, see Figure 6.2 for installation aid. Install and hand tighten the capscrews.

5) Make sure that antiseize compound is applied to each screw before the final tightening and torque the screws to 15 ft-lbs.

6) Reconnect all plumbing connections to pressure vessels.

7.0 PRESERVATION FOR STORAGE

When the Village Marine Tec RO unit is to be shut down for an extended period of time, it is necessary take steps to prevent the growth of biological organisms and to prevent the water in the RO unit from freezing. Either continue to flush the unit with fresh water each week, or circulate a preservative solution (see section 5.6). If the unit will at any time be exposed to air temperatures of 32ºF (0ºC) or less, the membranes must be removed and the unit fully drained or the unit filled with an anti freeze solution such as propylene glycol.

8.0 TROUBLESHOOTING

No amount of trouble shooting advice can replace common sense and direct plant knowledge gained through the operation and maintenance of your unit. However our experience taking tec calls suggests some points to check.

1. Always verify proper valve configuration for each of the operational modes selected. Verify valve positions for valves within the unit and also external valves are open as required.

2. Always check for positive pressure at the HP pump suction. Many problems stem from low or erratic feed water supply. Check filters, strainer, seacock, boost pumps, etc to be sure of flooded suction to the HP pump.

3. Always check for loose connections or broken wires when inspecting electrical parts. Checking for continuity and solid contact can sometimes avoid hours of troubleshooting effort.

4. Prior to cleaning or replacing membranes, verify that any reduction in product output is not the result of a corresponding variation in raw water inlet temperature or salinity. See Section 3.4 for more detailed information.

Call or email us at the Village Marine Tec Service representative or distributor for assistance.

9.0 SYSTEM DRAWINGS AND DIAGRAMS AND PARTS LIST

NOTES

1) PART NUMBERS FOR 60 HZ 3 PHASE UNITS SHOWN
PART NUMBERS FOR 50 HZ OR SINGLE PHASE UNITS – CONSULT FACTORY

2) *DIFFERENT MOTOR PULLEYS FOR PW8K AND PW10K. PART ITEMS NUMBERS ARE IDENTIFIED FOR 8K AND 10K RESPECTIVELY.

3) USE PUMP SEAL REPAIR KIT PN 90-0108

TABLE 1-1 PW3000-20000 PARTS MATRIX

QTY	PC NO	DESCRIPTION	PW3K-4K	PW5K-6K	PW7K	PW8-10K	PW12-16K	PW20K
1	44	FILTER, FLUSH	33-0315	33-0315	33-0315	33-0083	33-0083	33-0083
1	43	PULLEY, HP PUMP, 60Hz	70-0112	70-0112	70-0112	67-0189	67-0189	70-0018
1	42	BUSHING, MOTOR HP PUMP	70-0599	70-0244	70-0244	70-0035	70-0178	70-0178
1	39	RELIEF VALVE	60-7742	60-7742	60-7742	60-0047	60-0047	60-0047
1	38	FLOW METER, REJECT WATER	40-0210	40-0014	40-0014	40-0014	40-0212	40-0212
1	37	FLOW METER, PRODUCT WATER	40-0211	40-0211	40-0015	40-0015	40-0171	40-0171
1	35	SOLENOID VALVE, 110VAC	20-1141	20-1141	20-1141	20-1241	20-1241	20-1241
1	26	PULLEY, MOTOR, 60Hz	70-0040	70-0563	70-0563	*70-0262-8K *70-0406-10K	70-0182	70-0019
1	25	BELT, HP PUMP AND MOTOR	70-1448	70-1448	70-1448	70-1440	70-1440	70-1440
1	24	BUSHING, HP PUMP	70-0167	70-0167	70-0167	70-0142	70-0142	70-0142
1	23	PUMP, HIGH PRESSURE	70-2030	70-2030	70-2030	70-3000	70-3000	70-3000
1	22	MOTOR, HP PUMP, 60Hz	20-0062	20-2333	20-2333	20-0095	20-4103	20-1503
1	20	RELAY, LP PUMP MOTOR, 440VAC	20-1015	20-1015	20-1015	20-1015	20-1015	20-1015
1	20	RELAY, LP PUMP MOTOR, 220 VAC	20-1017	20-1017	20-1017	20-1017	20-1017	20-1017
1	20	CONTACTOR, LP PUMP MOTOR, 110 COIL	20-0264	20-0264	20-0264	20-0264	20-0264	20-0264
1	19	RELAY, HP PUMP MOTOR, 440VAC	20-0004	20-0373	20-0373	20-0373	20-0951	20-0951
1	19	RELAY, HP PUMP MOTOR, 220 VAC	20-0951	20-0951	20-0951	20-0374	–	–
1	19	CONTACTOR, HP PUMP MOTOR, 110 COIL	20-0581	20-0372	20-0372	20-0372	20-0372	20-0372
1	13	VALVE, TRIM, V9	60-0044	60-0044	60-0044	60-0106	60-0106	60-0106
–	7	MEMBRANE, SEA WATER	33-0440	33-0440	33-0036	33-0036	33-0036	33-0036
–	6	PRESSURE VESSEL ASSEMBLY	32-0444	32-0444	32-6040	32-6040	32-6040	32-6040
–	4	END CAP, PRESSURE VESSEL INCLUDING RING	32-4012	32-4012	32-6012	32-6012	32-6012	32-6012

QTY	PC NO	DESCRIPTION	P&ID #	MATERIAL	MAT'L SPEC	REMARKS	LOC
1	43	PULLEY, HP PUMP	–	VARIOUS	–	SEE TABLE	–
1	42	BUSHING, MOTOR HP PUMP	–	VARIOUS	–	SEE TABLE	–
6	41	VIBRATION ISOLATION MOUNT	–	VARIOUS	–	70-1595	–
1	40	SWITCH, LOW PRESSURE	PS1	316SS	–	20-0088	–
1	39	RELIEF VALVE, PRODUCT	V7	NYLON/PVC	–	SEE TABLE	–
1	38	FLOW METER, REJECT WATER	FM1	ACRYLIC	–	SEE TABLE	–
1	37	FLOW METER, PRODUCT WATER	FM2	ACRYLIC	–	SEE TABLE	–
1	36	VALVE, BY-PASS, HIGH PRESSURE	V4	316SS	–	60-0068	–
1	35	VALVE, SOLENOID, PRODUCT DIVERSION	V6	PVC	–	SEE TABLE	–
1	34	GAUGE, PRESSURE, 0-60 PSI, BACK CONN.	PG3	VARIOUS	–	40-0303	–
1	32	GAUGE, PRESSURE, 0-1000 PSI, BACK CONN	PG2	VARIOUS	–	40-0302	–
1	31	GAUGE, PRESSURE, 0-100 PSI, BACK CONN	PG1	VARIOUS	–	40-0016	–
1	30	VALVE, SELECTOR	V1	316SS	–	60-0013	–

QTY	PC NO	DESCRIPTION	P&ID #	MATERIAL	MAT'L SPEC	REMARKS	LOC
1	29	MONITOR, SALINITY	MON1	VARIOUS	–	40-4097	–
2	28	PUSH BUTTON, START/STOP	–	VARIOUS	–	20-1592	–
2	27	PUSH BUTTON, START/STOP	–	VARIOUS	–	20-1591	–
1	26	PULLEY, MOTOR	–	VARIOUS	–	SEE TABLE	–
1	25	BELT, HP PUMP AND MOTOR	–	VARIOUS	–	SEE TABLE	–
1	24	BUSHING, PULLEY HP PUMP	–	VARIOUS	–	SEE TABLE	–
1	23	PUMP, HIGH PRESSURE	–	TITANIUM	–	SEE TABLE	–
1	22	MOTOR, HP PUMP	–	VARIOUS	–	SEE TABLE	–
1	21	TRANSFORMER, 0.150 KVA, SPECIFY VOLTAGE	–	VARIOUS	–	20-1441 (3 PHASE ONLY)	–
1	20	RELAY, OVERLOAD, LP PUMP MOTOR	–	VARIOUS	–	SEE TABLE	–
1	20	CONTACTOR, LP PUMP MOTOR	–	VARIOUS	–	SEE TABLE	–
1	19	RELAY, OVERLOAD, HP PUMP MOTOR	–	VARIOUS	–	SEE TABLE	–
1	19	CONTACTOR, HP PUMP MOTOR	–	VARIOUS	–	SEE TABLE	–
1	18	PUMP, LOW PRESSURE W/ 60Hz MOTOR	P1	NI AL BRONZE	–	70-0027 (SEE NOTE 3)	–
1	17	ENCLOSURE, NEMA 4X	–	FIBER GLASS	–	20-1287	–
1	16	MANIFOLD, REJECT	–	NYLON	–	50-0027	–
1	15	PROBE, CONDUCTIVITY, 15' WIRE	SR1	VARIOUS	–	20-4100	–
1	14	MANIFOLD, PRODUCT	–	NYLON	–	50-0026	–
1	13	VALVE, TRIM	V9	316SS	–	SEE TABLE	–
1	12	VALVE, HP REGULATOR, 40 GPM	V3	316 SS	–	60-0040	–
2	11	HOUSING, FILTER, 100 SQ-FT	F1	316 SS	–	30-0101	–
1	10	FILTER, 100 SQ-FT, 20 MICRON	F1	VARIOUS	–	33-2100	–
1	9	FILTER, 100 SQ-FT, 5 MICRON	F2	VARIOUS	–	33-5100	–
2	8	VALVE, 3-WAY, 1-1/2", PVC, CLEANING	V5,V10	PVC	–	60-0023	–
–	7	MEMBRANE, SEA WATER	X	VARIOUS	–	SEE TABLE	–
–	6	PRESSURE VESSEL ASSEMBLY	X	VARIOUS	–	SEE TABLE	–
–	5	ADAPTOR, END CAP	–	TITANIUM	–	30-1110	–
–	4	END CAP, PRESSURE VESSEL INCLUDING RING	–	NYLON	–	SEE TABLE	–
–	3	HOSE, H/P, 3/4", SPECIFY LENGTH	–	VARIOUS	–	(SPECIFY LENGTH)	–
–	2	VALVE, SAMPLE, MEMBRANE PRODUCT	–	BRASS	–	60-0375	–
1	1	STRAINER, Y TYPE, SCREEN ONLY	ST1	NYLON	–	30-1658	–

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE, LEVEL 2	3/18/99	JM
A	ADDED PRESSURE SWITCH AND NEMA BOXES	11/5/99	JM
B	ADDED PW20000 INFORMATION	2/2/00	JM
C	3 PLUNGER 8000 & 10000	3/13/00	JM
D	P/N FOR MOTOR PULLEY CHANGED PW 4K	12/12/01	JM
E	UPDATED DRAWINGS, PART NUMBERS, AND VIEWS	08/20/04	BG
F	ADDED PWM VIEWS	11/02/04	BG
G	CORRECTED P/N FOR PC 8	12/08/04	BG
H	CORRECTED PWF DIMENSION DEPTH	05/07/05	BG
I	CORRECTED P/Ns FOR PC: 1,15,21	03/27/08	BG
J	CHANGED P/N'S FOR PC 20 & 31	02/08/10	OT
K	CORRECTED P/N FOR PC 20(CONTACTOR)	11/05/10	OT
L	REMOVED PC NO 3 PART NUMBER, ADDED NOTE 3	02/08/11	OT
M	CORRECT PART NUMBERS FOR PC NO 38 TABLE 1-1	06/13/11	OT
N	REMOVED PC NO.39	01/13/12	OT
P	UPDATED TABLE #1 PC #20	02/23/12	AK
R	CHANGED PN'S & QTY FOR PC27, PC 28 PER ECO-0022888	07/25/12	VR, OT, AK, GA

6	5	4	3	2	1	SH	REVISION STATUS OF SHEETS
J	J	J	K	J	R	REV	

DIMENSIONAL TOLERANCES – UNLESS OTHERWISE SPECIFIED

MACHINED			WELDMENT	
DIMENSION	DECIMALS		DIMENSION	TOLERANCE
	2 PL	3 PL		
UNDER 6"	± .02	± .010	UNDER 24"	± .12
6" TO 24"	± .03	± .015	24" & OVER	± .25
24" & OVER	± .06	± .030		
ANGULAR ± 0° 30'			ANGULAR ± 0° 30'	

125 UNLESS OTHERWISE NOTED

UNLESS OTHERWISE NOTED

NEXT HIGHER ASSEMBLY: ?

APPLICATION

DRAWING FILE NO. 11300.DWG

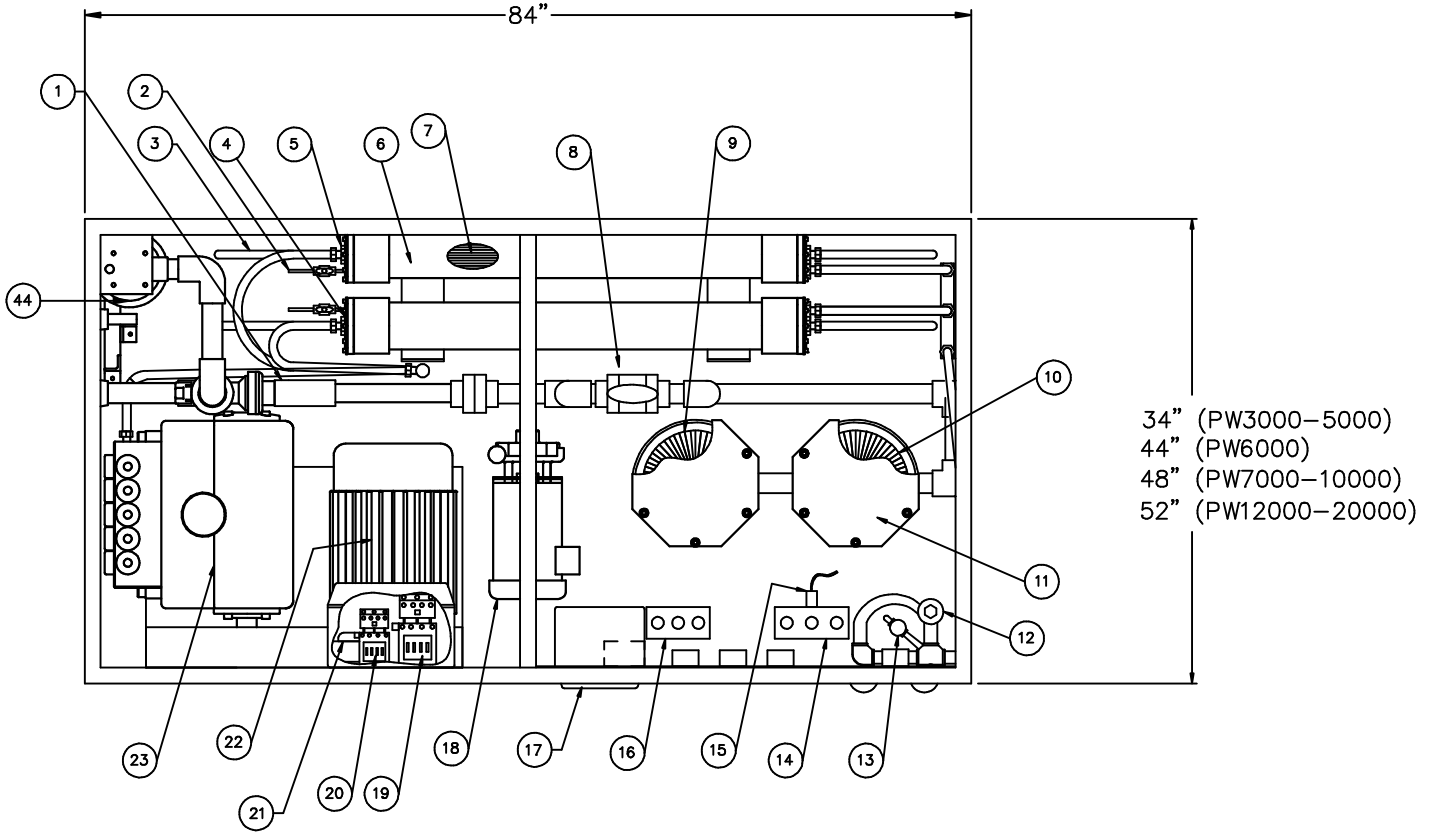
DRAWN JPM DATE 8/17/99
CHECKED MB DATE 02/23/12
APPROVED OT DATE 02/23/12
ISSUE DATE
CONTRACT NO.

Village Marine Technology
2000 West 135th Street - Gardena - California 90249

PW3000-20000
GENERAL ARRANGEMENT & PARTS LIST

SIZE E | CAGE NO 62144 | DWG NO 11300 | REV R
SCALE ? | SHEET 1 OF 6

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE; LEVEL 2	3/19/99	JM
A	ADDED PRESSURE SWITCH AND NEMA BOXES	11/5/99	JM
B	ADDED PW20K INFORMATION	2/3/00	JM
C	3 PLUNGER 8K & 10K	3/13/00	JM
D	P/N FOR MOTOR PULLEY CHANGED PWNK	12/12/01	JM
E	UPDATED DRAWINGS, PART NUMBERS, AND VIEWS	08/20/04	BG
F	ADDED PWM VIEWS	11/02/04	BG
G	CORRECTED P/N FOR PC 8	12/08/04	BG
H	CORRECTED PWF DIMENSION DEPTH	06/07/05	BG
I	CORRECTED P/Ns FOR PCs 1,15,21	03/27/08	BG
J	CHANGED P/N'S FOR PC 29 & 31	02/08/10	GT

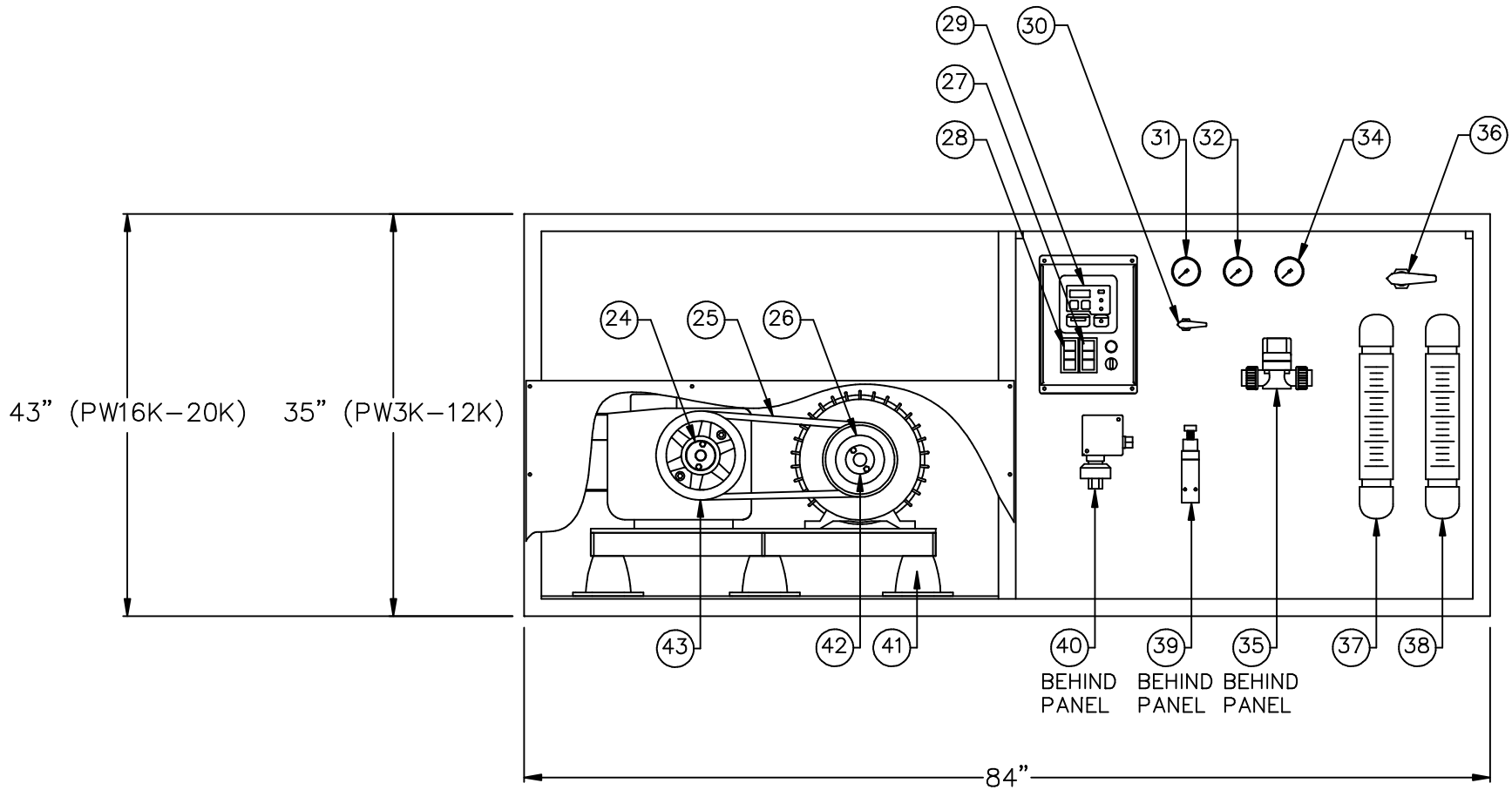


TOP VIEW

DRAWN JPM 8/17/99	SIZE E	CAGE NO 62144	DWG NO 11300	REV J
ISSUED ?	SCALE NONE			SHEET 2 OF 6

CAGE NO. 62144 DWG NO. 11300 REV J SHT 2

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE; LEVEL 2	3/10/99	JM
A	ADDED PRESSURE SWITCH AND NEMA BOXES	11/5/99	JM
B	ADDED PW20000 INFORMATION	2/3/00	JM
C	3 PLUNGER 8K & 10K	3/13/00	JM
D	P/N FOR MOTOR PULLEY CHANGED PWNK	12/12/01	JM
E	UPDATED DRAWINGS, PART NUMBERS, AND VIEWS	08/20/04	SG
F	ADDED PWM VIEWS	11/02/04	SG
G	CORRECTED P/N FOR PC 8	12/08/04	SG
H	CORRECTED PWF DIMENSION DEPTH	06/07/05	SG
I	CORRECTED P/Ns FOR PCs: 1,15,21	03/27/08	SG
J	CHANGED P/N'S FOR PC 29 & 31	02/08/10	GT
K	REMOVED PC NO.33	01/13/12	GT

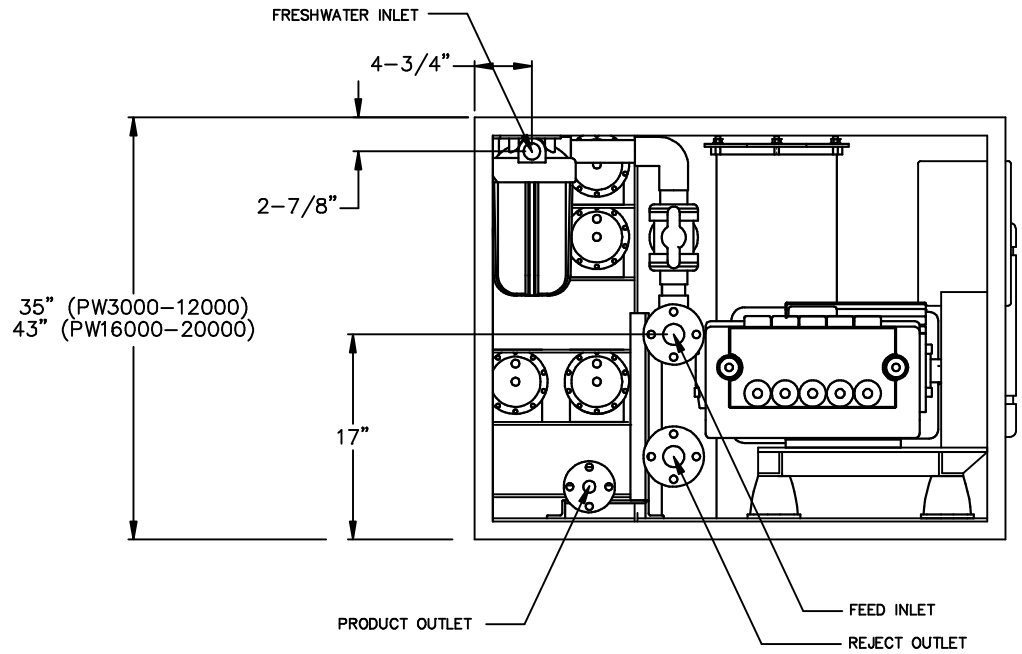


FRONT VIEW

DRAWN JPM 8/17/99	SIZE E	CAGE NO 62144	DWG NO 11300	REV K
ISSUED ?	SCALE NONE		SHEET 3 OF 6	

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE; LEVEL 2	3/19/99	JM
A	ADDED PRESSURE SWITCH AND NEMA BOXES	11/5/99	JM
B	ADDED PW20000 INFORMATION	2/3/00	JM
C	3 PLUNGER 8K & 10K	3/13/00	JM
D	P/N FOR MOTOR PULLEY CHANGED PWMK	12/12/01	JM
E	UPDATED DRAWINGS, PART NUMBERS, AND VIEWS	08/19/04	SG
F	ADDED PWM VIEWS	11/02/04	SG
G	CORRECTED P/N FOR PC 8	12/08/04	SG
H	CORRECTED PWF DIMENSION DEPTH	06/07/05	SG
I	CORRECTED P/Ns FOR PCs 1,15,21	03/27/08	SG
J	CHANGED P/N'S FOR PC 20 & 31	02/08/10	GT

SERVICE ENVELOPE
24" ABOVE UNIT
24" IN FRONT OF UNIT

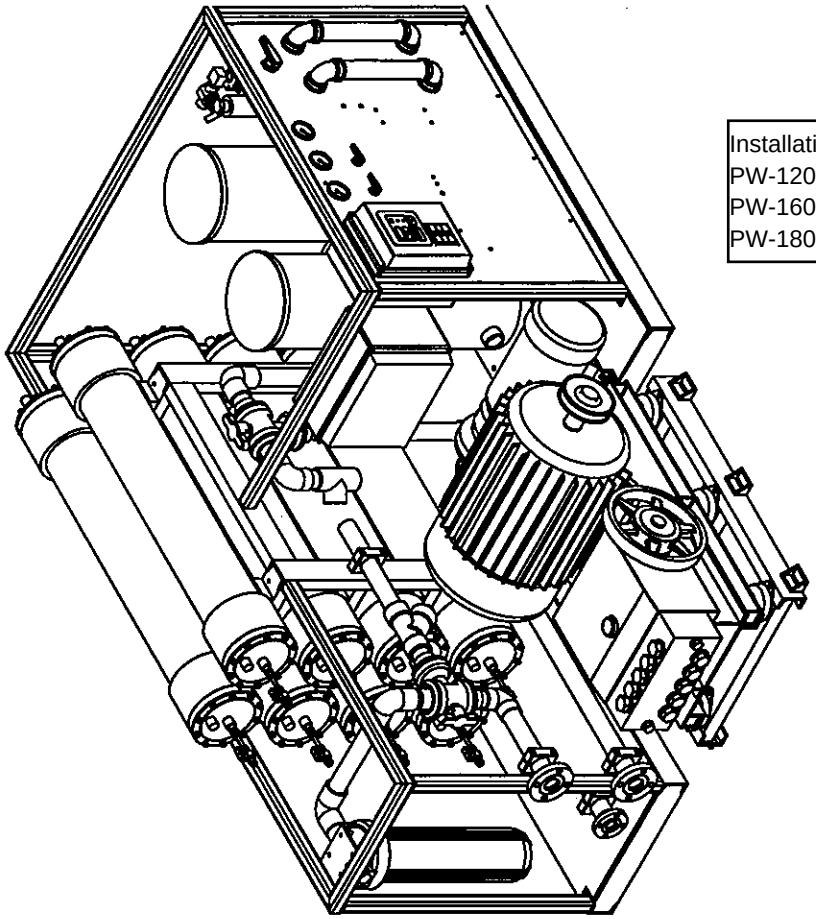


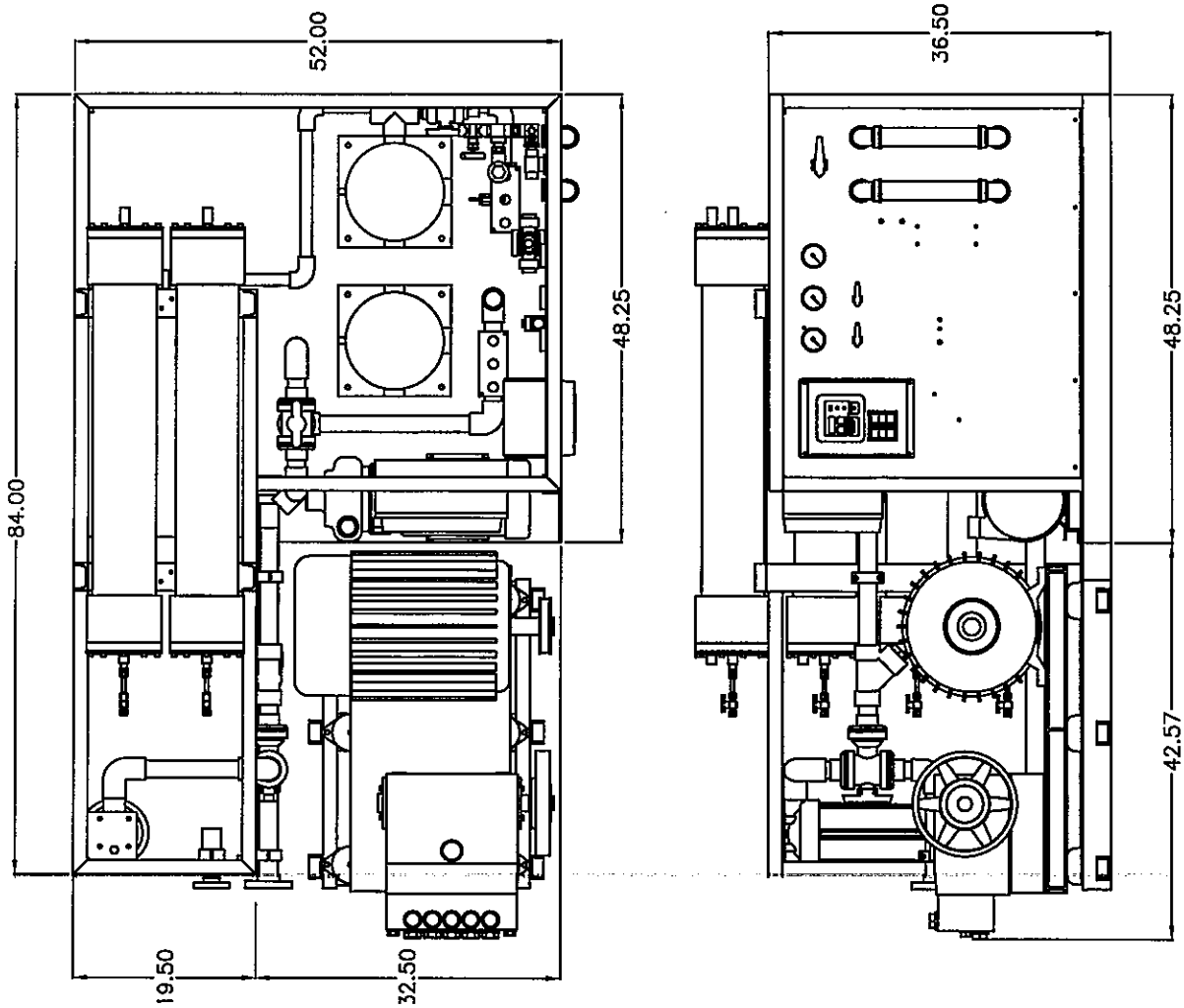
LEFT SIDE VIEW

DRAWN JPM 8/17/99	SIZE E	CAGE NO 62144	DWG NO 11300	REV J
ISSUED ?	SCALE NONE			SHEET 4 OF 6

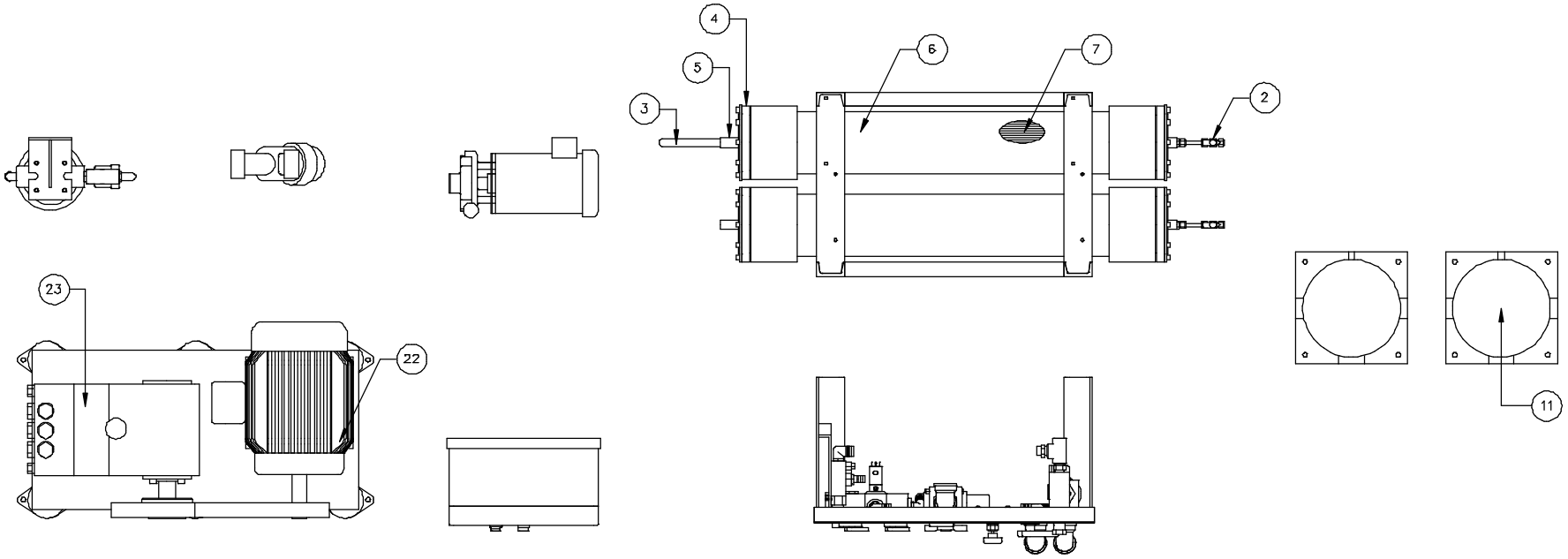
62144 11300 4 J

Installation Layout
PW-12000
PW-16000
PW-18000





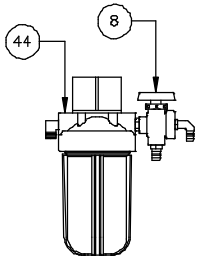
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
-	INITIAL RELEASE: LEVEL 2	3/19/99	JM
A	ADDED PRESSURE SWITCH AND NEMA BOXES	11/15/99	JM
B	ADDED PV2000 INFORMATION	2/3/00	JM
C	.5 PLUNGER BK & TCK	3/13/00	JM
D	P/N FOR MOTOR PULLEY CHANGED PW4K	12/12/01	JM
E	UPDATED DRAWINGS, PART NUMBERS, AND VIEWS	08/20/04	BC
F	ADDED PWM VIEWS	11/02/04	BC
G	CORRECTED P/N FOR PC 8	12/08/04	BC
H	CORRECTED PWT DIMENSION DEPTH	08/27/05	BC
I	CORRECTED P/Ns FOR PCs 1,15,21	03/27/08	BC
J	CHANGED P/N'S FOR PC 20 & 31	02/08/10	BT

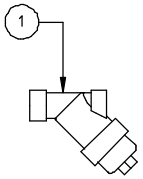


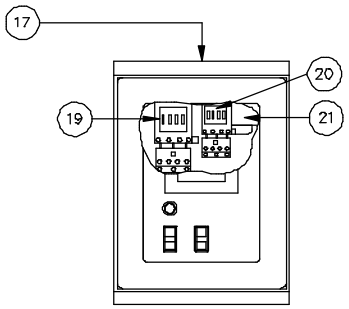
PWM – TOP VIEW

DRAWN JPM 8/17/99	SIZE E	BASE NO 62144	DWG NO 11300	REV J
CHECKED ?	SCALE NONE		SHEET 5 OF 6	

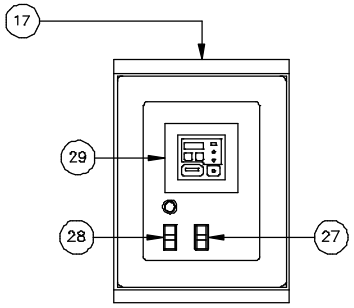
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE: LEVEL 2	3/19/99	JM
A	ADDED PRESSURE SWITCH AND NEMA BOXES	11/8/99	JM
B	ADDED PV2000 INFORMATION	2/3/00	JM
C	.5 PLUNGER BK & TCK	3/13/00	JM
D	P/N FOR MOTOR PULLEY CHANGED PW4K	12/12/01	JM
E	UPDATED DRAWINGS, PART NUMBERS, AND VIEWS	08/20/04	BC
F	ADDED PWM VIEWS	11/02/04	BC
G	CORRECTED P/N FOR PC 8	12/08/04	BC
H	CORRECTED PWT DIMENSION DEPTH	08/07/05	BC
I	CORRECTED P/N's FOR PC: 1,15,21	03/27/08	BC
J	CHANGED P/N'S FOR PC 20 & 31	09/08/10	BT
K	REMOVED PC NO 33	01/13/12	BT



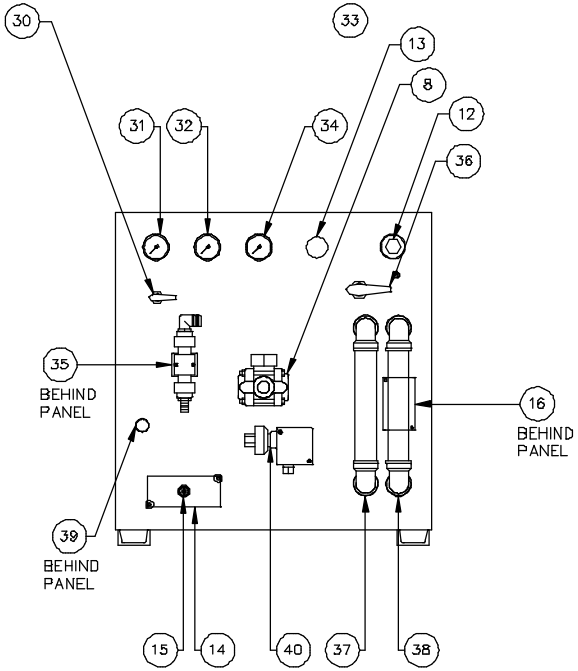


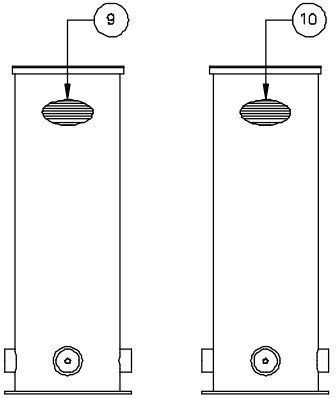


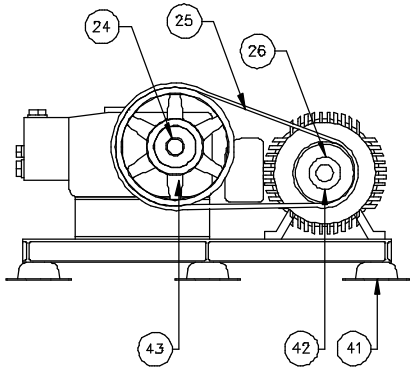
CONTROL BOX – INTERIOR

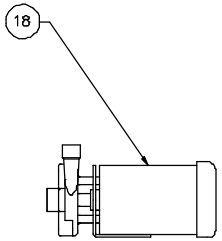


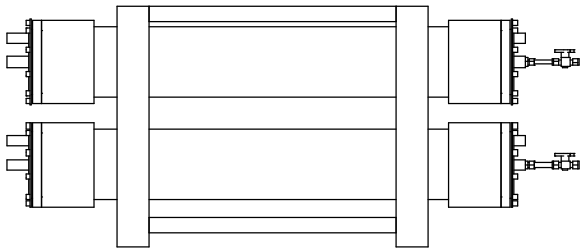
CONTROL BOX







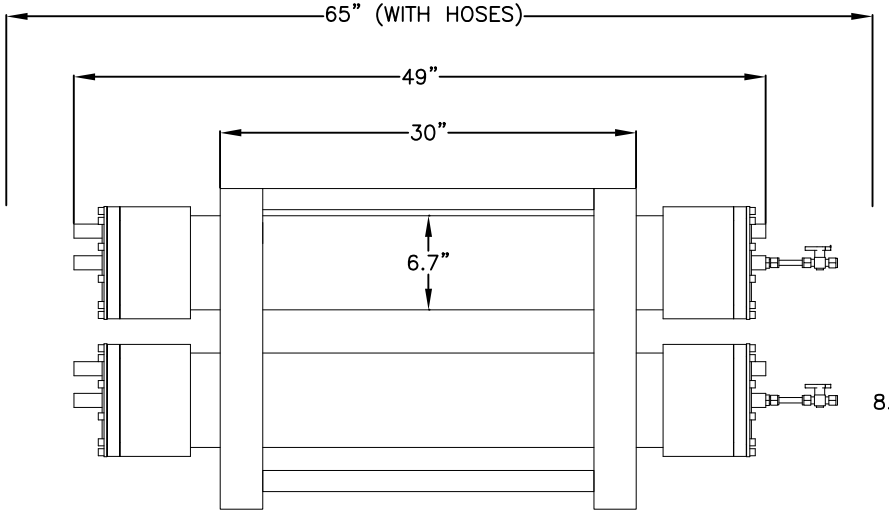


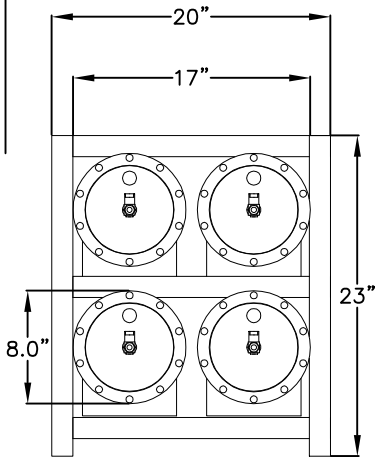


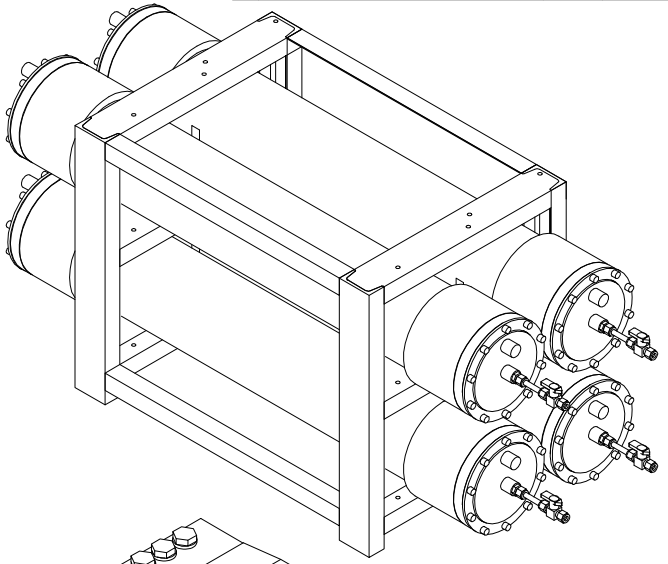
PWM – FRONT VIEW

DRAWN JPM 8/17/99	SIZE E	BASE NO 62144	DWG NO 11300	REV K
CHECKED ?	SCALE NONE		SHEET 5 OF 6	

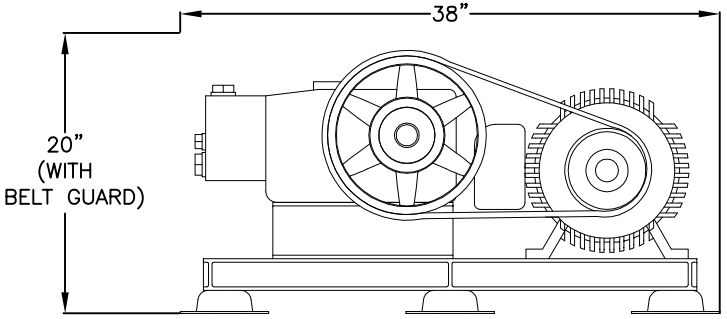
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	10/28/04	BG
A	ALIGNED PWM7K PRESSURE VESSEL ASSEMBLY VIEW	11/01/04	BG

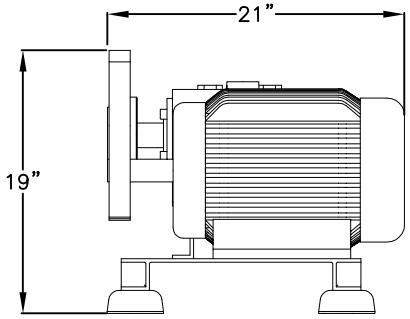


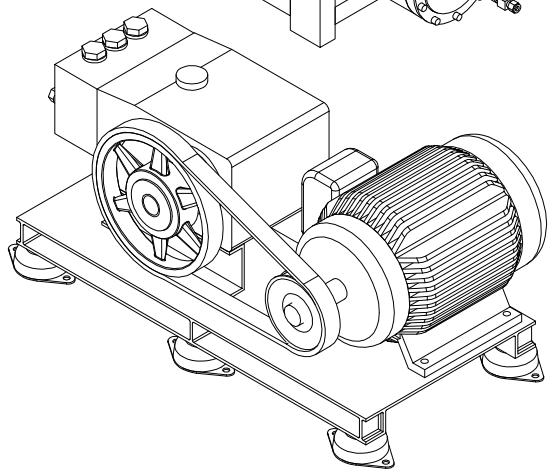




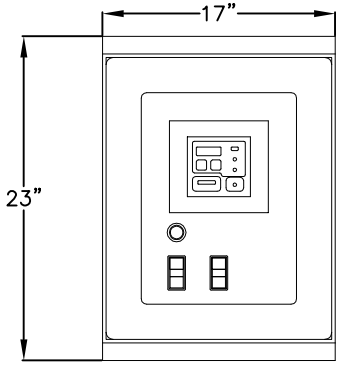
PRESSURE VESSEL ASSEMBLY

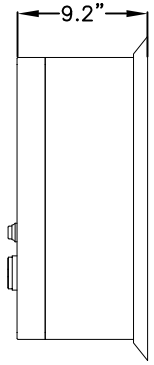


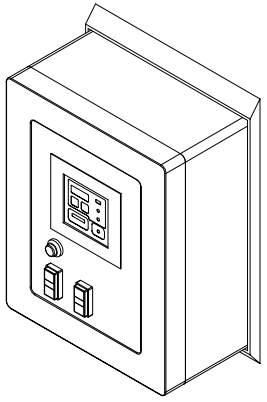




HIGH PRESSURE PUMP AND MOTOR







ELECTRONIC PANEL

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	REVISION STATUS OF SHEETS
A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	A	A	

DRAWING FILE NO. 11303.DWG

Village Marine Technology
2000 West 135th Street– Gardena – California 90249

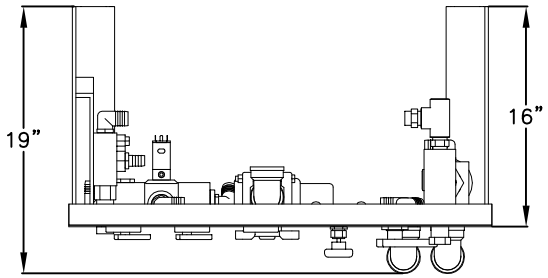
PURE WATER MODULAR
GEN. ARRANGEMENT & DIM.
PWM: 7000

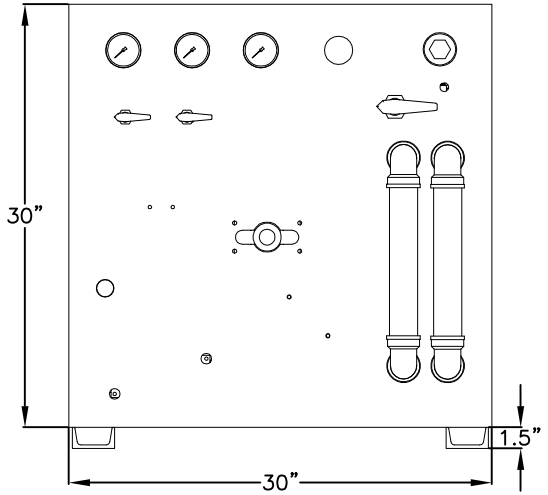
DRAWN	BG	DATE	10-28-04		
CHECKED		DATE			
APPROVED		DATE			
ISSUE DATE					
CONTRACT NO.					

SIZE	CAGE NO	DWG NO	REV
E	62144	11303	A
SCALE	–		SHEET 15 OF 30

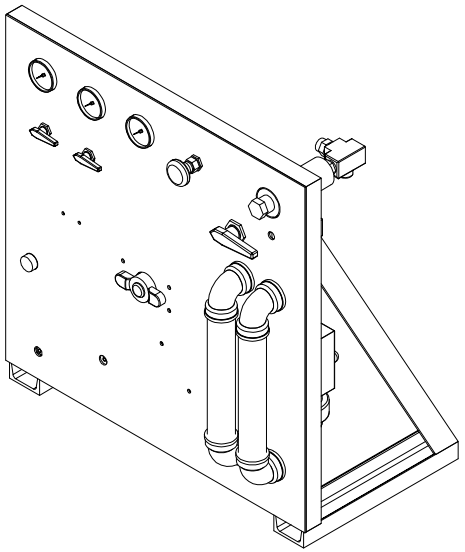
CAGE NO. 62144 DWG NO. 11303 REV. A

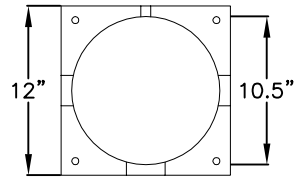
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	10/28/04	BG
A	ALIGNED PW7K PRESSURE VESSEL ASSEMBLY VIEW	11/01/04	BG

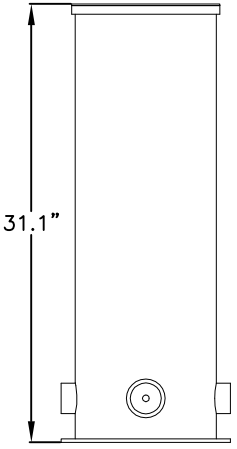


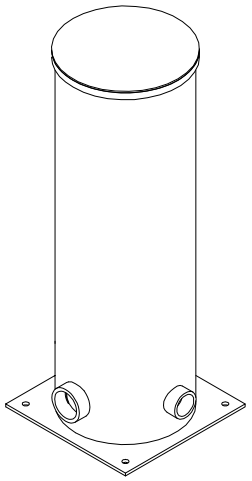


INSTRUMENT PANEL

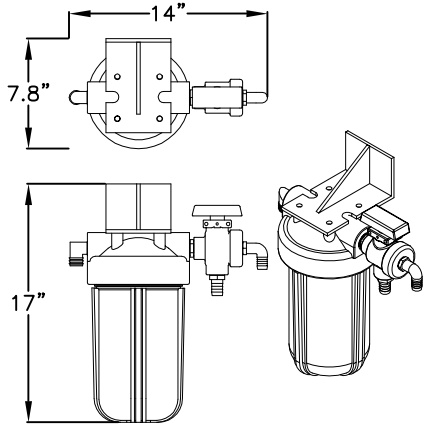




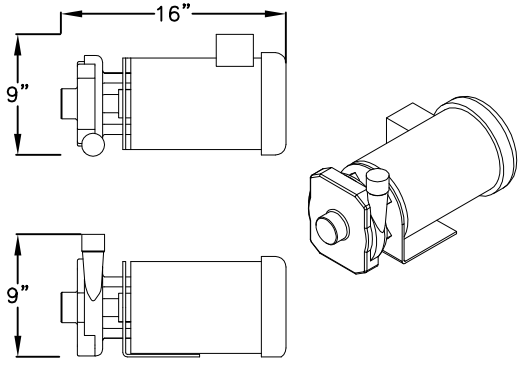




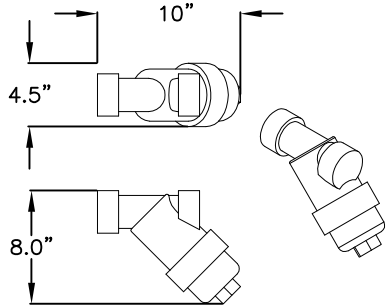
MICRON FILTER (2X) – 20 MIC AND 5 MIC



FLUSH FILTER



LOW PRESSURE BOOST PUMP



STRAINER (Y-TYPE)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	REVISION STATUS OF SHEETS
A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	A	A	

DRAWING FILE NO. 11303.DWG

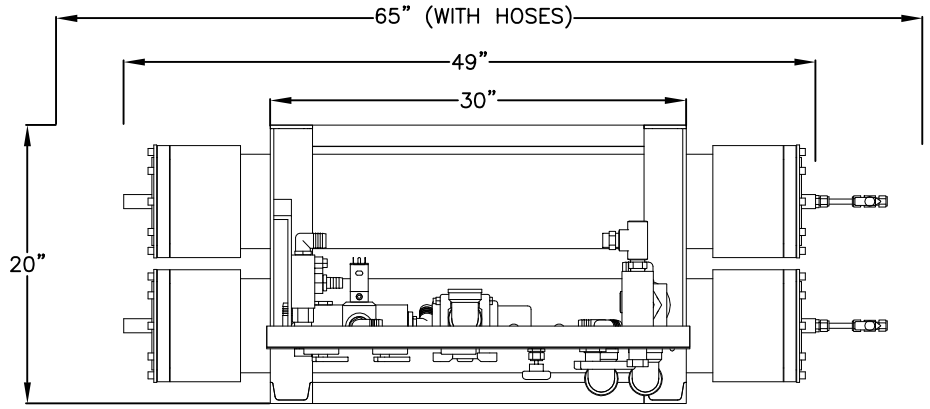
Village Marine Technology
2000 West 135th Street– Gardena – California 90249

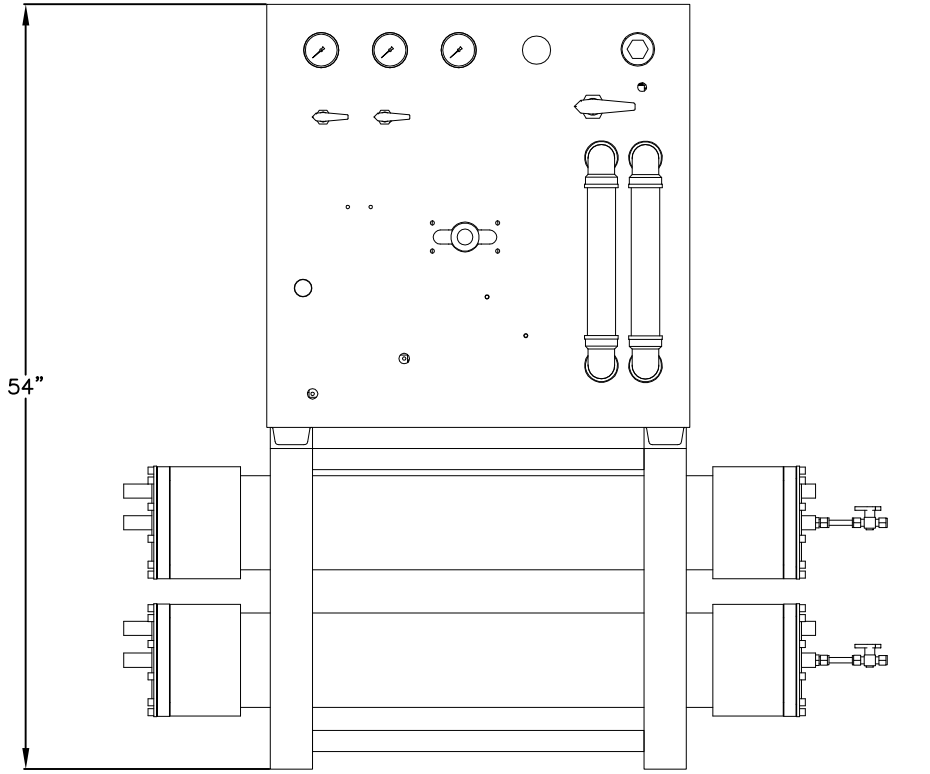
PURE WATER MODULAR
GEN. ARRANGEMENT & DIM.
PWM: 7000

DRAWN	BG	DATE	10-28-04	SIZE	E
CHECKED		DATE		CAGE NO	62144
APPROVED		DATE		DWG NO	11303
ISSUE DATE				REV	A
CONTRACT NO.				SCALE	–
				SHEET	16 OF 30

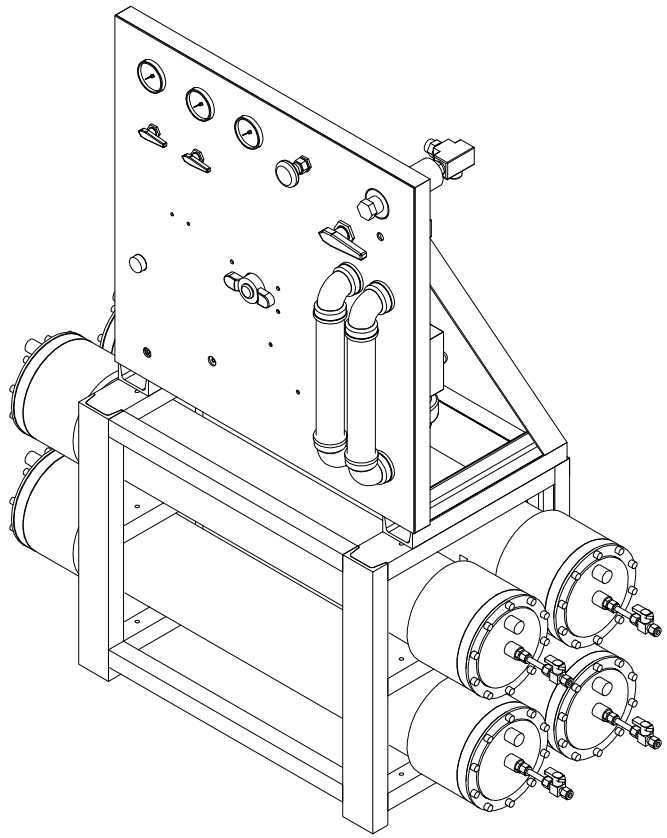
CAGE NO. 62144 DWG NO. 11303 REV A SHT 16

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	10/28/04	BG
A	ALIGNED PW7K PRESSURE VESSEL ASSEMBLY VIEW	11/01/04	BG





OPTIONAL CONFIGURATION



15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	REVISION STATUS OF SHEETS
A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	A	A	

CAGE NO. 62144 DWG NO. 11303 REV. A SHT. 17

DRAWING FILE NO. 11303.DWG

Village Marine Technology
2000 West 135th Street– Gardena – California 90249

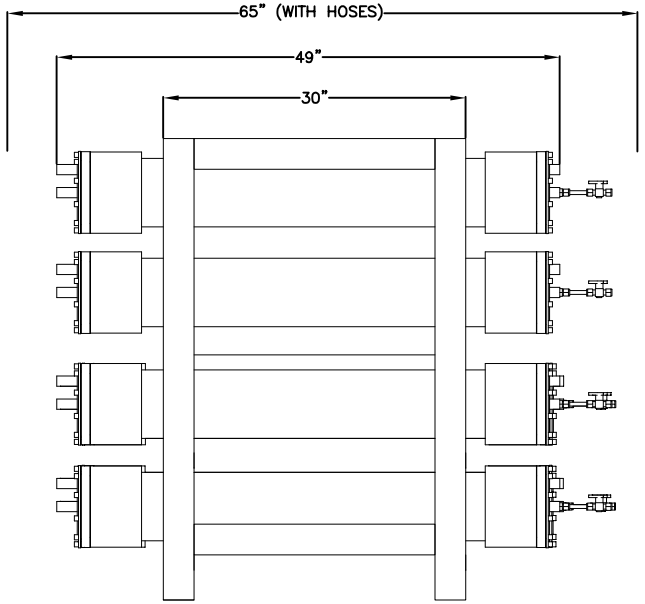
PURE WATER MODULAR
GEN. ARRANGEMENT & DIM.
PWM: 7000

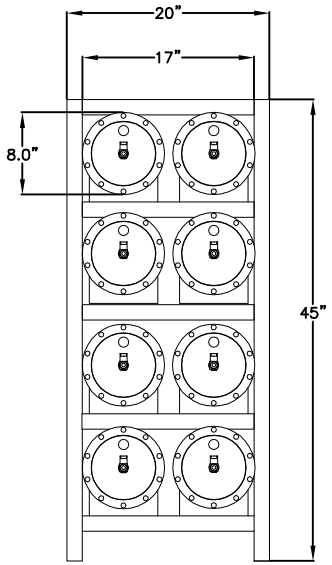
DRAWN	BG DATE 10-28-04
CHECKED	DATE
APPROVED	DATE
ISSUE DATE	
CONTRACT NO.	

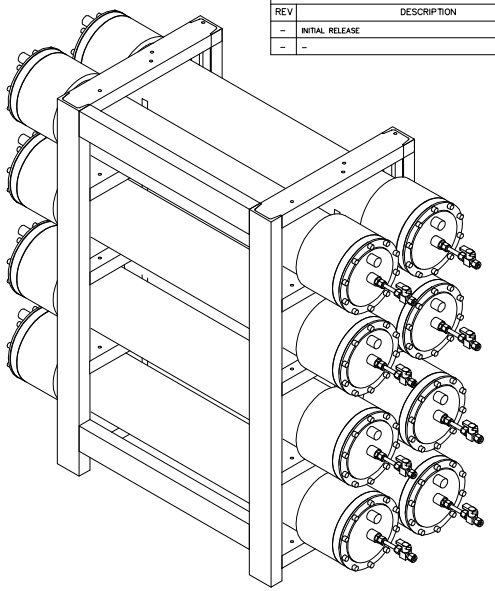
SIZE	CAGE NO	DWG NO	REV
E	62144	11303	A

SCALE – SHEET 17 OF 30

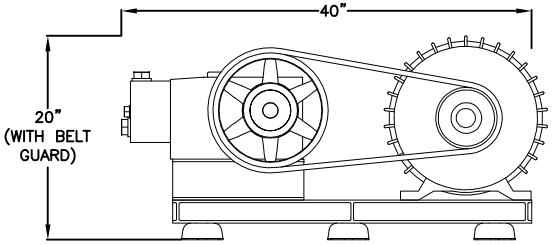
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	12/29/05	BG
–	–	–	–

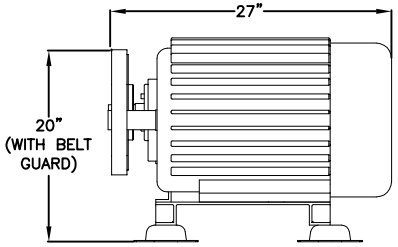


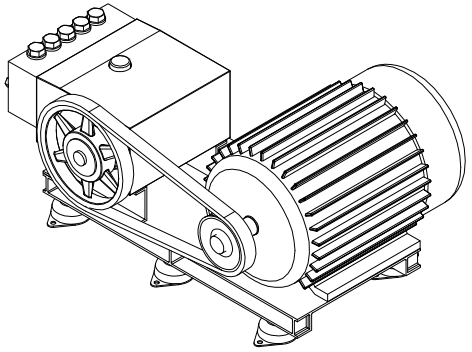




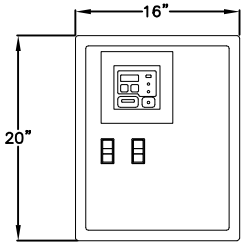
PRESSURE VESSEL ASSEMBLY

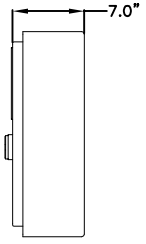


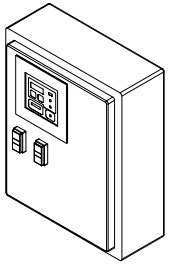




HIGH PRESSURE PUMP AND MOTOR







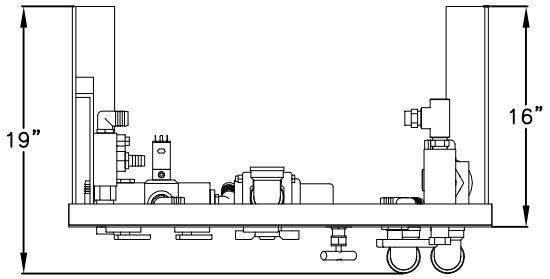
ELECTRONIC PANEL

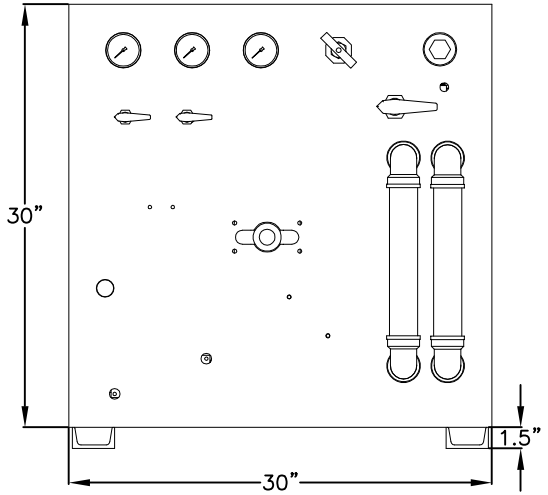
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

DRAWING FILE NO. 11303.DWG	Village Marine Technology 2000 West 135th Street– Gardena – California 90249		
	PURE WATER MODULAR GEN. ARRANGEMENT & DIM. PWM: 16000–18000		
DRAWN BG DATE 12-29-05			
CHECKED DATE			
APPROVED DATE	SIZE E	CAGE NO 62144	DWG NO 11303 REV –
ISSUE DATE			
CONTRACT NO.	SCALE –		SHEET 28 OF 30

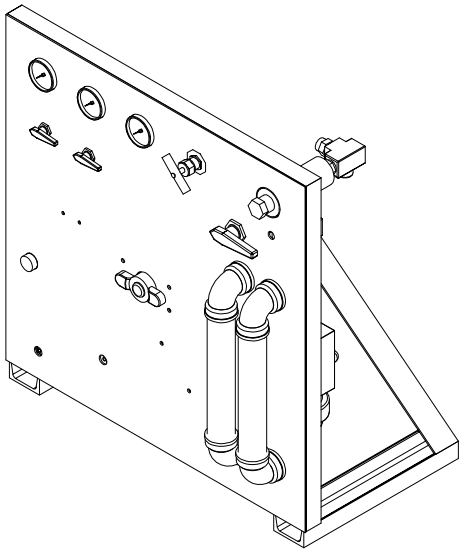
CAGE NO. 62144 DWG NO. 11303 REV –

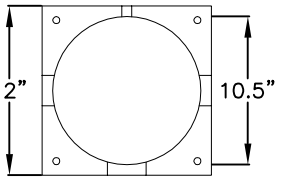
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	12/29/05	BG
–	–	–	–

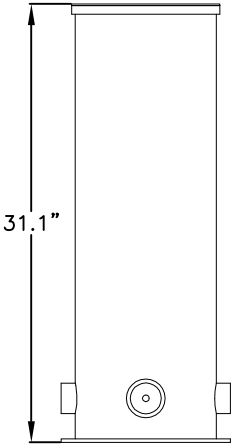


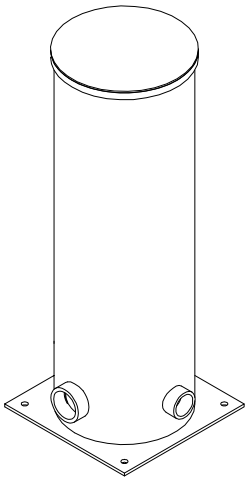


INSTRUMENT PANEL

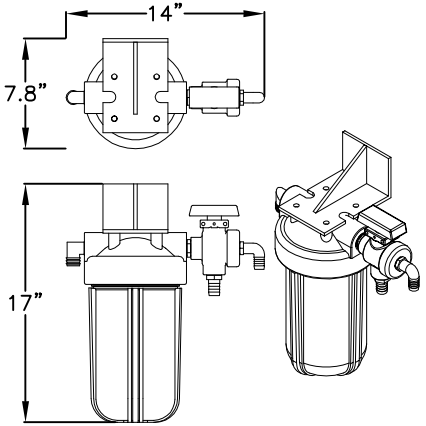




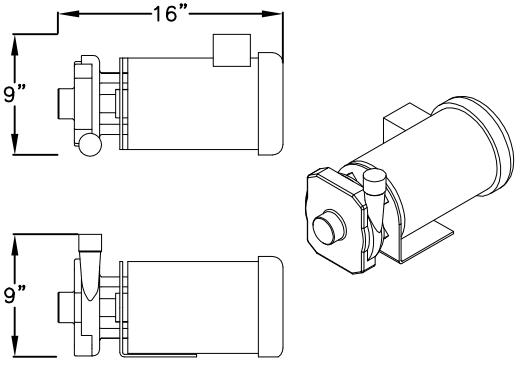




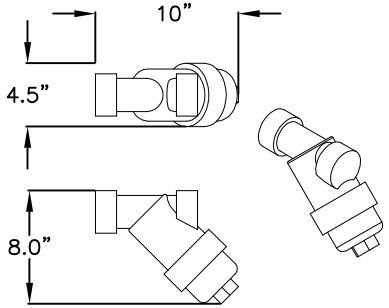
MICRON FILTER (2X) – 20 MIC AND 5 MIC



FLUSH FILTER



LOW PRESSURE BOOST PUMP



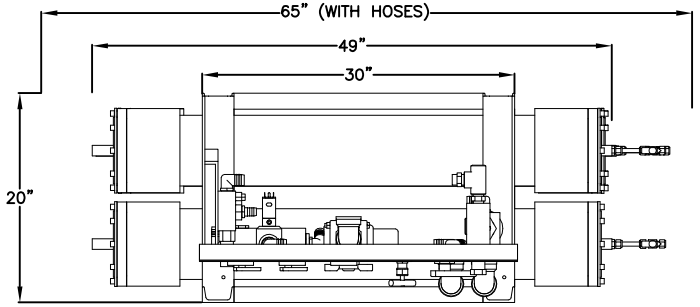
STRAINER (Y–TYPE)

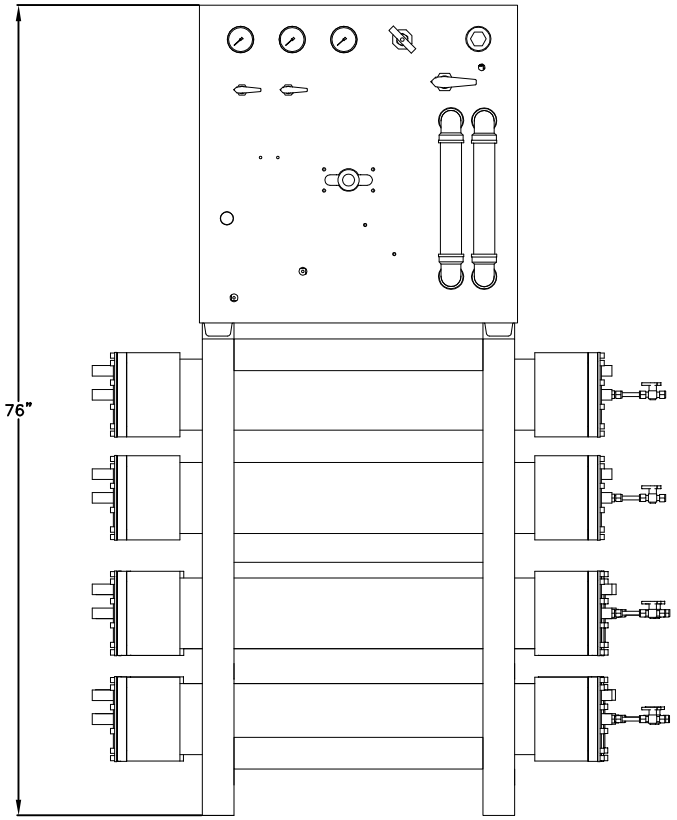
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

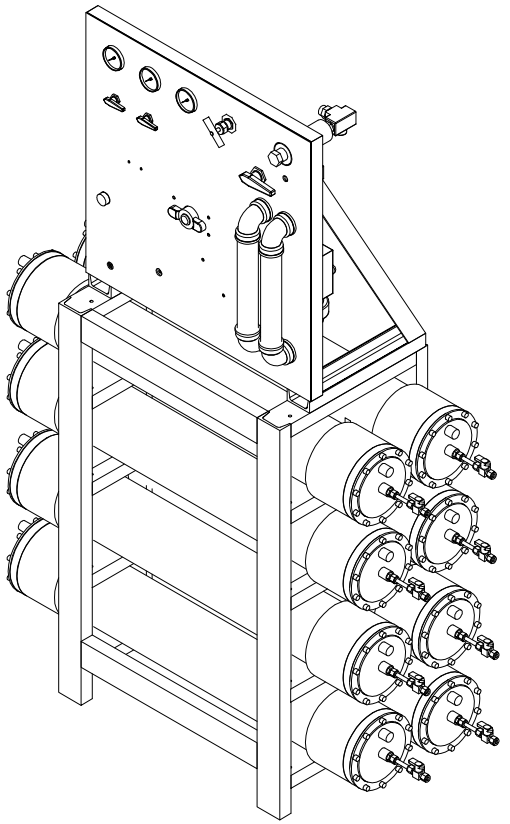
DRAWING FILE NO. 11303.DWG	Village Marine Technology 2000 West 135th Street– Gardena – California 90249		
	PURE WATER MODULAR GEN. ARRANGEMENT & DIM. PWM: 16000–18000		
DRAWN BG DATE 12-29-05			
CHECKED DATE			
APPROVED DATE	SIZE E	CAGE NO 62144	DWG NO 11303 REV –
ISSUE DATE			
CONTRACT NO.	SCALE –		SHEET 29 OF 30

CAGE NO. 62144 DWG NO. 11303 REV –

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	12/29/05	BG
–	–	–	–







OPTIONAL CONFIGURATION

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	REVISION STATUS OF SHEETS
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

CAGE NO 62144 DWG NO 11303 REV A SHT 30

DRAWING FILE NO. 11303.DWG

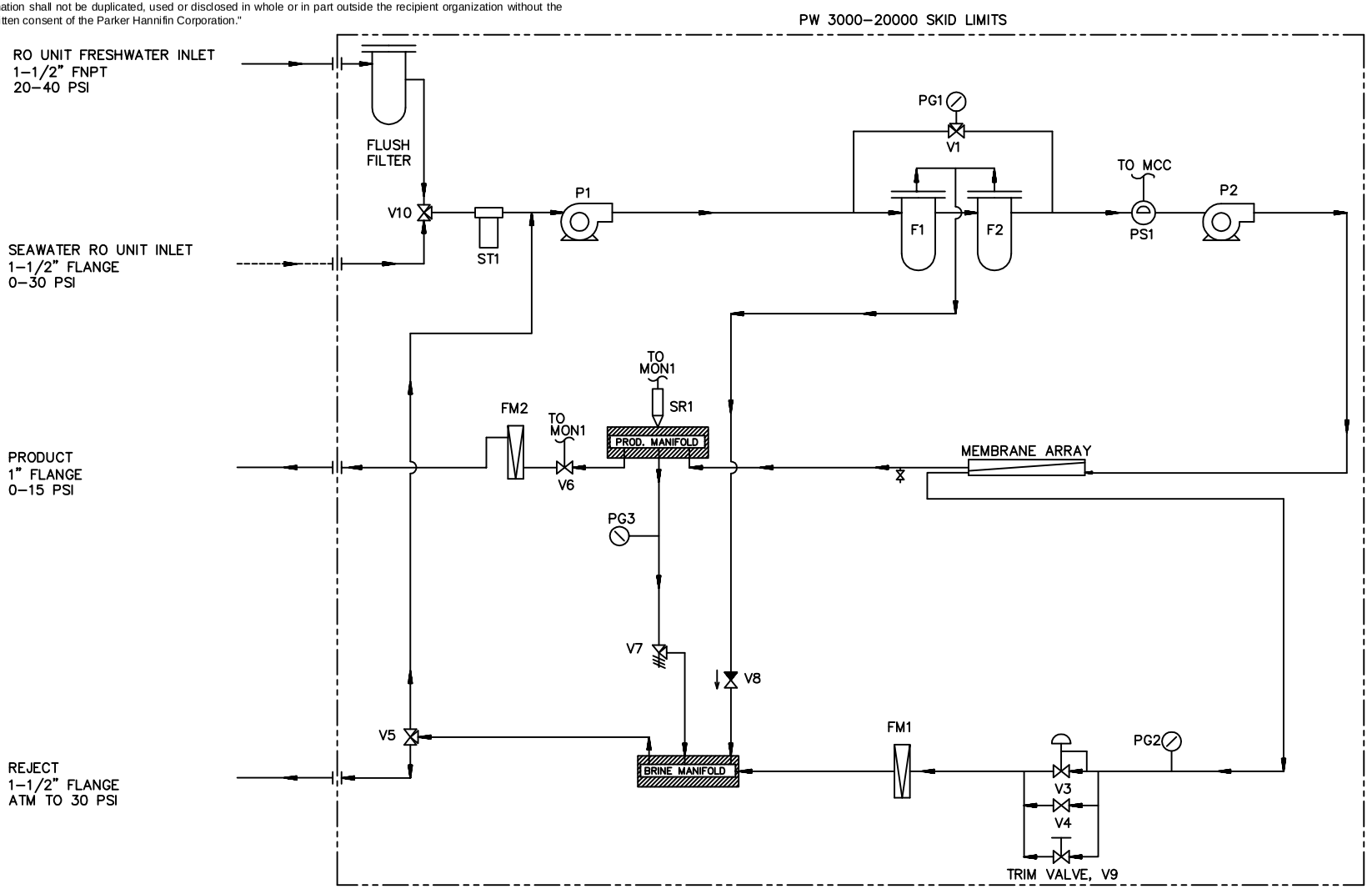
DRAWN BG DATE 12-29-05
CHECKED DATE
APPROVED DATE
ISSUE DATE
CONTRACT NO. _____

Village Marine Technology
2000 West 135th Street– Gardena – California 90249

PURE WATER MODULAR
GEN. ARRANGEMENT & DIM.
PWM: 16000–18000

SIZE E | CAGE NO 62144 | DWG NO 11303 | REV A
SCALE – | SHEET 30 OF 30

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	12/22/97	JM
A	UPDATED DWG: ASSIGNED SERIES NUMBER	08/13/04	BG
B	REASSIGNED SERIES NUMBER	11/02/04	BG
C	REMOVED CYCLONE SEPARATOR,AND REMOVED V2	01/13/12	GT



1	SH	REVISION STATUS OF SHEETS
C	REV	

NOTE

PREFERRED INSTALLATION IS TO USE DEDICATED PRODUCT LINE TO TANK AND DEDICATED REJECT LINE TO OVERBOARD ABOVE WATER LINE.

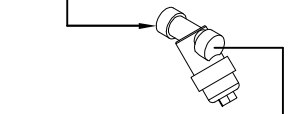
IF SERVICE MUST BE TEED INTO A COMBINED LINE, USE VALVES TO ISOLATE UNIT AND TO PREVENT ANY POSSIBLE CROSS CONTAMINATION.

ISOLATION VALVES MUST BE FULLY OPEN BEFORE UNIT IS STARTED!

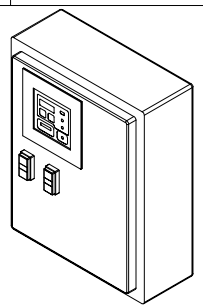
DRAWING FILE NO. 11311.DWG	Village Marine Technology 2000 West 135th Street– Gardena – California 90249
DRAWN JM DATE 12/22/97	PURE WATER 3K–20K (PW 3K–20K)
CHECKED MB DATE 1/12/12	PIPING & INSTRUMENTATION DIAGRAM
APPROVED GA DATE 1/12/12	SIZE E · CAGE NO 62144 · DWG NO 11311 · REV C
ISSUE DATE	SCALE NONE · SHEET 1 OF 1
CONTRACT NO.	

CAGE NO 62144 · DWG NO 11311 · REV C

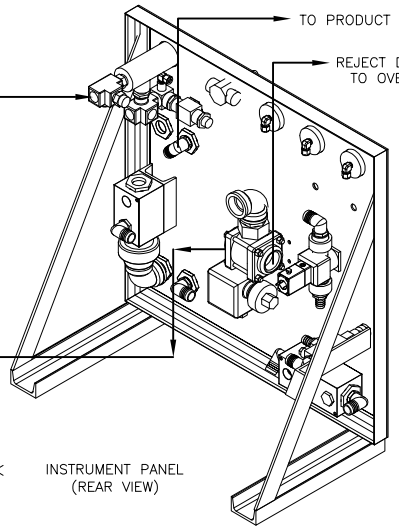
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	11/02/04	BG
–	–	–	–



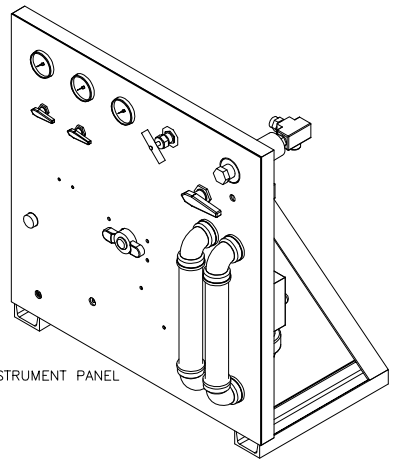
STRAINER



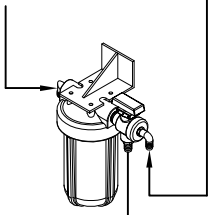
CONTROL PANEL



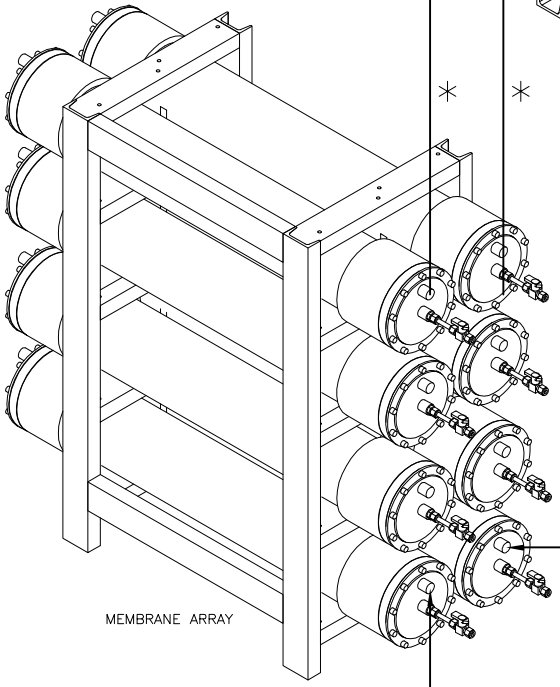
INSTRUMENT PANEL
(REAR VIEW)



INSTRUMENT PANEL

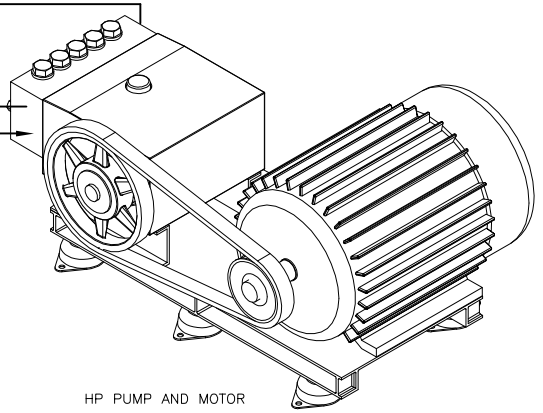


FLUSH
SYSTEM

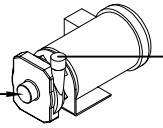


MEMBRANE ARRAY

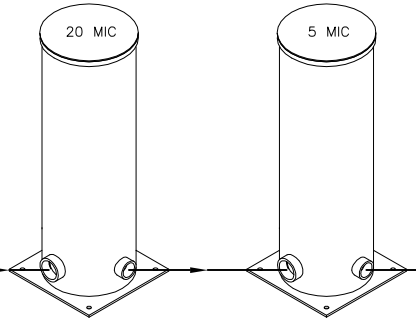
NOTE:
* PW 3000–8000 SINGLE HOSE
* PW 10000–18000 TWO HOSES



HP PUMP AND MOTOR



LP BOOST PUMP



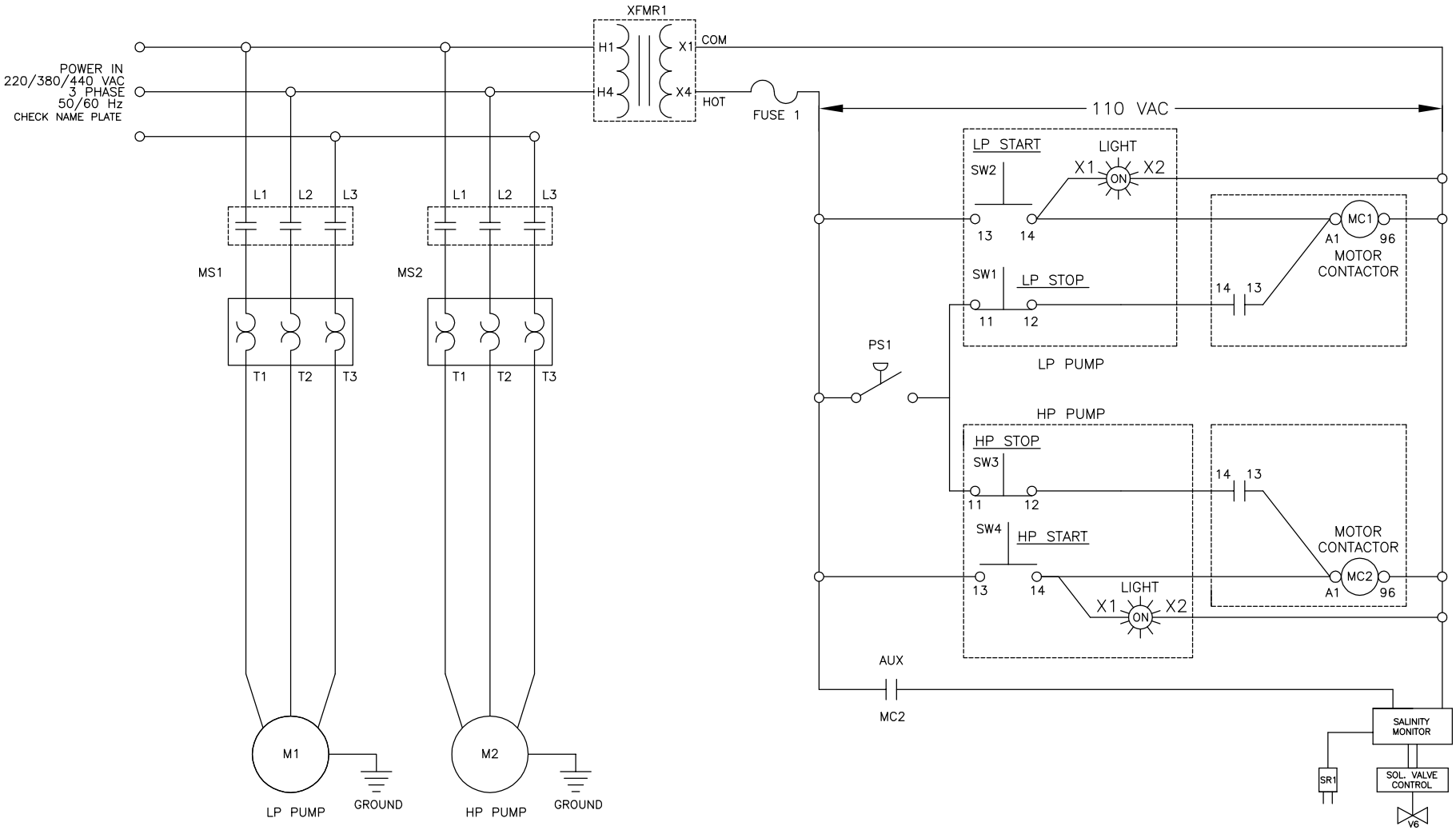
MICRON FILTERS

REVISION STATUS OF SHEETS	
1	–

DRAWING FILE NO. 11323.DWG	Village Marine Technology 2000 West 135th Street– Gardena – California 90249		
	PURE WATER MODULAR MODULAR CONFIGURATION PW SERIES		
DRAWN BG DATE 12-29-05			
CHECKED DATE			
APPROVED DATE	SIZE E	CAGE NO 62144	DWG NO 11323 REV –
ISSUE DATE			
CONTRACT NO.	SCALE –		SHEET 1 OF 1

CAGE NO. 62144 DWG NO. 11323 REV –

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	07/19/99	JPM
A	INCLUDED MOTOR HEATERS	09/10/99	JPM
B	ASSIGNED SERIES NUMBER; REVISED VOLTAGES AND HP PUMP CONNECTION	07/20/04	BG

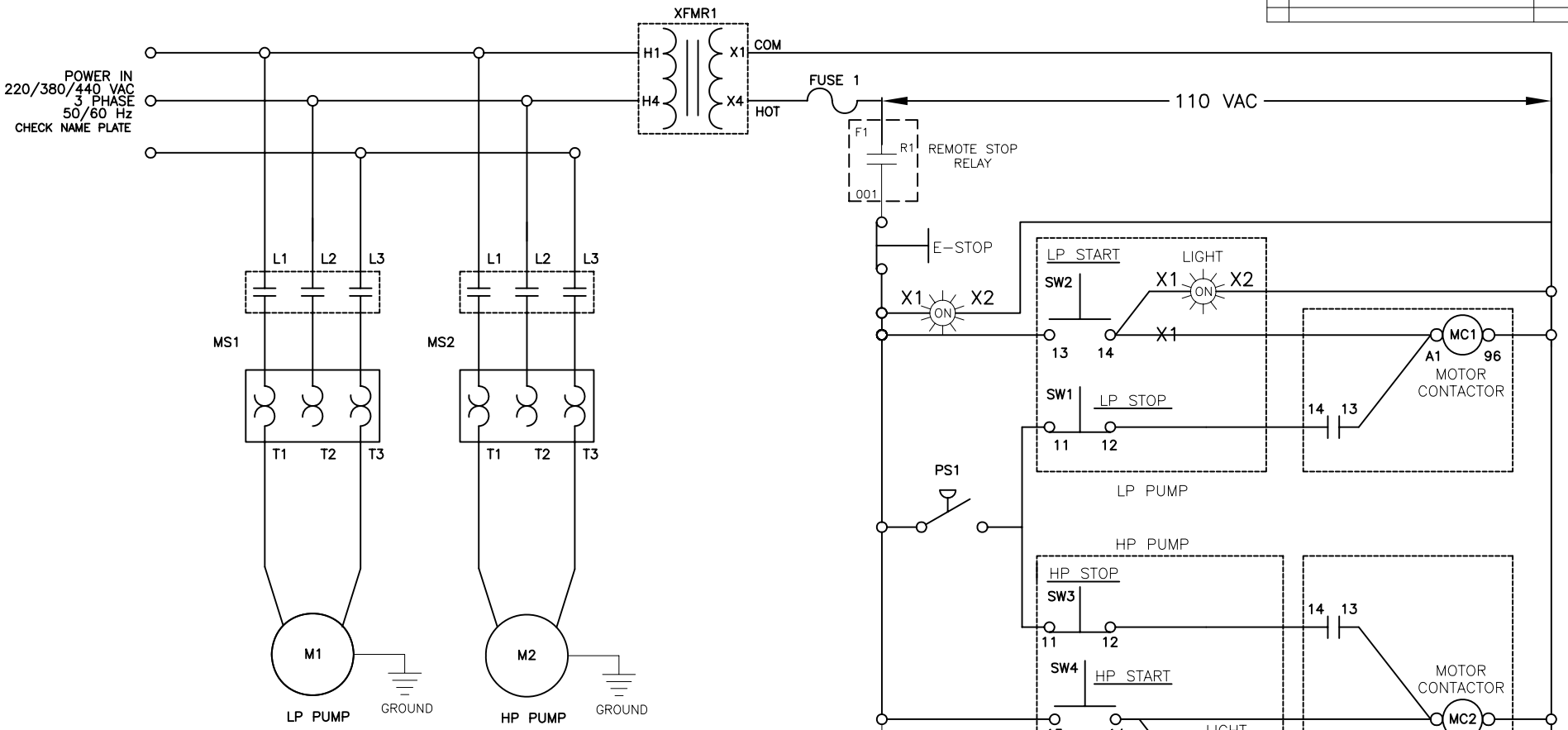


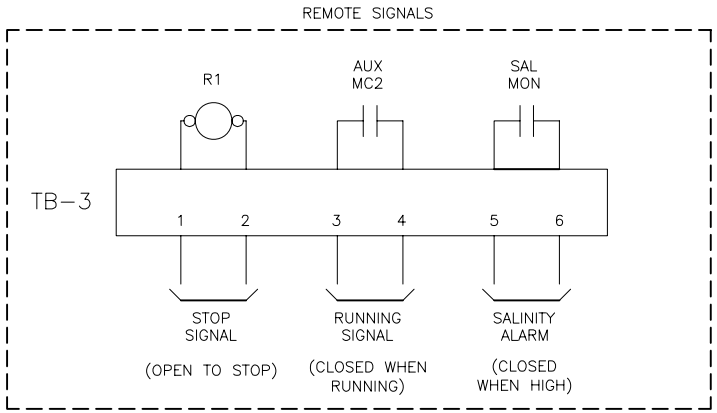
2	1	REVISION STATUS OF SHEETS
B	B	

CAGE NO. 62144 DWG NO. 11351 REV B

DRAWING FILE NO. 11351.DWG	Village Marine Technology, 2000 West 135th Street– Gardena – California 90249
DRAWN JPM DATE 07-19-99	PURE WATER IND 3K–16K
CHECKED KOS DATE 09-10-99	ELECTRICAL SCHEMATIC
APPROVED DATE	220/380/440VAC 3PH 50HZ/60 HZ
ISSUE DATE	SIZE E · CAGE NO 62144 · DWG NO 11351 · REV B
CONTRACT NO.	SCALE – · SHEET 1 OF 2

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	INITIAL RELEASE	05/21/09	





3	2	1	REVISION STATUS OF SHEETS
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DRAWING FILE NO. 11351.DWG

DRAWN	OT	DATE 05-21-09
CHECKED		DATE
APPROVED		DATE
ISSUE DATE		
CONTRACT NO.		

Village Marine Technology
2000 West 135th Street– Gardena – California 90249

PURE WATER IND 3K–16K
ELECTRICAL SCHEMATIC
OPTIONAL SIGNAL PACKAGE

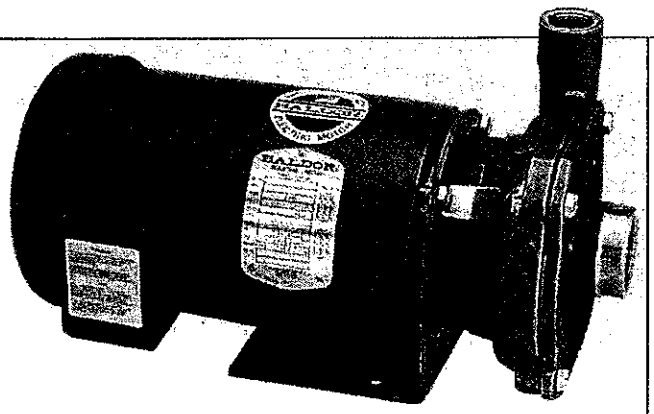
SIZE	CAGE NO	DWG NO	REV
E	62144	11351	–

SCALE –
SHEET 2 OF 3

CAGE NO. 62144 DWG NO. 11351 SH 2 REV –

10.0 MANUFACTURER'S LITERATURE AND OPTIONS

KC2/KP2 PUMPS



INSTRUCTIONS

The care required of this pump, while nominal, is very important. We recommend a careful review of the installation and maintenance covered in this instructional pamphlet to ensure extended trouble-free service.

LOCATION

The motors used on Ampco pump units have been selected as the best for the anticipated environment. For greatest service life, mount the pump and motor where the environment is relativity clean, dry, and non-corrosive. Standard totally enclosed motors may be installed where dirt, moisture and mild corrosion are present or in outdoor locations. Specialty motors may be required for moist, corrosive, or explosive environments. Motor drain plugs (if not equipped with automatic drains) must be removed periodically to drain accumulated condensation. Pump units should be located where daily visual inspection is possible and no surrounding structure interferes with ventilating air over or through the motor.

INSTALLATION

Installation of Ampco pumps should be made as close to the supply of liquid as possible, with short and direct suction piping. Avoid high points in the piping where air pockets can form. The suction and discharge piping should be simple with the connections properly aligned to prevent any strain from being placed on the pump casing. Provisions should be made for pipe expansion and contraction in services handling hot or cold liquids. Base-mounted pedestal pumps must be realigned AFTER installation and piping is completed.

ROTATION

Check direction of rotation **BEFORE** starting the pump. Correct rotation is counter clockwise as viewed from the pump inlet. Incorrect rotation may cause catastrophic failure. Close coupled pumps will be equipped with single phase motors properly sequenced or with three phase motors labeled to indicate required power sequence ABC or CBA for correct rotation. Use a phase sequence indicator to identify power source sequence. For base mounted pumps disconnect the coupling and check motor rotation while disconnected from the pump.

MAINTENANCE

Daily observation of Ampco pumps while in operation is the ounce of prevention needed to extend the service life. Mechanical seals are selected for maximum life with due consideration to the economy of the installation. The seal is the only expendable item. Other pump parts are designed for indefinite life expectancy, except as they may be corroded and/or eroded by aggressive products or by misapplication such as undersizing, oversizing, cavitation, etc. Bearings on some pedestal pumps and some motors are prelubricated and require no additional lubrication. Schedule for regreasing other types of bearings will vary, depending on size speed, duty, and environment. For guidance, a steady running, indoor installation in a relatively clean atmosphere at 40C (104F) ambient should not require grease for two years. Care should also be taken not to over grease motors. Pumps handling corrosive or otherwise aggressive solutions should be flushed with clean water after each use because stagnant conditions are usually most corrosive. In seawater, Ampco Alloy pumps provide cathode protection for stainless steel parts. To prevent crevice corrosion and pitting, drain and then flush out the pump with fresh water when inactive for periods greater then one week.

Ampco KC2 and KP2 pumps fitted with standard mechanical seals have all-metal seal parts of 316 stainless steel, carbon rotating face, ceramic stationary seat, and Buna-N elastomers. Other seal types are supplied when specified. Optional materials such as Viton, EPDM, or Teflon elastomers, Tungsten Carbide, Silicon Carbide, or Ni-Resist faces can be supplied when requested. The mechanical seal should be replaced at the first sign of leakage where the shaft enters the pump. Leakage may cause motor bearing damage. Also, since the primary seal surfaces are lapped to precise flatness, the seal should be replaced whenever the pump is dismantled to the point of separating the seal faces. Always keep a replacement seal kit on hand. It includes a complete seal along with the gasket and o-ring required to rebuild the pump.

There may be other pump assemblies, parts and seal arrangements not shown or otherwise described in this pamphlet, that require the same philosophy of seal positioning. It is suggested that highlights of these instructions be applied while paying close attention to parts arrangement during dismantling.

DISMANTLE AND REPLACE PARTS AS FOLLOWS:

Before attempting any service on the pump or motor, disconnect or lock out electrical power to the pump motor. If the pump and motor are to be removed as a unit, note the wiring configuration. Use colored or numbered tape to mark the wire connections of the motor and power source, to retain correct direction of rotation when reconnecting. Incorrect rotation may cause catastrophic failure.

It is recommend that the complete unit be removed and serviced on a workbench. For the close-coupled KC2 disconnect the power marking the wires for reconnection. For the base mounted KP2, disengage the coupling and remove the pump and pedestal.

1. Remove the suction cover by unbolting the four capscrews (9/16 wrench). Note the condition of the gasket, which will adhere either to the suction cover or the casing.

2. Unscrew the impeller from the shaft, turning in a counterclockwise direction. Loctite used during assembly may require heating impellers of all type KC2 and KP2 to assist in removal. Apply approximately 350F heat to the center of the impeller. A screwdriver slot on the motor shaft opposite the pump is provided for steadying the shaft. Use of a strap wrench on the impeller hub is recommended to prevent marring. Otherwise, file or polish out wrench marks before reusing impeller.

The fluid end of the pump is now sufficiently dismantled for completing most repairs and replacements, including the mechanical seal.

3. If it is necessary to repair or replace the motor of a close coupled assembly or the bearing adapter of a pedestal assembly, unbolt the capscrews fastening the pump to motor or pedestal, thus disengaging the casing and bracket.

The mechanical seal is the only expendable pump part. It is suggested that the complete mechanical seal, both stationary and rotating members, be replaced whenever dripping or leakage occurs at the shaft, or whenever parts are removed to the point of separating the primary sealing surfaces.

4. Remove the rotating parts of the mechanical seal from the impellers shaft like extension (see drawing). The seals flexible bellows may stick tightly to the impeller stem. Bathe in oil to soften the adhesive, or cut away with knife. Remove the o-ring from the shaft I.D.

5. The stationary seat and its cup gasket or o-ring may be removed while the casing is in an assembled position with a wire hook (coat hanger wire). Insert the hook between the I.D. of the seat and the shaft and pull forward, or remove the casing and press out the seat.

6. Thoroughly clean impeller stem, seat cavity and motor shaft with solvent and dry with a clean cloth.

An anti-seize lubricant was originally applied to the I.D. of the impeller that fits over the shaft and is retained by an o-ring. Either preserve this lubricant or add fresh lubricant to the I.D., not the shaft, and replace the o-ring. One drop of oil applied on the shaft will prevent the o-ring from binding on the shaft while assembling the impeller.

7. Lightly oil bore and finger press stationary seat with gasket or o-ring into its cavity. Seat (usually ceramic) is fragile. Do not abuse.

8. Clean the polished face of the stationary seat with a lint-free cloth or tissue, and lightly coat this surface with an SAE-10 or equivalent oil. Care should be taken that the cleansing material and the oil are free of foreign particles. Do not use grease or allow grease onto the sealing surfaces.

9. Place the rotating portion of the mechanical seal on the shaft like extension of the impeller that may be lightly oiled (SAE 10W-30) to facilitate sliding of the bellow by softening an adhesive film on the seal (Use soap, glycerin, etc. if oil is not permitted i.e. EPDM). Do not use grease, as this would prevent the adhesive film from resetting. Final adherence to the impeller stem is essential for shaft, impeller, and seal to rotate as a unit. First place the spring retainer and spring over the impeller shaft. Then press the carbon rotating subassembly down the impeller shaft until it engages the spring. Do not continue to slide the assembly down the shaft once the rotating assembly has engaged the spring. Inspect the carbon sealing face and remove any foreign particles with a lint-free cloth or tissue. Do not allow grease on the sealing surfaces.

10. Place the impeller with mechanical seal in place on the drive shaft. A slight extra push is required to start the o-ring onto the shaft. Proceed to screw the impeller clockwise onto the treaded shaft, utilizing the slot on the opposite end of the shaft to steady the shaft. Hand tighten or use a strap wrench, or other non-marring device such as a jar opener.

11. The pump assembly is completed by reinstalling the suction cover plate and its gasket. Be sure casing and gasket surfaces are relativity clean and free of foreign particles.

12. Your pump is now ready to be reinstalled into its accompanying pipe system and the motor reconnected.

One way to damage a new seal is to run it dry. Be sure the pump is in place and primed before operating or checking rotation.

NOTE: Starting motor in direction of unthreading impeller will result in jamming and damaging bearing and possibly other motor and pump parts. Motor connections should have been marked to avoid this possibility. Also, an economical phase sequence indicator will identify your A-B-C connections. If a reassembled pump unit is not going to be put back in service immediately, or if there is a real possibility for incorrect start up rotation, a suitable thread-locking compound may be used (i.e. Loctite #271).

REVISION D

5P50 Titan Series
High Pressure Titanium
Positive Displacement Pump

Owner's Manual

Aqua Pro Pumps
The Professional's Choice

Aqua Pro Pumps
2000 W. 135th Street · Gardena, CA 90249
(310) 516-9911 · 800-421-4503

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INTRODUCTION

Aqua Pro Pumps “Titan Series” High Pressure Pumps are the product of our years of experience in the water treatment industry, and have been specifically designed and engineered for corrosive and high-pressure applications. Your new Aqua Pro Pump is made with dependable and proven technology to meet your highest demands.

SPECIFICATIONS

Specifications subject to change without notice.

Pump type:	Reciprocating Plunger
Number of Plungers:	5
Bore:	1.259”
Stroke:	1.516”
Oil Capacity:	5.8 Qts.
Oil Type:	Village Marine Tec. High Pressure Pump Oil (Part No. 85-0050-quart size)
Maximum Inlet pressure:	Flooded (zero) to 60 PSI
Maximum Fluid Temperature:	120 degrees Fahrenheit (82 degrees Celsius)

Model Number	GPM	Inlet Port Size	Discharge Port Size	Dimensions L x W x H	Weight	Shaft
5P50	20-50	1.5” MS16142-24	1” MS16142-16	18.5”x 14.5” x 9”	157 lbs.	∅1.625

INITIAL START-UP INFORMATION

WARNING

This is a positive displacement pump. A properly designed pressure relief safety valve must be installed in the discharge piping. Failure to install such a relief mechanism could result in personal injury or damage to the pump or system. Aqua Pro Pumps does not assume any liability or responsibility for the operation of a customer's high-pressure system.

The performance of the pump depends on the entire fluid system and will operate best with the proper installation of plumbing, operation, and maintenance of the pump.

LUBRICATION

It is recommended that the pump be filled with Village Marine Tec's specially blended high pressure pump oil (PN 85-0050). To check the oil level, ensure the pump has stopped running. Observe oil level through the sight glass in the crankcase cover. The oil should be level with the mark on the sight glass (Fig. 1).

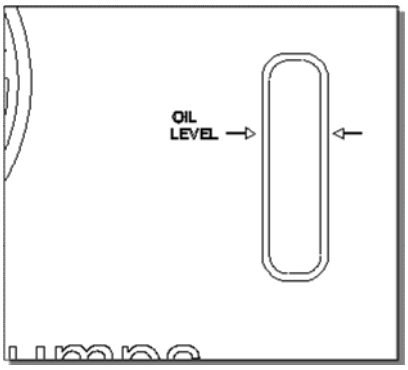


Fig. 1: Oil Level Sight Glass Detail.

NOTE

Change the original oil in the pump after 50 hours of operation. After the initial oil change, the oil should be changed at 500-hour service intervals.

Ensure drive belt is adequately sized for system and shaft bearings. Pulley alignment is critical to the proper operation of the system. To check for proper alignment, place a straight edge, square, or rule against the pulleys to make sure they are in line. Proper alignment of the drive pulleys will minimize crankshaft bearing and belt wear. Over-tensioning of the drive belt may cause pump crankshaft bearing damage.

DISCHARGE PLUMBING

CAUTION

Start system with all valves open or with minimal flow restriction to avoid deadhead overpressure conditions and severe damage to the pump or system. Discharge regulating devices should be at minimum pressure setting at start-up.

CAUTION

DO NOT RUN PUMP WITH FROZEN FLUID. DO NOT RUN PUMP DRY.

STORAGE

For extended storage or between uses in cold climates, drain all pumped fluids from pump and flush with antifreeze solution to prevent freezing and damage to the pump.

PREVENTIVE MAINTENANCE SCHEDULE

The Required Maintenance Schedule specifies how often you should have your pump inspected and serviced. It is essential that your pump be serviced as scheduled to retain its high level of safety, dependability, and performance. Not performing these tasks could result in catastrophic failure.

TASKS	DAILY	WEEKLY	As Determined by Condition	FIRST 50 HRS.	EVERY 500 HRS.	EVERY 1500 HRS.	EVERY 10000 HRS.
Inspect for Water Leaks/ Oil Leaks	**X**						
Check Oil Level	**X**						
Check Belt Tension		**X**					
Inspect Plumbing		**X**					
Inspect Pump Valves						**X**	
Change Pump Oil				**X**	**X**		
Replace Pump Valves			**X**				
Replace Seals			**X**				
Crankcase Service and Inspect Connecting Rods and Crank Bearings							**X**
Manifold Rebuild							**X**
Replace Connecting Rods and Bearings			**X**				

MAINTENANCE RECORD

Keep record of all maintenance activities to ensure maintenance is performed. Note trends and increase maintenance as necessary.

HOURS	RECOMMEND SERVICE	ACTIONS / NOTES	ACTUAL HOURS	SIGNATURE	DATE
50	Oil				
550	Oil				
1050	Oil				
1550	Valve Inspection, Oil				
2050	Oil				
2550	Oil				
3050	Valve Inspection, Oil				
3550	Oil				
4050	Oil				
4550	Valve Inspection, Oil				
5050	Oil				
5550	Oil				
6050	Valve Inspection, Oil				
6550	Oil				
7050	Oil				
7550	Valve Inspection, Oil				
8050	Oil				
8550	Oil				
9050	Valve Inspection, Oil				
9550	Oil				
10000	Crankshaft Bearing, Manifold Rebuild, Oil				

*HP seal is not routinely replaced during low pressure seal change. HP seal is replaced only in case of seal failure (see low-pressure troubleshooting, pg.6).

** Oil changes are mandatory at the specified hour intervals.

TROUBLESHOOTING

Use the troubleshooting table below. If problems persist, contact your dealer.

PROBLEM	PROBABLE CAUSE	SOLUTION
Low Pressure	Belt Slippage	Make sure the correct belt is used. If the correct belt is used and the belt is slipping, then tighten. Replace belt if worn.
	Leaky discharge hose	Check connections. Replace hose if worn or cracking.
	Pressure gauge inoperative or not registering correctly.	Check pressure with new gauge and replace as needed.
	Air leak in inlet plumbing	Use PTFE liquid or tape to seal the threads. Make certain that the PTFE does not go beyond the last thread. Doing so may damage the pump.
	Inlet suction strainer clogged or improperly sized	Clear the obstruction, or use adequate size for inlet pump connection and fluid being pumped.
	Relief valve stuck, partially plugged or improperly sized	Clean and reset relief valve to system pressure and correct bypass. Check supply tank for contamination.
	Worn or dirty valves	Clean valve or replace with a rebuild kit.
	Worn high-pressure seals; abrasives in pump fluid, severe cavitation; inadequate water supply; stressful inlet conditions.	Replace seals with rebuild kit. Install and maintain proper filter, check line size and flow available to pump
Pulsation Pump runs extremely rough, pressure low	Faulty pulsation dampener (if a pulsation dampener has been installed.)	Check pre-charge. Check manufacturer's literature on recommended pressure.
	Restricted inlet, or air entering inlet plumbing	Be sure that inlet hose is the proper size. Check filters and clean as needed. Check fittings and use PTFE liquid or tape for airtight connection.
	Valve or spring damage	Clean or replace valve and spring, check inlet supply tank for contamination
	Seal damage	Replace seals.
Slight water leakage from under the manifold	Possible Condensation	No fix needed.
	Worn low pressure seals	Replace seals with seal kit, check inlet pressure and inspect ceramic plunger for damage.
Excessive oil leak between crankcase and pumping section (1 drop every 15 min)	Worn crankcase oil seals	Replace crankcase oil seals.

PROBLEM	PROBABLE CAUSE	SOLUTION
Oil leaking from crankshaft area	Worn crankshaft oil seal	Replace damaged oil seals.
	Bad bearing	Replace bearing.
	Cut or worn o-ring on bearing cap	Replace o-ring on bearing cap.
Water in crankcase	Humid air condensing into water inside the crankcase	Change oil every three months or 500 hours
Excessive play in the end of the crankshaft	Worn bearing	Replace bearing.
Oil leaking in the rear portion of the crankcase	Damaged or improperly installed crankcase cover, crankcase cover o-ring, drain-plug, or drain-plug o-ring.	Replace crankcase cover o-ring or drain-plug o-ring.
Loud knocking noise in pump	Pulley loose on crankshaft	Check key and pulley bushing.
	Restricted Inlet	Clear obstruction or replace valve.
	Worn bearing, connecting rod or crankshaft.	Service crankcase.
	Worn belts	Replace belts.
Frequent or premature failure of the seals	Running pump dry	NEVER RUN THE PUMP WITHOUT WATER.
	Abrasive material in the fluid being pumped	Install proper filtration on pump inlet plumbing.
	Excessive temperature of pumped fluid (120 degrees F max.)	Reduce fluid inlet temperature to specifications.

SERVICE

CAUTION

Ensure pump is disconnected from the motor or any driving devices. Service the pump in a clean, dirt-free environment.

Pump rebuild kits are available for valve or seal overhauls. Contact your dealer for ordering information.

INTRODUCTION

All tasks should be performed in a clean environment, free from dust and debris. It is imperative that the utmost cleanliness be maintained during the rebuild of your Aqua Pro Pump. The numbers following the parts are callout numbers. They correspond to the parts shown in the figures and in the assembly drawings at the end of the manual.

READ THE INSTRUCTIONS COMPLETELY BEFORE ATTEMPTING TO PERFORM ANY SERVICE.

Before assembling, clean all parts to make free of oil, grease, dirt, and lint. Use a lint-free cloth to wipe any part of the pump.

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated. Only silicon grease (PN. 21-1122) should be used on all o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

TOOLS NEEDED

Table 2: Tool List for Pump Service

3/16" Allen Wrench	Wrench Hex Jaw
1/4" Allen Wrench	Pick
3/8" 12-point Socket Wrench	Pry-bar
9/16" Socket/ Socket Wrench or Combination Wrench	Snap Ring Pliers
15/16" Socket/ Socket Wrench or Combination Wrench	Torque Wrench (50 ft.-lb.)
1" Socket/ Socket Wrench or Combination Wrench	Seal Insertion Tool (PN 91-7228)
1-1/2" Socket/ Socket Wrench or Combination Wrench	Weep Ring Removal Tool (PN 91-7230)
Flat-Head Screwdriver	Die M7 X 1.0
Phillips-head Screwdriver	Bearing Puller
Tap M7 X 1.0	Anti-Seize Lubricant (PN 85-0094)
Silicon Grease (PN 21-1122)	Ceramic Lubricant (PN 85-0087)
Arbor press for Connecting Rod/Plunger Pin	Press for Crankshaft removal
Torque Wrench	Red Loctite
Dead Blow Hammer	

VALVE INSPECTION AND SERVICE

Valves may be serviced while the manifold assembly is attached to the crankcase assembly. In most cases, service can be completed while the pump is in place within the watermaker system.

Remove ten valve plugs (44) from the manifold using a 1 ½" socket wrench. Remove the valves (41) and springs (42) from each valve port. Inspect the curved valve surface for damage or distortion. A circular mark from the valve seat is normal, but should not advance to distorting the valve shape. If a valve is broken or pitted, use a flashlight to examine the seat inside the valve port. Inspection will ensure that the valve seat has not been damaged by debris.

Depending on the condition, either replace or clean and reuse valves and springs. A set of 10 valve and 10 springs is available as PN 70-1057. Apply a light coat of silicon grease (PN 21-1122) to the valve plug o-ring (43). Apply anti-seize lubricant (PN 85-0094) to the valve plug threads. Assemble the valves, springs and plugs as shown in Fig. 9, and tighten the valve plugs back into the manifold.

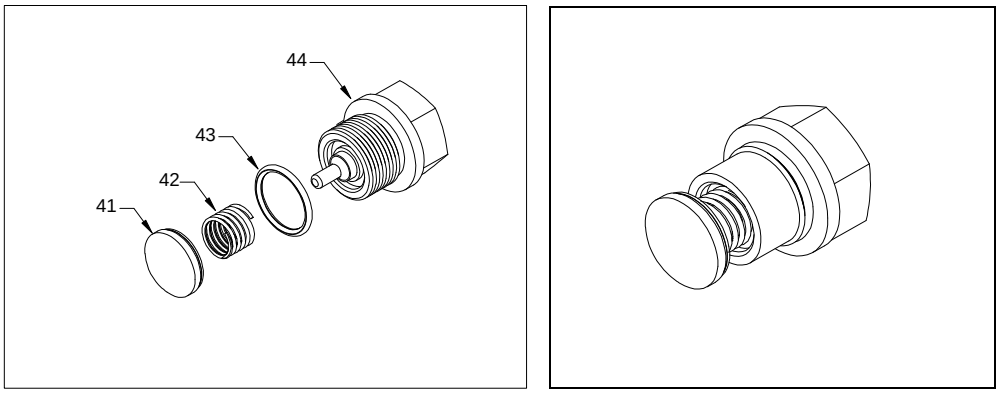


Fig. 2: Valve Assembly

DETACHING THE MANIFOLD FROM THE CRANKCASE

Remove the 2 manifold nuts (53), see Fig. 13, with a 15/16" socket wrench or Combination Wrench. Loosen the manifold assembly by prying off the manifold using the slots in the crankcase as shown in Fig 2. Set the manifold assembly aside in a clean work area. If the manifold assembly locating dowel pins (50) fall out, reinsert them into the manifold alignment pin hole.

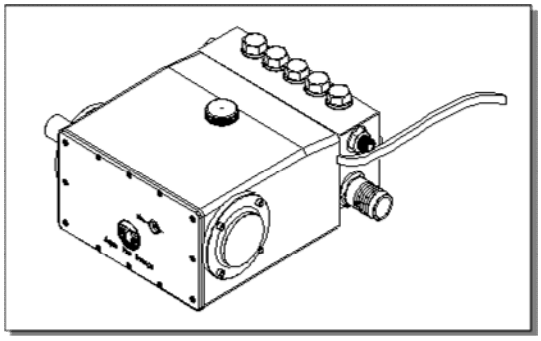


Fig. 3: Manifold Assembly Removal

SEAL REPLACEMENT

If condition based seal service is required (Seal Kit PN 70-3080), use the following instructions outlined in the OIL SEAL REPLACEMENT section. To determine the need of condition based service, look for signs of oil or water drip under the pump. Once the manifold is detached from the crankcase, the low pressure water seals (40) are exposed on the manifold surface and can easily be replaced. If undertaking the complete 10,000 hour service with kits 70-3075 and 70-3078, then follow the detailed instructions.

SERVICING THE CRANKCASE

The following are the procedures for servicing the crankcase assembly using the 5P50 Crankcase Rebuild Kit (PN. 70-3078). The manifold assembly must be detached from the crankcase to do the following service.

PLUG, OIL DRAIN, O-RING REPLACEMENT

Remove the oil drain plug (5) with a 1" wrench and drain the crankcase oil. Clean the drain plug (5), and remove the o-ring (4) with the aid of the pick if necessary. Replace the o-ring with the new one supplied with kit. Apply anti-seize lube to the threads of the drain plug (5) and reinstall.

OIL SEAL REPLACEMENT

Remove the seal retainer (33) and set aside, see Fig. 6. Remove the plunger retainer nut (32) with a 9/16" wrench and set aside. Remove the plunger retainer washer (31) and back-up ring (29), Fig. 5, and remove the ceramic plunger (8). Remove the keyhole washer (26), then remove the slinger (25), see Fig. 4. Using a flat head screwdriver and hammer, drive the screwdriver into the meat of the seal (6). Be careful not to scratch the inner or outer metal sealing surfaces. A quick twist of the screwdriver will remove the seal. Do not attempt to preserve the seal for reuse. Inspect the seal retainer washers for damage; if none is evident then reuse.

NOTE

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Insert new plunger rod oil seal (6) into crankcase ensuring that the seal is fully seated. Place slinger (25) onto the plunger rod (8), followed by the keyhole washer (26) as shown in Fig. 4. Chase the thread of the plunger rod and the retainer stud with the tap and die to ensure the removal of any left over loctite prior to reassembly.

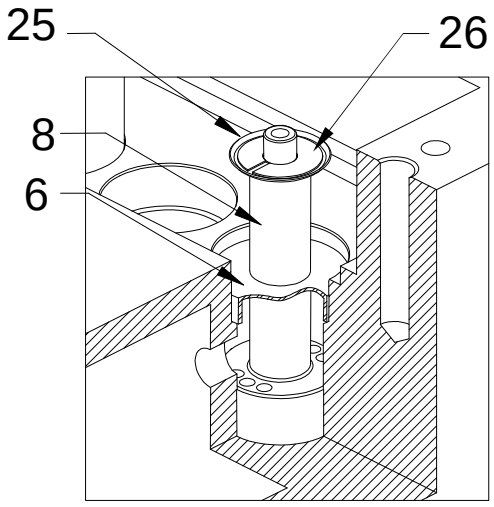


Fig. 4: Plunger Assembly View

NOTE

Examine the ceramic plungers (27), Fig. 6, for cracks, heavy scoring, or unusual wear.

Slide ceramic plungers (27) onto plunger rod, and insert the new plunger retainer washer (31) into the plunger. Clean the plunger retaining nuts (32), Fig. 5. With the aid of a pick remove the plunger retainer back-up ring (29) and the plunger retainer o-ring (30). Replace the o-ring (30) and back-up ring (29) with the new one supplied in the kit as shown in Fig. 5.

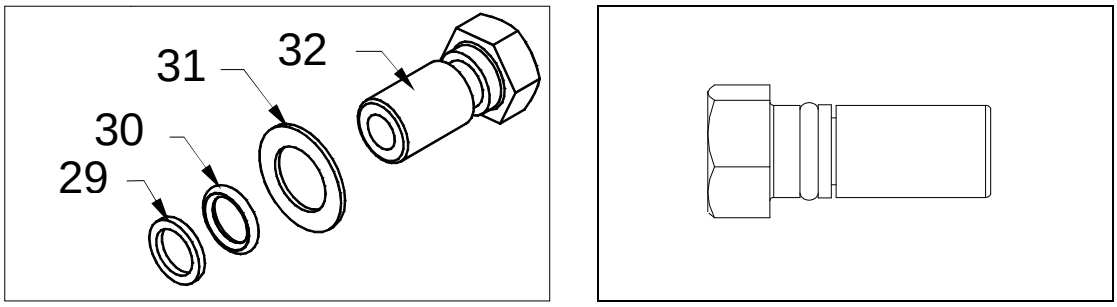


Fig. 5: Plunger Retaining Nut Assembly

Apply Red Loctite # 262 to retainer stud (28) threads. Reinstall the plunger retainer nut (32) and torque to 100 in. lb. using a 9/16" socket.

NOTE

Be careful not to get the red loctite on any other components. Failure to use loctite on the retainer stud and nut could lead to catastrophic failure of the pump.

Apply Aqua Pro's special Ceramic Lubricant (PN. 85-0087) to the ceramic plungers (27). Slide the seal retainer (33) over the ceramic plungers (27). Make sure that the flanged side is in close proximity to the manifold assembly, and that the hole is oriented downward ensuring that the seal retainer has adequate water drainage. Slide manifold assembly over plungers and reinstall manifold nuts (53).

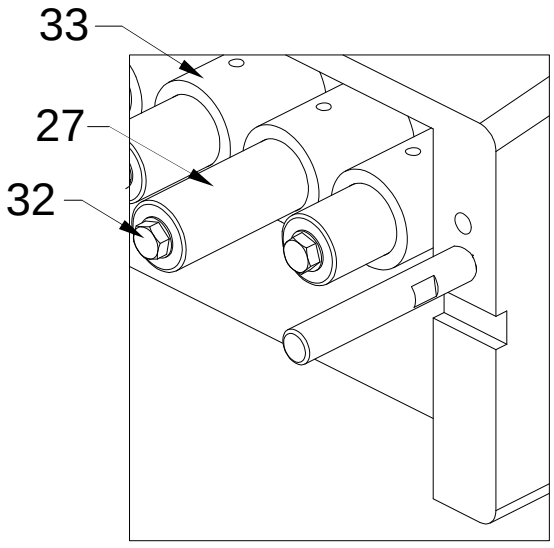


Fig. 6: Seal Retainer

BEARING CAP O-RING/SEAL REPLACEMENT

You will need these tools and parts to do the following:

- 1/4" Allen Wrench
- Pick
- Seal, Oil, Crankshaft (16): PN. 70-0701
- O-Ring, Bearing Cap (15): PN. 70-0703
- Silicon Grease Lubricant: PN. 21-1122
- Anti-Seize Lubricant: PN. 85-0094

Remove the 4 socket head cap screws (17) with a 1/4” Allen Wrench from each of bearing side plates (13), (14). With the aid of a pick remove the o-rings from the grooves and remove the crankshaft oil seal (16) from the pulley side bearing cap (14).

CAUTION

Crankshaft oil seal is press-fit at the factory, so care is to be exercised during removal to prevent any damage to sealing surface.

NOTE

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Press new crankshaft oil seal (16) into pulley side bearing cap (14), install o-ring (15) in o-ring groove on the crankshaft bearing caps (13) and (14), and reinstall caps on pump.

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Install the 4 socket head cap screws (17) onto each of the bearing side plates and tighten with a 1/4” Allen Wrench.

COVER, CRANKCASE O-RING REPLACEMENT

In this procedure you will replace the o-rings on the crankcase cover as provided in the rebuild kit.

You will need these tools and parts to do the following:

- 3/16” Allen Wrench
- Phillips-head Screwdriver
- Pick
- Silicone Grease Lubricant: PN. 21-1122
- Red Loctite # 262
- Anti-Seize Lubricant: PN. 85-0094

Unscrew the 12 crankcase cover screws (24) with the 3/16” Allen wrench. Remove the 6 sight glass retaining screws (23) with the Phillips-head screwdriver. Remove the sight glass retaining frame (22) and the sight glass (21). With the aid of the pick remove the sight glass o-ring (20), and remove the crankcase cover o-ring (18).

NOTE

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Install the new sight glass o-ring (20) and the crankcase cover o-ring (18) provided with the rebuild kit.

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Install the sight glass (21) and the sight glass frame (22). Apply Red Loctite #262 to the 6 sight glass retaining screws (23) and tighten. Reinstall the crankcase cover (19) and tighten the 10 crankcase cover screws (24) with the 3/16" Allen wrench in the sequence shown in Fig. 7.

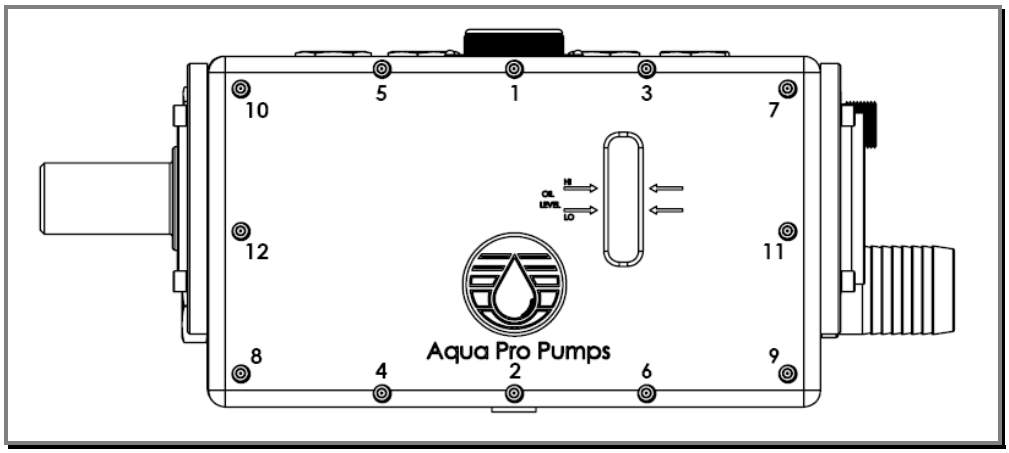


Fig. 7: Bolt tightening sequence

CRANKSHAFT BEARING, CONNECTING ROD-PISTON SERVICE

When feasible, it is recommended that any service to the Crankshaft (11), Connecting Rods (10), and Plunger Rods (8) be done by sending the pump back to the factory for rebuilding.

CRANKSHAFT REMOVAL

Crankshaft removal is not necessary for overhaul of seals.

NOTE: The Manifold, Plunger assembly, Bearing Side Plates, and Crankcase Cover must be removed before attempting to remove the crankshaft.

You will need these tools and parts to do the following:

- 3/8" 12-point Socket Wrench
- Arbor press for Connecting Rod/Plunger Pin
- Bearing Puller
- Snap Ringer Pliers

Using a 23-point socket, unscrew the connecting rod Bolts (10)

(NOTICE: Unscrew one connecting rod cap at a time. Keep the bolts in the same hold it came out of. Store the connecting rod caps like the picture below in order from 1-5. Fig. 8)

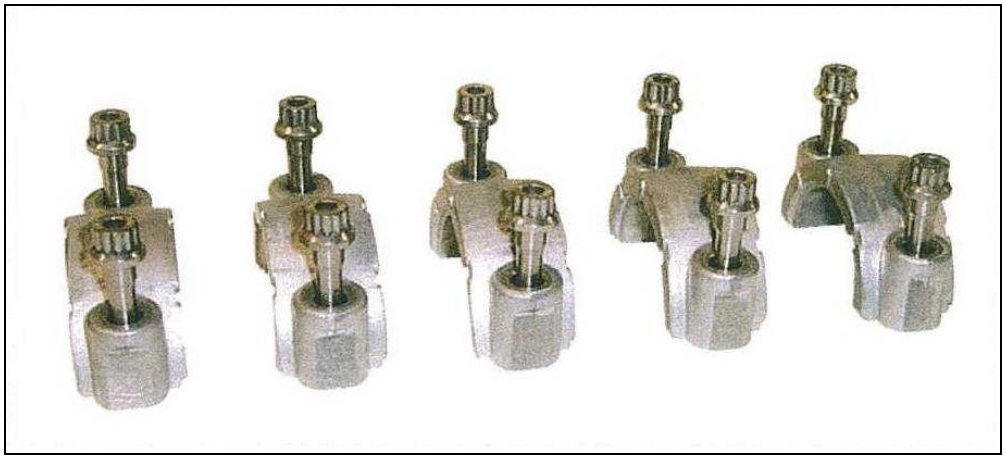


Fig. 8 Keep parts organized

Push the connecting rod assembly in as far as possible away from the Crankshaft (11).

Make sure the Connecting Rods (10) are clear from the path of the crankshaft.

Rotate the Crankshaft (11) by hand to feel for smooth bearing movement. If movement is rough, Bearings (12) needs to be replaced. Inspect the bearing surface of the connecting rod end caps. Some scoring is considered acceptable, but irregular wear patterns are not. This is where the decision is made on whether to replace the connecting rods and crank bearings. If bearing surface passes inspection, reassembly can begin.

If not already done, remove both Bearing Side Plates (13)(14).

Using a press, press out the Crankshaft (11) from the key slotted side.

The crankshaft should come out of the crankcase with one Bearing (12) on the non-key slotted side and one Bearing (12) still in the Crankcase (1).

Pull off the Bearing (12) on the Crankshaft (11) with a bearing puller (fig. 9).

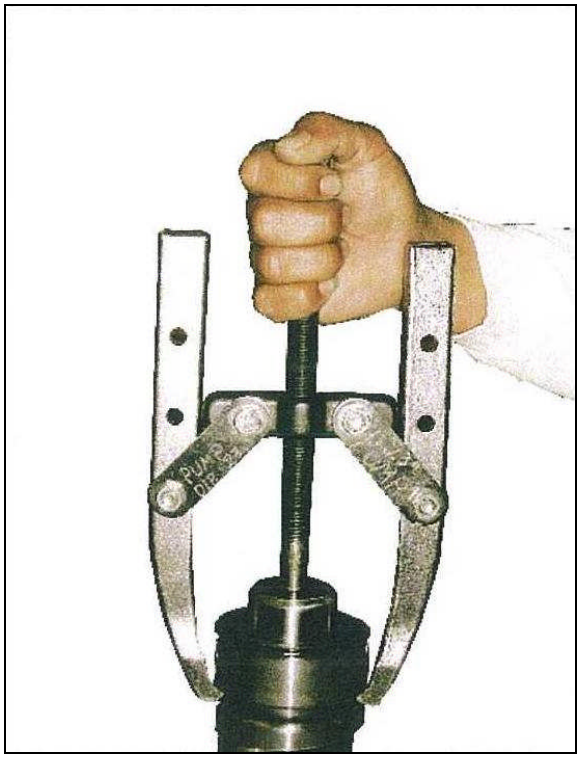


Fig. 9 Removal of the Crankshaft bearing

Slide out the Connecting Rods (10) and the Plunger Rod Assembly (8). Check for abnormal wear or scoring.

***Note: Remember where each connecting rod came out of the crankcase. Keep them in the same order. The connecting Rods and Caps are numbered for this reason. (Lay down connecting rods and caps in order removed. Ensure connecting rods remain in order with caps.)

Remove the Plunger Rod Seal (6). (Do this step only if not already done.)

The Connecting Rod (10) is attached to the Plunger Rod Assembly (8) by a press fit Pin (9). Unless necessary, do not disassemble.

CRANKSHAFT INSTALLATION

You will need these tools and parts to do the following:

- Arbor press for Connecting Rod/Plunger Pin
- Press for Crankshaft removal
- Torque Wrench
- ¼" Allen wrench
- 3/8" 12-point Socket Wrench
- Silicone Grease – PN. 21-1122
- Anti-seize lubricant – PN. 85-0094
- Red Loctite
- Snap Ring Pliers

Press in the Crankshaft Bearing (12) into the right Crankshaft bore of the Crankcase (1). If any wear, rough spinning, or looseness is noted, then use new bearings. (Freezing the bearing may help with the press fit.)

Apply silicone grease onto the O-ring (15) and the Crankshaft Seal (16). Install the Bearing Plate O-ring (15) and Crankshaft Seal (16) into the pulley side Bearing Plate (14).

Apply a light coat of anti-seize to the 4 Socket Head Cap Screws (17). Install the pulley side Bearing Side Pate (14) using the 4 Socket Head Cap Screws (17) with a ¼" Allen wrench

Insert Plunger oil Seal (6) into crankcase. Make sure that the seal is fully seated. (Do this step only if not already done.)

Attach the Connecting Rod (10) and Plunger Rod Assembly (8) using the Press Fit Pin (9). Press the pins in using an arbor press (Freezing the Pins (9) and assembling while cold may help in this process.)

Insert the Connecting Rod (10) and the Plunger Rod Assembly (8) in the Crankcase (1) in the same order as when they were take out. (The connecting rods are numbered 1, 2, 3… Make certain that the order is correct and that the connecting rod caps' number corresponds to the connecting rods' number. The number one Connecting Rod should be closest to the pulley side of the Crankshaft.)

Push the connecting rod assembly in as far as possible away from the Crankshaft (11) insertion path. Make sure the Connecting Rods (10) are clear from the path of the crankshaft.

Slide in the Crankshaft (11), keyed side first, from the right side of the Crankcase (1) to the left side, through the Crankshaft Bearing (12). A press may be needed to accomplish this step. The connecting rod bearing surfaces must exactly align with the plunger bores to avoid bending pressure on the connecting rods.

Press in the left Crankshaft Bearing (38) (closed center hole side).

Apply a light coat of silicone grease to the new Bearing Side Plate O-rings (15).

Apply a light coast of anti-seize to the 4 Socket Head Cap Screws (17). Install the Closed Bearing Side Plate (13) using the 4 Socket Head Cap Screws (17) with a ¼" Allen Wrench.

Apply red loctite to the threads of the Connecting Rod Cap Bolts. Install the Connecting Rod Caps to their corresponding Connecting Rods (10) (There are numbers inscribed on the connecting rods and the connecting rod caps. Make sure that they match up, e.g. 1 and 1, 2 and 2, and 3 and 3.) Pre torque the Connecting Rod Bolts to 100 in. lb. Then torque the Connecting Rod Bolts to **230 in. lb.** with a 3/8" 12-point Socket Wrench

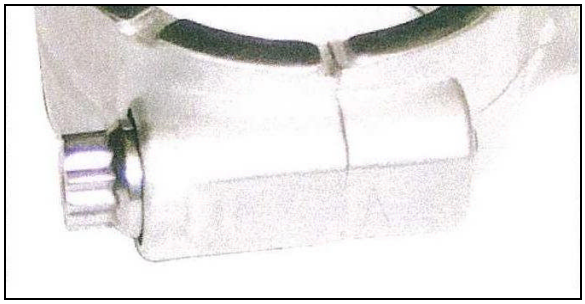


Fig. 10 Correct Connecting Rod Pairing

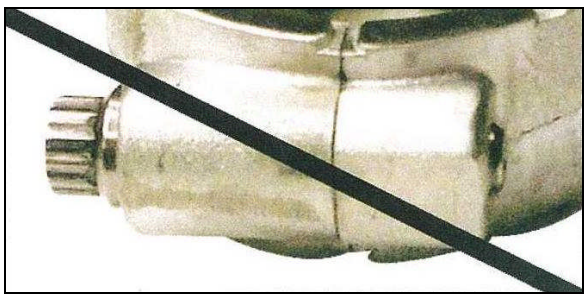


Fig. 11 Incorrect Connecting Rod Pairing

***Make sure the flat sides numbers are matched up together on the Connecting Rods (10) (like figure 10 not figure 11).

SERVICING THE MANIFOLD

The following are the procedures for servicing the manifold assembly using the 5P50 Manifold Rebuild Kit (PN. 70-3075). The manifold assembly must be detached from the crankcase to do the following service.

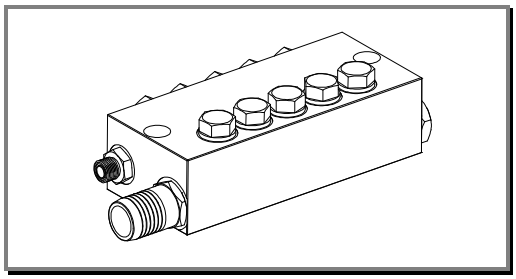


Fig. 12: Manifold Assembly

ADAPTER O-RING REPLACEMENT

You will need these tools and parts to do the following:

- Wrench Hex Jaw
- Pick
- O-Ring, Inlet Plug Adapter (43): PN. 70-3002
- O-Ring, Discharge Plug Adapter (45): PN. 70-3074
- Silicone Grease Lubricant: PN. 21-1122
- Anti-Seize Lubricant: PN. 85-0094

Remove the Inlet/Discharge/Plug, (46), (47), (48), and (49) adapters from the manifold assembly with a hex jaw wrench. With the aid of a pick remove the o-rings (45) and (43) from each of the adapters.

NOTE

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Install the new o-rings, (45) and (43), provided with the kit onto each of the adapters.

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Reinstall each of the adapters onto the manifold assembly, then tighten adapter with hex jaw wrench.

VALVE ASSEMBLY SERVICING

You will need these tools and parts to do the following:

- 1 1/2" Socket Wrench or Combination Wrench
- Pick
- Spring, Valve (42): PN. 70-7049
- Assembly, Valve (41): PN. 70-3004
- O-Ring, Valve Plug (43): PN. 70-3002
- Silicone Grease Lubricant: PN. 21-1122
- Anti-Seize Lubricant: PN. 85-0094
- Lint-Free Cloths

NOTE

Valves may be serviced while the manifold assembly is attached to the crankcase assembly.

If manifold assembly has been removed from the crankcase assembly, place the assembly on a clean work surface. Remove all of the valve plug assemblies from the manifold assembly using a 1 1/2” socket wrench or combination wrench. Remove the valve (41) from the assembly, followed by the valve spring (42). With the aid of a pick remove the o-ring (43) from the valve plug.

NOTE

Valve plugs (44) will be reused.

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Clean and inspect all valve plugs (44) prior to reassembly. Once all valve plugs (44) are clean and dry, install new valve plug o-ring (43) onto valve plug (44). Install the valve spring (42) onto the valve plug (44). Press the valve (41) onto the valve spring (42). Complete valve assembly shown in Fig. 13.

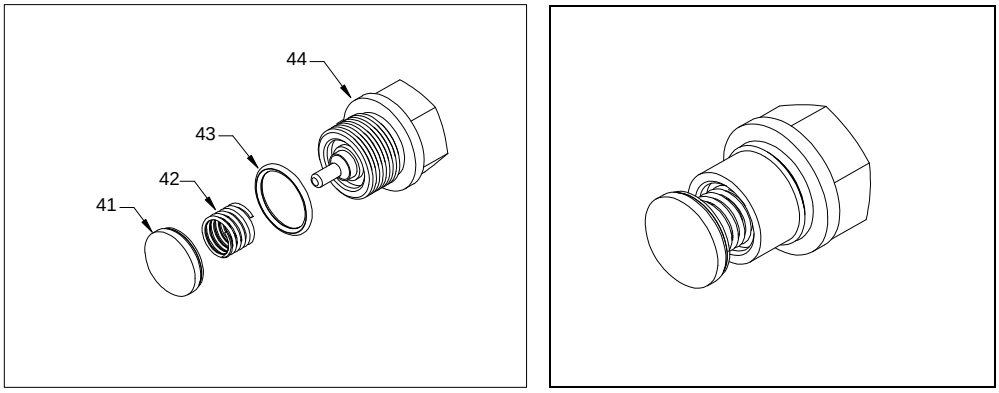


Fig. 13: Valve Assembly

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Inspect the manifold (34) for debris or other fouling and clean if necessary. Inspect the valve seat surface in the manifold. Reinstall all the valve plug assemblies with a 1 1/2" socket wrench or combination wrench and tighten.

MANIFOLD SEAL SERVICING

NOTE

Pump manifold assembly must be detached from the crankcase assembly to service the seals.

You will need these tools and parts to do the following:

- Snap Ring Pliers
- Tool, Seal Insertion: PN. 91-7228
- Flat screw driver
- Seal, HP (36): PN. 70-2502
- Ring, Snap (38): PN. 70-3009
- Ring, Weep (37): PN. 70-3008
- Seal, LP (40): PN. 70-2501
- Silicone Grease Lubricant: PN. 21-1122
- Lint-Free Cloths

Routine seal service is the replacement of the exposed low pressure seal (40) only. The following instructions are for a complete manifold rebuild at the 10,000 hour service mark.

For manifold seal servicing purposes the manifold must be placed with the valve plugs sitting on a flat surface and the plunger bores facing upward. This will facilitate service technician access to the seals for removal and installation, as shown in Fig. 14.

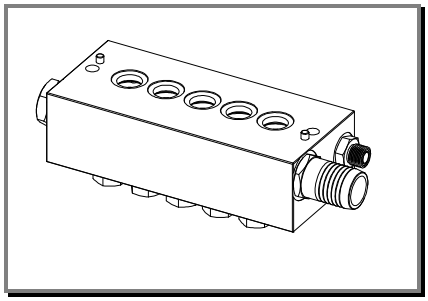


Fig. 14: Orientation for Manifold Seal Servicing

With a flat screw driver remove the low-pressure seal (40). Manually remove the low-pressure seal spacer (39). With the snap ring pliers remove the snap ring (38). Using the weep ring extracting tool, remove the weep ring (37) as shown in Fig. 15.

NOTE

Extraction of the weep rings is accomplished by inserting tool in relaxed state into the inner diameter of the rings, then tightening the expansion bolt to grip the ring.

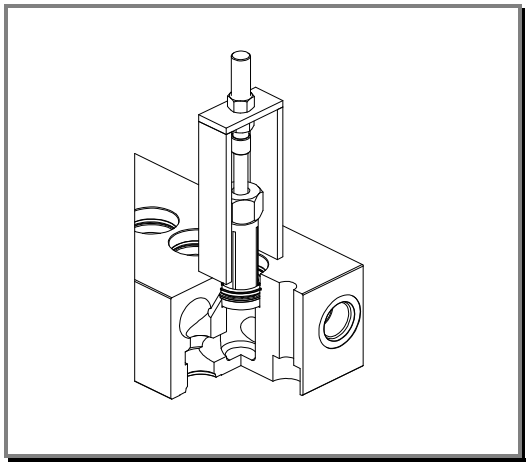


Fig. 15: Weep Ring Extraction

With a flat screwdriver remove the high-pressure seals (36). Manually remove the high-pressure seal spacer (35).

Insert the high-pressure seal spacer (35) into the bore.

NOTE

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Insert the high-pressure seal (36) into the bore until the seal is fully seated on the high-pressure seal spacer (35), using the seal insertion tool. See Fig. 12 for high-pressure seal installation view.

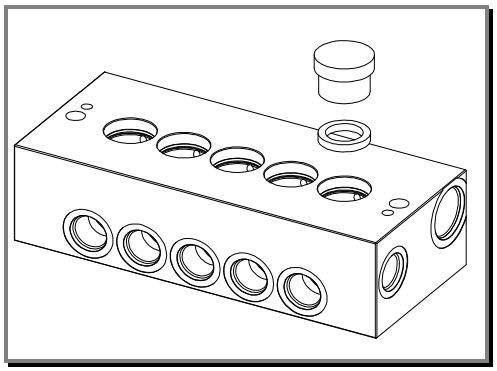


Fig. 16: High-Pressure Seal Installation View

Insert the weep ring (37) into the bore after the installation of the high-pressure seals (36), using the driver from the seal insertion tool. Install the snap ring (38) using the snap ring pliers.

NOTE

Ensure that the snap ring (38) is fully seated in the snap ring groove before continuing.

Insert the low-pressure seal spacer (39), then install the new low-pressure seal (40). The manifold seal servicing is complete.

ATTACHING THE MANIFOLD TO THE CRANKCASE

You will need these tools and parts to do the following:

- 15/16" Socket/ Socket Wrench or Combination Wrench
- Dead Blow Hammer
- Manifold Nut (53): PN. 70-1305
- Ceramic Lubricant: PN. 85-0087
- Anti-Seize Lubricant: PN. 85-0094

If a crankcase seal rebuild was not performed at this time then ensure that the dowel locating pins (50) are pressed into their corresponding hole. Ensure that ceramic lubricant is applied to the ceramic plunger assemblies and that the seal retainers are installed with the flange located away from the crankcase assembly.

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Align manifold assembly to crankcase assembly as shown in Fig. 13 and tighten the two manifold nuts (53) with a 15/16" socket wrench or combination wrench, torque to 90 ft-lbs.

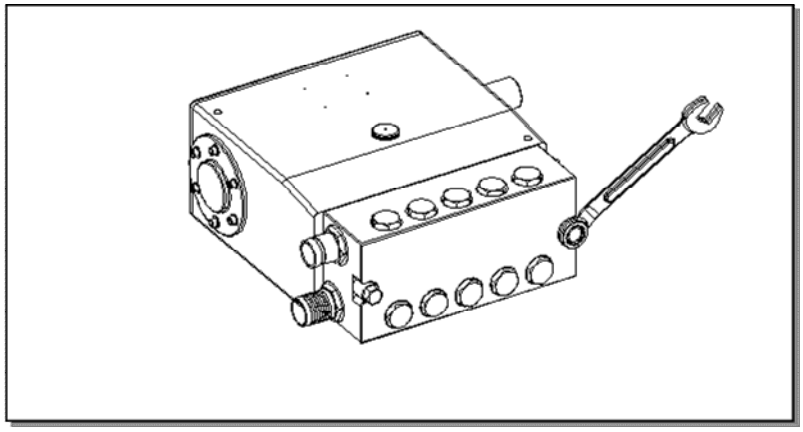


Fig. 17: Pump Assembly Orientation View

OIL CHANGE PROCEDURE

You will need these tools and parts to do the following:

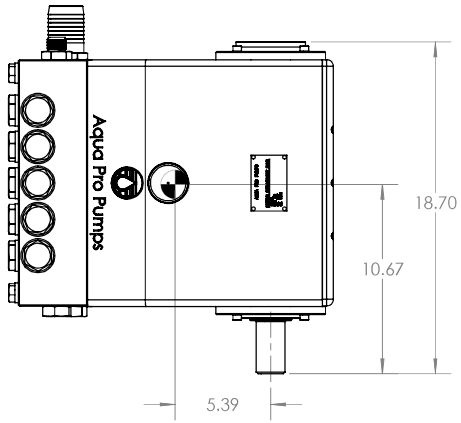
- 1" Socket/ Socket Wrench
- Lint-free Cloths
- Funnel, 4 oz, plastic
- Village Marine High-Pressure Pump Oil, PN. 85-0050

Clean area around the oil filler cap (3) and the oil drain plug. Remove the oil filler cap, and then drain the crankcase oil. Once the used oil is completely drained, slowly add high-pressure pump oil to the level shown on the sight glass. Reinstall oil filler cap (3) and wipe off any excess oil.

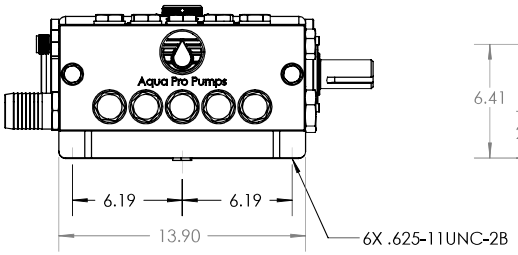
5P50 DRAWINGS

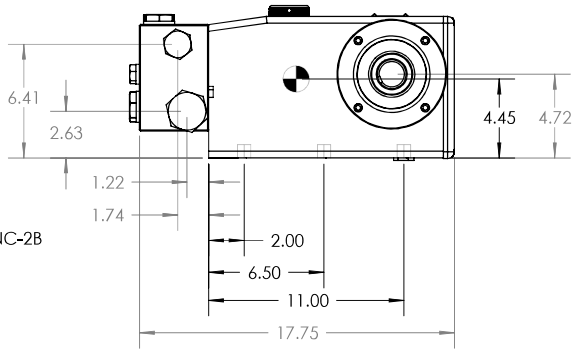
5P50 PUMP SPECIFICATIONS
5P50 CRANKCASE ASSEMBLY
5P50 MANIFOLD ASSEMBLY
5P50 MAIN ASSEMBLY

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
-	INITIAL RELEASE		
A	SHEETS 2 AND 3 HAVE BEEN REVISED	4/21/10	CC
B	SHEET 2 AND 3 HAVE BEEN REVISED	4/23/11	CC



NOTES:
1) WEIGHT OF PUMP: 157 LBS
2) PUMP MANUFACTURER:
   VILLAGE MARINE TEC.
   CAGE CODE: 62144
3) THE PUMP SHALL BE RATED AT 50 GPM(±0.5 GPM) AT A SHAFT SPEED OF 1200 RPM. THE PUMP SHALL WITHSTAND A HYDROSTATIC TEST OF 1800 PSI WITHOUT ANY LEAKAGE, DAMAGE OR LOSS OF FUNCTION. EACH PUMP SHALL BE PERFORMANCE TESTED.
4) THE FLUID PORTS FOR THE PUMP SHALL BE STRAIGHT THREAD BOSSES IAW MS16142. THE INLET SHALL BE SIZED FOR A MS16142-24 IPS AND THE OUTLET SIZED FOR A MS16142-16 IPS. THE DISCHARGE AND SUCTION PLUGS SHALL BE SUPPLIED WITH THE PUMP AND WITH O-RINGS.
5) LABEL PLATE DATA:
   AQUA PRO PUMPS
   2000 W. 135TH ST., GARDENA, CA 90249(CAGE 62144)
   (310)516-9911
   POSITIVE DISPLACEMENT PUMP
   MODEL 5P50
   SER.NO
   OIL CAP 6 QTS(APPROX)
   OIL TYPE(SEE OWNERS MANUAL)
6) PUMP SHAFT ROTATION IS REVERSIBLE





4	3	2	1	SH	REVISION STATUS OF SHEETS
-	B	B	B	REV	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS & TOLERANCING ARE IN INCHES
PER ANSI Y14.5 M & MIL-STD-100

DECIMALS	ANGULAR
.X±.020	± 0°30'
.XX±.010	FRACTIONAL
.XXX±.005	± 1/32

125

MAT'L
WEIGHT LBS
FINISH

DRAWN	DATE
CHECKED	DATE
APPROVED	DATE

Aqua Pro Pumps

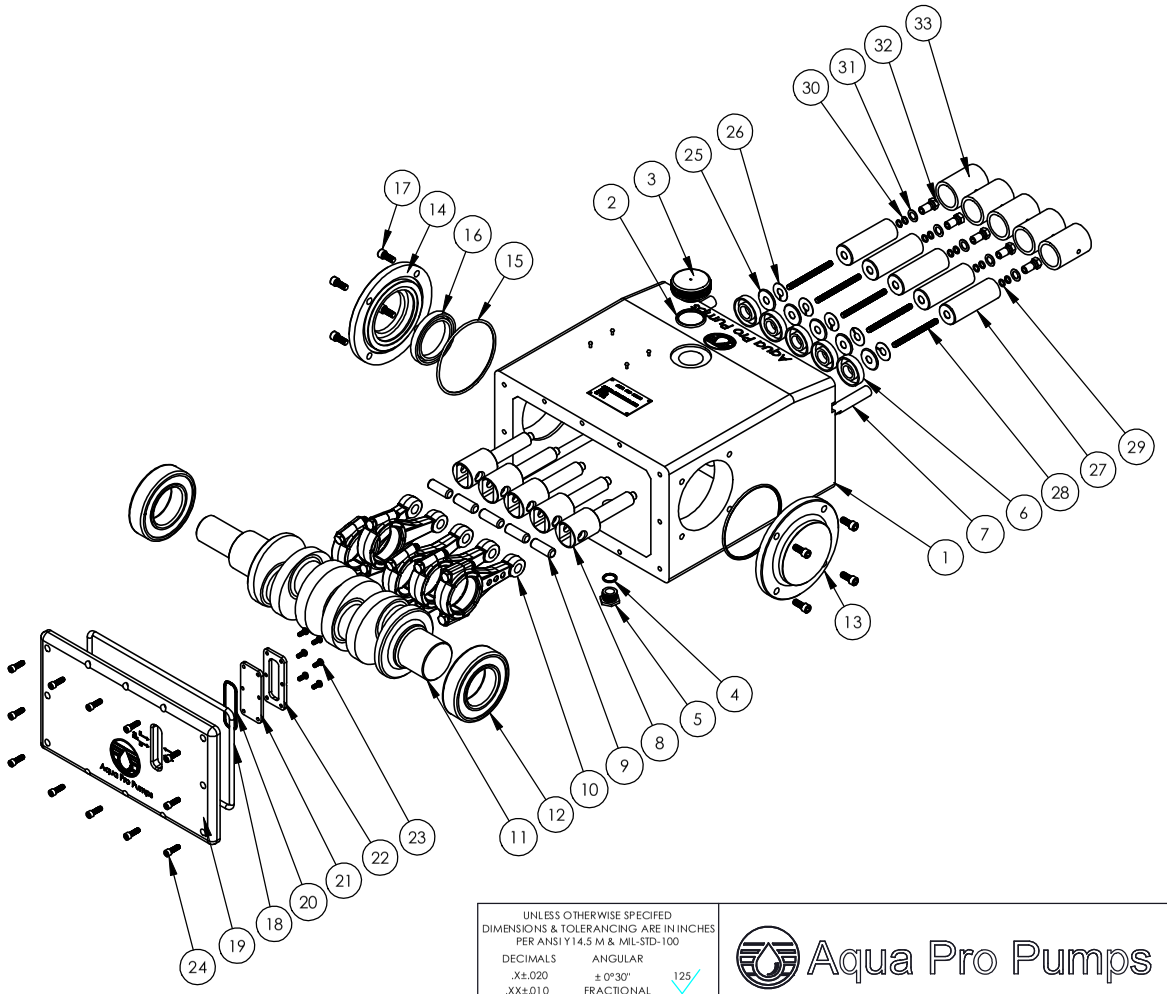
TITLE
ASSEMBLY, 5P50 MAIN

SIZE	DWG NO	REV
B	70-3000	B

SCALE 1:24 SHEET 1 OF 4

NOTES:
1) ASSEMBLY PART NUMBERS ARE AS FOLLOWS:
   70-3073 ASSY, CRANKCASE, 5P50 TITAN SERIES
   70-3078 KIT, SERVICE, CRANKCASE, 5P50
   70-3080 KIT, PUMP SEAL, 5P50
2) THE FOLLOWING PART NUMBERS ARE NOT SHOWN IN DRAWING BUT ARE INLCUDED IN EACH KIT:
   21-1122 SILICON GREASE
   85-0087 CERAMIC LUBRICANT
   85-0094 ANTISIEZE

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
-	INITIAL RELEASE	2/5/2007	BC
A	MODIFIED BOM QTY TITLE	3/17/2010	CC
B	ADDED PUMP SEAL KIT	5/20/2011	CC



ITEM	PART NUMBER	DESCRIPTION	QTY (70-3073)	QTY KIT (70-3078)	QTY KIT (70-3080)
33	70-3012	RETAINER, SEAL	5	-	-
32	70-3016	NUT, PLUNGER RETAINER	5	-	-
31	70-3017	WASHER, PLUNGER RETAINER	5	5	5
30	70-3411	O-RING, PLUNGER	5	5	5
29	70-3019	RING, BACK-UP, SPLIT	5	5	5
28	70-3020	STUD, M7x1.0, 3.40, PLUNGER	5	-	-
27	70-3021	PLUNGER, CERAMIC	5	-	-
26	70-3022	WASHER, KEYHOLE	5	-	-
25	70-3023	SLINGER, PLUNGER	5	-	-
24	86-0151	SCREW, REAR COVER	12	-	-
23	86-0120	SCREW, SIGHT GLASS	6	-	-
22	70-3060	FRAME, SIGHT GLASS	1	-	-
21	70-3039	SIGHTGLASS, OIL, 3P20/5P100	1	-	-
20	70-3040	O-RING, SIGHT GLASS	1	1	-
19	70-3087	COVER, CRANKCASE, TITAN SERIES 5P50	1	-	-
18	70-6101	O-RING, REAR COVER	1	1	-
17	86-0256	SCREW, SIDE CAP	8	-	-
16	70-0701	SEAL, OIL, CRANKSHAFT	1	1	-
15	70-0703	O-RING, BEARING CAP	2	1	-
14	70-3081	CAP,PULLEY BEARING,5P50,AL	1	-	-
13	70-3079	CAP, BEARING, CLOSED	1	-	-
12	70-0439	BEARING,TAPERED ROLLER,4130-STL	2	-	-
11	70-3034	CRANKSHAFT, 5P50	1	-	-
10	70-3098	ASSY, CONNECTING ROD, 5P50	5	-	-
9	70-3027	PIN, DOWEL	5	-	-
8	70-0344M	ASSEMBLY, PLUNGER ROD	5	-	-
7	70-3006	STUD, MANIFOLD RETAINING	2	-	-
6	70-3062	SEAL, OIL, PLUNGER, 3P20/5P50	5	5	5
5	70-3046	PLUG, OIL DRAIN	1	-	-
4	30-1286	O-RING, PLUG, OIL DRAIN	1	1	-
3	70-3044	CAP, OIL FILLER	1	-	-
2	70-6029	O-RING, OIL FILLER CAP	1	1	-
1	70-3082	CRANKCASE, TITAN SERIES 5P50, AL	1	-	-

UNLESS OTHERWISE SPECIFED
DIMENSIONS & TOLERANCING ARE IN INCHES PER ANSI Y14.5 M & MIL-STD-100
DECIMALS .X±.020 .XX±.010 .XXX±.005
ANGULAR ± 0°30'
FRACTIONAL ± 1/32
125

MATL VARIOUS
WEIGHT LBS
FINISH

DRAWN JR DATE 2/5/07
CHECKED BC DATE 4/28/08
APPROVED BC DATE 4/28/08

Aqua Pro Pumps

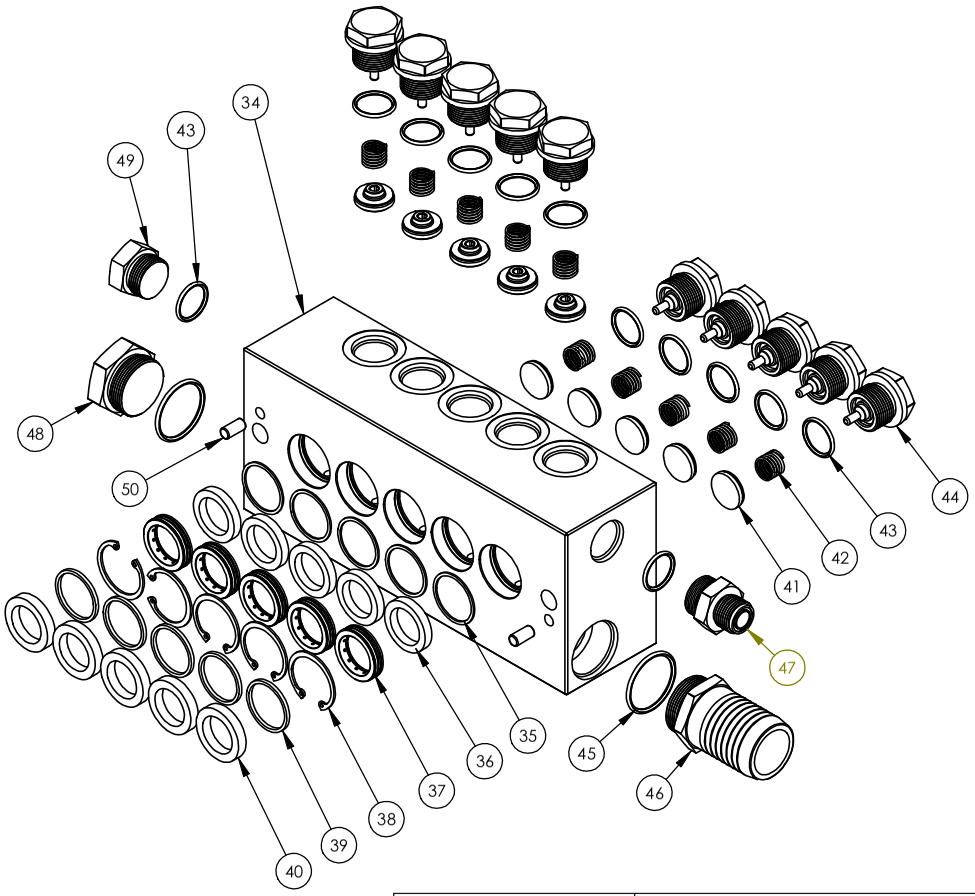
TITLE
ASSEMBLY, 5P50 CRANKCASE

SIZE B | DWG NO 70-3000 | REV B

SCALE 1:8 | SHEET 2 OF 4

NOTES:
1) ASSEMBLY PART NUMBERS ARE AS FOLLOWS:
   70-6120 ASSY, MANIFOLD, 5P50 TITAN SERIES
   70-3075 KIT, REBUILD, MANIFOLD, 5P50
   70-1057 KIT, PUMP VALVE
   70-3080 KIT, PUMP SEAL, 5P50
2) THE FOLLOWING PART NUMBERS ARE NOT SHOWN IN DRAWING BUT ARE INLCUDED IN EACH KIT:
   21-1122 SILICON GREASE
   85-0087 ANTISIEZE
   85-0094 CERAMIC LUBRICANT

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
-	INITIAL RELEASE	-	-
A	MODIFIED BOM QTY TITLE, NOTE INCLUDES ITEMS NOT IN BOM TABLE	3/26/10	CC
B	ADDED PUMP AND SEAL KITS	5/20/11	CC



ITEM	PART NUMBER	DESCRIPTION	QTY (70-6120)	QTY KIT (70-3075)	QTY KIT (70-3080)	QTY KIT (70-1057)
50	70-3050	PIN,DOWEL	2	-	-	-
49	70-3066	PLUG,MS18229-16,TI	1	-	-	-
48	70-3065	PLUG,MS18829-24	1	-	-	-
47	70-3059	ADTR, FACE SEAL	1	-	-	-
46	70-3064	ADTR, 2.0 HB, MS18229-24	1	-	-	-
45	70-3074	O-RING, APTR, HOSE-BARB	2	2	-	-
44	70-3001	PLUG, VALVE, MS18229-16	10	-	-	-
43	70-3002	O-RING, VALVE	12	12	-	-
42	70-7049	SPRING, VALVE, 3P20/5P50, TI	10	10	-	10
41	70-3004	ASSY, VALVE, 3P20/5P50 TITAN SERIES	10	10	-	10
40	70-2501	SEAL, LP,3P20/5P50, XYLAN, BLUE PTFE	5	5	5	-
39	70-3010	SPACER, LOW PRESSURE SEAL	5	5	-	-
38	70-3009	RING, RETAINING,3P20/5P50	5	5	-	-
37	70-3008	ASSEMBLY, WEEP RING,3P20/5P50	5	5	-	-
36	70-2502	SEAL, HIGH PRESSURE	5	5	-	-
35	70-0407	RING, SPACER, HP SEAL	5	5	-	-
34	70-3005	MANIFOLD, TITAN SERIES 5P50	1	-	-	-

UNLESS OTHERWISE SPECIFED
DIMENSIONS & TOLERANCING ARE IN INCHES PER ANSI Y14.5 M & MIL-STD-100
DECIMALS: .X±.020, .XX±.010, .XXX±.005
ANGULAR: ± 0°30'
FRACTIONAL: ± 1/32
125

MATL
WEIGHT LBS
FINISH
DRAWN DATE
CHECKED DATE
APPROVED DATE

Aqua Pro Pumps

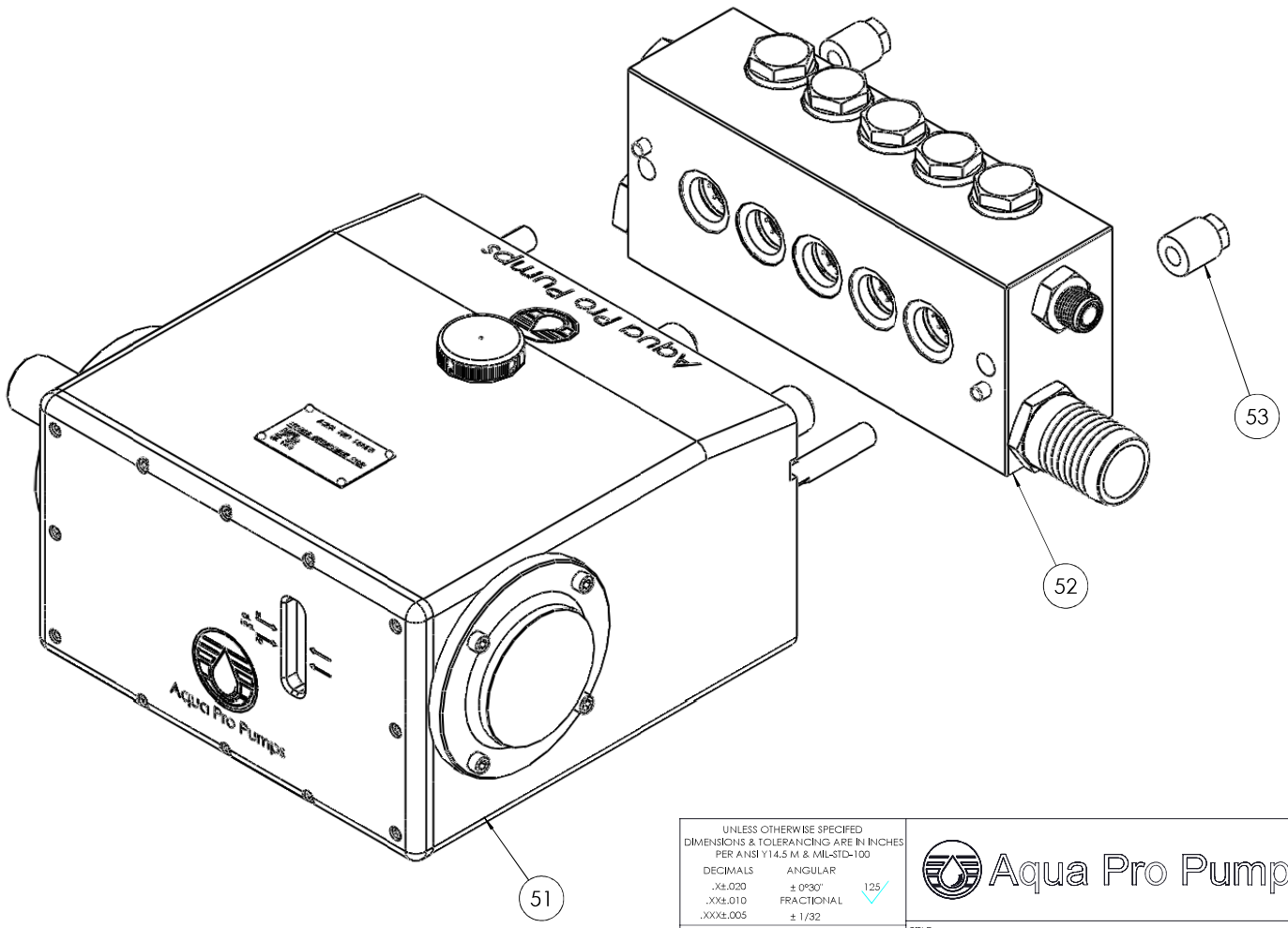
TITLE
ASSEMBLY, 5P50 MANIFOLD

SIZE B | DWG NO 70-3000 | REV B

SCALE 1:1 | SHEET 3 OF 4

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
-	INITIAL RELEASE	-	-

NOTES:
1) ASSEMBLY PART NUMBERS ARE AS FOLLOWS:
70-3000 PUMP, 5P50 TITAN SERIES



ITEM	PART NUMBER	DESCRIPTION	FOR MANUAL/QTY.
53	70-1305	NUT, MANIFOLD	2
52	70-3000	ASSEMBLY, 5P50 MANIFOLD	1
51	70-3073	ASSEMBLY, 5P50 CRANKCASE	1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS & TOLERANCING ARE IN INCHES
PER ANSI Y14.5 M & MIL-STD-100

DECIMALS	ANGULAR
.X±.020	± 0°30'
.XX±.010	FRACTIONAL
.XXX±.005	± 1/32

125

MAT'L
WEIGHT LBS
FINISH

DRAWN	DATE
CHECKED	DATE
APPROVED	DATE

Aqua Pro Pumps

TITLE
ASSEMBLY, 5P50 MAIN

SIZE	DWG NO	REV
B	70-3000	-

SCALE 1:24 SHEET 4 OF 4

Pressure Vessel Assemblies

For Seawater Elements

Contact Information:

Parker Hannifin Corporation
Racor Division/Village Marine Tec.
2000 W. 135th St.
Gardena, CA 90249

phone 310 516 9911
fax 310 538 3048
racor@parker.com
www.villagemarine.com

www.parker.com/racor

Key Features:

Racor Village Marine RO membrane pressure vessels feature non-metallic wetted surfaces for excellent corrosion resistance.
Simple end plug design allows quick removal for element servicing.
If the size you require is not shown please contact us for custom builds.

- Operating Pressure: 1000 psi/68 bar
- Shell: Filament Wound fiberglass
- Collars: 6061 T-6 Powdercoated aluminum
- End Plugs: Thermoplastic
- End Ring:
  6061 T-6 Anodized aluminum on **2.5”** and **4”** size
  SS316 on **6”** size
- Fasteners: SS316

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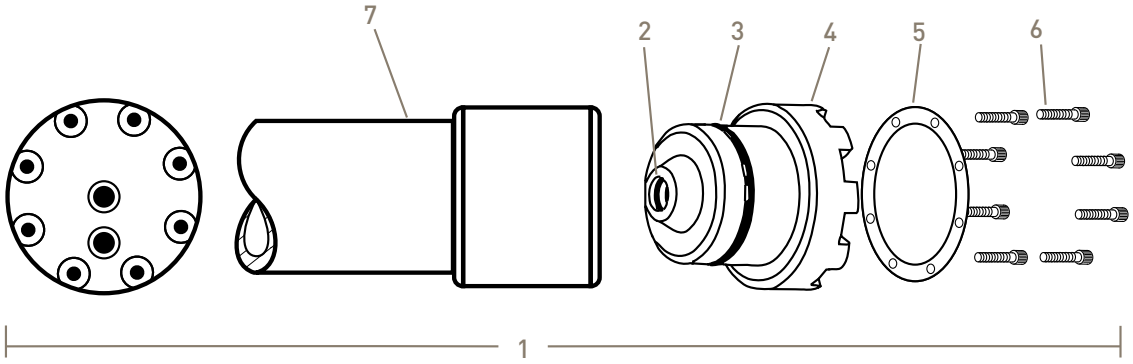
Pressure Vessel Assemblies

For Seawater Elements



Part Numbers:

Item	Description		Quantity per Assembly	2.5" x 19"	2.5" x 38"	4" x 40"	6" x 40"
1	Vessel Assembly**			32-2519	32-2538	32-0444	32-6040
2	Product O-ring		4	32-2116	32-2116	32-2116	32-2229
3	End Plug O-ring		2	32-2228	32-2228	32-4342	32-0640
4	End Plug		2	32-2513*	32-2513*	32-4012	32-6012
5	End Ring		2	32-4013	32-4013	32-4014	32-0096
6	Capscrews		***	86-0106	86-0106	86-0123	86-0136
7	Shell	White	1	32-0025	32-0026	Please Call	Please Call
		Gray	1	32-0098	32-0099	32-4001	32-0001
	Weight (lbs/kg)			5/2	7/3	22/10	45/20

Notes:

*End Plug 32-2517 is also available for 2.5" vessels, which offers straight, coarse thread feed/reject port used on some VMT PW watermakers

**Membrane not included. For applicable membrane elements see bulletin No. 7897 (Aqua Pro RO Membranes)

*** Capscrews:
Order 6 per end plug on 2.5" size
Order 8 per end plug on 4" size
Order 10 per en plug on 6" size

Print Reorder Number 7898 Rev- 10-15-2009

Parker Racor

ENGINEERING YOUR SUCCESS.

Aqua Pro® Sea Water RO Membranes

Contact Information:

Parker Hannifin Corporation
Racor Division/Village Marine Tec.
2000 W. 135th St.
Gardena, CA 90249

phone 310 516 9911
fax 310 538 3048
racor@parker.com
www.villagemarine.com

www.parker.com/racor

Key Feature:

Aqua Pro® thin film composite membranes deliver high salt rejection while maintaining high production rates to obtain the energy efficiency demanded by plant operators.

By selecting the highest grade of materials and thoroughly testing performance, Racor Village Marine is able to offer the highest quality Aqua Pro® products.

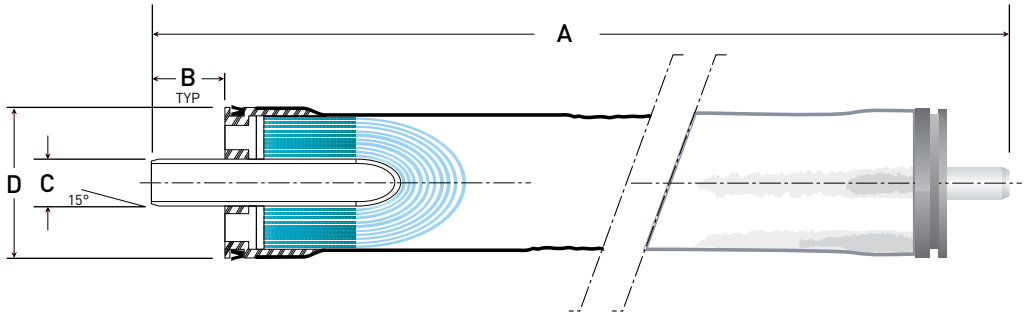
Parker Racor

ENGINEERING YOUR SUCCESS.

Aqua Pro®
Sea Water RO
Membranes

Recommended
Operating Limits:

- Maximum Operating Pressure: **1000 psi**
- Maximum Operating Temperature: **113°F (45°C)**
- Maximum Feed Turbidity: **1 NTU**
- Free Chlorine Tolerance: **0 PPM**
- Maximum Feed Silt Density Index: **SDI 5**
- pH Range:
  Continuous Operation: 4-11
  Short-term (30 min)
  Cleaning: 2.5-11



VMT Part No.	Nominal Size	Product Flow GPD m³/day	Typical Salt Rejection %	Dimensions inches/cm			
				A	B	C	D
33-2519	2519	220 - 0.83	99.4	19/48	1.1/2.8	0.75/1.9	2.4/6.1
33-0238	2538	550 - 2.08	99.4	38/96.5	1.1/2.8	0.75/1.9	2.4/6.1
33-0440	4040	1200 - 4.54	99.4	40/101.6	1.0/2.5	0.75/1.9	3.96/10.1
33-0036	6040	2500 - 9.47	99.4	40/101.6	1.27/3.2	1.5/3.8	5.98/15.2

Notes:

- Keep elements moist at all times
- Permeate obtained from first two hours of operation should be discarded
- To prevent biological growth during storage, shipping, or system shutdowns it is recommended that elements be immersed in a protective solution. The standard storage solution for long or short term storage should contain 1.0 percent (by weight) sodium metabisulfite (food grade)
- Standarized test conditions are 32,000 ppm NaCl at 77° F (25° C), with 800 psi feed. Production rates for individual elements may vary +/- 20% and rejection may vary +/- 0.4%

Print Reorder Number 7897 Rev- 10-27-2009

Parker Racor

ENGINEERING YOUR SUCCESS.

Filter Housings

FRP Shell with Nylon Caps
100X-FRP

Racor Village Marine offers fiberglass filter housings specifically designed for seawater use. Simple but secure closure systems allow quick cartridge change. Aluminum collars are bonded to fiberglass shells offer superior corrosion resistance. The base and lid are nylon.

The housings fit VMT pleated cartridge elements of 100 square feet area. Available in 0.5, 1, 5, 20, and 100 micron ratings.

Contact Information:

Parker Hannifin Corporation
Racor Division/Village Marine Tec.
2000 W. 135th St.
Gardena, CA 90249

phone: 310 516-9911
800 C-Parker
fax: 310 538-3048
email: racor@parker.com
www.villagemarine.com

www.parker.com/racor

Parker | Racor

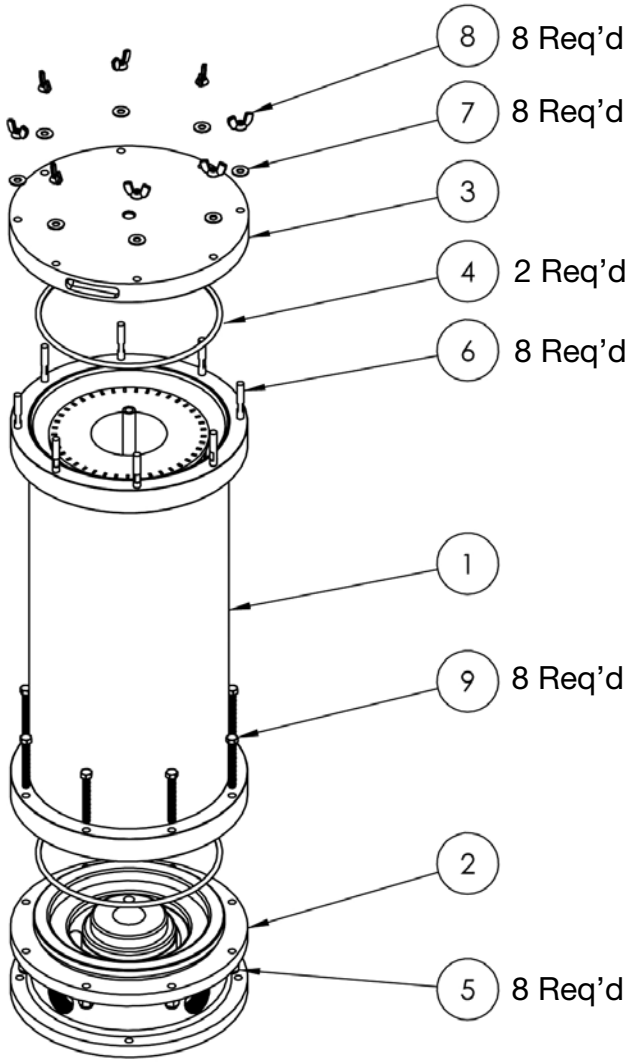
ENGINEERING YOUR SUCCESS.

Filter Housings

FRP Shell with Nylon Caps

100X-FRP

DWG	Description	Part Number
	Filter Assembly	30-4353
1	Vessel Shell	M4353-4
2	Base	M1157-1
3	Lid	M4353-2
4	O-Ring	30-0405
5	Nuts - Bottom	86-0022
6	Studs	86-0264
7	Washer	86-0006
8	Wingnut	86-0269
9	Bolt - Bottom	86-0260



Specifications	
Design Pressure*	80 psi
Test Pressure	120 psi
Inlet	1.5" FPT
Outlet	1.5" FPT
Height	33"/84 cm
Diameter	13"/33 cm

*Filter Housing Vessel is designed in accordance with ASME section x pressure vessel code.

To maintain peak performance always use genuine Parker Racor Village Marine replacement parts.
We reserve the right to change our specifications or standards without notice.

Print Reorder Number **7940** Rev-B 09-26-2011

Parker Racor

ENGINEERING YOUR SUCCESS.

Pleated Filters and Filter Cartridge Kits

Contact Information:

Parker Hannifin Corporation
Racor Division/Village Marine Tec.
2000 W. 135th St.
Gardena, CA 90249

phone: 310 516-9911
800 C-Parker
fax: 310 538-3048
email: racor@parker.com
www.villagemarine.com

www.parker.com/racor

The Village Marine Tec. line of pleated filters are designed specifically for the RO watermaker industry and are superior to wound or polyspun cartridges to give you a longer filter life as well as increasing flow rates and keeping cartridge size down.

Available in a wide arrange of sizes and micron ranges to ensure that every type of watermaker filter need is taken care of. Stock sizes fit most standard filter housings, if the size you need is not shown please contact us with the dimensions required.

Single use Cleaning and Preservative Cartridge Kits are designed specifically for small RO Systems. The Cartridges allow for easy and effective membrane maintenance.

The Cleaning and Preservative Cartridge Kits eliminate the trouble and mess of measuring powdered chemicals and ensuring correct chemical concentrations. The Chemical cartridges fit directly into 2.5" x 10" or 4.5" x 10" housings and contain the correct amount of chemical for a single use.

Parker Racor

ENGINEERING YOUR SUCCESS.

Pleated Filters and Filter Cartridge Kits

Features:

Pleated Filters

- Polypropylene pleated construction
- Longer service life over wound or polyspun cartridges
- Easily cleaned and reused
- Chemically compatible with a wide range of alkalies, most acids and saline solutions
- 0.5, 1, 5, and 20 micron nominal ratings available
- Pliable ends ensures filter seal to eliminate bypass
- High packing density reduces filter size while keeping flow rates up

Filter Cartridge Kits

- Cartridge with Blue stripe contains cleaner #1, a biological cleaner to remove algae, fungi and bacteria
- Cartridge with Red stripe contains cleaner #2, an acidic cleaner to remove scale from the membrane
- Cartridge with Green stripe contains the preservative. This chemical is used for pickling the membranes
- Cartridges are capable of being used in any housing that takes a standard 2.5" (64mm) x 10" (254mm) filter cartridges

Pleated Sediment Elements

Part Number	Microns	Filter Area ft^3/m^3	Diameter inch/cm	Length inch/cm
33-0118	20		2.75/7	9.75/25
33-0117	5		2.75/7	9.75/25
33-0053	20		4.5/11.4	9.75/25
33-0052	5		4.5/11.4	9.75/25
33-0020	20	30/2.79	8.63/22	7.75/20
33-0005	5	30/2.79	8.63/22	7.75/20
33-0058	20		4.5/11.4	20/51
33-0057	5		4.5/11.4	20/51
33-0172	100	100/9.29	8.63/22	24.3/62
33-2100	20	100/9.29	8.63/22	24.3/62
33-5100	5	100/9.29	8.63/22	24.3/62
33-1100	1	100/9.29	8.63/22	24.3/62
33-1105	0.5	100/9.29	8.63/22	24.3/62

Carbon Flushing Filters

Part Number	Diameter inch/cm	Length inch/cm
33-0311	2.75/7	9.75/25
33-0315	4.5/11.4	9.75/25
33-0083	4.5/11.4	20/50.8

Cartridge Filter Kits

Description	Part Number	Contents
Cleaning Kit	85-0102	One Blue stripe cleaner #1 plus One Red stripe cleaner #2
Preservation Kit	85-0103	Two Green stripe preservative

To maintain peak performance always use genuine Parker-Racor/Village Marine Tec. replacement parts.
We reserve the right to change our specifications or standards without notice.

Print Reorder Number 7905 Rev- 11-23-2009

Parker Racor

ENGINEERING YOUR SUCCESS.