

# Seafari Mini 170-350

## SYSTEM MANUAL



### Horizon Reverse Osmosis

P.O. Box 5463  
Carson, California 90745 U.S.A.  
Telephone: 1 (310) 631-6300  
Facsimile: 1 (310) 631-6395  
[www.hrosystems.com](http://www.hrosystems.com)

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## INTRODUCTION

Thank you for purchasing an HRO Systems Seafari 170 Reverse Osmosis Desalination System. Please read this manual carefully before attempting installation or operation. A better understanding of the system ensures optimum performance and longer service life from the system.

HRO Systems' reverse osmosis desalination systems are designed and engineered to function as a complete working unit. Generally speaking, the performance of each component within the unit is dependent on the component prior to it and governs the performance of all components after it. Proper performance of the system is thus dependent upon proper operation of every single component within the system.

The intent of this manual is to allow the operator to become familiar with each component within the Seafari 170 system. By understanding the function, importance, and normal operation of each component within each subsystem of the unit, the operator can readily diagnose minor problems. Such problems, when they first develop, usually require minor maintenance and are easily corrected. However, left unattended, a problem in one component affects the rest of the system and leads to further required repairs.

# HROSystems

## SYSTEM IDENTIFICATION INFORMATION

INSTRUCTIONS: Please complete the following information at the time of purchase of the Seafari 170 R.O. Desalinator. This information will be requested to provide better service by the Service Department whenever contacting HRO Systems for technical assistance or by the Sales Department whenever ordering parts.

### System Information:

Model Number: \_\_\_\_\_ Serial Number: \_\_\_\_\_

### Operating Voltage:

Direct Current:

\_\_\_ 12 VDC

\_\_\_ 24 VDC

Alternating Current:

\_\_\_ 110/115 VAC

\_\_\_ 220/230 VAC

Date Purchased: \_\_\_\_\_

Date Commissioned: \_\_\_\_\_  
(first tested or operated)

### Dealer Information:

Dealer's Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_

State: \_\_\_\_\_

Country: \_\_\_\_\_

Postal Code: \_\_\_\_\_

Dealer's Invoice Number: \_\_\_\_\_

## HROSystems

P.O. BOX 5463, CARSON, CALIFORNIA 90745-5463

U.S.A.

TELEPHONE 1-310-631-6300 FACSIMILE 1-310-631-6395

World Wide Web Site <http://www.searecovery.com>

e-mail [hrosystems@hrosystems.com](mailto:hrosystems@hrosystems.com)

# HROSystems

## WARRANTY REGISTRATION INFORMATION

**INSTRUCTIONS:** At the time of purchase of the Seafari 170 R.O. Desalinator, please complete the warranty information listed below. After completing this form please mail it, in the provided envelope, to HRO Systems Attn: Warranty Registration.

**System Information:**

Model Number: \_\_\_\_\_ Serial Number: \_\_\_\_\_

Date Purchased: \_\_\_\_\_

Date Commissioned: \_\_\_\_\_

**Dealer Information:**

Dealer's Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_

Country: \_\_\_\_\_ Postal Code: \_\_\_\_\_

Dealer's Invoice Number: \_\_\_\_\_

**Customer Information:**

Customer Name: \_\_\_\_\_

Street Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_

Country: \_\_\_\_\_ Postal Code: \_\_\_\_\_

Mail a copy to:

**HROSystems**

P.O. BOX 5463

CARSON, CALIFORNIA 90745-5463 U.S.A.

Attn: Warranty Registration

or visit our World Wide Web Site at <http://www.hrosystems.com>

and e-mail the Warranty Registration Information to us at

[hrosystems@hrosystems.com](mailto:hrosystems@hrosystems.com)

## HRO Systems Seafari 170 LIMITED WARRANTY

HRO Systems warrants that the Seafari 170 Desalination System performs according to specifications for a period of twelve (12) months and specifically listed separate components are warranted by HRO Systems for up to 5 years from the date of shipment. HRO Systems' liability under this warranty is limited to repair or replacement of the Seafari 170 Desalination System at HRO Systems' discretion. Under no circumstances is HRO Systems liable for consequential damages arising out of or in any way connected with the failure of the system to perform as set forth herein. This limited warranty is in lieu of all other expressed or implied warranties, including those of merchantability and fitness for a particular purpose.

Warranty Period from date of original shipment from HRO Systems:

- |   |                  |
|---|------------------|
| 1. System and accessories:                                      | 1 (one) year     |
| 2. Reverse Osmosis High Pressure Vessel:                        | 5 (five) years   |
| 3. High Pressure Pump stainless steel manifold and crankcase:   | 5 (five) years   |
| 4. Repairs made after the original warranty period has expired: | 3 (three) months |

Normal reoccurring user maintenance listed below is not covered by this or any HRO Systems limited warranty.

- |                              |                                 |
|------------------------------|---------------------------------|
| 1. Sea Strainer Element      | 6. Pump Valve Assemblies        |
| 2. Cartridge Filter Elements | 7. Pump Crankcase Oil           |
| 3. Fuses                     | 8. Gauge Instrument Calibration |
| 4. Pump Packing Assemblies   | 9. Valve Seals and Packings     |
| 5. Pump Seal Assemblies      | 10. Exterior Corrosion          |

Installation Components not supplied by HRO Systems are not covered by this or any HRO Systems limited warranty.

Improper Installation resulting in the Seafari 170 system or HRO Systems component failure or decline in performance is not covered by this or any HRO Systems limited warranty.

The Seafari 170 Reverse Osmosis Membrane Element is guaranteed to be cleanable for a minimum of one year from date of shipment, providing cleaning periods are adhered to, and foulant is acid soluble metal hydroxides and calcium carbonates or alkaline soluble organic, inorganic substances and microbiological slimes. The Seafari 170 Membrane Element is not guaranteed against iron fouling (rust), chemical or petroleum products attack, extreme temperatures (over 120° F/under 32° F), drying out, or extreme pressures (over 1000 psig).

In the event of a defect, a malfunction, or failure, specifically covered by this warranty and during the warranty period, HRO Systems will repair or replace, at its option, the product or component therein which upon examination by HRO Systems appears to be defective.

To obtain warranty service, the defective product or part must be returned to an authorized HRO Systems Factory Service Center or direct to HRO Systems. The purchaser must pay any transportation or labor expenses incurred in removing and returning the product to the service center or to HRO Systems.

The limited warranty does not extend to any system or system component which has been subjected to alteration, misuse, neglect, accident, improper installation, inadequate or improper repair or maintenance or subject to use in violation of instructions furnished by HRO Systems, nor does the warranty extend to components on which the serial number has been removed, defaced, or changed.

HRO Systems reserves the right to make changes or improvements in its product, during subsequent production, without incurring the obligation to install such changes or improvements on previously manufactured equipment.

The implied warranties, which the law imposes on the sale of this product, are expressly LIMITED in duration to the time period above. HRO Systems shall not be liable for damages, consequential or otherwise, resulting from the use and operation of this product, or from the breach of this LIMITED WARRANTY.

**CAUTION:** Use of non HRO Systems supplied parts and accessories, including but not limited to, maintenance parts, pre-filter elements, cleaning and storage chemical, pump oil, spare parts, replacement parts, system components, installation components and or system accessories, shall void all warranty expressed or implied.

P.O. BOX 5463  
CARSON, CALIFORNIA 90745-5463 U.S.A.

TELEPHONE 1-310-637-3400 • FACSIMILE 1-310-637-3430

## SPECIFICATIONS

### PERFORMANCE:

#### PRODUCT WATER PRODUCED PER 24 HOURS OF OPERATION:

(+/-15% at 850 psig / 56 BAR, 77°F / 25°C & 35,000 ppm TDS Feed Water Salinity )

**Model Number**  
HRO Seafari 170

**Production per 24 hours of operation:**  
170 U.S. Gallons / 644 liters

#### PRODUCT WATER PRODUCED PER HOUR OF OPERATION:

(+/-15% at 850 psi / 56.5 bar, 77°F / 25°C & 35,000 ppm TDS Feed Water Salinity)

**Model Number**  
HRO Seafari 170

**Production per 1 hour of operation:**  
7 U.S. Gallons / 26 liters

**SALT REJECTION (CHLORIDE ION):** Minimum 99.2 %, Average 99.4%

**PRODUCT WATER TEMPERATURE:** Ambient to feed water temperature

### SPECIFICATIONS:

**SALINITY MONITORING:** Automatic computer controlled electronic monitoring. Temperature compensated with the Water Quality Indicator. The salinity monitoring components of the system give a continuous readout in micromhos per cubic centimeter, are temperature compensated and of a fail-safe design.

#### SALINITY RANGE OF FEED WATER:

Seawater up to 50,000 ppm TDS (NaCl) (typical seawater salinity is 35,000 ppm)

**TEMPERATURE RANGE:** Max. 122°F / 50°C, Min. 33°F / .5°C

### SYSTEM FEED WATER:

<b>Model Number</b>	<b>Power Source Cycles (Hz)</b>	<b>Feed Water Flow Per Minute:</b>
HRO SF 170	DC & AC (60Hz)	0.50 U.S. Gallons / 1.86 liters
HRO SF 170	AC (50Hz)	0.42 U.S. Gallons / 1.56 liters

### REVERSE OSMOSIS MEMBRANE:

**TYPE:** Specifically selected High Rejection / High Yield aromatic tri-polyamid, thin film composite, spiral wound, single pass reverse osmosis membrane element.

**CHLORINE TOLERANCE:** 0.1 PPM.

**pH RANGE:** 3-11 (typical seawater pH is 8)

**SYSTEM PRESSURE:**

**FEED WATER:** Minimum 2 psi / .41 bar / .42 Kg/cm<sup>2</sup>. Maximum 30 psi / 2.41 bar / 2.46 Kg/cm<sup>2</sup>

**OPERATION:** Seawater @ 35,000 ppm & 77° F / 25 C: nominal 850 psi / 56.5 bar / 57.66 Kg/cm<sup>2</sup>.

**DIMENSIONS & WEIGHT:**

MODEL	WEIGHT	LENGTH	WIDTH	HEIGHT
HRO SF 170	70 lbs / 32 kg	16.75 in/ 43 cm	13.25 in/34 cm	10.00 in/25 cm

**EXTERNAL INSTALLATION WATER CONNECTIONS:** Pipe sizes to be supplied by the installer for connection of the Sea Recovery supplied components

Feed Inlet:	3/8" TUBE	(Parker Fast& Tite Fittings)
Brine Discharge	3/8" TUBE	(Parker Fast& Tite Fittings).
Product	1/4" TUBE	(Parker Fast& Tite Fittings)

**ELECTRICAL MOTOR SPECIFICATIONS:**

(H.P. = Horse Power; FLA = Full Load Amperes; LRA = Locked Rotor Amperes @ Start Up)

**ALTERNATING CURRENT SYSTEMS:**

H.P.				H.P.			
VAC	50 Hz	FLA	LRA	VAC	60 Hz	FLA	LRA
110	1/3	6	26	115	1/3	6	26
220	1/3	3	13	230	1/3	3	13

**BOOSTER PUMP MOTOR:**

1/8 horse power

Hz	VAC	FLA	LRA
50/60	115	4.4	20.2
50/60	220	2.2	10

**DIRECT CURRENT SYSTEMS:**

High Pressure Motor			Booster Pump Motor		
VDC	H.P.	FLA	VDC	H.P.	FLA
12	1/3	29	12	1/8	2.5
24	1/3	14	24	1/8	1.8

**RECOMMENDED CIRCUIT BREAKER:**

Operating Voltage	Recommended Circuit Breaker Size
12 VDC	40 Amperes
24 VDC	20 Amperes
115 VAC	10 Amperes
230 VAC	5 – 7.5 Amperes

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## **CHAPTER 1**

### **Introduction**

# 1. Introduction

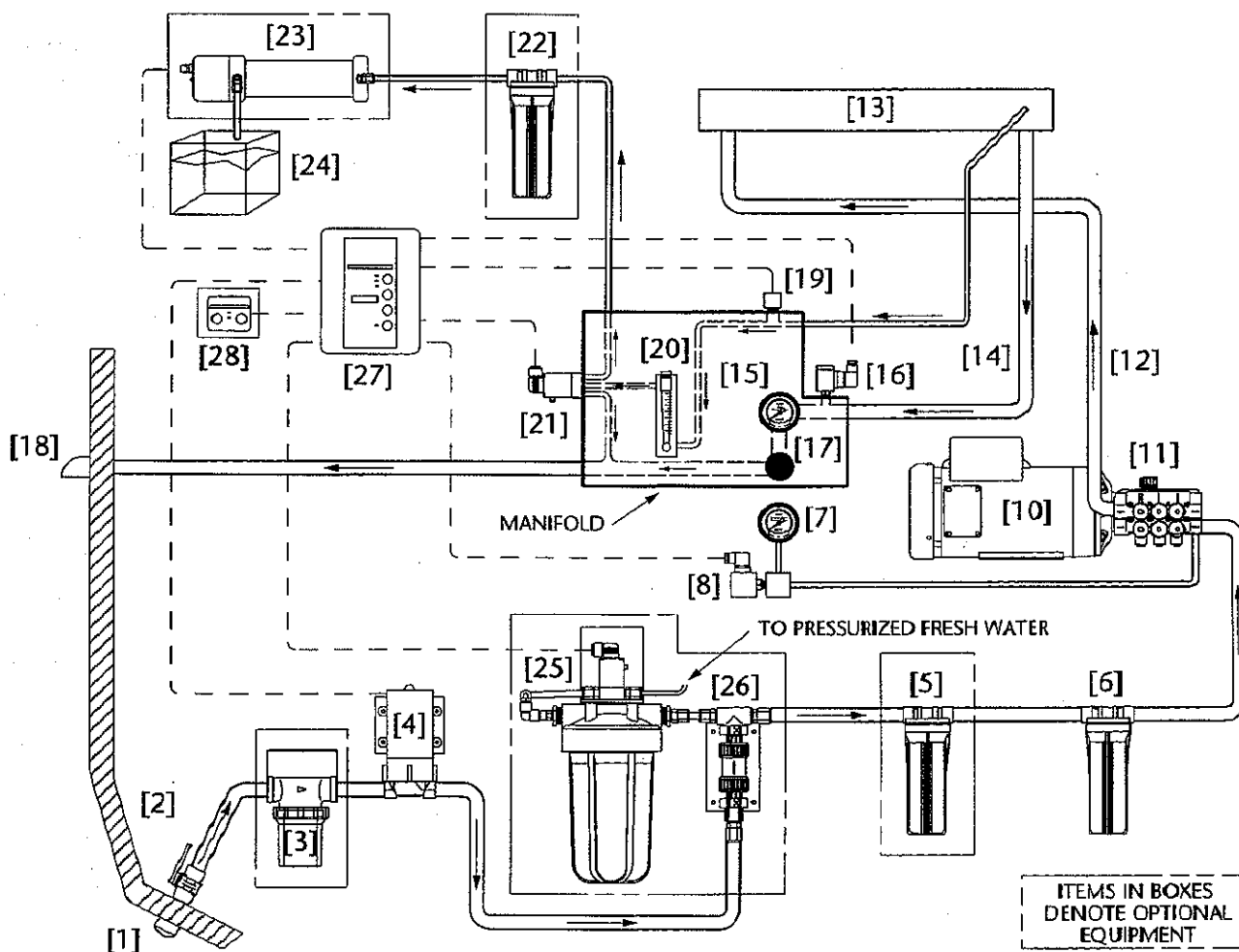
## COMPONENT DESCRIPTIONS

All components supplied by HRO, both standard and optional, are described in this section along with items required or desired by the installer. The location, operation, and purpose of each major component is briefly explained in this section. The descriptions in this chapter are listed according to the ID numbers each component is given in the System Piping and Interconnect Diagram below. Throughout this manual, components are followed by a number in brackets i.e., "Sea Strainer [3]", which refers to the component's location in the illustration below.

\*\* Denotes items supplied by installer

\*\*\* Denotes optional equipment.

### Seafari 170 U.S. GPD Reverse Osmosis Desalination System



### **A. PREFILTRATION SUBSYSTEM:**

This section of the system filters and delivers the Feed Water into the System. The raw feed water is filtered to remove suspended solids larger than 5 Micron size (5/1,000,000 of a meter). The pre-filtration protects the HRO Systems Membrane Element from undue fouling.

1. **Inlet Thru Hull Fitting with Forward Facing Scoop \*\*** is the point at which the feed water enters the system.
2. **Sea Cock Valve \*\*** is used in a ship installation for safety reasons to close the feed water line during nonuse of the Seafari 170 System.
3. **Sea Strainer \*\*\*** has a clear bowl with nylon body filter housing or optional bronze body containing a cleanable monel fine mesh filter screen. The Sea Strainer filters out large particulate matter and suspended particles that would otherwise damage the Booster Pump.
4. **Booster Pump** supplies a positive pressure to the Pre-filters, and through to the High Pressure Pump. The Seafari 170 utilizes a pump with a performance curve of 70 Ft Head (30 psi) at 1.0 GPM. The resulting pressure at the High Pressure Pump depends on the final configuration.
5. **Plankton Filter \*\*\*** This filter assembly contains a cleanable ultra fine monel mesh screen. The mesh screen removes suspended solids or biological growth such as plankton and provides longer life to the Pre-filter Elements and in turn provide lower system maintenance costs.
6. **Pre-Filter** This filter removes suspended solids 5 Microns and larger to protect the Reverse Osmosis Membrane from fouling.
7. **Low Pressure Gauge** displays the Inlet Pressure to the High Pressure Pump. The gauge assists the operator in diagnosing the Sea Strainer, Booster Pump, Plankton Filter Element, and Pre Filter Element.
8. **Low Pressure Switch** shuts the System off automatically when a plugged filter element or other condition causes a low flow situation. This protects the High Pressure Pump, the R.O. Membrane Element and the Booster Pump from damage.

### **B. PRESSURIZATION SUBSYSTEM:**

Proper pressure and proper flow across the Membrane Element are two basic requirements of Reverse Osmosis. Refer to Chapter 8 for Salinity and Temperature adjustments.

9. **Future Reference**
  10. **High Pressure Pump Motor** is a heavy-duty washdown motor, which is direct coupled to the High Pressure Pump.
  11. **High Pressure Pump** is a marine quality, positive displacement, ceramic plunger pump. The High Pressure Pump lasts for years with proper use and maintenance.
  12. **High Pressure Hose, HP Pump Outlet MVA Inlet,** transfers pressurized Sea Water from the High Pressure Pump to the inlet of the R.O. Membrane Element.
  13. **R.O. Membrane Element & Vessel** The Membrane Element allows potable water molecules to pass through while rejecting the salt ions. Only about 10% of the Seawater Feed becomes fresh Product Water. The remainder carries the rejected salt ions out of the R.O. Membrane Element in a concentrated brine stream.
- ### **C. BRINE DISCHARGE SUBSYSTEM:**
- This section of the System carries the Brine Discharge exiting from the R.O. Membrane Element.
14. **High Pressure Hose, MVA Outlet to Manifold,** transfers pressurized Sea Water from the Membrane Vessel Assembly to the Control Manifold Assembly.
  15. **High Pressure Gauge** displays the R.O. Membrane Vessel outlet pressure
  16. **High Pressure Switch** is used to automatically turn the System off in case of over-pressurization during operation.
  17. **Back Pressure Regulator** By turning the valve adjustment handle clockwise and counterclockwise pressure is increased and decreased accordingly. This increases and decreases the production of the R.O. Membrane Element.

18. **Thru Hull Discharge Fitting** \*\* should be installed above water level for discharge of the Brine Discharge Water from the System.

#### **D. PRODUCT WATER SUBSYSTEM:**

This section of the System gives a visual indication of the clarity, quantity, and quality of the product water. Post Filtration is the final step in Product Water quality control. The Post Filtration Subsystem is designed to limit unpleasant odor, taste, and biological matter, which may have passed through the R.O. Membrane Element.

19. **Temperature Compensated Salinity Probe** electrically determines whether the salinity content of the Product Water is acceptable. This Salinity Probe is temperature compensated and provides an accurate measurement of Product Water quality.
20. **Flow Meter, Product Water** The flow-through meter measures the rate of Product Water flow from the R.O. Membrane Element toward the Product Water Post Filtration Components.
21. **3-Way Electric Product Diversion Valve** the Controller energizes this valve to the "Potable" position when the system produces water, which meets or exceeds the salinity requirement. If the Product Water being produced is "Un-potable" then no signal is sent to the valve and it thus remains in the normally open position. The "fail safe" normally open position diverts the un-potable Product Water to discharge.
22. **Charcoal Filter** \*\*\* is designed to remove foul odors from the Product Water.
23. **Ultra Violet Sterilizer**\*\*\* destroys at least 99.9% of any virus, bacteria and other micro-organisms which may pass through the R.O. Membrane Element. The U.V. sterilizer is highly recommended if the Product Water Storage Tank is not otherwise treated by means such as chlorination.
24. **Potable Water Storage Tank**\*\* may be any container suitable for storing Potable Water, i.e. existing water storage tank.

#### **E. FRESH WATER FLUSH SUBSYSTEM:**

Consists of supplied valves and required tank or container for the cleaning, rinsing or storage of the R.O. System. The Seafari 170 should be rinsed, stored, and cleaned from time to time or as appropriate.

25. **Fresh Water Flush Charcoal Filter and Solenoid Valve**\*\*\* is the main component of the optional Fresh Water Flush System, which flushes the system with fresh water. The Solenoid Valve controls the flow of fresh water through the system. The charcoal filter removes particulate matter and chlorine from the fresh water to prevent damage to the R.O. membrane element. Fresh Water Flushing replaces the seawater in the system with less corrosive fresh water.
26. **Fresh Water Flush Check Valve Assembly** \*\*\* This check valve assembly isolates the Fresh Water Flush system, preventing seawater from flowing in the reverse direction through the Charcoal Filter.

#### **F. ELECTRONIC SUBSYSTEM:**

This subsystem measures water quality, controls the direction of Product Water flow, and contains the central electrical connection point of the System. It also ensures only potable Product Water passes into the Product Water Storage Tank.

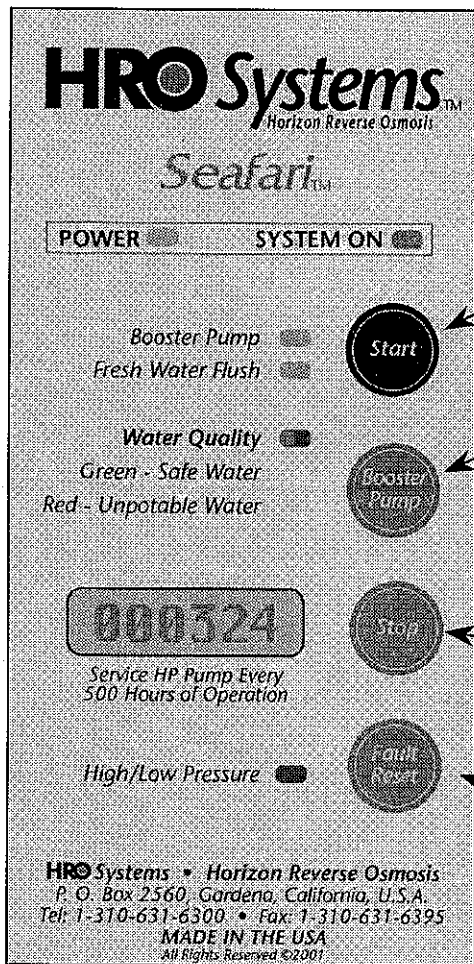
27. **Salinity Controller** The controller monitors the salt content of the product water, and signals the 3-Way Product Diversion Valve when Potable Water is being produced. The 3-Way Product Diversion Valve, Motors, Remote Control and U.V. Sterilizer are each governed by this Controller. This enclosure houses the high-voltage components of the system. It serves as the connection point for all the electrical systems such as the motors, switches, valves, and the controller.
28. **Remote Controller** \*\*\* (optional) allows for remote monitoring and or controlling of the system.

#### **G. ADDITIONAL EQUIPMENT**

**Soft Start**\*\*\* The soft start lowers the starting torque of the high-pressure pump motor, and gradually brings the motor to full speed. This reduces the initial startup amps required to start the motor. The soft start is available on single-phase systems and allows starting of the system when the power source is marginal or insufficient to start the system un-assisted.

### TOUCH PAD CONTROL DESCRIPTIONS:

**1. SWITCHES** The Touch Pad contains all of the system control switches. The system switches are identified and described below.



**START:** This switch initiates the start cycle. The Booster Pump [4] starts first and after a short delay, the High Pressure Pump Motor [10] starts.

**BOOST PUMP:** This switch controls the Booster Pump [4] independent of the High Pressure Pump [11]. When pressed, the booster pump starts and runs by itself, until the "Start" switch is pressed.

**STOP:** This switch stops all of the system functions when pressed. Each time the system is stopped, the Fresh Water Flush system is initiated. The Fresh Water Flush cycle is aborted by pressing the Stop switch a second time.

**FAULT RESET:** This switch resets the High/Low Pressure fault and allows the system to start.

**2. INDICATOR LAMPS** Above and to the left of the switches on the Touch Pad are the indicator lamps. These lamps either indicate the operation of the corresponding equipment or a fault condition. The following are descriptions of the indicator lamps.

**Power:** This indicator is lit when power is supplied to the controller. This indicates that the main power breaker has been switched on.

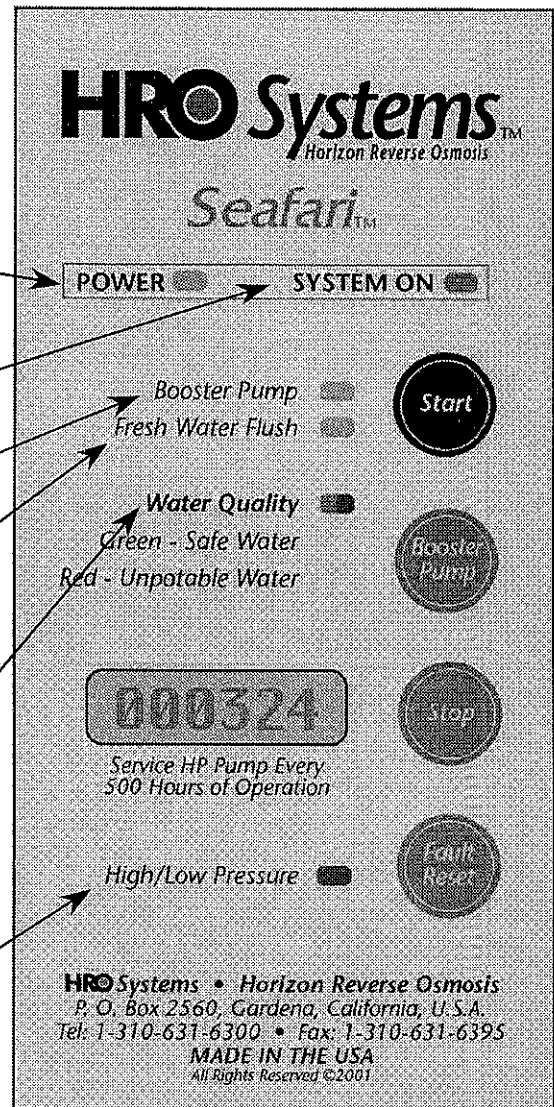
**System On:** This lamp illuminates when the High Pressure Pump is operating.

**Booster Pump:** This lamp illuminates when the booster pump is operating.

**Fresh Water Flush:** This indicator illuminates solidly during the Fresh Water Flushing operation. When the Fresh Water Flush is between the ten-minute flushings, which repeat every seven days, this lamp blinks on and off.

**Water Quality:** This lamp indicates the quality of the water being produced by the system. A red lamp illuminates when the system is producing un-potable water. A green lamp illuminates when the system is producing potable water.

**High/Low Pressure:** The High/Low pressure fault lamp illuminates when the system shuts down due to either a low-pressure condition, or a high-pressure condition. If the Low Pressure Switch senses a low-pressure condition, this lamp blinks for twenty seconds, and then the system shuts down.





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## **CHAPTER 2**

# **Installation & Commissioning**

## 2. System Installation & Commissioning

---

### A. STORAGE PRIOR TO UNCRATING:

1. Adhere to crate markings:
  - **DO NOT** store in direct sunlight;
  - **DO NOT** store above 120 degrees F / 50 degrees C;
  - **DO NOT** freeze; STORE ONLY on base with ARROWS UP;
  - **DO NOT** store longer than 3 months without additional storage chemical.
2. Refer to Chapter 4 of this manual for further cautions of the R.O. Membrane Element.

### B. UNCRATING:

1. DO NOT DISCARD ANY PACKAGING UNTIL YOU HAVE FOUND AND IDENTIFIED ALL PARTS!
2. Remove the Seafari 170 system from the shipping carton.
3. Some of the components are loose or separately packaged in the shipping container.

### C. COMPONENTS SUPPLIED BY OWNER:

#### 1. Inlet Thru Hull Fitting with Inlet Sea Cock Valve [1 & 2]

- Quarter turn ball valve min. 1/2" size, with a 1/2" MNPT connection for the supplied fitting.
- This inlet must be installed below water level and never be able to draw air
- A forward facing scoop type inlet is recommended.

#### 2. Brine Thru Hull Fitting [18]

- A minimum 1/2" size with a 1/2" MNPT connection.
- Must be located above water level.

#### 3. Potable Water Storage Tank [24]

- The installation fitting must be at least a 1/4" NPT with 1/4" FNPT for connection.
- The fitting must terminate above the maximum water level.
- No valves should be installed in this line.

#### 4. Properly sized Power Cable:

- Operating Voltage 12 VDC, Recommended Minimum Size Power Cable: 8 AWG
- Operating Voltage 24 VDC, Recommended Minimum Size Power Cable: 8 AWG
- Operating Voltage 120/220 VAC, Recommended Minimum Size Power Cable: 14 AWG

#### 5. An electrical power source (See Electrical Specifications on page 7.1)

#### System Packing List:

1. SYSTEM
2. BOOSTER PUMP
3. PRE-FILTER
4. ANY OPTIONAL ACCESSORIES
5. INSTALLATION KIT
  - o 30 feet 3/8" OD tubing
  - o 30 feet 1/4" OD tubing
  - o 1 - 1/2" ELB 90 FNPT PVC
  - o 1 - 3/8" ELB 90 TU X 1/2" MPT
  - o 1 - 3/8" ELB 90 TU X 3/4" MPT
  - o 1 - 1/4" ELB 90 TU X 1/4" MPT
  - o 8 - SCREW HEX "A" 1/4" X 1"
  - o 8 - WASHER FLAT OS 1/4"
  - o 4 - WASHER FLAT #10
  - o 4 - SCREW PHIL PAN #10 X 1 1/4"
  - o 1 - MCC-1 & 1 - MCC-2
  - o 1 - PUMP OIL
  - o OWNER'S MANUAL
  - o QUICK INSTALLATION GUIDE



#### **D. TOOLS REQUIRED FOR INSTALLATION:**

Not all installations are typical, therefore, it is recommended to have a full set of Mechanic's and Electrician's tools available. No special system tools are required for installation. A separate DS Meter, available from HRO Systems, and a volt/ohm meter (VOM) are beneficial and useful tools for system installation and commissioning.

#### **E. SPECIAL CONSIDERATIONS:**

##### **1. Length of Connection Lines:**

- All connection lines should be as short as possible. Increased length causes line-loss from the system.
- The connection lines must be as straight as possible with minimum number of fittings.

##### **2. Placement and routing of the Feed Water Line:**

- Always plumb the line so that all air may naturally bleed from the feed water line. (Excessive bends and elbows in the Feed Line results in pressure loss)
- Pressure losses cause inefficiency and shorter pre-filter life.

##### **3. System Feed Inlet:**

- Must be in constant contact with the feed water and provide an uninterrupted supply of air free feed water.
- The Inlet Thru Hull Fitting should be dedicated for only the Seafari 170.
- DO NOT use one Thru Hull Fitting for several auxiliary systems.

##### **4. Access for Maintenance:**

- Give careful consideration to access of items for maintenance purposes.
- Hidden or out of reach items may become forgotten and cause damage to other system components.

##### **5. The Control Panel:**

- Must be accessible for operation and viewing.

#### **F. DISTANCE BETWEEN COMPONENTS:**

##### **1. Inlet Sea Cock Valve [2] through the Pre-filter [6] and into the inlet of the High Pressure Pump [11]:**

30 feet of 3/8" O.D. flexible rigid wall tubing is supplied for the plumbing of the feed water line from the Inlet Sea Cock to the Inlet of the High Pressure Pump.

Caution must be exercised in extending the length of the feed water line. Feed pressure loss from the Booster Pump causes shorter Pre-filter Element life

Keep the distance from the Sea Cock valve to the High Pressure Pump as short and straight as possible.

**2. Brine Dump Tubing from the System to the Brine Discharge Outlet Fitting [18]:**

30 feet of 3/8" OD tubing is supplied to connect the Brine Discharge Line components.

Ensure that no backpressure is present on this line as backpressure causes bypassing at the 3-way product water diversion valve.

**3. Product water tubing from the Product Water outlet connection to the Product Water Storage Tank Inlet:**

30 feet of 1/4" OD tubing is supplied for this purpose.

**G. HIGH PRESSURE PUMP PREPARATION:**

1. **Remove the shipping tape on the High Pressure Pump Oil Fill Cap.** *This prevents oil from leaking during shipping.*
2. **Ensure that the pump oil level is higher than the center of the pump sight glass.**

The pump oil must be filled with HRO Systems supplied pump oil.

**AVOID CHEMICAL ATTACK TO THE SYSTEM**

**CAUTION:** Do Not expose the Seafari 170 to intake Feed Water that contains:

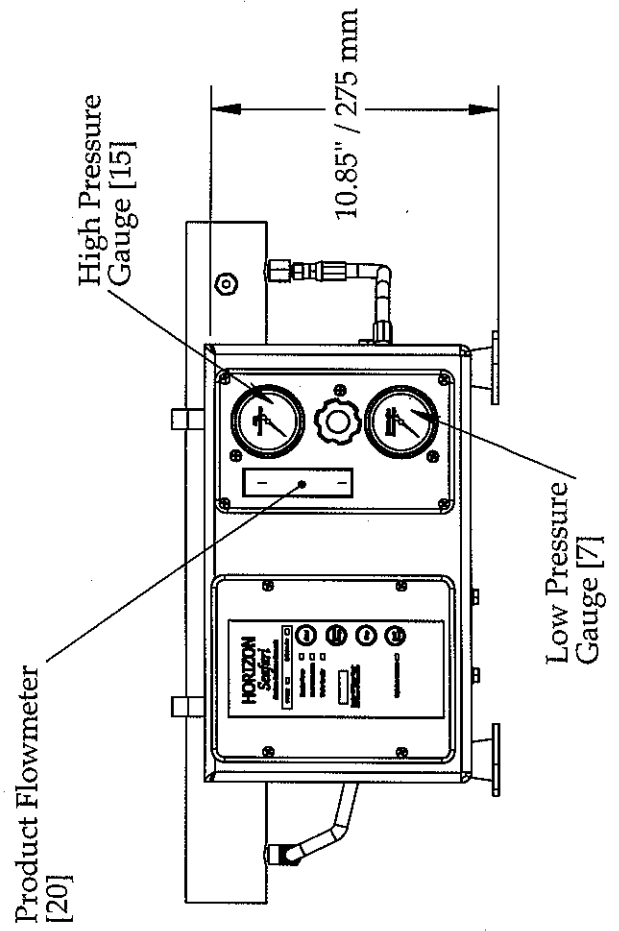
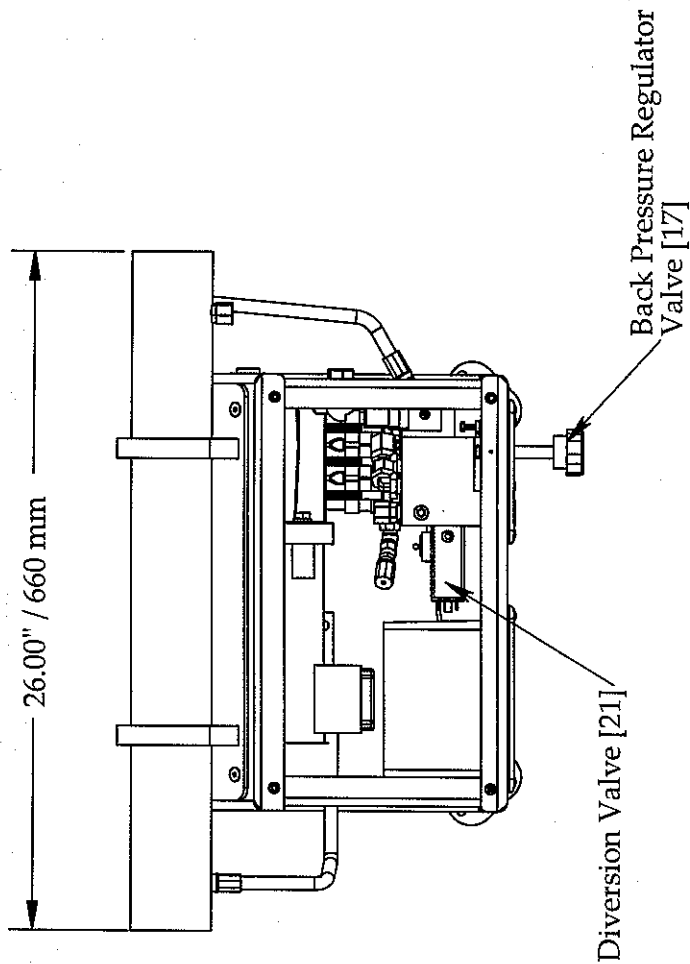
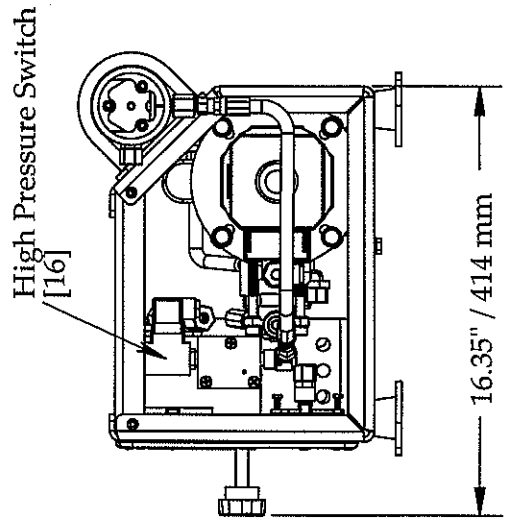
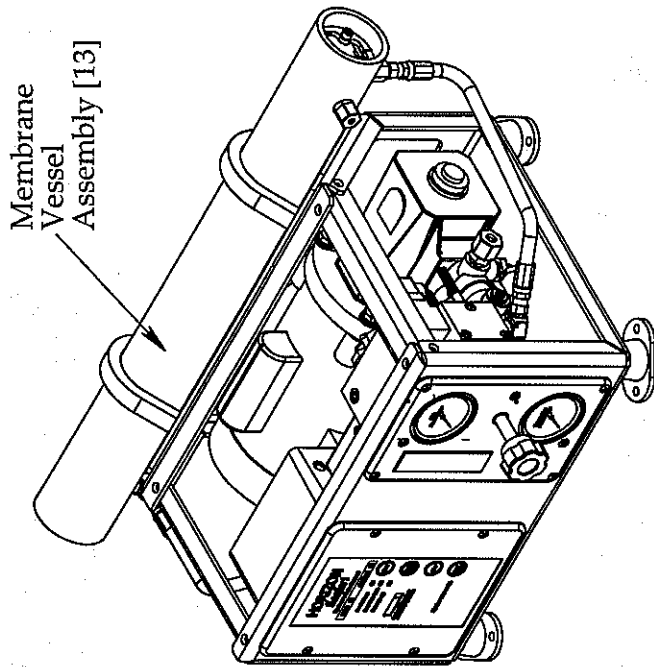
Hydrogen peroxide	chloramines	chloramines-T	N-chloroisocyanurates
Chlorine dioxide	hypochlorite	chlorine	iodine
Bromine	Bromide	phenolic disinfectants	petroleum products

Any chemical, not approved in writing by HRO Systems.

**USE OF NON-AUTHORIZED OR MISUSE OF AUTHORIZED CHEMICALS VOIDS SYSTEM WARRANTY.**

**Do not connect any water line to the Seafari 170 system that may contain any of the above listed chemicals.**

**Example:** Do not connect the inlet of the Seafari 170 to the ship's potable water system if the system contains chlorinated or brominated water. These chemicals destroy the copolymer components within the system. These oxidants and others also damage the R.O. Membrane Element. **A Fresh Water Flush system removes chlorine and bromine from the ship's potable water system.**



## 2.1 System Installation

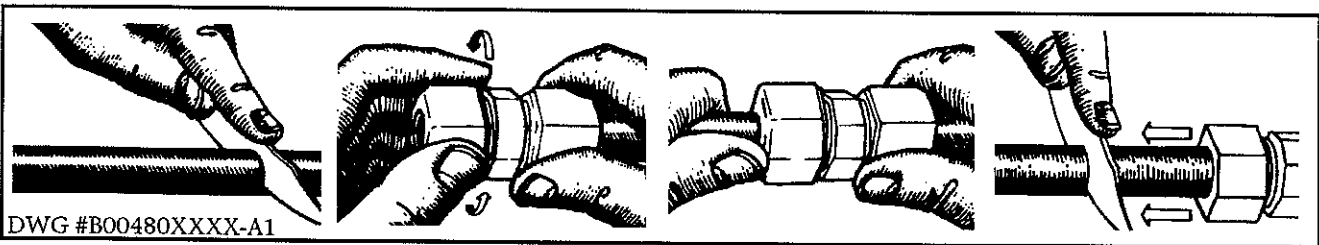
Follow these instructions exactly to prevent system failure and possible damage to the components. Read this section and other appropriate sections of the manual in order to gain familiarity with the requirements of the system and functions of each component.

### INSTALLATION CAUTIONS:

1. Do not over tighten PVC fittings. If threaded pipe fittings leak after installation, remove the fitting, clean the mating threads, apply 3 to 4 wraps of Teflon tape to the male threads and thread the parts back together. PVC fittings should only be hand tightened.
2. The Inlet Connection [1], Sea Strainer [3], and Booster Pump [4] should be below water level.
3. Always allow the tube to enter and exit straight from the tube fitting for a minimum of one inch prior to a bend
4. The Seafari 170 MUST have a dedicated Feed Line that does not feed any other auxiliary systems.
5. DO NOT mount the Seafari 170 in areas exposed to heat in excess of 120° F / 40 C.
6. Avoid skin and eye contact with the membrane packaging solution. In case of skin contact, rinse the skin thoroughly with water. In case of eye contact, flush repeatedly with water and notify a physician immediately.

**NOTE:** The following steps illustrate the installation of the Seafari 170. The illustrations show the system installed in the port-aft section of a vessel as an example. It is understood that this may not always be possible, and there are a variety of places the system may be mounted. The components in the illustrations are spaced farther apart than they may be in a vessel application to illustrate tube connections between components.

### FAST & TITE CONNECTIONS



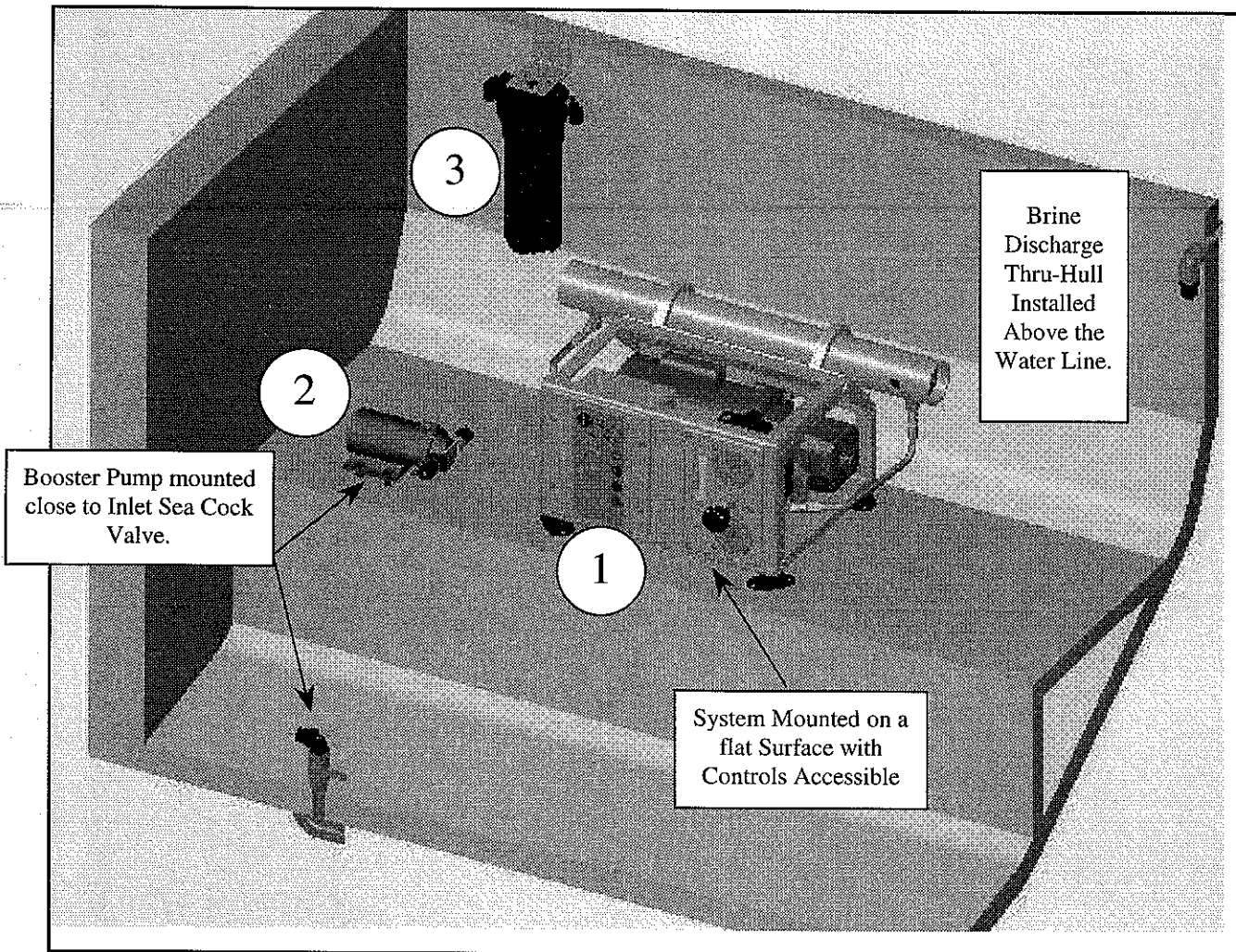
### ASSEMBLY

1. Cut tube end square and clean
2. Loosen nut on fitting three turns.
3. Insert tube into fitting until it bottoms. Loosen nut completely and remove tube with attached parts from body. Check to ensure that the O-Ring is seated onto the tube under the spacer (and not pinched into the body). Insert tube with attached parts into the body and tighten nut finger tight.

**TUBE MUST HAVE AT LEAST 1" OF STRAIGHT TUBE FROM CONNECTION BEFORE ANY BENDS.**

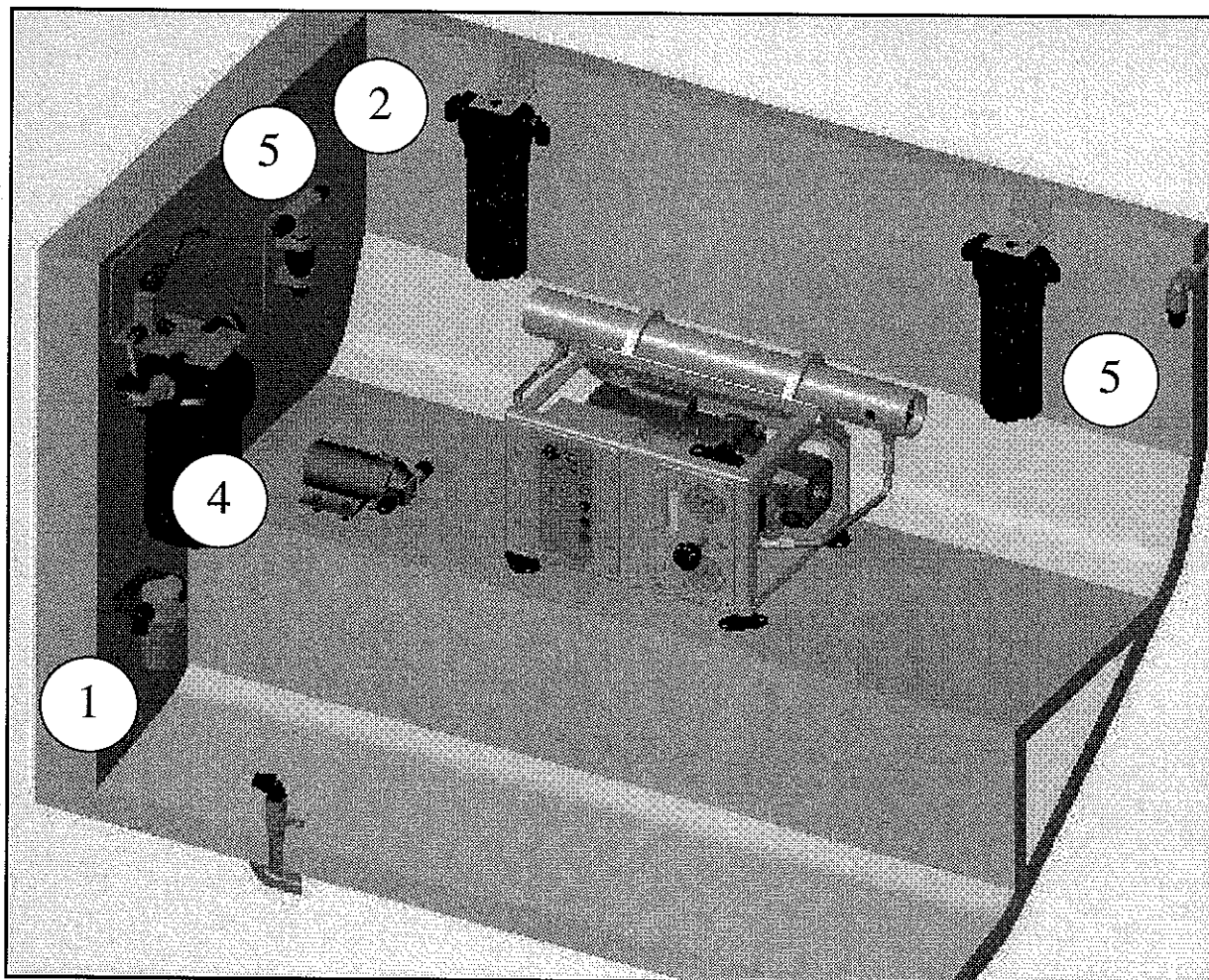
## STEP 1 MAJOR COMPONENT MOUNTING

1. The System is mounted to a flat surface using the supplied 1/4" x 1" Type "A" Screws in the Installation Kit.
2. Mount the Booster Pump to a flat surface using the supplied (4) #10 Type "A" 1 1/4" long screws. The Booster Pump is mounted horizontally and in an accessible location to allow access for maintenance. *The inlet hoses must be accessible so that they can be relocated during storage or cleaning operations.* Mount Booster Pump close to the Inlet Thru Hull/ Sea Cock Valve and the Sea Strainer (If purchased).
3. Mount the Pre-filter to a bulkhead using the supplied (4) #10 Type "A" 1" long screws.



## STEP 2 OPTIONAL COMPONENT MOUNTING

1. Mount the Sea Strainer between the Inlet Sea Cock Valve and Booster Pump as shown. Allow at least 2" of clearance below the bowl to access the mesh screen for cleaning or replacement.
2. If installed, the Plankton Filter should be mounted inline between the Booster Pump and the Pre Filter.
3. Mount the Fresh Water Flush Filter Canister to a Vertical Bulkhead. Allow at least four inches of clearance below for element replacement.
4. Mount the Fresh Water Flush Check Valve Assembly *vertically* in close proximity to the Booster Pump, Fresh Water Flush Filter Canister, and the Pre-Filter as shown in below.
5. Mount the Charcoal Filter to a bulkhead using the supplied (4) #10 Type "A" 1" long screws. Mount the UV Sterilizer (not shown) to a bulkhead directly after the Charcoal Filter. The UV should be mounted vertically with the electrical fitting on the top. The UV should be plumbed with the inlet on the bottom and the outlet on top.





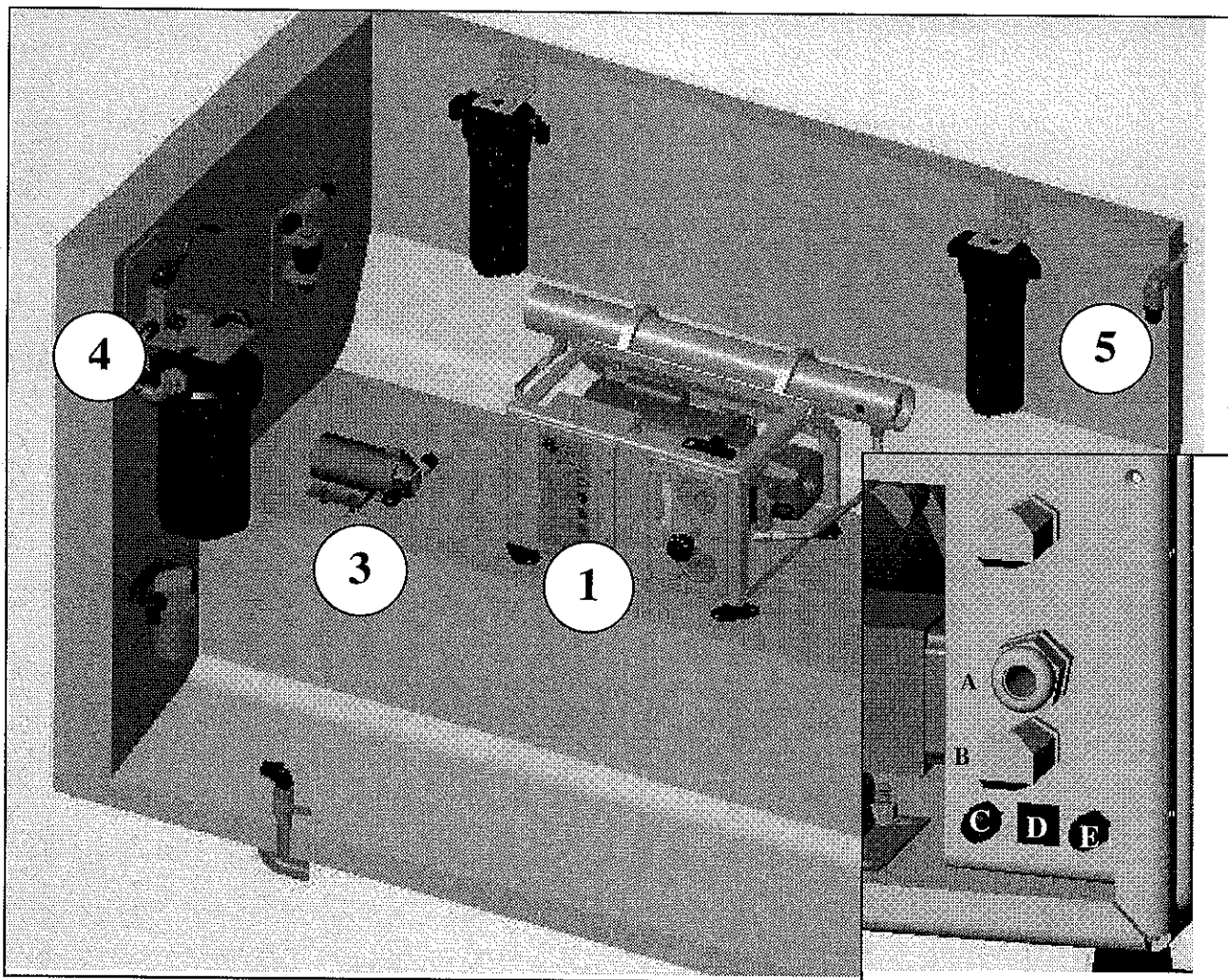
## STEP 3 ELECTRICAL CONNECTIONS

### Refer to Chapter 7 for Wiring Diagrams

1. Remove the Front cover from the system controller to access the Main Terminal Strip and Printed Circuit Board.
2. Connect main power using minimum 8 AWG cable for DC systems, and 14 AWG for AC. The power cable is inserted through strain relief "A" in inset below. (DC SYSTEMS: USE SUPPLIED CABLE FOR MAIN POWER)
3. Connect the Booster Pump power through strain relief "B" in below inset. Use the supplied cable. (12 AWG for DC and 14 AWG for AC)

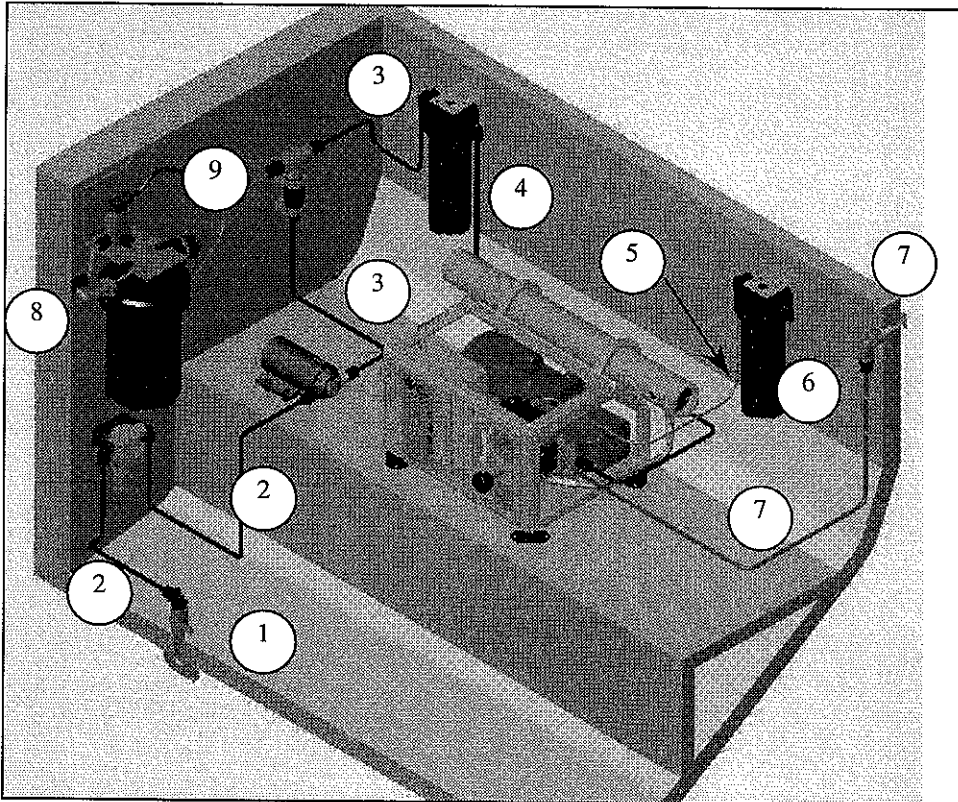
### Connect any Optional Accessories

4. Connect the Fresh Water Flush Solenoid Valve using supplied Orange Cable. Loosen the "C" strain relief in inset below and insert the Orange cable. Connect to the Printed Circuit Board.
5. UV Sterilizer using supplied purple cable. Loosen "E" strain relief in inset below and insert the Purple cable. Connect to the Printed Circuit Board.
6. Remote Control: Remove "D" Strain Relief from controller as it is replaced with the new strain relief supplied with the Remote. Close supplied Strain Relief around the flat cable and snap together. Insert in Controller Enclosure square cutout.



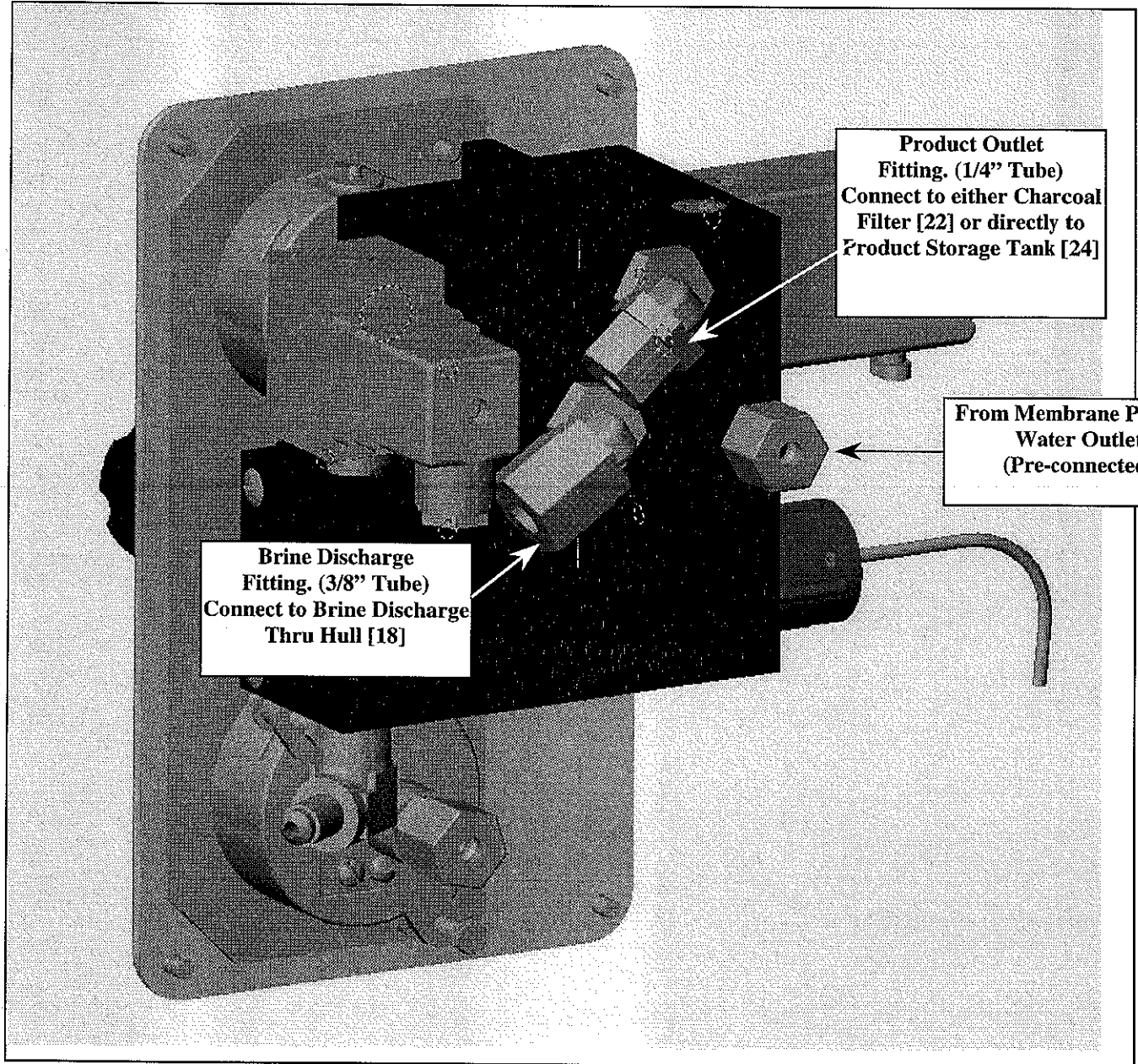
## STEP 4 PLUMBING CONNECTIONS

1. The Seafari 170 system was supplied with two fittings for connection to the Inlet Sea Cock Valve. Use either the elbow 3/8" Tube x 1/2" MPT or the 3/8" Tube x 3/4" MPT depending upon the available Inlet Sea Cock Valve Connection Size.
2. Use the supplied 3/8" tubing to connect the Inlet Sea Cock Valve to the Booster Pump Inlet. This tube must first connect to the optional Sea Strainer if one is ordered/installed.
3. Using the 3/8" tubing, connect the Booster Pump Outlet to the Pre-Filter Inlet. If A Fresh Water Flush is installed, this tube first connects to the Fresh Water Flush Check Valve Assembly as shown.
4. Using the supplied 3/8" tubing, connect the Pre-filter Outlet to the High Pressure Pump Inlet.
5. Using the supplied 1/4" tubing, connect the Product Water Outlet on the rear of the Control Manifold to the Charcoal Filter Inlet. See page 2.10 for location of Product Water Outlet fitting on the rear of the Control Manifold.
6. *If Installed*, connect the Charcoal Filter Outlet to the Product Water Tank using the supplied 1/4" tubing. Use the supplied 1/4" Elbow in the Installation Kit to connect to the Product Tank.
7. Using the supplied 3/8" tubing, connect the Brine Discharge Outlet on the rear of the control Manifold to the Brine Discharge Thru Hull. With the 1/2" PVC elbow and 1/2" Connector, connect to the Brine Discharge Thru Hull. See page 2.10 for location of Product Water Outlet fitting on the rear of the Control Manifold.
8. *If Installed*, Connect the Ship's Fresh Water System to the Fresh Water Flush Solenoid Valve. Use 3/8" tube.
9. *If Installed*, Connect the Fresh Water Flush Canister to the Fresh Water Flush Check Valve as shown. Use 3/8" tube.





**CONTROL MANIFOLD CONNECTIONS**



## 2.2 System Commissioning

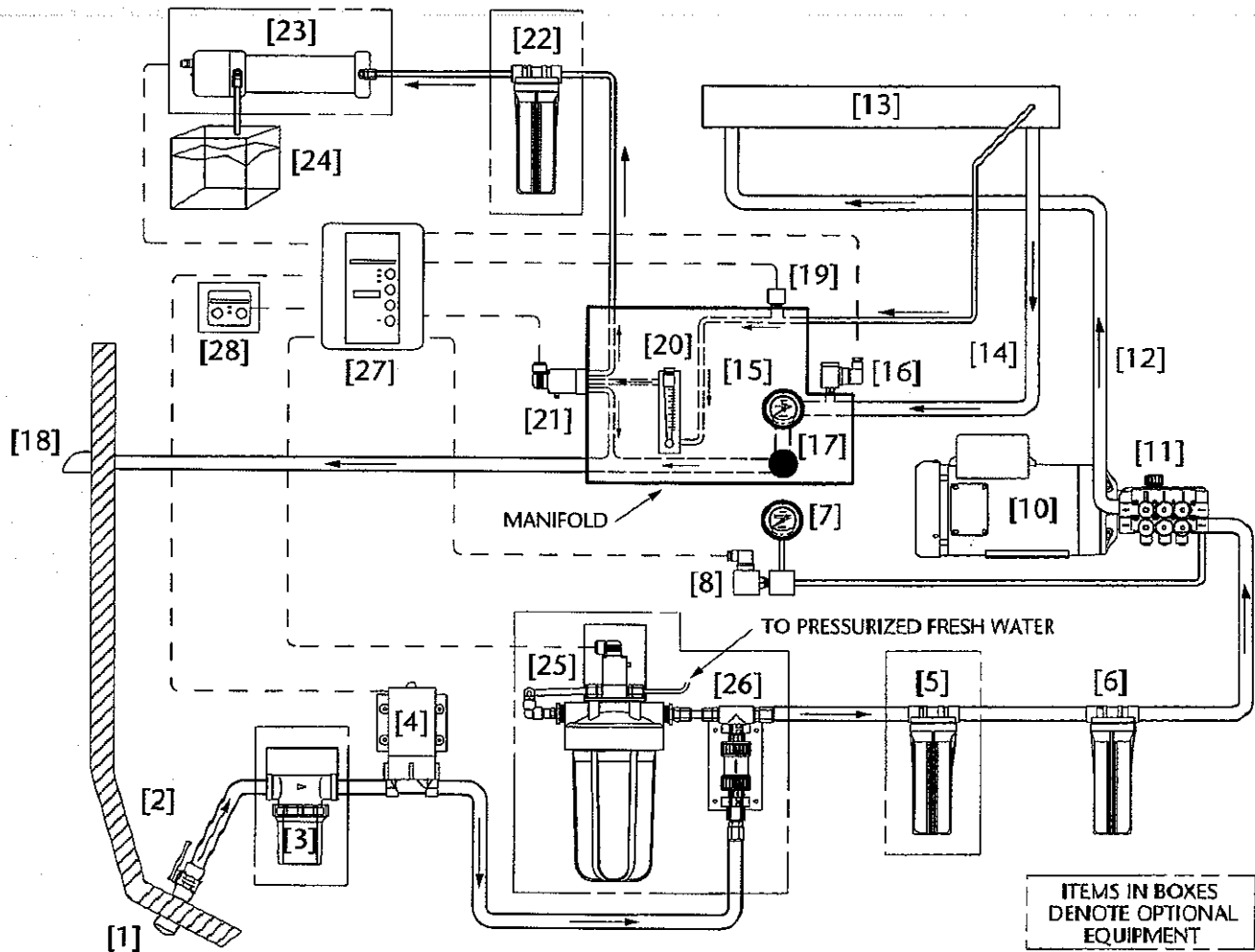
### INITIAL START-UP PROCEDURE OF A NEW Seafari 170.

Throughout this Manual, Numbers in [ brackets ] refer to the I.D. numbers illustrated below.

The Commissioning instructions must be carried out for initial start-up of a NEW system. For every day use starting procedures, refer to Chapter 3, Operation.

Failure to follow these instructions exactly leads to system failure, and causes damage to the components. Read this section and other appropriate sections of the manual in order to gain familiarity with the requirements of the system and functions of each component.

### Seafari 170 U.S. GPD Reverse Osmosis Desalination System





### START-UP PROCEDURE OF A NEW Seafari 170.

1. Ensure that all Tube Plugs and shipping caps have been removed prior to commissioning. Failure to remove these caps could cause damage to the system.
2. Install the Reverse Osmosis Membrane, if not already installed. Refer to page 6.11 for Installation Instructions.
3. Check the level of the oil in the High Pressure Pump crankcase. Ensure that the oil level is higher than the center of the sight glass.

*Use only HRO supplied Pump Oil as it is special hydraulic oil, which contains anti rust and wear inhibitors essential to the high-pressure pump crankcase section.*

4. Check each tube connection to the System to ensure that the installer has properly connected and properly routed each tube. Improper routing and any blockage in any line causes damage to the system. **Do not rely on the installer's word, check it yourself.**
5. Make sure that the Electrical Power Source to the System is switched "OFF".
6. Open the front panel of the Main Power Enclosure. Check all connections for proper wiring and attachment. Refer to the wiring diagrams in Chapter 7.
7. Close the Main Power Enclosure front panel.
8. Ensure that the manual By-Pass lever on the Diversion Valve [21] is positioned outward (away from the coil body).
9. Open any auxiliary Valve within the incoming Feed Line; Outgoing Brine Discharge Line; and Outgoing Product Water Line.

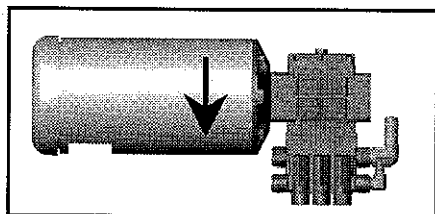
**CAUTION:** *Any auxiliary Valve in these lines damages the Seafari 170 if left closed during starting and or operation of the System.*

10. Open the Back Pressure Regulator Valve [17] FULL OPEN by turning counter clockwise.

**CAUTION:** *The Back Pressure Regulator Valve [17] must be full open when starting the Seafari 170. If this valve is left closed, it may cause damage to the system.*

11. Switch the Electrical Power Source to the Salinity Controller "ON".
12. **HIGH PRESSURE ELECTRIC MOTOR ROTATIONAL CHECK:** Ask an assistant to view the fan section of the Electric Motors, (High Pressure Pump Electric Motor [10]) while you Jog the System.

Press the "Start" switch, and then immediately press the "Stop" switch. Ensure that the High Pressure Pump Electric Motor turned in the proper rotation. If the motor turned in the wrong direction, refer to the wiring diagrams on pages 7.3 – 7.5 to correct. *For DC systems, polarity may be reversed.*



**HIGH PRESSURE PUMP & MOTOR**

13. To start the system press the "Start" Switch, or press the "Booster Pump" Switch and then the "Start" switch. *If the system automatically shuts off after several seconds of operation, this may be due to a system fault. Look at the Touch Pad to confirm whether a fault has occurred. After a fault has been corrected (refer to Chapter 5 for Troubleshooting), press the Fault Reset button on the touchpad and restart the system.*

**HIGH/LOW PRESSURE FAULT LAMP EXPLANATION:**

- a. Low Pressure Fault: When the inlet pressure to the high-pressure pump falls below 6 psi, the "High/Low Pressure" lamp blinks. If the condition is not corrected, the system shuts down after 20 seconds. The Low Pressure switch monitors this condition caused by a closed Inlet Sea Cock Valve or restriction in the inlet line.
- b. High Pressure Fault Lamp: The High Pressure Switch stops the system if pressure exceeds 950 psi.

14. After 5 minutes of running un-pressurized, slowly adjust the Back Pressure Regulator Valve [17] by turning clockwise to increase the pressure to the proper setting (example: 850 psi for 35,000 ppm seawater @ 77° F).

**DO NOT EXCEED 7 GALLONS PER HOUR ON SYSTEM FLOWMETER OR 900 PSI ON HIGH PRESSURE GAUGE.**

15. If any abnormality develops, stop the System and correct the problem.
16. Use the Product Water Flow Meter [20] to measure the product flow. The system may not produce "potable" water for up to 30 minutes. The salinity of the Product Water diminishes gradually, until it reaches the factory setting at which time it is directed to the "potable" (good water) position. This allows product water to pass into the Post Filtration components, & onto the Ship's Storage Tank [24]. *At the same time, the Water Quality LED on the touchpad changes from red to green.*
17. Check for:
  - a. A constant feed water flow.
  - b. A consistent system pressure.
  - c. Leaks in the system.
  - d. Unusual noises or other occurrences.

**At this time, the person commissioning the Seafari 170 system should fill out the INITIAL SYSTEM READINGS form on Page 2.15.**

**Retain the form on page 2.15 for the owner and future operator's reference. This information is valuable to the servicing technicians in providing technical support to the owner and future operators of the Seafari 170.**

**The person or company who performed the commissioning of the Seafari 170 system should retain a copy of the form on page 2.15. This information is valuable to the servicing technicians in providing support to the owner and future operators of the Seafari 170 system.**

# **HRO** *Systems Seafari 170* NEW SYSTEM INITIAL READINGS

Record the following information at the time of system shutdown. Maintain a log of the completed forms with the Systems Owner's Manual for future reference and troubleshooting. This information should be given to the HRO Systems Service Technician, when requesting assistance from HRO Systems.

Record at the time of initial system commissioning the following after one hour continuous proper running of the system. Maintain this original form with the System Owner's Manual for future reference and troubleshooting.

Serial Number: \_\_\_\_\_ Model Number: \_\_\_\_\_

Name of Operator: \_\_\_\_\_ Date: \_\_\_\_\_

Name & Company of Installer: \_\_\_\_\_

Name of Owner: \_\_\_\_\_

System Power (Circle AC or DC): \_\_\_\_\_ Volts AC DC

Feed Water Temperature: \_\_\_\_\_ ° Farenheit or \_\_\_\_\_ Centigrade

Hour Meter Reading: \_\_\_\_\_ Hours

### **PRESSURE GAUGE READINGS:**

Low Pressure Gauge Reading: \_\_\_\_\_ psi

High Pressure Gauge reading: \_\_\_\_\_ psi

### **WATER FLOW METER READINGS:**

Product Water Flow Meter: \_\_\_\_\_ US gph or \_\_\_\_\_ Liters Per Hr.

### **WATER QUALITY:**

Feed Water Salinity: \_\_\_\_\_ ppm or Location of use \_\_\_\_\_

Product Water Salinity: \_\_\_\_\_ ppm

Unusual occurrences: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



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## **CHAPTER 3**

### **Operation**

### 3. Operation

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The fresh water production of the HRO Systems Seafari 170 depends on four factors: feed water temperature, feed water salinity, feed water flow, and feed water pressure. Feed water temperature and salinity vary depending upon location of operation. Feed water flow is fixed at ½ gallon per minute by design. The only operator adjustment that remains is the feed water pressure, which is adjusted at startup.

There are two parameters, which are controlled by a single operator adjustment: Feed Water Pressure and Product Water Flow. The system is rated to produce 7 gph (gallons per hour). The Feed Water Pressure is adjusted upward until the unit produces 7 gph. The maximum Feed Water Pressure is 900 psi. The system automatically shuts down if this maximum Feed Water pressure exceeds 950 psi.

#### OPERATION CAUTIONS:

1. Open all valves on the piping or hoses leading to and from the system
2. Check the Oil level in the High Pressure Pump.
3. Check for any abnormalities such as leaks, damaged hoses or wires, etc.

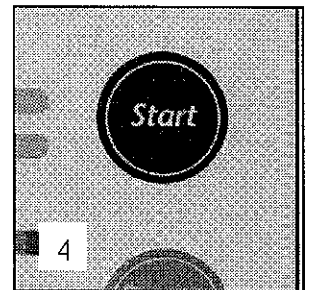
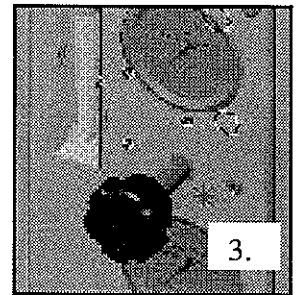


#### STARTUP PROCEDURE

1. **Open the Inlet Sea Cock Valve [2] fully.**
2. **Switch the electrical power to the system on at the circuit breaker.** *The "POWER" lamp on the system touchpad should illuminate.*
3. **Ensure that the back-pressure regulator valve [17] is fully open (counterclockwise).** *This is not required and is commonly skipped on systems equipped with a Remote. Performing this step reduces wear and tear on the mechanical and electrical components.*
4. **Press the "Start" switch.** *This initiates the automatic start sequence. The automatic start sequence begins with the booster pump starting immediately and the high-pressure pump following after a brief delay.*

or

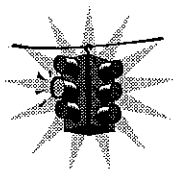
**Press the "Booster Pump" switch, then press "Start" switch.** *Pressing the booster pump switch starts just the booster pump. It continues running by itself until the start switch is pressed.*





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## HIGH/LOW PRESSURE FAULT LAMP EXPLANATION:



- A. **Low Pressure fault:** When the inlet pressure to the high-pressure pump falls below 6 psi, the “High/Low Pressure” lamp blinks. If the condition is not corrected, the system shuts down after 20 seconds. The Low Pressure switch monitors this condition caused by a dirty pre-filter, a closed Inlet Sea Cock Valve, or restriction in the inlet line..
- B. **High Pressure fault:** The High Pressure switch stops the system if pressure exceeds 950 psi

After a fault condition has been corrected, press “Fault Reset” and repeat Step 4.

---

5. **Slowly adjust the backpressure regulator [17] until the system produces 7 gph at the Product Flow meter, but do not exceed 900 psi.**
- *Do not exceed 7gph or 900 psi.*
  - *Pressure settings vary depending upon feed water salinity and temperature.*
  - *See “Temperature Effects Chart” and “Salinity Effects Chart” on Page 8.2 & 8.3 for expected pressure settings.*

---

**Colder Water:** At sea water temperatures 76° F and lower, the Seafari 170 must operate at a higher pressure to produce the same amount of fresh water. As water temperature drops, the individual H<sub>2</sub>O molecules are less active and higher pressure is required to drive them through the membrane surface. Another result of lower temperature feed water is that the fresh water produced has a lower salt content. ***Do not operate with feed water below 33 °F / 1 C.***

---

**Warmer Water:** At water temperatures 78° F and above, the Seafari 170 operates at a lower pressure to produce the same amount of fresh water. As water temperature rises, the individual H<sub>2</sub>O molecules are more active and do not need as high a pressure behind them to drive them through the membrane surface. Higher temperatures also allow more salt to make its way into the fresh water. ***Do not operated with feed water that exceeds 122 °F / 50 C.***

---

6. **If any abnormality develops, stop the system and correct the problem.**
7. **Check for unusual noises or other occurrences.**



## SHUTDOWN PROCEDURE

1. **Observe and compare the performance of the system to the previously recorded normal operating specifications on Page 2.15.** *This allows the operator to monitor performance and spot deviations or deficiencies when they occur. This insures a properly functioning system when it's needed. Use the Operators' Log Record to record performance.*
2. **Open the Back Pressure Regulator Valve fully (counterclockwise).**
3. **Depress the "Stop" button on the system controller.** *If installed, the Fresh Water Flush (FWF) system is initiated when the "Stop" switch is pressed. The Fresh Water Flush lasts for 10 minutes. After the ten minutes, the fresh water flush stops, but it remains in FWF mode. In this mode, the fresh water flush repeats the ten-minute rinse every 7 days. To continue the 7-day cycle, skip steps 5 - 7.*
4. **Close the Inlet Sea Cock Valve [2].** *This is a safeguard for vessel installations.*
5. **Press the "Stop" switch a second time to exit Fresh Water Flush Mode.**
6. **Turn off the electrical power source (circuit breaker) to the system.** *This eliminates the chance of inadvertently starting the system. Lockout/Tagouts must be used on the system circuit breaker when performing maintenance to the system.*
7. **Refer to Chapter 4 for proper Storage procedures.** *This section describes the proper storage of the system for various time intervals.*



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## **CHAPTER 4**

# **Storage & Cleaning**

## 4. System Storage and Cleaning

---

### **R.O. MEMBRANE ELEMENT HANDLING & SYSTEM STORAGE CAUTIONS:**

#### **1. TEMPERATURE:**

Never store the R.O. membrane assembly in direct sunlight or expose the HRO Systems R.O. membrane to storage temperatures above 120° F / 50 C or below 32° F / 0 C. High temperatures cause up to 40% loss of production from the R.O. membrane element. This damage is irreversible. Freezing temperatures cause mechanical damage to the system and irreversible damage to the R.O. membrane element.

#### **2. DRYING OUT:**

Never allow the R.O. membrane element to dry out, as 40% production loss occurs. This Membrane damage may be irreversible. The R.O. membrane element must remain wet at all times.

#### **3. BIOLOGICAL FOULING:**

Protect the R.O. membrane element from biological fouling. Up to 40% flux loss occurs if the element becomes fouled by biological slimes. Some, but not all production may be restored after cleaning.

#### **4. CHEMICAL FOULING:**

Never expose the R.O. Membrane Element to chemicals other than those supplied by HRO Systems. Use caution when operating the System in harbors that may be polluted with chemicals, oil, or fuel. Chemical attack to the R.O. Membrane Element may damage the element beyond repair and is not covered by warranty.

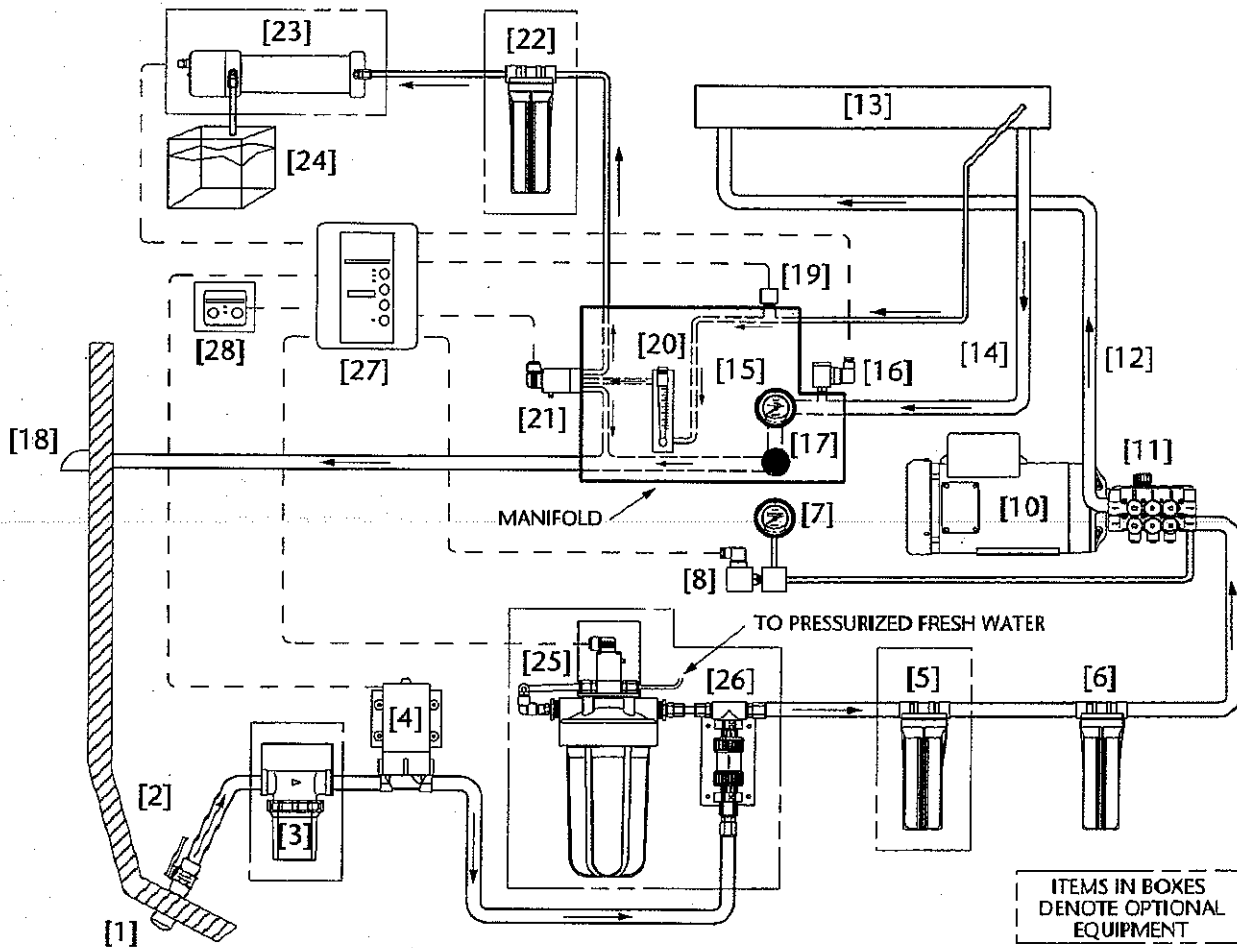
#### **5. STORAGE:**

The dark and moist interior of a membrane element is an excellent breeding ground for microorganisms. Simply operating the system does not protect the R.O. Membrane Element from up to 40% production loss due to biological fouling. During short-term shutdowns the system must be rinsed as explained in the following pages. During long-term shutdowns the system must be rinsed as well as chemically treated as explained later in this chapter.

#### **6. NEW SYSTEM STORAGE:**

Do not install the membrane and store the system for longer than 3 months prior to actual use. If storage of the new system is longer than 3 months the system must be rinsed with fresh water and stored with fresh storage solution every 3 months, otherwise biological fouling and or drying out damages the R.O. Membrane Element.

### Seafari 170 U.S. GPD Reverse Osmosis Desalination System




## 4.1 SHORT-TERM SHUTDOWN:

---

A short-term shutdown is defined as a period of time in which the Seafari 170 system is not utilized for two to fourteen days. An effective short-term protection for the system and R.O. membrane element is a Fresh Water Rinse of the entire system with fresh water (product water from the system). This prolongs the system life by minimizing electrolysis and retarding biological growth.

**FRESH WATER RINSE PROCEDURE:** Follow the directions below. This procedure displaces the system feed water with fresh water and allows a short-term shutdown for up to two weeks. Five gallons (19 liters) of fresh product or potable water is required for the fresh water rinse.

**NOTE:** If the Seafari 170 is equipped with a Fresh Water Flush system, the fresh water flush is a substitute for the below procedure. The Fresh Water Flush is timed and repeats every seventh day unless the "Stop" switch is pressed, or the power supply is interrupted.

- 
1. Close the Inlet Sea Cock Valve [2].
  2. Fill a 5-gallon container with clean, fresh water.
  3. Disconnect the inlet line of the Booster pump [4] and place the inlet line in the bucket filled with the clean fresh water.
  4. Fully open the Back Pressure Regulating Valve [17].
  5. Press the "Start" switch. The fresh water rinses the Seafari 170 system and discharges out to waste.
  6. Apply 200 psi of pressure to the System by turning the Back Pressure Regulator [17] Clockwise. *This allows the system to produce a minimal amount of product water, which ensures that the product water line remains wet.*
  7. Just prior to depleting the rinse water from the tank, stop the system.
  8. Reconnect the Booster Pump inlet line. The system is now exposed to fresh rinse water and may be left unattended for up to two weeks. This procedure should be repeated every two weeks if the system is not in use.

## 4.2 LONG TERM SHUTDOWN:

---

A Long Term or Prolonged Shutdown is a period in which the Seafari 170 system goes un-used for longer than three months. For this shut down interval, the system should first be rinsed with fresh water, then stored with System and Membrane Element Storage Chemical (HRO SC). This chemical inhibits bacterial growth while maintaining the high flux and salt rejection of the HRO R.O. Membrane Element. The Long Term Shutdown procedure requires 10 gallons (38 liters) of potable water. Follow the directions listed below.

**WINTERIZING AND FREEZING TEMPERATURE STORAGE NOTE:** If the system is exposed to freezing temperatures add twenty percent (1 to 2 gallons / 8 to 15 liters) food grade glycerin (propylene glycol) to the rinse water. This prevents the water in the system from freezing.

1. Close the Inlet Sea Cock Valve [2].
2. Replace the Pre-filtration Cartridge with a new HRO Systems Pre-filtration Element.
3. Fill a clean 5-gallon container with non-chlorinated product water.
4. Remove the Booster Pump inlet tube from the Sea Strainer or Inlet Sea Cock Valve [2] and place the inlet tube in the 5-gallon container so that the Booster Pump draws from the container.
5. Open the Back Pressure Regulating Valve full open counter clockwise.
6. Start the system. The rinse water rinses the entire system and discharging to waste.
7. Apply 200 psi of pressure to the System. This produces a minimal amount of product water, which ensures the product water line remains wet.
8. Just prior to depleting the rinse water from the container, stop the system (Press stop button twice to abort Fresh Water Flush Cycle).
9. Open the Back Pressure Regulating Valve [17] full open counterclockwise.
10. Fill the 5-gallon container with product water. Add 6 ounces (1/4 bottle) of HRO SC Storage Chemical to the water in the plastic bucket. **DO NOT ADD ANY OTHER CHEMICAL.**
  - Mix and thoroughly dissolve the solution in the container.
  - The ratio for the Storage Chemical (SC) is one bottle per 20 gallons of product water.
11. Detach the Brine Discharge line from the Brine Discharge Through Hull [18] and place it in the 5-gallon container for Closed Loop circulation.
12. Operate the system by pressing the "Start" Switch. The Storage Chemical Solution flows from the container, through the System, and back into the container in a Closed Loop configuration. **Do not pressurize the system above 50 psi maximum.**
13. After approximately 20 minutes of circulation, stop the system (Press stop button twice to abort Fresh Water Flush Cycle).
14. Empty the 5-gallon container by reconnecting the Brine Discharge line to the Brine Discharge Thru-Hull fitting.

15. Operate the system, which discharges the Storage Chemical Mixture through the Brine Discharge Thru Hull Fitting.
16. Stop the system just before depleting the Storage Chemical Solution from the tank.
17. Reconnect the Booster Pump Inlet Line to the Inlet Sea Cock Valve [2] or optional Sea Strainer as appropriate.

The system may now be left unattended for up to 3 to 6 months. With ideal conditions including a relatively new R.O. Membrane Element, a clean system prior to storage, cool temperatures, and no leakage of storage chemical within the system, it provides protection for up to 6 months. Adverse conditions provide only a month or less of safe storage. Evaluate these factors before determining the proper interval between repeated rinsing and storage periods.

### **4.3 R.O. MEMBRANE ELEMENT CLEANING PROCEDURES**

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Do not arbitrarily clean a new system. If a new system experiences low production or high salinity then it should be operated for up to 12 or more hours *continuously* to clear the R.O. Membrane Element and product water channel. *If a new system still experiences low production and or high salinity after 12 hours of continual operation then contact the factory.*

The membrane element requires cleaning from time to time. Biological growth and salt accumulation eventually make replacement necessary. The frequency of required cleaning depends on the amount of production loss and salt rejection loss resulting from normal use. In order to properly assess performance changes, it is important to maintain daily log readings for comparison.

During performance comparisons, Feed Water Temp, Feed Water Salinity, and System Operating Pressure must be taken into consideration (See Chapter 8) and compensated for. After compensations, a 10% decline in productivity (GPH Flow) and/or a 10% increase in salt passage indicate that the R.O. Membrane Element requires cleaning.

If Production rate has dropped dramatically since the last time the system was used, this may be due to drying out of the R.O. Membrane Element and/or fouling during storage. If the system has not been used for several months and the production rate has dropped dramatically since the last time used, try operating the system for 12 or more continuous hours to saturate the Product Water Channel within the R.O. Membrane Element.

If Production rate drops dramatically from one day to another, this may be due to chemical attack or suspended solids fouling, which is not cleanable. Sewage chemicals or petroleum products cause irreparable damage to the R.O. Membrane Element. Suspended solids fouling results from silt, coral dust, river or inland waterway debris, or other small solid matter.



**4.4 R.O. MEMBRANE ELEMENT CLEANING CAUTIONS AND INFORMATION:**

1. The Seafari 170 system must be rinsed with fresh water before any cleaning procedure.
2. The process of rinsing and cleaning the R.O. Membrane Elements requires 20 gallons / 76 liters of fresh non-chlorinated product water.
3. Product Water Required For Cleaning of the R.O. Membrane Element:

Chemical	Rinse	Clean	Circulation	Final Rinse	Total Water Used
CC-1	5	5	5	5	20
CC-2	5	5	5	5	20
CC-3	5	5	5	5	20

4. The HRO Systems cleaning compounds are designed to clean moderate fouling from the R.O. membrane elements in a closed-loop configuration. If the R.O. Membrane Elements are excessively fouled and in-field cleaning is not successful, the R.O. Membrane Element may be returned to HRO Systems or to one of HRO Systems' many Service Dealers for Professional chemical cleaning. If your membranes require Professional Cleaning, please contact us for a Return Authorization Number, price quotation and return instructions.
5. **HRO CC-1**, Membrane Cleaning Compound "# 1" is an alkaline cleaner designed to clean biological fouling and slight oil fouling from the R.O. Membrane Element. Biological fouling is usually the first cause of the R.O. Membrane Element fouling. The system is constantly exposed to seawater, and biological growth occurs from the first day forward. If exposed to seawater and left to sit, the R.O. Membrane Elements become unusable and un-cleanable even with no actual system use. This fouling is minimized with fresh water rinsing whenever the system is not in use.
6. **HRO CC-2**, Membrane Cleaning Compound "# 2" is an acid cleaner designed to clean calcium carbonate and other mineral deposits from the R.O. Membrane Element. Mineral fouling is a slow process, which takes place during use. Therefore, if the System has relatively few hours of use yet shows signs of R.O. Membrane Element fouling then that fouling is likely biological fouling. If the System has in excess of 1000 hours of use then there may be some mineral fouling combined with biological fouling.
7. **HRO CC-3**, Membrane Cleaning Compound "# 3" is used for iron fouling. It is not included in the HRO kit. If the HRO Systems R.O. membrane elements are fouled with rust from iron piping then HRO CC-3 may be used for effective removal of light or moderate rust fouling. Heavily rust fouled RO Membranes may not be recoverable as rust not only fouls the Membrane Element but also damages the membrane surface.

**DO NOT MIX DIFFERENT CLEANING CHEMICALS TOGETHER. DO NOT USE DIFFERENT CLEANING CHEMICALS TOGETHER AT THE SAME TIME. MIX THE CLEANING CHEMICALS SEPARATELY AND USE THEM SEPARATELY.**



#### 4.5 R.O. MEMBRANE ELEMENT CLEANING INSTRUCTIONS:

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1. Close the Inlet Sea Cock Valve [2].
2. Replace the Pre-filtration Cartridge with a new HRO Systems supplied Pre-filtration Element.
3. Disconnect the Booster Pump Inlet Tube and place the end of the tube in a clean 5-gallon container. *This allows the system to draw liquid from this container.*
4. Fill the 5-gallon container full with non-chlorinated product water. The bucket must contain enough product water to rinse the system until all of the feed water is displaced.
5. Open the Back Pressure Regulating Valve [17] full open counterclockwise.
6. Operate the system by pressing the "Start" switch. The rinse water rinses the entire system and discharges out to waste.
7. Just prior to depleting the rinse water from the 5-gallon container, stop the system.

**NOTE: FOR OPTIMUM CLEANING RESULTS USE WATER BETWEEN 90-110° F/32-43 C.  
DO NOT EXCEED 120° F / 50 C.**

8. Fill the 5-gallon container with product water. Add 6 ounces (1/4 bottle) of either the HRO CC-1, CC-2, or CC-3 Cleaning Chemical to the water in the plastic bucket. **USE ONLY ONE CHEMICAL AT A TIME.**
  - Mix and thoroughly dissolve the solution in the container.
  - The ratio for the Membrane Cleaning Chemical (CC) is one bottle per 20 gallons of product water.
9. Disconnect the Brine Discharge line from the Brine Discharge Thru-Hull fitting and place it in the 5-gallon container for rinse circulation.
10. Press the "Start" switch to begin circulating the Cleaning Chemical solution from the container, through the System, and back into the container. **Do not pressurize the system above 50 psi maximum.**
11. After approximately 60 minutes of circulation, stop the system (Press the stop button twice to abort the Fresh Water Flush Cycle).

**NOTE: FOR BEST CLEANING RESULTS, ALLOW THE CLEANING SOLUTION TO SIT IN SYSTEM FOR 4 - 12 HOURS. THIS WILL ALLOW IT TO SOAK, DISLODGE, AND DISSOLVE FOULING.**

12. Empty the 5-gallon container by reconnecting the Brine Discharge line to the Brine Discharge Thru-Hull fitting [18].
13. Press the "Start" switch to discharge the solution out the Brine Discharge Thru Hull Fitting [18].
14. Just prior to depleting the Cleaning Chemical solution from the container, stop the system (Press the stop button twice to abort the Fresh Water Flush Cycle).
15. Fill the 5-gallon container full with non-chlorinated product water.

16. Disconnect the Brine Discharge line from the Brine Discharge Thru-Hull fitting [18] and place it in the 5-gallon container for Rinse Circulation.
17. Press the "Start" switch to circulate the water from the container, through the system, and back into the container. Continue rinsing for 20 minutes.
18. After 20 minutes stop the system by pressing the "Stop" switch (Press the stop button twice to abort the Fresh Water Flush Cycle).
19. Empty the 5-gallon container by reconnecting the Brine Discharge line to the Brine Discharge Thru-Hull fitting [18].
20. Press the "Start" switch to discharge the rinse water out the Brine Discharge Thru Hull Fitting [18].
21. Just prior to depleting the rinse water from the 5-gallon container, stop the system (Press the stop button twice to abort the Fresh Water Flush Cycle).
22. Fill the 5-gallon container with non-chlorinated product water.
23. Start the system to begin rinsing the System, and discharging out the Brine Discharge Thru Hull Fitting to waste.
24. Just prior to depleting the Final Rinse Water from the container, stop the system (Press the stop button twice to abort the Fresh Water Flush Cycle).

**The System is now ready for additional cleaning, Storage, or use.**

25. If further Membrane cleaning is necessary, repeat steps 8 through 24 for each additional cleaning.
26. If cleaning is completed and the System is to be stored, go to the beginning of this section and review Shutdown instructions in section 4.1 and 4.2.
27. If cleaning is complete and the System will be operated again within a short period of time, proceed to step 28 below.
28. Reconnect the Booster Pump Inlet Line to the Inlet Sea Cock Valve [2] or optional Sea Strainer [3] as appropriate.



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## **CHAPTER 5**

# **Troubleshooting**



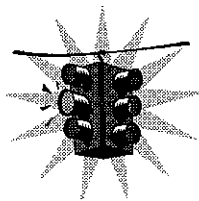
## 5. Troubleshooting

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This section deals with common occurrences with the HRO Systems Seafari 170 system. Some occurrences may have many different causes. For each symptom, one or more causes are given. In turn, each cause has one or more corresponding tests to help identify whether the cause of the occurrence is the correct one. When the test(s) has confirmed the source of the problem, the appropriate remedy is given to correct it.

There may be more than one cause of a problem. In the following guide, when there is more than one cause of a problem, the causes are listed starting with the least serious. The tests given are designed to determine whether or not the cause of the problem is the correct one. When diagnosing the causes of a problem in this case, eliminate the listed causes one by one until the correct cause is found. Then the appropriate remedy is performed. Diagnosing and correcting the various occurrences in this manner, makes troubleshooting easier and less time consuming.

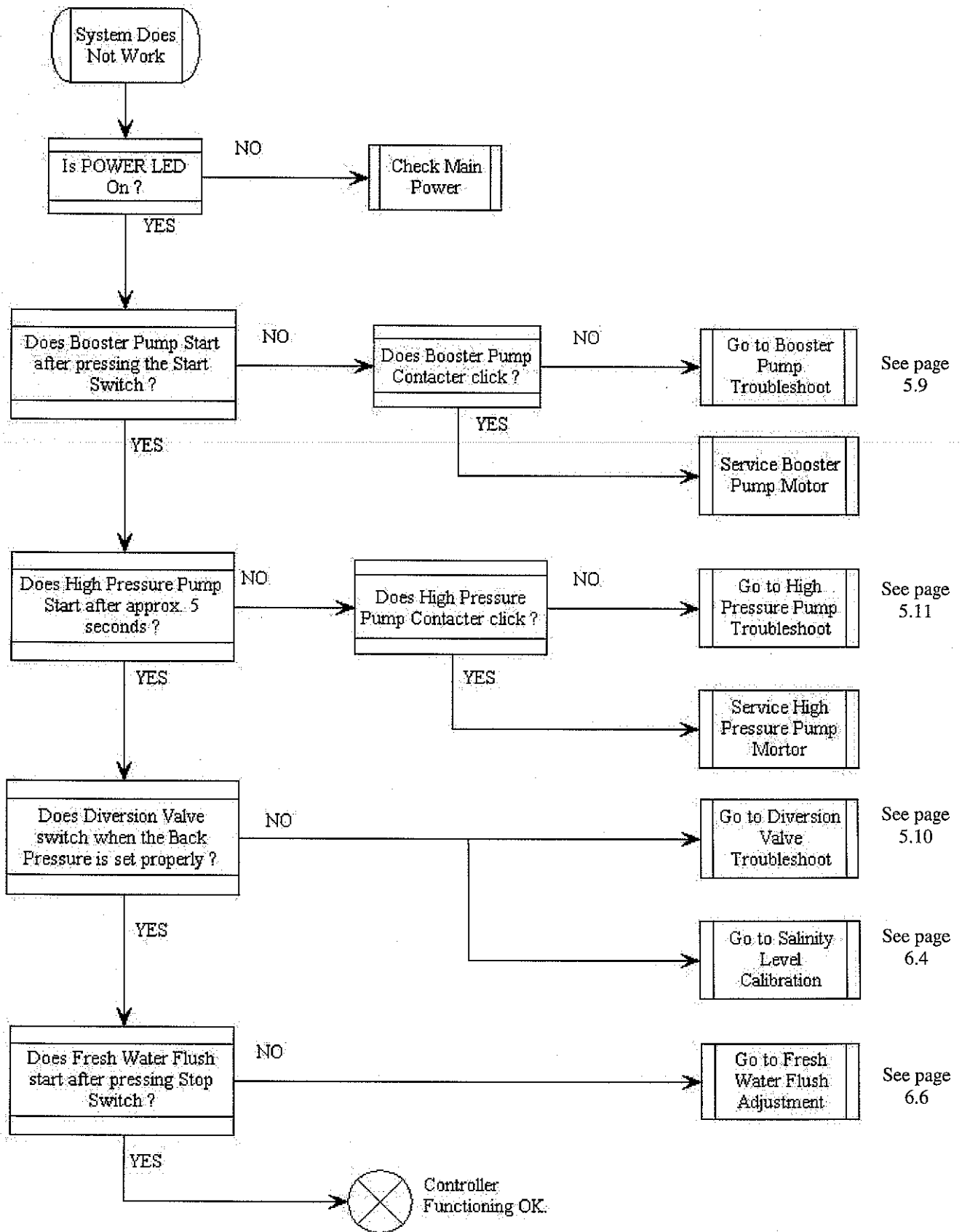
The second page of this section gives a flowchart that gives a roadmap as to the subsystem responsible when the system does not work. This is yet another tool to determine where to start.



**USE CAUTION WHEN TROUBLESHOOTING. DO NOT PERFORM MAINTENANCE UNLESS:**

1. The System Feed Water Sea Cock Valve [2] is closed.
2. The system main electrical disconnect switch is switched "**OFF**", **LOCKED**, and **TAGGED**.
3. Chapter 9, "EXPLODED PARTS VIEWS" of the USERS MANUAL is available.

Electrical Troubleshooting Guide



Symptom	Possible Causes	Test	Remedy
<b>1. The System Shut Down By Itself &amp; High/Low Pressure Lamp is Lit.</b>	1. Low Pressure Fault.	<ol style="list-style-type: none"> <li>1. Reset Fault</li> <li>2. Start System and observe Low Pressure Gauge.</li> <li>3. If the Low Pressure Gauge reads less than 6 psi and the High/Low Pressure Lamp blinks after 5 minutes or LESS, and the System shuts off, it is due to a Low Pressure Fault.</li> </ol>	<ol style="list-style-type: none"> <li>1. Make sure Sea Cock Valve is Open.</li> <li>2. Replace Pre-Filter Element.</li> <li>3. Clean Sea Strainer. (If Installed)</li> <li>4. Clean or Replace Plankton Filter (If Installed)</li> <li>5. Ensure there are no kinks or blockages in Feed Line.</li> <li>6. Ensure there are no air suction Leaks in Feed Line.</li> </ol>
	2. High Pressure Fault	<ol style="list-style-type: none"> <li>1. Check to see if there are and blockages or Closed Valves in Brine Discharge Line.</li> <li>2. Check to see if there are and blockages or Closed Valves in Product Line.</li> <li>3. Fully Open Back Pressure Regulator. Reset Fault. Start system &amp; check to see if System Pressure is less than 50 psi.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check High Pressure Switch Setting. Adjust if necessary. Refer to page 6.4 for instructions. Replace Switch if necessary.</li> <li>2. Feed Water Salinity or Temperature may have changed causing pressure to increase.</li> </ol>
<b>2. The System Shut Down By Itself &amp; High/Low Pressure Lamp is <u>NOT</u> Lit.</b>	Electrical System	<ol style="list-style-type: none"> <li>1. Check Voltage at system                      12 DC Systems shut down when the voltage falls below 11 VDC                      24 VDC Systems shut down when the voltage falls below 22 VDC.                      AC systems may experience a voltage spike or cycle fluctuation causing the circuit breaker to trip.</li> <li>2. Is Circuit Breaker tripped or is it rated too low for the system.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check Electrical Source</li> <li>2. Check for Loose electrical connections.</li> <li>3. Reset Circuit Breaker.</li> </ol>
<b>3. Low Pressure Gauge reading low or no pressure but system remains running.</b>	Low Pressure Gauge orifice is clogged with debris.	Inspect Pressure Gauge orifice at the pressure inlet port on the rear of the gauge.	Clean Orifice of corrosion & debris. Replace Gauge if necessary.
	Low Pressure Switch has drifted from factory setting.	Test Low Pressure Switch by slowly closing the Inlet Sea Cock Valve with the system running. If the High/Low Pressure Lamp does not begin blinking at 6 psi or below as the system is starved of water, there is a problem with the Low Pressure Switch.	Adjust Low Pressure switch. Refer to page 6.3 for instructions. Replace switch if necessary

Symptom	Possible Causes	Test	Remedy
<b>4. The System Shut Down at 800 psi or lower, &amp; High/Low Pressure Fault Lamp is lit.</b>	1. High Pressure Switch has drifted from factory setting.	1. Check to see if there are any blockages or Closed Valves in Brine Discharge Line.  2. Check to see if there are any blockages or closed Valves in Product Lines	1. Adjust High Pressure switch. Refer to page 6.4 for instructions. Replace switch if necessary.
	2. High Pressure Gauge may be corroded & is not displaying the actual system pressure.	Inspect Pressure Gauge orifice at the pressure inlet port on the rear of the gauge.	Clean Gauge orifice with a small drill. Be careful not to damage the gauge.
<b>5. The System pressurizes past 1000 psi and does not automatically shut down.</b>	1. High Pressure Switch has drifted from factory setting.	Slowly pressurize system to 950 psi. (Do not exceed Product Water Production Specification of 7 gph )	Adjust High Pressure switch. Refer to page 6.4 for instructions. Replace switch if necessary.
	2. High Pressure Gauge may be corroded & is not displaying the actual system pressure.	Inspect Pressure Gauge orifice at the pressure inlet port on the rear of the gauge.	Clean Gauge orifice with a small drill. Be careful not to damage the gauge.
<b>6. The System is running at 850 psi &amp; is not reading 7 gph on system Flow Meter.</b>	1. System is running in Feed Water greater than 35,000 ppm.	Check salinity of Feed Water. <i>Higher salinity Feed Water Requires higher Pressure to make rated flow.</i>	Refer to Salinity Effects chart to identify expected pressure for Higher Salinity Feed Waters. <i>Do not exceed 900 psi Feed Pressure or 7 gph rated flow.</i>
	2. System Feed Water is a lower temperature.	Check Temperature of Feed Water. If feed water is below 76° F / 24 C, pressure should be expected to be higher.	Refer to "Temperature Effects" chart on page 8.2 to find expected pressure adjustment. <i>Do not exceed 900 psi Feed Pressure or 7 gph rated flow.</i>
	3. RO Membrane.	Membrane just installed recently.	Run System at pressure for at least 30 minutes. Re-evaluate performance after 30 minutes.
	4a. RO Membrane Element is fouled.	Investigate whether the RO membrane element been stored improperly, without proper flushing and/or storage solution or if it has slowly degraded.	Membrane is biologically fouled and cleaning may restore performance. If not, membrane should be replaced.
	4b. Membrane is fouled.	Membrane was operated in water where oil or chemicals were present.	Membrane needs to be replaced.
	4c. Membrane is fouled.	RO membrane is dried out.	Membrane needs to be replaced.
	4d. Membrane is fouled.	RO membrane was exposed to temperatures in excess of 140° F / 60 C.	Membrane needs to be replaced.
	4e. Membrane is fouled.	RO membrane was exposed to pressures in excess of 1000 psi and is compacted.	Membrane needs to be replaced.
<b>7. The Booster Pump does not operate.</b>	Various	See page 5.8 (this section) for step by step testing.	See page 5.9 for remedies.
<b>8. The High Pressure Pump does not operate.</b>	Various	See page 5.10 for step by step testing.	See page 5.11 for remedies.
<b>9. The Diversion Valve does not operate.</b>	Various	See page 5.9 (this section) for testing.	See page 5.10 for remedies.



Symptom	Possible Causes	Test	Remedy
10. The System does not produce rated flow of 7 gph after Adjusting for Temperature and Salinity Effects.	1. Restriction in the Product outlet line/hose.	Ensure there are no blockages in product hoses or lines.	Straighten lines and hoses leading from the product outlet. Open all valves on product line completely.
	2. Error in calculating Salinity or Temperature Effects.	Higher salinity of Feed Water lowers production and requires increase in pressure.  Lower temperature of Feed Water decreases production and requires an increase in Feed Water Pressure.	Refer again to "Salinity Effects" and "Temperature Effects" charts.
	3. Fouled Membrane	Membrane has been:  1. Stored Improperly for extended period of time  2. Been operated in contaminated waters containing oil or other chemicals.  3. Been exposed to temperatures in excess of 140° F / 60 C.  4. Been pressurized past 1000 psi and become compacted.  5. Allowed to dry out.	1. In tests 1 and 2, Membrane Cleaning is performed. This may not be completely effective in all situations.  2. In tests 3 through 5, RO Membrane element must be replaced.
11. The System produces more than 7 gph when pressure is lower than 420 psi in full salinity seawater.	1. Cracked RO Membrane Element.	1. Water Quality Lamp is Red.  2. Salinity of Product water is extremely high.	Membrane needs to be replaced.
	2. Product Water O-ring on one or more of End Plug is damaged.	1. Water Quality Lamp is Red.  2. Salinity of Product water is extremely high.	Replace damaged O-rings. <i>Use care during re-assembly.</i>
12. The Water Quality Indicator remains Red (Un-potable water) for Extended Period.	1. Salinity Probe	Salinity Probe has debris on the probe, causing the system to read poor water quality.	Clean the Salinity Probe with a toothbrush.
	2. Salinity Monitor out of calibration.	Test the actual Salinity of the product water with a portable TDS meter. <i>The system switches from "potable" water to un-potable water at 800 TDS.</i>	If the Salinity Monitor is found to need calibration, refer to page 6.4 for instructions.
	3. Product O-rings	Check to see if Product Water O-rings are damaged. <i>These are the O-rings that separate the brine from the product in the Membrane Vessel Assembly. They are item 16 on page 9.11.</i>	Repair O-rings if they are found to be damaged.

Symptom	Possible Causes	Test	Remedy
<b>13. The Water Quality Indicator remains Red (Unpotable water) for Extended Period.</b> <i>(Continued)</i>	4. Membrane has a broken Product Tube.	The system not only produces bad water, but also produces 7 gph or more at a lower than normal Pressure setting.	Replace RO Membrane element. Refer to page 6.11 for instructions.
	5. Membrane is fouled, or has been attacked by chemicals.	The system produces the appropriate amount of product water, but the product water remains of poor quality.	Membrane is fouled and cleaning may restore performance. If not, membrane should be replaced. Refer to page 4.6 & 4.7 for Membrane Cleaning and page 6.11 for Membrane Replacement.
<b>14. The Water Quality Indicator is Green (Potable water lamp) but the water has a definite salt taste.</b>	1. Blockage or pressure in excess of 55 psi is present in the Brine discharge line.	A blocked brine discharge line causes brine water to mix with product at the Diversion Valve. Flow through the flowmeter will be normal.	Ensure that the Brine discharge line is free from kinks and that any valves installed in the brine discharge line are fully open.
	2. Salinity Probe	Salinity Probe has debris on the probe causing the system to read good water quality.	Clean the Salinity Probe with a toothbrush.
<b>15 Product Water is leaking from the Product Tubing when the Green (Potable water lamp) comes on.</b>	1. Blockage or pressure in excess of 55 psi is present in the product outlet line from the system.	Is water flowing from the product outlet line in the ship fresh water storage tank?	Ensure that the Product line is free from kinks and that any valves installed in the product line are fully open.
	2. Clogged Charcoal Filter or pH Neutralizer.	Leaks occur forward of this filter, but not downstream.	Change the appropriate Charcoal or pH Neutralizing element.
<b>16 There is a Sulfurous smell (rotten eggs) in the product tank.</b>	1. Dirty Pre-Filtration Element.	Dirty Pre-Filtration Elements allow biological matter to grow in a very amiable environment. When this biological matter decomposes sulfur gas is released as a byproduct.	Replace Pre-Filter element and/or Plankton Element if installed.
	2. Charcoal Filter	Charcoal filter has not been replaced in the recommended time interval.	Change Charcoal element.
	3. Product Tank	Product tank is dirty or has biological growth in it.	Clean and Chlorinate Product tank.
<b>17 The UV sterilizer is flickering or does not light. (Do not look directly at the UV lamp)</b>	1. UV lamp.	UV lamp has not been changed in the recommended period of time.	Replace the UV lamp.
	2. Voltage.	The UV ballast is very sensitive to voltage changes.	Ensure that the voltage supplied to the UV sterilizer is within 11.5 VDC to 13 VDC.

High Pressure Pump Troubleshooting (See also Electrical Troubleshooting if Pump Fails to Operate)

Symptom	Possible Causes	Test	Remedy
18. The High Pressure Pump flow is normal when the system operating pressure is at zero, but the flow drops below normal as pressure is applied.	1. Faulty Seals	1. Leaking from High Pressure Pump Manifold 2. More than 2000 hrs.on Seals	Replace High Pressure Pump Seals
	2. Worn High Pressure Pump valves, valve seats, valve springs and or valve seat "O" rings are allowing internal by-passing.	1. Pump is noisier than usual 2. Vibration in High Pressure Gauge and or Hoses. 3. Valves accumulated more than 2000 hrs.	Replace High Pressure Pump Valve Assemblies
	3. Improper Voltage (DC systems)	Check Voltage at system	Check Electrical Source
	4. Improper Cycles (AC systems)	Check Cycles at system	Check Electrical Source
19. High Pressure Pump flow is normal when Operating pressure is at zero, but the flow becomes erratic and pulsates as pressure is applied.	1. Worn High Pressure Pump valves, valve seats, valve springs and or valve seat "O" rings are allowing internal by-passing.	1. Pump is noisier than usual 2. Vibration in High Pressure Gauge and or Hoses. 3. More than 2000 hrs. on Valves.	Replace High Pressure Pump Valve Assemblies
	2. Foreign Material Interfering with Valve Operation.	1. Pump is noisier than usual 2. Vibration in High Pressure Gauge and or Hoses. 3. Less than 2000 hrs. on Valves.	Remove manifold & Inspect High Pressure Pump Valve Assemblies
20. High Pressure Pump flow is normal when operating pressure is at zero, but the flow becomes erratic and pulsating as pressure to the system is applied.	1. Worn High Pressure Pump Valves, Valve Seats, Valve Springs and or Valve Seat "O" Rings are allowing internal by-passing.	1. Pump is noisier than usual 2. Vibration in High Pressure Gauge and or Hoses. 3. More than 2000 hrs. on Valves.	Replace High Pressure Pump Valve Assemblies
	2. Foreign Material Interfering with Valve Operation.	1. Pump is noisier than usual. 2. Vibration in High Pressure Gauge and or Hoses. 3. Valves have fewer than 2000 hrs.	Remove manifold & Inspect High Pressure Pump Valve Assemblies
21. High Pressure Pump Leaks Oil	Drain Plug	Inspect bottom of pump	Tighten Pump Drain Plug or Replace Plug O-ring
22. High Pressure Pump leaks water between manifold and Drive End.	1. Worn Inlet Packings.	Pump operated dry or at a vacuum	Replace Inlet Packings
	2. Worn Seals.	Seals have not been replaced in 2000 or more hours	Replace Seals

## Electrical Troubleshooting

Symptom	Possible Causes	Test	Remedy
<b>23. The Start Switch is Pressed, but the system does not attempt to start.</b>	1. System is in Fresh Water Flush Mode.	Fresh Water Flush Lamp is Blinking.	Press Stop to exit Fresh Water Flush Mode. Press Start to operate the system.
	2. System has a Fault.	High/Low Pressure lamp is lit.	Press Fault Reset on controller. Press Start to operate the system.
	3. No power to the system	The Power LED on the touchpad is not illuminated.	Reset the system circuit breaker.
	4. Microprocessor has locked up.	None.	Turn power off at the circuit breaker for a minimum of 20 seconds to reset the microprocessor.
	5. Blown Fuse in controller.	Check the fuse in the controller.	Replace fuse if blown.
	6. Improper wiring.	Ensure that system is wired correctly and/or there are loose wires.	Check the system wiring. Refer to Chapter 7 for wiring diagrams.
	7. Inadequate power source to the system	AC & DC Systems: Ensure that the voltage does not drop below the industry standard of 15%. If the voltage drops below this standard during the system startup, the system will not start.	Provide adequate power to the system. Refer to page 7.1 for power requirements.
	8. Defective Start Switch on touchpad.	Test with Substitute Touchpad.	Replace Touchpad..
<b>24. The Stop Switch is Pressed, but the system does not stop.</b>	1. Microprocessor has locked up.	None.	Turn power off at the circuit breaker for a minimum of 20 seconds to reset the microprocessor.
	2. Defective Stop Switch on touchpad.	Test with Substitute Touchpad.	Replace Touchpad..
	3. Water damage to printed circuit board.	Inspect Printed Circuit board for presence of water.	If board had had water spilled on it, it is possible to use a blow drier to dry the water causing the short. If this does not solve the problem, replace the printed circuit board.
<b>25. Fuse in the controller blows at startup.</b>	1. Power source	There is either low voltage or high voltage into the system.	Provide adequate power to the system. Refer to page 7.1 for power requirements.
	2. Defective Component that relies on the fuse for power.	Check the 3-Way Diversion Valve, Printed Circuit board, Fresh Water Flush, UV Sterilizer (If installed), or the Touchpad.	Repair or replace Defective Component.

### **Booster Pump Troubleshooting:**

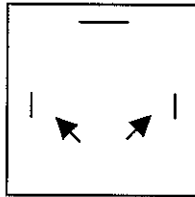
If the Booster Pump fails to operate, follow these steps to isolate the problem.

1. Make sure the system is receiving proper power and the "POWER" LED is on.
2. Press "Booster Pump" switch to activate the motor. Do not press any other switch.
3. Measure the voltage between terminals 1 and 2 on the Main Terminal Strip in the controller.
4. If the voltage measured in the step 3 matches the system voltage, then problems may be in the motor wiring or the motor itself.
5. If low or no voltage present in the step 3 above, then check for proper operation of the Booster Pump Contactor. To deactivate the contactor, press the "Stop" switch twice. To activate the contactor again press "Booster Pump" switch.
6. If the contactor is mechanically operating, but no voltage present at the motor terminal (step 3 above), then the contactor may be at fault.
7. If the contactor does not operate mechanically, then measure DC voltage between A1 and A2 terminals. It should read 12V DC when activated.
8. If the contactor gets 12V DC, but inoperative, then its coil may be open. Replace the contactor.
9. If 12V DC is not present when the booster pump is activated, trace yellow and yellow/black wires to the main circuit board and measure the DC voltage at the terminals. It should read 12V when activated.
10. Confirm the "BOOSTER PUMP (BP)" LED (on circuit board), is on when the Booster Pump is activated. Whenever this LED is on, BP terminals on the circuit board has 12V. If it is not the case, replace the controller circuit board.

## Diversion Valve (3-Way Valve) Troubleshooting

If the Diversion Valve fails to operate, follow these steps to isolate the problem.

1. Disassemble Controller Enclosure by removing 4 screws. This exposes the main controller circuit board.
2. Disconnect 3 wires from "SAL PROBE" terminals temporarily after noting wire connections. (Main Printed Circuit "PC" Board) This fools the controller to "think" there is good water.
3. Start the system.
4. Approximately 10 seconds after the system starts, the Water Quality LED turns green from red. If this is not observed, then go to Salinity Level Calibration procedure on page 6.4.
5. When the Water Quality LED is illuminating in green, disconnect a control cable connector at the Diversion Valve. If the solenoid inside of the valve is functioning, a distinct click sound is heard.
6. If the valve is silent, measure the continuity of its solenoid coil as shown below.



Measure the DC resistance  
between pins 1 & 2.  
It is approx. 12 to 15  $\Omega$ .

7. If the resistance value is abnormal (shorted or open), then replace the Valve.
8. If resistance value is OK, then measure the DC voltage at the connector, pins between 1 & 2. This should be 12V.
9. If the voltage is 0 on the step above, measure a DC voltage on the terminals marked as "3WAY" on the Control Circuit board. If there is 12V present, then check the connecting cable between the Valve and Circuit board.
10. If no voltage indication on the terminals, check to see if the "3-WAY VALVE" LED is illuminated on the board. If it is off, then replace the Control board.

### **High Pressure Pump:**

If the High Pressure Pump fails to operate, follow these steps to isolate the problem.

1. Make sure the system is receiving a proper power and the "POWER" LED is on.
2. Press "Start" switch to activate the motor. It will take approximately 5 seconds before the High Pressure Pump Motor to start. Do not press any other switch.
3. Measure the AC voltage between terminals 4 and 5 (AC Systems) or 3 and 4 (DC systems) on the main terminal strip.
4. If the voltage measured in the step 3 above matches the system voltage, then problems may be in the motor wiring or the motor itself.
5. If low or no voltage present in the step 3 above, then check for a proper operation of the High Pressure Pump Contactor. To deactivate the contactor, press the "Stop" switch twice. To activate the contactor again press "Start" switch.
6. If the contactor is mechanically operating, but no voltage present at the motor terminal (step 3 above), then the contactor may be at fault.
7. If the contactor does not operate mechanically, then measure DC voltage between A1 and A2 terminals. It should read 12V DC when activated.
8. If the contactor gets 12V DC, but inoperative, then its coil may be open. Replace the contactor.
9. If 12V DC is not present when the High Pressure Pump is activated, trace orange and orange/black wires to the main circuit board and measure the DC voltage at the terminals. It should read 12V when activated.
10. Confirm the "HIGH PRESSURE PUMP (HP)" LED (on circuit board), is on when the High Pressure Pump is activated. Whenever this LED is on, HP terminals on the circuit board has 12V. If it is not the case, replace the main circuit board.



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## **CHAPTER 6**

# **Maintenance & Repair**



## 6. Maintenance & Repair

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**Weekly Quick Check:** The following steps ensure that potential problems are resolved preventing major repairs.

1. Inspect all fasteners for tightness including brackets, screws, nuts, and bolts. Pay special attention to the High Pressure Pump [11] and Electric Motor [10] since they are subject to increased vibration.
2. Make sure Sea Strainer [3] & Plankton Filter [5], if either are installed, are clean and do not restrict flow.
3. Check the level of the crankcase oil. The minimum oil level is the center of the sight glass, located at the right side of the system. The maximum oil level is the top of the sight glass.

Use only HRO High Pressure Pump oil. **DO NOT USE MOTOR OR OTHER HYDRAULIC OIL.**

4. Clean any salt water or salt deposits from the system with a wetted rag.
5. Check for fluid leaks; either oil from the High Pressure Pump or water from anywhere in the system.
6. Check all tubing and high-pressure hoses for wear and friction against abrasive surfaces. *The hoses should not contact heated or abrasive surfaces.*
7. Check Inlet Pressure to the high Pressure Pump. If pressure is below 10 psi after 5 minutes of operation, replace Pre-Filter element.

### **DO NOT PERFORM MAINTENANCE UNLESS:**

1. The System Feed Water Sea Cock Valve [2] is closed.
2. The system main electrical disconnect switch is switched "**OFF**", **LOCKED**, and **TAGGED**.
3. Chapter 9, EXPLODED PARTS VIEWS of the USERS MANUAL is available.

## 6.1 Operator Maintenance Intervals

The frequency of required maintenance is dependent on the regularity of usage, the condition of the intake water (the location of use), the length of time the system is exposed to water, the total running time and, in some cases, the manner in which the System is installed. Because of these factors, it is virtually impossible to comprise an exact timetable for required maintenance. The following maintenance timetable is an estimate of the time intervals at which maintenance may be required on the various systems components. This is based upon factual data compiled from HRO Systems installations around the world. However, this schedule must be adjusted to each individual system depending upon the variables listed.

COMPONENT	MAINTENANCE REQUIRED	TIME INTERVAL INTERMITTANT DUTY
Sea Strainer	Inspect & Clean Screen & Housing	weekly.
Plankton Filter	Inspect & clean	weekly
Pre-filter	Replace element	Low Pressure is <6 psi
Flow Meter	Clean Inside of the clear tube	As required when dirty
High Pressure Pump	Change oil	500 hrs.
	Replace Seal Kit	2000 hrs. / as required
	Replace Valve Kit	2000 hrs. / as required
R. O. Membrane	Clean Element	When production or salt rejection decreases by 10%
Salinity Probe	Clean Probes	Annually
Charcoal Filter	Replace Element	3 months
U.V. Sterilizer	Replace lamp & clean quartz sleeve	2000 Hours
Fresh Water Flush Charcoal Briquette	Replace Element	3 months
Other _____		
Other _____		
Other _____		

## 6.2 Small Item Maintenance & Repair

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1. **Inlet Thru Hull Fitting [1]:** Keep the Inlet Thru Hull Fitting free and clear of debris and marine growth. If the Inlet Thru Hull Fitting is clogged, this results in a low feed pressure condition, which causes the System to shut off.
2. **Inlet Sea Cock Valve [2]:** The packings and connections of the Inlet Sea Cock Valve must be tight and must properly seal. Clean the valve cavity of debris or replace the seal and seat, or the entire valve, as required.
3. **Sea Strainer [3]:** Keep the mesh screen free and clear of debris. When the mesh screen is clogged, it results in a low-pressure condition causing system shut off. To clean the Sea Strainer:
  1. Remove the bowl by turning it counter-clockwise.
  2. Remove the Mesh Screen from the bowl.
  3. Remove the flat sealing gasket from the bowl and take care to not damage it.
  4. Wipe the sealing gasket with a damp cloth. Lubricate it sparingly with Parker "O" ring lubricant.
  5. Place the seal back onto the bowl. Seat the mesh screen back into the bowl.
  6. Screw the lid on clockwise. *Hand-tighten only enough to seal water in and air out.*
4. **Plankton Filter [5] Element Cleaning:** Identical procedure for Pre-filter and Charcoal Elements
  1. Unscrew the blue bowl counter clockwise.
  2. Remove the Plankton Filter Element from the bowl.
  3. Remove the O-Ring from the top of the bowl and take care to not damage it.
  4. Clean the mesh screen filter element with a bristle brush and water spray.
  5. Wipe the O-Ring with a damp cloth.
  6. Lubricate it sparingly with O-Ring lubricant.
  7. Place the O-Ring back onto the bowl.
  8. Insert the cleaned, or a new, plankton filter element into the bowl.
  9. Screw the bowl on clockwise.
5. **Pre-filter [6] Element Replacement:** The pre-filter elements must be cleaned, or replaced, when plugged to the extent that the Low Pressure Gauge at the control panel reads below 10 PSI. At or slightly below 6 PSI the Low Pressure Switch shuts the System off. *Pre-filter element replacement procedure is identical to the plankton filter element, see item #4 above for replacement.*
6. **Low Pressure Gauge [7]:** If the pressure gauge fails to register the orifice may be corroded with debris. Use a thin wire to dislodge any debris trapped within the pressure port orifice.
7. **Low Pressure Switch [8]:** The Low Pressure Switch contains one N.O. (Normally Open) contact. As the Booster Pump builds pressure on the Pre-filtration Section, the Low Pressure Switch closes at 6 PSI (+/- 2 psi). When pressure decreases below 6 PSI (+/- 2 PSI), the Low Pressure Switch opens and shuts the system off. Adjustment of the Low Pressure Switch is not recommended.

If in field adjustment is absolutely necessary:

1. Stop the Seafari 170 system.
2. Remove the cap located in the center top of the pressure switch to expose the calibration screw.
3. Adjust the calibration screw, maximum 1/8th turn (45 degrees) at a time, clockwise to increase and counter clockwise to decrease the set point.
4. Restart the system and check the setting by slowly closing the Inlet Sea cock Valve while observing the Low Pressure Gauge at the point of shut down.
5. Repeat as necessary to calibrate the switch.

8. **High Pressure Gauge [15]:** If the pressure gauge fails to register, the orifice may be corroded with debris. Use a thin wire to dislodge debris trapped in the orifice.
9. **High Pressure Switch [16]:** The High Pressure switch keeps the system in operation when high pressure is below 950 PSI ( $\pm 50$  psi). When the high pressure reaches 950 PSI ( $\pm 50$  psi) the High Pressure Switch shuts the System off. In field, adjustment of the High Pressure Switch is not recommended. If adjustment is absolutely necessary:
  1. Open fully the Back Pressure Regulator [17].
  2. Start the Seafari 170 system.
  3. Remove the sealing cap located on the top of the pressure switch to expose the calibration screw.
  4. Using a 3/16" hex wrench, gently adjust the calibration screw, maximum 1/8th turn (45 degrees) at a time. Turn the screw clockwise to increase and counter clockwise to decrease as appropriate.
  5. Slowly increase operating pressure while observing the High Pressure Gauge. The High Pressure Switch should stop the system at 950 PSI ( $\pm 50$  PSI). *If the system shuts off below 900 PSI or above 1000 PSI, then repeat the adjustment procedure and retest the set point.*
  6. Once the High Pressure Switch is properly set replace the adjustment screw cover.
10. **Back Pressure Regulator [17]:** The Back Pressure Regulator Stem does not require maintenance.
11. **Flow Meter [20]:** Since the flow meter body is clear, light penetrates it and supports biological growth. To clean the flow meter body, remove the top access fitting, the guide rod, float and O-Ring bumpers and tube stops. Clean the interior of the tube using a bottlebrush, soft rag, cotton swab or other soft item. Reassemble the unit.
12. **Salinity Probe [19]:** The salinity probe requires cleaning once a year. To clean the probe:
  1. Unscrew the probe from the control manifold.
  2. Using a soft bristle brush, scrub the probes to remove any built up debris.
  3. Clean the Salinity Probe threads and replace all old Teflon tape before reinstalling hand tight only.

**Salinity Probe Calibration:**

1. Disconnect the system from power source.
2. Temporarily disable the Booster Pump and High Pressure Pump by removing power cords at the main terminal strip in the Controller, after noting the original connections.
3. Remove the Salinity Probe from its mounting tee, and wipe electrodes clean with a clean soft cloth.
4. Restore the power to the system and press the "Start" switch. Wait for approximately 10 seconds.
5. If the Salinity Probe is exposed in the air and it is dry, the "Water Quality" LED should turn green.
6. If the LED does not turn on green, disconnect probe cable from the circuit board terminals. If the LED comes on green, inspect the Salinity Probe thoroughly and replace it if necessary.
7. Dip the Salinity Probe electrodes well into the test solution of 1,000 ppm.
8. Turn the "SALINITY SET" control on the main circuit board to fully clockwise position, then slowly turn back counter clockwise until the LED turn red. Do not over turn. Note that there is a 5 second delay for the LED to change from red to green, no delays from green to red.
9. This completes the calibration of the Salinity Level.

10. Disconnect the system from power source and revert disconnected wires to original terminals, and assemble enclosures.
13. **Charcoal Filter [22]:** A sulfurous (rotten egg) smell from the product water requires the replacement of the Charcoal Element. Otherwise, the Charcoal Element should be replaced every 3 to 4 months. It is not cleanable.
14. **Ultraviolet Sterilizer [23]:** The UV Sterilizer lamp emits a low frequency form of light. This light degrades the lamp glass during use. As it degrades, the glass begins to prevent the transmission of the UV light into the water, reducing the efficiency of the sterilizer. Therefore, the lamp may remain lit, but requires replacement every 2000-4000 hrs.

**CAUTION:** *Make sure that system power is turned off before beginning sterilizer maintenance.*

**Lamp Replacement:**

1. Remove the top lid. *The ballast should remain in the lid.*
2. Remove the lamp and the lamp plug from the quartz sleeve.
3. Replace the lamp. *During lamp replacement, it is also a good idea to clean the quartz sleeve as well. The quartz sleeve should be crystal clear, if it has yellowed, it should be replaced.*

**Quartz Sleeve Cleaning:**

1. Remove the top cap (cap, ballast, and lamp).
2. Remove the three Phillips-head screws on the top end bushing.
3. Remove the top bushing and the top O-Ring and place in a safe place.
4. Remove the three Phillips-head screws on the bottom bushing (Do not remove the center screw). *When you lower the bottom bushing, the quartz sleeve should slide with it.*
5. Remove the bottom O-Ring and clean it with a damp cloth.
6. Clean the quartz tube with water and a bottlebrush. Dry with a soft cloth. *Handle the quartz sleeve carefully.*

**Reassembly:**

Insert the quartz tube into the Bottom End Plug and seat it into the center O-Ring. Attach a new U.V. Lamp into the plug. Slide the lamp into the Quartz Tube and seat the Top end plug into the vessel. Replace the three 1/4-20 cap head screws.

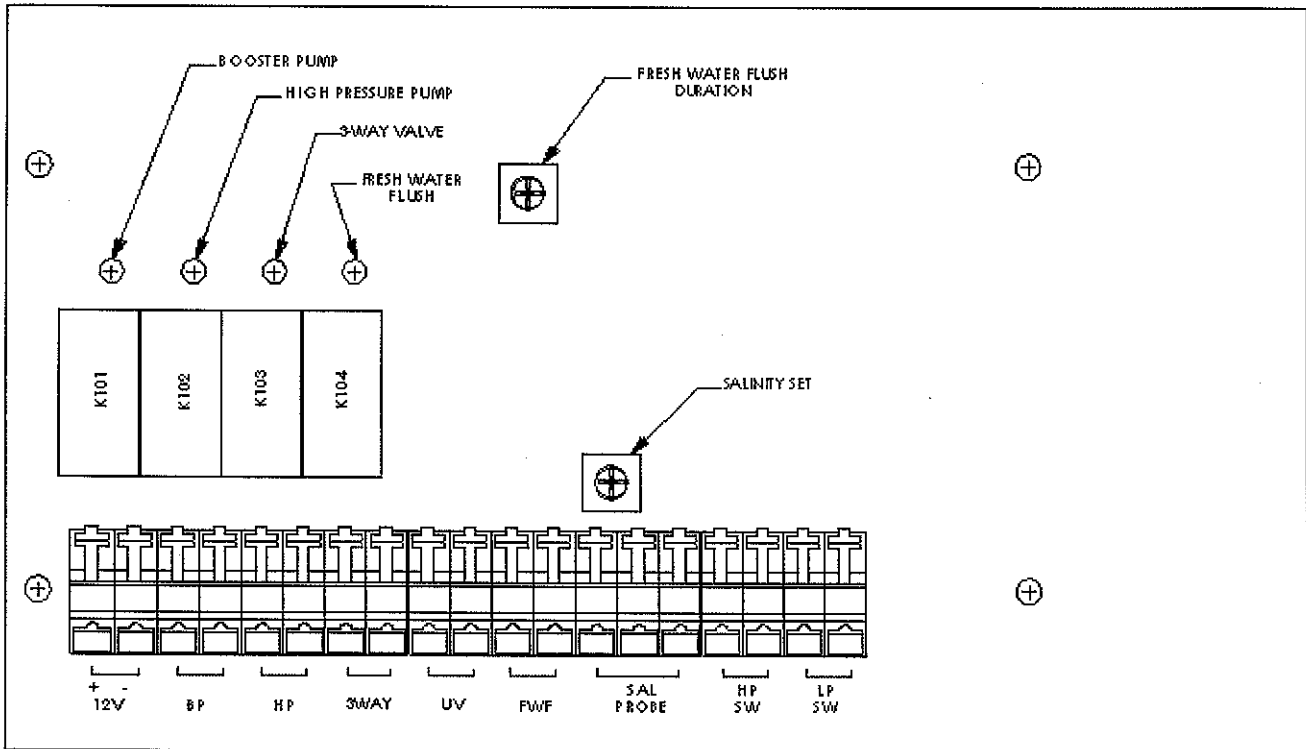
15. Fresh Water Flush [25 & 26] The Charcoal Element in the Fresh Water Flush should be replaced every 3 months.

Fresh Water Flush Adjustment:

1. Disassemble the Controller Enclosure and open it by removing 4 screws.
2. Press the "Start" switch, then the "Stop" switch.
3. Note that the "Fresh Water Flush" LED is either on or flashing.
4. Adjust "FRESH WATER FLUSH DURATION" control on the main circuit board (shown below) to obtain the a desired length of operation. Full counter clockwise position is approximately 9 minutes and full clockwise position gives approximately 14 minutes.
5. To time the duration, repeat the step 2 above.

**This completes the adjustment.**

6. Reassemble the Controller Enclosure.



16. **Controller [27]:** The salinity controller does not require any routine maintenance.

## 6.3 High Pressure Pump Maintenance & Repair

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Failure Signs and possible causes (troubleshooting):

1. Pulsations at the High Pressure Gauge are caused by.
  - Worn or broken Valve
  - Worn or broken Valve Spring
  - Worn or broken Valve Seat
  - Debris in Valve Chamber
  
2. Water Leak between the High Pressure Pump Manifold and Rear Section caused by.
  - Worn Seals or Seals damaged due to running dry.
  
3. Flow drops dramatically when attempting to pressurize and there is no flow at the Product Flow Meter. This is caused by:
  - Worn Seals
  - Seals damaged due to running dry
  - Broken Valve
  - Broken Valve Spring
  - Debris in Valve Chamber

### High Pressure Pump Servicing

#### a. Disassembly of the Discharge Valve Assemblies:

**Tools required:** 3/8" Drive Ratchet; 6 mm Hex Socket; O-Ring Pick; Two slotted screwdrivers, Torque Wrench; Needle Nose Pliers.

- 1) Only one valve kit is required to repair all of the valves in one pump. The Valve Kit includes new valve O-Rings, valve seats, valves, and springs.
- 2) Disconnect all plumbing.
- 3) Remove the six socket head screws from the manifold. Remove the outer screws first, then the inner screws.
- 4) Using a soft mallet, tap the back side of the Discharge Manifold from alternate sides to maintain alignment and avoid damage to the plungers
- 5) Grasp the Discharge Manifold from the underside and gradually lift manifold while you pull away from the Crankcase.
- 6) The Adapter/Spacers may stay with either the Discharge or Inlet Manifold. By inserting two opposing screwdrivers between Spacer and manifold, you can easily pry them out of the Discharge Manifold. If they stay in the Inlet Manifold, gently work them up and down as you pull away from the Inlet Manifold.

- 7) The Valve Assemblies are in the Discharge Manifold ports and will fall out when manifold is turned over. A complete valve assembly includes: Retainer, Spring, Valve and Seat.

**b. Disassembly of the Seal Assembly:**

Tools Required: 3/8" Drive Ratchet; 6mm Hex Socket; Packing Extractor; and Colette.

- 1) Remove the Inlet Valve Assembly from the exposed plunger rod ends, including Cotterpin, Nut, Washer, Spring, Spacer and Inlet Valve.
- 2) Grasp the Inlet Manifold from the front and underside and pull to remove from Plunger Rods.
- 3) Carefully examine backside of Low Pressure Seal before removing from manifold as it will be damaged during removal. If worn, insert screwdriver into I.D. of seal and pry out. Exercise caution to avoid damage to the Inlet Manifold.
- 4) Press ceramic Plunger with thumb or soft tool from backside of Inlet Manifold. (The High Pressure Seal may stay with the plungers or remain in the Inlet Manifold. If on the plungers, slide off by hand. If in the manifold, use a reverse pliers to remove.)
- 5) Remove Seal Retainers from Crankcase by grasping tab with pliers and pulling out.
- 6) Examine Crankcase Oil Seal to determine if Crankcase servicing is needed.
- 7) Examine Ceramic Plunger, Low Pressure Seals, V-Packings for scoring, cracks and wear and replace.

**c. Reassembly of Seal Assembly:**

- 1) Examine Seal Retainers and replace if worn or damaged. Install on Plunger Rod and press into Crankcase **with tab out**.
- 2) Place Inlet Manifold on work surface with **Crankcase Side up**.
- 3) Lubricate new Low Pressure Seals and press into position with **garter spring down**. Be certain the seal is seated squarely on the shoulder on the inlet manifold chamber.
- 4) Place the inlet Manifold on work surface with **Crankcase side down** (Larger ID ports up).
- 5) Carefully examine the Plungers for scoring or cracks and replace if worn.
- 6) Lubricate Ceramic Plungers and new High Pressure Seals. Press the plunger into the seal and position seal in middle of plunger.

NOTE: Place the deeper recessed end of the plunger into the seal from the metal back side.

- 7) Insert the Plungers into the manifold ports. Press into position using the **larger I.D. end of Discharge Valve Spacer**. Examine the O-Ring and Back-up-ring under the Sleeve for cuts or wear and replace. Examine the Barrier Slinger for wear and replace as needed. Install the Barrier Slinger with the concave side facing away from the Crankcase. Lubricate the Plunger Rod O-Ring to avoid cutting during installation. Install the Back-up-ring first then the O-Ring into the groove on the Plunger Rod. Install the Sleeve with the tapered end facing out. Gently press towards the Plunger Rod shoulder until flush with the Barrier Slinger.
- 8) Carefully install Inlet Manifold over Plunger Rod ends and slowly press into Crankcase.



- 9) Examine Inlet Valve and replace if worn. **Inlet valves cannot be reversed if worn.** The SS Inlet Valves may be lapped if not badly worn. Install the SS Inlet Valves with **square edges towards the plungers** (round edges towards the discharge). Install the Nylon Inlet Valve with **ridged side towards the discharge**.
- 10) Examine Spacers for wear and replace as needed. Install Spacer on each Plunger Rod with **smaller O.D. towards inlet valve**.
- 11) Examine Springs for damage or fatigue and replace as needed. Place on Plunger Rods.
- 12) Install Washers next with **concave side towards Inlet Manifold**.
- 13) Install Nuts and torque to 55 in. lbs. / 4 ft. lbs. / 4 Nm.
- 14) **Always install new Cotterpins** and turn ends to secure in position.

**f. Reassembly of the Discharge Valve Assembly:**

- 1) Examine Adapter Spacer O-Rings and replace if worn. Lubricate and install O-Rings and Back-up-Rings on **both front and rear of the Adapter Spacer**.
- 2) Examine the Valve Retainers for scale build up or war and install into each Discharge Manifold port with tab down into the manifold chamber.
- 3) Replace worn or damaged Springs and place into Retainers.
- 4) Examine Valve and Seats for pitting, grooves, or wear and replace as needed.
- 5) Place Valves over Springs with **concave side down**.
- 6) Place Valve Seats on Valves with **concave side down**.
- 7) Lubricate O.D. of Adapter/Spacer and insert smaller I.D. into Discharge Manifold ports. Snap into position. Exercise caution not to cut or pinch O-Rings.
- 8) Carefully guide Discharge Manifold with Spacers over Plunger Rod ends and press into Inlet Manifold.
- 9) Replace Socket Head Screws and torque to 115 in. lbs. / 9.4 ft. lbs. / 13 Nm
- 10) If oil was not changed, be sure oil is to proper level on the sight gauge.

Torque sequence for tightening the manifold:

3	1	5
X	X	X
X	X	X
6	2	4

## 6.4 Removal of the Reverse Osmosis Membrane Element

### RECOMMENDATIONS:

- The Seafari 170 Membrane Element is accessible with the Vessel still attached to the frame.
- Replace all O-Rings within the High Pressure Vessel Assembly each time the Reverse Osmosis Membrane Element is removed or replaced. Ensure these O-Rings are on hand prior to repair.
- Membranes are only installed and removed from the Inlet (LEFT) side of the High Pressure Vessel.



### REMOVAL PROCEDURE:

1. Using a 5/16" Allen wrench remove the 3 each Socket Head Cap Screws from the three-piece Segment Ring located at the end of the Pressure Vessel.
2. Push inward on the End Plug and Remove the three-piece segment ring.
3. Remove the Port Retainer.
4. Remove the High Pressure Port.
5. Insert all three of the Socket Head Cap Screws back into the End Plug. These screws are used as a handle to remove the End Plug.
6. Grasp one or more of the Socket Head Cap Screws with a pair of pliers and pull slowly outward to remove the End Plug. There is some resistance due to the two Brine O-Rings exerting friction against the Vessel wall. *With the End Plug removed from the High Pressure Vessel, the Reverse Osmosis Membrane Element is visible.*
7. Inspect each End Plug assembly and its High Pressure Fittings for signs of wear. *Inspect the O rings in the High Pressure Port fittings and replace them if they show signs of wear.*
8. Remove the 2 Brine O-Rings and Product Water O-Rings from all End Plugs removed from the High Pressure Vessel.
9. Clean the end plugs with a cloth and sparingly lubricate new Brine O-Rings and new Product Water O-Rings with O-Ring lubricant. Place them onto the End Plug.
10. With your fingers grasp the Product Water Tube and pull outward. If resistance is met then cup the open end of the High Pressure Vessel with one hand and shake downward to dislodge the R.O. Membrane Element. Run a rag through the High Pressure Vessel to remove any biological film or debris from the High Pressure Vessel.

### Tools Required:

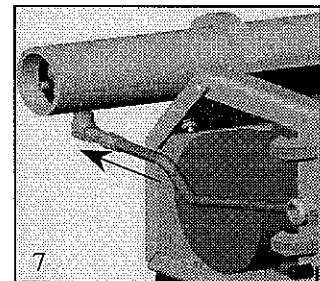
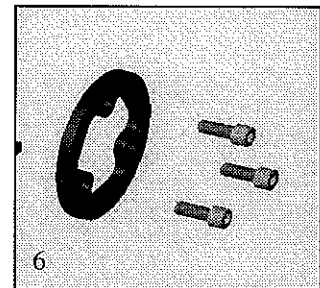
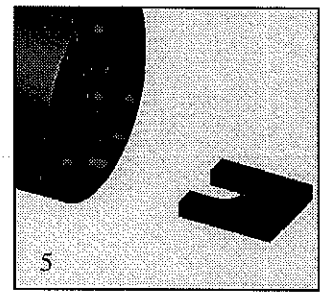
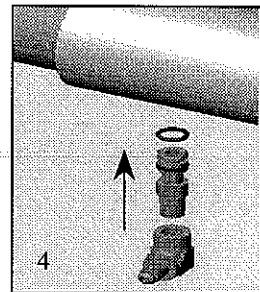
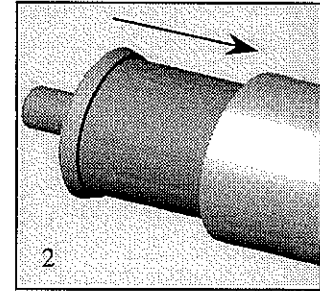
- 5/16" Allen wrench
- regular pliers
- Needle-Nose Pliers

**CAUTION:** At each end of the Reverse Osmosis Membrane Element is a Product Water Tube approximately 3/4" diameter by 1" long. The outside diameter surface of this product water tube is a sealing surface, which isolates the Product Water from the Feed Water. The surface of the Product Water Tube must be scratch free. Never use pliers or other grabbing tools on the Product Water Tube. Do not drop the R.O. Membrane onto a hard surface as the Product Water Tube may be damaged.

## 6.5 Installation/Replacement of the Reverse Osmosis Membrane Element

A new HRO Systems Reverse Osmosis Membrane Element comes from complete with a "U" cup Brine Seal at one end of the Element. **This Brine Seal must be installed at the inlet end of the High Pressure Vessel.**

1. Insert the down stream end (end without a brine seal) of the Reverse Osmosis Membrane Element into the upstream inlet end of the High Pressure Vessel.
2. Slide the Membrane Element into the High Pressure Vessel, past the brine seal, until the Membrane Element product water tube is 4 inches past the end lip of the High Pressure Vessel.
3. Insert the End Plug with new attached O-Rings into the High Pressure Vessel while aligning the High Pressure Port and Product Water Port to the respective holes in the High Pressure Vessel. Continue pushing inward on the End Plug until it's exposed end travels just past the Segment Ring Groove in the Pressure Vessel. Ensure that the Ports of the End Plug are aligned with the Port Holes of the High Pressure Vessel.
4. Insert the High Pressure Port Fitting with attached O-Rings into the High Pressure Port.
5. Replace the Port Retainer.
6. Insert the three-piece Segment Ring Set into the Segment Ring Groove of the High Pressure Vessel. Align the Segment Ring Set with the tapped holes in the End Plug for insertion of the three Socket Head Cap Screws. Attach the three Socket Head Cap Screws and tighten.
7. Connect the High Pressure Hose to the inlet end fitting of the MVA. Do not over tighten the female swivel nut.





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# **CHAPTER 7**

## **System Electrical**

# 7. System Electrical

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## ELECTRICAL REQUIREMENTS

The Electric Motors within the Seafari 170 Systems start in series with time delay between each motor starting. First, the Booster Pump starts, then the main High Pressure Pump Electric Motor starts.

For a normal Marine Ship installation, the current surges with the Booster Pump starting, then drop down to Booster Pump Electric Motor running Amperes. At the instant of the High Pressure Pump starting, the current surges up again then drop down to normal system running amperage.

Therefore, the Maximum surge current equals the Booster Pump Running Amperage plus the High Pressure Pump Starting Amperage. The normal running Amperage equals both the Booster Pump Motor and High pressure Pump Motor combined running Amperage.

## POWER SOURCE REQUIREMENTS:

After unpacking, check for damage. Be sure that the shaft rotates freely.

Check line voltage and frequency to ensure that it agrees with system nameplate. Grounding and circuit protection should be done in accordance with National Electrical Code. See connection diagram on nameplate of motor or refer to the diagrams on pages 7.3 – 7.5.

Voltage	HZ (AC)	Min. Voltage	Max. Voltage	Min. HZ	Max. HZ
<b>DC Systems</b>					
12 VDC	NA	11 VDC	15 VDC	NA	NA
24 VDC	NA	22 VDC	30 VDC	NA	NA
<b>AC Systems</b>					
110 VAC	60 HZ	108 VAC	132 VAC	58 HZ	62 HZ
220 VAC	60 HZ	207 VAC	253 VAC	58 HZ	62 HZ

## 7. System Electrical

### **RECOMMENDED CIRCUIT BREAKER, COPPER WIRE & SIZE FOR MAIN POWER LINE:**

Operating Voltage 12 VDC, Circuit Breaker Size 40 Amperes, Minimum Power Line Wire Size 12 AWG

Operating Voltage 24 VDC, Circuit Breaker Size 20 Amperes, Minimum Power Line Wire Size 12 AWG

Operating Voltage 110 VAC, Single Phase, Circuit Breaker Size 10 Amperes, Minimum Power Line Wire Size 14 AWG

Operating Voltage 230 VAC, Single Phase, Circuit Breaker Size 5 – 7.5 Amperes, Minimum Power Line Wire Size 14 AWG

### **MOTOR ROTATION:**

#### **AC Systems:**

The High Pressure Pump Electric Motor rotation is pre-wired prior to shipment.

#### **DC Systems:**

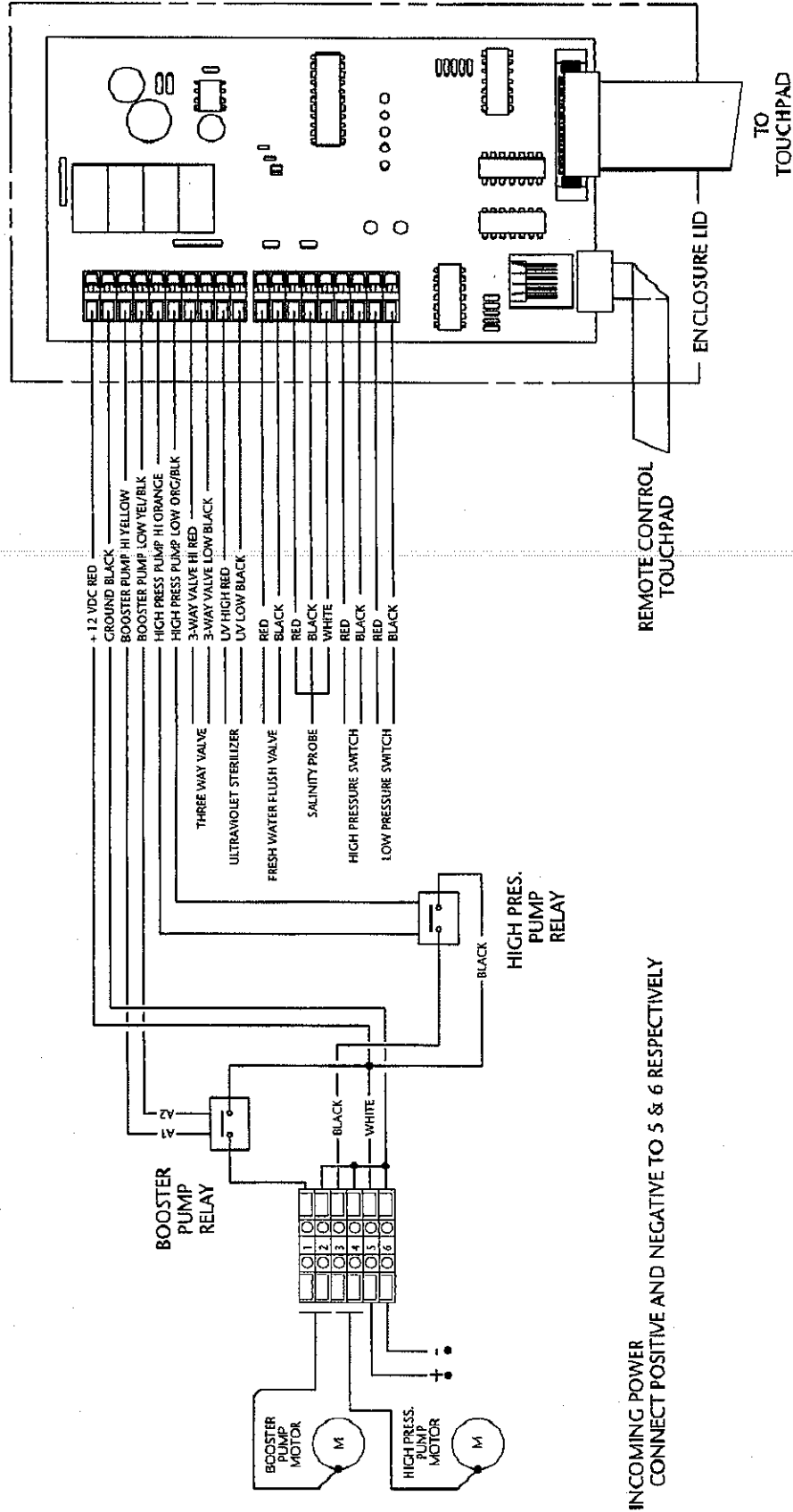
The High Pressure Pump Electric Motor and Booster Pump rotation are polarity sensitive. If rotation is incorrect, check incoming polarity and Individual motor wiring. *JOG TO CHECK ROTATION BEFORE OPERATING.*

### **WIRING CONNECTIONS**

Refer to each individual Electrical Motor, which include attached name plate with wiring diagram or separate wiring diagram plate, decal or label.

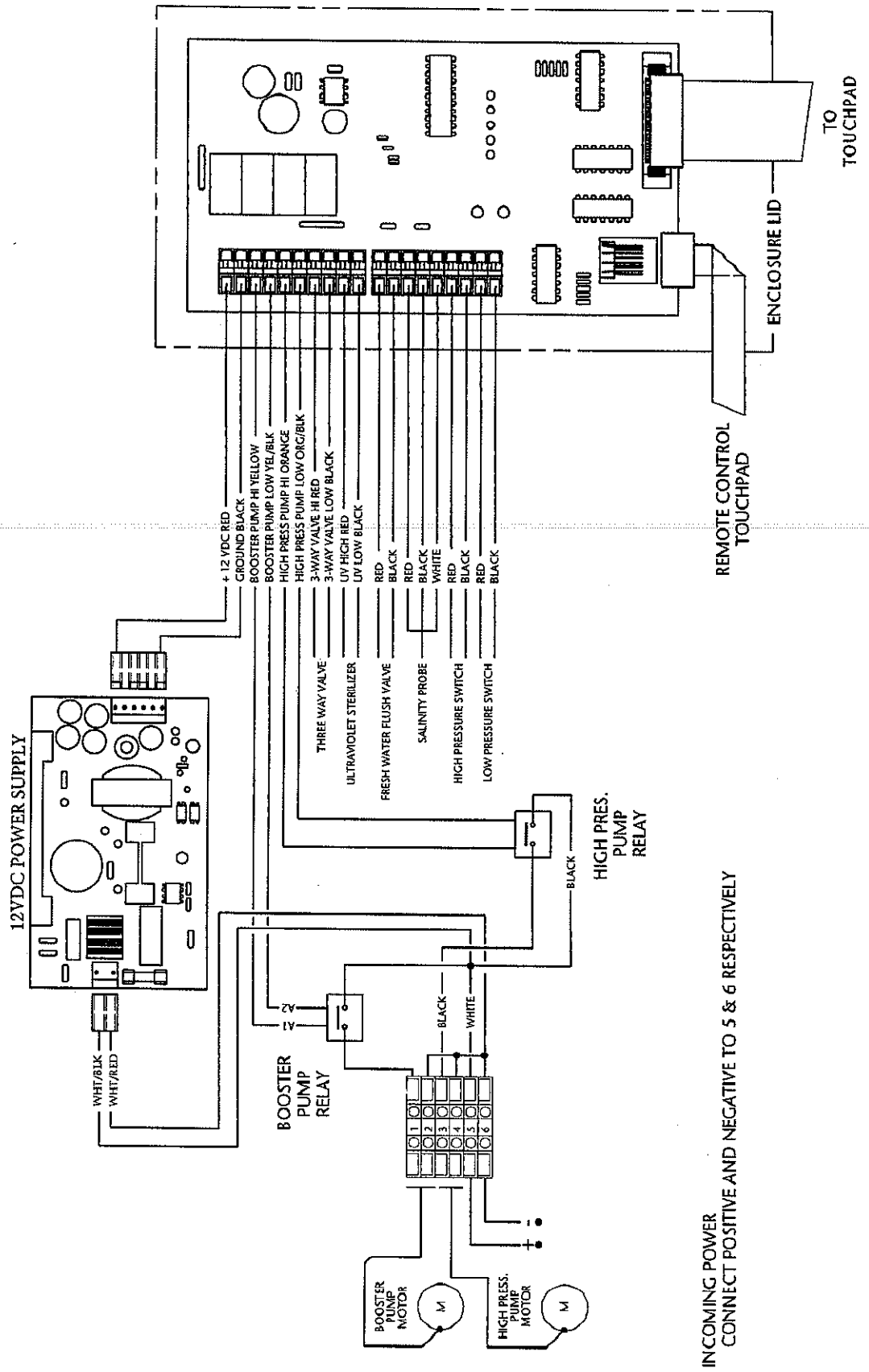
# Seafari 170 Electrical Diagram

## 12 VDC Controller



# Seafari 170 Electrical Diagram

## 24 VDC Controller

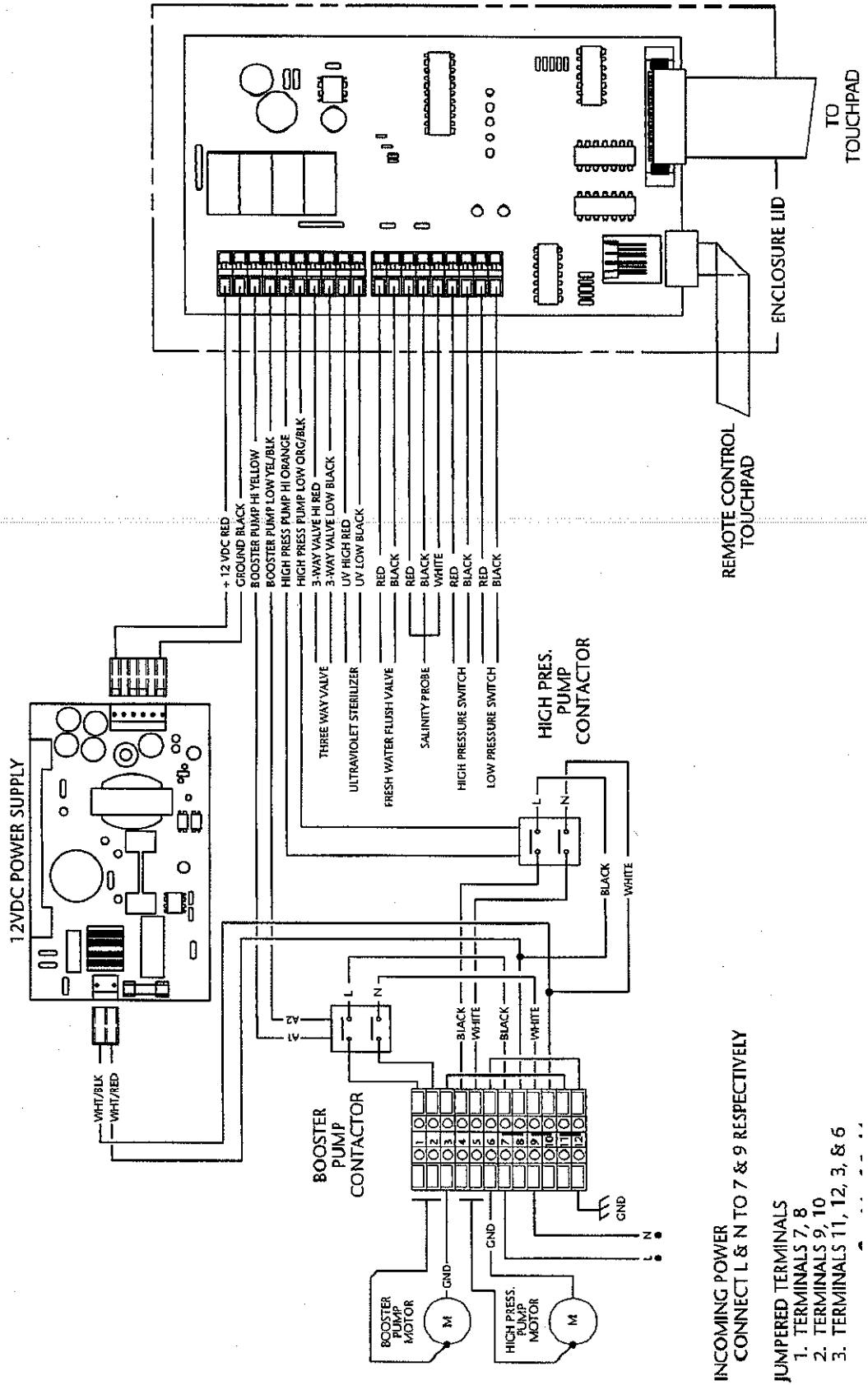


INCOMING POWER  
CONNECT POSITIVE AND NEGATIVE TO 5 & 6 RESPECTIVELY



# Seafari 170 Electrical Diagram

110/220 VAC Single Phase Controller



**INCOMING POWER**  
CONNECT L & N TO 7 & 9 RESPECTIVELY

**JUMPED TERMINALS**

1. TERMINALS 7, 8
2. TERMINALS 9, 10
3. TERMINALS 11, 12, 3, & 6



Horizon  
Reverse  
Osmosis™

Pioneer of fresh water since 1975

## **CHAPTER 8**

# **Charts & Graphs**

## 8. Charts

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This Chapter contains useful charts for determining the proper performance of the HRO Systems Seafari 170. Proper system operating pressure depends upon the temperature and salinity of the feed water. This section allows the user to adjust for changes in Feed Water Salinity and Feed Water Temperature. It also contains useful conversion tables.

**MICRON / INCH / MESH**  
**COMPARISON MEASUREMENTS**

MICRON	INCH	INCH (opening)	MESH
1	.00003937	.0070	100
5	.00019685	.0075	90
10	.00039370	.0075	80
15	.00059055	.0078	70
20	.00078740	.011	60
25	.00098425	.013	50
30	.00118110	.018	40
40	.00157480	.026	30
50	.00196850	.041	20
75	.00295275	.085	10
100	.0039370	.177	5
200	.0078740	.937	1

**TEMPERATURES CELSIUS vs FAHRENHEIT**

**CONVERSION CHART**

°F	°C	°F	°C
0	-32	122	50
32	0	131	55
41	5	140	60
50	10	149	65
59	15	158	70
68	20	167	75
78	25	176	80
86	30	185	85
95	35	194	90
104	40	203	95
113	45	212	100

°CELSIUS = 0.556 (°F - 32)

°FAHRENHEIT = (1.8°C) + 32

# HRO Systems TEMPERATURE EFFECT COMPARISON CHART

(At 820 psi & 35,000 ppm TDS NaCl feed water conditions)

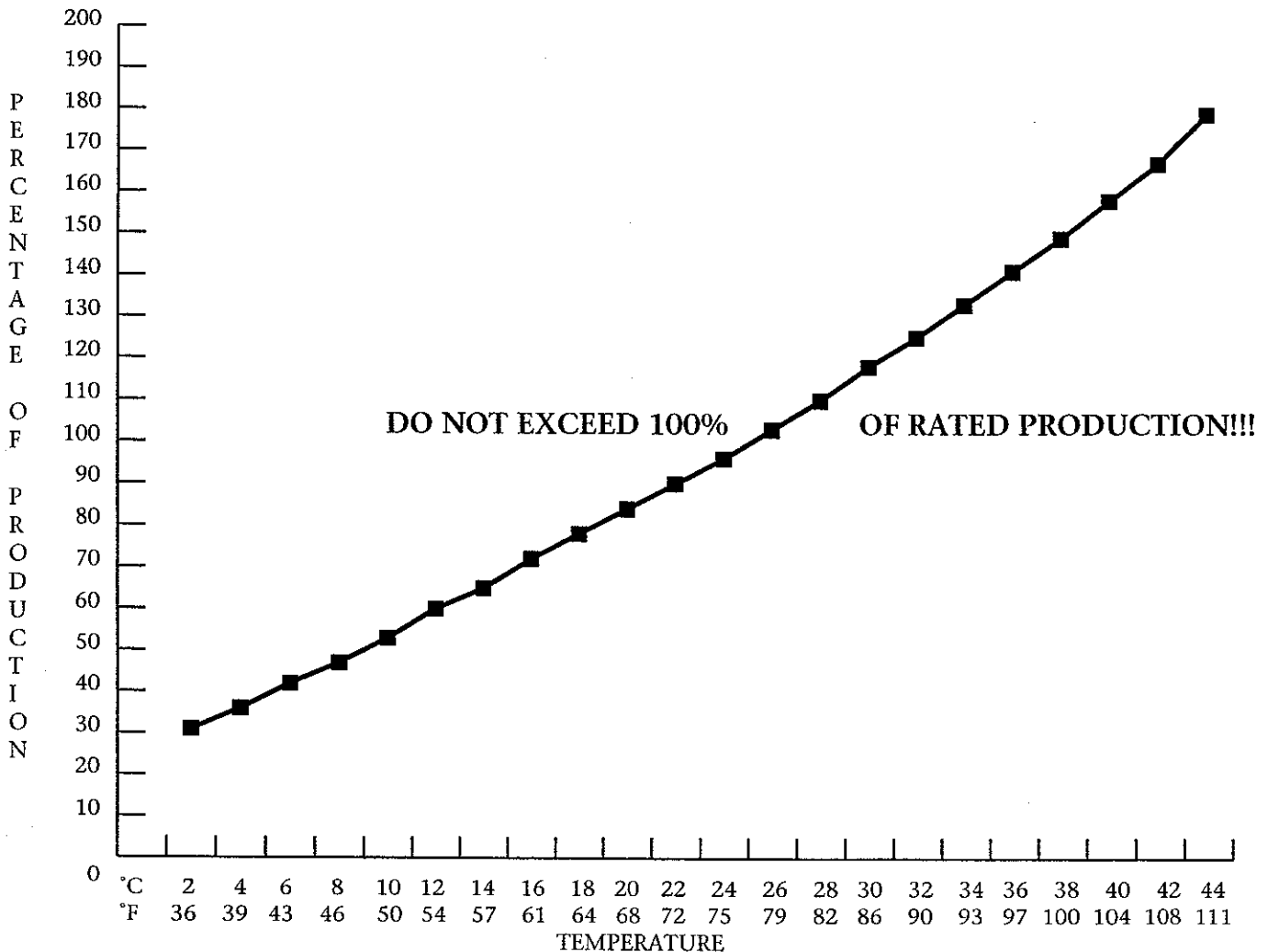
The Temperature Effect Chart on this page illustrates the loss or gain of productivity across the RO membrane.

To determine what normal (in spec.) flow of the RO membrane would be at 77° F / 25° C follow these directions:

- 1) Determine feed source temperature.
- 2) Locate the corresponding temperature on the chart
- 3) Follow the corresponding temperature in a vertical line up to the plotted production line.
- 4) From this temperature point at the production line, move left horizontally to the plotted productivity percent.
- 5) Calculate the system's present productivity in U.S. gallons per day by multiplying the gallon per hour product water flow meter reading by 24.
- 6) Divide the figure reached in step 5 above, present gallon per day productivity, by the plotted productivity percentage from step 4 above. The answer will be equivalent to the membranes present productivity at specification test parameters, 820 psi & 77° F / 25° C.

Example:

- 1) With the system operating at 820 psi.
- 2) Present feed temperature is 61°F or 16° C.
- 3) Plotted productivity is therefore 72% of normal.
- 4) The system is a 400 gallon per day model and it is presently producing 280 gallons per day.
- 5) 280 gallons per day divided by .72 equals 388 gallons per day calculated productivity. The system is rated at 400 gallons per day ±15% (340 to 460 gallons per day). Therefore, the system is within specifications at 280 gallons per day actual productivity at 61° F/16° C, 820 psi and 35,000 ppm feed.



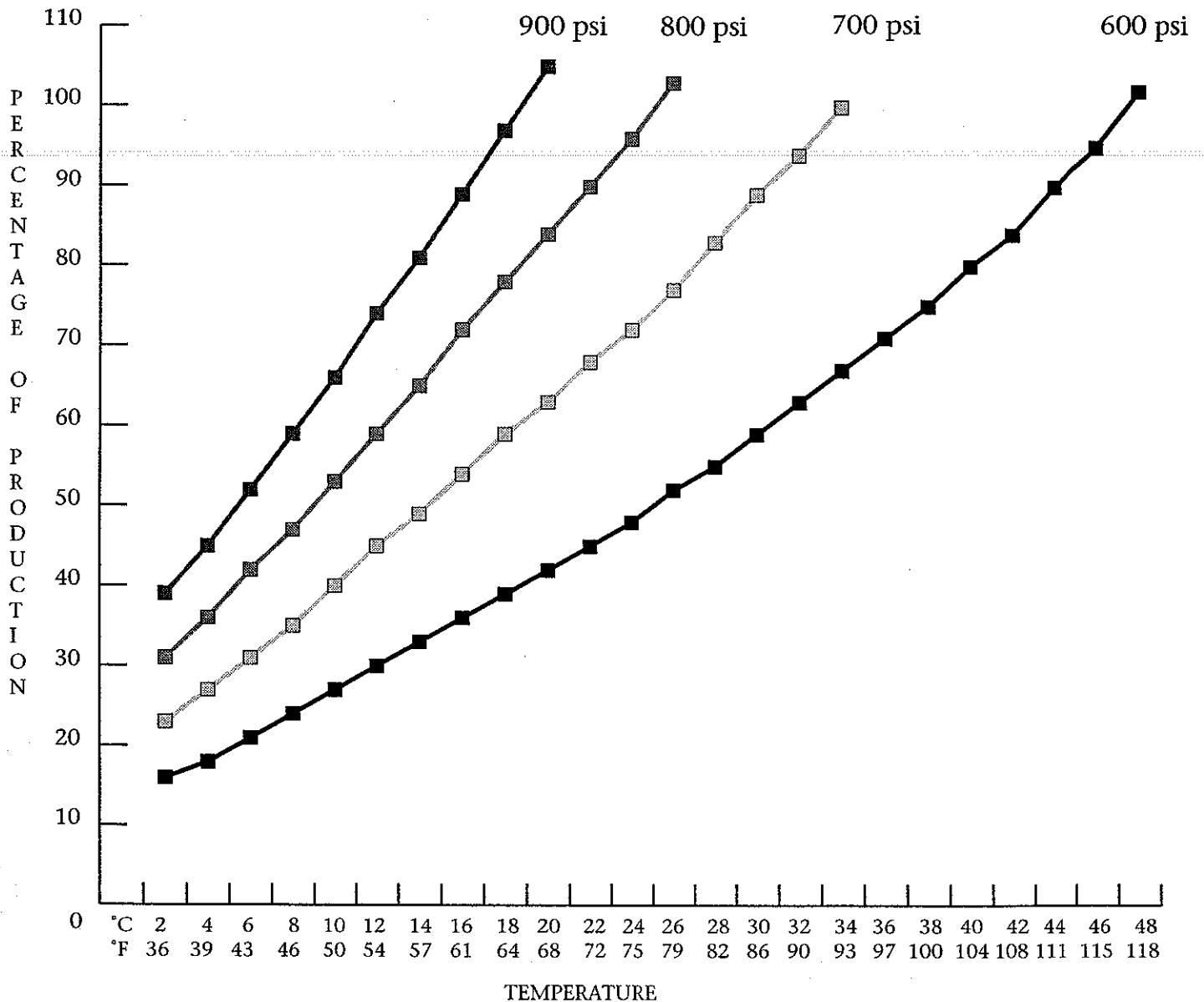
# HRO Systems

## SEAWATER TEMPERATURE & PRESSURE EFFECTS CHART

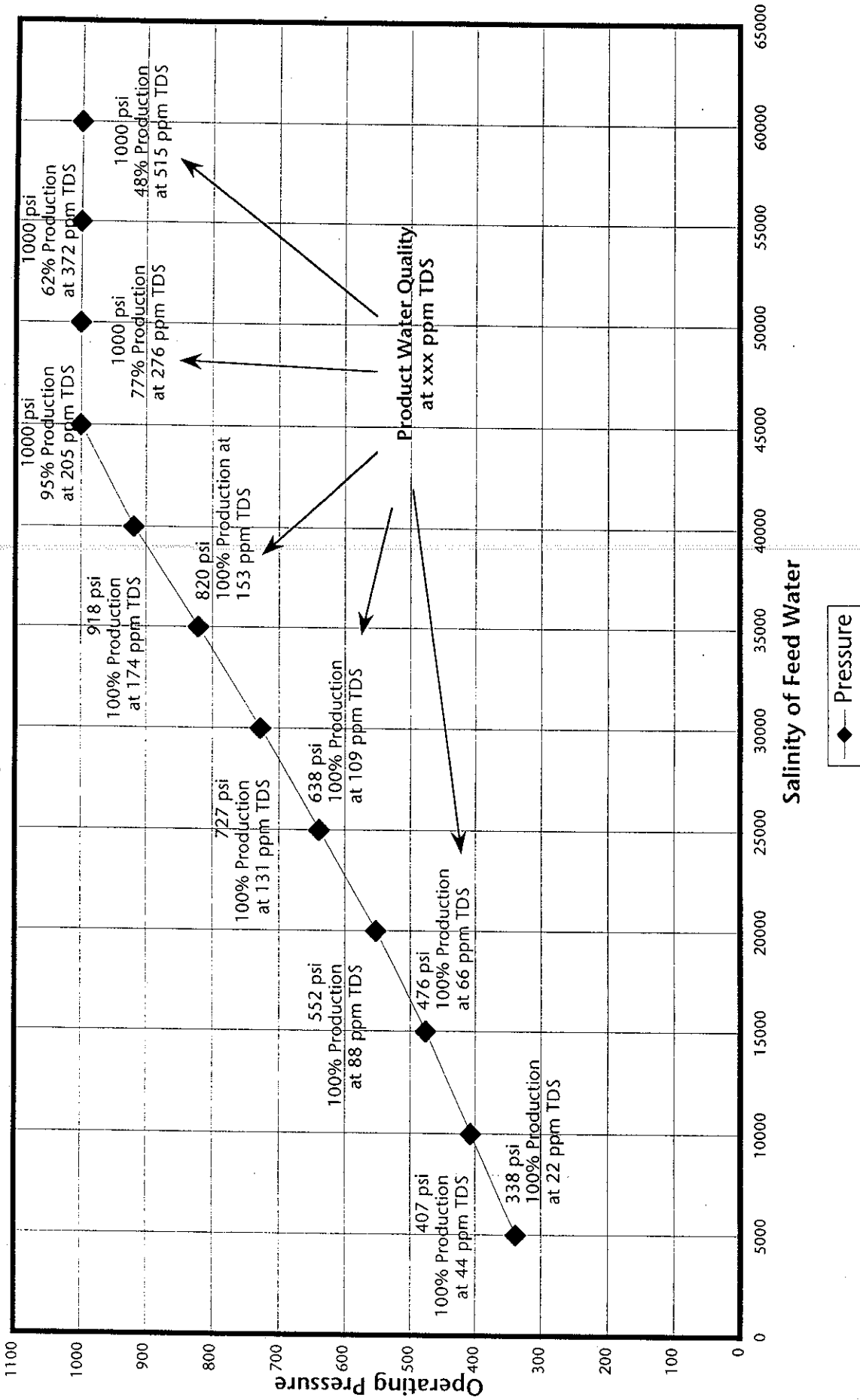
(Do not use this chart for brackish water systems & applications)

As the seawater temperature increases, the Sea Recovery system pressure must be adjusted so that the system achieves no greater than 100% of rated product water flow. Product water flow greater than 100% of rated product water flow will cause premature fouling of the SRC RO membrane element. This will lead to more frequently required cleaning and void all warranties of the SRC RO membrane element.

**DO NOT EXCEED 100% OF RATED PRODUCTION!!!**



# Salinity Effects Chart



## WATER COMPARISON CHART

### GALLONS / VOLUME / WEIGHT

U.S. GALLON	CUBIC FEET	CUBIC YARD	CUBIC METER	TON SHORT	TON METRIC
1	.13	.005	.004	.004	.004
5	.67	.025	.019	.021	.019
10	1.34	.050	.038	.041	.038
25	3.34	.129	.10	.104	.094
50	6.68	.248	.19	.208	.189
100	13.37	.50	.38	.42	.38
200	26.74	.99	.76	.83	.76
300	40.10	1.49	1.14	1.25	1.13
400	53.47	1.98	1.51	1.67	1.51
500	66.84	2.48	1.89	2.08	1.89
600	80.21	2.97	2.27	2.50	2.27
700	93.58	3.47	2.65	2.92	2.65
800	106.94	3.96	3.03	3.33	3.02
900	120.31	4.46	3.41	3.75	3.40
1,000	133.68	4.95	3.79	4.17	3.78
2,500	334.20	12.38	9.46	10.41	9.45
5,000	668.40	24.76	18.93	20.83	18.89
7,500	1002.60	37.13	28.39	31.24	28.34
10,000	1336.81	49.51	37.85	41.65	37.79
25,000	3342.00	123.80	94.60	104.10	94.50
50,000	6684.00	247.60	189.30	208.30	188.90
75,000	10026.00	371.30	283.90	312.40	283.40
100,000	13368.06	495.11	378.54	416.50	377.85

1 U.S. GALLON	=	231. CU. INCH
1 U.S. GALLON OF WATER	=	8.33 LBS.
1 SHORT TON	=	2000 LBS.
1 METRIC TON	=	2204.6 LBS.
1 CU. INCH OF WATER	=	0.0360 LBS.
1 CU. FOOT OF WATER	=	62.4 LBS.
1 IMPERIAL GALLON OF WATER	=	10.0 LBS.
1 GALLON	=	3.7854 LITERS
1 CUBIC METER	=	1000 LITERS
1 CUBIC METER	=	264 GALLONS



## PPM CONVERSION CHART

SPECIFIC CONDUCTANCE IN MICROMHOS	SPECIFIC RESISTANCE IN OHMS	DISSOLVED SOLIDS		RESISTANCE*	
		P.P.M.	MHOS	OHMS	P.P.M.
.0385	26,000,000	NONE	250.0	4,000	125
.0556	18,000,000	.02777	256.4	3,900	128
.0625	16,000,000	.03125	263.2	3,800	132
.0714	14,000,000	.03571	270.3	3,700	135
.0833	12,000,000	.04166	277.8	3,600	139
.1	10,000,000	.05	285.7	3,500	143
.125	8,000,000	.0625	294.1	3,400	147
.167	6,000,000	.08333	303.0	3,300	152
.2	5,000,000	.1	312.0	3,200	156
.25	4,000,000	.125	322.5	3,100	161
.5	2,000,000	.25	333.3	3,000	166
1	1,000,000	.5	344.8	2,900	172
2	500,000	1	357.0	2,800	179
4	250,000	2	370.4	2,700	185
6	166,666	3	384.6	2,600	192
8	125,000	4	400.0	2,500	200
10	100,000	5	416.6	2,400	208
12	83,333	6	434.8	2,300	217
14	71,428	7	454.5	2,200	227
16	62,500	8	476.2	2,100	238
18	55,555	9	500.0	2,000	250
20	50,000	10	526.3	1,900	263
22	45,454	11	555.5	1,800	278
24	41,666	12	588.2	1,700	294
26	38,461	13	625.0	1,600	312
28	35,714	14	666.6	1,500	333
30	33,333	15	714.2	1,400	357
40	25,000	20	769.2	1,300	384
50	20,000	25	833.3	1,200	416
60	16,666	30	909.0	1,000	500
70	14,286	35	1,000	1,000	500
80	12,500	40	1,111	900	555
100	10,000	50	1,250	800	625
120	8,333	60	1,428	700	714
140	7,142	70	1,666	600	833
160	6,250	80	2,000	500	1,000
180	5,555	90	2,500	400	1,250
200	5,000	100	3,333	300	1,667
			5,000	200	2,500
			10,000	100	5,000

\*Approximate dissolved solids expressed as Calcium Carbonate (CaCO<sub>3</sub>)

**PRESSURE**

<b>psi</b>	<b>Kg/cm<sup>2</sup></b>	<b>"Hg</b>	<b>bar</b>	<b>kPa</b>	<b>atmosphere</b>
<b>1</b>	0.0704	2.036	0.0689	6.895	0.0681
14.22	<b>1</b>	28.96	0.981	98.07	0.968
0.4912	0.0345	<b>1</b>	0.0339	3.386	0.03342
14.504	1.02	29.53	<b>1</b>	100	0.987
0.14504	0.0102	0.295	0.01	<b>1</b>	0.00987
14.7	1.033	29.92	1.013	101.3	<b>1</b>

**PRESSURE**

<b>psi</b>	<b>Kg/cm<sup>2</sup></b>	<b>"Hg</b>	<b>bar</b>	<b>kPa</b>	<b>atmosphere</b>
<b>1 psi</b>	= 0.0704 Kg/cm <sup>2</sup>	= 2.036 Hg	= 0.0689 bar	= 6.895 kPa	= 0.0681 atm
14.22	= <b>1</b>	= 28.96	= 0.981	= 98.07	= 0.968
0.4912	= 0.0345	= <b>1</b>	= 0.0339	= 3.386	= 0.03342
14.504	= 1.02	= 29.53	= <b>1</b>	= 100	= 0.987
0.14504	= 0.0102	= 0.295	= 0.01	= <b>1</b>	= 0.00987
14.7	= 1.033	= 29.92	= 1.013	= 101.3	= <b>1</b>

**METRIC / U.S. CUSTOMARY UNIT EQUIVALENTS**

<b>multiply:</b>	<b>by:</b>	<b>to get or multiply:</b>	<b>by:</b>	<b>to get:</b>
<b>LINEAR</b>				
inch	x 25.4	= millimeters (mm)	x 0.03937	= inch
feet	x 0.3048	= meters (m)	x 3.281	= feet
yard	x 0.9144	= meters (m)	x 1.0936	= yard
mile	x 1.6093	= kilometers (km)	x 0.6214	= mile
inch	x 2.54	= centimeters (cm)	x 0.3937	= inch
<b>VOLUME</b>				
fluid oz	x 29.57	= milliliters (ml)	x 0.03381	= fluid oz
U.S. quart	x 0.94635	= liters(l)	x 1.0567	= quarts
U.S. gallon	x 3.7854	= liters(l)	x 0.2642	= gallons
feet <sup>3</sup>	x 28.317	= liters	x 0.03531	= feet <sup>3</sup>
feet <sup>3</sup>	x 0.02832	= meters <sup>3</sup>	x 35.315	= feet <sup>3</sup>
yard <sup>3</sup>	x 0.7646	= meters <sup>3</sup>	x 1.3080	= yard <sup>3</sup>
<b>MASS</b>				
ounces	x 28.35	= grams(g)	x 0.03527	= ounces
pounds	x 0.4536	= kilograms (kg)	x 2.2046	= pounds
tons (2000lb)	x 907.18	= kilograms (kg)	x 0.001102	= tons
tons (2000lb)	x 0.90718	= metric tons(t)	x 1.1023	= tons



Horizon  
Reverse  
Osmosis™

Pioneer of fresh water since 1975

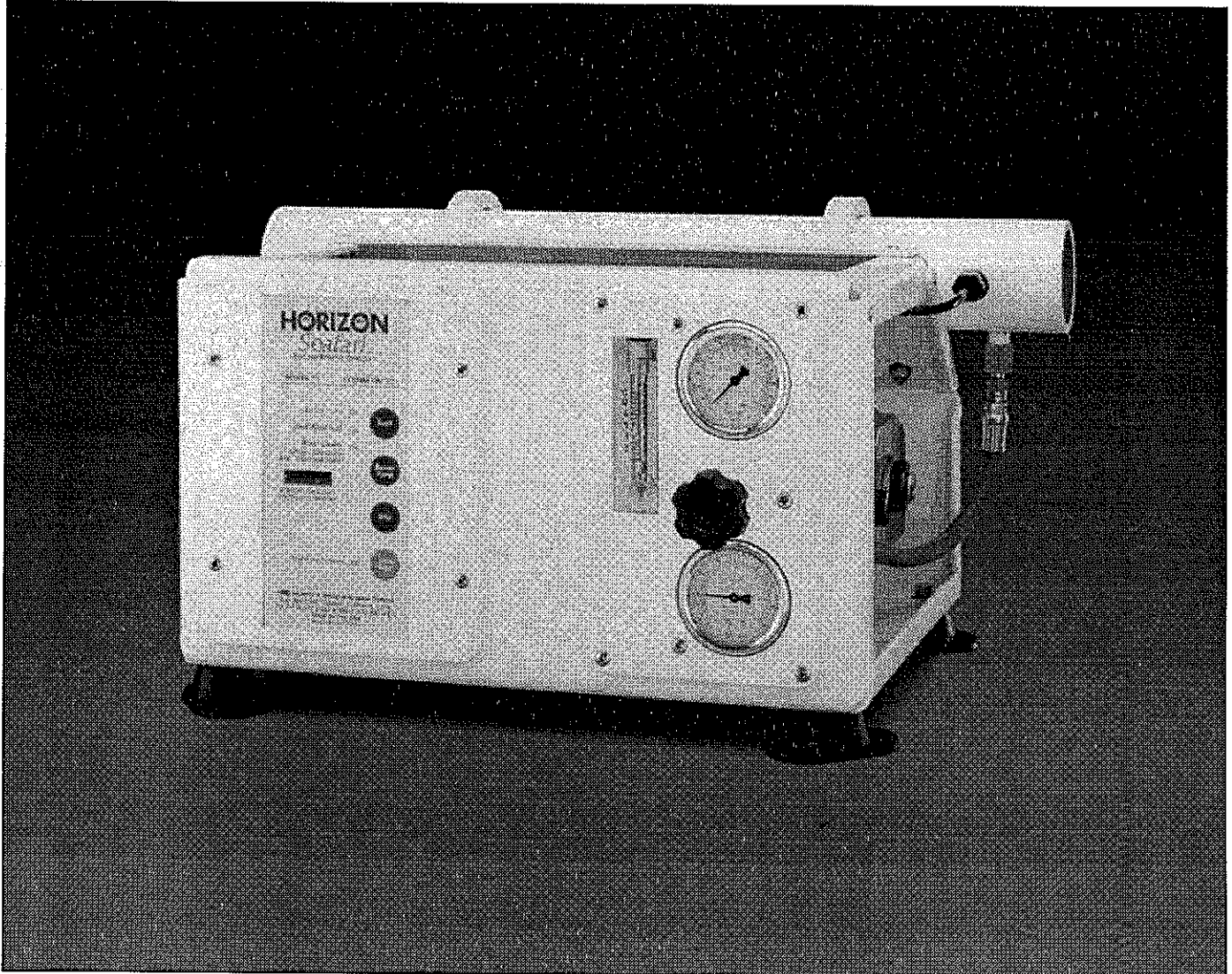
## CHAPTER 9

### Index

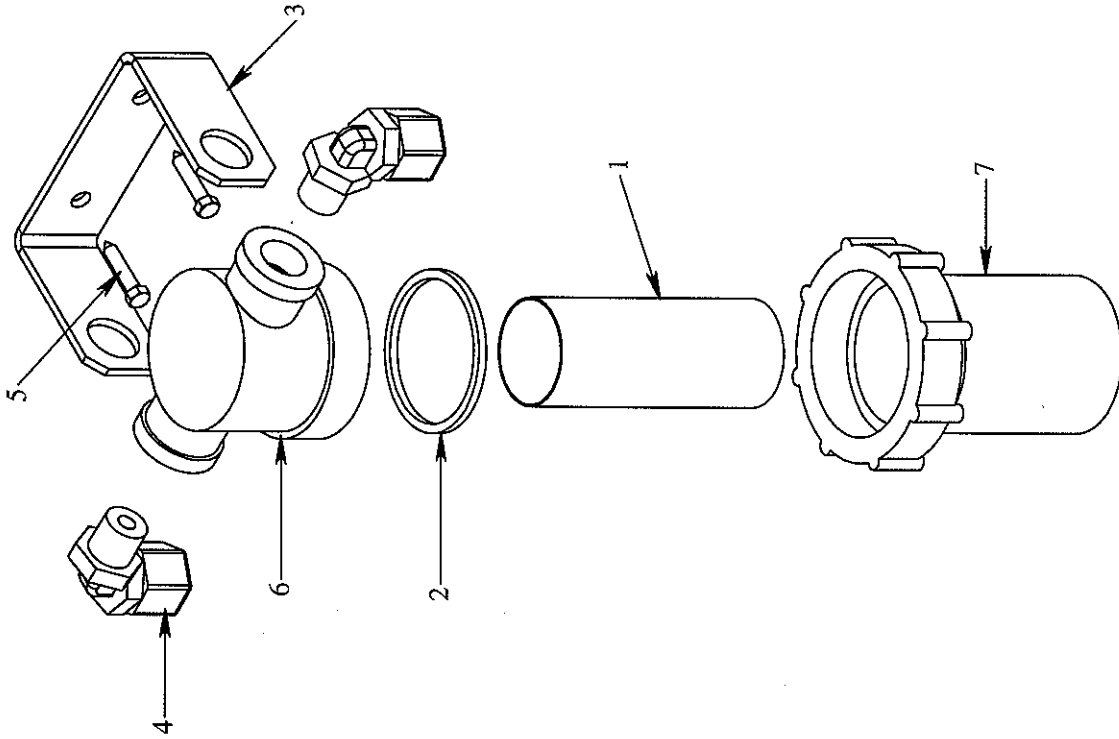
## 9. System Exploded Parts Views

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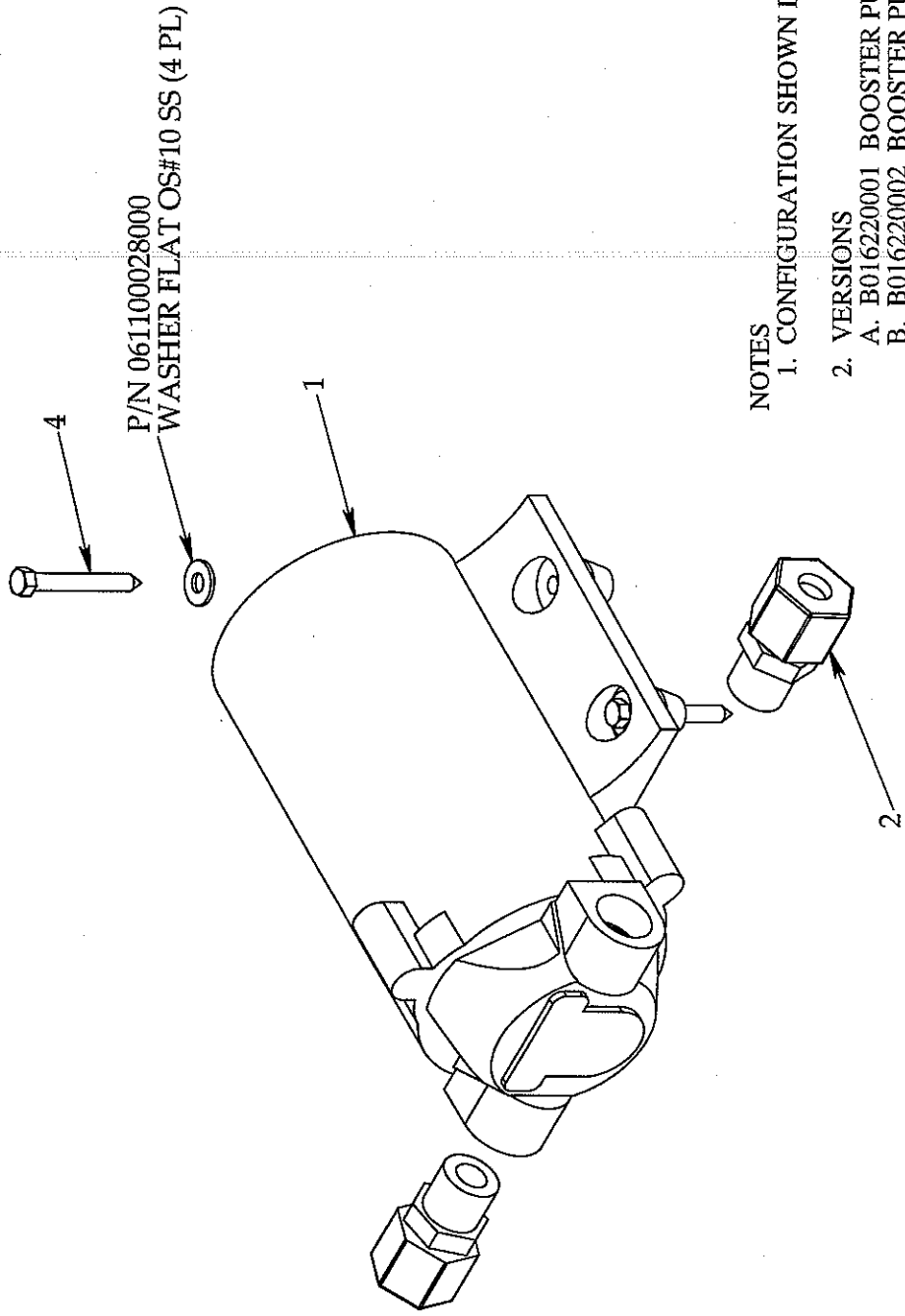
This Chapter Details the major components of the Seafari 170 system. It provides location of major components in the system and their part number and description. During maintenance and repair please refer to Chapter 4, Storage and Cleaning; Chapter 5, Troubleshooting; Chapter 6, Maintenance and Repair.



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	0804743278	MESH SCREEN STRAINER 3/8"
2	1	2614100278	O-RING SEA STRAINER 3/8"
3	1	20200403010	BRACKET SEA STRAINER 3/8"
4	2	0204021869	ELB90 3/8 TUBE X 3/8 MPT PLASTIC
5	2	061170628016	SC PHIL PAN "A" 10 x 1" SS
6	1	0412034678-1	SEA STRAINER LID, 3/8"
7	1	0412034678-2	SEA STRAINER BOWL, 3/8"



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	12124001SF	BOOSTER PUMP/MOTOR 170/12
2	2	0204091869	CONN 3/8 TUBE x 3/8 MPT PLASTIC
4	4	061180628024	SC PHIL PAN "A" 10 X 1 1/2" SS



NOTES

1. CONFIGURATION SHOWN IS 12 VDC.

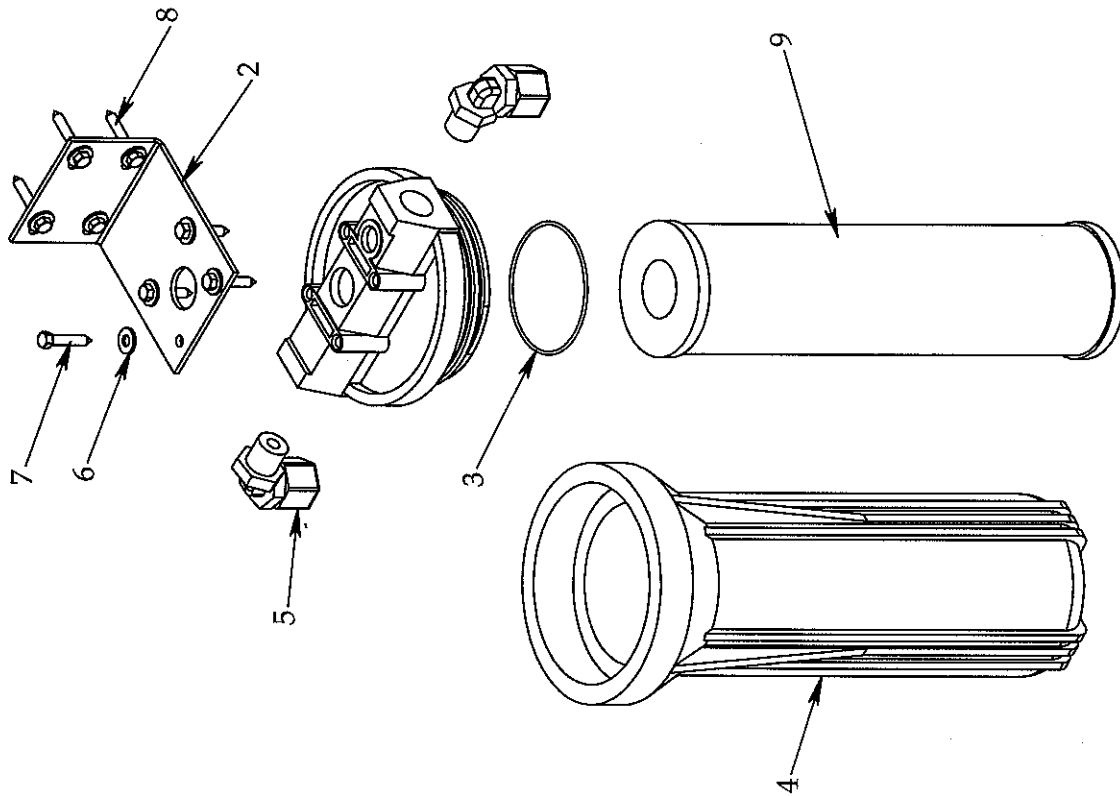
2. VERSIONS

- A. B016220001 BOOSTER PUMP ASSY SF 170 12 VDC
- B. B016220002 BOOSTER PUMP ASSY SF 170 24 VDC
- C. B016220003 BOOSTER PUMP ASSY SF 170 115 VAC
- D. B016220004 BOOSTER PUMP ASSY SF 170 220 VAC

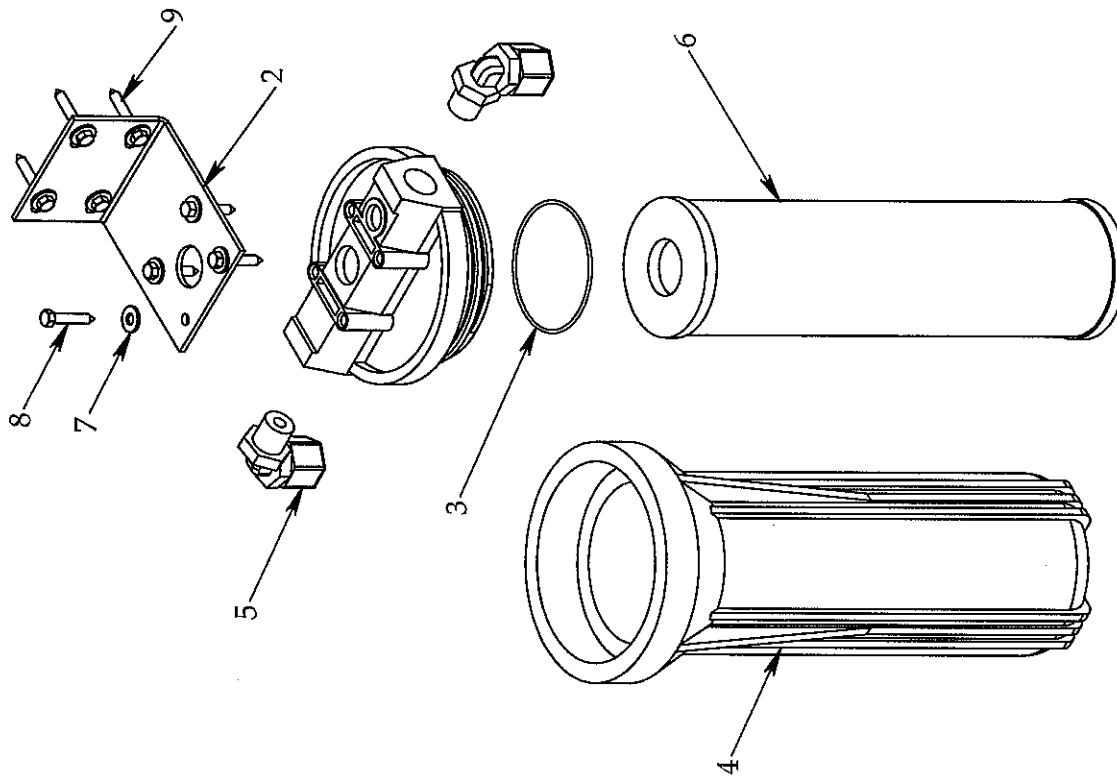
3. BOOSTER PUMPS

- 12 VDC - LISTED ABOVE
- 24 VDC - P/N 12124002SF BOOSTER PUMP/MOTOR 170/24
- 110 VAC - P/N 12124003SF BOOSTER PUMP/MOTOR 170/115
- 220 VAC - P/N 12124004SF BOOSTER PUMP/MOTOR 170/220

ITEM NO.	QTY.	PART NO.	DESCRIPTION
2	1	20200402100	BRACKET PREFILTER/CHRCL/PLNKTN
3	1	2614010473	O-RING BLUE HOUSING #237
4	1	0713020573	FILTER HOUSING/LID 3/8 X 10
5	2	0204021869	ELB90 3/8 TUBE X 3/8 MPT PLASTIC
6	8	065080028000	WASHER FLAT OS#10 SS
7	4	061170628016	SC PHIL PAN "A" 10 x 1" SS
8	4	061170628020	SC PHIL PAN "A" 10 X 1 1/4 SS
9	1	0805823578	ELEMENT PLANKTON



ITEM NO.	QTY.	PART NO.	DESCRIPTION
2	1	20200402100	BRACKET PREFILTER/CHRCL/PLNKTN
3	1	2614010473	O-RING BLUE HOUSING #237
4	1	0713020573	FILTER HOUSING/LID 3/8 X 10
5	2	0204021869	ELB90 3/8 TUBE X 3/8 MPT PLASTIC
6	1	0801060157	ELEMENT PREFILTER 10/05
7	8	065080028000	WASHER FLAT OS#10 SS
8	4	061170628016	SC PHIL PAN "A" 10 x 1" SS
9	4	061170628020	SC PHIL PAN "A" 10 X 1 1/4 SS

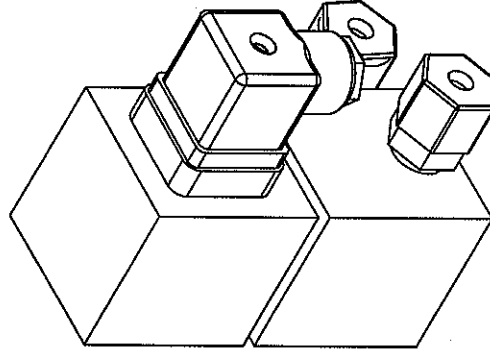
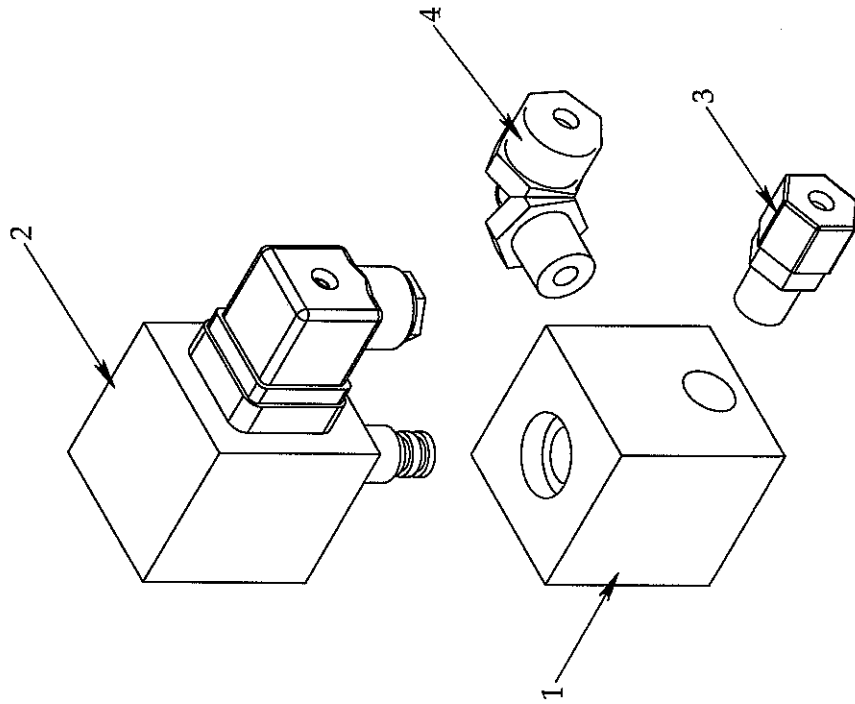




ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	5333220800	MANIFOLD LP SF 170
2	1	2301020658	SWITCH LOW PRESSURE
3	1	0204090869	CONN 1/4 TUBE X 1/4 MPT PLASTIC
4	1	0204020869	ELB90 1/4 TUBE X 1/4 MPT PLASTIC

NOT SHOWN

1. P/N 2614015800 GAUGE/SWITCH O-RING (2 PL)
2. P/N 061160630012 SC PHIL OVAL 10-24 X 3/4" SS (2 PL)

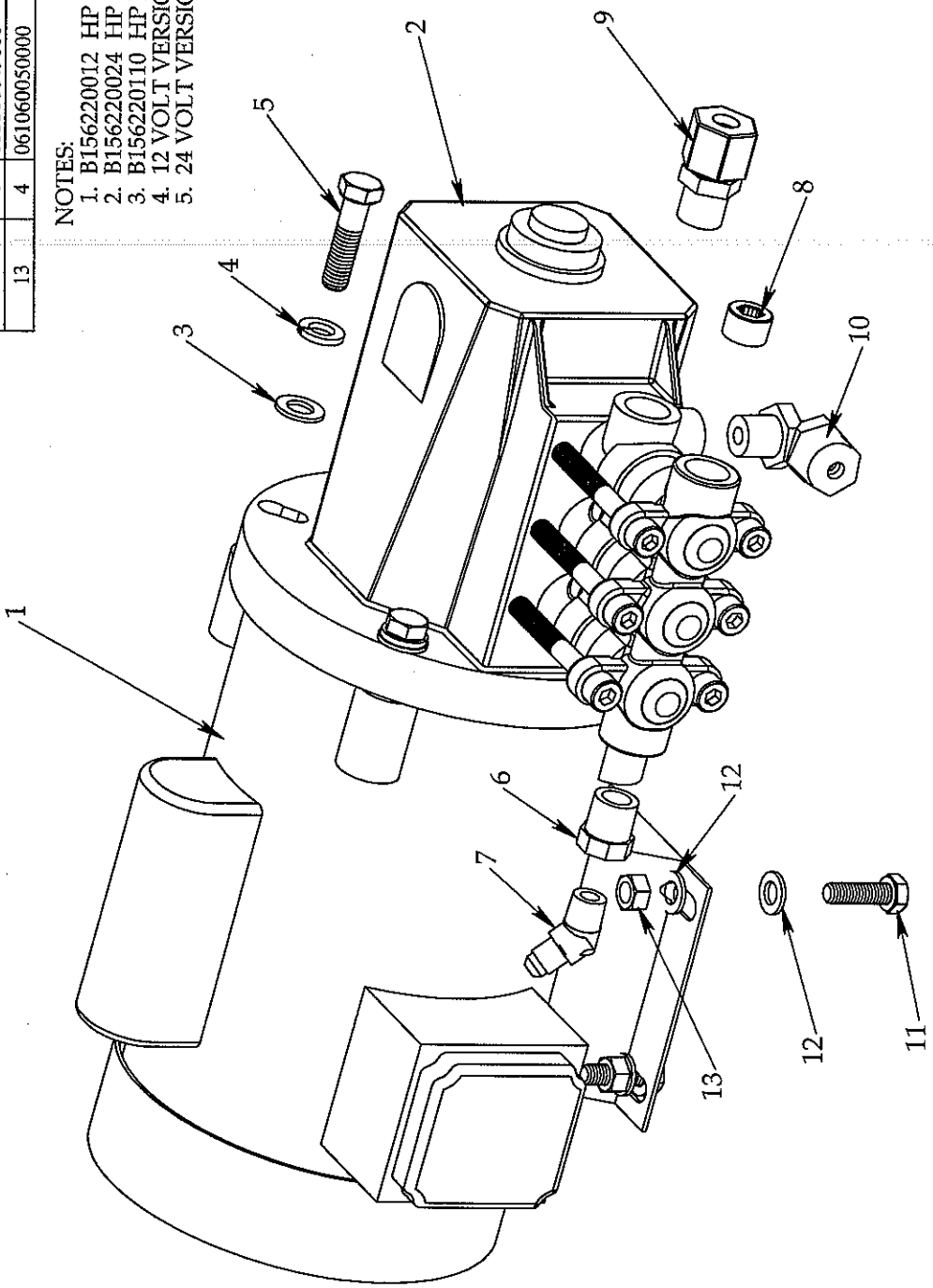


ASSEMBLED VIEW

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	15AG250912	MOTOR 1/3 HP 50/60/1
2	1	1218181422	HP PUMP 0.5 GPM SS CAT
3	4	061100056000	WASHER FLAT OS 3/8 SS
4	4	061120056000	WASHER SPLIT LOCK 3/8 SS
5	4	061142157024	BOLT HEX 3/8-16 X 1 1/2 SS
6	1	0117291700	RB 3/8 MT X 1/4 FT SS
7	1	1317060800	ELB45 -4 FLARE X 1/4 FPT SS
8	1	0117341869	PLUG 3/8" MPT SOC SS
9	1	0204091869	CONN 3/8 TUBE x 3/8 MPT PLASTIC
10	1	0204020869	ELB90 1/4 TUBE X 1/4 MPT PLASTIC
11	4	061142150016	BOLT HEX 5/16-18 x 1 SS
12	8	061100049000	WASHER FLAT OS 5/16 SS
13	4	061060050000	NUT HEX 5/16-18 W/INSERT SS

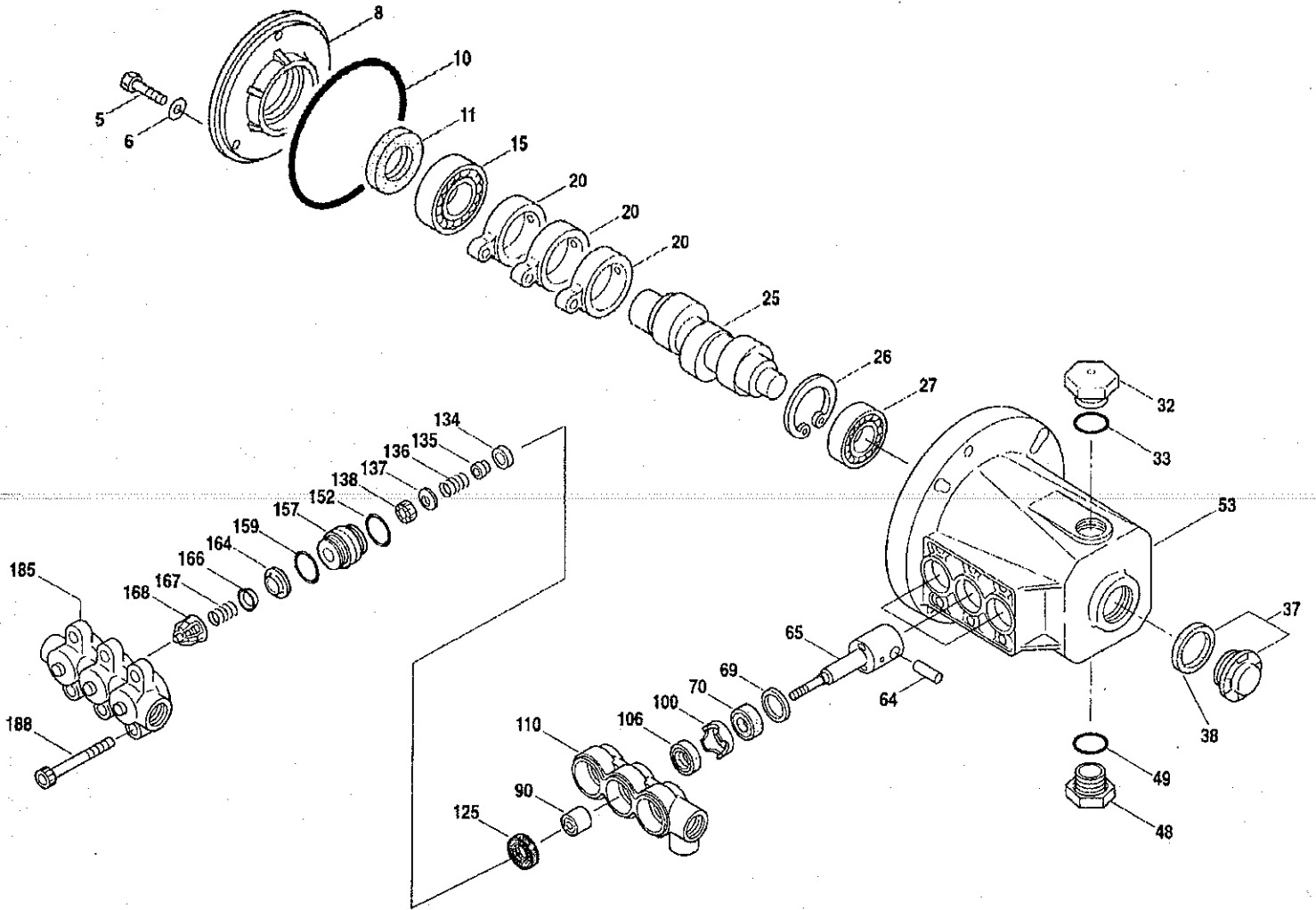
NOTES:

1. B156220012 HP PUMP/MOTOR 12 VDC SF 170
2. B156220024 HP PUMP/MOTOR 24VDC SF 170
3. B156220110 HP PUMP/MOTOR I10/220
4. 12 VOLT VERSIONS USE MOTOR P/N 15093110CF
5. 24 VOLT VERSIONS USE MOTOR P/N 15103210CF

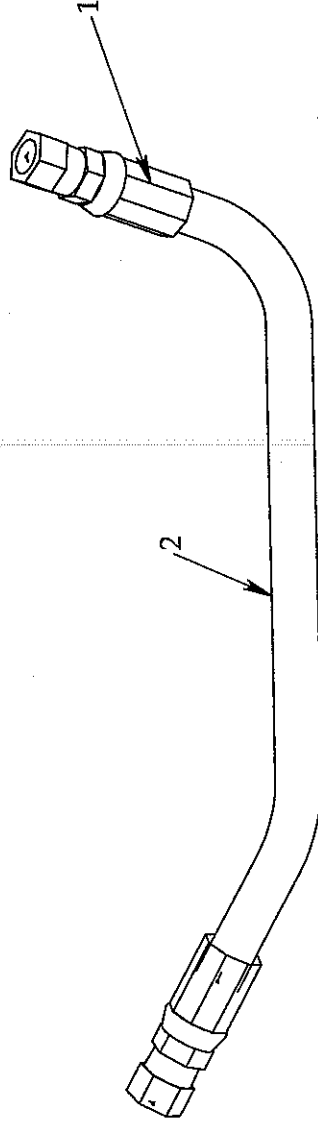


ITEM	PART NUMBER	DESCRIPTION	QTY
5 - 255	1218181422	HP PUMP 0.5 GPM SS CAT	1
5 - 90	1218181422 - 01	HP PUMP 0.5 GPM SS CAT CRANKCASE ASSY	1
100 - 188	1218181422 - 02	HP PUMP 0.5 GPM SS CAT MANIFOLD ASSY	1
5	not sold separately	Screw, HHC (M6 X 16)	3
6	not sold separately	Washer, Seal (M6)	3
8	not sold separately	Cover, Bearing	1
10	not sold separately	O-Ring Bearing Cover	1
11	not sold separately	Seal, Oil, Crankshaft	1
15	not sold separately	Bearing, Ball	1
20	not sold separately	Rod, Connecting	3
25	not sold separately	Crankshaft, 1.7mm	1
26	not sold separately	Ring, Retaining, Bearing	1
27	not sold separately	Bearing, Ball	1
32	1218181422 - 04	OIL FILL CAP 0.5 CAT	1
33	1218181422 - 05	O-RING OIL FILL CAP 0.5 CAT	1
37	not sold separately	Sight Glass	1
38	not sold separately	Gasket, Flat, Sight Glass	1
48	not sold separately	Oil Drain Plug	1
49	not sold separately	O-Ring, Oil Drain Plug	1
53	not sold separately	Crankcase	1
64	not sold separately	Pin, Crosshead	3
65	not sold separately	Rod, Plunger	3
69	not sold separately	Washer, Oil Seal	3
70	not sold separately	Seal, Oil Crankcase	3
90	not sold separately	Plunger, Ceramic	3
100	not sold separately	Retainer, Seal	3
106	not sold separately	Seal, LPS w/SS-Spg	3
110	not sold separately	Manifold, Inlet	1
125	not sold separately	Seal, HPS w/SS	3
134	not sold separately	Valve Inlet	3
135	not sold separately	Spacer	3
136	not sold separately	Spring, Inlet Valve	3
137	not sold separately	Washer, Conical	3
138	not sold separately	Nut	3
152	not sold separately	O-Ring, Adapter Spacer, Inner	3
157	not sold separately	Spacer, Discharge Valve	3
159	not sold separately	O-Ring, Adapter Spacer, Outer	3
164	not sold separately	Seat	3
166	not sold separately	Valve	3
167	not sold separately	Spring	3
168	not sold separately	Retainer, Spring	3
185	1218181422 - 03	MANIFOLD, DISCHARGE 0.5GPM SS CAT	1
188	not sold separately	Screw HSH	6
255	061142157024	BOLT HEX 3/8-16 X 1 1/2 SS	4
	061120056000	WASHER SPLIT LOCK 3/8 SS	4
	061100056000	WASHER FLAT OS 3/8 SS	4
106, 125, 152, 159, 134, 135, 136, 137, 138, 164, 166, 167, 168	B652220001	HP PUMP-C PUMP KIT (SEALS & VALVES)	3 Seals, 6 Valves
106, 125, 152, 159	B653220001	HP PUMP-C SEAL KIT	3 Seals
134, 135, 136, 137, 138, 152, 159	B654220001	HP PUMP-C INLET VALVE REBUILD KIT	3 Valves
152, 159, 164, 166, 167, 168	B654220002	HP PUMP-C DISCHARGE VALVE REBUILD KIT	3 Valves

# HIGH PRESSURE PUMP SEAFARI 170



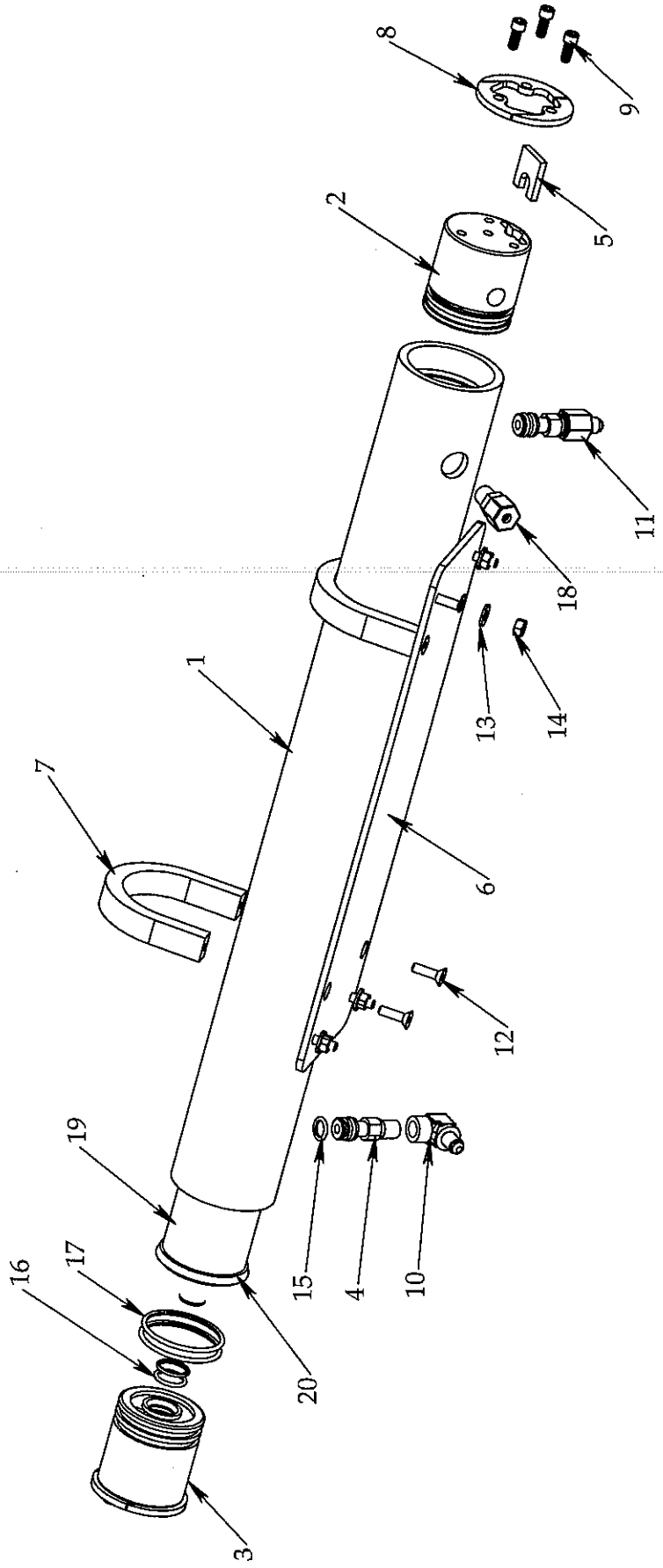
ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	2	1317481001	SWIVEL FITTING -4 TTC
2	1	2404063601	HOSE HP-4 GH194



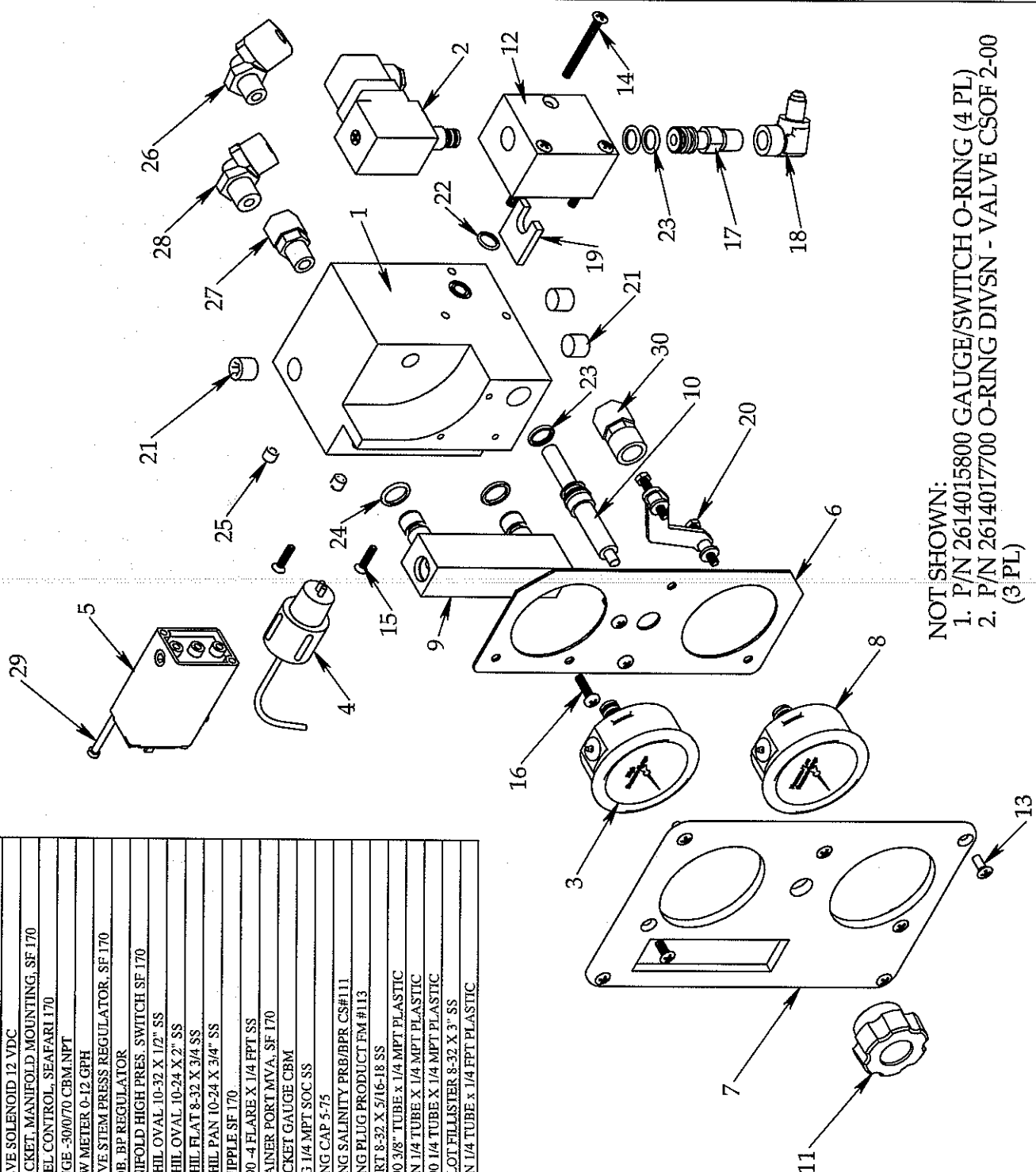
INLET HOSE [12], 15" LG, PART NUMBER B390220014

OUTLET HOSE [14], 12" LG, PART NUMBER B390220015

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	2408132026	VESSEL, 170 SF
2	1	2453497000	END PLUG DUAL 2 1/2", SF 170
3	1	2453487000	END PLUG SINGLE 2 1/2", SF 170
4	2	0117410801	HP NIPPLE SF 170
5	2	0520210500	RETAINER PORT MVA, SF 170
6	1	2020052407	PANEL MVA, SEAFARI 170
7	2	05202402GR	BRACKET MVA, SEAFARI 170
8	2	20201022000	SEGMENT RING, HIGH PRESSURE VESSEL
9	6	061162345010	SC SOCKET CAP 1/4-20 X 5/8" SS
10	1	1317010869	ELB90 -4 FLARE X 1/4 FPT SS
11	1	1317120869	CONN -4 FLARE X 1/4 FPT SS
12	8	061161845014	SC ALLEN FLAT 1/4-20 X 7/8 SS
13	4	061100043000	WASHER FLAT OS 1/4" SS
14	4	061060045000	NUTHEX 1/4-20 W/INSERT SS
15	4	2614017100	O-RING SALINITY PRB/BPR CS#111
16	4	2614010100	O-RING PRODUCT
17	4	2614010200	O-RING BRINE 2 1/2"
18	1	0204090869	CONN 1/4 TUBE X 1/4 MPT PLASTIC
19	1	2724010633	MEMBRANE 200SW AS W/ SEAL
20	1	2614050133	BRINE SEAL 2 1/2"

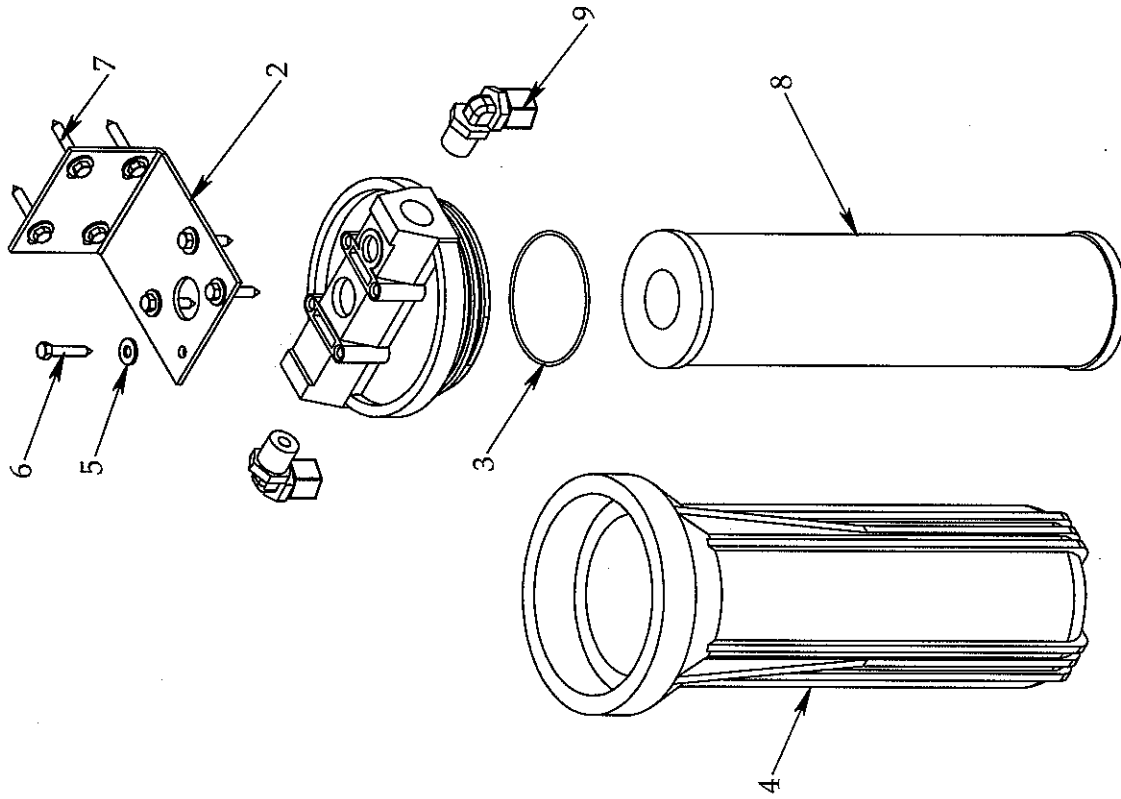


ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	533320700	MANIFOLD CONTROL, SF 170
2	1	2321020458	SWITCH HIGH PRES 900PSI O RING
3	1	10181421CC	GAUGE 0-1400 CBM O-RING SEAL
4	1	B511080001	SALINITY PROBE ASSY SF
5	1	1401096100	VALVE SOLENOID 12 VDC
6	1	2018042406	BRACKET, MANIFOLD MOUNTING, SF 170
7	1	2020052405	PANEL CONTROL, SEAFARI 170
8	1	10181522CC	GAUGE -300/70 CBM,NPT
9	1	1105400153	FLOW METER 0-12 GPH
10	1	1417021000	VALVE STEM PRESS REGULATOR, SF 170
11	1	H32458020158	KNOB, BP REGULATOR
12	1	5333220800	MANIFOLD HIGH PRES. SWITCH SF 170
13	7	061161131008	SC PHIL OVAL 10-32 X 1/2" SS
14	3	061161130032	SC PHIL OVAL 10-24 X 2" SS
15	2	061161626012	SC PHIL FLAT 8-32 X 3/4 SS
16	3	061160630012	SC PHIL PAN 10-24 X 3/4" SS
17	1	0117410801	HP NIPPLE SF 170
18	1	1317010869	ELB90 -4 FLARE X 1/4 FPT SS
19	1	0520210500	RETAINER PORT,MVA, SF 170
20	1	05180851CC	BRACKET GAUGE CBM
21	3	0117340800	PLUG 1/4 MPT SOC SS
22	1	2614014653	O-RING CAP 5-75
23	4	2614017100	O-RING SALINITY PRB/BPR CS#111
24	2	2614014600	O-RING PLUG PRODUCT FM #113
25	2	H50612730006	INSERT 8-32 X 5/16-18 SS
26	1	0204021769	ELB90 3/8" TUBE x 1/4 MPT PLASTIC
27	1	0204090869	CONN 1/4 TUBE X 1/4 MPT PLASTIC
28	1	0204020869	ELB90 1/4 TUBE X 1/4 MPT PLASTIC
29	2	061160526048	SC SLOT FILLISTER 8-32 X 3" SS
30	1	0204120869	CONN 1/4 TUBE X 1/4 FPT PLASTIC



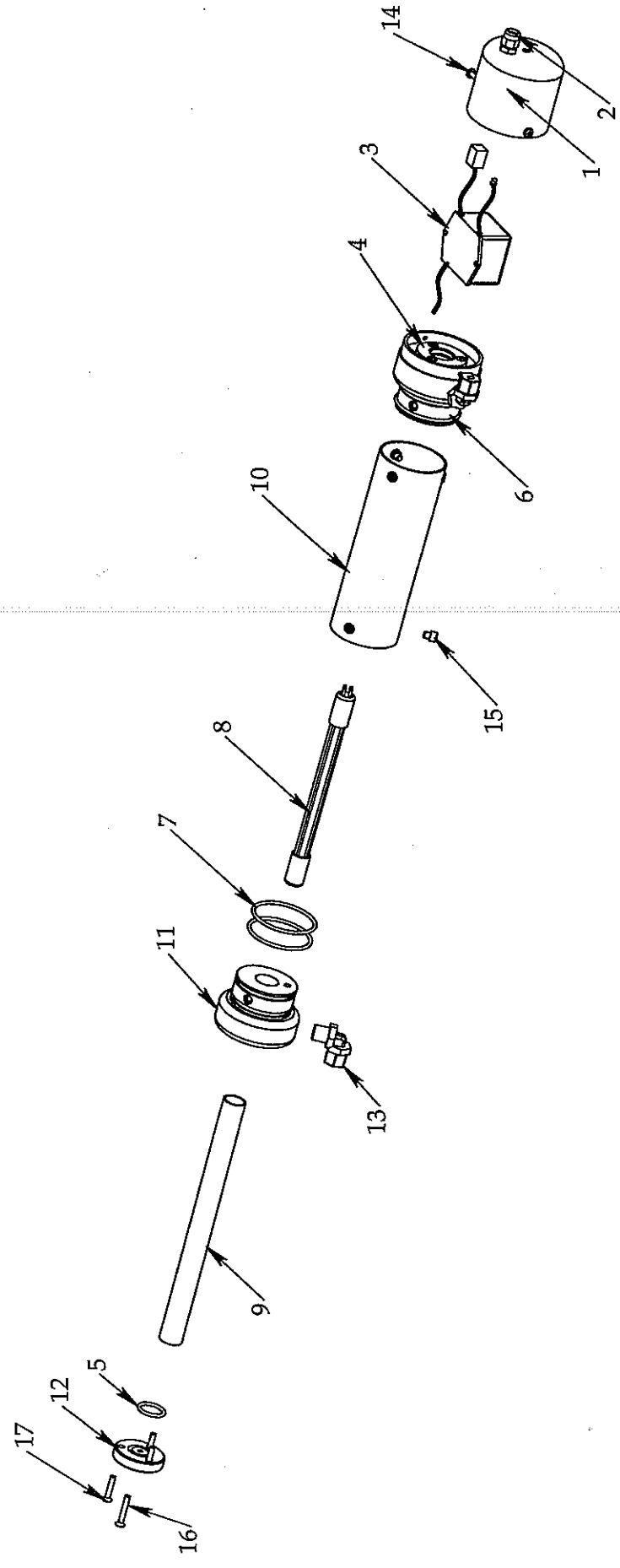
NOT SHOWN:  
 1. P/N 2614015800 GAUGE/SWITCH O-RING (4 PL)  
 2. P/N 2614017700 O-RING DIVSN - VALVE CSOF 2-00 (3 PL)

ITEM NO.	QTY.	PART NO.	DESCRIPTION
2	1	20200402100	BRACKET PREFILTER/CHRC/L/PLNKTN
3	1	2614010473	O-RING BLUE HOUSING #237
4	1	0713020573	FILTER HOUSING/LID 3/8 X 10
5	8	065080028000	WASHER FLAT OS#10 SS
6	4	061170628016	SC PHIL PAN "A" 10 x 1" SS
7	4	061170628020	SC PHIL PAN "A" 10 X 1 1/4 SS
8	1	0803004773	ELEMENT CHARCOAL 10"
9	2	0204020969	ELB90 1/4 TUBE X 3/8 MPT PLASTIC

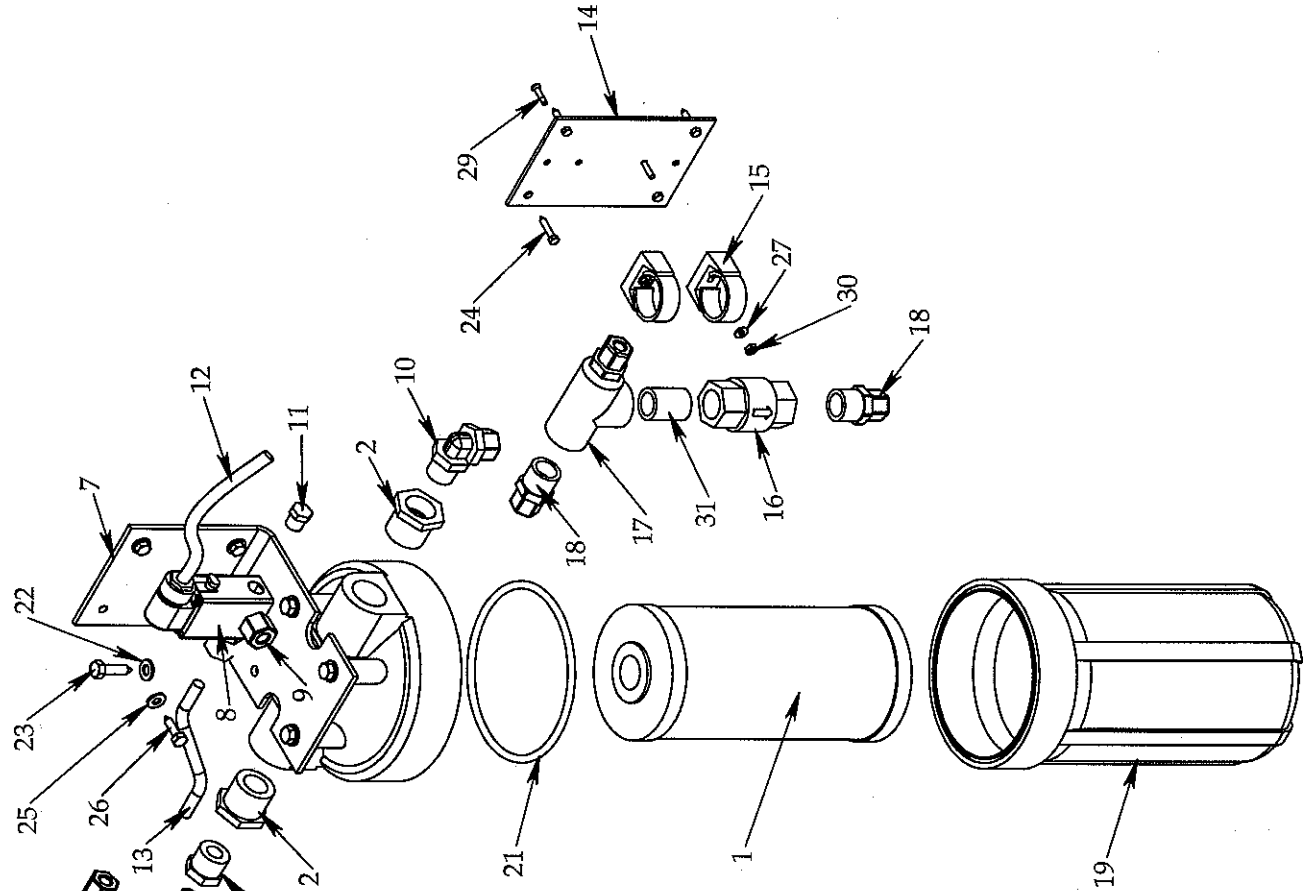




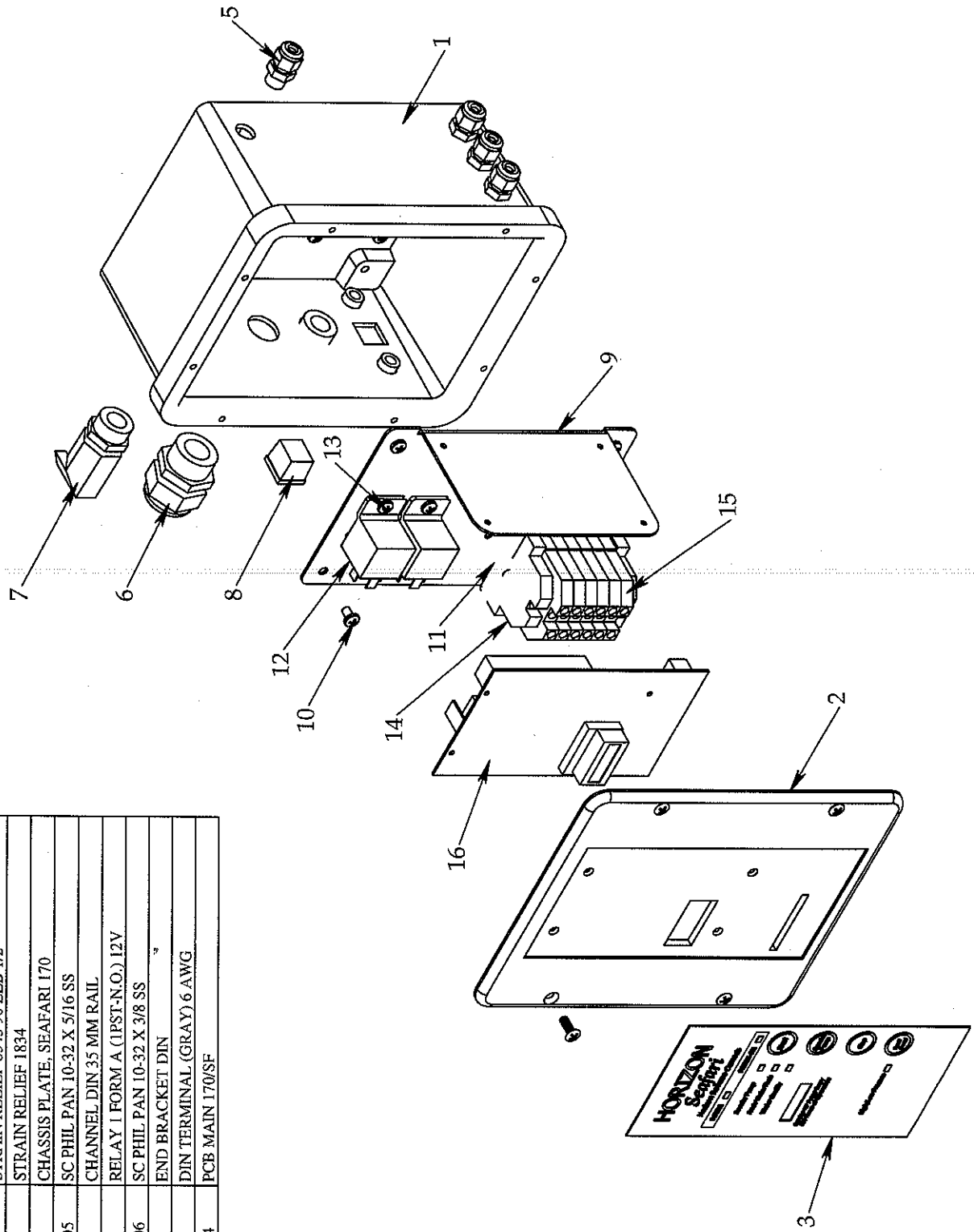
ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	4000160100	CAP ELECTRICAL U.V. STL
2	1	1904010643	STRAIN RELIEF 3444 BLK
3	1	4000021400	BALLAST 12VDC-4C
4	1	4000100200	BUSHING TOP END U.V. STL
5	2	2614011800	O-RING AIR BLEED VALVE
6	1	2401532200	END PLUG TOP U.V.
7	4	2614010200	O-RING BRINE 2 1/2" #227
8	1	4000010400	LAMP UV
9	1	4000040400	QUARTZ SLEEVE UV
10	1	2417202200	VESSEL U.V. STERILIZER
11	1	2401522200	END PLUG BTM U.V.
12	1	4000100300	BUSHING BTM END U.V. STL
13	2	0204020869	ELB90 1/4 TUBE X 1/4 MPT PLASTIC
14	2	061160630008	SC PHIL PAN 10-24 X 1/2 SS
15	6	061162345004	SC SOC CAP 1/4-20 X 1/4 SS
16	1	061161130020	SC PHIL OVAL 10-24 X 1 1/4
17	6	061161130016	SC PHIL OVAL 10-24 X 1



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	0803004906	ELEMENT CARBON BRIQUETTE
2	1	0101294383	REDUCER BUSHING 3/4" MT x 1/4" FT PVC
3	1	0101293483	REDUCER BUSHING 3/4" MT x 1/4" FT PVC
4	1	14172105AT	VALVE CHECK 1/4" MPT SS
5	1	0101010883	ELBOW 90 1/4" FT x 1/4" FT PVC
6	1	0204021769	ELBOW 90 3/8" TUBE x 1/4" MPT PLASTIC
7	1	2020040001	BRACKET BIG BLUE HOUSING
8	1	1401095998	VALVE DIVERSION 3-WAY 12VDC
9	2	0204021769	CONNECTOR 3/8" TUBE x 1/4" MT PLASTIC
10	1	0204022069	ELBOW 90 3/8" TUBE x 3/4 MPT PLASTIC
11	1	0101340883	PLUG 1/4" MPT PVC
12	1		CABLE ASSEMBLY FWF
13	1	0312123569	TUBE 3/8" BLACK
14	1	20200400029	BRACKET CHECK VALVE FWF
15	2	0501164400	PIPE SUPPORT 1"
16	1	14012118AR	VALVE CHECK 3/4" FPT WITH VITO
17	1	0101423783	TEE 3/4 FT X 3/4 FT X 3/4 FT
18	3	0204092069	CONNECTOR 3/8" TUBE x 3/4" MPT PLASTIC
19	1	0713020606	FILTER HOUSING BIG BLUE
21	1	2614010500	O-RING BIG BLUE HOUSING
22	4	061100049000	WASHER FLAT OS 5/16" SS
23	4	061172149020	SC HEX "A" 5/16 X 1 1/4 LAG
24	4	061170628016	SC PHIL PAN "A" 10 X 1" SS
25	4	061080043000	WASHER FLAT 1/4" SS
26	4	061172143016	SC HEX "A" 1/4 X 1 SS
27	6	065080023000	WASHER FLAT #8 NYLON
28	4	061170623008	SC PHIL PAN "B" 8 X 1/2 SS
29	2	061161626012	SC PHIL FLAT 8-32 X 3/4 SS
30	2	061060026000	NUT HEX 8-32 W/INSERT SS
31	1	01013737CL	NIPPLE 3/4 NPT X CLOSE PVC



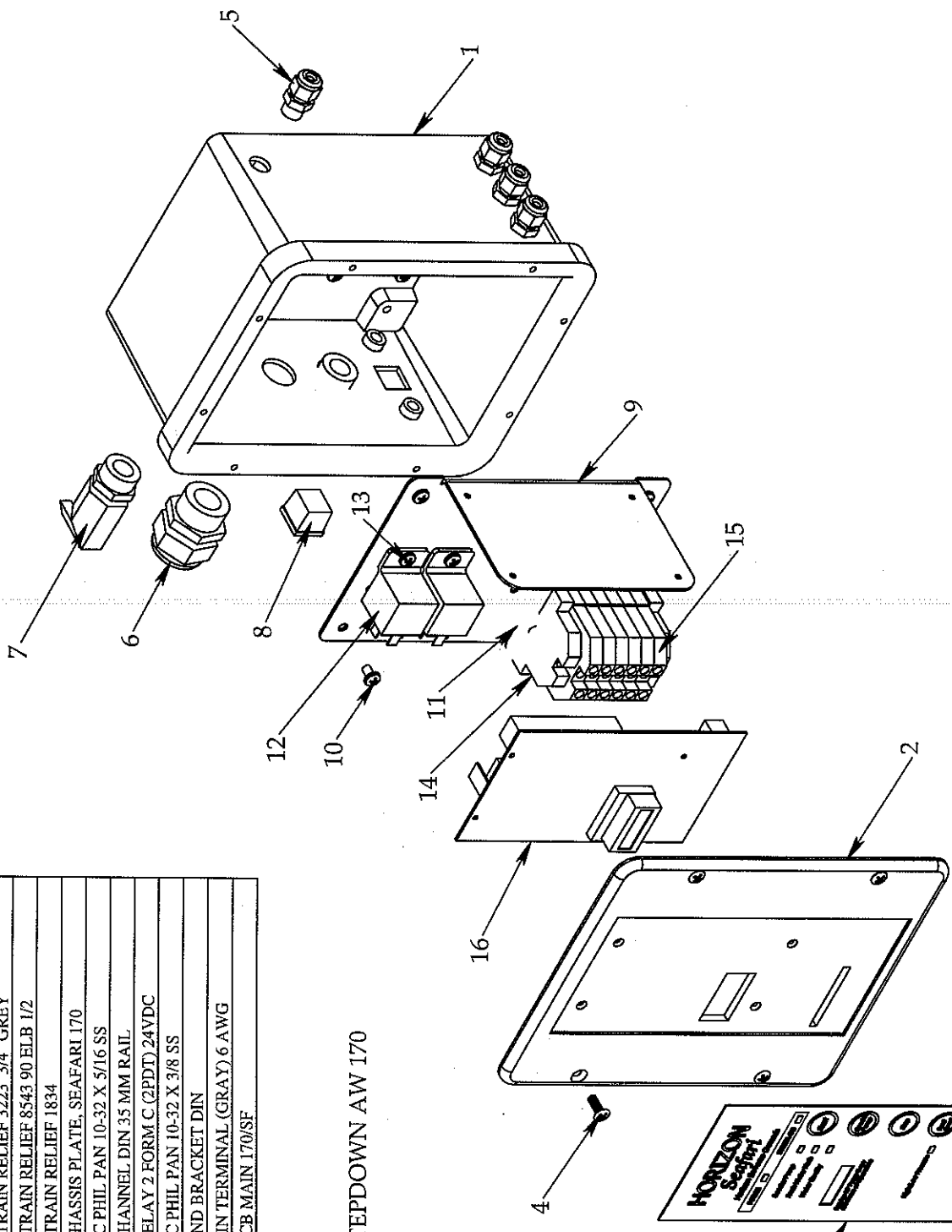
ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	31312222AB	ENCLOSURE, SF 170
2	1	3131222300	ENCLOSURE LID, SF 170
3	1	H310315601CU	TOUCH PAD MAIN
5	6	1904010643	STRAIN RELIEF 3444 BLK
6	1	1904010343	STRAIN RELIEF 3223 3/4" GREY
7	2	1904013643	STRAIN RELIEF 8543 90 ELB 1/2
8	1	1904019243	STRAIN RELIEF 1834
9	1	3131232200	CHASSIS PLATE, SEAFARI 170
10	6	061160631005	SC PHIL PAN 10-32 X 5/16 SS
11	1	3131170147	CHANNEL DIN 35 MM RAIL
12	2	3131110600	RELAY 1 FORM A (FST-N.O.) 12V
13	2	061160631006	SC PHIL PAN 10-32 X 3/8 SS
14	2	31311601BY	END BRACKET DIN
15	6	31311522BY	DIN TERMINAL (GRAY) 6 AWG
16	1	H2596210004	PCB MAIN 170/SF



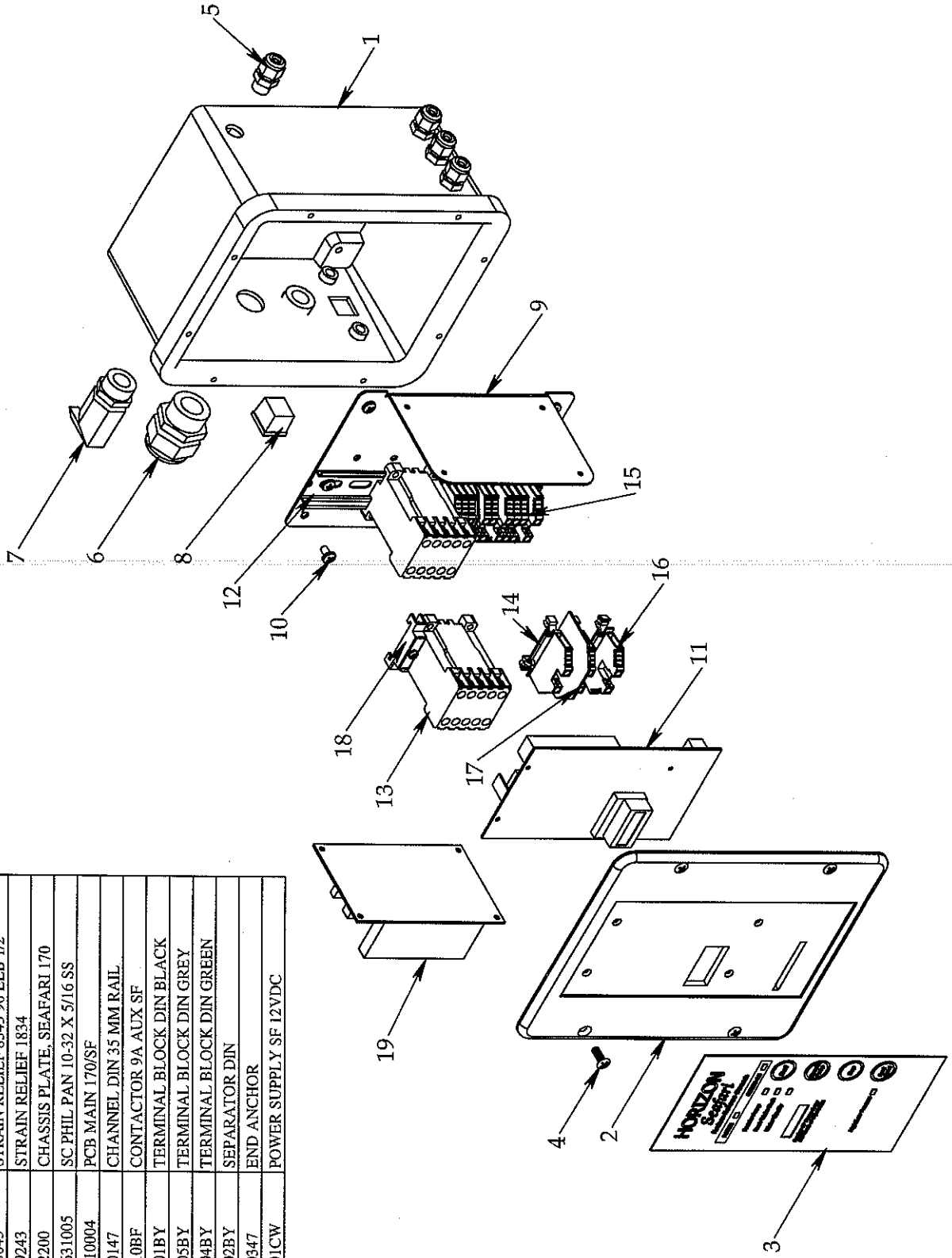
ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	31312222AB	ENCLOSURE, SF 170
2	1	3131222300	ENCLOSURE LID, SF 170
3	1	H310315601CU	TOUCH PAD MAIN
4	4	061160630012	SC PHIL PAN 10-24 X 3/4" SS
5	6	1904010643	STRAIN RELIEF 3444 BLK
6	1	1904010343	STRAIN RELIEF 3223 3/4" GREY
7	2	1904013643	STRAIN RELIEF 8543 90 ELB 1/2
8	1	1904019243	STRAIN RELIEF 1834
9	1	3131232200	CHASSIS PLATE, SEAFARI 170
10	6	061160631005	SC PHIL PAN 10-32 X 5/16 SS
11	1	3131170147	CHANNEL DIN 35 MM RAIL
12	2	3131110500	RELAY 2 FORM C (2PDT) 24VDC
13	2	061160631006	SC PHIL PAN 10-32 X 3/8 SS
14	2	31311601BY	END BRACKET DIN
15	6	31311522BY	DIN TERMINAL (GRAY) 6 AWG
16	1	H2596210004	PCB MAIN 170/SF

NOT SHOWN:

P/N B596220020 PCB STEPDOWN AW 170



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	31312222AB	ENCLOSURE, SF 170
2	1	3131222300	ENCLOSURE LID, SF 170
3	1	H310315601CU	TOUCH PAD MAIN
4	4	061160630012	SC PHIL PAN 10-24 X 3/4" SS
5	6	1904010643	STRAIN RELIEF 3444 BLK
6	1	1904010343	STRAIN RELIEF 3223 3/4" GREY
7	2	1904013643	STRAIN RELIEF 8543 90 ELB 1/2
8	1	1904019243	STRAIN RELIEF 1834
9	1	3131232200	CHASSIS PLATE, SEAFARI 170
10	6	061160631005	SC PHIL PAN 10-32 X 5/16 SS
11	1	H2596210004	PCB MAIN 170/SF
12	1	3131170147	CHANNEL DIN 35 MM RAIL
13	2	313101108F	CONTACTOR 9A AUX SF
14	4	31311501BY	TERMINAL BLOCK DIN BLACK
15	4	31311505BY	TERMINAL BLOCK DIN GREY
16	4	31311504BY	TERMINAL BLOCK DIN GREEN
17	2	31311602BY	SEPARATOR DIN
18	2	3131190347	END ANCHOR
19	1	31314301CW	POWER SUPPLY SF 12VDC



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