Cat. No. 01022940
Rev. E 02/14/14
DCO # 014260

Installation, Operation and Service Instructions

# CULLIGAN®
## M1 Series
### Reverse Osmosis Water Treatment Systems

## Models from 2011

Culligan®

# Attention Culligan Customer:

Your local independently operated Culligan dealer employs trained service and maintenance personnel who are experienced in the installation, function and repair of Culligan equipment. This publication is written specifically for these individuals and is intended for their use.

We encourage Culligan users to learn about Culligan products, but we believe that product knowledge is best obtained by consulting with your Culligan dealer. Untrained individuals who use this manual assume the risk of any resulting property damage or personal injury.

**NOTICE** **Please send any suggestions for improving this manual to productmanuals@culligan.com**

**WARNING! Electrical shock hazard! Prior to servicing equipment, disconnect power supply to prevent electrical shock.**

**WARNING! If incorrectly installed, operated, or maintained, this product can cause severe injury. Those who install, operate, or maintain this product should be trained in its proper use, warned of its dangers, and should read the entire manual before attempting to install, operate, or maintain this product. Failure to comply with any warning or caution that results in any damage will void the warranty.**

**CAUTION! This product is not to be used by children or persons with reduced physical, sensory or mental capabilities, or lack of experience or knowledge, unless they have been given supervision or instruction.**

**CAUTION! Children should be instructed not to play with this appliance.**

**CAUTION! If the power cord from the transformer to the unit looks or becomes damaged, the cord and transformer should be replaced by a Culligan Service Agent or similarly qualified person in order to avoid a hazard.**

**WARNING! This device complies with Part 15 of the FCC rules subject to the two following conditions: 1) This device may not cause harmful interference, and 2) This device must accept all interference received, including interference that may cause undesired operation.**

This equipment complies with Part 15 of the FCC rules. Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**CAUTION! To reduce the risk of fire, use only No. 26 AWG or larger telecommunications line cord.**

**NOTE This system is not intended for use with water that is microbiologically unsafe or of unknown quality without adequate disinfection either before or after the system.**

**NOTE Check with your public works department for applicable local plumbing and sanitation codes. Follow local codes if they differ from the standards used in this manual. To ensure proper and efficient operation of the Culligan equipment to your full satisfaction, carefully follow the instructions in this manual.**



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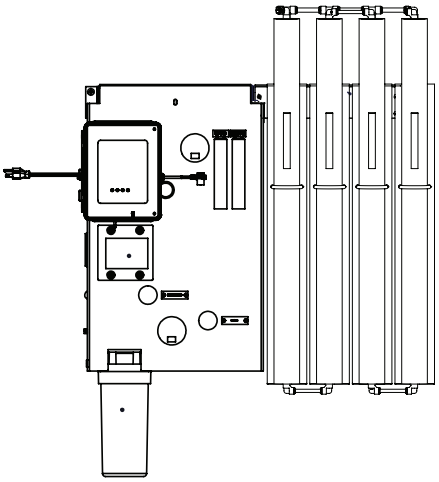


Installation and Operation Instructions

# Culligan®
# M1 Series
## Reverse Osmosis Water Treatment Systems

## Using the CP Plus Controller

## Models From 2011

### Contents



Cat. No. 01022940

## Units of Measure Conversion: U.S. to Metric

| Convert From | To | Multiplication Factor |
|---|---|---|
| gallons per minute (gpm) | liters per minute (l/min) | 3.785 |
| gallons per day (gpd) | cubic meters per hour (m^3/hr) | 0.000158 |
| gallons (gal) | liters (l) | 3.785 |
| pounds per square inch (psi) | bar | 0.0689 |
| degrees Fahrenheit (F) | degrees Centigrade (C ) | (F-32) x 0.556 |
| pounds (lbs) | kilograms (kg) | 0.4536 |
| Inches (in) | millimeters (mm) | 25.4 |
| parts per million (ppm) | mg/l | 1.00 |

# Introduction

## Read this Manual First

Before you operate the Culligan® M1 Series reverse osmosis systems, read this manual to become familiar with the device and its capabilities.

Culligan® M1 Series reverse osmosis systems are designed to meet the needs of applications for high quality water. This manual contains important information about the unit, including information needed for installation, operating, and maintenance procedures. A troubleshooting section provides a guide for quick and accurate problem solving.

In order for the water treatment system to continue to provide high quality water, you must develop a thorough understanding of the system and its operation. Review this manual before making any attempt to install, operate, or service the system. Installation or maintenance done on this system by an untrained service person can cause major damage to equipment or property damage.

Culligan® M1 Series reverse osmosis systems are tested and certified by WQA against NSF/ANSI 372 and NSF/ANSI Standard 61 for material requirements.

## About this Manual

This manual:

- Familiarizes the operator with the equipment
- Explains installation and setup procedures
- Explains the various modes of operation
- Gives specifications and troubleshooting information

This publication is based on information available when approved for printing. Continuing design refinements could cause changes that might not be included in this publication.

## Safe Practices

Throughout this manual there are paragraphs set off by special headings.

### Notice

Notice is used to emphasize installation, operation or maintenance information which is important, but does not present any hazard. For example,

**NOTICE** **The nipple must extend no more than 1 inch above the cover plate.**

### Caution

Caution is used when failure to follow directions could result in damage to equipment or property. For example,

**CAUTION!** **Disassembly while under water pressure can result in flooding.**

### Warning

Warning is used to indicate a hazard which could cause injury or death if ignored. For example,

**WARNING!** **Electrical shock hazard! Unplug the unit before removing the timer mechanism or cover plates!**

The CAUTION and WARNING paragraphs are not meant to cover all possible conditions and situations that may occur. It must be understood that common sense, caution, and careful attention are conditions which cannot be built into the equipment. These MUST be supplied by the personnel installing, operating, or maintaining the system.

Be sure to check and follow the applicable plumbing codes and ordinances when installing this equipment. Local codes may prohibit the discharge of acid or caustic solutions to drain. An extra solution tank should be used to neutralize the solution before discharging to drain.

Use protective clothing and proper face or eye protection equipment when handling chemicals or power tools.

# Features

The Culligan® M1 Series Reverse Osmosis systems are the direct result of Culligan's long-time experience in membrane applications around the world. From process water for any size business to treating water for an entire city, Culligan has the knowledge and the range of products you need to get the job done.

The M1 reverse osmosis system is sized to serve small-to-medium-sized applications that require high-quality reverse osmosis water. It is designed with the flexibility to closely match your treatment requirements from 0.2 to 2.8 gallons per minute (288 to 4,000 gallons per day). Mount the system on a wall to save floor space, or install it on the floor using an optional floor stand. A rich standard feature set with multiple options can satisfy virtually any application. Select the right size and choose any options needed to complete your system.

## Key Product Features

- Simple System Integration
- Flexible Configurations
- Quick Delivery/Easy Installation
- Culligan Electronic Features
  - Pretreatment Lockout
  - Storage Tank Level  and Pressure Control
  - Low Pressure Auto-Restart
  - Automatic Shutdown in poor product quality conditions (optional)
- Line Pressure Front Side Flush Prior to Startup—see page 27
- Line Pressure Front Side Flush at Timed Intervals—see page 28

# M1 Series Specifications

**NOTE Specifications for M1 RO 230V (international) are in "M1 RO International Specifications" on page 60.**

| | 1S | 2S | 3S | 4S | 2L | 3L | 4L | 1F | 2F |
|---|---|---|---|---|---|---|---|---|---|
| Nominal Capacity, GPD [m³/hr]* | 250 [0.04] | 500 [0.08] | 750 [0.12] | 1000 [0.16] | 1200 [0.19] | 1700 [0.27] | 2200 [0.35] | 2000 [0.32] | 4000 [0.63] |
| Dimensional, Series M1 Units | | | | | | | | | |
| Width - in [mm] | 34.5 [876] | | | 38.5 [978] | 34.5 [876] | | 38.5 [978] | 34.5 [876] | |
| Depth - in [mm] | 8.7 [221] | | | | | | | | |
| Height - in [mm] | 34.8 [884] | | | | 45.5 [1156] | | | | |
| Operating Weight, lb [kg] | 77 [35] | 81 [37] | 92 [42] | 96 [44] | 88 [40] | 103 [47] | 111 [50] | 97 [44] | 129 [59] |
| Unit Connections | | | | | | | | | |
| Inlet (Tube) - in | 1/2" | | | | | | | | |
| Product (Tube) - in | 1/2" | | | | | | | | |
| Concentrate (Tube) - in | 3/8" | | | | | | | | |
| Electrical | | | | | | | | | |
| Motor Horsepower, hp [kW] | 0.333 [0.25] | | | | 0.75 [0.56] | | | | |
| Power Requirement (VAC/phase/Hz) | 115/1/60 | | | | | | | | |
| Full Load Current, amp (@115V) | 8 | | | | 12 | | | | |
| Hydraulic - Prefilter | | | | | | | | | |
| Housing Quantity | 1 | | | | | | | | |
| Cartridge Rating, micron | 5 | | | | | | | | |
| Cartridge Length - in [mm] | 10 [254] | | | | | | | | |
| Hydraulic - RO | | | | | | | | | |
| RO Housing Quantity | 1 | 2 | 3 | 4 | 2 | 3 | 4 | 1 | 2 |
| RO Element Quantity | 1 | 2 | 3 | 4 | 2 | 3 | 4 | 1 | 2 |
| RO Element Size - in [mm] | 2.5x21 [63.5x533.4] | | | | 2.5x40 [63.5x1016] | | | 4x40 [101.6x1016] | |
| RO Array | 1 | 1:1 | 1:1:1 | 1:1:1:1 | 1:1 | 1:1:1 | 1:1:1:1 | 1 | 1:1 |
| Product Flow - gpm [L/min]* | 0.17 [0.64] | 0.35 [1.32] | 0.52 [1.97] | 0.69 [2.61] | 0.83 [3.14] | 1.18 [4.47] | 1.53 [5.79] | 1.40 [5.30] | 2.8 [10.6] |
| Concentrate Flow - gpm [L/min]* | 0.51 [1.93] | 0.35 [1.32] | 0.52 [1.97] | 0.69 [2.61] | 0.83 [3.14] | 1.18 [4.47] | 1.53 [5.79] | 4.17 [15.78] | 2.78 [10.52] |
| Required Inlet Feed Flow - gpm [L/min] | 0.68 [2.57] | 0.7 [2.65] | 1.04 [3.94] | 1.38 [5.22] | 1.66 [6.28] | 2.36 [8.93] | 3.06 [11.58] | 5.56 [21.04] | 5.56 [21.04] |
| Pump Flow @ 150 psi, gpm [L/min] | 1.6 [6.06] | | | | 2.7 [10.44] | | 3.1 [11.73] | 5.6 [21.2] | |
| Maximum Module Feed Pressure psig [kPa] | 150 [1034] | | | | | | | | |
| Nominal Module Feed Pressure psig [kPa]† | 95 [654.6] | 100 [689] | 103 [709.7] | 104 [716.6] | 96 [661.4] | 97 [668.3] | 101 [695.9] | 95 [654.6] | 101 [695.9] |
| Max. Product Pressure psig [kPa] | 40 [275.6] | | | | | | | | |
| Inlet Pressure Min., dynamic psig [kPa] | 20 [137.8] | | | | | | | | |
| Maximum, dynamic psig [kPa] | 50 [344.5] | | | | | | | | |
| Operating Temp °F [°C] | 33-100 [1-38] | | | | | | | | |
| Recovery (%)* | | | | | | | | | |
| Design | 25 | 50 | 50 | 50 | 50 | 50 | 50 | 25 | 50 |
| Minimum | 15 | 15 | 40 | 40 | 40 | 40 | 40 | 15 | 40 |
| Salt Rejection, Nominal (%) | 98 | | | | | | | | |

†Calculated using a 0.85 fouling factor

*Nominal capacity based on new RO membranes operating on a properly pretreated feed water of 500 ppm TDS as NaCl, 77 °F (25 °C), Silt Density Index (SDI) below 3, and supplying water to atmosphere. Productivity will vary depending on the actual feed water quality and temperature. See "Feed Water Limits" on page 77 in Appendix B.

# Unit Configurations

A four-membrane unit is pictured in Figure 1 and Figure 2. The membrane rack width varies by model; see "M1 RO Parts Diagrams and Lists" on page 44 for system part numbers.

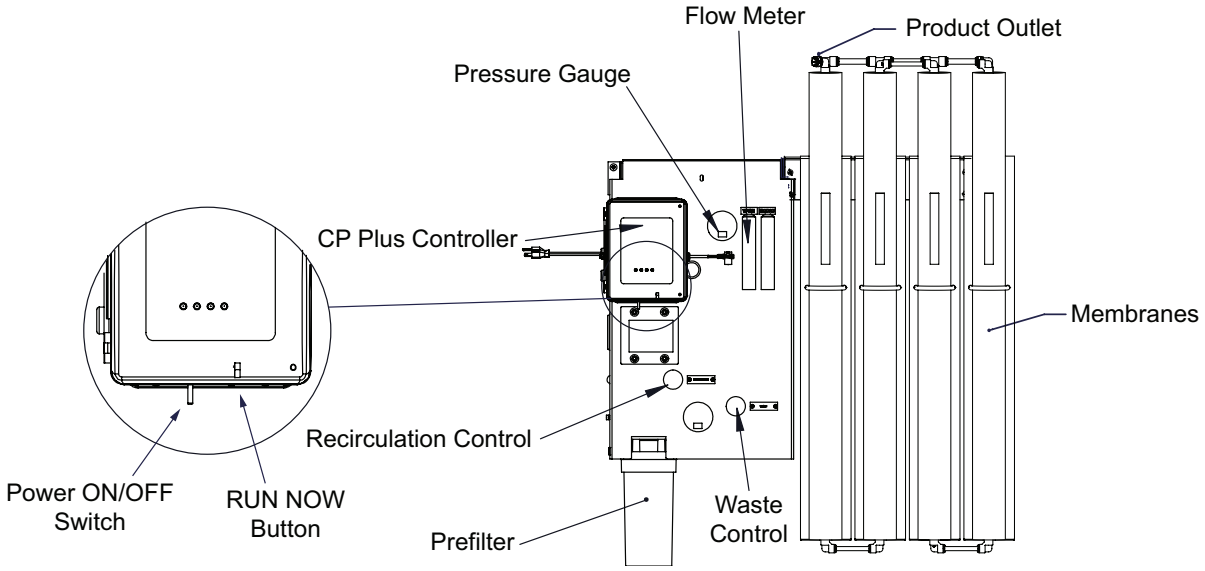



Figure 1. M1 RO front view.

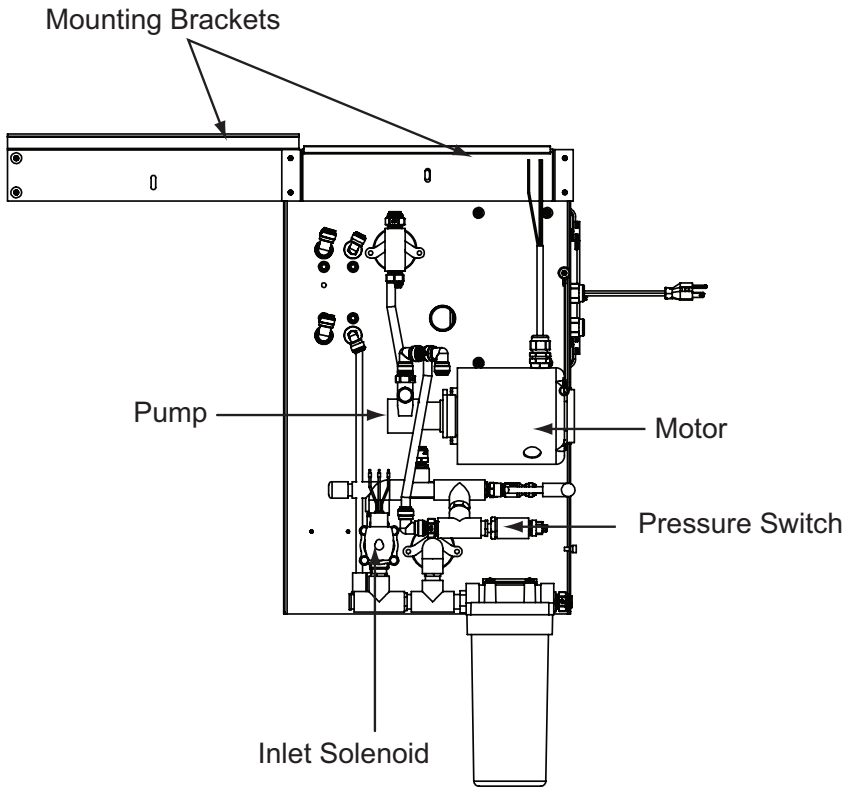



Figure 2. M1 RO back view.

## Unpacking the M1 RO

This manual, the warranty, and registration card are packed in the control assembly box. Please complete the registration card and mail it promptly.

| | |
|---|---|
| **NOTICE** | **Examine each unit component carefully to check for loose or damaged parts. Report any apparent or concealed shipping damage to the freight carrier immediately.** |

## Materials Required

To install the system, the following items are required:

1. Level
2. Drill
3. Screws for mounting the bracket for the main plumbing assembly
4. Screwdrivers, including a small, flat-bladed (1/8” wide) screwdriver for wiring
5. Adjustable wrench
6. Tubing;
   All—Nat 1/2” Feed Water and Product Water Tubing, P/N 00901801
   All—Nat 3/8” Product Concentrate (Waste) Water Tubing, P/N 00444973
7. Bucket calibrated for taking flow rates
8. Clean rags
9. Thermometer
10. Stopwatch with a second hand
11. Portable Total Dissolved Solids meter
12. Safety glasses

## Location

Series M units are designed for wall mounting so that all components are accessible for maintenance and monitoring.

The wall you choose for mounting the unit must be capable of supporting at least 130 pounds. See the assembly section below for installation detail.

A 120 VAC/60 Hz/1 Phase grounded electrical receptacle with 15 amp fuse protection is required for use with the six-foot, three-wire power cord.

| | |
|---|---|
| **NOTICE** | **Do NOT use any bolt size smaller than 1/4" diameter.** |

The unit must be located near a drain able to handle 10 gallons per minute (37.9 liters/min). This is in addition to the flow from any other water treatment equipment.

| | |
|---|---|
| **CAUTION!** | **The system must not be located near any corrosive chemicals which may cause failure of the plastic or metal parts of the unit. In addition, do not locate the unit where the temperature may exceed the feed water temperature limits.** |

# Assembly

## Concrete Wall Installation

Refer to Figure 3 to install the RO system to a concrete wall. Place the unit against the wall, level the unit and mark the wall through the mounting holes. Drill the holes in the wall and mount the unit. Horizontal holes are on 16" centers. Vertical holes are on 2" centers.

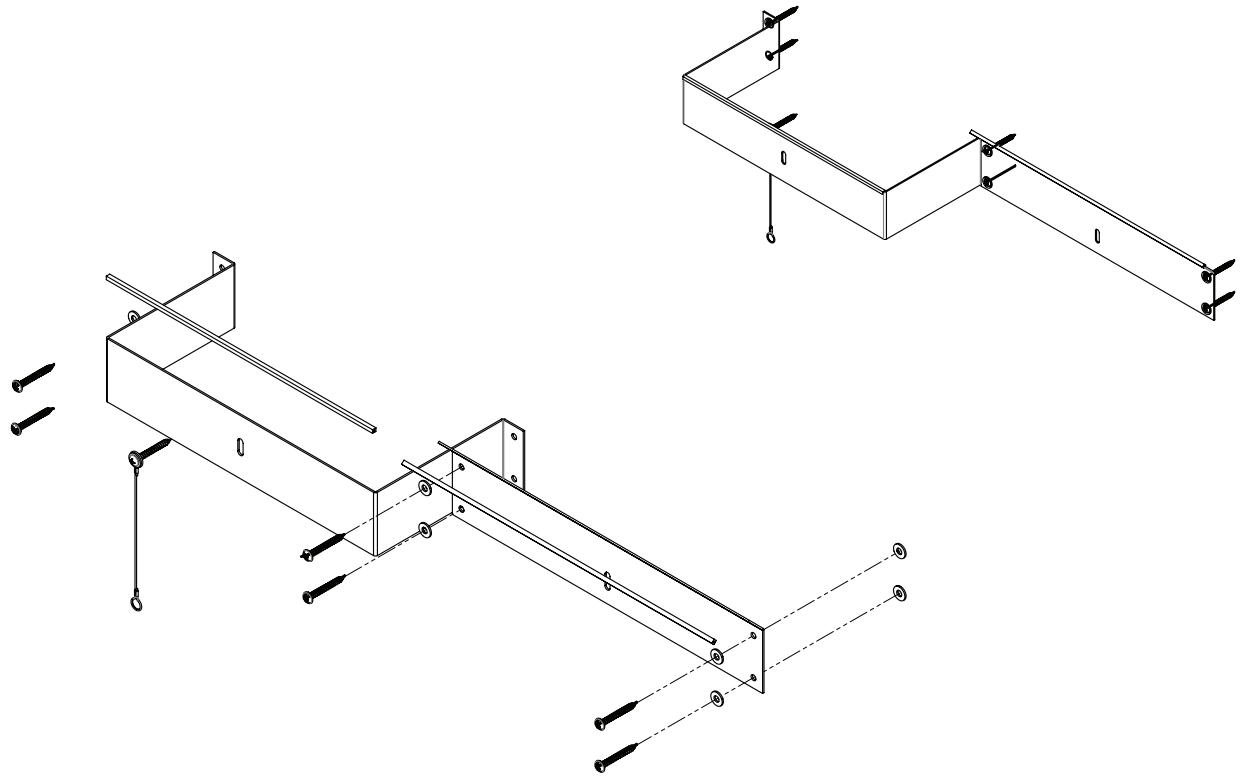


Figure 3. RO wall assembly bracket kit (included with unit).

## Wall Mounting Kit (optional)

If the wall is not concrete and wall mounting is necessary, a wall mounting bracket kit is available. The bracket has holes for mounting on 18” and 20”centers. Use bracket P/N 01023017 for all models.

Place the bracket adapter on the wall with the flat side towards the wall. Level the bracket adapter and mark the wall through the appropriate holes. Drill holes in the wall. Assemble the wall brackets to the bracket adapter. Mount the adapter and wall brackets to the wall. Mount the pump/motor assembly and the membrane assembly to the brackets.

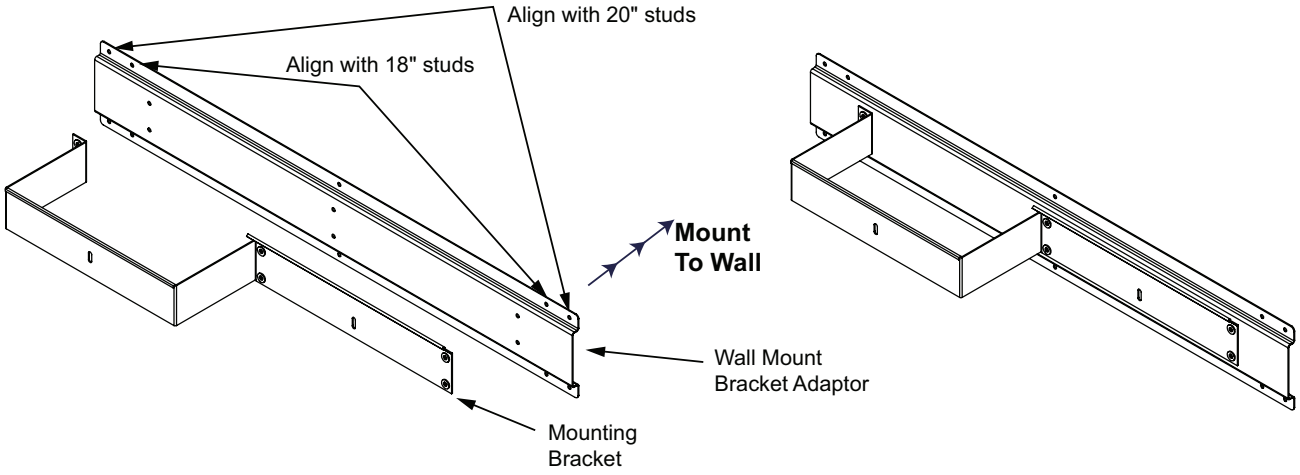



Figure 4. Optional Wall Mount Bracket.

## Stand Mounting (optional)

If the RO unit requires floor mounting, a rigid steel stand (P/N 01021987) is available. Wall mount brackets are used with floor stand to mount unit and membranes.

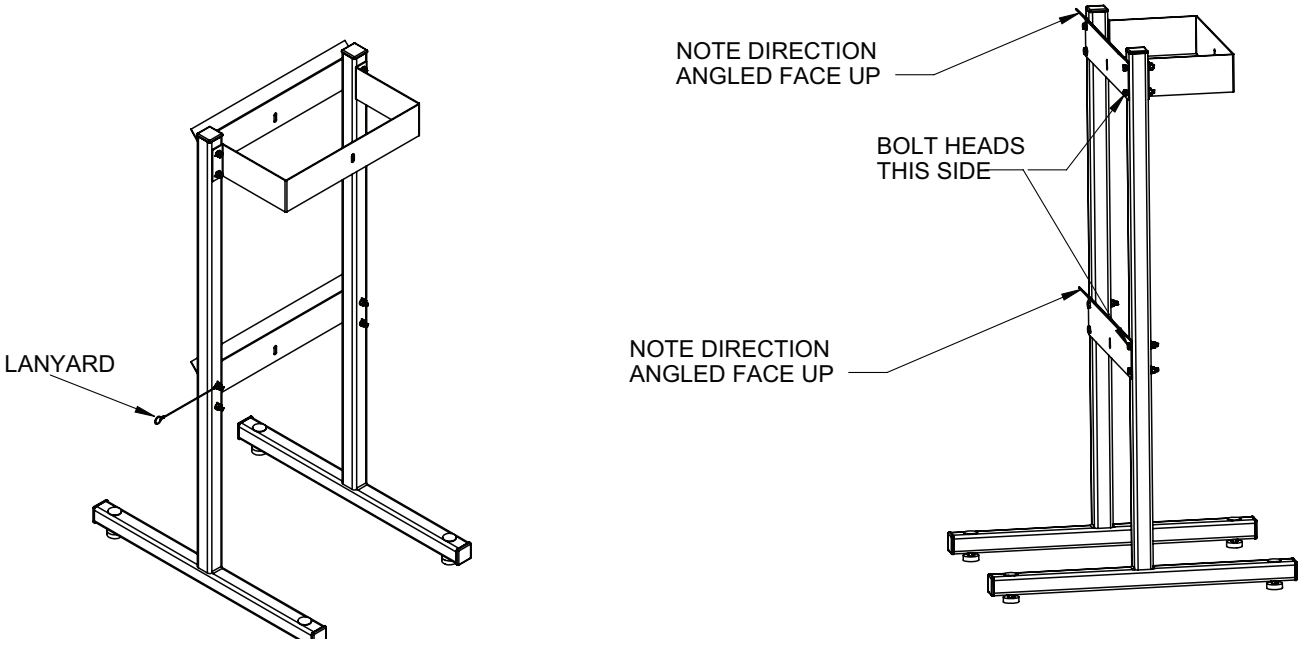



Figure 5.RO floor stand assembly.

## Pump/Motor Panel

Hang the pump motor panel on the mounting bracket. The top edge of panel hooks on to the bracket. See Figure 6.

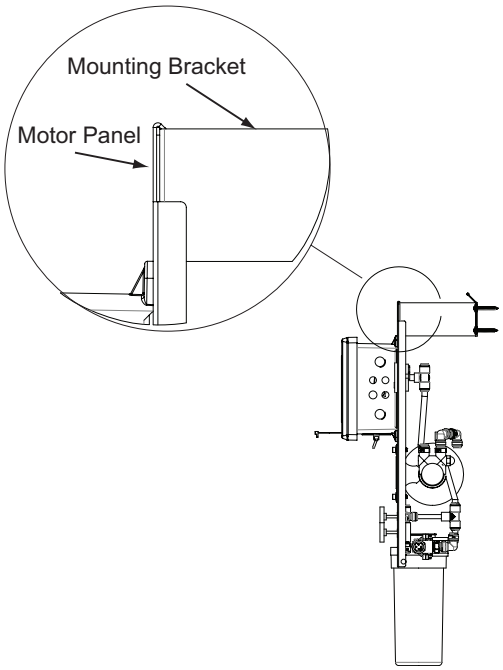



Figure 6.Pump motor panel hanging on mounting bracket.

## Fittings

Locate the Membrane Fitting Kit that was shipped with the unit. This kit includes all the fittings needed to connect the membranes to the pump/motor panel. Refer to Figure 10 on page 12 through Figure 15 on page 17 for the tubing assembly instructions. Detailed drawings of the fittings and housings can be found in the parts section.

## Prefilter Cartridge

1. Locate the prefilter cartridge packed with the main unit.
2. Unscrew the prefilter bowl.
3. Lubricate the seal ring with silicone lubricant as required.
4. Remove the paper wrapper from the cartridge, place the cartridge in the bowl, and screw the bowl onto the head.

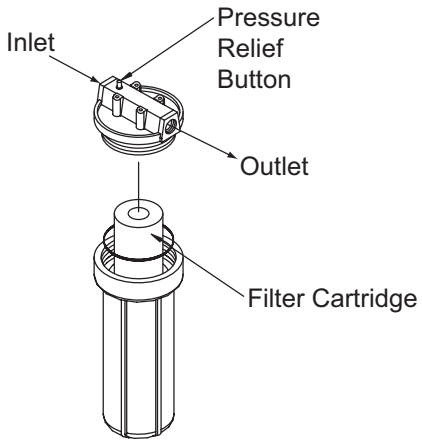



Figure 7. Installing the Prefilter.

## Membranes

Before mounting the membrane housings, the membranes must be inserted into the housings. Take care to not damage the end cap O-rings or membrane brine seal.

The membranes are shipped in a sealed package. Use extreme caution when opening the package with a sharp instrument. Any damage to the membrane can cause poor quality coming from the unit.

1. The membrane housings have directional arrows on them that indicate direction of flow. Install the membranes in the direction of flow.
2. Remove the end caps from all vessels by removing the two Allen head screws that hold down the retaining clips. The clips are pushed into an internal groove in the housing, so completely remove the screws so the clip can be slid out of the groove. Note placement of the caps to assure reinstallation in the same orientation.
3. Check the O-ring seals on the membrane and end plug, and the membrane brine seal for damage. If an O-ring is cut or crimped, it may cause high flow and poor quality. Replace any suspicious-looking O-rings.

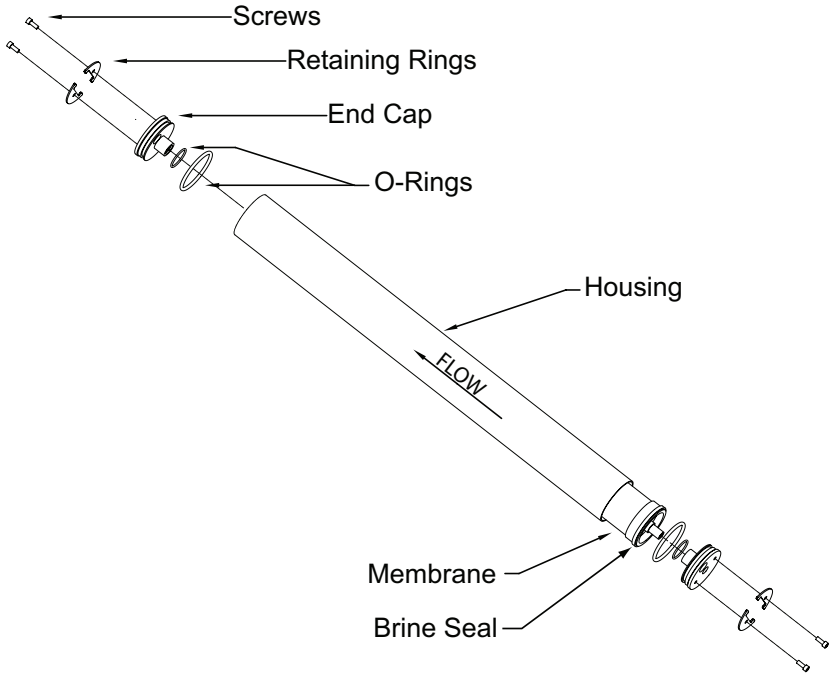



Figure 8. Membrane and its housing.

4. Remove a new membrane from its plastic bag. Lightly lubricate the O-rings with a silicone-based lubricant or use a mixture of 70% glycerin and 30% water.

**CAUTION! Do not use a petroleum-based lubricant. It will damage the synthetic rubber and the membrane.**

5. Install the membrane in the same direction as indicated by the arrow on the outside of the membrane vessel. The brine seal end should go in last.
6. Repeat for the remaining membrane housings. There may be one to four housings on each model.

## Tubing Configuration

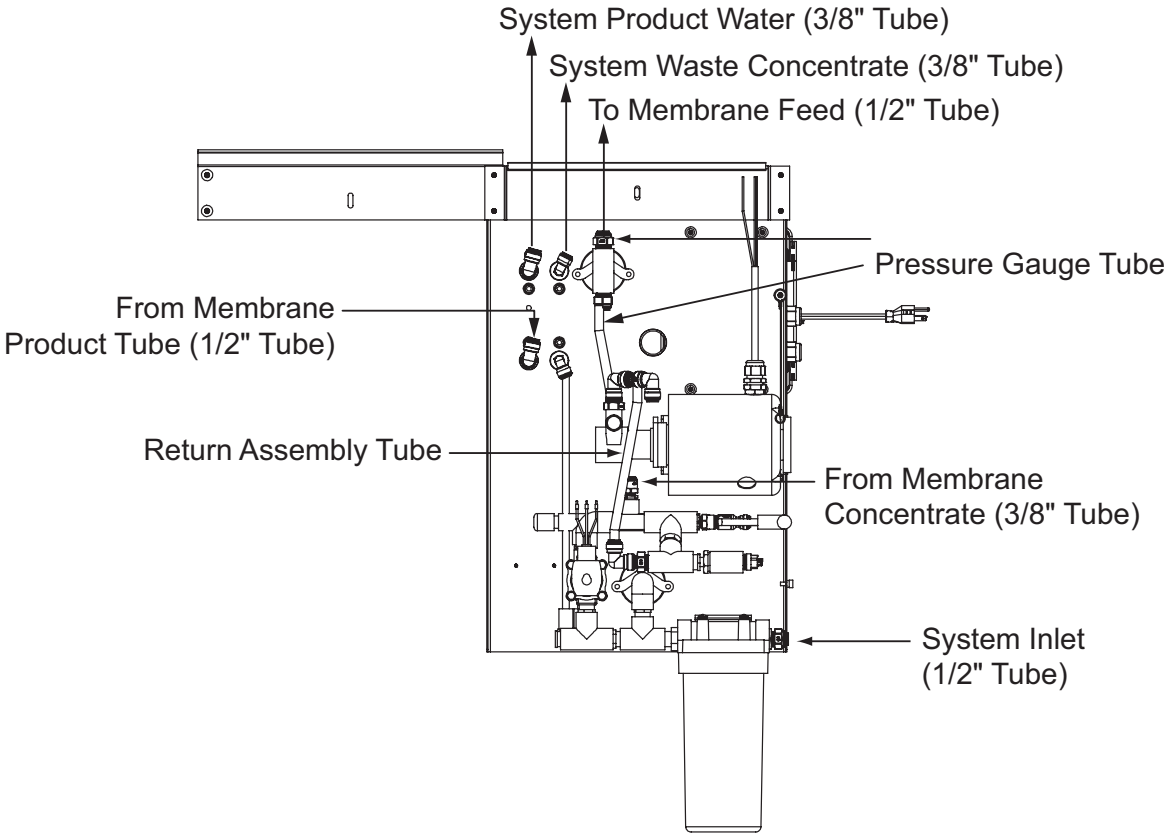



Figure 9. M1 Series tubing configuration.

# Plumbing Installation

Refer to the tubing assembly instructions in Figure 10 on page 12 through Figure 15 on page 17 and the hydraulic schematic/flow diagram on page 42 for further information.

## Feed Water Connections

Connect tubing to the Feed water inlet. Observe the following:

1. To minimize pressure loss, the tubing size should be at least 1/2”.
2. Install an optional pressure gauge (part number D1006272) before the pre-filter. This allows you to measure the pressure differential across the filter cartridge.
3. Install a tee, with a shutoff valve on the branch, to provide a connection for introducing cleaning solutions.
4. If necessary, install a pressure regulator (50 psi downstream max. setting) in the inlet plumbing, to assure constant pressure and to prevent harmonic vibration.
5. Install a shutoff valve in the inlet plumbing to simplify maintenance and service.
6. If the feed water can be used for a short period, install bypass plumbing around the unit.

## Concentrate Water Connections

1. Direct 3/8" piping to drain from the outlet of the unit.
2. To prevent siphoning of the water in the unit to drain, raise the concentrate piping above the level of the modules and provide an anti-siphon loop.

**WARNING! An air gap must be provided between the end of the concentrate tubing and the drain to prevent back-siphoning of drain contents.**

## Product Water Connections

The product water exits the unit at the top of the module housings. Connect the product tubing as shown in Figure 10 on page 12 through Figure 15 on page 17.

**CAUTION! This unit produces high quality product water. This water can be contaminated by plumbing following the unit or it can corrode the plumbing. Use only plumbing components of inert material that are compatible with the application.**

The connection of the main product tubing to service plumbing will depend on how the product water will be stored.

**CAUTION! Reverse osmosis elements will fail immediately if pressurized product water is allowed to flow backward into the unit.**

## 1S Tubing Assembly Instructions

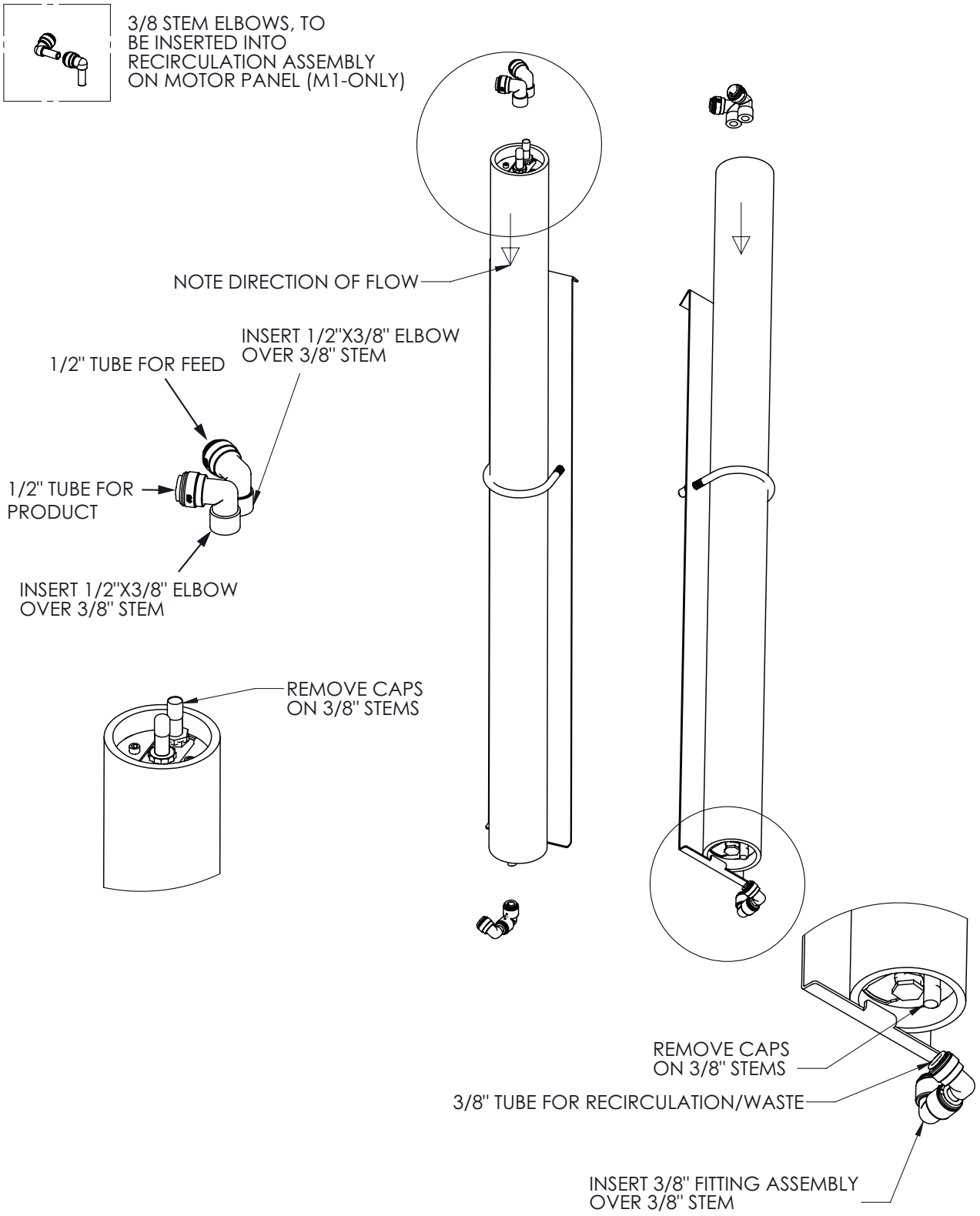



Figure 10. RO 1S tubing assembly instructions.

## 2S/2L Tubing Assembly Instructions

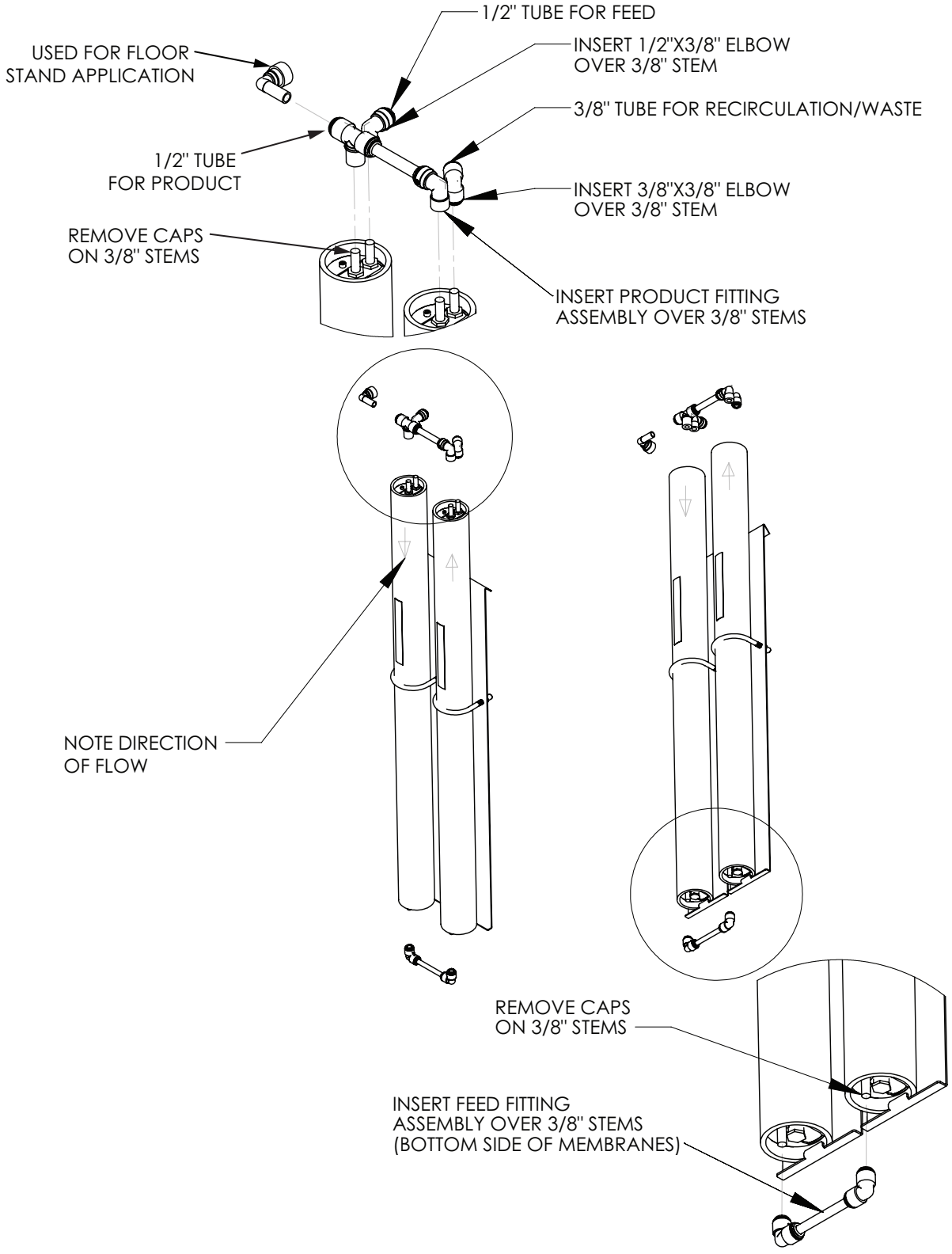



Figure 11. RO 2S/2L tubing assembly instructions.

## 3S/3L Tubing Assembly Instructions

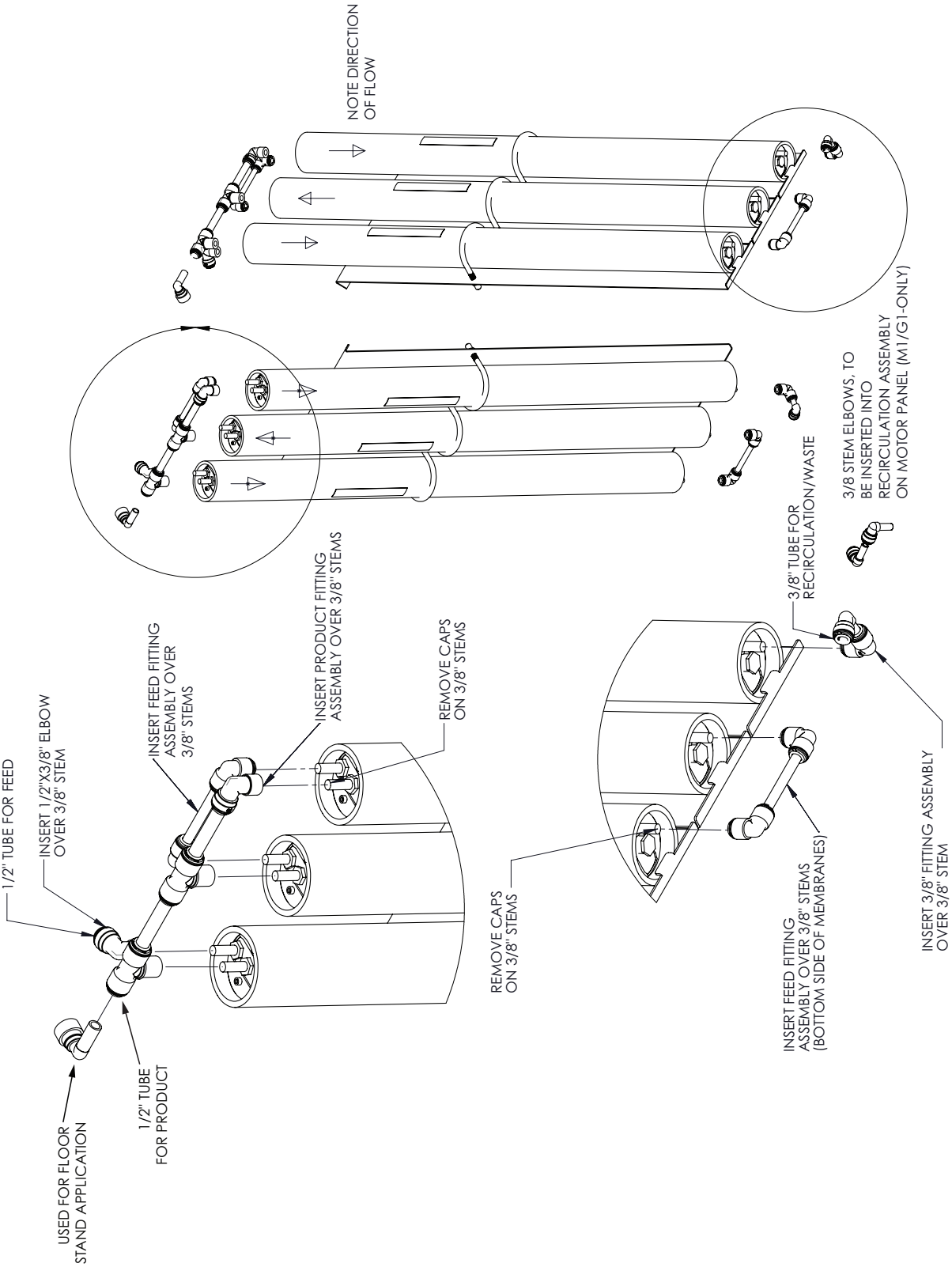



Figure 12. RO 3S/3L tubing assembly instructions.

## 4S/4L Tubing Assembly Instructions

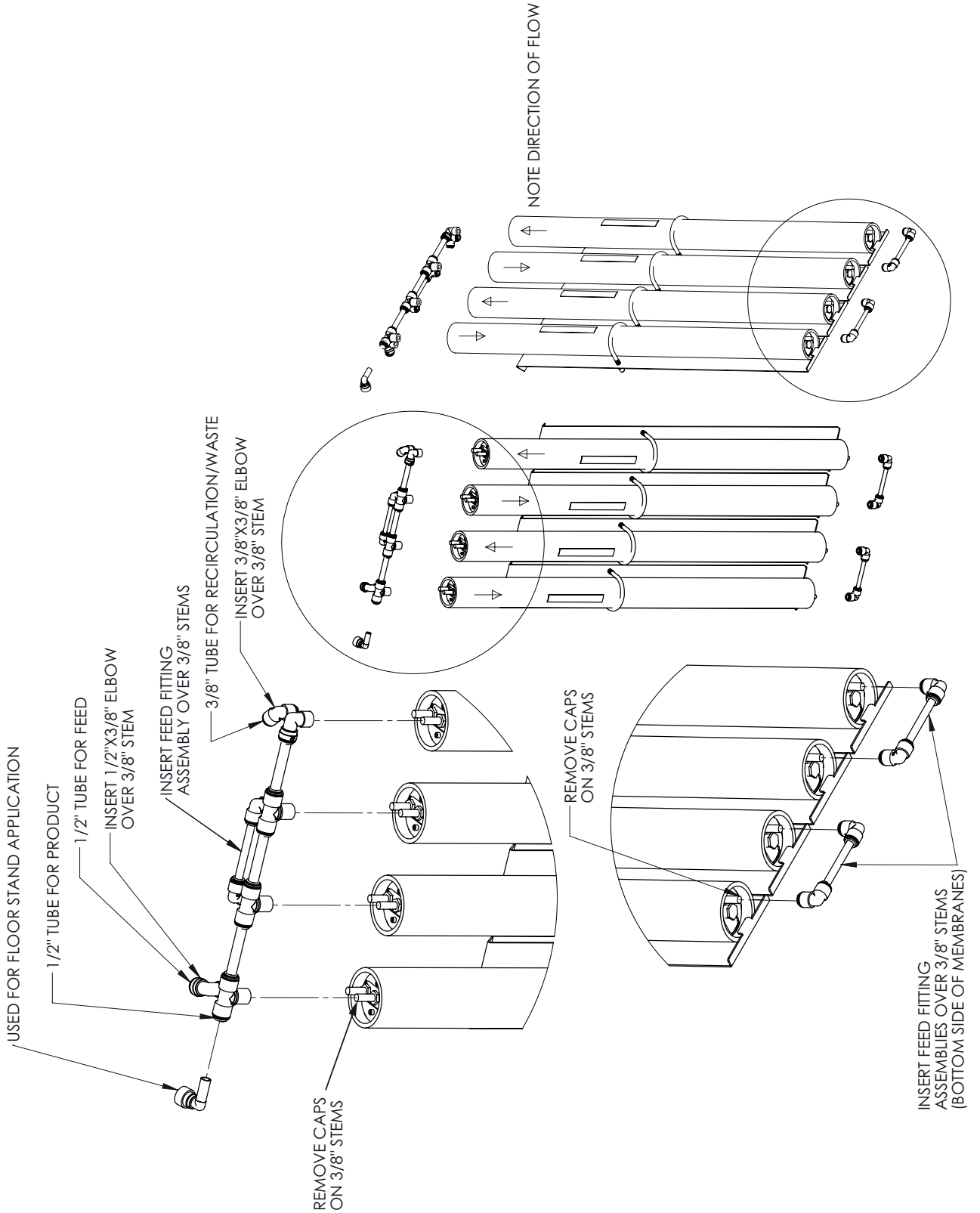



Figure 13. RO 4S/4L tubing assembly instructions.

## 1F Tubing Assembly Instructions

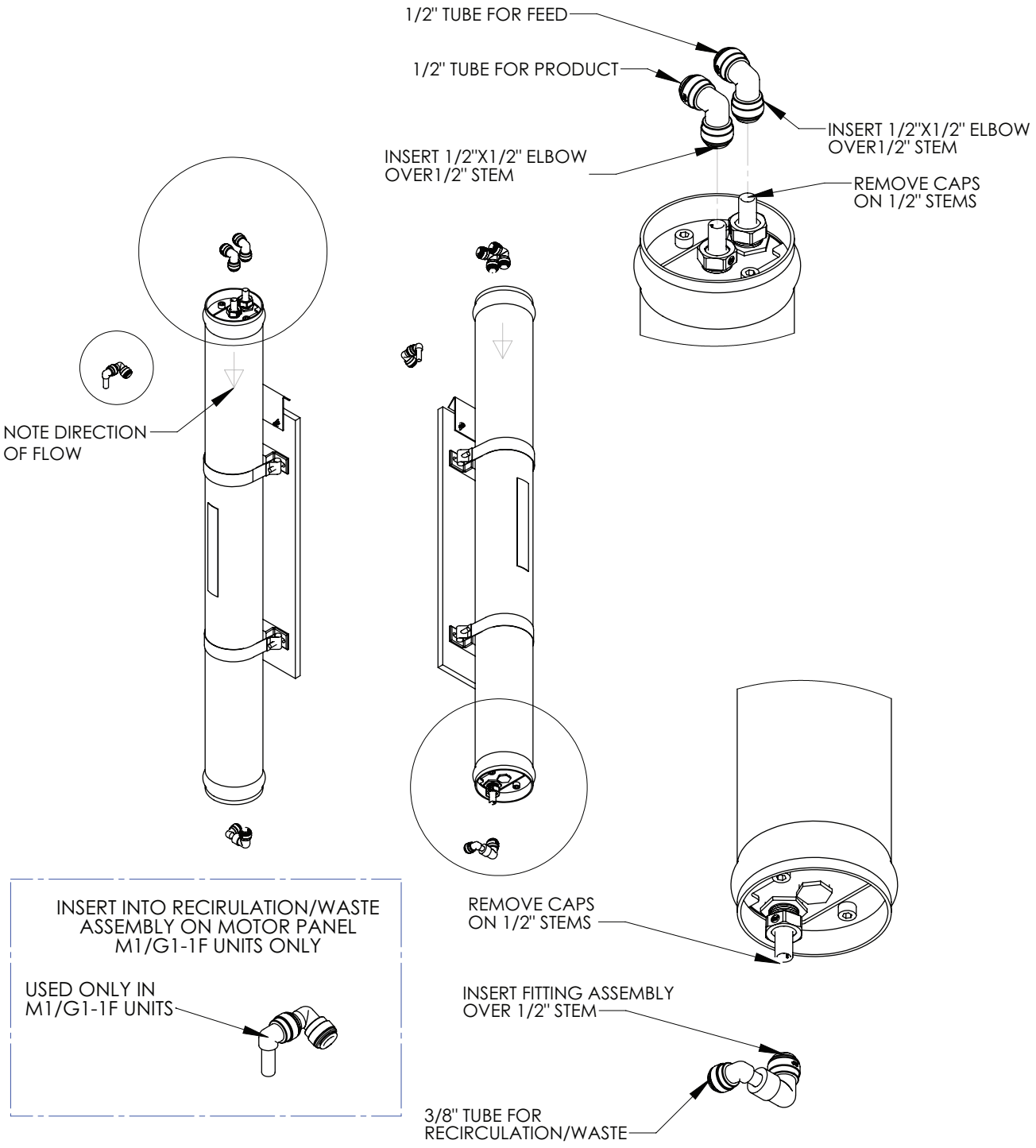



Figure 14. RO 1F tubing assembly instructions.

## 2F Tubing Assembly Instructions

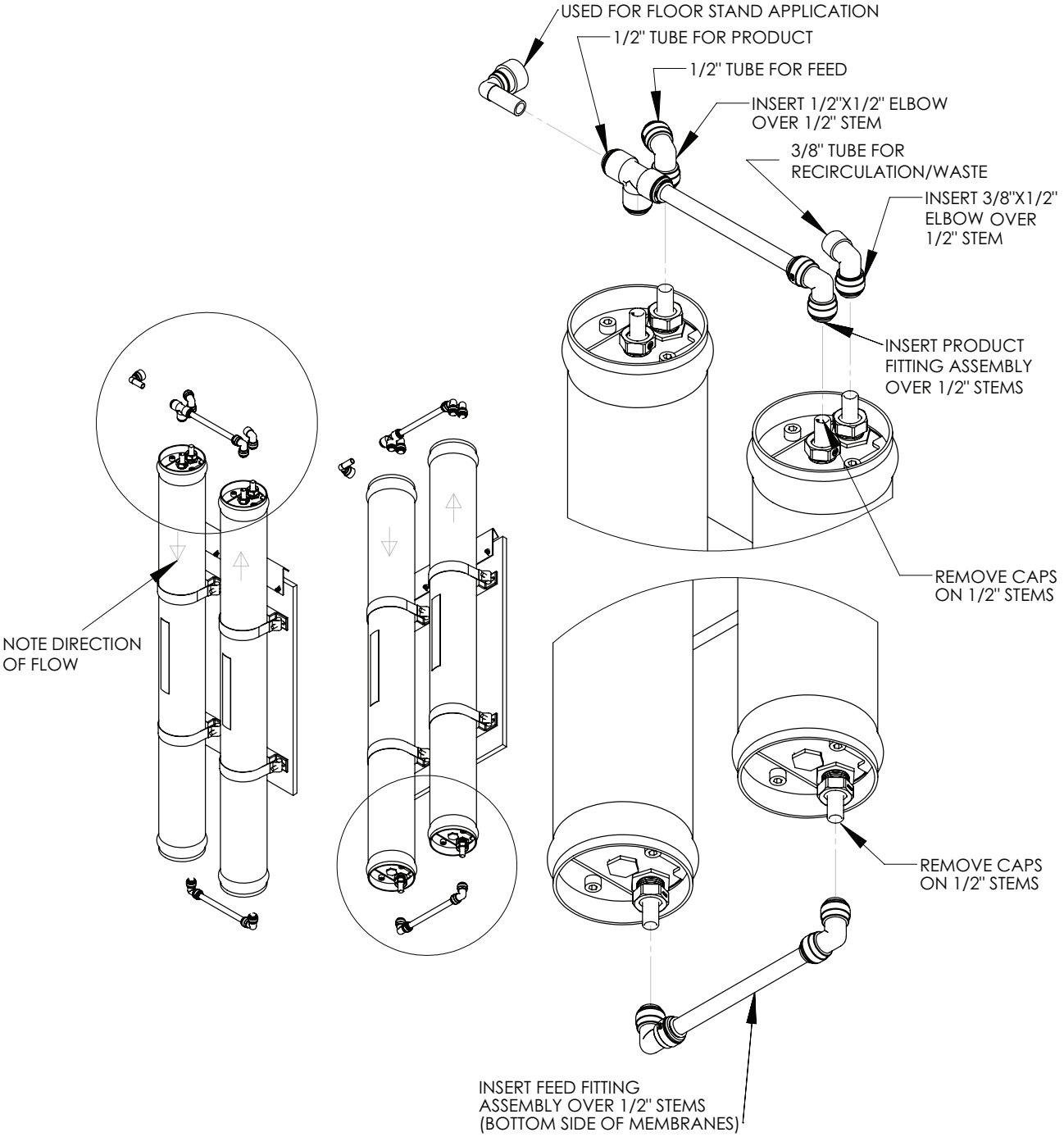



Figure 15. RO 2F tubing assembly instructions.

## Pressurized Storage Tank

The product water can be stored in a pressurized storage tank with the reverse osmosis unit controlled by a pressure switch. Use the same components used for direct feed (see Figure 16) with the addition of a pressure switch which needs to be wired to the control panel (see Figure 22 on page 28). A pressurized water storage kit is available under part number D1013880. Connect the product tubing to a bulkhead fitting at the top of the storage tank such as P/N 01005095 (2-gallon), P/N 01004776 (3-gallon), or P/N 01004765 (9-gallon).

## Non-Pressurized Product Water Storage Tank

Connect the product tubing to a bulkhead fitting at the top of the storage tank.

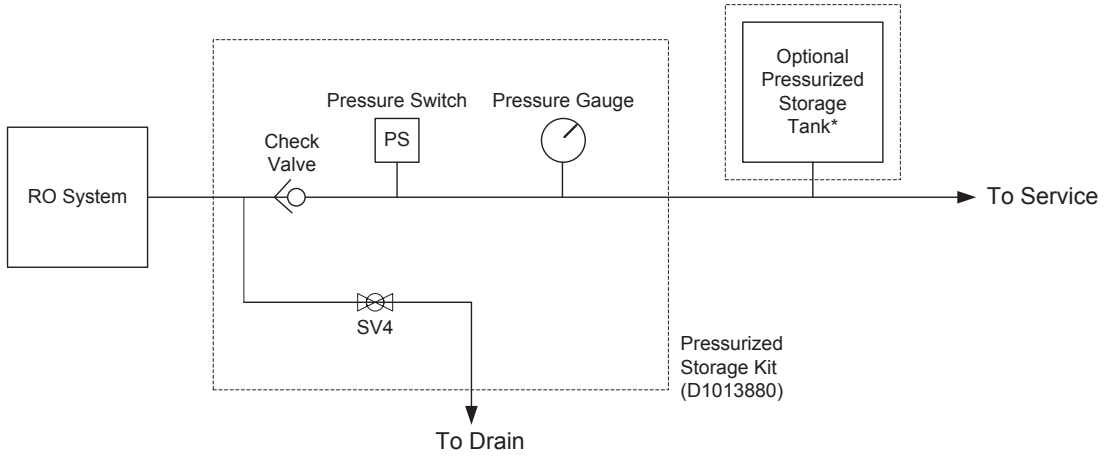
Depending on the type of application, a level control may be required to turn the unit off when the storage tank is full. Install the level control according to the instructions provided with the control. Refer to the wiring section in this manual for electrical connections.

| | |
|---|---|
| **NOTICE** | **If a repressurization pump is used, an additional level control is recommended to prevent the pump from running dry if the storage tank is empty.** |

To maintain high water quality, a hydrophilic air vent filter, vacuum breaker, pop-off valve, ultraviolet lamp, and pressure relief valve may be required.

## Direct Feed

If the product water is to be used directly, without storage, a few precautions are necessary to prevent damage to the elements. Install a pressure gauge, pressure switch, and a normally-open (“dump”) solenoid in the product water line as shown in Figure 16, or use pressurized storage kit (P/N D1013880). The pressure gauge will allow the operator to monitor the product water pressure. The switch, which should be set to open at 40 psig, will prevent the product water pressure from exceeding 40 psi. The dump solenoid will relieve all pressure when the unit is off.




*Use of Pressurized Storage Tank requires use of Pressurized Storage Kit D1013880.

Figure 16. Direct feed connection.

Wire the direct feed/pressurized storage solenoid valve in parallel with the motor.

Valve SV4 closes when the RO pump runs; SV4 opens when the pump stops, allowing all membrane back proessure to be relieved.

| | |
|---|---|
| **NOTICE** | **Product back pressure will decrease the net pressure pushing water through the reverse osmosis elements. Therefore, the flow of product water will decrease.** |

# Electrical Installation

**WARNING! The system must be grounded. Do not remove grounding prong! An improperly grounded unit could cause injury from electrical shock!**

**CAUTION! Observe the cautions listed below before the electrical installation of the controller. Failure to do so might cause permanent damage to the RO controller.**

**CAUTION! Before performing any electrical wiring refer to the electrical schematics.**

**WARNING! Disconnect ALL power supplies when performing any electrical wiring.**

A 120 VAC/60 Hz/1 phase grounded electrical receptacle with 15 Amp fuse protection is required for use with the six-foot, three-wire power cord..

## Pre-Installation Recommendations

- Follow the local electrical code requirements.
- Be sure electrical power is off and disconnected at the source before completing any wiring/cabling connections.
- Maintain a distance of at least 10 feet between the controller and any electrical distribution panels, raceways carrying 300 volts or more.
- Use the cabling provided. Failure to do so may affect performance of the controller adversely.

## High Voltage Connections

To open the control panel, unscrew the door screws in the counter clock-wise direction and swing the door open.

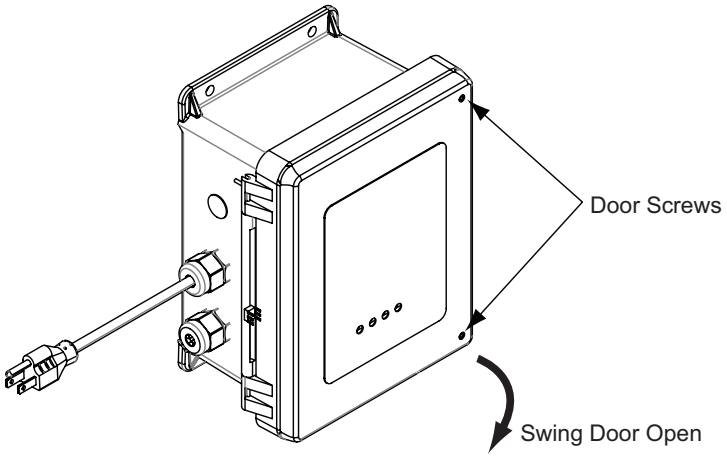



Figure 17. M1 control panel door.

The high voltage terminal strip is located on the circuit board (Figure 18). This terminal strip is prewired to the power cord, motor power cord and the solenoid valve.

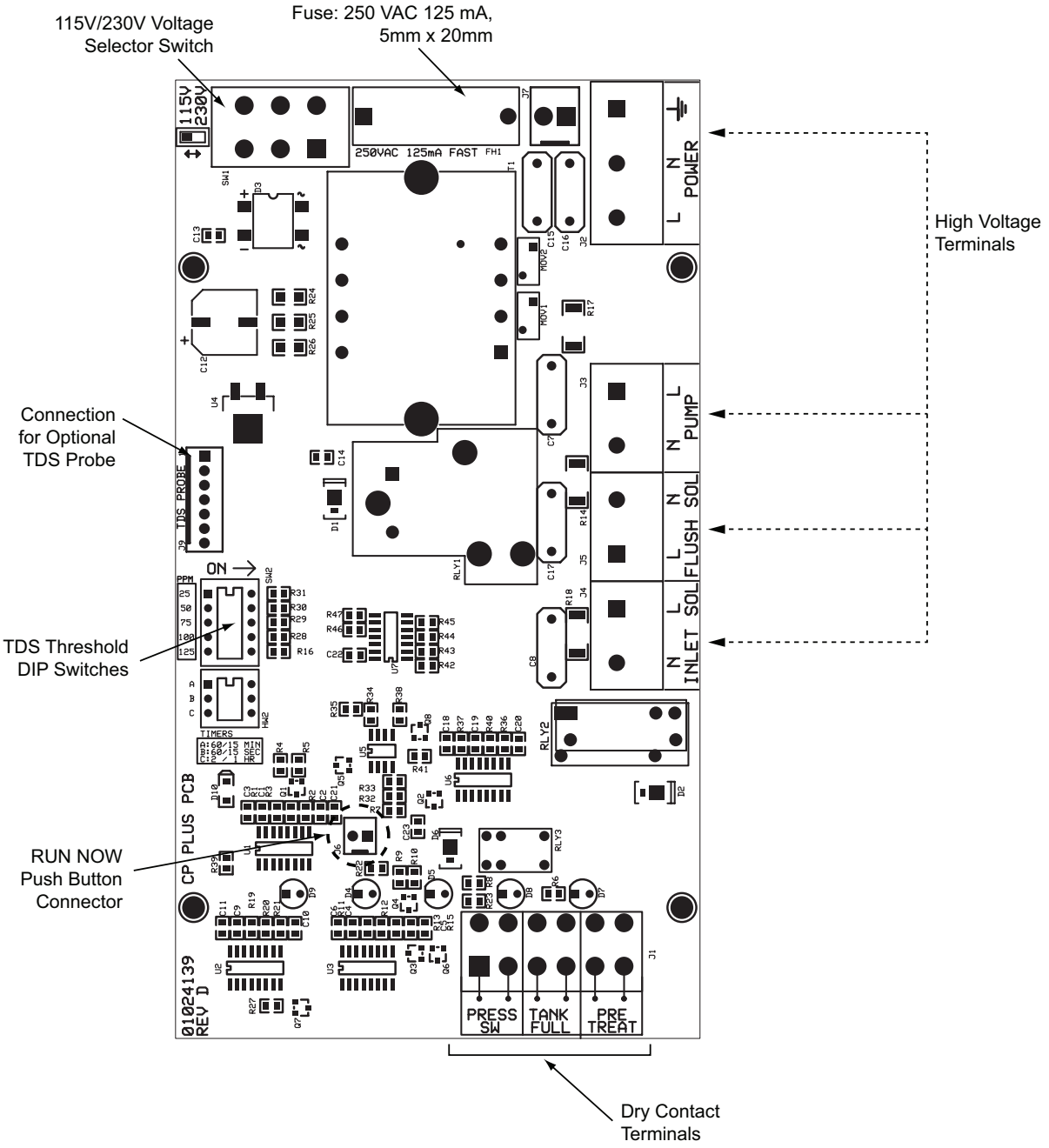



Figure 18. CP Plus circuit board.

## Dump Solenoid Connection

For direct feed applications, the dump solenoid is wired to the 120 Volt motor cord contacts L1 and L2. When the motor is running the dump solenoid valve is energized and closes. When the unit shuts down, the dump solenoid valve opens to drain.

## Dry Contact Connections

The dry contact terminal strip is located on the bottom right of the circuit board (see Figure 18). Do not apply any voltage to these terminals. Use dry contacts only.

## CP Plus Controller

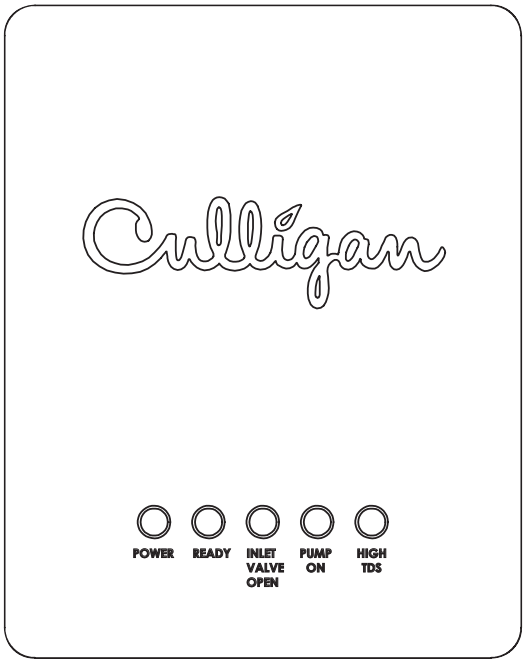



Figure 19. CP Plus controller front panel.

The CP Plus controller monitors the Culligan E1 Plus, M1, and E2 Plus commercial RO product lines. The controller requires no programming and has the following capabilities:

- Control for 115 VAC or 230 VAC single-phase motor (refer to page 58 for 230 VAC applications)
- Line pressure front side flush prior to startup
- Line pressure front side flush every two hours of continuous make water
- Shut-down upon loss of inlet water pressure and auto-restart
- Power-loss-and-return auto-restart
- Pretreatment lockout
- Storage tank level (or pressure) switch control
- Diagnostic indicator lights and “Run Now” button

The CP Plus controller has the following characteristics:

- Inlet pressure switch to detect the presence/absence of feed water pressure to the RO
- Inlet solenoid valve, which is normally closed when the RO is off. The valve opens just prior to startup, remaining open as long as the RO is in a make-water mode.

### CP Plus Controller Description

Five LED lights are displayed on the front of the CP Plus controller:

- POWER (red light)
- READY (green light)
- INLET VALVE OPEN (green)
- PUMP ON (green)
- HIGH TDS (red)

On the bottom of the CP Plus controller unit there is an on/off toggle switch and a RUN NOW button.

# Initial Startup

1. Open the feed water supply valve.
2. Direct the product water tubing to drain.
3. Open the recirculation valves HCV-1 and HCV-2 fully counterclockwise.
4. Turn the power switch ON. You must press the RUN NOW button for the unit to start up without delay.

**NOTE** **If the inlet pressure falls below 20 psi during operation, a booster pump will be necessary.**

**CAUTION!** **If the pump chatters loudly, it is starving for water (cavitating). Turn the unit OFF immediately to prevent pump damage. Correct the low pressure condition before proceeding.**

5. Check for leaks at all tube fittings and threaded joints.
6. Slowly close the waste valve until the product and waste flows are approximately equal.
7. Slowly close the recirculation valve and adjust the waste valve to match the membrane feed pressure and system recovery flow rates (see "M1 Series Specifications" on page 3).

**NOTICE** **The RO elements (membranes) require a 24 hour pre-service flush.**

**CAUTION!** **As the concentrate flow is reduced, the system pressure will increase. Open the system pressure control valve as required to prevent the system pressure from exceeding 150 psi (1034 kPa). Excessive pressure will damage the pump and may cause property damage.**

**NOTICE** **Depending on the feed water quality, it may be possible to operate the unit with a lower concentrate flow rate, which would decrease operating costs. Refer to the printout from the Culligan® CAAP® (Computer Aided Application Program) software, which indicates maximum allowable recovery. If a printout is not available, contact the Culligan dealer.**

**CAUTION!** **DO NOT exceed 150 psi (1034 kPA) or the membranes may be damaged. The fittings and tubing may also fail and may cause property damage.**

**NOTICE** **By adjusting the feed pressure as low as possible to meet the application requirement, the service life of the pump and RO elements will be optimized. The system should run continuously, rather than go through frequent start/stop cycles. Do not exceed specified product flow rate!**

8. Once all the desired flows are set, allow the system to run for approximately 30 minutes, and then record the following measurements using the units gauges (U) and your instruments (I):
   a. Feed Water Temperature, °F (I) _____
   b. Feed Water SDI (I) _____
   c. Feed TDS, ppm (I) _____
   d. Inlet Pressure, psig (I) _____
   e. System (pump outlet) pressure, psig (U) _____
   f. Waste Flow, gpm (U) _____
   g. Product Pressure, psig (I) _____
   h. Product flow, gpm (U) _____ x TCF[1] = _____
   i. Feed Flow (=Waste Flow + Product Flow) _____
   j. % Recovery (see page 76) _____
   k. % Rejection (see page 76) _____

   [1]TCF = Temperature Correction Factor. Refer to Table 1 on page 25 for this value.
9. Turn the power OFF. Connect the product tubing to the service plumbing.
10. Apply power to the unit, and then press the RUN NOW button.
11. Test the operation of the inlet pressure switch by closing the inlet water supply valve. The unit should shut down the pump and inlet valve immediately. The POWER and READY lights should remain on.

**CAUTION! If the unit does not automatically shut down, turn the unit power switch OFF immediately to prevent pump damage. Disconnect electrical power source, then check the wiring and replace the switch, if necessary.**

12. Open the inlet water supply valve, apply power, and press the RUN NOW button. The unit should begin producing RO water.
13. If connected, test the storage tank level control shutdown and the pretreatment lockout function.

## Controller Behavior when Power First Applied

1. When main power is first applied to the CP Plus controller, the POWER LED is lighted.
2. If pretreatment lockout is not in effect and the storage tank is not full, the READY LED is lighted.
3. **The controller will first wait for a one-hour delay**. To immediately start the system, apply power and then press the RUN NOW button on the bottom of the controller. The controller opens the RO inlet solenoid valve.

**NOTE The RUN NOW button will not work if any of the following five events are occuring:**

- Tank Full switch is OPEN (open status indicates the water level in the tank has reached the TANK FULL state)
- Pretreatment lockout switch is OPEN (open status indicates a device upstream of the RO is requesting that the RO not be in service)
- Loss of electrical power
- Loss of inlet pressure
- Two-hour continuous make-water timer expiration

4. Wait for an additional one-minute period. The INLET VALVE OPEN LED is lighted. During this period, feed water under line pressure enters the RO, passes through the pump, flushes through the upstream (feed water side) of the membranes, and then passes to the drain.
5. Because the line pressure is expected to be fairly low (lower than 100 psi) very little permeate water is created during this flush time. Instead, any high-TDS water on the membrane feed side is flushed to drain.

6. When the one-minute period has elapsed, the controller checks to see if there is sufficient incoming water pressure to operate the RO.
    a. If there IS pressure, the controller turns on the main pump and the RO produces permeate water. The PUMP ON LED is lighted.
    b. If there is NOT sufficient pressure, the entire process starts over, beginning with the one-hour delay.
    c. As long as there is applied power and water pressure is being supplied to the unit, the RO will repeat this delay, flush, and attempt to start cycle indefinitely up to 24 restart attempts per day.
7. Once the controller successfully enters the make-water mode, the first four LEDs will be lighted: red, green, green, and green. The pump will continue to operate and produce RO water until one of the following five events occurs:
    - Tank Full switch is OPEN
    - Pretreatment lockout switch is OPEN
    - Loss of electrical power
    - Loss of inlet pressure
    - Two-hour continuous make-water timer expiration

    When any of these five events occurs the system immediately ceases making RO water. The pump will turn off, and the inlet solenoid will close.
8. If the unit has stopped for either tank full or pretreatment lockout conditions, it will remain off until these conditions no longer exist, and the LED indicating POWER status will be lighted. Once the tank is full or the pretreatment lockout condition ends, the LED indicating READY is lighted and the unit will then reopen the inlet solenoid. Wait one minute, and then start the pump to return to the make-water condition.
9. If the unit has stopped because of either an electrical power loss or loss of inlet pressure, the system will follow the behavior described in step 1.
10. If the unit stops because it has been in a continuous make-water operation for the previous two hours, the pump will remain off for one minute. During this time, the inlet solenoid valve will remain open, and the system will perform a line-pressure front-side membrane flush to drain. The first three LEDs will be lighted. At the end of the minute, the system will return to make-water mode. The fourth LED will now be lighted again.

If the system includes an optional TDS probe, and the measured product TDS rises above the customer-set threshold for at least three minutes, then the product quality is too low. The system will shut off the pump (to stop making water) and close the inlet valve. The LEDs for POWER, READY, and HIGH TDS will be lighted.

## Setting the TDS Threshold

There is a bank of DIP switches located along the left side of the CP Plus controller. See Figure 18 on page 20. Each switch can be set to either ON or OFF. The system continuously monitors the product water TDS while it is making RO water. If the product TDS falls below the specified threshold for more than three minutes, the system will stop making RO water. The threshold specifications is selected as shown below:

| Dip Switch 1 | Dip Switch 2 | Dip Switch 3 | Dip Switch 4 | Dip Switch 5 | Product Water TDS Approximate Threshold |
|---|---|---|---|---|---|
| ON | OFF | OFF | OFF | OFF | 25 ppm max TDS |
| OFF | ON | OFF | OFF | OFF | 50 ppm max TDS |
| OFF | OFF | ON | OFF | OFF | 75 ppm max TDS |
| OFF | OFF | OFF | ON | OFF | 100 ppm max TDS |
| OFF | OFF | OFF | OFF | ON | 125 ppm max TDS |

**NOTE** **DIP switch settings are not designed to perform accurately when multiple DIP switches are in the ON position. Setting more than one switch to the ON position will result in a reading less than either switch setting.**

## Normal Operation

During normal operation, the system usually will start up and shut down based on signals from a level control or pressure switch. Adjust the feed pressure as required (no higher than 150 psig) to maintain a constant product flow. Record the performance data regularly and compare it to the performance on initial start up. If any changes are noticed, the product flow should be normalized to determine if cleaning is required (see “Product Flow Calculations”).

## Product Flow Calculations

The product flow rate depends primarily on feed water pressure, product water pressure, and temperature. All Series E and M units have specified nominal flow rates based on approximately 105 psig net pressure and 77°F temperature. However, in most applications the temperature and pressure are lower, so the product flow rate is lower than the nominal flow rate. The actual flow rate must be converted to flow under standard conditions, then compared to the initial performance (also converted to standard conditions) to determine whether the system is still working properly.

To convert the data to standard conditions,

1. Measure the product flow. Example: 1000 ml/min
2. Measure the feed pressure. Example: 120 psig
3. Measure the product pressure. Example: 5 psig
4. Subtract the product pressure from the feed pressure. Example: 115 psig
5. Divide the product flow by the result from step 4. Example: 1000 ÷ 115 = 8.69 ml/min/psi
6. Multiply the result from step 5 by 105. Example: 8.69 x 105 = 913 ml/min
7. Measure the temperature of the feed water, then determine the temperature correction factor from Table 1. Example: At a temperature of 55°F , the factor is 1.54.

| Temp. °F | Temp. °C | Correction Factor | Temp. °F | Temp. °C | Correction Factor |
|---|---|---|---|---|---|
| 40 | 4.4 | 2.12 | 75 | 24 | 1.04 |
| 45 | 6.7 | 1.90 | 80 | 27 | 0.95 |
| 50 | 10 | 1.71 | 85 | 29 | 0.86 |
| 55 | 13 | 1.54 | 90 | 32 | 0.79 |
| 60 | 16 | 1.39 | 95 | 35 | 0.72 |
| 65 | 18 | 1.26 | 100 | 38 | 0.66 |
| 70 | 21 | 1.14 | | | |

Table 1. Temperature Correction Factors

8. Multiply the result of step 6 by the temperature correction factor. Example: 913 ml/min x 1.54 = 1406 ml/min.

**NOTICE** **To convert ml/min to gallons per day, multiply by 0.38. For example, 1406 ml/min x 0.38 = 534 gpd.**

9. Compare the current standardized flow to the initial standardized flow. If the flow has decreased by 15% or more, it is time to clean the elements.

   Example: If the initial standardized flow was 570 gpd, and the current standardized flow is 470 gpd, the flow has decreased by 100 gpd, or 18% (100/570) = 0.18. The elements should be cleaned.

10. If the problem cannot be corrected with the troubleshooting guide and assistance is required, please have the following information available when calling the Culligan dealer:
    - Product flow rate
    - Concentrate flow rate
    - Feed pressure
    - Product water quality
    - Feed water quality
    - Feed water temperature
    - Prefilter outlet (and inlet if the optional prefilter inlet gauge was installed)
    - Product pressure

## Pretreatment Lockout

The controller allows an external contact closure to cause the RO to go into a “pre-treat lockout” condition. This signal is Normally Closed. When OPEN it indicates that the system should STOP because a piece of pretreatment equipment is in a regeneration state.

When this event occurs, the system immediately stops making RO water and the pump will turn off and close the inlet solenoid. It will remain off until this condition no-longer exists and then it will re-open the inlet solenoid, wait one minute and then start the pump to return to the “make water” condition.

Timeclock controlled softeners, such as the Hi-Flo® 3, do not offer pretreatment lockout. If these units are used for pre-treatment, they should be duplexed, or regenerated by a timeclock so that regeneration can occur when the RO unit is not in operation.

### Wiring for Hi-Flo® 22, Hi-Flo® 55e, CSM Softeners and Filters with MVP Controls

For these systems, you must add a 24 VAC relay, part number 01016156, to provide the pretreatment contact.

MVP to Relay: Connect a wire from terminal 5 of the relay to the left terminal of P8 (Aux 2) on the MVP circuit board. Connect another wire from terminal 1 of the relay to the right terminal of P8. See Figure 20.

Relay to CP Plus: Connect a pair of wires from the PRE-TREAT terminals on the CP Plus board to terminals 2 and 4 on the relay. Remove the installed jumper wire when making this connection.

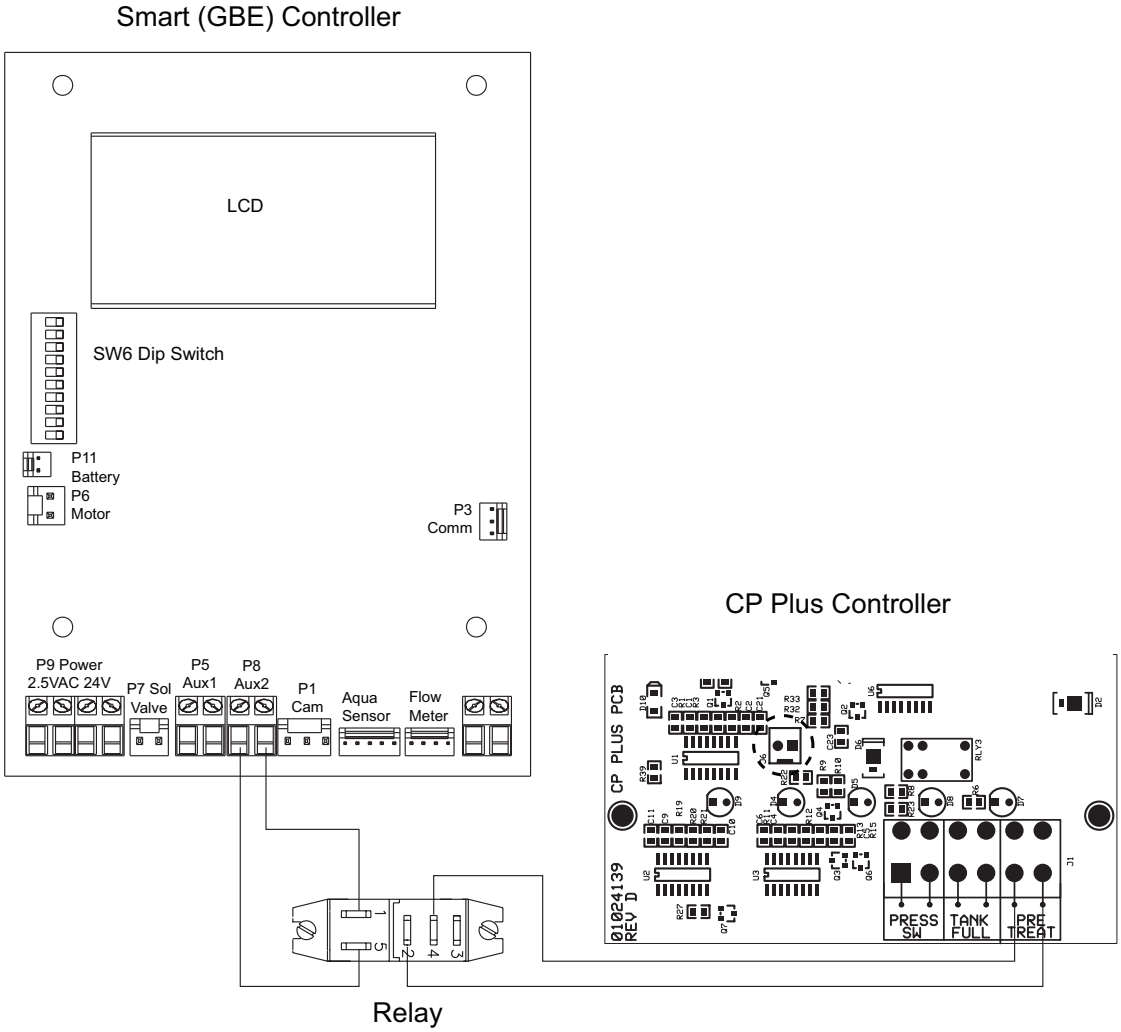



Figure 20. MVP to CP Plus relays.

## Wiring for Hi-Flo® 22, Hi-Flo® 55e, CSM Softeners and Filters with GBE Controls

For these systems, you must add a 24 VAC relay, part number 01016156, to provide the pretreatment contact.

GBE to Relay: Connect a wire from terminal 5 of the relay to the left terminal of Aux 4 on the GBE softener/filter circuit board. Connect another wire from terminal 1 of the relay to the right terminal of Aux 4. See Figure 21.

Relay to CP Plus: Connect a pair of wires from the PRE-TREAT terminals on the CP Plus board to terminals 2 and 4 on the relay. Remove the installed jumper wire when making this connection.

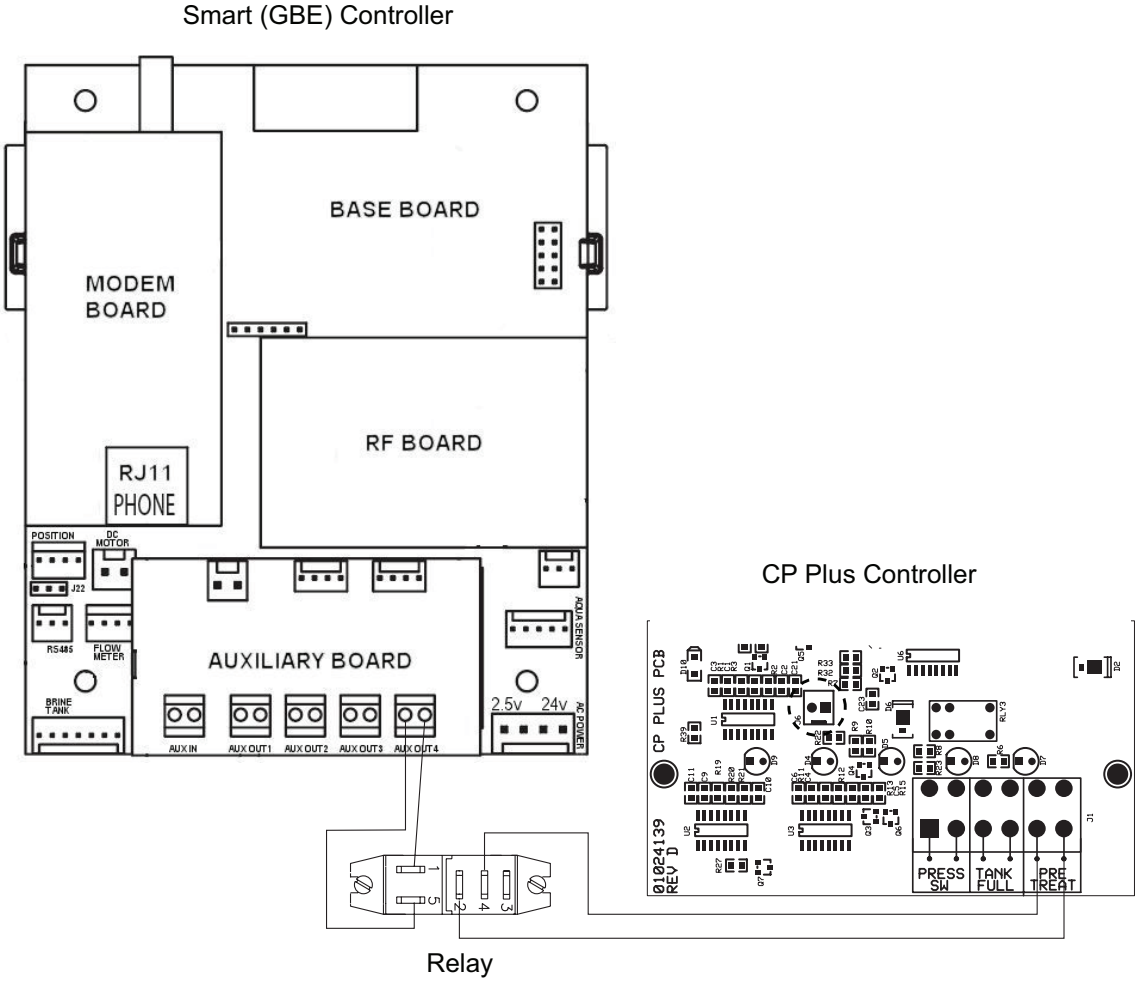



Figure 21. GBE-CP Plus wiring.

# Flush Modes

## Line Pressure Front Side Flush Prior to Startup

When main power is first applied to the CP Plus controller, the controller will first wait for a one-hour delay and will then open the RO inlet solenoid valve and waits for an additional period of one minute. During this one minute, feed water under line pressure enters the RO, passes thru the pump and flushes through the upstream (feed water side) of the membranes and then passes to drain. When the one-minute time is elapsed, the controller checks to see if there is sufficient incoming water pressure to operate the RO. If there IS pressure, the controller turns on the main pump and the RO begins to produce permeate water. If there IS NOT sufficient pressure, the entire process starts over beginning with the one-hour delay.

## Line Pressure Front Side Flush Every Two Hours of Continuous Make Water

The unit will stop when it has been in a continuous make-water operation for two hours. The pump will remain off for one minute. During this time, the inlet solenoid valve will remain open and the system will perform a line-pressure front-side membrane flush to drain. At the end of the one minute, the system will return to the “make-water” mode.

# Level Control/Float Switch

The RO controller accepts a dry contact signal that causes the RO to turn off when the water level inside an atmospheric storage tank reaches a high-level float switch. A normally closed (NC) high-level float switch is required.

The RO is in the RUN state when the dry contact input is closed. When the water in the tank reaches the high-level float switch, the switch should open. When the switch opens, the controller will turn off the RO.

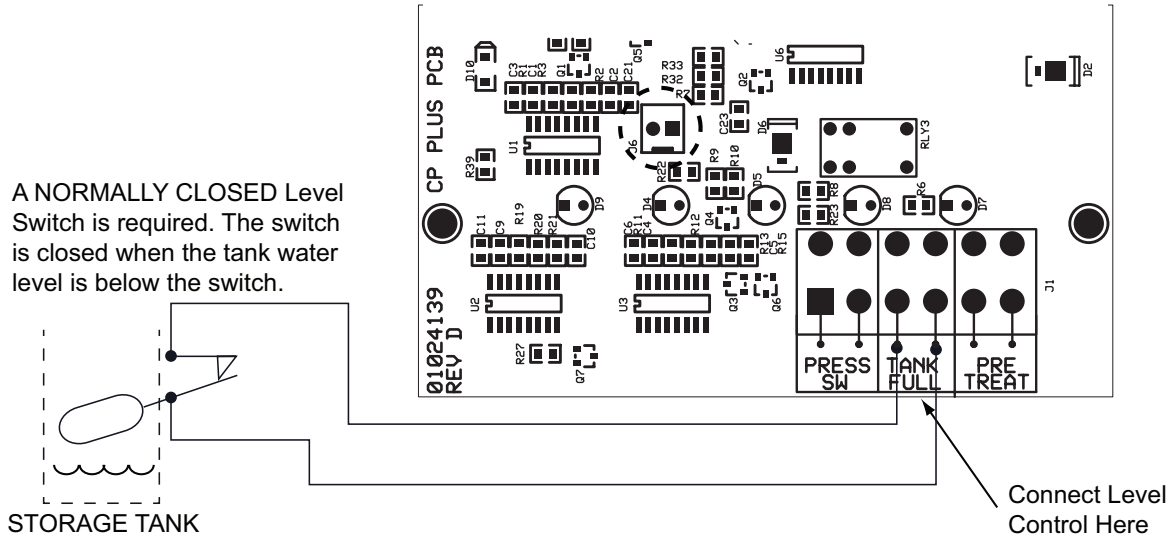



Figure 22. RO level control switch.

Connect the level control (or pressure switch) to the TANK FULL terminals (see Figure 22). These terminals are intended for dry-contact wiring using 18-24ga wire. Remove the installed jumper wire when making this connection.

When this event occurs, the system immediately stops making RO water and the pump will turn off and close the inlet solenoid. It will remain off until this condition no-longer exists and then it will re-open the inlet solenoid, wait one minute and then start the pump to return to the “make water” condition.

## Storage Tank Setup When Using a Pressure Switch

When using pressurized storage, you must use a pressure switch that provides a closed signal when the tank is below the specified shut off pressure, such as the switch provided in the Pressurized Water Storage Kit.

**CAUTION! Do not apply power to these terminals. Use dry contacts only.**

## TDS Probe (Optional: Order Separately)

An optional TDS probe (P/N 01021876) monitors the water quality in the system. If the total dissolved solids measured by the TDS probe exceeds the required quality level set by the DIP switches, the system will stop producing treated water.

The probe is connected to the CP Plus board via an MT board (P/N 01022143): see Figure 23.

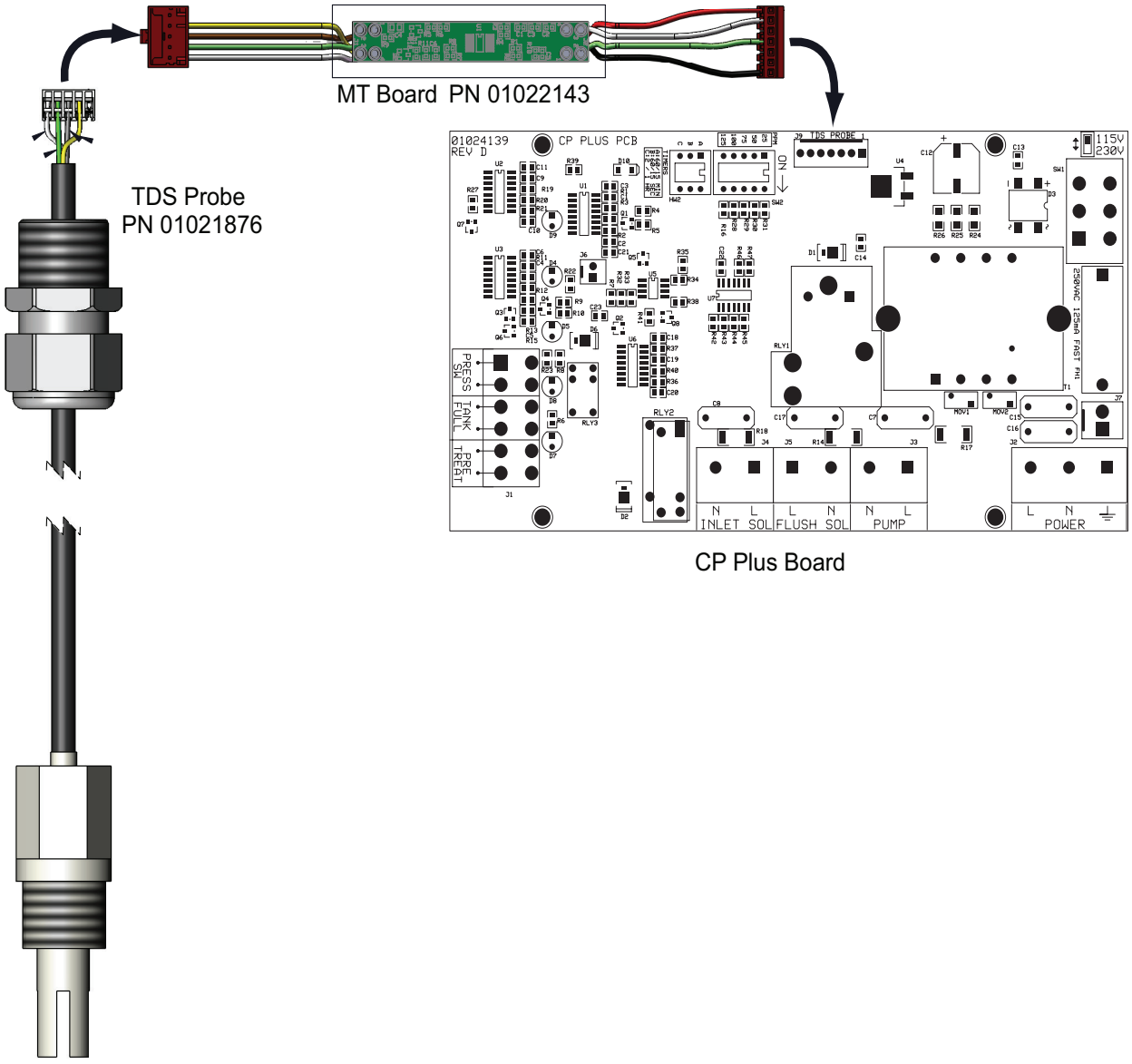



Figure 23. CP Plus-MT Board-TDS Probe connection.

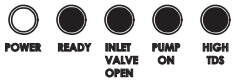
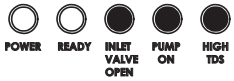
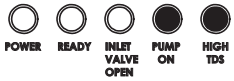
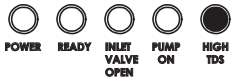
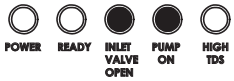
# Service and Maintenance

## Serial Numbers

The Culligan M1 units have a serial number located directly behind the electronic controller on the side panel. Do not remove or destroy these serial number labels.

They must be referenced if you require repairs or parts replacement under warranty.

## LED Status Indicators

| LED Lights [ ON ○ OFF ● ] | Solution |
|---|---|
|  | The system has power but is not making water because either the storage tank is full or the pretreatment equipment is in pretreat lockout mode. |
|  | The system is in a one-hour delay period. These delay periods occur when either the system has lost electrical power, or the system has lost sufficient incoming water pressure. During this delay period you may push the RUN NOW button located on the bottom of the control; the system will skip the remaining portion of the delay. |
|  | The system is in start-up flush mode or timed flush mode. These modes usually last one (1) minute. |
|  | The system is making RO water. |
|  | On systems equipped with an optional TDS probe, the system has stopped making water because the product TDS has risen above the required water quality set by the DIP switches. If the system has stopped, it might indicate that the RO membrane has failed or there might be some other problem with the system. After resolving the problem, restart the RO by momentarily switching the power OFF and then back ON. When the Power and Ready lights are ON, you can press the RUN NOW button. The system should begin to produce RO water. Use a handheld TDS meter to measure the TDS of the product water. If it remains above the specified threshold, the system will turn back off after approximately three (3) minutes.The system will continue running if you unplug the TDS meter from the CP+ controller board or specify a DIP switch setting that corresponds to a higher TDS threshold level. |

## Troubleshooting

| Problem | Probable Cause | Solution |
|---|---|---|
| 1. Unit does not start. | A. No power to unit. | A. Check circuit breaker. |
| | B. Low feed pressure. | B. Correct low pressure condition. |
| | C. Inlet solenoid failure | C. Replace solenoid |
| | D. Prefilter fouled. | D. Replace cartridge |
| 2. Unit running but not holding high pressure. | A. Pump malfunction. | A. Replace pump. |
| | B. System pressure control valve malfunction. | B. Replace valve. |
| | C. Concentrate flow too high. | C. Check and adjust concentrate flow, replace tubing on A. |
| | D. Product flow too high. | D. Test modules. |

| | | |
|---|---|---|
| 3. Unit running but poor quality (less than 95% rejection) | A. Low pump pressure. | A. See 2. |
| | B. Module failure. | B. Replace modules. Check product line over pressurization. |
| | C. Concentrate throttling valve open. | C. Throttle valve down. |
| | D. Poor seal on endcap or membrane. | D. Check o-rings inside endcap. Replace o-rings if necessary. Check membrane sealing surface for debris. Check membrane O-ring and replace if necessary. |
| 4. Low quantity of product water. | A.-D. Same as 3. | A.-D. Same as 3. |
| | E. Cold water. | E. Install additional modules. |
| 5. Excessive noise. | A. Air in the plumbing. | A. Check fittings for leaks. Purge air from system. |
| | B. Misaligned pump. | B. Remove pump and check for bearing wear. |
| | C. Harmonic vibration. | C. Install a pressure regulator ahead of the prefilter. |
| | D. Low feed pressure. | D. Increase feed pressure above 20 psig. |
| 6. Inadequate product pressure (direct feed systems) | A. Low quantity of product water. | A. See 4. |
| | B. Demand for product water exceeds unit capacity. | B. Install additional modules. |

# Prefilter Cartridge Replacement

The prefilter cartridges should be changed when the pressure drop across the prefilter increases by 15 psi (103 kPa). Refer to the diagram in the installation section.

**CAUTION! The pressure after the prefilter should not be less than 20 psi (138 kPa), or the pump might be damaged.**

## Replacing the Prefilter Cartridge

1. Disconnect power to the unit, then shut off the inlet water supply.
2. Unscrew the filter bowl.
3. Remove the old cartridge.
4. Clean the filter bowl with a damp cloth, rinse thoroughly.
5. Remove the wrappers from a new cartridge (10" P/N 01022387). Install the cartridge in the bowl, making sure it seats in the bottom of the bowl.
6. Check the O-ring seal for dryness and cuts. Replace the seal if necessary and use silicone lube as needed.

**CAUTION! Do not use petroleum-based lubricants, because they destroy the synthetic rubber seal.**

7. Screw the filter bowl back onto the filter head.
8. Turn on the inlet water supply.

## Membrane Replacement

Replace an element that has been damaged or cannot be cleaned. See Figure 24.

1. Disconnect power to the unit. Allow pressure to be completely relieved. Turn main feed line to RO off.
2. Remove retaining rings from both ends of all vessels. Do not dispose of retaining rings. They will be needed during replacement
3. Remove end caps from all vessels, with the tubing remaining in place. Note placement the caps to assure re-installation in the same orientation.
4. Remove the RO element from the housing. Note orientation of membranes to assure re-installation in same orientation. Flow direction is indicated by the arrow on the outside of the membrane vessel.
5. Check the O-ring seals on the element and end plug, and the element brine seal for damage. If an O-ring is cut or crimped, it may have caused high flow and poor quality. Replace the O-rings and retest before replacing the entire element.
6. Remove a new element from its plastic bag. Lightly lubricate the O-rings with a silicone-based lubricant or use a mixture of 70% glycerin and 30% water.

**CAUTION! DO NOT use a petroleum-based lubricant, because it will damage the synthetic rubber and the membrane.**

7. Make sure the brine seal is located in the direction of the incoming feed to that vessel according to the flow arrow and the original membrane orientation.
8. Lubricate the O-ring on the end plugs with a silicone-based lubricant or use a mixture of 70 percent glycerin and 30 percent water. Re-install the end plugs in to the vessels same as the original orientation. Reinstall the retaining rings.
9. Refer to the section on Initial Startup for information on flushing the shipping solution form the new elements.

**NOTE Do not forget to enter the new values for flow, pressure, temperature, and TDS.**

**NOTICE The RO elements (membranes) require a 24 hour pre-service flush.**

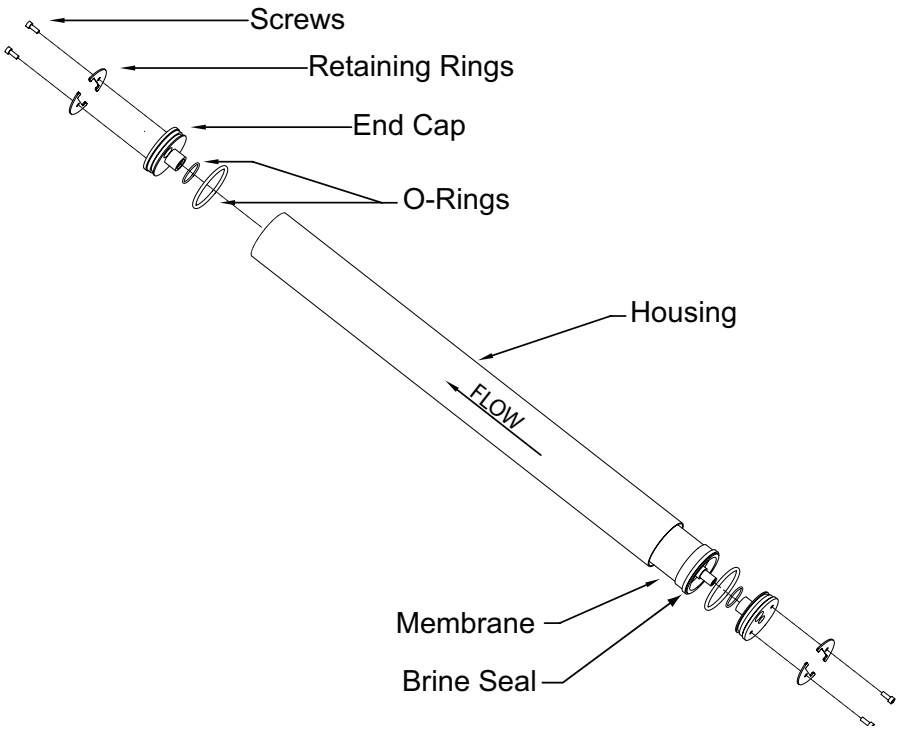



Figure 24. M Series membrane.

## Pump Replacement

The most common cause of pump failure is inadequate pressure to the pump inlet. Therefore, correct any low inlet pressure problem before replacing the pump to prevent damage to the new pump. Replace the pump when it cannot develop the pressure required to maintain the desired product flow rate, up to the maximum pump pressure of 150 psig.

To replace the pump:

1. Disconnect power to the unit, then shut off the inlet water supply.
2. Remove the tubing from the pump inlet and outlet.
3. While holding the bottom of the pump with one hand, loosen the screw on the coupling band securing the pump to the motor. The pump will drop down. Remove the coupling band.
4. Examine the pump shaft. If it is broken or rounded, remove the old shaft and install a replacement shaft, P/N 01000331. Examine the slot in the motor. If the slot is damaged, replace the motor.
5. Remove the plumbing fittings from the old pump, apply fresh Teflon tape, and install the fittings in the new pump. (Skip this step if replacing only the shaft.)
6. Place the coupling band over the shaft end of the new pump. Insert the pump shaft into the slot in the motor.
7. Observe the alignment of the pump against the motor, making certain the pump and motor flanges are in complete contact and are not skewed.
8. Make sure the clamp is fully seated around the entire circumference of the pump and motor flanges. Tighten the coupling screw fully, then loosen the screw 1/4 to 1/2 turn.
9. Rotate the pump so that the inlet and outlet ports point to the right. Verify that the pump is still aligned properly to the motor.

**CAUTION! If the pump is not properly aligned, the pump bearings will wear prematurely.**

10. Tighten the coupling screw using 15 to 30 inch-pounds of torque, then attach the inlet and outlet.

## Motor Replacement

1. Disconnect the pump from the motor as outlined in steps 1-4 in pump replacement section.
2. Disconnect the motor cord from the old motor.
3. Remove the pump and motor assembly from the mounting bracket by removing the four (4) nuts, lock-washers and washers, holding the motor onto the motor mounts.
4. Mount the new motor onto the motor mounts and secure with nuts and washers.
5. Wire the motor cord connections to the new motor as indicated on the wiring schematic on the motor label for 110 volt operation.
6. Reinstall the pump, fittings and tubing following steps 7 through 10 as outlined in the pump replacement section.

**NOTICE** **Some replacement motors may be prewired for 230 Volt operation at shipment. Refer to wiring schematic on the motor label and verify that the motor is wired for 110 Volt operation.**

## Sanitizing Modules

The modules may need sanitizing if either of the following conditions exist:

- The RO system is subject to biofouling and the operator wants to reduce the cleaning frequency.
- The water treatment application limits the microbial count in the product water.

**CAUTION! The bottom of the tank must be higher than the pump on the RO unit to prevent cavitation of the pump when solution is drawn from the tank.**

**NOTICE Replace the prefilter cartridges if they are discolored by iron.**

The frequency of sanitization will depend on the frequency of biofouling or excess microbial counts. Once the frequency of the problem has been determined, sanitization can be scheduled for preventative maintenance. To sanitize the system, obtain a tank which will hold the sanitizing solution volume.

**NOTE When cleaning the 1-series RO units that use brass pumps and solenoid valves, do not use a cleaning agent with a pH below 5.0.**

**CAUTION! Always use caution when handling any chemical. Refer to the material safety data sheet for recommendations in the safe handling of this chemical. The MSDS is available from the manufacturer of the chemical. Use the proper protective safety equipment.**

**CAUTION! Local codes may prohibit the discharge of hazardous materials to drain. If necessary, an extra tank can be used to neutralize the solutions before discharge to drain.**

### Prepare Equipment for Sanitizing

1. Prepare the cleaning solution (see Table 2 and Table 3) with permeate water for a five-gallon solution.
2. Turn the unit power off.
3. Disconnect the product line from service and direct the line into a drain.
4. Turn off the inlet water supply.
5. Open the waste and recirculation valves fully counterclockwise.

| Max Temp 45°C (113°F) pH Range | Max Temp 35°C (95°F) pH Range | Max Temp 25°C (77°F) pH Range |
|---|---|---|
| 5–10.5 | 5–12 | 5–13 |

Table 2. pH range and temperature limits during cleaning.

| Cleaner / Foulant | 0.1% (W) NaOH and pH 12, 35°C max. or 1% (W) $Na_4EDTA$ and pH 12, 35°C max. | 0.1% (W) NaOH and pH 12, 35°C max. or 0.025% (W) Na-DSS and pH 12, 35°C max. | 1.0% (W) $Na_2S_2O_4$, 25°C and pH 5 |
|---|---|---|---|
| Inorganic Salts (e.g. $CaCO_3$) | | | Preferred |
| Sulfate Scales ($CaSO_4$) | Preferred | | |
| Metal Oxides (Iron) | | | Preferred |
| Inorganic Colloids (Silt) | | Preferred | |
| Silica | Alternative | Preferred | |
| Biofilms | Alternative | Preferred | |
| Organic | Alternative | Preferred | |

Table 3. Cleaning solutions.

## Service the Filter and Tubing

1. Remove the sediment filter from the cartridge.
2. Install the bowl without the filter.
3. Connect the tubing from the solution bucket to the RO feed connection.
4. Install a wire jumper between the two connections labeled “PRESS SW” on the CP Plus board.
5. Disconnect the concentrate tubing from the membrane to the motor panel and direct the tubing to the drain.

## Draw the Sanitizing Solution Through the Unit

1. Apply power to the unit, and then press the RUN NOW button.
2. Allow about half of the sanitizing solution to be drawn through the system.

**CAUTION! If the unit vibrates severely, the pump may be cavitating. Turn the power switch OFF. Raise the bucket to ensure adequate pressure to the pump.**

3. Turn the unit power off.
4. Allow the unit to sit undisturbed for at least two hours.

**NOTICE If the unit is going to be left unused for up to three months, allow the solution to remain in the unit. If the unit will remain unused for longer than three months, sanitize the unit every three months.**

## Flush the Unit

1. Connect the inlet water supply.
2. Apply power to the unit, and then press the RUN NOW button.
3. Slowly close the recirculation and drain valves until the system operating pressure increases to normal pressure.

**NOTE Increase the pressure no faster than 5 psi per second.**

4. Allow the unit to run for at least 30 minutes. Check the product water until the pH for the concentrate and product remains stable for five (5) minutes and the TDS is greater than 95 percent rejection.
5. Turn the unit power off.
6. Connect the concentrate tubing from the membrane to the motor panel.
7. Reconnect the product tubing to the service line. Install the new sediment filter.
8. Remove the jumper on the pressure switch and then reinstall the pressure switch cable.

The system is now ready for use.

## Testing

If the product flow calculations show a loss of flow, or the product quality has become poor, one or more elements will require cleaning or replacement. Because poor performance might be due to only one element, test the product flow and quality from individual housings.

To test each element:

1. Disconnect the product tubing from the housing to be tested.
2. Apply power to the unit, and then press the RUN NOW button. Measure the product flow and TDS from the test element.
3. Disconnect power to the unit and reinstall the tubing.
4. Continue testing the elements as needed to determine which should be cleaned or replaced.

## Cleaning

During the operation of any reverse osmosis system, dissolved solids and particulate matter are concentrated inside the module element. If these contaminants are present in relatively low concentrations, the concentrate flow from the system flushes them to drain. In most cases, water pretreatment such as filters and softeners will prevent the deposit of these contaminants.

When these deposits occur, there will be a decrease in the product water flow and quality. When these symptoms become excessive, the modules must be cleaned before they are permanently damaged.

To determine when cleaning is needed, compare the current system performance to the performance of the system when the reverse osmosis elements were new. Use Table 4 to obtain data and compare the performance of the system, “new” and “now” (record the data in pencil).

| Test Data | Feed | | Product | | Concentrate | |
|---|---|---|---|---|---|---|
| | New | Now | New | Now | New | Now |
| Flow (gpm) | | | | | | |
| TDS (ppm) | | | | | | |
| Pressure (psi) | | | | | | |
| Temp. (°F) | | | | | | |

Table 4. System performance—new vs. present.

| NOTICE | **If new data is not available, use the specifications listed earlier in these instructions. However, keep in mind that the new elements may have exceeded these specifications, so performance may have decreased even if the unit still exceeds specifications.** |
|---|---|

In addition to differences in product flow and quality (TDS), determine whether there were any changes in concentrate water flow, feed water TDS, feed water temperature and feed or product pressures. Changes in these values provide clues to indicate the cause of any problems with the product water.

If there were changes in feed water temperature or pressure, the product water flow rates will have to be converted to flow rates under standard conditions (77° F and 100 psig) in order for any comparison to be valid. Refer to the Product Flow Calculation section to calculate flow rates under standard conditions, then compare the converted values. A decrease in

the product water flow may have been due only to a decrease in temperature or pressure, in which case cleaning would not be indicated.

If any change in the performance of the elements was not due to a change in operating conditions, it may be time to clean the elements. In general clean the elements:

1. When the product flow rate decreases by 10% (or when the feed pressure must be increased by 10% to maintain the same product flow), or
2. When the percent of rejection decreases below specification.

| NOTICE | **Because strong chemicals are used to clean the elements, maintenance cleaning is not recommended. If the elements need to be cleaned frequently (more than twice a year), the pretreatment may be inadequate. Obtain a current water analysis and test the Silt Density Index and the Total Chlorine level of the water on-site to review what changes in pretreatment may be needed.** |
|---|---|

When cleaning is required, the type of material which is fouling the element should be identified, if possible. Refer to Table 5 to determine the possible causes of the performance change.

| Percent Rejection | Flow | | |
|---|---|---|---|
| | Low | Normal | High |
| Low | Hardness Scale | Hardness Scale (light) or Iron | Membrane Damage |
| High | Silt or Biofouling | — | Membrane Damage (light) |

Table 5. Performance change possible causes.

For example, if the product flow is low but the percent rejection is normal, the likely causes of the problem are silt or biofouling. Please note that if the product flow rate has increased (with no increase in temperature or pressure) the likely reason is damage to the membrane, which cannot be repaired by cleaning.

Once the foulant has been identified, choose the recommended cleaning chemical(s) from Table 6.

| Membrane Problem | Cleaning Chemical |
|---|---|
| Hardness Scale | Hydrochloric acid, phosphoric acid |
| Iron | Hydrochloric acid, phosphoric acid |
| Silt | Phosphoric acid and sodium hydroxide |
| Biofouling | Phosphoric acid and sodium hydroxide |

Table 6. Recommended membrane cleaning chemicals.

Because phosphoric acid can be used by itself or in combination with sodium hydroxide to clean almost all types of foulants, it is generally recommended over hydrochloric acid when choosing a “stock” acid.

| NOTICE | **Some municipal surface water supplies are treated with alum. Aluminum fouling results in low flow and, occasionally, in low rejection. If aluminum fouling is suspected, use only hydrochloric acid.** |
|---|---|

Use a pH meter to prepare acid and caustic solutions, and to monitor pH changes as the solutions react with any foulants.

Materials required:

1. Solution tank (50 gallon capacity, minimum), to prepare and store the chemical solution.
2. Tank stand, to elevate solution tank to level above pump.
3. Tubing 1/2” O.D. to connect cleaning adapter ahead of Pre-filter.
4. A pH meter.
5. A pre-filter cartridge (P/N 00955004).

Before proceeding record the “NOW” values in Table 4.

## Prepare the Equipment for Cleaning

1. Turn the unit power off.
2. Place the solution tank on the tank stand. Connect the tubing to the cleaning adapter then place the other end of the tubing at the bottom of the solution tank.

**NOTICE** **The tubing length should be as short as possible to prevent excessive pressure drop. Cut the tubing as required to minimize the length.**

3. Remove the product tubing from the service connection and place the end in the solution tank. The concentrate tubing should still be directed to drain.
4. Replace the Pre-filter cartridge.
5. Apply power to the unit, and then press the RUN NOW button.
6. Fill the tank with 30-40 gallons of RO product water.

**CAUTION!** **DO NOT turn on the RO system unless water can flow from the product and waste lines.**

**NOTE** **Soft water is an acceptable substitute for RO water. When the solution tank is filled, direct the product tubing to drain. Next, open the pump system pressure control valve until the system pressure is approximately 50 psig.**

7. Turn the unit power off. Remove wires from terminals 3 and 4 (Pressure switch) and install a jumper wire across those two terminals.
8. Open the cleaning valve to allow feed water to displace air in the cleaning tubing, then close the inlet water shutoff valve.

## Step 1: Clean the Unit

1. Apply power to the unit, and then press the RUN NOW button.

**CAUTION!** **If the pump is noisy, cavitation is occurring and the pump will be damaged. Turn the power switch OFF and check for any obstructions to flow. Reduce the pump pressure as required to prevent cavitation.**

2. Record the pump pressure and measure the product water flow at low pressure. This flow will be used to estimate if cleaning has been successful. Turn the unit power off.
3. Add enough acid to the solution tank until the pH is between 2.0 and 2.5.

**NOTE** **If the foulant to be removed is silt or a biofilm, use phosphoric acid.**

**WARNING!** **Acid and Sodium Hydroxide are strong chemicals that must be handled carefully to avoid injury. Wear protective clothing and have a source of water nearby to flush any spills.**

**CAUTION!** **Local codes may prohibit the discharge of acid and caustic solutions to drain. If necessary, an extra tank can be used to neutralize the solutions before discharging to drain.**

4. Apply power to the unit, and then press the RUN NOW button. After approximately 5 gallons have been drawn from the solution tank, turn the unit power off.
5. Allow elements to soak for 15 minutes. Apply power to the unit, and then press the RUN NOW button. Draw another 5 gallons from the solution tank. Turn the unit power off.

6. Remove the end of concentrate tubing from the drain and place it in the solution tank.
7. Apply power to the unit, and then press the RUN NOW button. Allow the acid solution to circulate for 30 minutes. During recirculation, monitor the pH of the solution. If the pH rises above 3.0, add acid to reduce the pH to 2.0.

**CAUTION! The temperature of the chemical solution will rise as it is recirculated. If the temperature exceeds 95°F, turn the power switch to OFF and allow the solution to cool to prevent damage to the RO elements.**

**NOTE A plastic gallon jug filled with ice may be placed in the solution to cool it.**

8. When 30 minutes have passed, adjust the system pressure to the pressure recorded in Step 9. Measure the product flow rate, then compare this flow to the flow recorded in Step 9. If cleaning is successful a noticeably higher product flow should now be observed.
9. Turn the unit power off. If the cleaning was for removal of hardness scale or iron only, go to "Direct feed connection."

## Step 2: Clean Silt or Biofouling

1. If the cleaning was for silt or biofouling, take a 250 ml sample of phosphoric acid solution and carefully add sodium hydroxide until the pH is at least 12. If the solution turns cloudy, it contains hardness and/or iron. Discard the contaminated acid and prepare a fresh 30 gallons of phosphoric acid solution.Add sodium hydroxide to the phosphoric acid solution. The pH of the solution should be increased to 11.0-11.5.

**NOTE The result is an alkaline solution of tri-sodium phosphate (TSP), a common ingredient in detergents.**

2. If the solution remains clear, direct the concentrate tubing to drain, apply power to the unit, and then press the RUN NOW button. Check that the unit is drawing chemical solution.

**CAUTION! If the pump is noisy, cavitation is occurring and the pump will be damaged. Turn the unit power off and check for any obstructions to flow. Reduce the pump pressure as required to prevent cavitation.**

3. After approximately 5 gallons have been drawn from the solution tank, turn the unit power off.
4. Allow the elements to soak for 15 minutes. Apply power to the unit, and then press the RUN NOW button. Draw another 5 gallons from the solution tank. Turn the unit power off.
5. Remove the end of concentrate tubing from the drain and place it in the solution tank. Apply power to the unit, and then press the RUN NOW button. Allow the alkaline solution to circulate for 30 minutes. During recirculation monitor the pH of the solution. If the pH drops below 10.0 add sodium hydroxide to increase the pH to 11.5.

**NOTE If the caustic solution becomes dark brown (like coffee), it probably is saturated with organic material. Discard the solution and prepare a fresh batch of phosphoric acid and sodium hydroxide.**

**For more accurate testing, use a Hach Model DE-2 detergent test kit or equivalent to ensure that the product water is less than 0.05 ppm detergent.**

**A plastic gallon jug filled with ice may be placed in the solution tank to cool the solution.**

**CAUTION! The temperature of the chemical solution will rise as it is recirculated. If the temperature exceeds 95°F, turn the unit power off and allow the solution to cool to prevent damage to the RO elements.**

## Step 3: Finish Cleaning Procedure

1. When 30 minutes have passed, adjust the system pressure to the pressure recorded during low pressure. Measure the product flow rate, then compare this flow to the flow recorded during low pressure. If cleaning is successful a noticeably higher product flow should now be observed.
2. Turn the unit power off. Remove the concentrate and product tubing from the solution tank and direct them both to drain. Apply power to the unit, and then press the RUN NOW button to draw most of the remaining cleaning solution from the tank.

**CAUTION! Do not allow the unit to draw air from the tank, or the pump will be damaged.**

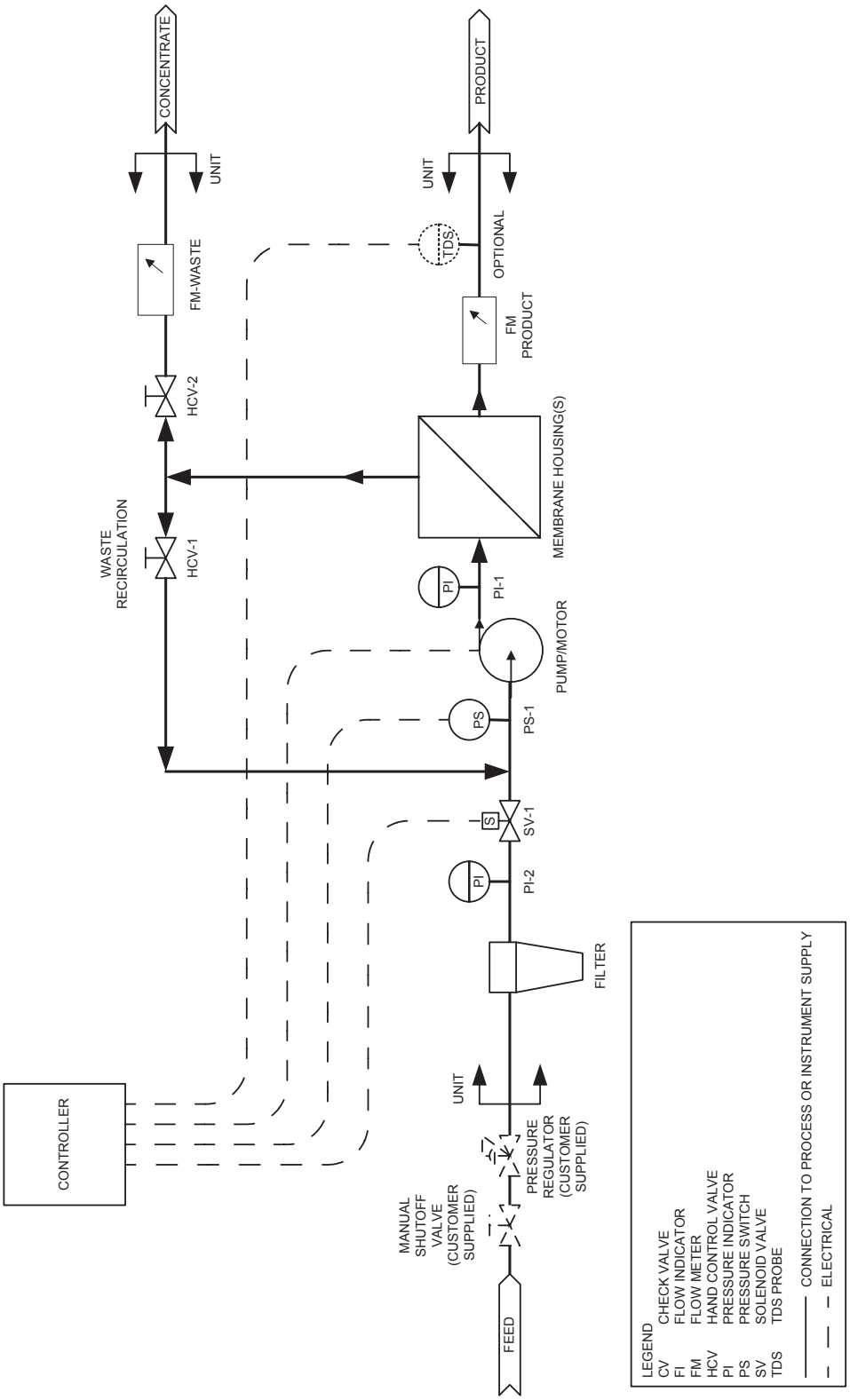
3. Turn the unit power off. Close the cleaning valve, reconnect the wires to the pressure switch, then open the feed water valve.
4. Apply power to the unit, press the RUN NOW button, and then flush the cleaning solution from the unit for 30 minutes or until the pH levels of the concentrate water and the product water remain constant.

**CAUTION! Soft water must be used to flush the caustic solution, or hardness will precipitate. If soft water is not available, use temporary portable exchange softener tanks.**

5. Adjust the system pressure to the normal value. Measure all flows, TDS levels, pressures, and temperature. Compare these values with the “new” and “now” values to determine if cleaning has been successful. If cleaning has not been successful, contact the service department at Culligan International Company for suggestions on alternate cleaning chemicals. If cleaning has been successful, note which chemicals were effective. Use the same chemical(s) when the unit is cleaned again.
6. Replace the Pre-filter cartridge.
7. After cleaning and rinsing have been completed, connect the product tubing to the service line. Remove the jumper installed and reconnect the pressure switch. Rinse the cleaning tank and tubing with fresh water.

# Flow Diagram

## Reverse Osmosis Process Flow Diagram



## Series M1 Wiring Diagram

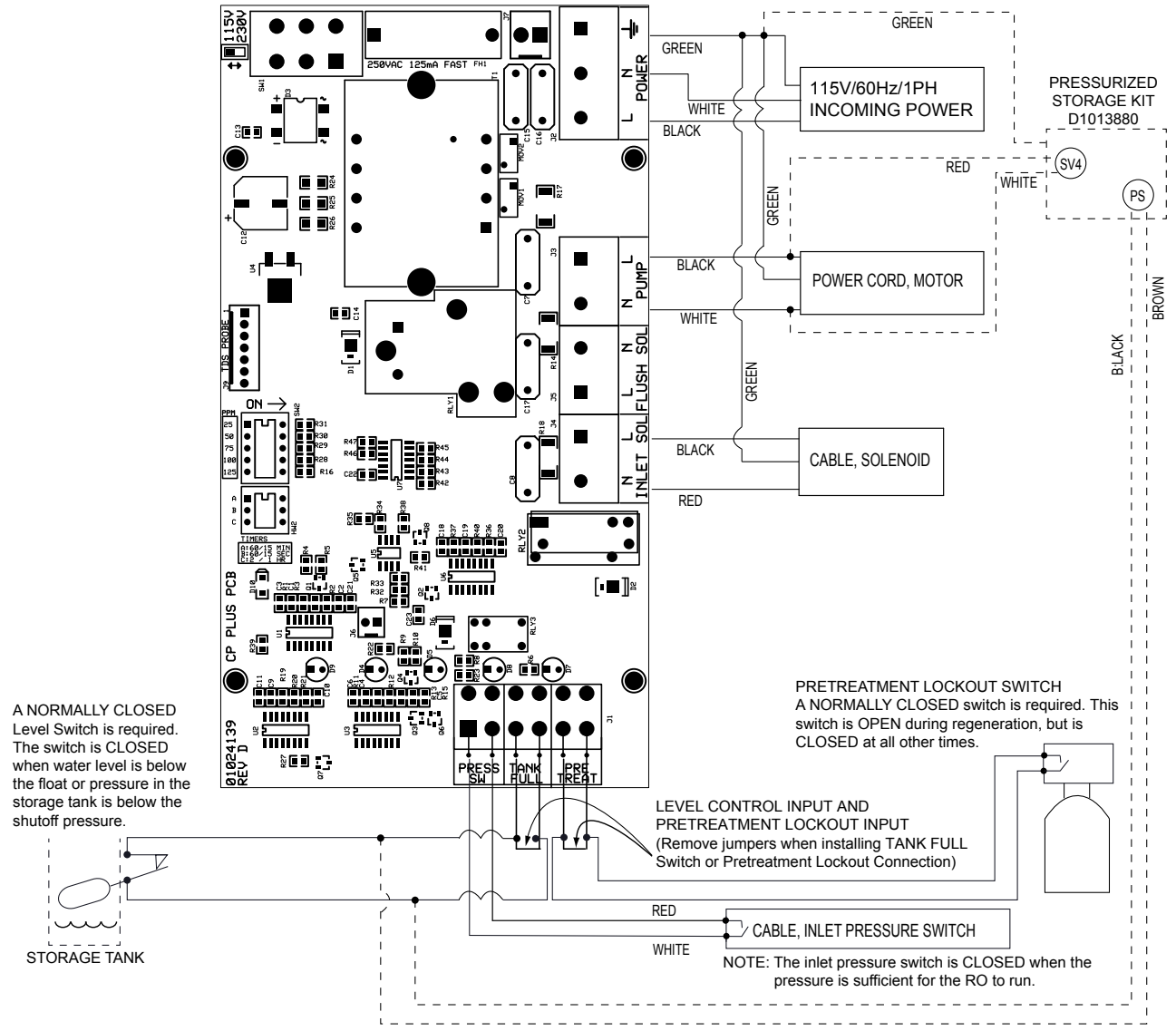



Figure 25. Series M1 wiring diagram.

# M1 RO Parts Diagrams and Lists

## M1 Major Components and Water Connections

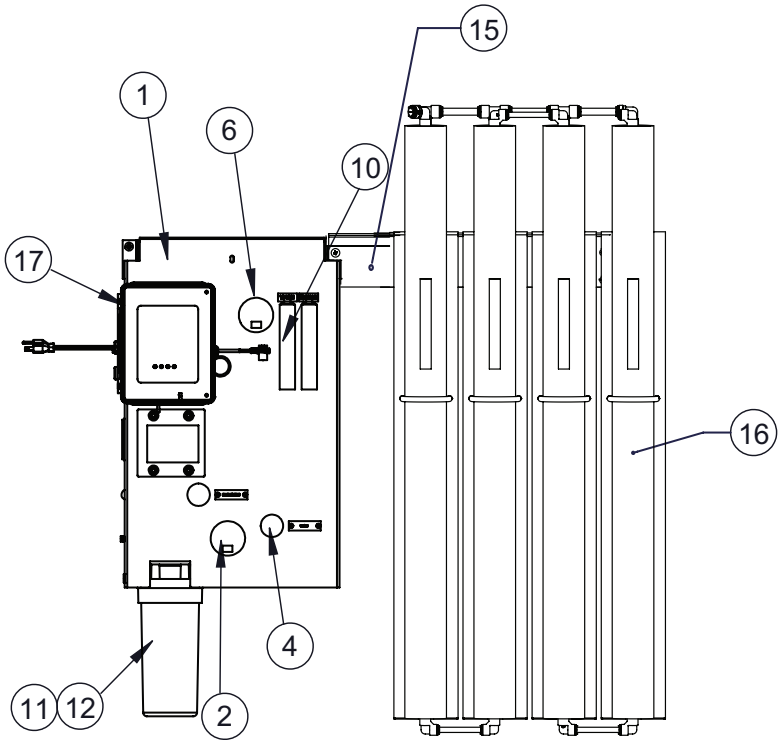



Figure 26. M1 RO front view.

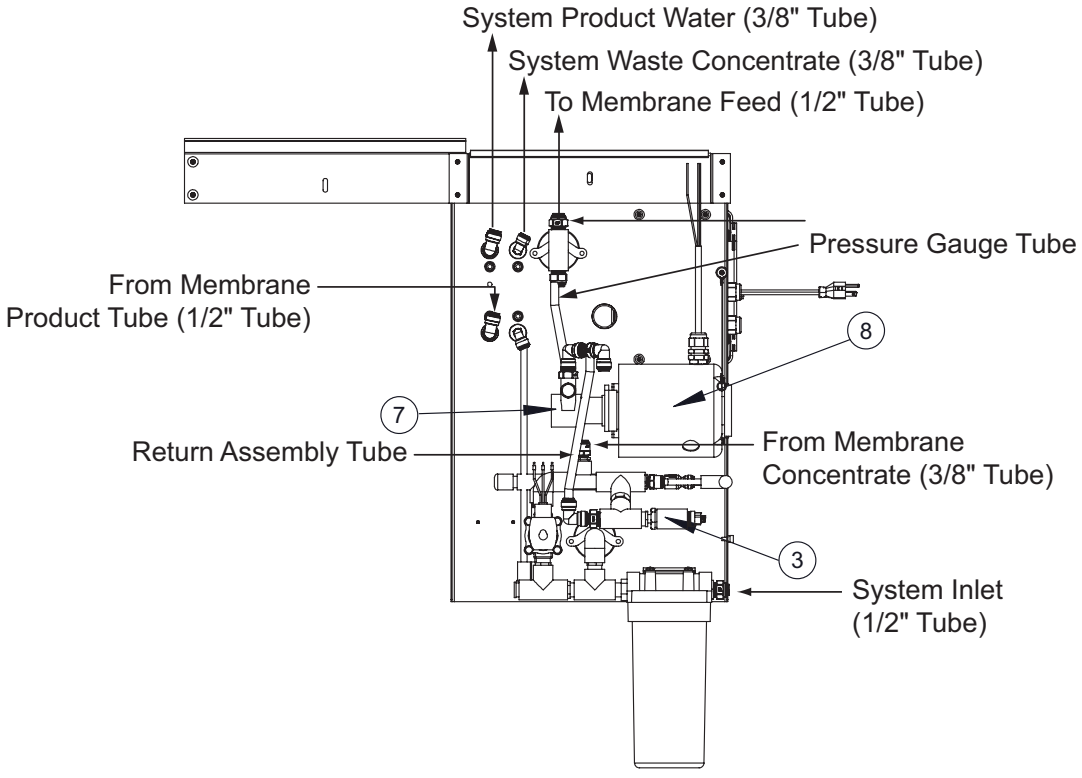



Figure 27. M1 RO rear view.

| M1 RO Series | | | 1S | 2S | 3S | 4S | 2L | 3L | 4L | 1F | 2F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Item | Part No. | Description | Qty | Qty | Qty | Qty | Qty | Qty | Qty | Qty | Qty |
| 1 | 01024485 | Motor Panel Assembly, M1-1S, M1-2S, M1-3S, M1-4S | 1 | 1 | 1 | 1 | | | | | |
| 1 | 01024504 | Motor Panel Assembly, M1-2L, M1-3L | | | | | 1 | 1 | | | |
| 1 | 01024505 | Motor Panel Assembly, M1-4L | | | | | | | 1 | | |
| 1 | 01024506 | Motor Panel Assembly, M1-1F, M1-2F | | | | | | | | 1 | 1 |
| 2 | 01021992 | Assembly, Feed | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 01021993 | Assembly, Return | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 01022053 | Assembly, Drain | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6 | 01021997 | Assembly, Pressure Gauge | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 7 | 01022855 | Pump, Rotary Vane, Brass, 100 GPH | 1 | 1 | 1 | 1 | | | | | |
| 7 | 01023798 | Pump, Rotary Vane, Brass, 165 GPH | | | | | 1 | 1 | | | |
| 7 | 01023800 | Pump, Rotary Vane, Brass, 190 GPH | | | | | | | 1 | | |
| 7 | 01022106 | Pump, Rotary Vane, Brass, 330 GPH | | | | | | | | 1 | 1 |
| 8 | 01022856 | Motor, 1/3 HP, 115V, 1725 RPM, Nema Frame 48Y, Carbonator Mount Style | 1 | 1 | 1 | 1 | | | | | |
| 8 | 01022107 | Motor, 3/4 HP, 115V, 1725 RPM, Nema Frame 48Y, Carbonator Mount Style | | | | | 1 | 1 | 1 | 1 | 1 |
| — | 01022033 | V-band, Pump/Motor | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 | 01025339 | Flow Meter, 0.1–1 gpm, Panel Mount | 1 | 1 | 1 | 1 | | | | | |
| 10 | 01025340 | Flow Meter, 0.35–3.5 gpm, Panel Mount | | | | | 1 | 1 | 1 | 1 | 1 |
| 11 | 01025480 | Filter Housing, 10" BB | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12 | 01022387 | Cartridge Filter | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 15 | 01024455 | Bracket Kit, Wall Mount | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 |
| 15 | 01024484 | Bracket Kit, Wall Mount | | | | 1 | | | 1 | | |
| 16 | 01023412 | Assembly, Membrane Housing, Single, 2.5"x21" | 1 | 2 | 3 | 4 | | | | | |
| 16 | 01023417 | Assembly, Membrane Housing, Single, 2.5"x40" | | | | | 2 | 3 | 4 | | |
| 16 | 01022875 | Assembly, Membrane Housing, Single, 4.0"x40" | | | | | | | | 1 | 2 |
| 17 | 01024478 | Controller, CP+, complete | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| — | 01024139 | Circuit Board, CP+ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**WARNING! The 115/230V Voltage Selector Switch must be set at the appropriate voltage. Setting the CP Plus board to incorrect voltage will cause permanent damage to equipment.**

**WARNING! Motors must be wired to the appropriate voltage and Hz. Connecting to incorrect voltage will cause permanent damage to equipment.**

## Feed Assembly and Solenoid Cable

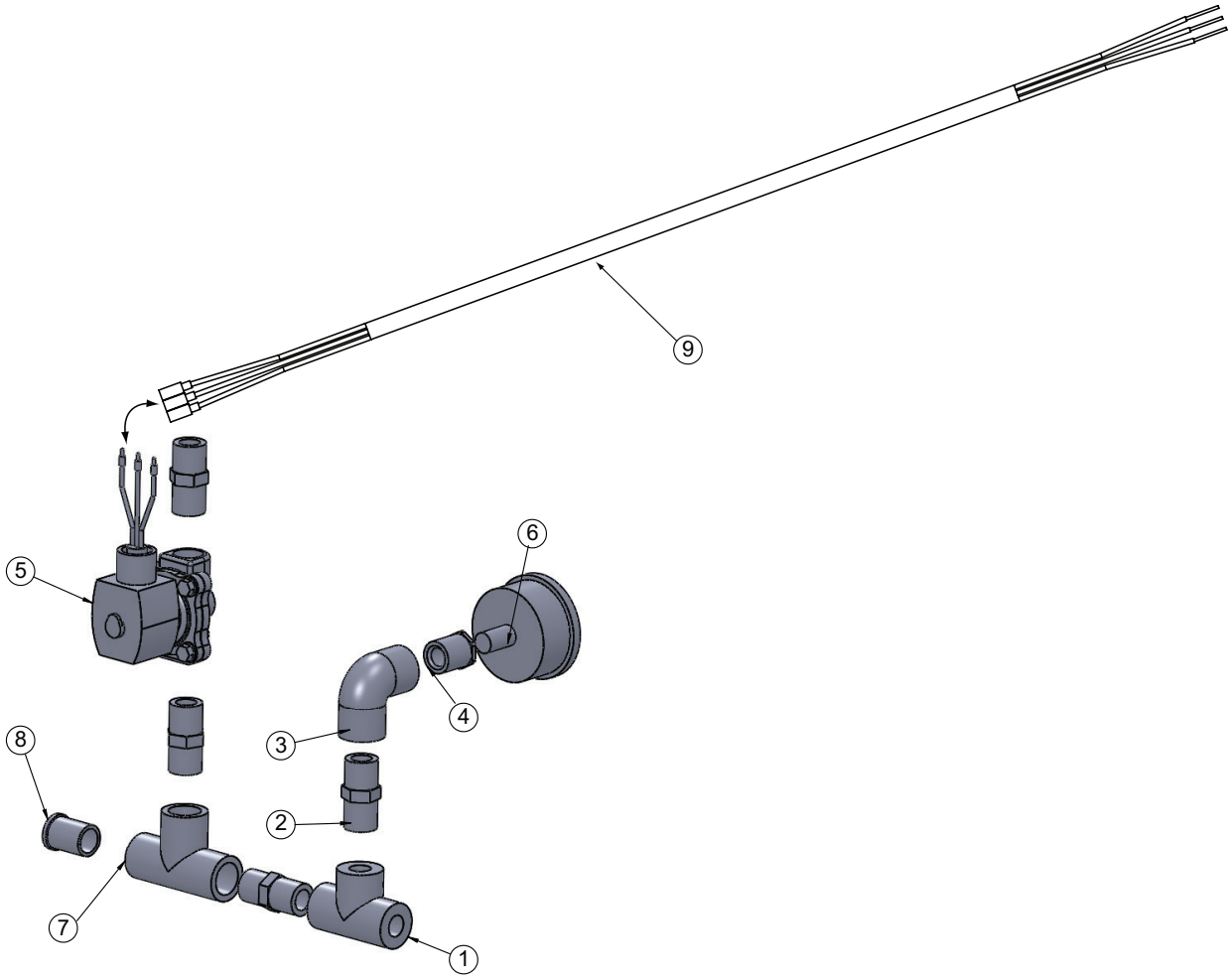



Figure 28. Manual feed assembly (includes solenoid cable).

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01021992 | Assembly, Feed, M1 (items 1–8) | |
| 1 | — | Tee, 1/2", Threaded, PVC Sch. 80 | 1 |
| 2 | — | Male Adapter, 1/2" Spigot x NPT, Sch. 80 | 4 |
| 3 | — | Elbow, 1/2" Soc, PVC Sch. 80 | 1 |
| 4 | — | Bushing, 1/2 x 1/4, SxT, PVC Sch. 80 | 1 |
| 5 | 01023380 | Solenoid Assy, 120V/60Hz with bullet connectors | 1 |
| 5 | 01023070 | Solenoid Coil, Repl, 110-120V/50–60Hz | 1 |
| 6 | 01007604 | Pressure Gauge, 1/4" NPT, 0–200 PSI, Liquid filled | 1 |
| 7 | — | Tee, 1/2" Socket, PVC Sch. 80 | 1 |
| 8 | — | Plug, 1/2", Spig | 1 |
| 9 | 01024477 | Cable, Solenoid, E1/M1/G1 | 1 |

## Return/Recycle Assembly and Pressure Transducer

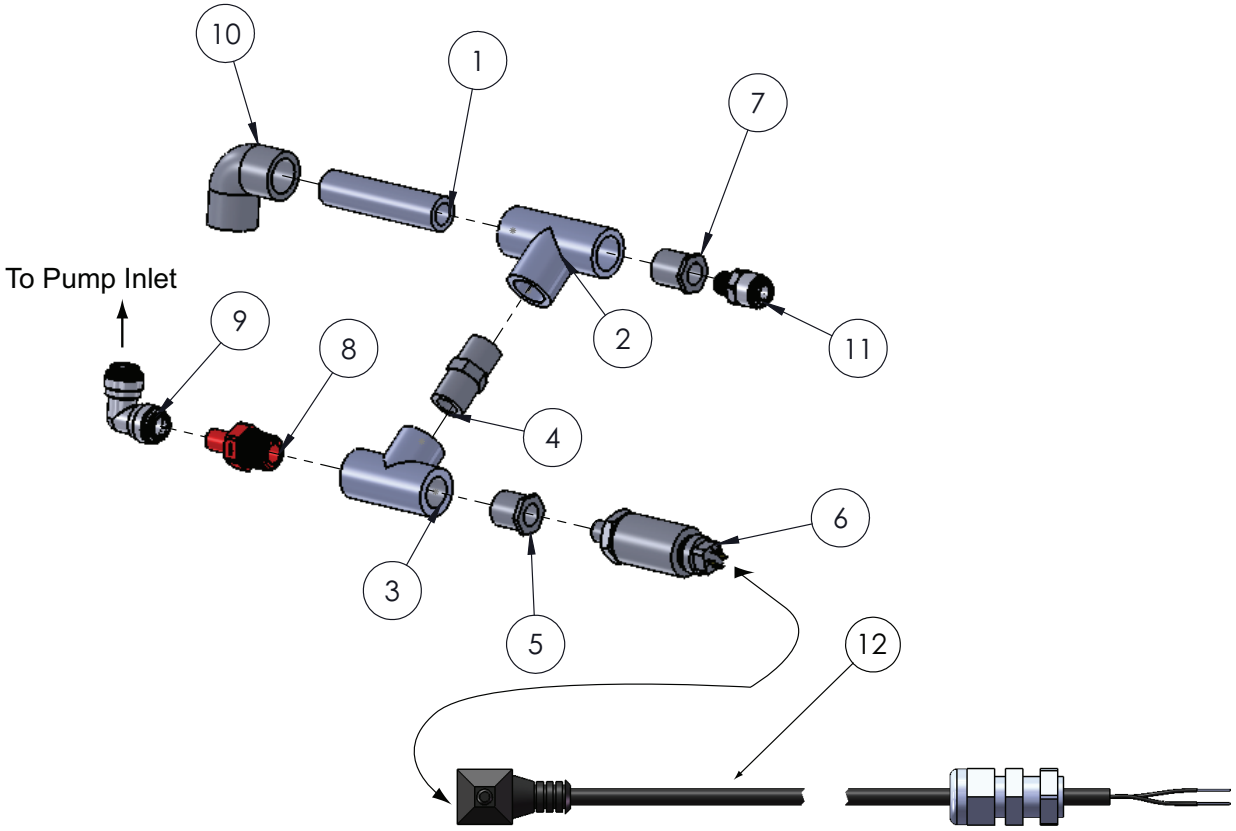



Figure 29. Return/Recycle assembly with pressure transducer.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01021993 | Assembly, Return (items 1–11) | |
| 1 | — | 1/2" Sch.80 Pipe, 3.5" length | 1 |
| 2 | — | Tee, 1/2” Socket, PVC Sch.80 | 1 |
| 3 | — | Tee, 1/2", Threaded, PVC Sch.80 | 1 |
| 4 | — | Male Adapter, 1/2" Spigot x NPT, Sch.80 | 1 |
| 5 | — | Bushing, 1/2"x1/4", TxT, PVC Sch.80 | 1 |
| 6 | 01024302 | Switch, Adjustable Pressure, 6–30 PSI | 1 |
| 7 | — | Bushing, 1/2”x1/4”, SxT, PVC Sch.80 | 1 |
| 8 | — | Stem Adapter, 1/2T x 1/2 Stem, Polypropylene | 1 |
| 9 | — | Elbow, Union, 1/2 Tube, Polypropylene | 1 |
| 10 | — | Elbow, 1/2” Soc, Sch.80 | 1 |
| 11 | — | Connector, Male, 1/4 NPT x 3/8 Tube, PI, Polypropylene | 1 |
| 12 | 01022370 | Cable, Pressure, Transducer, 39"L | 1 |

## Drain Assembly

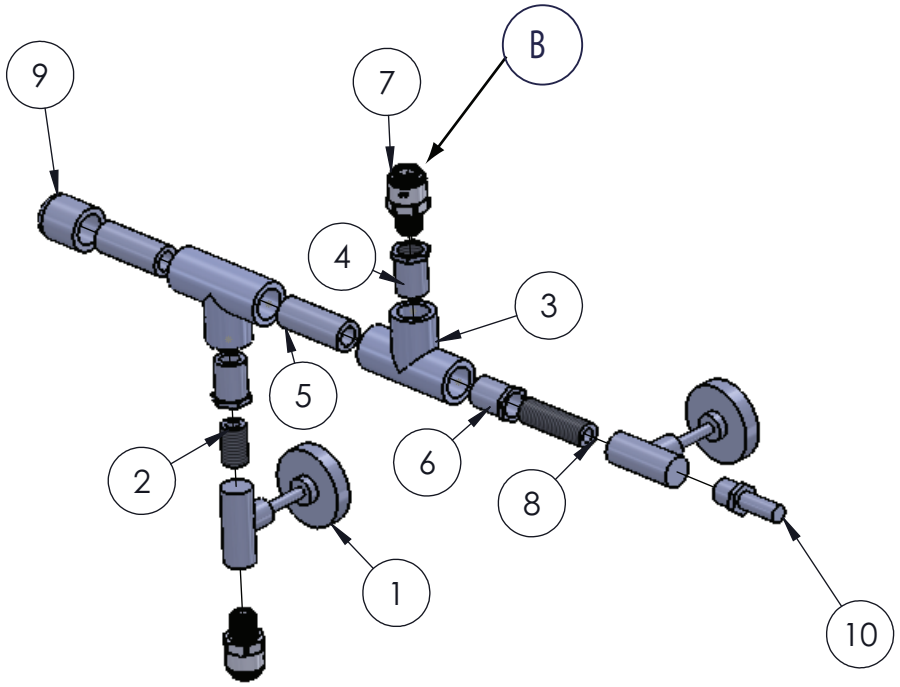



Figure 30. Drain Assembly with Fast Flush Solenoid Valve.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01022053 | Return/Drain Assembly | |
| 1 | 01022013 | Needle Valve, 1/4" FNPT, Brass | 2 |
| 2 | — | Nipple,1/4xClose,PVC Sch.80,TBE | 1 |
| 3 | — | Tee,3/8",Socket,PVC Sch.80 | 2 |
| 4 | — | Bushing,3/8x1/4,SxT,PVC Sch.80 | 2 |
| 5 | — | Pipe, 3/8", SCH 80, Length 1.75" | 2 |
| 6 | — | Bushing,3/8x1/4,SxS,PVC Sch.80 | 1 |
| 7 | — | Connector,Male,1/4 NPTx3/8 Tube,PI,PP | 2 |
| 8 | — | Nipple,1/4x1-3/4,PVC Sch.80,TOE | 1 |
| 9 | — | Plug, 3/8" Cap, Socket | 1 |
| 10 | — | Stem Adapter,1/4Tx3/8 Stem,PP | 1 |

## System Pressure Gauge Assembly

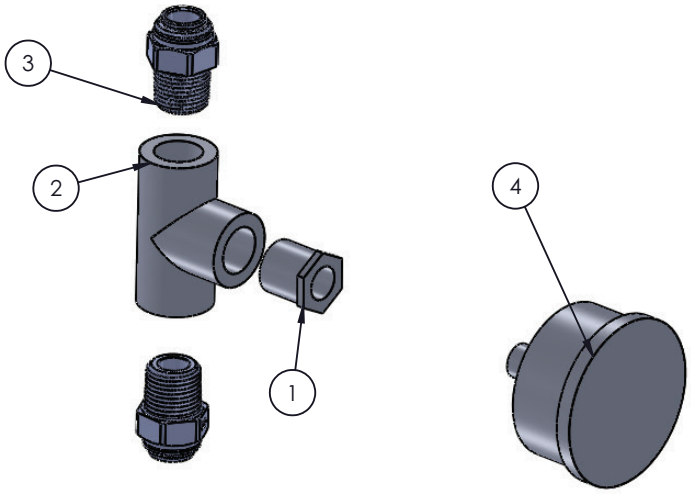



Figure 31. Pressure Gauge Assmbly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01021997 | System Pressure Gauge Asembly | |
| 1 | — | Bushing, 1/2"x1/4", TxT, PVC Sch. 80 | 1 |
| 2 | — | Tee, 1/2”, Threaded, PVC Sch. 80 | 1 |
| 3 | — | 1/2”-1/2” NPT Tube, Male Connector | 2 |
| 4 | 01007604 | Pressure Gauge | 1 |

## Membrane Vessel

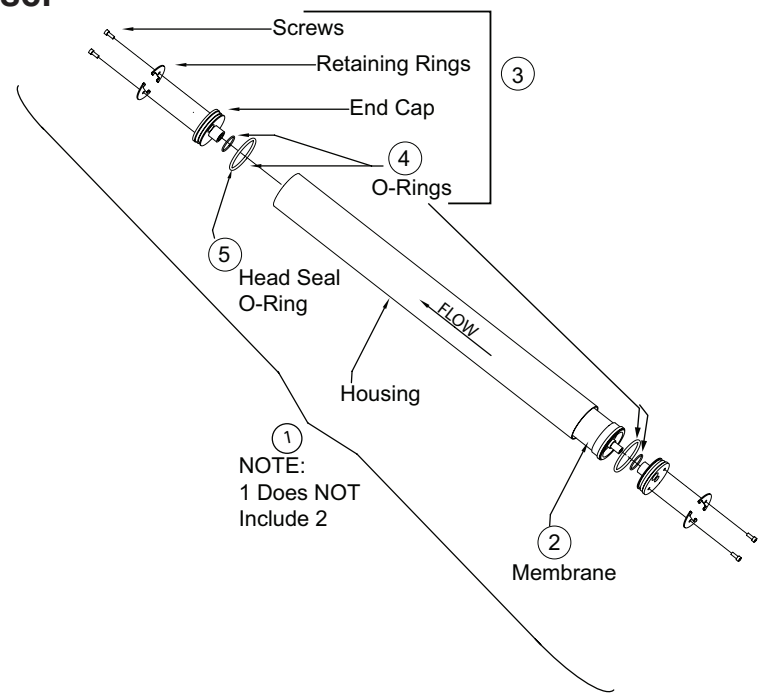



Figure 32. Membrane vessel.

| Item | Part No. | Description | 1S | 2S | 3S | 4S | 2L | 3L | 4L | 1F | 2F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| — | 01023412 | Assembly, Membrane Housing, Single, 2.5"x21" | 1 | 2 | 3 | 4 | | | | | |
| — | 01023417 | Assembly, Membrane Housing, Single, 2.5"x40" | | | | | 2 | 3 | 4 | | |
| — | 01022875 | Assembly, Membrane Housing, Single, 4.0"x40" | | | | | | | | 1 | 2 |
| 1 | 01022666 | Housing, 2.5"x21"Membrane | 1 | 2 | 3 | 4 | | | | | |
| 1 | 01022825 | Housing, 2.5"x40"Membrane | | | | | 2 | 3 | 4 | | |
| 1 | 01022877 | Housing, Filter, FRP 4" End Port | | | | | | | | 1 | 2 |
| 2 | 01024288 | RO Membrane, 2.5"x21" | 1 | 2 | 3 | 4 | | | | | |
| 2 | 01024289 | Membrane, 2.5"x40" | | | | | 2 | 3 | 4 | | |
| 2 | 01024290 | Membrane, 4"x40" | | | | | | | | 1 | 2 |
| 3 | 01023071 | End Plug Assy 2.5" | 2 | 4 | 6 | 8 | 4 | 6 | 8 | | |
| 3 | 01023073 | End Plug Assy 4" | | | | | | | | 2 | 4 |
| 4 | 01023072 | O-Ring kit 2.5" | 1 | 2 | 3 | 4 | 2 | 3 | 4 | | |
| 4 | 01023074 | O-Ring Kit 4" | | | | | | | | 1 | 2 |
| 5 | P1022648 | O-Ring, Head Seal, 2.5” (20 Pack) | 2 | 4 | 6 | 8 | 4 | 6 | 8 | | |
| 5 | P1021848 | O-Ring, Head Seal, 4” (20 Pack) | | | | | | | | 2 | 4 |
| | 01023411 | Clamps, RO Housings, 2.5" | 2 | 4 | 6 | 8 | 4 | 6 | 8 | | |
| | 01023075 | Clamps, RO Housings, 4" | | | | | | | | 2 | 4 |

[1]Housing assemblies do not include membranes.

[5]The amount listed for the units refers to the number of individual o-rings required NOT the number of packets required for an entire unit; i.e. an entire M1-2S unit requires 4 individual o-rings NOT 4 packages of o-rings.

## 1S Sub-Assembly

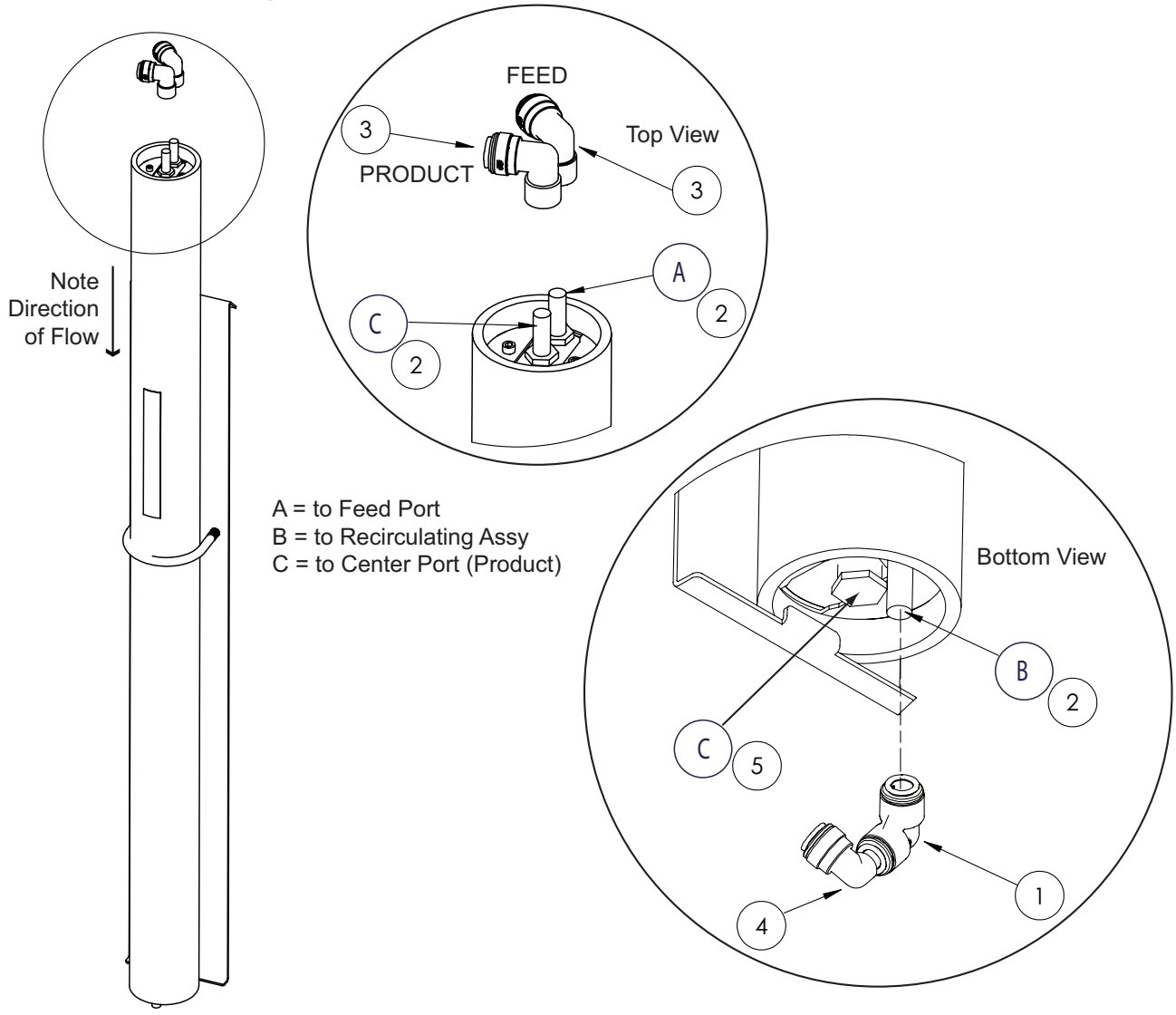



Figure 33. M1-1S sub-assembly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01023412 | Assembly, Membrane, Single, 2.5"x21" | |
| | 01023904 | Kit, Tube and Fittings, 1S (includes items 1–5) | |
| 1 | — | Elbow, Union, 3/8 Tube, PI, Polypropylene | 1 EA |
| 2 | — | Fitting, Stem Adapter, 1/4Tx3/8 Stem, Polypropylene | 3 EA |
| 3 | — | Elbow, Union, Reducing, 1/2 x 3/8, PI, Polypropylene | 2 EA |
| 4 | — | Fitting, Stem Elbow, 3/8T x 3/8 Stem, Polypropylene | 3 EA |
| 5 | — | Plug, 1/4" NPT, PVC Sch 80 | 1 EA |

## 2S/2L Sub-Assembly

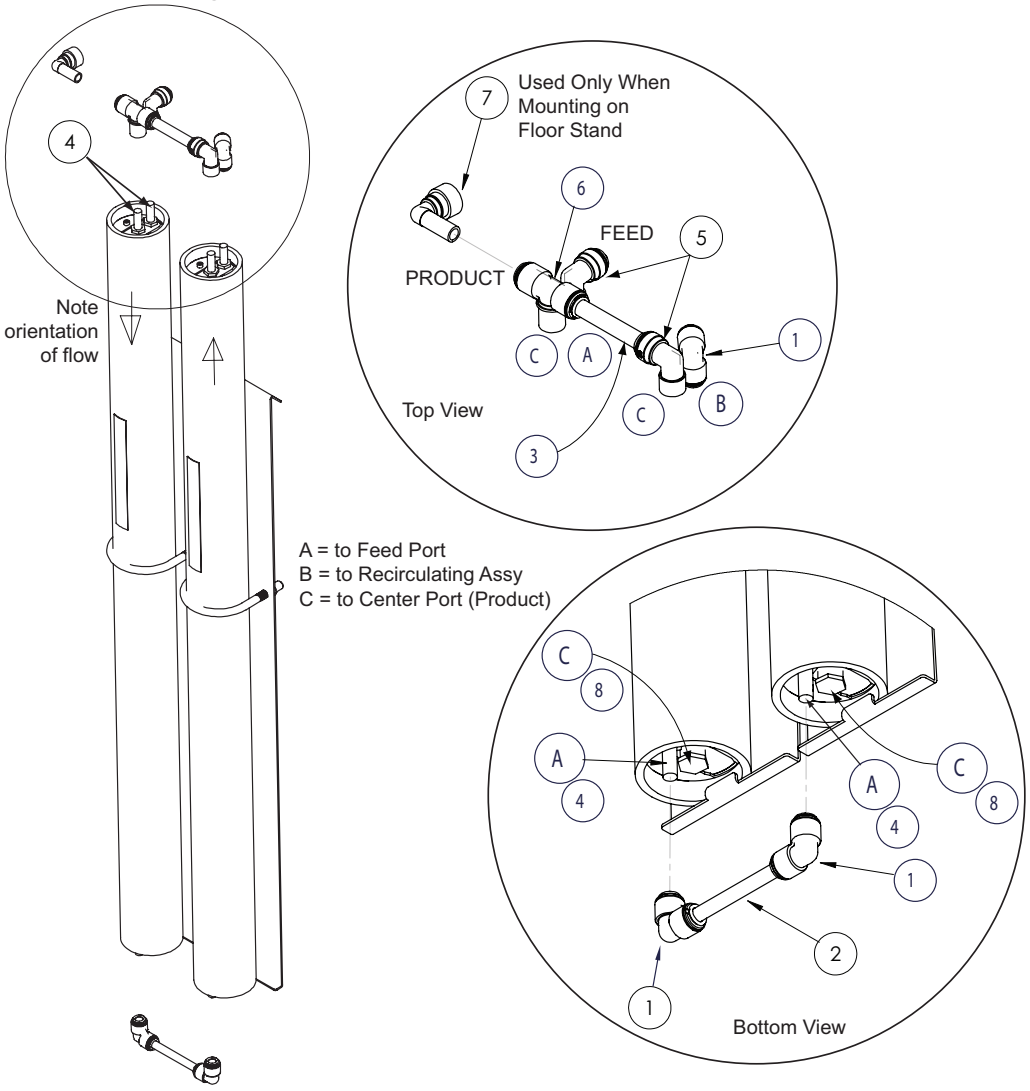



Figure 34. M1-2S/2L sub-assembly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01023412 | Assembly, Membrane Housing, Single, 2.5"x21" (2S) | |
| | 01023417 | Assembly, Membrane Housing, Single, 2.5"x40" (2L) | |
| | 01023907 | Kit, Tube and Fittings, 2S, 2L (includes items 1–8) | |
| 1 | — | Elbow, Union, 3/8 Tube, PI, Polypropylene | 3 EA |
| 2 | — | Tube, 3/8", cut length 3" | 1 EA |
| 3 | — | Tube, 1/2", Length 3.5" | 1 EA |
| 4 | — | Stem Adapter, 1/4Tx3/8 Stem, Polypropylene | 6 EA |
| 5 | — | Elbow, Union, Reducing, 1/2 x 3/8, PI, Polypropylene | 2 EA |
| 6 | — | Tee, Union, Reducing, 1/2 Ends, 3/8 Branch, PI, Polypropylene | 1 EA |
| 7 | — | Elbow,1/2 Stem x 1/2T,PI | 1 EA |
| 8 | — | Plug, 1/4" NPT, PVC Sch 80 | 2 EA |

## 3S/3L Sub-Assembly

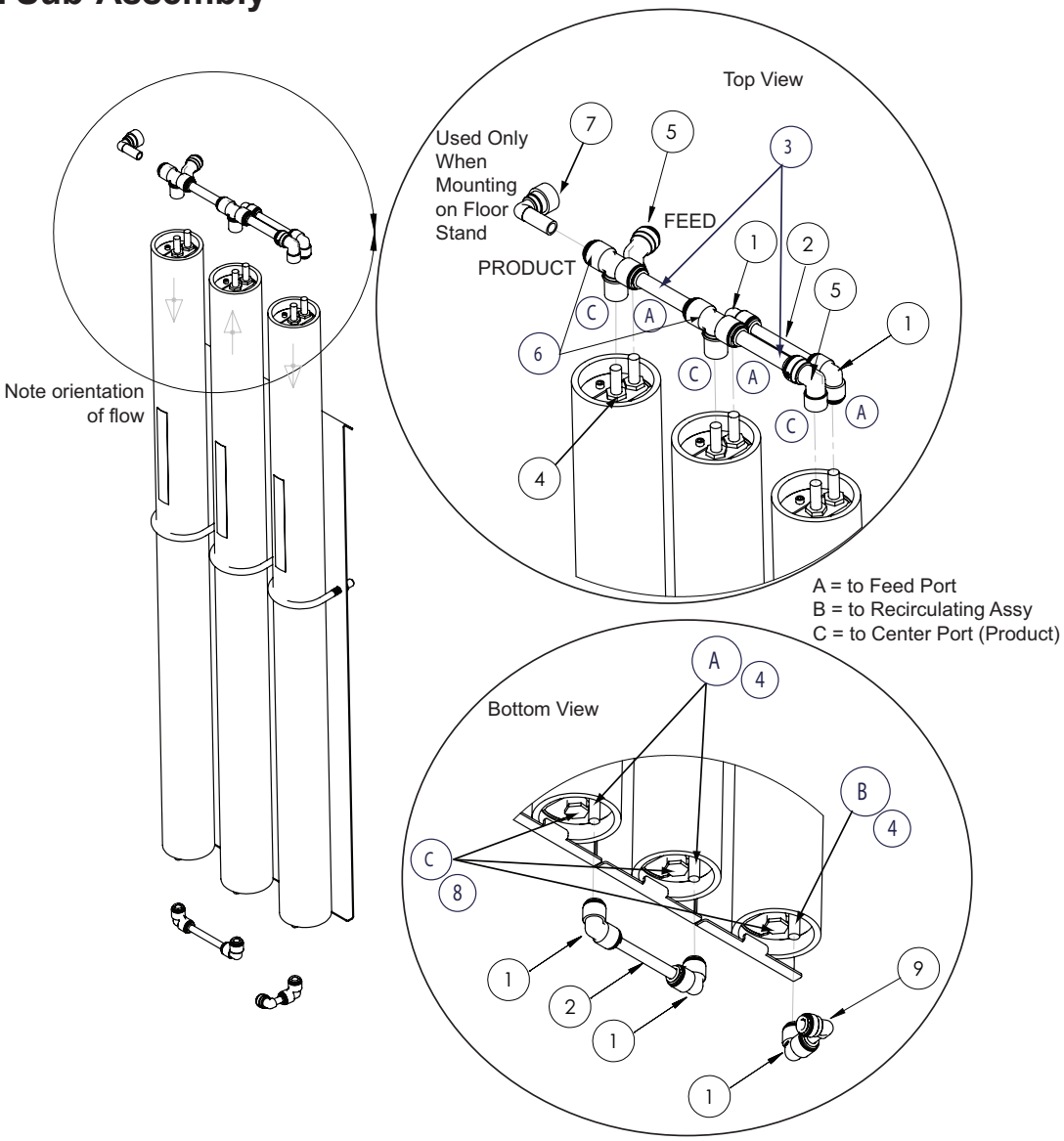



Figure 35. M1-3S/3L sub-assembly.

| Item | Part No. | Description | Qty |
|---|---|---|---|
| | 01023412 | Assembly, Membrane Housing, Single, 2.5"x21" | |
| | 01023417 | Assembly, Membrane Housing, Single, 2.5"x40" | |
| | 01023908 | Kit, Tube and Fittings, 3S, 3L (includes items 1–9) | |
| 1 | — | Elbow, Union, 3/8 Tube, PI, Polypropylene | 5 EA |
| 2 | — | Tube, 3/8", cut length 4.4" | 2 EA |
| 3 | — | Tube, 1/2", Length 4.25" | 2 EA |
| 4 | — | Stem Adapter, 1/4Tx3/8 Stem, Polypropylene | 9 EA |

| Item | Part No. | Description | Qty |
|---|---|---|---|
| 5 | — | Fitting, Union, Reducing, 1/2 x 3/8, PI, Polypropylene | 2 EA |
| 6 | — | Tee, Union, Reducing, 1/2 Ends, 3/8 Branch, PI, Polypropylene | 2 EA |
| 7 | — | Elbow,1/2 Stem x 1/2T,PI | 1 EA |
| 8 | — | Plug, 1/4" NPT, PVC, Sch 80 | 3 EA |
| 9 | — | Elbow, 3/8" stem, 3/8 tube | 1 EA |

## 4S/4L Sub-Assembly

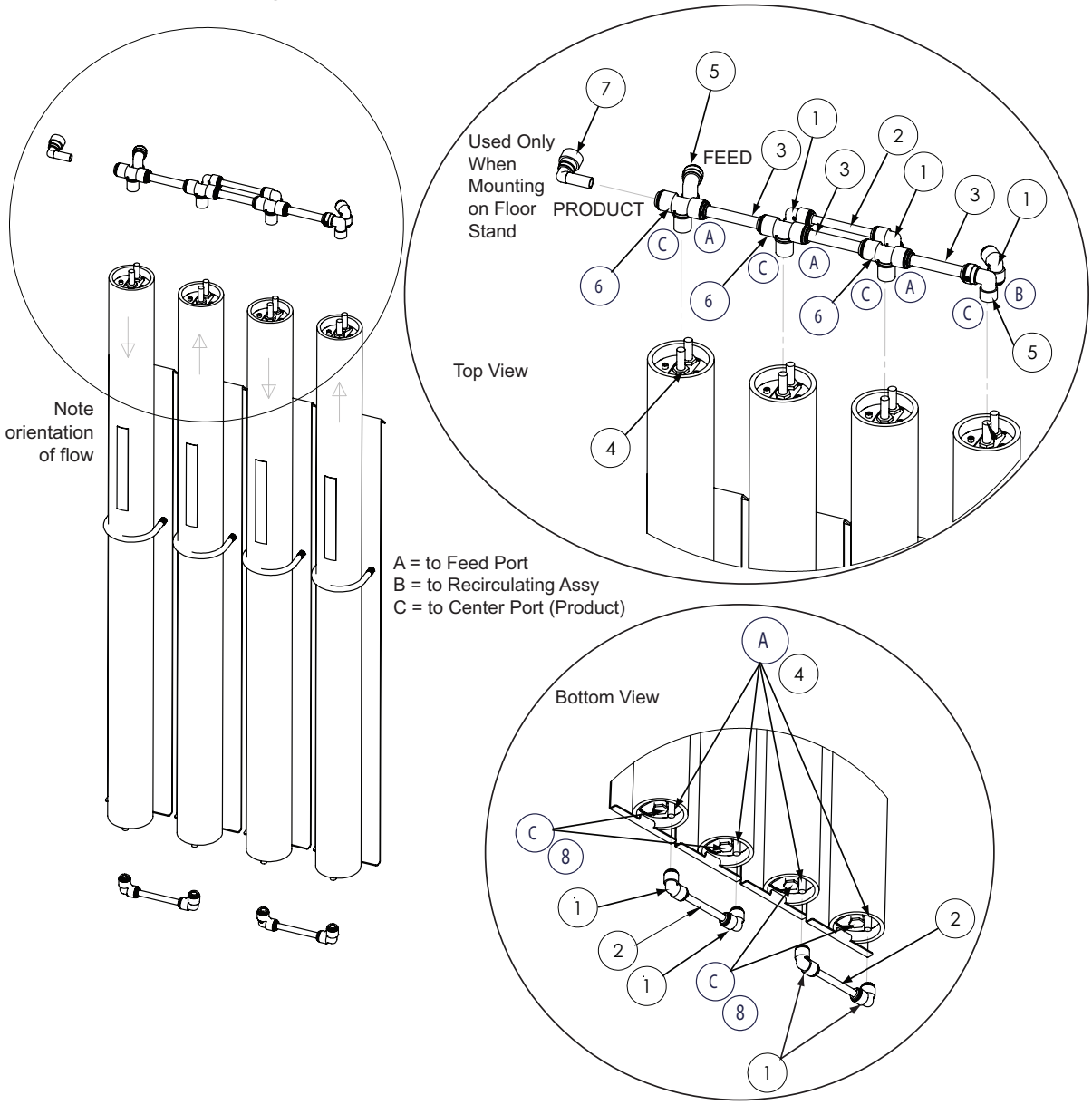



Figure 36. M1-4S/4L sub-assembly.

| Item | Part No. | Description | Qty |
|---|---|---|---|
| | 01023412 | Assembly, Membrane Housing, Single, 2.5”x21” | |
| | 01023417 | Assembly, Membrane Housing, Single, 2.5"x40" | |
| | 01023909 | Kit, Tube and Fittings, 4S,4L (includes items 1–8) | |
| 1 | — | Elbow, Union, 3/8 Tube, PI, Polypropylene | 7 EA |
| 2 | — | Tube, 3/8", cut length 4.4" | 3 EA |
| 3 | — | Tube, 1/2", Length 4.25" | 3 EA |

| Item | Part No. | Description | Qty |
|---|---|---|---|
| 4 | — | Stem Adapter, 1/4Tx3/8 Stem, Polypropylene | 12 EA |
| 5 | — | Elbow, Union, Reducing, 1/2 x 3/8, PI, Polypropylene | 2 EA |
| 6 | — | Tee, Union, Reducing, 1/2 Ends, 3/8 Branch, PI, Polypropylene | 3 EA |
| 7 | — | Elbow,1/2 Stem x 1/2T,PI | 1 EA |
| 8 | — | Plug, 1/4” NPT, PVC, Sch 80 | 4 EA |

## 1F Sub-Assembly

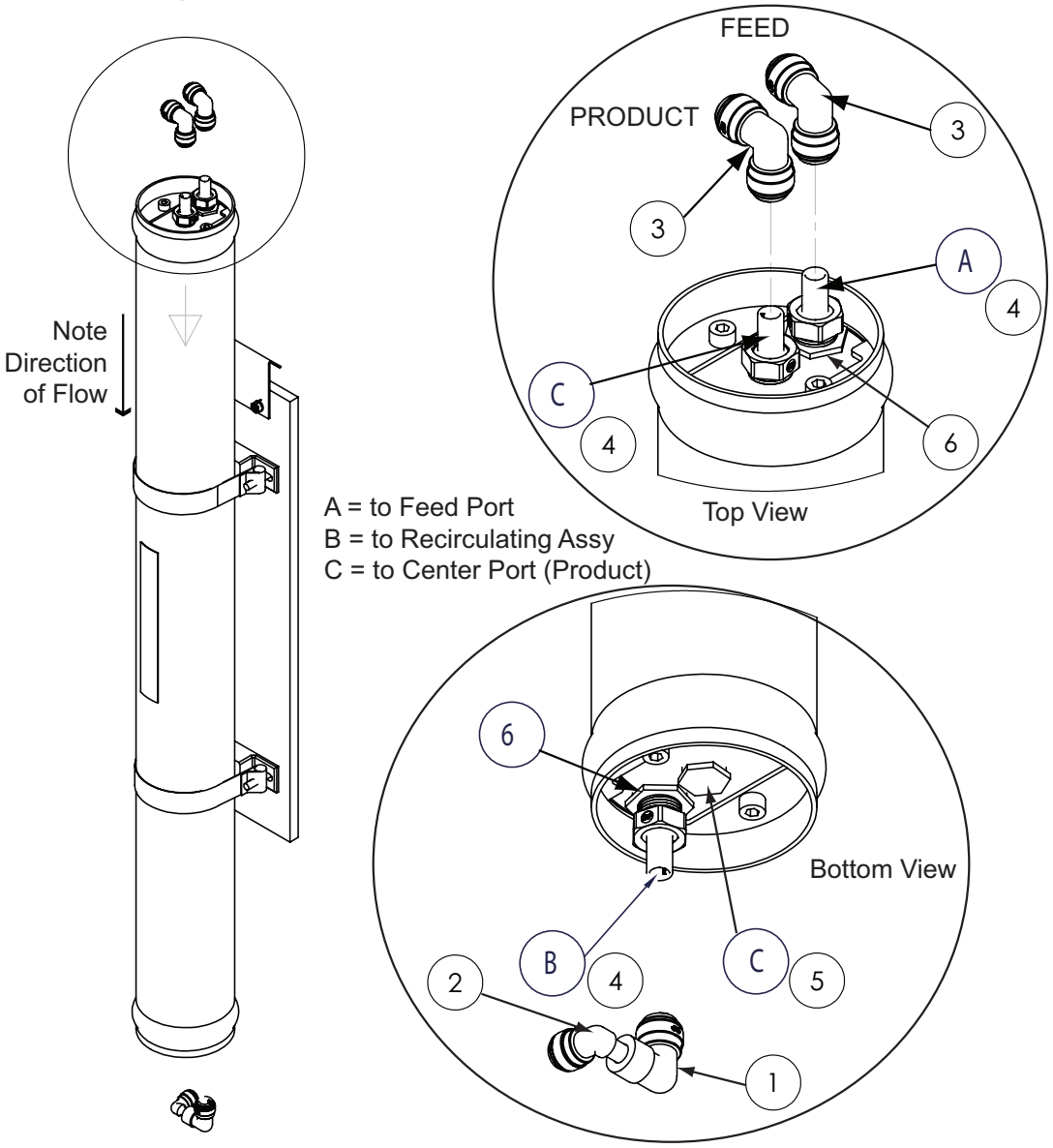



Figure 37. M1-1F sub-assembly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01022875 | Assembly, Membrane Housing, Single, 4.0"x40" | |
| | 01023922 | Kit, Tube and Fittings, 1F (includes items 1–7) | |
| 1 | — | Elbow, Union, Reducing, 1/2 x 3/8, PI, Polypropylene | 1 EA |
| 2 | — | Elbow, Plug In, 3/8" stem, 3/8 tube | 1 EA |
| 3 | — | Elbow, Union, 1/2 Tube, Polypropylene | 2 EA |
| 4 | — | Stem Adapter, 1/2Tx1/2 Stem, Polypropylene | 3 EA |
| 5 | — | Plug, 1/2" NPT, PVC Sch 80 | 1 EA |
| 6 | — | BUSHING,3/4x1/2,TxT,PVC SCH.80, | 2 EA |
| 7 | — | Carton, Tubing and Fittings Kit | 1 EA |

## 2F Sub-Assembly

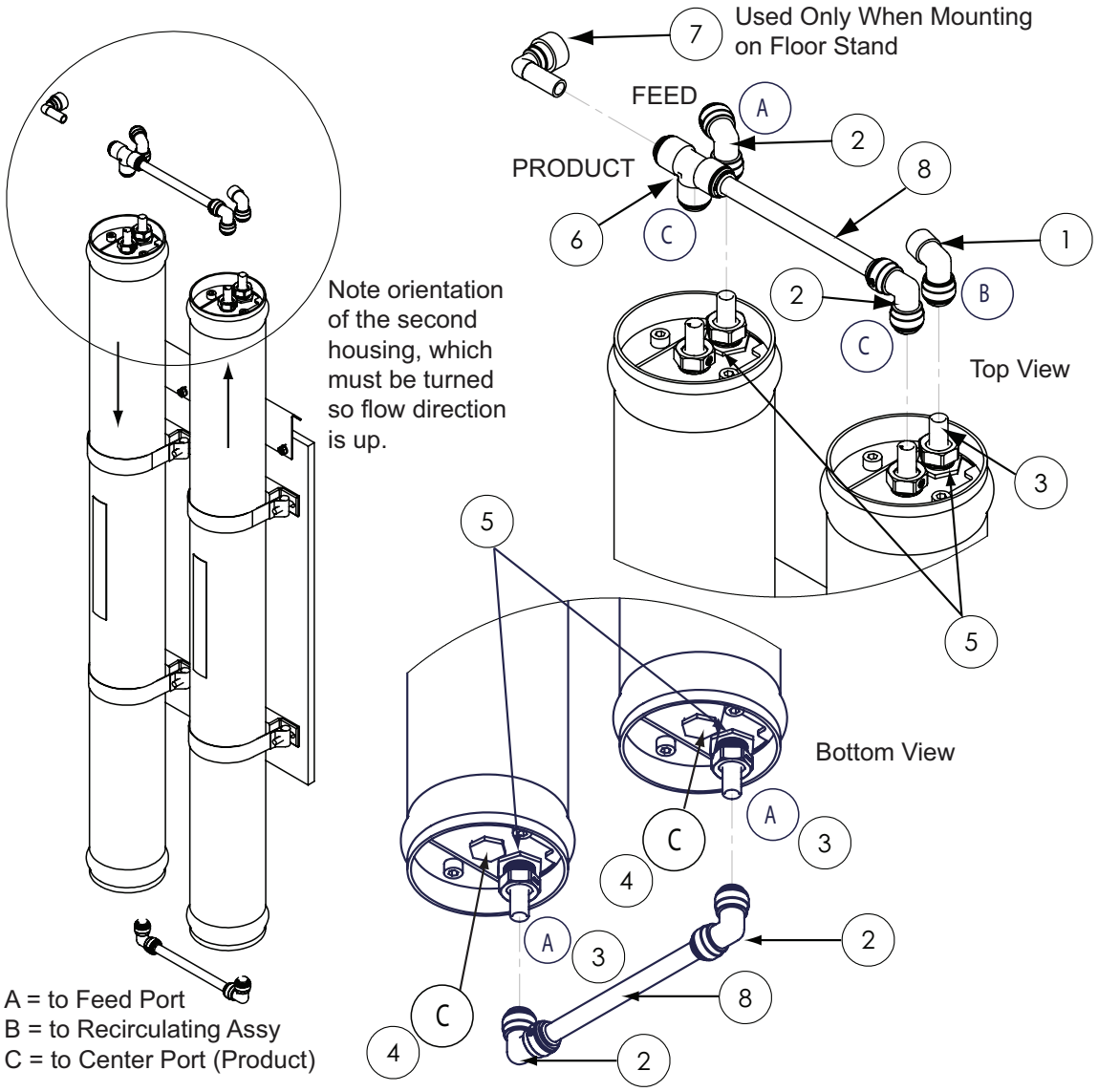



Figure 38. M1-2F sub-assembly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01022875 | Assembly, Membrane Housing, Single, 4.0"x40" | |
| | 01023914 | Kit, Tube and Fittings, 2F (includes items 1–8) | |
| 1 | — | Elbow, Union, Reducing, 1/2 x 3/8, PI, Polypropylene | 1 EA |
| 2 | — | Elbow, Union, 1/2 Tube, Polypropylene | 4 EA |
| 3 | — | Stem Adapter, 1/2Tx1/2 Stem, Polypropylene | 6 EA |
| 4 | — | Plug, 1/2" NPT, PVC Sch 80 | 2 EA |
| 5 | — | BUSHING,3/4x1/2,TxT,PVC SCH.80, | 4 EA |
| 6 | — | Tee, Union, 1/2 Tube, PI, Polypropylene | 1 EA |
| 7 | — | Elbow,1/2 Stem x 1/2T,PI | 1 EA |
| 8 | — | Tube, 1/2", Length 7.5" | 2 EA |

## CP Plus Controller Assembly

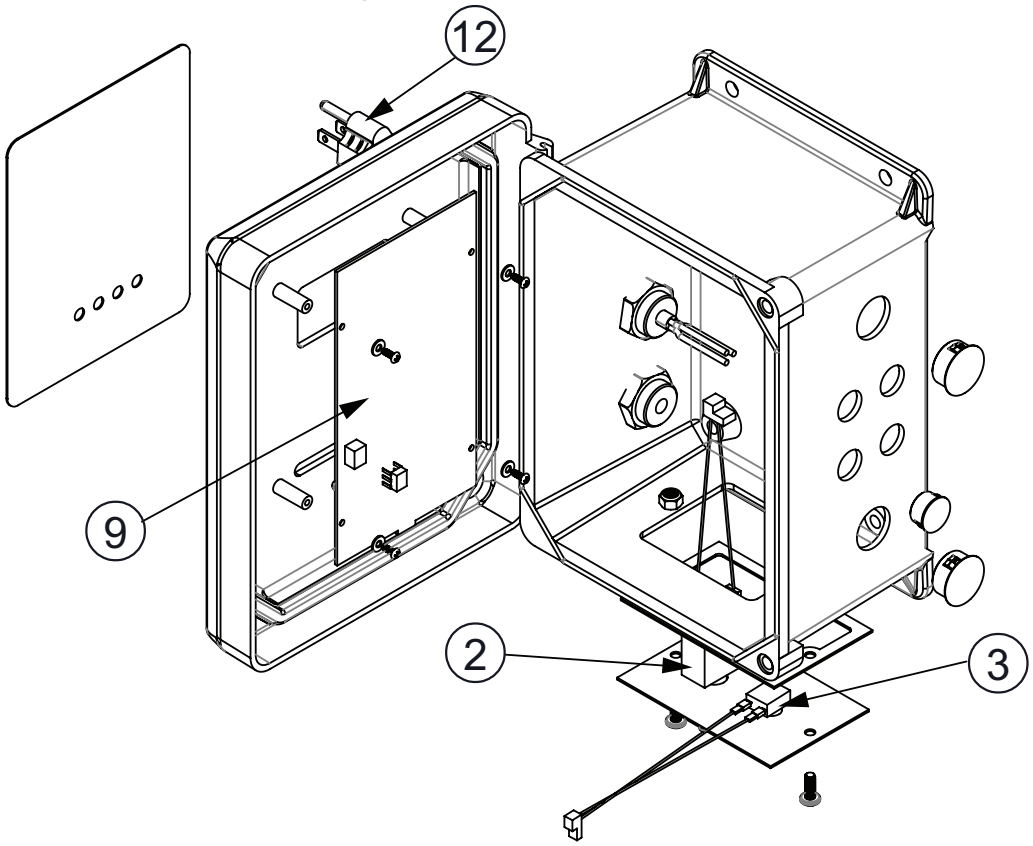



Figure 39. CP Plus Controller assembly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| — | 01024478 | Controller, CP Plus, complete | 1 |
| 2 | 01025746 | Assembly, Cable, Rocker Switch | 1 |
| 3 | 01024282 | Assembly, Cable, Push Button | 1 |
| 9 | 01024139 | Circuit Board, CP Plus Controller | 1 |
| 12 | 01024179 | Power Cord, CP Plus Controller | 1 |

# Appendix A M1 RO International

The M1 RO water treatment system is also available for use with international voltage (230 VAC). This appendix provides information about the international version that is different from the U.S. version.

**WARNING! Use only 230V/50Hz/1 Phase electrical connections. Connecting to incorrect voltage will cause permanent damage to equipment.**

## Series M1 Wiring, 230 VAC/50 Hz

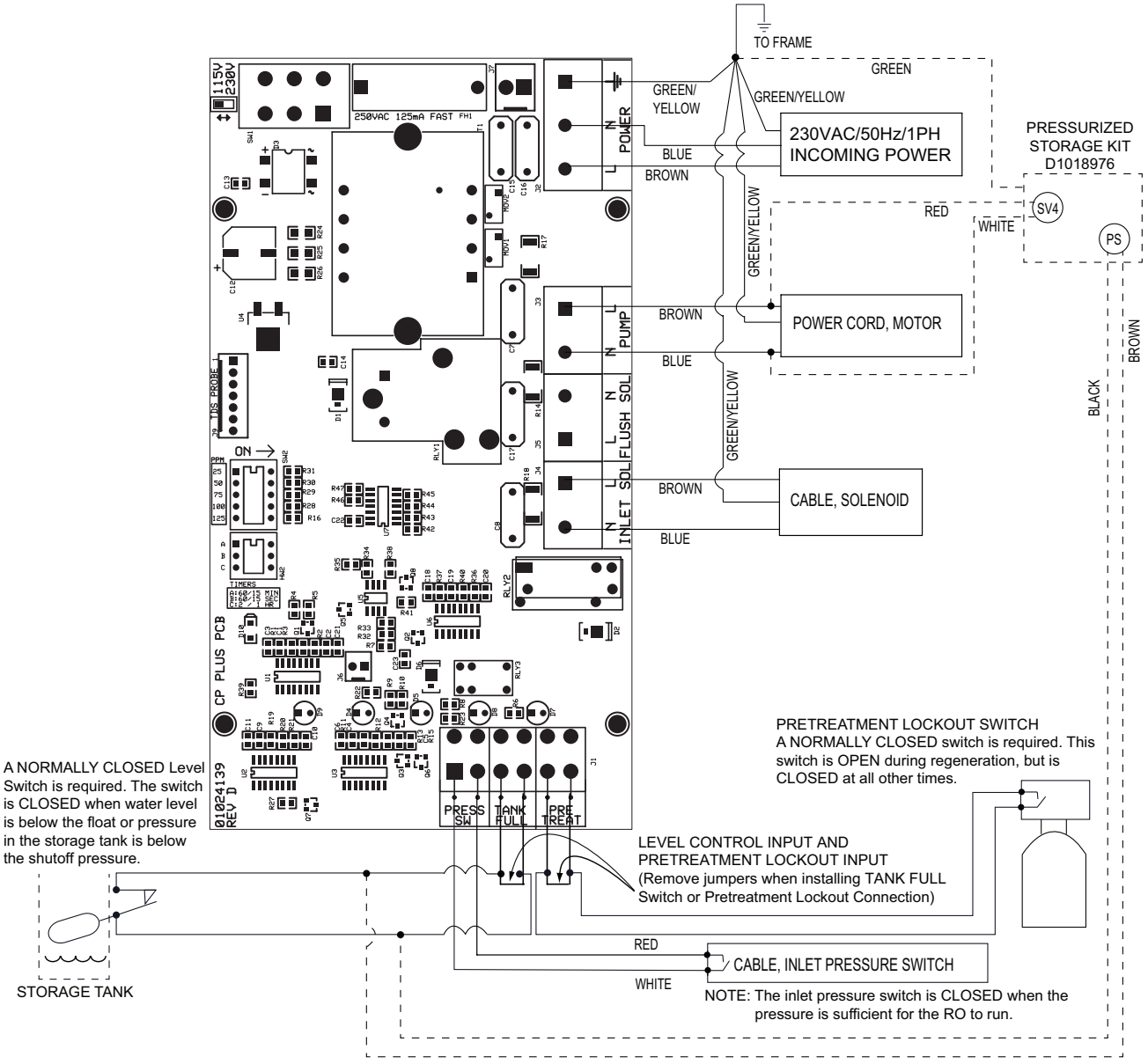



Figure 40. Series M1 wiring diagram, 230 VAC/50 Hz.

**NOTE *Agency certified and marked by VDE, HAR, or equivalent agency 6A, 250 VAC, 65C, PVC, VW-1, or FV-1 Flame Rating. Type H05VV-F/H07RN-F or equivalent, 3x1.5 mm wire size, 10.5x12.5 cable OD. The supply cord shall have a green/yellow core that is connected to the grounding terminal of the appliance and to the grounding contact of the plug.**

## CP Plus Circuit Board 230V

**WARNING! The 115/230V Voltage Selector Switch must be set at 230V. Setting the CP Plus board to incorrect voltage will cause permanent damage to equipment.**

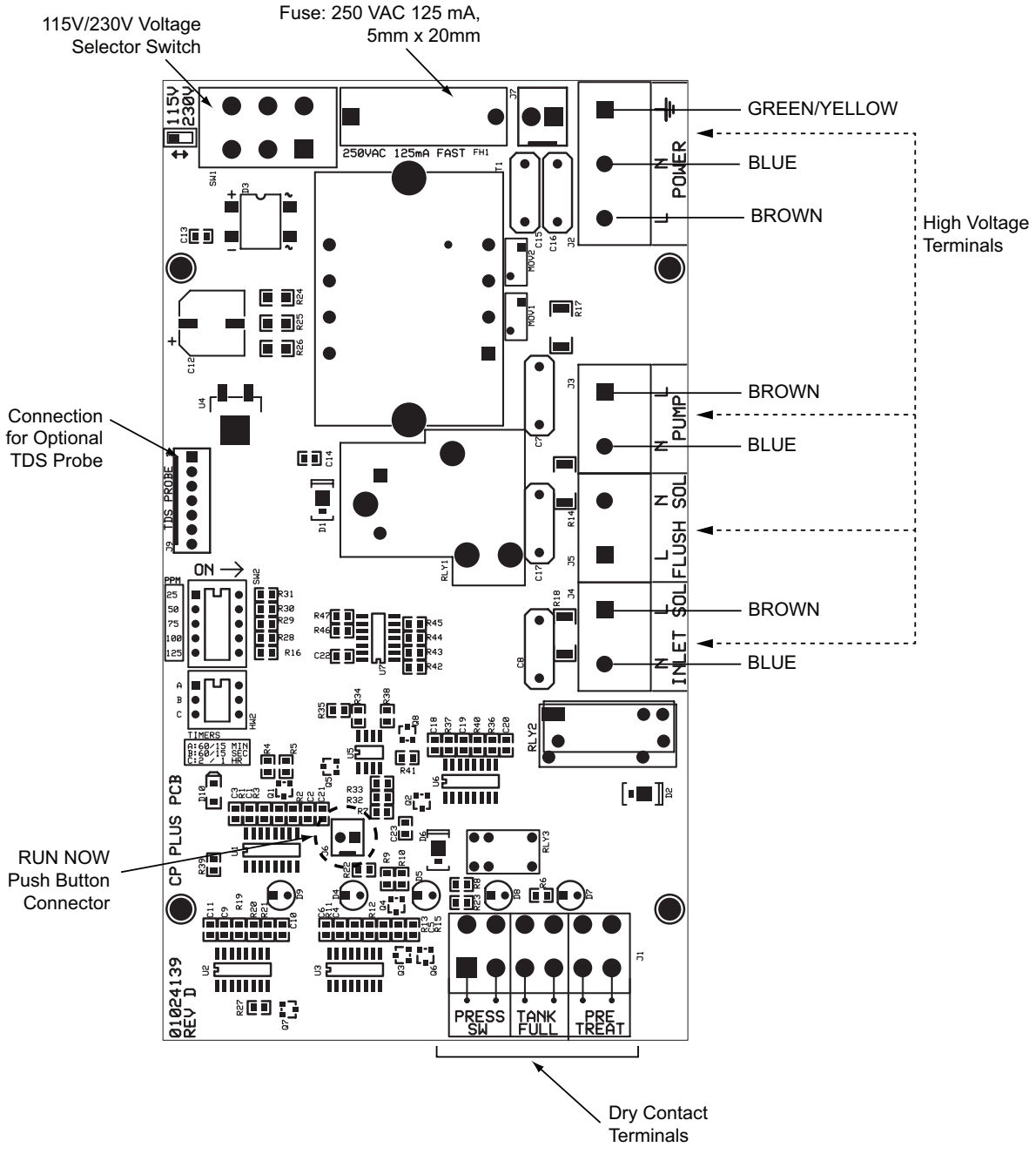



Figure 41. CP Plus circuit board configured for 230 VAC.

## M1 RO International Specifications

| | M1-1S | M1-2S | M1-3S | M1-2L | M1-3L | M1-4L |
|---|---|---|---|---|---|---|
| Nominal Capacity, GPD [m³/hr]* | 250 [0.04] | 500 [0.08] | 750 [0.12] | 1200 [0.19] | 1700 [0.27] | 2200 [0.35] |
| Dimensional, Series M1 Units | | | | | | |
| Width - in [mm] | 34.5 [876] | | | | | 38.5 [978] |
| Depth - in [mm] | 8.7 [221] | | | | | |
| Height - in [mm] | 34.8 [884] | | | 45.5 [1156] | | |
| Operating Weight, lb [kg] | 77 [35] | 81 [37] | 92 [42] | 88 [40] | 103 [47] | 111 [50] |
| Unit Connections | | | | | | |
| Inlet (Tube) - mm | 10 | | | | | |
| Product (Tube) - mm | 10 | | | | | |
| Concentrate (Tube) - mm | 10 | | | | | |
| Electrical | | | | | | |
| Motor Horsepower, hp [kW] | 0.333 [0.25] | | | 0.75 [0.56] | | |
| Power Requirement (VAC/phase/Hz) | 230/1/50 | | | | | |
| Full Load Current, amp (@230V) | 4 | | | 6 | | |
| Hydraulic - Prefilter | | | | | | |
| Housing Quantity | 1 | | | | | |
| Cartridge Rating, micron | 5 | | | | | |
| Hydraulic - RO | | | | | | |
| RO Housing Quantity | 1 | 2 | 3 | 2 | 3 | 4 |
| RO Element Quantity | 1 | 2 | 3 | 2 | 3 | 4 |
| RO Element Size - in [mm] | 2.5x21 | | | 2.5x40 | | |
| RO Array | 1 | 1:01 | 1:01:01 | 1:01 | 1:01:01 | 1:1:1:1 |
| Product Flow - gpm [L/min]* | 0.17 [0.64] | 0.35 [1.28] | 0.52 [1.97] | 0.83 [3.14] | 1.18 [4.47] | 1.53 [5.79] |
| Concentrate Flow - gpm [L/min]* | 0.51 [1.93] | 0.35 [1.28] | 0.52 [1.97] | 0.83 [3.14] | 1.18 [4.47] | 1.53 [5.79] |
| Required Inlet Feed Flow - gpm [L/min] | 0.68 [2.57] | 0.7 [2.65] | 1.04 [3.94] | 1.66 [6.28] | 2.36 [8.93] | 3.06 [11.58] |
| Pump Flow @ 150 psi, gpm [L/min] | 1.33 [5.03] | | | 2.53 [9.58] | | 3.1 [11.73] |
| Maximum Module Feed Pressure psig [kPa] | 150 [1034] | | | | | |
| Nominal Module Feed Pressure psig [kPa]† | 95 [654.6] | 100 [689] | 103 [709.7] | 96 [661.4] | 97 [668.3] | 101 [695.9] |
| Max. Product Pressure psig [kPa] | 40 [275.6] | | | | | |
| Inlet Pressure Min., dynamic psig [kPa] | 20 [137.8] | | | | | |
| Maximum, dynamic psig [kPa] | 50 [344.5] | | | | | |
| Operating Temp °F [°C] | 33-100 [1-38] | | | | | |
| Recovery (%)* | | | | | | |
| Design | 50 | | | | | |
| Minimum | 40 | | | | | |
| Salt Rejection, Nominal (%) | 98 | | | | | |

†Calculated using a 0.85 fouling factor

*Nominal capacity based on new RO membranes operating on a properly pretreated feed water of 500 ppm TDS as NaCl, 77 °F (25 °C), Silt Density Index (SDI) below 3, and supplying water to atmosphere. Productivity will vary depending on the actual feed water quality and temperature.

## 1S Tubing Assembly Instructions, 230V

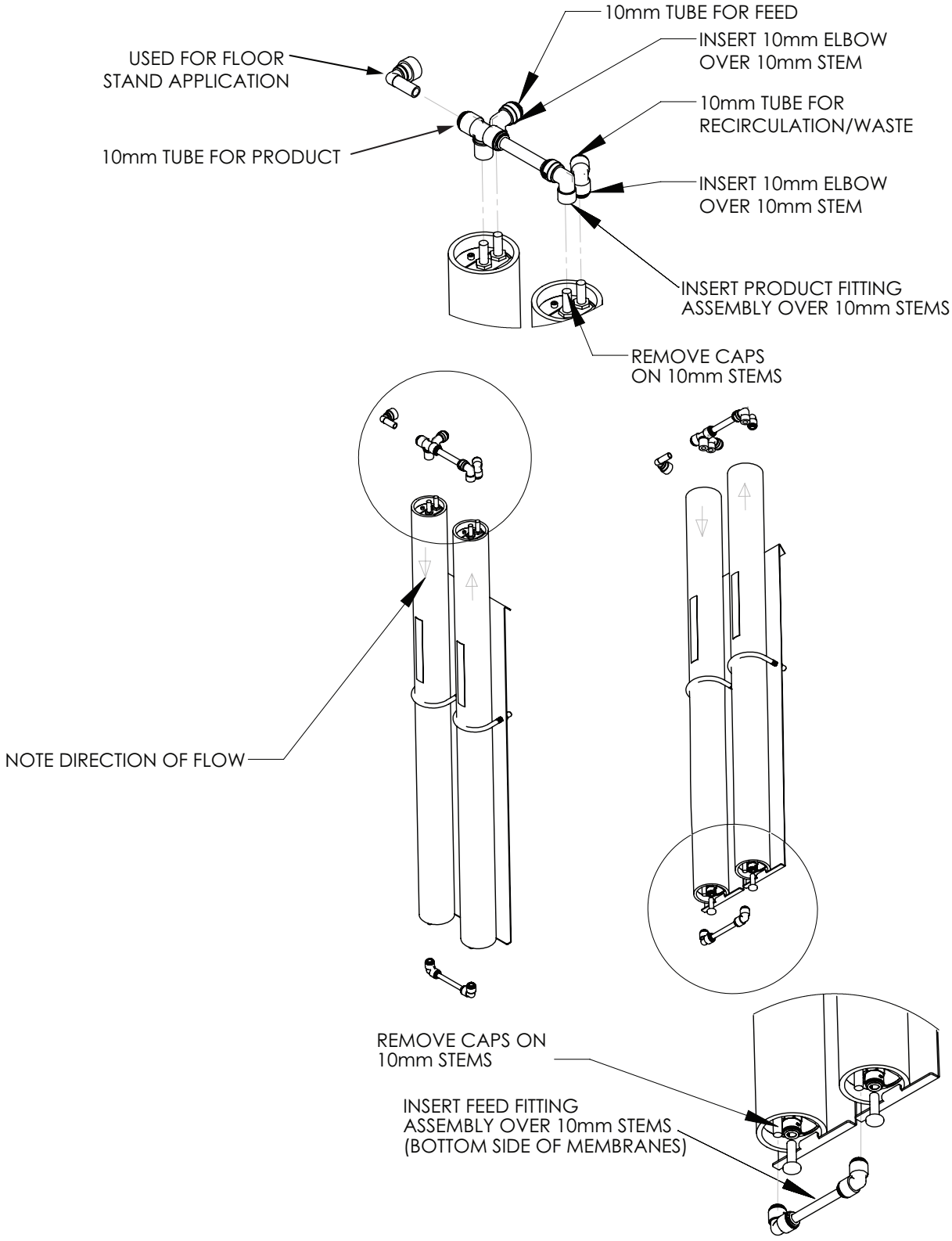



Figure 42. RO 1S tubing assembly instructions, 230V.

## 2S/2L Tubing Assembly Instructions, 230V

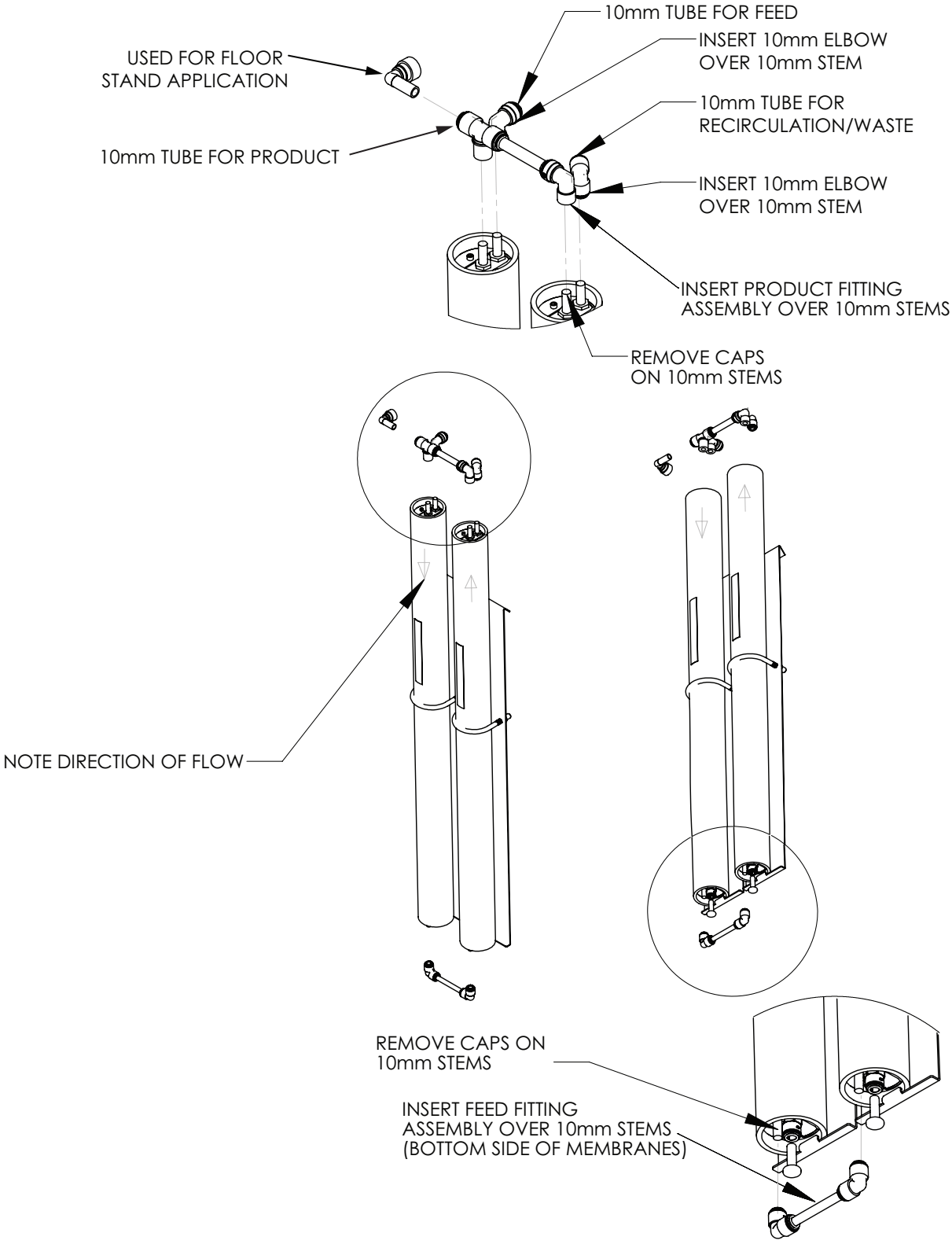



Figure 43. RO 2S/2L tubing assembly instructions, 230V.

## 3S/3L Tubing Assembly Instructions, 230V

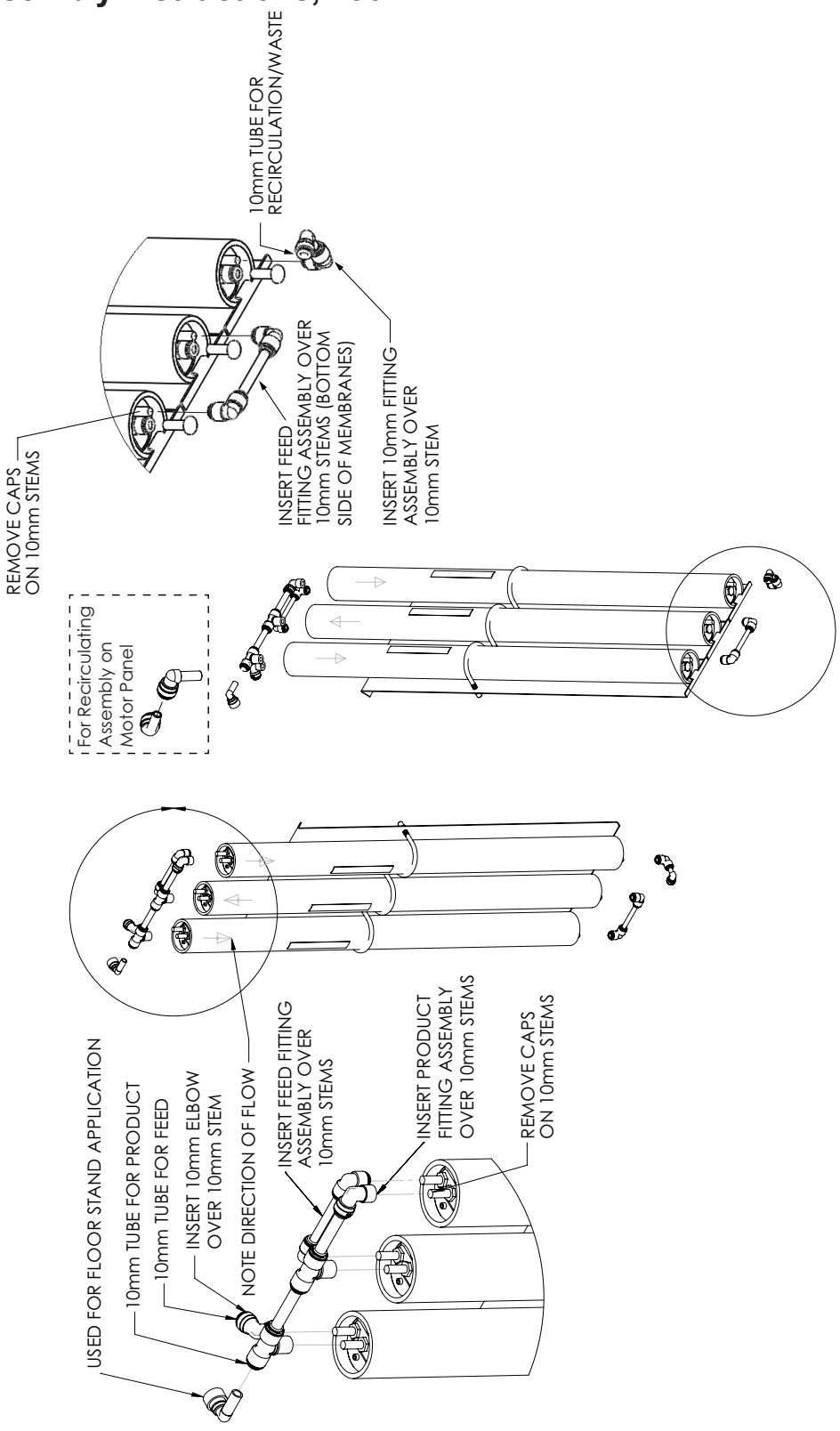



Figure 44. RO 3S/3L tubing assembly instructions, 230V.

# 4S/4L Tubing Assembly Instructions, 230V

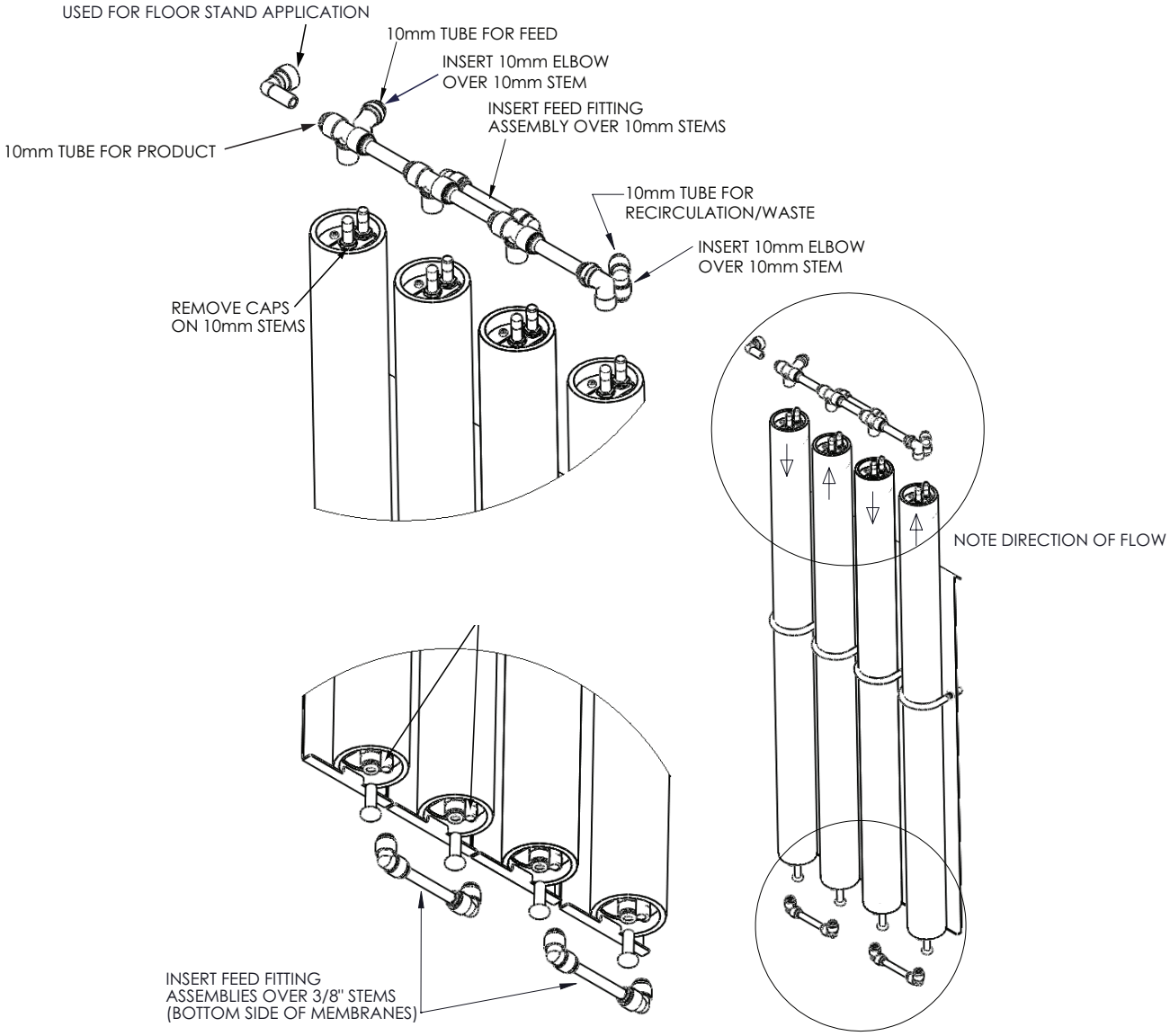



Figure 45. RO 4S/4L tubing assembly instructions, 230V.

## M1 RO International Parts

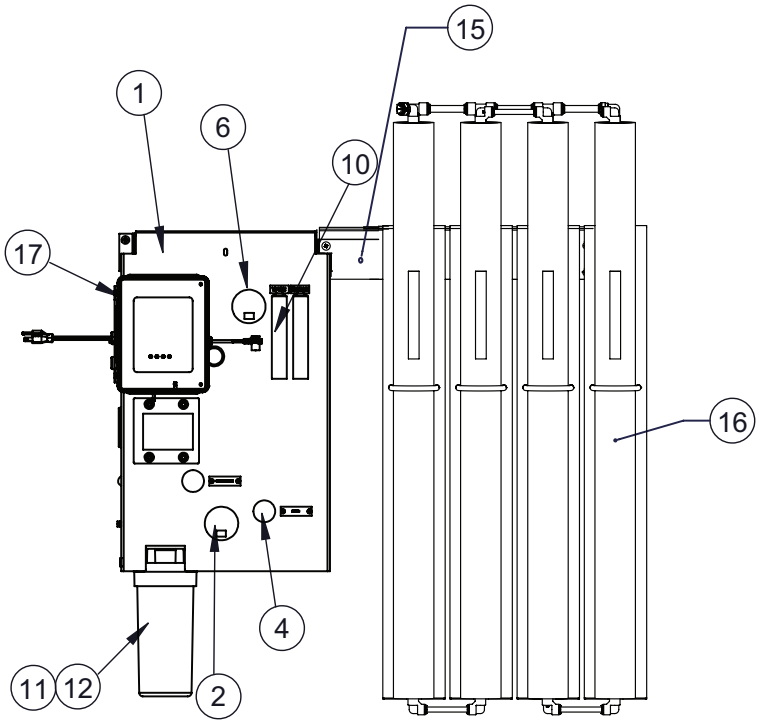



Figure 46. M1 RO front view.

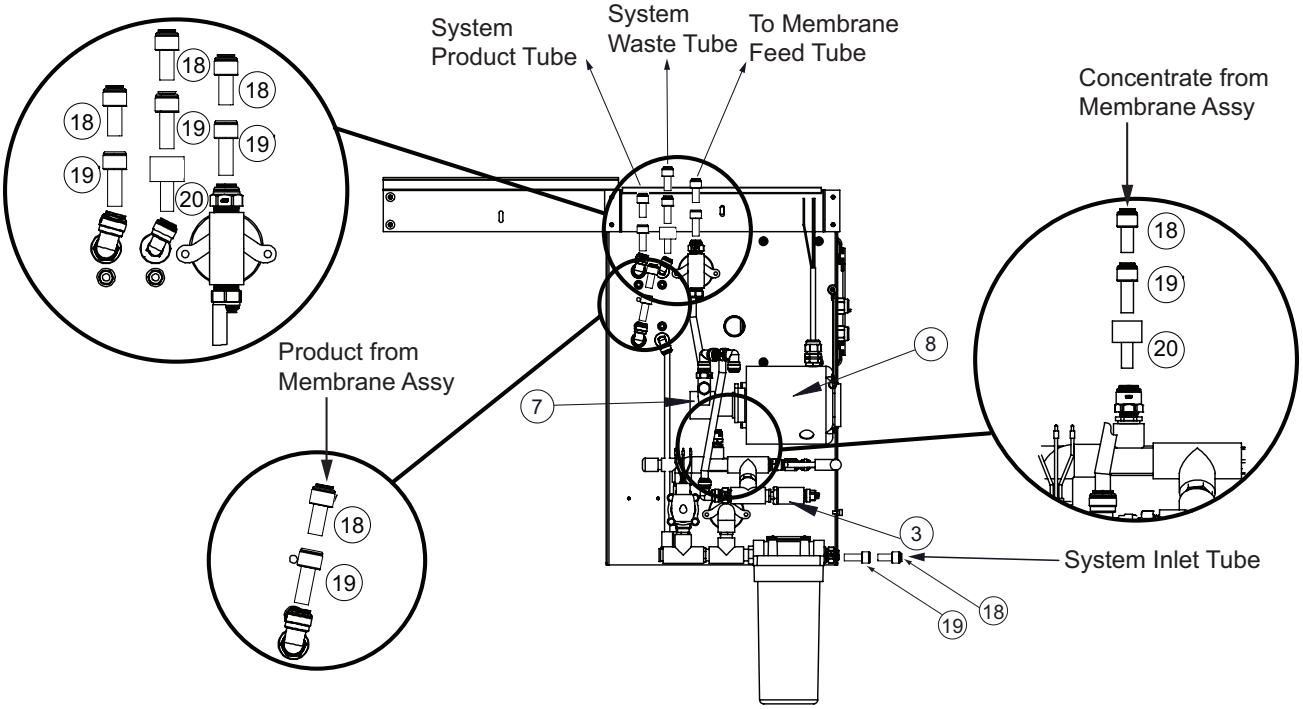



Figure 47. M1 RO rear view.

| M1 Plus RO Series, 230V/50Hz | | | 1S | 2S | 3S | 2L | 3L | 4L |
|---|---|---|---|---|---|---|---|---|
| Item | Part No. | Description | Qty | Qty | Qty | Qty | Qty | Qty |
| 1 | 01024587 | Motor Panel Assembly, 220V, M1-2S, 3S | 1 | 1 | 1 | | | |
| 1 | 01025353 | Motor Panel Assembly, 220V, M1-2L, 3L, 4L (4L requires 01022826) | | | | 1 | 1 | 1 |
| 2 | 01024238 | Assembly, Feed, M1, 220V | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 01021993 | Assembly, Return | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 01022053 | Assembly, Drain | 1 | 1 | 1 | 1 | 1 | 1 |
| 6 | 01021997 | Assembly, Pressure Gauge | 1 | 1 | 1 | 1 | 1 | 1 |
| 7 | 01022855 | Pump, Rotary Vane, Brass, 100 GPH | 1 | 1 | 1 | | | |
| 7 | 01023800 | Pump, Rotary Vane, Brass, 190 GPH | | | | 1 | 1 | |
| 7 | 01022826 | Pump, Rotary Vane, Brass, 240 GPH | | | | | | 1 |
| 8 | 01022856 | Motor, 1/3 HP, 115V, 1725 RPM, Nema Frame 48Y, Carbonator Mount Style | 1 | 1 | 1 | | | |
| 8 | 01022107 | Motor, 3/4 HP, 115V, 1725 RPM, Nema Frame 48Y, Carbonator Mount Style | | | | 1 | 1 | 1 |
| — | 01022033 | V-band, Pump/Motor | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 | 01025339 | Flow Meter, .1–1 GPM/.5–4 LPM, Panel Mount | 1 | 1 | 1 | | | |
| 10 | 01025340 | Flow Meter,.5–5 GPM/2–18 LPM, Panel Mount | | | | 1 | 1 | 1 |
| 11 | 01025480 | Filter Housing, 10" BB | 1 | 1 | 1 | 1 | 1 | 1 |
| 12 | 762350 | Cartridge Filter | 1 | 1 | 1 | 1 | 1 | 1 |
| 15 | 01024455 | Bracket Kit, Wall Mount | 1 | 1 | 1 | 1 | 1 | |
| 15 | 01024484 | Bracket Kit, Wall Mount | | | | | | 1 |
| 16 | 01025333 | Assembly, Membrane, 2.5x21, Metal, Metric | 1 | 2 | 3 | | | |
| 16 | 01025334 | Assembly, Membrane 2.5x40, Metal, Metric | | | | 2 | 3 | 4 |
| 17 | 01024478 | Controller, CP+, complete | 1 | 1 | 1 | 1 | 1 | 1 |
| 18 | 01025327 | Reducer, Stem 15mm, Tube 10 mm | 6 | 6 | 6 | 6 | 6 | 6 |
| 19 | 01025326 | Adapter, Stem to Tube, 1/2" Stem, 15mm Tube | 6 | 6 | 6 | 6 | 6 | 6 |
| 20 | 01025328 | Enlarger, Stem 3/8", Tube 1/2" | 2 | 2 | 2 | 2 | 2 | 2 |
| — | 01024139 | Circuit Board, CP+ | 1 | 1 | 1 | 1 | 1 | 1 |

**WARNING! The 115/230V Voltage Selector Switch must be set at the appropriate voltage. Setting the CP Plus board to incorrect voltage will cause permanent damage to equipment.**

**WARNING! Motors must be wired to the appropriate voltage and Hz. Connecting to incorrect voltage will cause permanent damage to equipment.**

# M1 RO International Feed Assembly

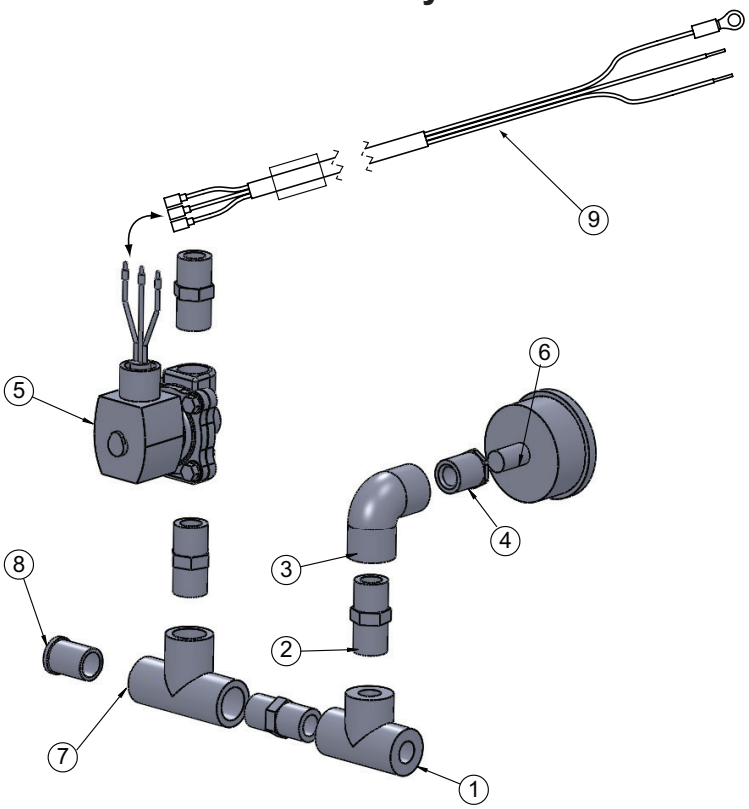



Figure 48. Feed Assembly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01024238 | Assembly, Feed, 220V, M1 (items 1–8) | |
| 1 | — | Tee, 1/2", Threaded, PVC Sch. 80 | 1 |
| 2 | — | Male Adapter, 1/2" Spigot x NPT, Sch. 80 | 4 |
| 3 | — | Elbow, 1/2" Soc, PVC Sch. 80 | 1 |
| 4 | — | Bushing, 1/2 x 1/4, SxT, PVC Sch. 80 | 1 |
| 5 | 01022601 | Solenoid Assy, 220V/50Hz with bullet connectors | 1 |
| 5 | 01024635 | Coil, Solenoid, Repl, 220–240V/50–60Hz | 1 |
| 6 | 01007604 | Pressure Gauge, 1/4" NPT, 0–200 PSI, Liquid filled | 1 |
| 7 | — | Tee, 1/2" Socket, PVC Sch. 80 | 1 |
| 8 | — | Plug, 1/2", Spig | 1 |
| 9 | 01025739 | Cable, Solenoid, M1, 220V | 1 |

## 1S Sub-Assembly, 230V

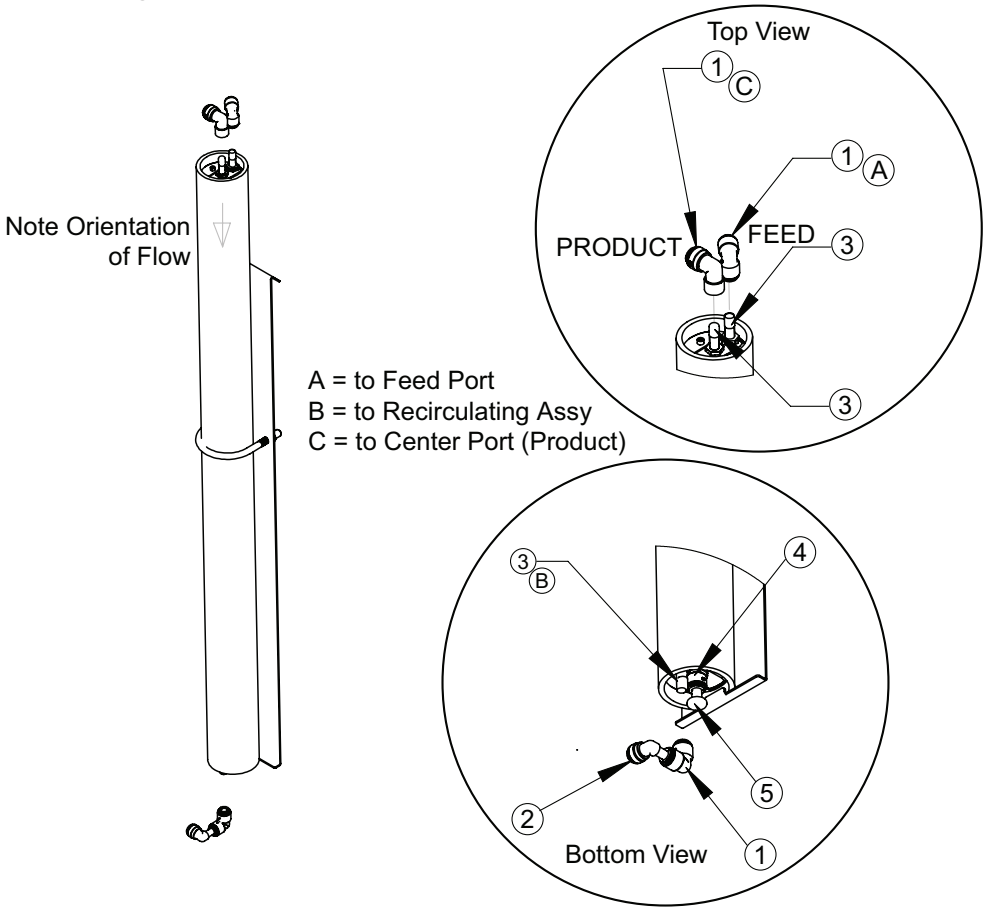



Figure 49. 1S/1L sub-assembly, 230V.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01025333 | Assembly, Membrane Housing, Metric, Single, 2.5"x21" (1S) | |
| | 01025816 | Kit, Tube and Fittings, Metric, 1S (includes items 1–5) | |
| 1 | — | Elbow, Union, 10mm | 3 EA |
| 2 | — | Elbow, Stem, 10mm | 1 EA |
| 3 | — | Stem Adapter, 1/4 BSPP, 10mm | 3 EA |
| 4 | — | Connector, 1/4 BSPP, 10mm | 1 EA |
| 5 | — | Plug, 10mm | 1 EA |

## 2S/2L Sub-Assembly, 230V

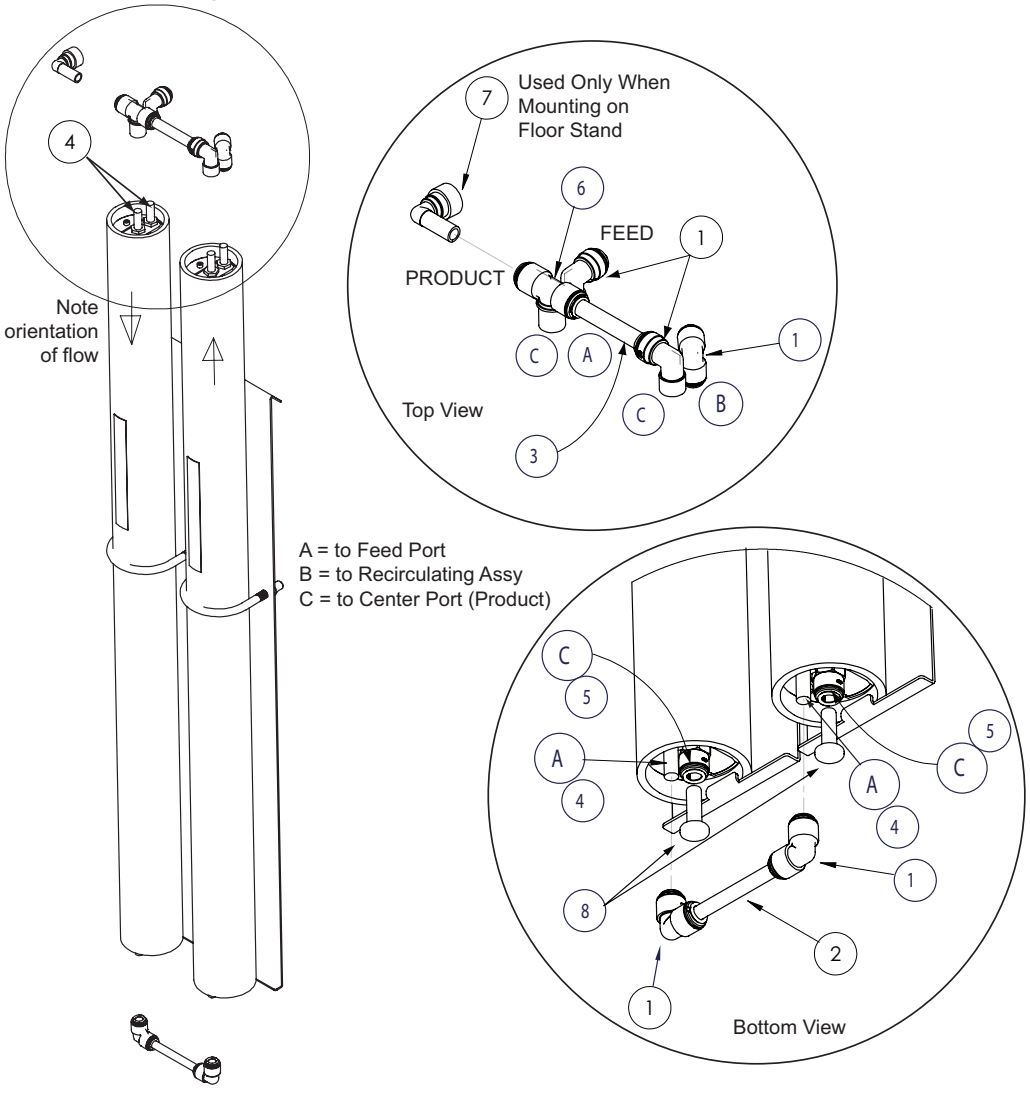



Figure 50. 2S/2L sub-assembly, 230V.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01025333 | Assembly, Membrane Housing, Metric, Single, 2.5"x21" (2S) | |
| | 01025334 | Assembly, Membrane Housing, Metric, Single, 2.5"x40" (2L) | |
| | 01025330 | Kit, Tube and Fittings, Metric, 2S, 2L (includes items 1–8) | |
| 1 | — | Elbow, Union, 10mm | 5 EA |
| 2 | — | Tube, 10mm | 1 EA |
| 3 | — | Tube, 10mm | 1 EA |
| 4 | — | Stem Adapter, 1/4 BSPP, 10mm | 6 EA |
| 5 | — | Connector, 1/4 BSPP, 10mm | 2 EA |
| 6 | — | Tee, Union, 10mm | 1 EA |
| 7 | — | Elbow, Stem, 10mm | 1 EA |
| 8 | — | Plug, 10mm | 2 EA |

## 3S/3L Sub-Assembly, 230V

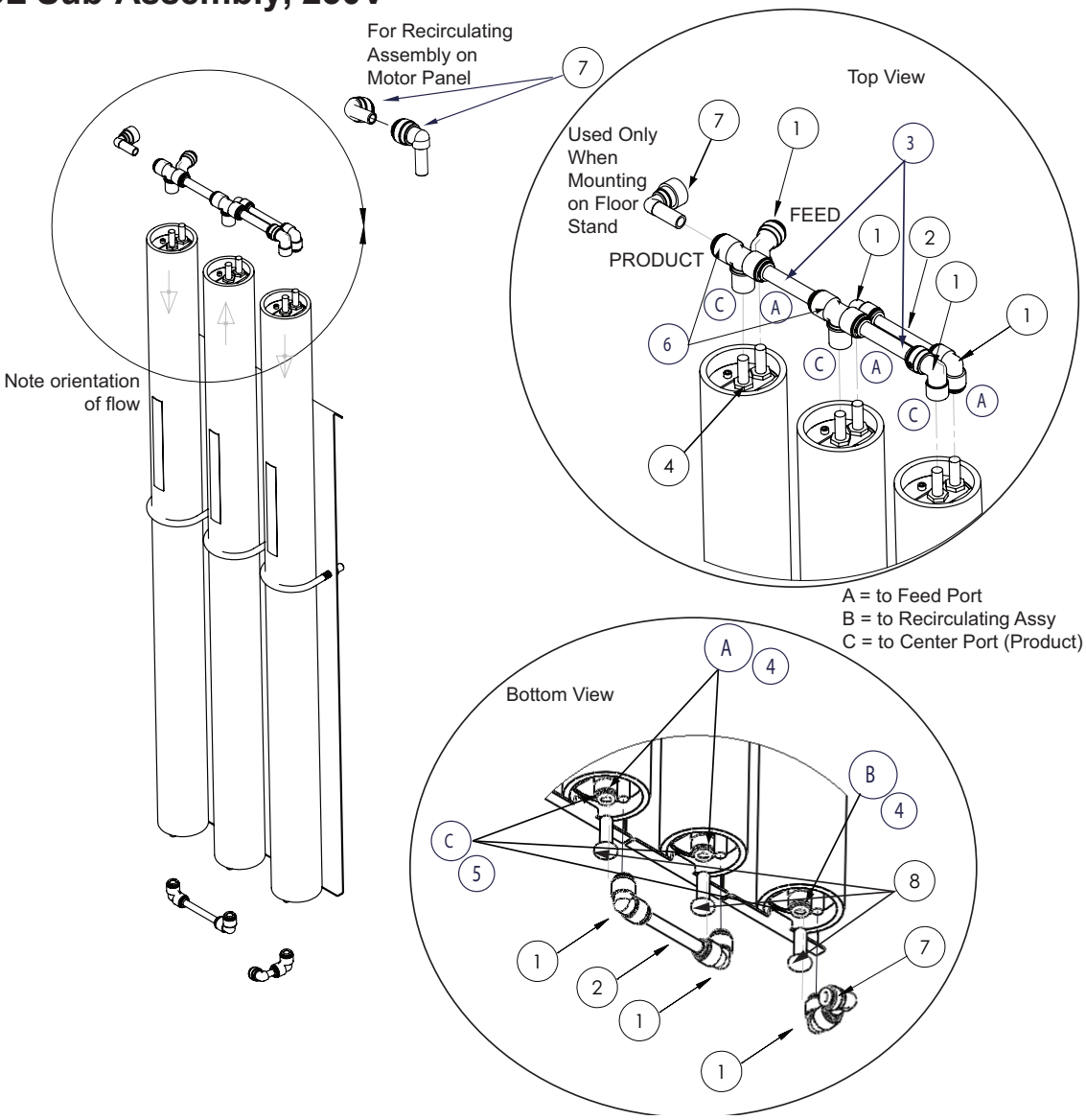



Figure 51. 3S/3L sub-assembly, 230V.

| Item | Part No. | Description | Qty |
|---|---|---|---|
| | 01025333 | Assembly, Membrane Housing, Metric, Single, 2.5"x21" | |
| | 01025334 | Assembly, Membrane Housing, Metric, Single, 2.5"x40" | |
| | 01025337 | Kit, Tube and Fittings, Metric, 3S, 3L (includes items 1–9) | |
| 1 | — | Elbow, Union, 10mm | 7 EA |
| 2 | — | Tube, 10mm | 2 EA |
| 3 | — | Tube, 10mm | 2 EA |
| 4 | — | Stem Adapter, 1/4BSPP, 10mm | 9 EA |
| 5 | — | Connector, 1/4BSPP, 10mm | 3 EA |

| Item | Part No. | Description | Qty |
|---|---|---|---|
| 6 | — | Tee, Union, 10mm | 2 EA |
| 7 | — | Elbow,10mm Stem | 4 EA |
| 8 | — | Plug, 10mm | 3 EA |

# 4L Sub-Assembly, 230V

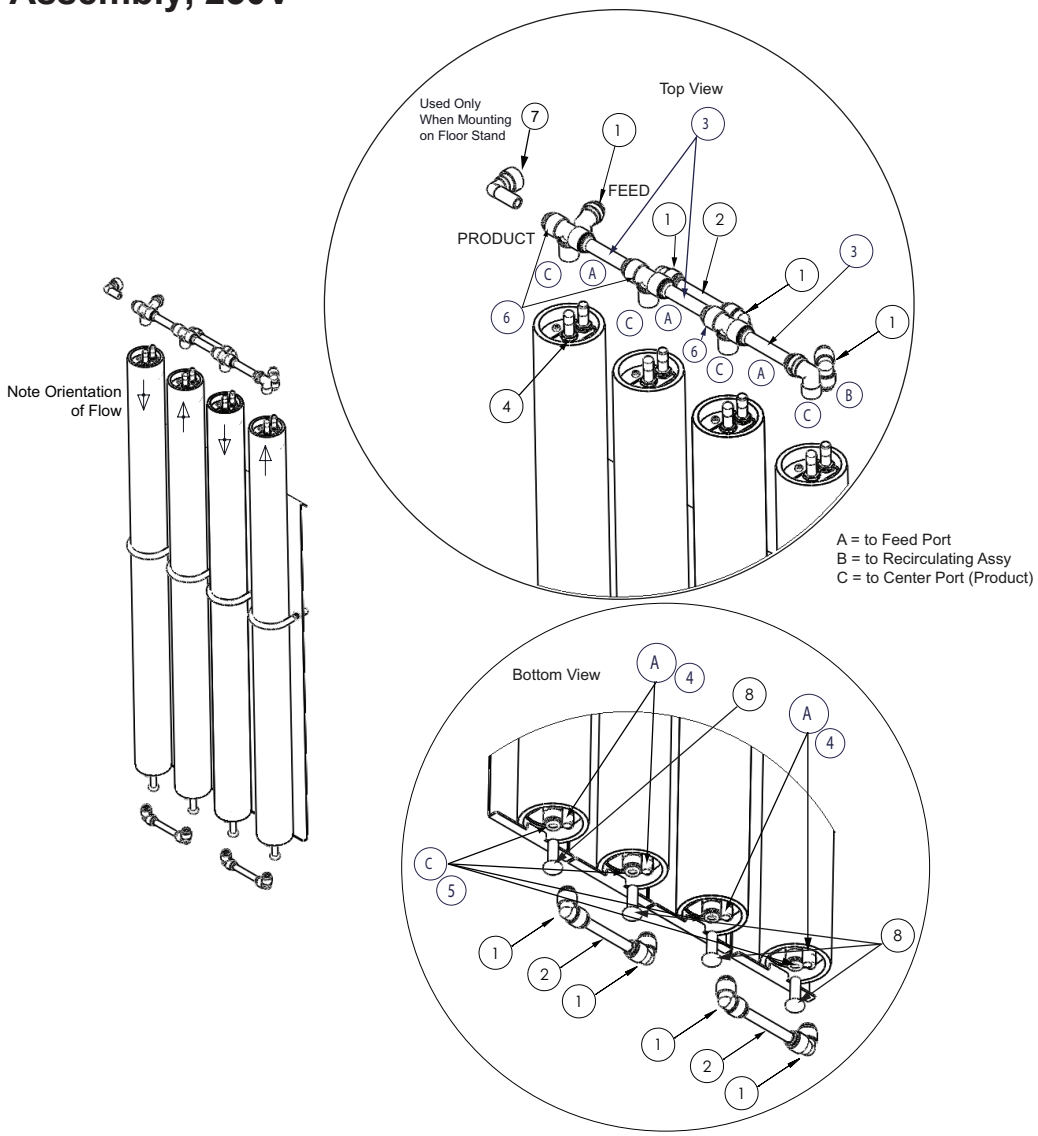



Figure 52. 4L sub-assembly, 230V.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| | 01025334 | Assembly, Membrane Housing, Metric, Single, 2.5"x40" | |
| | | Kit, Tube and Fittings (includes items 1–9) | |
| 1 | — | Elbow, Union, 10mm | 9 EA |
| 2 | — | Tube, 10mm | 3 EA |
| 3 | — | Tube, 10mm | 3 EA |
| 4 | — | Stem Adapter, 1/4BSPP, 10mm | 12 EA |
| 5 | — | Connector, 1/4BSPP, 10mm | 4 EA |
| 6 | — | Tee, Union, 10mm | 3 EA |
| 7 | — | Elbow,10mm Stem | 1 EA |
| 8 | — | Plug, 10mm | 4 EA |

## Membrane Vessel

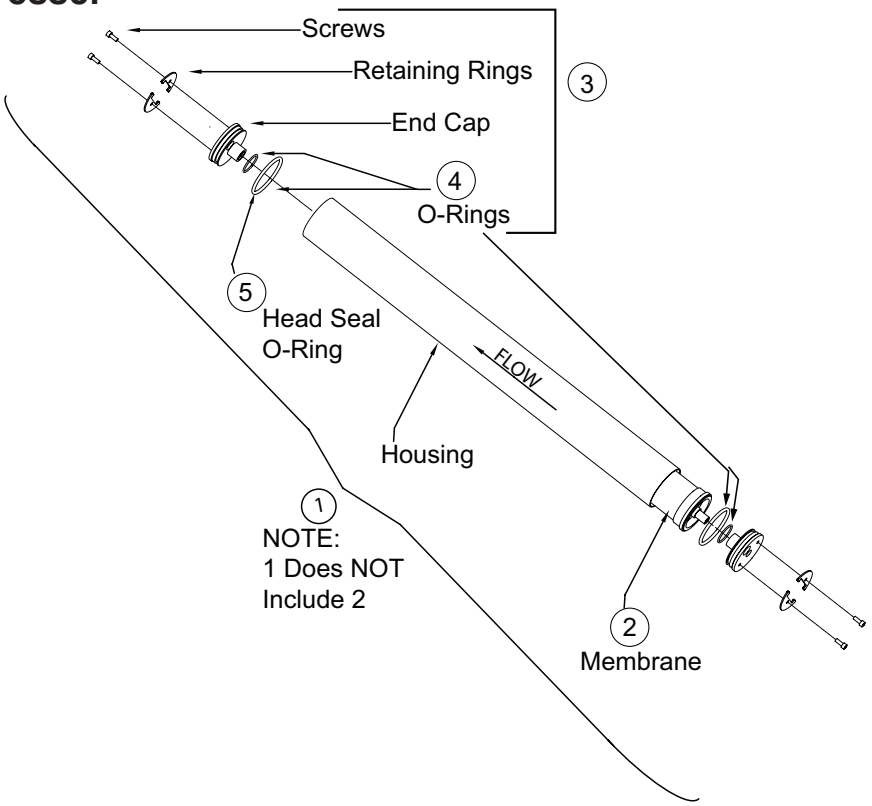



Figure 53. Membrane vessel.

| Item | Part No. | Description | 1S | 2S | 3S | 2L | 3L | 4L |
|---|---|---|---|---|---|---|---|---|
| | 01025333 | Assembly, Membrane Housing, Single, 2.5"x21" | 1 | 2 | 3 | | | |
| | 01025334 | Assembly, Membrane Housing, Single, 2.5"x40" | | | | 2 | 3 | 4 |
| 1 | 01025336 | Housing, FRP, 2.5"x21"with endcaps | 1 | 2 | 3 | | | |
| 1 | 01025335 | Housing, FRP, 2.5"x40"with endcaps | | | | 2 | 3 | 4 |
| 2 | 01024288 | RO Membrane, 2.5"x21" | 1 | 2 | 3 | | | |
| 2 | 01024289 | RO Membrane, 2.5"x40" | | | | 2 | 3 | 4 |
| 3 | 01025324 | End Plug Assy 2.5", metric | 2 | 4 | 6 | 4 | 6 | 8 |
| 4 | 01023072 | O-Ring kit 2.5" | 1 | 2 | 3 | 2 | 3 | 4 |
| 5 | P1022648 | O-Ring, Head Seal, 2.5” (20 Pack) | 2 | 4 | 6 | 4 | 6 | 8 |
| | 01023411 | Clamps, RO Housings, 2.5", metric | 1 | 2 | 3 | 2 | 3 | 4 |

[1]Housing assemblies do not include membranes.

[5]The amount listed for the units refers to the number of individual o-rings required NOT the number of packets required for an entire unit; i.e. an entire M1-2S unit requires 4 individual o-rings NOT 4 packages of o-rings.

## CP Plus Controller Assembly, 230V

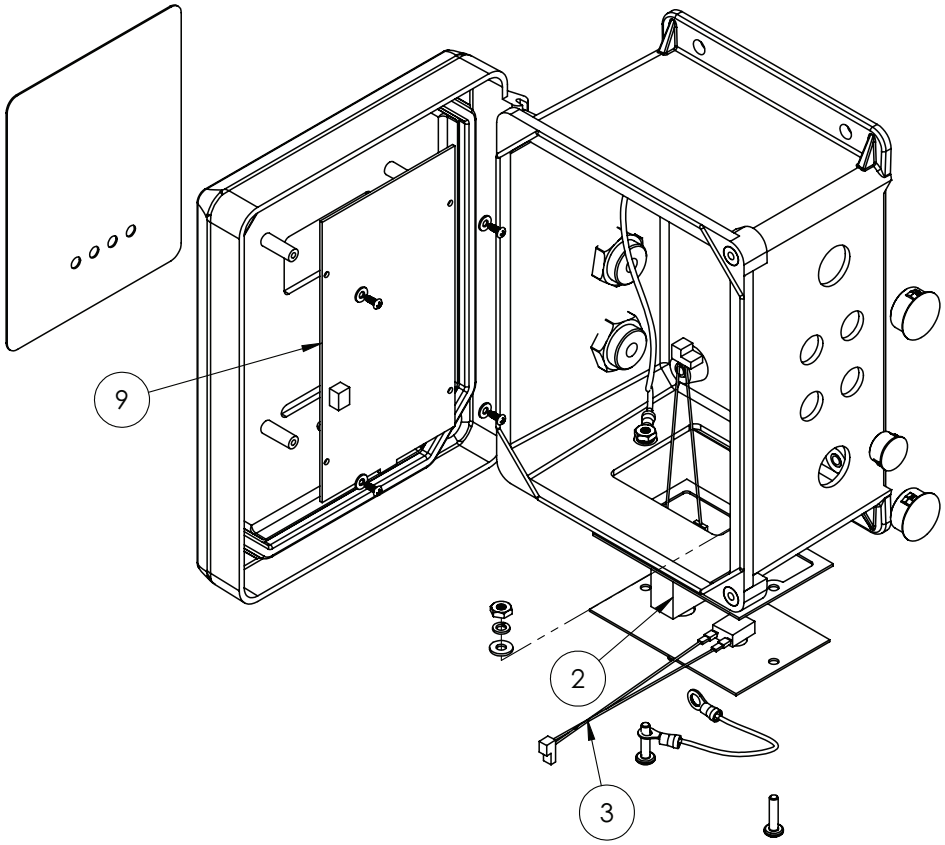



Figure 54. CP Plus Controller assembly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| — | 01024558 | Controller, CP Plus, 220V, complete | 1 |
| 2 | 01025746 | Assembly, Cable, Rocker Switch | 1 |
| 3 | 01024282 | Assembly, Cable, Push Button | 1 |
| 9 | 01024139 | Circuit Board, CP Plus Controller | 1 |

## Floor Stand

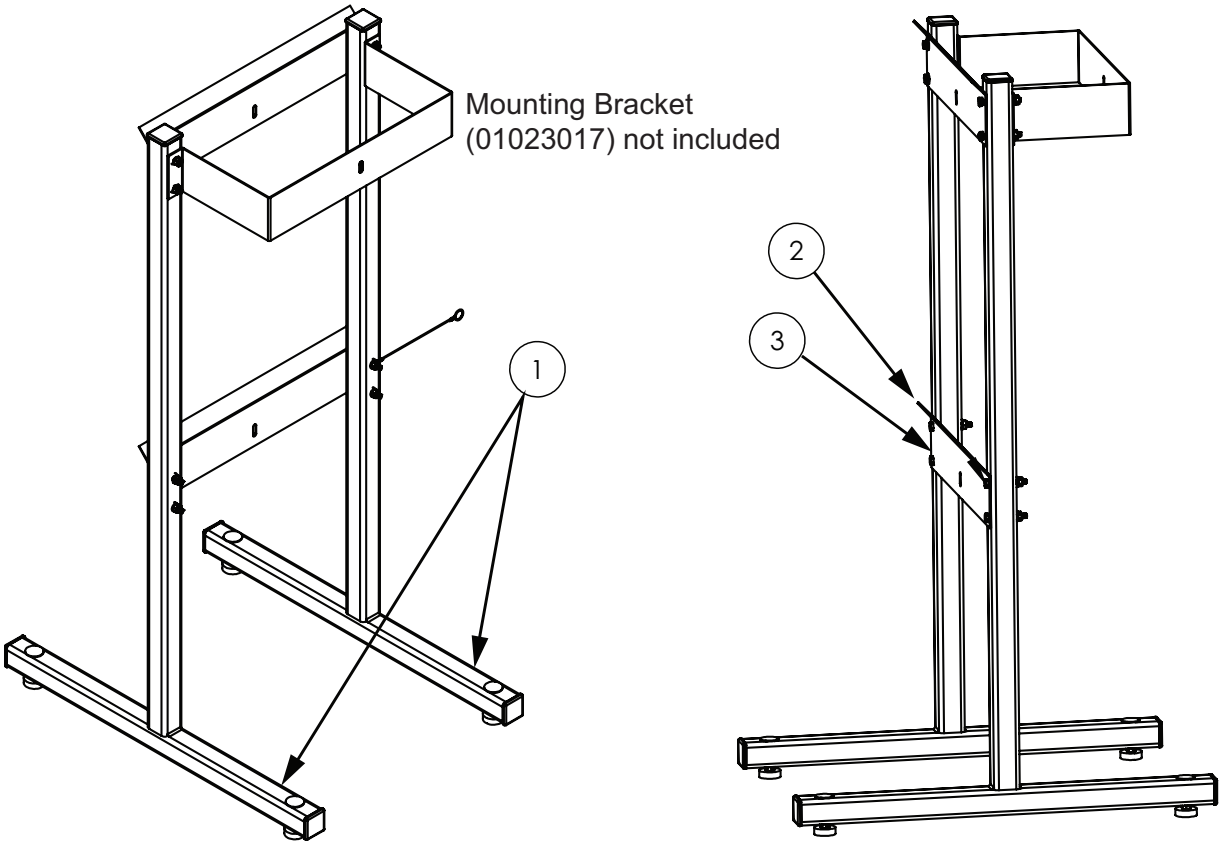



Figure 55. Floor stand assembly.

| Item | Part No. | Description | Quantity |
|---|---|---|---|
| — | 01021987 | Floor Stand Assembly, 1 Series RO | 1 |
| 1 | — | Stand, Side Rail Assembly | 2 EA |
| 2 | — | Trim, Edge, Length 17" | 1 EA |
| 3 | — | Bracket, Membrane Hanger Mount | 1 EA |

## Reverse Osmosis

In order to understand reverse osmosis, we must first define osmosis. Osmosis is the passage of a liquid through a semi-permeable membrane. A semi-permeable membrane is a membrane which allows one component of a solution to pass through it and not the others. In osmosis, there is a tendency for a liquid to go from an area of less concentration to an area of more concentration through a semi-permeable membrane. Figure 56 shows the osmotic process.

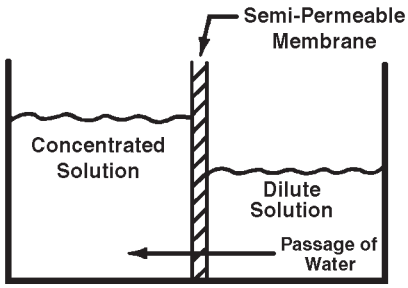



Figure 56. Osmotic process.

If sufficient pressure is applied to the concentrated solution, reverse osmosis will take place. The pressure causes a flow through the semi-permeable membrane into the dilute solution. The semi-permeable membrane acts as a barrier to most ions and many other contaminants and does not allow them to pass through into the dilute solution. When applied to water, this means that the product water has a reduced total dissolved solids content as a result of the passage of water molecules through the membrane while the mineral ions are rejected. See Figure 57.

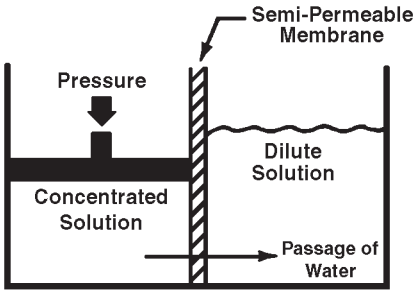



Figure 57. Effect of pressure on reverse osmosis.

## Rejection and Recovery

Feed water entering the system is split into two streams, a product stream and a concentrate stream. See Figure 58.


Figure 58. Feed water product stream and concentrate stream.

During the process of reverse osmosis, some of the water has its dissolved solids content reduced by approximately 98 percent. This high quality product water is sent to service.

The rest of the feed water contains the dissolved solids removed from the product water, in addition to the dissolved solids already present in the feed water. This concentrate water is sent to drain.

The amount of total dissolved solids rejected by the system is expressed as a percentage. A 90 percent rejection means that 90 percent of the dissolved solids have been removed from the feed water by the system. To calculate the percent rejection, use the following equation:

$$\frac{\text{(Feed TDS - Product TDS)}}{\text{(Feed TDS)}} \times 100 = \%\ \text{Rejection}$$

Where Feed TDS is the total dissolved solids content of the water going into the system, and Product TDS is the total dissolved solids content of the high quality product water. The TDS needs to be measured with a handheld meter.

For example, if the Feed TDS is 600 ppm and the Product TDS is 24 ppm,

$$\frac{600\text{-}24}{600} \times 100 = 96\%\ \text{Rejection}$$

The amount of high quality water recovered for use as a percentage of the water fed into the reverse osmosis system is called percent recovery. Use the following equation to calculate percent recovery:

$$\frac{\text{Product Water Flow Rate (PFLOW)}}{\text{Feed Water Flow Rate (FFLOW)}} \times 100 = \%\ \text{Recovery}$$

**NOTE Numbers used in these examples might not reflect those of your unit.**

**CAUTION! An understanding of rejection/recovery percentages and temperature compensation is essential for monitoring and evaluating the performance or condition of the reverse osmosis system. DO NOT operate the system before becoming familiar with these concepts.**

## Temperature Compensation

As the feed water temperature decreases so will the product water production. The rated product flow (gallons per minute, gpm) as shown for the various models on page 3 is based upon the feed water temperature equal to 77° F.

## Feed Water Limits

Before starting the installation, verify that the feed water meets the limits shown in Table 7 and that a water softener is used for pretreatment.

| Property | Minimum | Maximum |
|---|---|---|
| Turbidity (NTU) | 0.0 | 1.0 |
| pH* | 6 | 11 |
| Chlorine (ppm) | 0.0 | 0.1 |
| Total Dissolved Solids (ppm) | 50 | 2500 |
| Temperature (°F) | 33 | 100 |
| Silt Density Index | 0.0 | 5.0 |
| Iron (ppm) | 0.0 | 0.1 |

Table 7. Feed water limits.

*Short term cleaning is acceptable for pH ranges between 2.0/12.0. Additional treatment is required when chloramines are present and the pH levels exceed 9.0.

| | |
|---|---|
| **NOTICE** | **In some applications, a water softener is not required. Consult an independently operated Culligan dealer for further information on these special applications.** |

# Index

# Notes