Cat. No. 01016370
Rev. F 02/24/14
DCO # 014223

Installation, Operating and Service Instructions

CULLIGAN® CSM SERIES
WATER SOFTENER

Culligan®

©2014 Culligan International Company

Printed in USA

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.

Products manufactured and marketed by Culligan International Company (Culligan) and its affiliates are protected by patents issued or pending in the United States and other countries. Culligan reserves the right to change the specifications referred to in this literature at any time without prior notice. Culligan, Aqua-Sensor, Tripl-Hull, and SoftMinder are trademarks of Culligan International Company or its affiliates.

Culligan International Company
9399 West Higgins Road, Suite 1100
Rosemont, Illinois 60018
1-847-430-2800
www.culliganmatrixsolutions.com

Installation, Operating and Service Instructions

CULLIGAN® CSM SERIES
WATER SOFTENER

Contents

Introduction 1
Performance Specifications 2
Basic Principles 4
Flow Diagrams 5
Controller Features 10
Operation 12
Installation 13
Schematic 30
Programming 39
Final Start-up 54
Suggested Preventative Maintenance 57
Service 65
Service Parts 74
Appendix A System Data 92
Appendix B Flow Device K-Factor Data 95
Appendix C Aqua-Sensor Guidelines 96
Operation Log 97

Cat. No. 01016370

This page intentionally left blank.

Introduction

Read this Manual First

Before you operate the Culligan CSM Water Softener, read this manual to become familiar with the device and its capabilities.

The Culligan CSM Water Softeners are tested and certified by WQA against NSF/ANSI 372 for low lead requirement.

About this Manual

This manual:

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

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 sanitizing or descaling solutions to drain.

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

NOTE The Culligan CSM Water Softener 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 CSM Water Softener to your full satisfaction, carefully follow the instructions in this manual.

Performance Specifications

Culligan commercial water softeners are designed to remove hardness minerals from water. In order to function properly, some operational parameters must be followed. They include:

- An operating pressure of water or air between 30 and 100 psi. If pressure is greater, a pressure regulating valve should be installed ahead of the system. If pressure is lower, additional equipment will be required to maintain a 30 psi minimum operating pressure.
- Operating temperature between 40° and 120°F or 4.4° to 48° C.
- Clear (non-turbid) water supplies (Less than 5 NTU)

Specifications Tables for CSM Series Water Softeners

*Allow a minimum of 24" clearance above the overall system height for access into top of tank(s).

[1]Dimensions assume systems includes an optional, standard size brinemaker.

NOTE The tanks are available with Non-A.S.M.E. code steel tanks (NC) or with A.S.M.E. code steel tanks (CD).

Table 1. CSM Softener Flow Rates

Model	Exchange Capacity (kgr) Per Tank		Service Flow Rate (GPM) Per Tank		Recommended Minimum Flow Rate (GPM) Per Tank	Backwash Flow Rate (GPM) Per Tank
	Maximum (grains)	Minimum (grains)	Continuous @ 15 psi max. pressure loss	Peak @ 25 psi max. pressure loss		
150-2	150	100	67	94	3	10
210-2	210	140	76	102	4	13.5
300-2	300	200	84	112	5	20
300-3			152	210		
450-2	450	300	79	106	8	20
450-3			135	192		
600-2	600	400	94	125	10	30
600-3			183	252		
750-2	750	500	97	129	13	45
750-3			201	267		
900-2	900	600	96	127	15	45
900-3			193	259		

Table 2. CSM Softener Dimensions

Model	Resin Tank Size - Brinemaker[1] *Minimum System LxWxH Dimensions (in.)			Valve Size (in.)
	CSM Single	CSM Duplex	CSM Triplex	
150-2	20x54-24x48	20x54-24x48	20x54-24x48	2
	56x30x74	88x30x74	120x30x74	
210-2	24x54-24x48	24x54-24x48	24x54-24x48	2
	60x34x76	96x34x76	132x34x76	
300-2	30x60-30x48	30x60-30x48	30x60-30x48	2
300-3	72x41x85	114x41x85	156x41x85	3
450-2	30x60-30x48	30x60-30x48	30x60-30x48	2
450-3	72x41x85	114x41x85	30x60-30x48	3
600-2	36x60-36x48	36x60-36x48	36x60-36x48	2
600-3	87x47x91	135x47x91	183x47x91	3
750-2	42x60-42x48	42x60-42x48	42x60-42x48	2
750-3	96x54x94	150x53x94	204x53x94	3
900-2	42x60-42x48	42x60-42x48	42x60-42x48	2
900-3	96x54x94	150x53x94	204x53x94	3

Basic Principles

WHAT IS HARD WATER?

Water is said to be hard when it carries too high a concentration of calcium and magnesium. Acceptable water hardness levels will vary depending on the application.

WHY SHOULD HARDNESS BE REMOVED?

Hard water causes scaling and etching which greatly impairs the life and efficiency of boilers, air-conditioning systems, cooling towers, water heaters, refrigeration plants and other equipment using water.

HOW DOES IT WORK?

The components of dissolved minerals are called ions. They carry either a positive or negative charge. Hardness ions of minerals dissolved in water carry a positive charge. These positively charged ions (cations) are attracted to a synthetic softening material called ion exchange resin.

The heart of the softening system, therefore, is a deep bed of resin which draws calcium and magnesium ions, as well as ferrous iron, from the water as it passes through the resin bed.

CAN THE RESIN DRAW OUT HARDNESS IONS INDEFINITELY?

No. During normal operation, the resin becomes saturated with positive ions and functions less efficiently. When hardness leakage occurs, the resin should be regenerated to restore its efficiency.

HOW DO YOU REGENERATE RESIN?

You regenerate a resin bed by removing the mineral ions through a process called “ion exchange”. This regeneration process occurs in four steps and takes approximately 80 to 90 minutes. Each of the following steps are graphically depicted in "Flow Diagrams" on page 5.

BACKWASH

During the backwash step, raw water flows rapidly upward (in reverse direction to the service flow) through the resin bed to expand the bed and flush out accumulated dirt, sediment and other sources of turbidity.

BRINE DRAW

The brine solution consisting of water and salt is drawn from a brine storage tank and allowed to flow slowly down through the resin bed. The brine solution removes the calcium and magnesium ions from the resin.

This cycle can also be split into three “sub-cycles” which allow for the cost saving feature of brine reclaim.

SLOW RINSE

Brine draw is then followed by a raw water slow rinse. This rinse step will slowly remove most of the remaining brine, exchanged calcium and magnesium ions from the resin.

FAST RINSE

Slow rinse is followed by a raw water flush, a very rapid down flow of raw water which removes the last traces of brine, and settles the resin bed.

HOW OFTEN MUST YOU REGENERATE?

Frequency must be determined for each installation based on the amount of water usage, its degree of hardness and the amount of resin through which it flows. In some cases it is necessary to utilize a resin cleaner when the raw water contains iron. Contact your local Culligan dealer for more information.

HOW DO YOU CONTROL THE REGENERATION PROCESS?

The regeneration process for your commercial water softener is controlled automatically either on a predetermined time, volume, or external signal basis through the use of the Culligan MVP controller with optional AquaSensor® or flow sensor. See page 10, for further information. The regeneration process can also be initiated manually by the operator as required.

Flow Diagram - Service Step (Home Position)

1. These diagrams illustrate the simplicity of the Brunermatic valve and positive control of flow direction.
2. Note that only diaphragm valves 1 & 4 are open and flow is directed to top of resin tank, through resin bed, out bottom of tank into service line.
3. Pressure is directed to pilot valve which distributes pressure to other valves.
4. Pressure is also directed through the brine injector ports to the brining assembly in brinemaker, where proper liquid level is maintained.

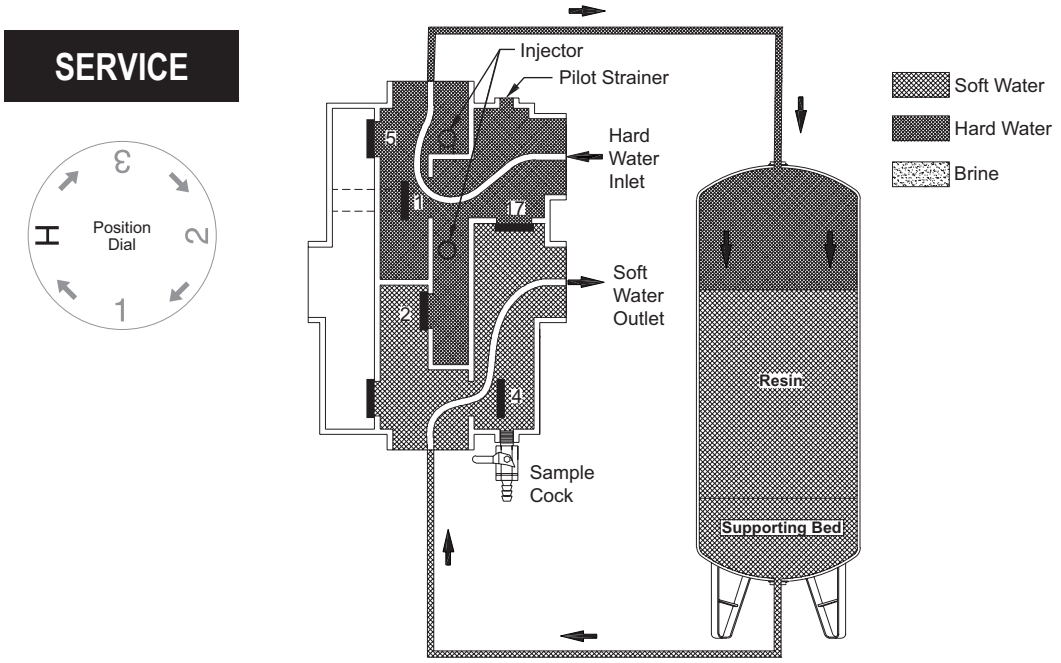


Figure 1. Service

Flow Diagram - Backwash Step (Position 1)

1. Expands and cleans the resin bed.
2. Pilot valve changes ports to direct water into bottom of resin bed and out the top of tank. Diaphragm valves 2, 5, and 17* are open.
3. Flow to drain is controlled by automatic backwash flow control assembly.
4. The backwash flow control assembly is accurate over a range of 30-100 psi and insures against resin loss.

* Single tank systems only

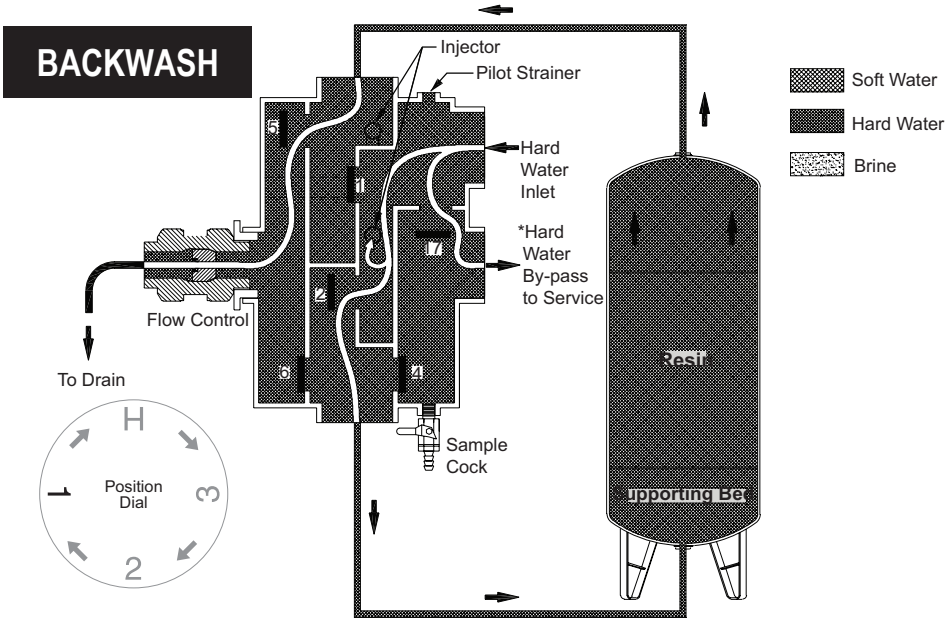


Figure 2. Backwash

Flow Diagram - Brine Draw Step (Position 2)

1. Diaphragm valve #6 opens.
2. Note that only two valves are open in this cycle (No. 6 and No. 17*).
3. Pressure directed through pilot valve holds other valves closed.
4. Flow through brine injector creates vacuum and draws brine.
5. Note brining assembly detail showing valve in open position.
6. Brine is blended with water by brine injector.
7. Brine passes into resin tank, down through the resin bed, and out to drain.
8. Brine draw rate is controlled by injector.

* Single tank systems only

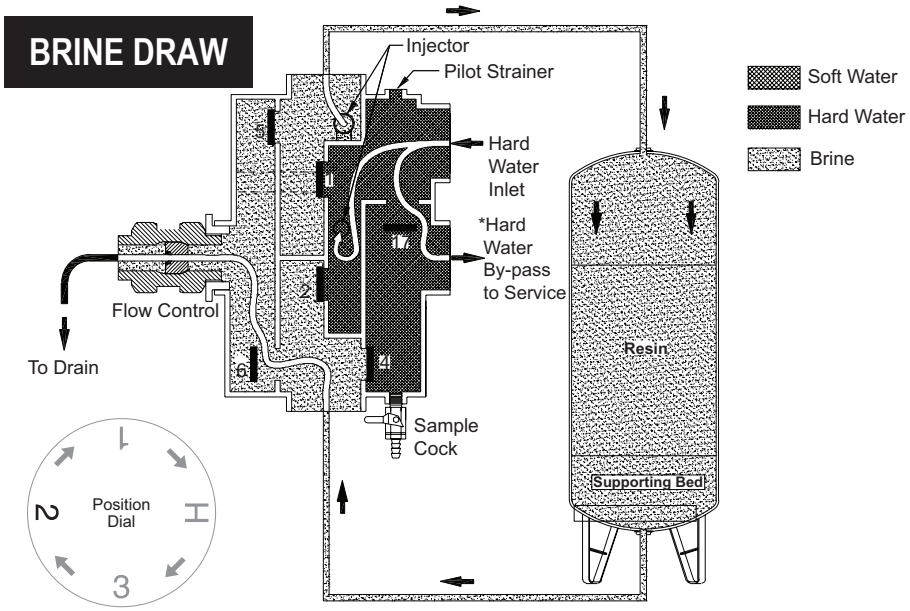


Figure 3. Brine Draw

Flow Diagram - Slow Rinse Step (Position 2)

1. A continuation of Brine Draw cycle.
2. Pilot Valve Position Dial does not move.
3. Measured amount of brine introduced to resin tank.
4. Air shut-off valve closes (see brining assembly detail). All diaphragm valves remain in same position.
5. Brine injector is controlling rinse rate at 1.2 GPM/sq. ft. of bed area.
6. Brine is slowly rinsed through resin bed to insure good contact with resin.
7. Spent brine is directed to drain.
8. By-pass remains open. (No. 17)*

* Single tank systems only

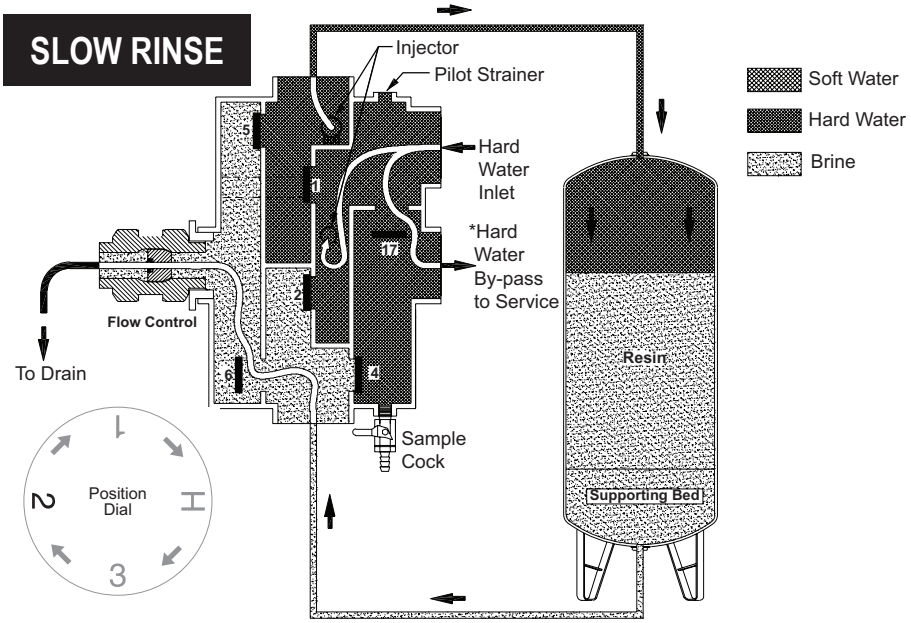


Figure 4. Slow Rinse

Flow Diagram - Flush Step (Position 3)

1. Diaphragm valves 1, 6 and 17* are open.
2. Increased flow is directed to top of resin tank, down through bed, and out to drain.
3. Settles and packs resin bed.
4. Purges resin tank of hard water.
5. nsures that all brine has been rinsed out.
6. At the end of the flush step, the unit returns to the service step (Home Position) or standby, and by-pass closes.*

NOTE *By-pass is always closed on twin units.

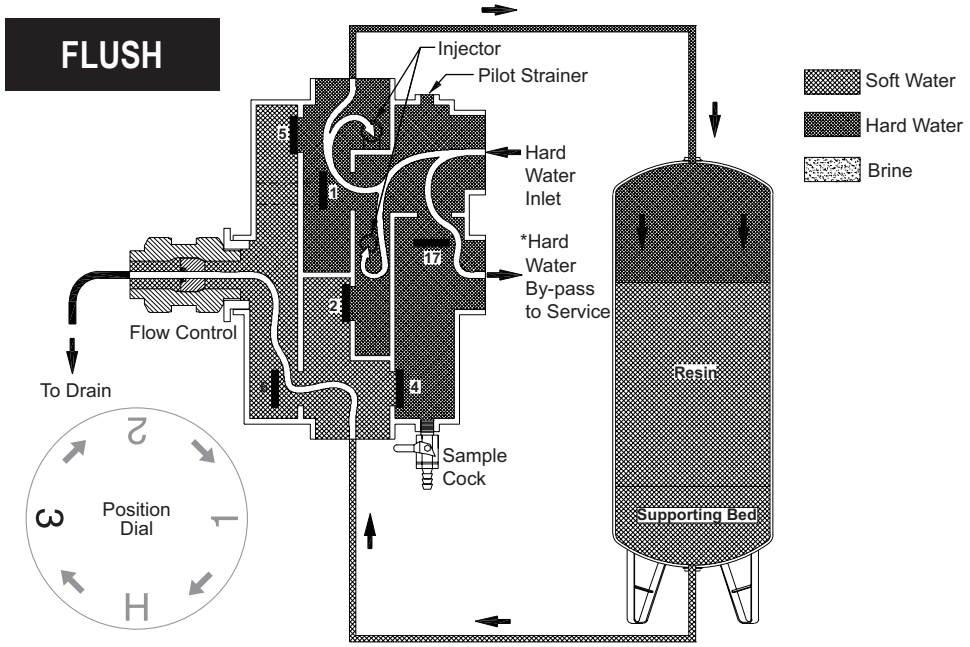


Figure 5. Flush

Controller Features

The Culligan MVP control's primary function is to initiate and control the regeneration process via methods that are most convenient and cost effective for the customer while offering many operation features and benefits.

Figure 6.

Features

Power Source

Electrical power required for the control is 24-Volt 50/60 Hz AC current. A plug-in transformer (120v/24v) is provided

Battery Backup

Battery backup is available as an optional field add-on. The battery backup will maintain the time of day for a minimum of 4 weeks using a 3.6V 1/2AA-lithium type battery as supplied by Culligan.

EEPROM

Saves programmed and statistical functions.

AC Outputs

Four AC outputs are found within the controller for the following purposes:

- Motor control
- Blocking Valve (blocks the flow of water to service)
- Two programmable outputs for various optional accessories

One-Touch Program Update

Multiple controls can have their programs updated simply through the touch of a button on the primary or "Master" control eliminating the need to the programming process for each subsequent control in a system.

Lock/Unlock

Allows the control to be easily locked out from inadvertent program changes or abuse. This feature can be disabled if desired.

Time of Day

Displays current time in either 12 hour (AM/PM) or 24 hour format.

Current Day of Week Regeneration

This feature is available for single, time clock operated systems.

Regeneration Interval

Provides an ability to initiate a time clock operated system on a number of days (range from 1 to 99 days), hours (range 1 to 24 hours), or a specific day of the week (single, time clock systems).

Progressive Flow Trip Point

Use of this patented feature allows multiple tank systems operating with water meters to be brought on-line or off-line as facility flow demands increase or decrease.

Regeneration Start Delay

Allows a user determined number of hours (up to 9) to be input into the control for the purpose of increasing the amount of time between multiple regeneration initiations.

Program Beeper

Emits an audible beep when key pads are depressed to help identify valid (short beep) or invalid (3 short beeps) key pad touches. Can be enabled or disabled as desired.

Screen Blanking

The screen can be programmed to go blank once programming is complete (After 5 minutes of no keypad activity).

Aqua-Sensor Input

The Culligan Aqua-Sensor® is a patented conductivity sensor used to efficiently initiate a regeneration sequence.

Flow Meter/Sensor Input

Various types of Hall effect flow sensors can be used to measure the amount of treated water provided and initiate a regeneration sequence.

Auxiliary Input

The auxiliary input is capable of accepting a remote signal from a dry contact device such as an operator push-button for the purpose of initiating the regeneration sequence.

Home and Position Switch Inputs

The home and position switch inputs work to automatically detect the cycle position of the valve and properly configure the circuit board for operation with either a four or five-cycle valve. The inputs also assist the operator to troubleshoot many types of service problems.

Multiple Unit Communication Input/Output (RS485)

The communication input/output feature routinely recognizes when another controller within a multiple controller system is in a regeneration sequence, prohibiting the chance of multiple units regenerating simultaneously. Additionally, the Communication input/output feature provides the means to operate the controller in the Progressive Flow mode.

Segmented Brine Draw/Rinse Cycle - Brine Reclaim Capability

This is a feature of the Culligan MVP controller program which allows the user to configure the system for brine reclaim with a minimum of additional valves and/or other types of hardware.

Operation

Modes of Operation

Time Clock

The controller will initiate a regeneration based upon a time schedule of either hours (between 1 to 24 hours), intervals of days (i.e., every 3 days) or on a specific day of week schedule (i.e., Mondays, Wednesdays and Saturdays). Because regeneration will occur at the prescribed schedule regardless of water use, this method is usually the most inefficient method of water softener operation.

Flow Meter/Sensor

When a flow meter or sensor is connected to the controller circuit board, the controller has the ability to measure the amount of water treated and initiate a regeneration sequence based upon the user determined gallon capacity of the water softening equipment. The controller can also delay the regeneration signal until a convenient time of day (known as a delayed regeneration) or act and initiate the regeneration sequence as soon as the signal is received (known as immediate regeneration).

When installing an alternating duplex system (one tank on-line, the other in standby), only one flow measuring device is required to be installed in the common outlet header of the system. Parallel systems (multiple tank systems, all on-line simultaneously) require one flow device for each mineral tank in the system.

This method is a good, cost effective means to operate a water softening system.

Progressive Flow

Used with up to six and as few as two mineral tanks in a system, the Progressive Flow mode allows more than one tank in a system to either be on-line or off-line depending upon the downstream flow demand. If flow demand is greater than the flow capability of the tank on-line, another tank can be brought on-line to help satisfy the excess demand. Once the demand has decreased, the second tank is returned to a standby mode and the system reverts to just one tank on-line providing treated water.

The progressive flow mode of operation relies on a user programmable set point or Trip Point. The Trip Point is a unit of flow (gallons or liters) on a per minute basis. Once attained the trip point will cause the second unit (in multiple resin tank system) to come on-line. Each additional resin tank in the system will subsequently be brought on-line as multiples of the trip point are attained. (Example: a 3 tank system with a trip point of 50 gpm will bring have two tanks on-line once the facility flow demands is equal to or greater than the 50 gpm trip point. Should the flow demand reach 100 gpm or more, the third tank shall be brought on-line.

Additional tanks shall be returned to stand-by once the facility flow demand is <95% of the trip point for two tank systems, <95% of 2X the trip point for triplex systems and <95% of 3X the trip point for quad systems, and remains there for 60 seconds. Up to 6 tanks can be connected for progressive flow.

Utilizing the progressive flow feature may allow the owner to use smaller water softening models, resulting in the potential for reduced capital and operation costs.

Aqua-Sensor

The Aqua-Sensor detects when the resin bed has reached its point of exhaustion and, as a result, initiate a regeneration sequence. This is the most cost-effective method of operation and may be combined with any of the operational modes previously described.

Suggested Piping Installations

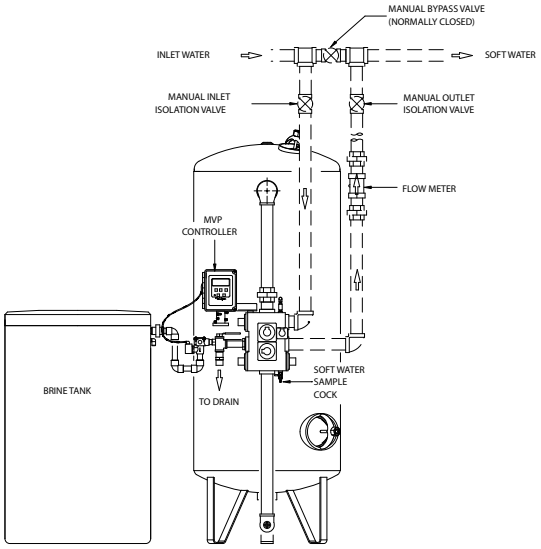


Figure 7. Single (Drawing Not to Scale)

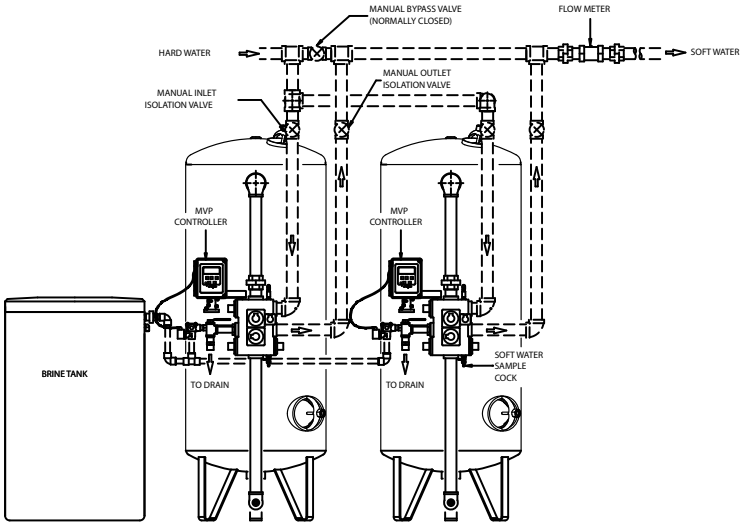


Figure 8. Duplex Alternating (Drawing Not to Scale)

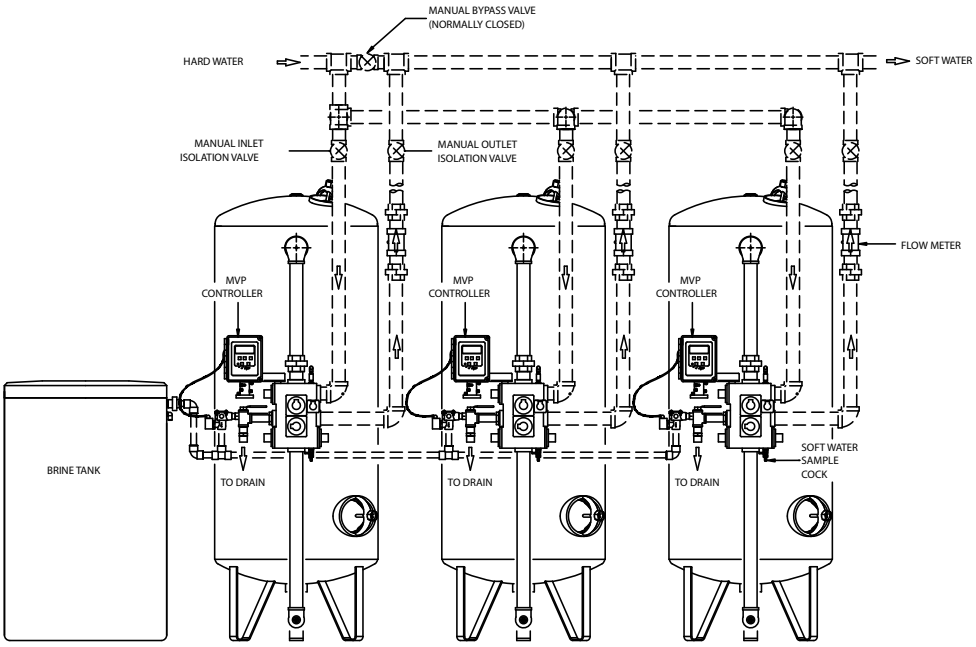


Figure 9. Triplex Parallel (Drawing Not to Scale)

NOTE	***Interconnecting pipe and fittings, bypass valve, and isolation valves are not supplied.**
NOTE	****Refer to page 17 for the proper flow device installations.**

Make certain to follow each step carefully to insure that the softener runs trouble free. Also, be sure all plumbing practices conform to local plumbing codes.

LOCATE SOFTENER

1. Check inside the tank to make sure that all of the laterals are tight. (Figure 10)

CAUTION! Do Not Proceed if any laterals are broken. Consult Culligan for assistance. If any are loose, hand tighten only. Do not use a wrench.

2. If the tank drain valve option kit was purchased, install it at this time.
3. Select a position near a floor drain that has adequate carrying capacity to handle the softener's backwash flow rate. Refer to section, Performance Specifications for specific backwash flow rate.
4. Erect the resin tank on a level firm foundation, preferably concrete. The valve and piping normally face the front for easy access.
5. Level the system.

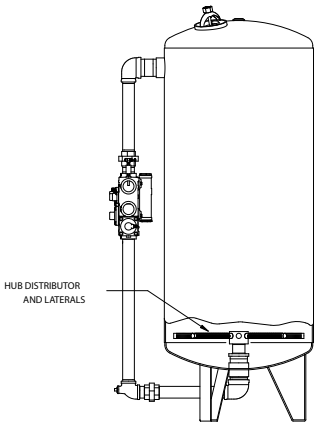


Figure 10.

INSTALL PIPING

1. Depending on the type of softener system (i.e. single, twin, etc.) and installation parameters, required pipe lengths and piping accessories will vary. Sample layout drawings (Figure 7, Figure 8, and Figure 9 on page 13) are provided to aid the installation. If the layout drawings are not sufficient for your application, consult the equipment provider for specific installation guidelines.

The use of unions on the inlet and outlet isolation valves is recommended to facilitate service of the softener unit. It is recommended that a full flow by-pass line be provided.

NOTE All pipe fittings and assemblies should follow good plumbing practices for installation.

They are:

- Check the threads and make certain that they are clean and free of foreign matter.
- Fittings must be free of cracks or chips.
- Prepare threads with either a pipe dope sealant or Teflon tape.
- Make certain that the fittings are not cross threaded during the assembly process.
- Do not over-tighten fitting or threaded pipe being inserted into a cast or forged part.

CAUTION! Never connect two dissimilar metals together when plumbing the valve to the piping system. The use of unions on copper or galvanized steel pipe followed by schedule 80 PVC or CPVC short nipples to attach the piping to the control valve is strongly recommended to reduce the potential of corrosion by galvanic reaction.

Figure 11.

2. Pipe a drain line from the backwash flow control assembly (left side of the Brunermatic valve) to the drain. Use a minimum of elbows and increase or decrease the pipe size in order to make a connection to the backwash flow control assembly. (see Figure 11)

   DO NOT install a valve in this line or use pipe smaller than listed in the Table 3:

3. Install a union near the backwash flow control assembly to facilitate service when required.

   DO NOT make a direct connection to the drain. Provide an air gap of at least four times the diameter of the drain pipe or conform to local sanitation codes and to permit the observation of the drain flow.

Table 3.

Tank Diameter	Drain Pipe Size
20”	1”
24”	1”
30”	1.25”
36”	1.25”
42”	2”

Timed Brine Refill Valve Installation

The timed brine, refill valve, (accessory kit 01019576) contains one refill valve assembly and a selection of timed refill flow control washers. To determine which washer is to be used, select the washer as indicated in the table below and install it in the position shown in Figure 12. Note that each controller will require a timed brine refill controller.

Table 4.

Model	Tank Diameter	Washer Flow Rate (GPM
150	20”	0.5
210	24”	2.0
300	30”	2.0
450	30”	2.0
600	36”	3.0
750	42”	3.0
900	42”	3.0

Installation of the Brine Refill Valve

Locate the injector feed line on the CSM softener unit. Screw the pipe nipple from the kit into the ball valve, followed by the brine refill valve. See Figure 13.

Electrical connections are described on page 32.

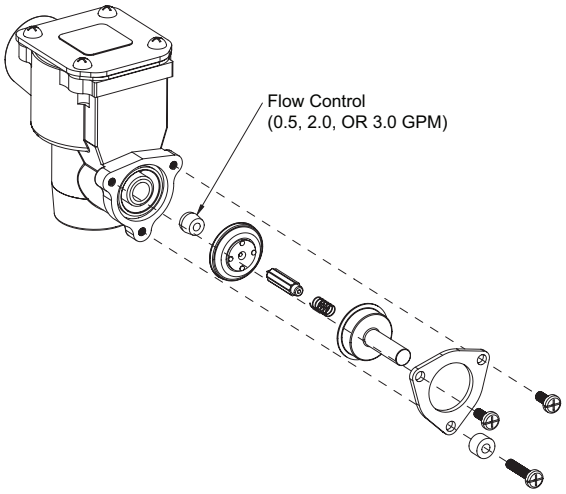


Figure 12.

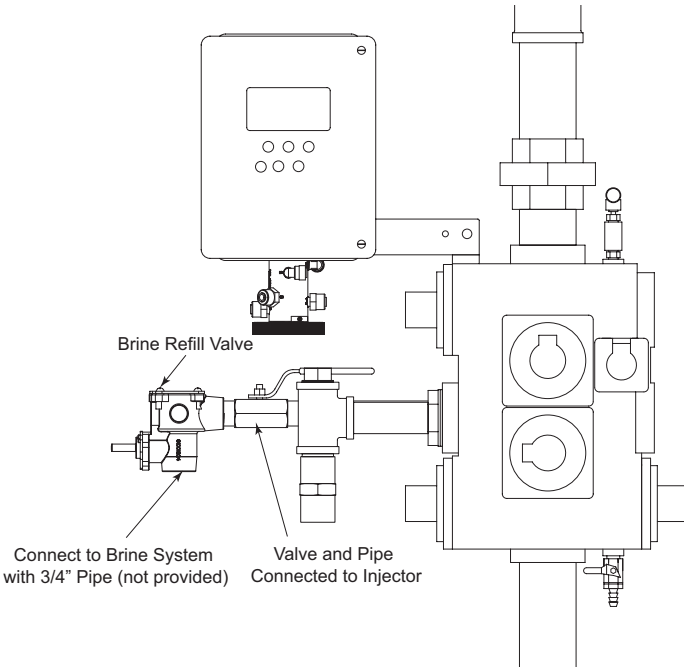


Figure 13.

Brine System Installation

NOTE	**The brine system is purchased as an optional item to allow the dealer to use various brine tank sizes to better suit the needs of the user.**

The CSM system is normally regenerated using a timed brine refill, dry or wet salt storage brine system (See page 55). To properly install the brine system, locate the brine tank assembly in a convenient location for ease of service and refill of salt into the brine tank.

The piping from the brine valve within the brine tank and the timed refill controller should be done using 3/4” pipe and fittings (not included). Plastic pipe is recommended because of its corrosion resistance and ease of installation. Refer to the layout drawings on page 13.

Brine Piping

The softeners can be used with a variety of brine systems. Please refer to Appendix A, Table 16 on page 94 for sizing parameters. Position the salt storage tank in a convenient location on a smooth surface.

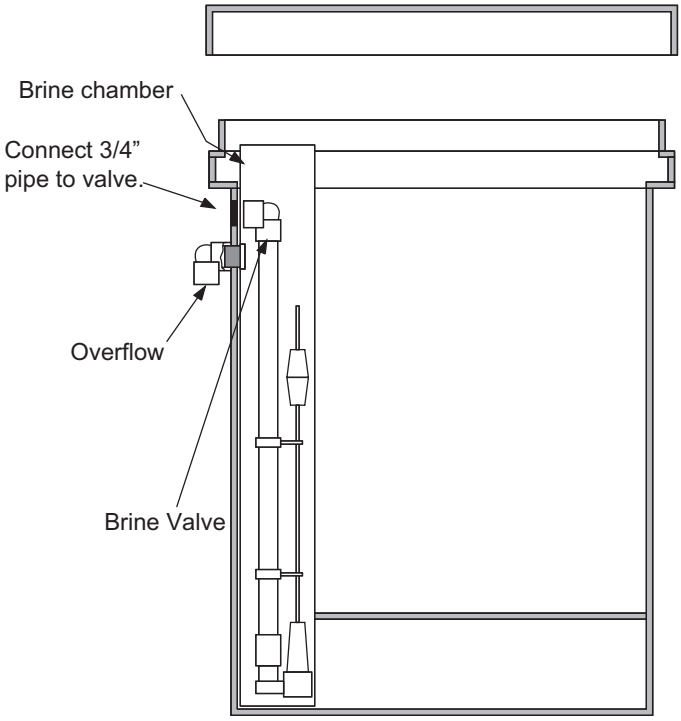


Figure 14.

Installation of the Flow Measuring Device (Option)

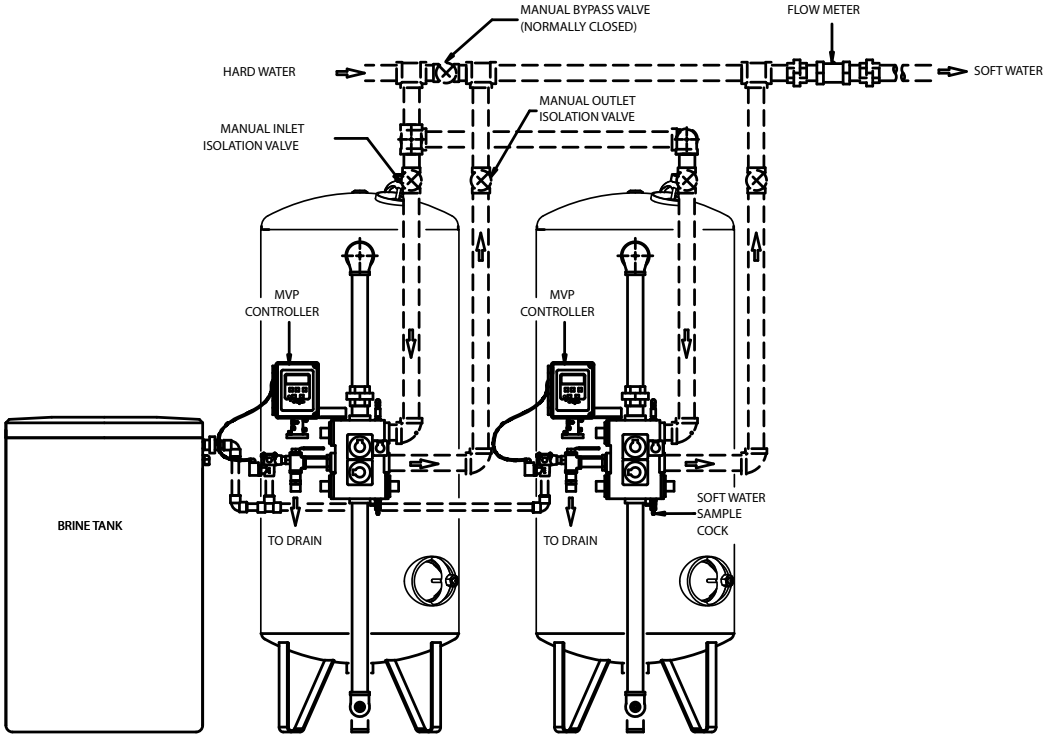


Figure 15. Duplex Alternating Layout (See page 13 for other system piping configurations.)

NOTE **Time or Aqua-Sensor initiated regenerated systems do not necessarily require the use of a flow-measuring device. Therefore your system may not utilize this portion of the manual.**

Two popular types of flow measuring devices can be used with the controller; paddlewheel flow sensors or the Culligan in-line turbine meter. Please refer to the following chart for the number of meters required for your system configuration.

Table 5.

System Configuration	Paddlewheel Flow Sensor	Turbine Meter
Single	1	1
Duplex Parallel/Progressive Flow	2	2
Duplex Alternating	1	1
Triplex Parallel/Progressive Flow	3	3

To properly measure flow accurately, the paddlewheel flow sensor(s) must be installed with a certain amount of straight pipe both before and after the paddlewheel flow sensor. The proper installation for these types of systems is shown on page 18 and page 19. Turbine meters do not have the same installation requirements and therefore may be positioned immediately following the Brunermatic valve if the system is a single or parallel configuration or at any point in the common outlet header for alternating configurations.

Location of the Paddlewheel Flow Sensor Package

The flow sensor is to be mounted on the outlet piping of each softener for single and duplex and triplex parallel systems and in the common outlet piping of duplex alternating systems.

The piping that the flow sensor is being connected to should be the same diameter as the mounting fitting. The flow sensor must also be located in a free-flowing straight run of pipe. This straight run includes the upstream piping and downstream piping of the flow sensor.

The proper length of upstream and downstream straight piping is a minimum of 10 pipe diameters of free-flowing straight pipe upstream of the flow sensor and 5 pipe diameters of free-flowing straight pipe downstream.

EXAMPLE: A flow sensor that is installed on a length of 2” diameter straight pipe (see Figure 17).

Major obstructions will require considerably longer straight runs of upstream piping, due to the turbulence created by their presence.

EXAMPLE: A flow sensor on a length of 2” diameter pipe that has a 90° elbow upstream from the desired location (see Figure 18).

The examples below are intended as guide lines for the proper length of straight pipe required both upstream and downstream of the flow sensor installation point.

These recommendations are minimum requirements (see Figure 16).

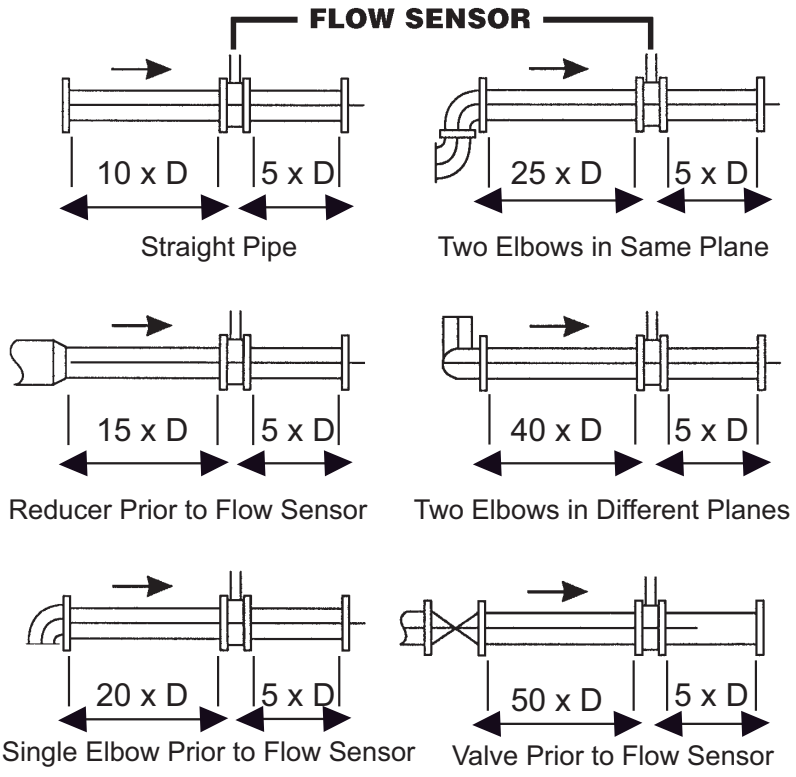


Figure 16.

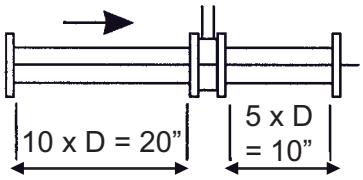


Figure 17. Example: D = 2”

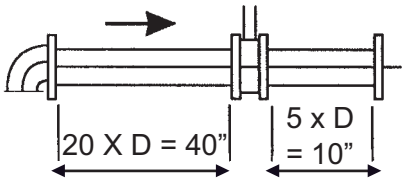


Figure 18. Example: D = 2”

Position of the Flow Sensor Package

The flow sensor position is also important to the accuracy of the output signal. When installing the flow sensor in a horizontal pipe, the optimum position of the flow sensor in the pipe is at 0 or 180 degrees, assuming the pipe is always full of liquid and contains no suspended solids. Air pockets or sediment in the pipe will disturb the rotation of the flow sensor, causing inaccuracy in the output signal.

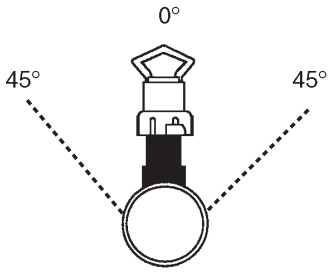


Figure 19.

Because of certain installation requirements due to space restrictions, it may be necessary to tilt the flow sensor slightly, (max. 45° angle). Excessive angles will cause bearing drag on the flow sensor rotor at lower flow rates (see Figure 19).

On a vertical pipe run, it is preferable to locate the flow sensor where the flow is upward. But, if downward flow is necessary, the system must be designed to prevent air/water vapor pockets from developing in the pipe which will affect the performance of the flow sensor.

The maximum distance that the flow sensor can be located from the MVP controller is 500'. Paddlewheel type flow sensors should be supported in the piping as required by local plumbing codes; typically 18" before and after each joint (in a horizontal run of pipe).

Signet Flow Sensor Installation

NOTE	**Signet flow sensors must be installed as indicated. Failure to follow these instructions may result in improper operation. Please refer to any supplemental instructions accompanying the flow sensor for additional information.**

1. Once you have located the flow sensor package and confirmed it is the correct size and material type for the equipment at the site, proceed with installing the flow sensor mounting package.
2. You should follow good plumbing practices for all the installations. They are:
   - Check the threads and make certain that they are clean and free of foreign matter.
   - Fittings must be free of cracks and chips.
   - Prepare threads with either a pipe sealant or Teflon tape.
   - Make certain that the fittings are not cross threaded during the assembly process.
   - Do not over-tighten the fittings or the threaded pipe that is being threaded into a casting or forging.
   - Follow proper soldering processes as outlined in the plumbing code.
3. For each of the different types of installations, certain requirements must be followed to assure a proper installation.
   a. Copper sweat tee - for use on copper tubing sizes. 1" 1-1/4", 1-1/2" and 2". With the exception of the 1" copper sweat tee, all of the copper tees include a plastic insert which the flow sensor will attach to. This insert should be removed in order to properly solder the tee into the correct position. A tag is attached to the fitting to indicate the proper "H" dimension of the plastic insert when reassembling. This dimension is critical to the proper calibration of the flow sensor. Note the location of the notch to the pipe (see Figure 20 and Figure 21).

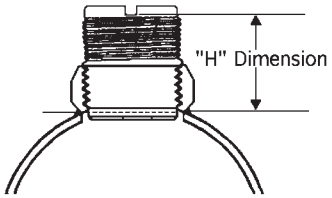


Figure 20.

   b. Threaded galvanized tee - for use on galvanized/iron pipe sizes 1", 1-1/4", 1-1/2" and 2". All tees are threaded with NPT threads and have a plastic insert to attach flow sensor. This insert is factory installed and should not be removed. It is necessary for determining the proper location for the flow sensor wheel when inserted into the fitting. Again this insert should not be removed from the tee assembly (see Figure 21).

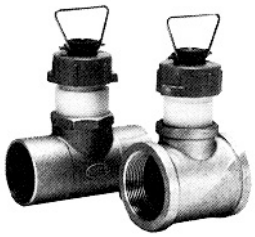


Figure 21.

c. Copper brazolet - for use on copper pipe sizes 2-1/2” and 3”. The copper brazolet should be installed by a certified welder. A hole will need to be drilled in the pipe at the desired location as described in this section. The hole size should be 1-7/16” and must be completely deburred and free of any projections. Prior to welding the brazolet, the plastic insert must be removed. A special tool is provided with each brazolet assembly for the removal and the replacement of the plastic insert. When the plastic insert is replaced (after the welding is complete), Teflon tape should be used on the threads. There is a special card that is attached to the insert, this card indicates the proper “H” dimension for the insert depth when you reassemble the insert back into the brazolet. This dimension is critical to the proper calibration of the flow sensor. Note the location of the notch to the pipe (see Figure 22).

Figure 22.

d. Iron saddle - for use on steel pipe 2”, 2-1/2” and 3”. A 1-7/16” hole will need to be drilled in the pipe at the desired location as described in this section. The assembly comes complete with a plastic insert which is factory installed and should not be removed. The assembly also comes with a rubber washer which must be installed between the clamp and pipe. Coat the rubber washer with a silicon lubricant and place it on the inside of the saddle and form it around the raised groove. With the flat side of the rubber washer facing the pipe surface, insert the plastic insert and saddle to the drilled hole. Using the saddle clamps, tighten the saddle into place.

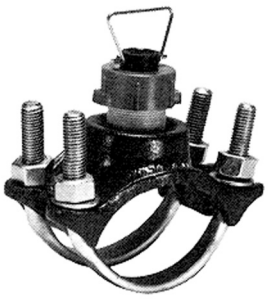


Figure 23.

e. PVC socket weld tee - for use on sizes 1”, 1-1/4”, 1-1/2”, 2”, 2-1/2”, 3” and 4” schedule 80 PVC pipe. All tees are socket welded with a NPT threaded port containing a plastic insert to attach the flow sensor. This insert is factory installed and should not be removed. It is necessary in determining the proper location for the flow sensor wheel when inserted into the fitting. Again, this insert should not be removed from the tee assembly. Once the flow sensor installation is completed, locate the warning decal attached to the flow sensor. Apply the decal to a visible location near the flow sensor in the event service is required.

CAUTION! Be certain there is no pressure in pipe BEFORE removing or installing flow sensor.

Turbine Meter Installation

Turbine meters are less sensitive to position. They can be mounted horizontally or vertically but straight runs before and after the meter are best for accuracy. If mounted vertically, the water flow must be upward. Turbine meters however must be supported as required by local plumbing codes; typically 18” before and after each joint (in a horizontal run of pipe).

Figure 24.

Figure 25.

Installing the Gravel Support Bed

1. Verify that the correct type and amount of gravel for the system is on site. The proper amount of gravel is indicated on the following table. If the correct type and amount of gravel is not on site, DO NOT load the tank. Contact the equipment provider for assistance.

Table 6.

Model	Tank Diameter	Drain Line	Non-ASME Code Steel Tanks 1/8" x 1/16" Gravel (lbs)	ASME Code Steel Tanks 1/8" x 1/16" Gravel (lbs)	Resin	
					Resin Qty ($Ft.^3$)	Freeboard "M"
150	20"	1"	100	100	5	25.5"
210	24"	1"	200	200	7	24.0"
300	30"	1-1/4"	300	300	10	26.5"
450	30"	1-1/4"	300	300	15	21.0"
600	36"	1-1/4"	400	500	20	24.5"
750	42"	2"	600	800	25	26.25"
900	42"	2"	600	800	30	20.5"

2. Make sure all manual valves are closed. Remove the hand-hole or manhole cover located in the top of the tank. Visually inspect the distributor system (laterals and plastic distributors) in the bottom of the tank.

3. Make sure all manual valves are closed. To prevent damage to the distribution system, add approximately 2 feet of water to the resin tank with a hose (Figure 28). It is not recommended that the resin tank be entered to receive and load the gravel. With water in the resin tank, carefully pour the gravel slowly into the resin tank, leveling as loading progresses. On resin tanks with only a hand-hole in the top, it is recommended that a funnel be used to load the gravel into the resin tank to help prevent spillage. When properly loaded, the gravel should cover the distributor system in the bottom of the tank. If it does not, contact the equipment provider before proceeding to Step 4.

CAUTION! Should it be necessary to enter the resin tank, it is recommended that a respirator be worn by any person entering the tank to load gravel. Wet the bags of gravel to reduce the amount of dust caused by the loading procedure.

4. Level the Gravel Support Bed. An easy way to determine the uniformity of the gravel support bed is to add water to the surface of the gravel. It may be necessary to add or remove water to insure that the water level is at or near the same height of the gravel level. Make certain that no foreign materials are left in the tank. This includes the bags that the gravel is shipped in.

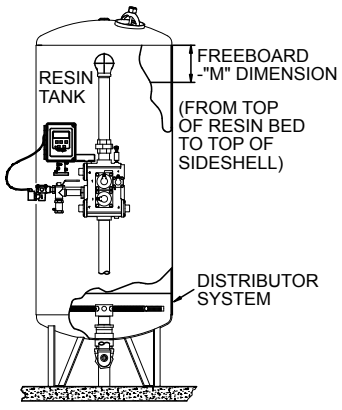


Figure 26.

Figure 27.

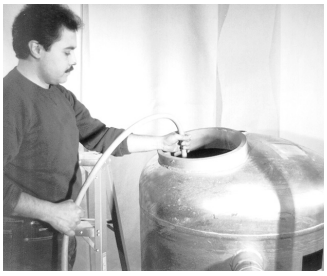


Figure 28.

Aqua-Sensor Installation (Option)

NOTE **The Aqua-Sensor (Figure 30) is purchased as an optional item. This device detects and initializes a regeneration based upon changes in the electrical conductivity of the resin bed. It shall also similarly detect reverse changes during the regeneration process so as to allow for optimum slow rinse times and potential water saving operation.**

WARNING! **For best results do not subject the Aqua-Sensor to conditions outside the operating parameters of the water softening system. (See page 2).**

The Aqua-Sensor device is installed through the top of the tank, usually through a plug found in the top access opening (and using the bushing provided with each Aqua-Sensor option kit). Because of it's unique capabilities, the Aqua-Sensor can be positioned near the upper portion of the resin bed (providing greater reserve capacities normally required for delayed regeneration purposes) , near the bottom of the resin bed (most common for immediate regeneration) or anywhere in between.

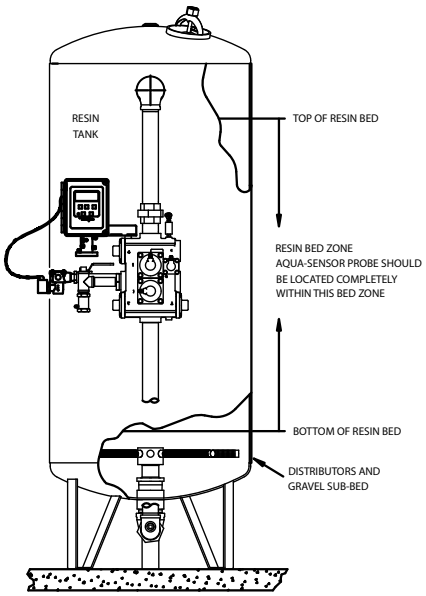


Figure 29.

To install the Aqua-Sensor simply use the outside of the softener tank as a template for determining the length of the Aqua-Sensor cable to be placed inside the tank. If greater system capacity is required before a regeneration signal is sent to the controller then the Aqua-Sensor should be positioned just above the gravel sub-bed inside the softener tank. Measure sufficient cable to allow the Aqua-Sensor to hang in place within the resin bed but not so much that the probe would be in contact with the gravel sub-bed and potentially be damaged during the regeneration process.

Appendix C on page 96 provides detailed information about Aqua-Sensor Application Guidelines, resin bed depths, and the estimated capacity per inch of resin bed depth at varying salt dosages.

NOTE **During the backwash cycle the resin bed will be agitated which will allow the probe to settle to a level equal to the overall length of the probe and cable. DO NOT leave more cable than necessary inside the tank. Any excess cable should be coiled near the controller, outside of the resin tank.**

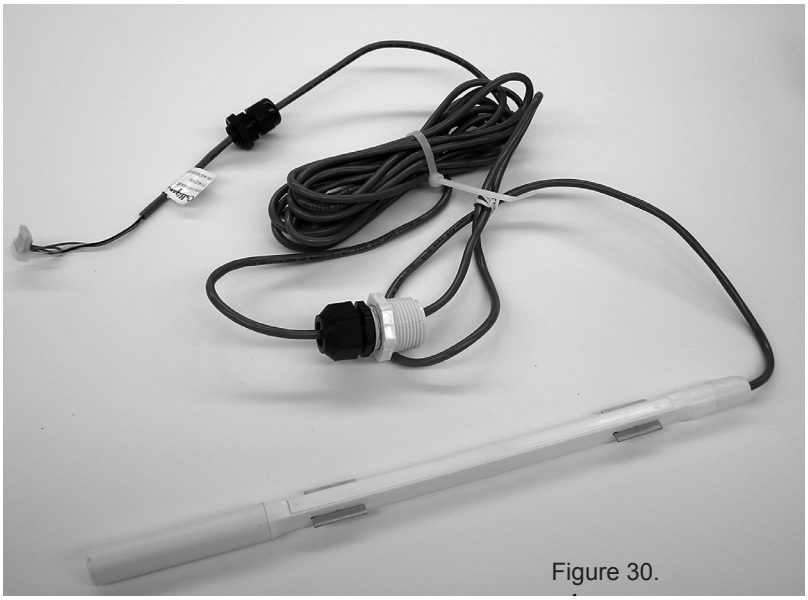


Figure 30.

Installing Resin

Figure 31.

1. Before adding the resin, verify that the correct type and amount of resin for the softener you are installing is on site. Again, refer to the table on the previous page for the correct resin quantity. If the correct type and amount of resin is not on site, contact the equipment provider.
2. Slowly pour in the correct amount of resin (see Figure 31). It is recommended that a funnel be used on those units with hand-hole covers, when loading resin into the resin tank. Make certain that no foreign material is left in the resin tank.
3. Use a tape measure or measuring stick to verify the “M” or freeboard distance after the resin is installed. (See Figure 26 and Table 6 on page 21)
4. Do not install the hand-hole or manhole cover on the resin tank at this time.

Controller Mounting

The MVP controller is shipped in its own box, complete with transformer assembly, tubing assembly, mounting bracket, and hardware.

1. Remove the controller mounting bracket from the shipping carton. If the conditioning cartridge option kit was ordered, follow the instructions included with the kit to install the cartridge assembly on the mounting bracket.
2. Install the controller to the mounting bracket using the supplied hardware. Refer to Figure 32.
3. Install the bracket mounted controller to the Brunermatic valve using the supplied hardware.
4. Retain the other items in the shipping carton for future use.

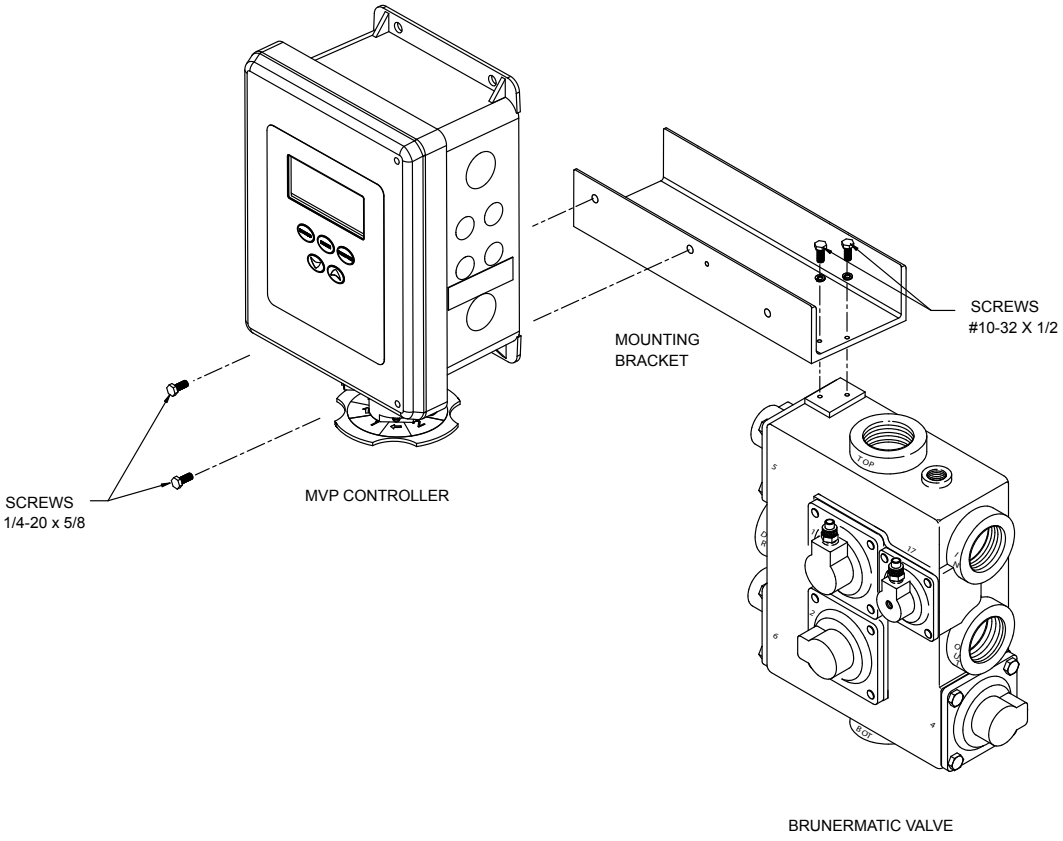


Figure 32.

Tubing Installation

The tubing assembly is shipped in the same carton as the controller. The tubing is suppled in lengths pre-cut to connect up to a 3" Brunermatic valve.

1. Using the tubing supplied, interconnect the controller, Brunermatic valve, brine line diaphragm valve (multiple units), and any accessory kits ordered with the system. Refer to Figure 35, Figure 36, and Figure 38 for system tubing diagrams.
2. For ease of installation, some tube fittings on the system are the push-in type. Tubing is simply inserted into the fitting collet to make a secure, leak free connection. Refer to Figure 33 and Figure 34 for details on proper connection and disconnection.

CONNECTION

To make a connection, simply push the tubing in by hand.

NOTE **the fitting will grip before it seals. Make certain the tubing is fully pushed into the tube stop.**

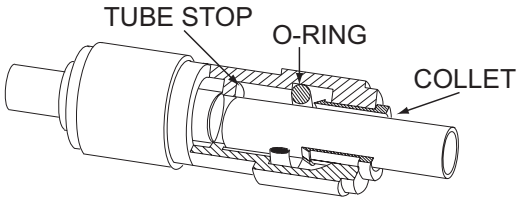


Figure 33.

DISCONNECTION

To disconnect tubing, push in the collet against the face of the fitting. With the collet held against the face of the fitting, the tubing can be removed.

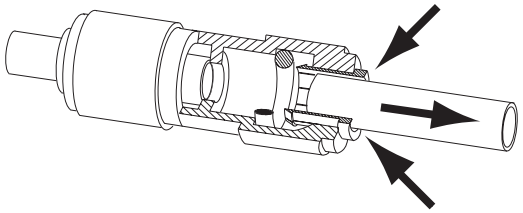
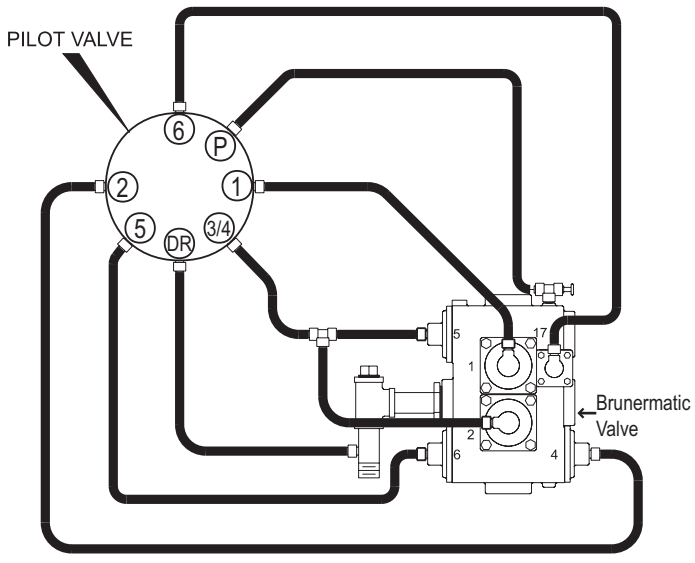


Figure 34.

CAUTION! The port numbers on the Brunermatic valve may not coincide with the ports on the MVP pilot valve. Refer to the port numbering chart for cross-reference information.



SINGLE SYSTEM
W/ BYPASS

Figure 35.

Table 7. Cross Reference Port Chart

Pilot Valve	Brunermatic Valve
1	1
3	2
2	4
4	5
5	6
6	17

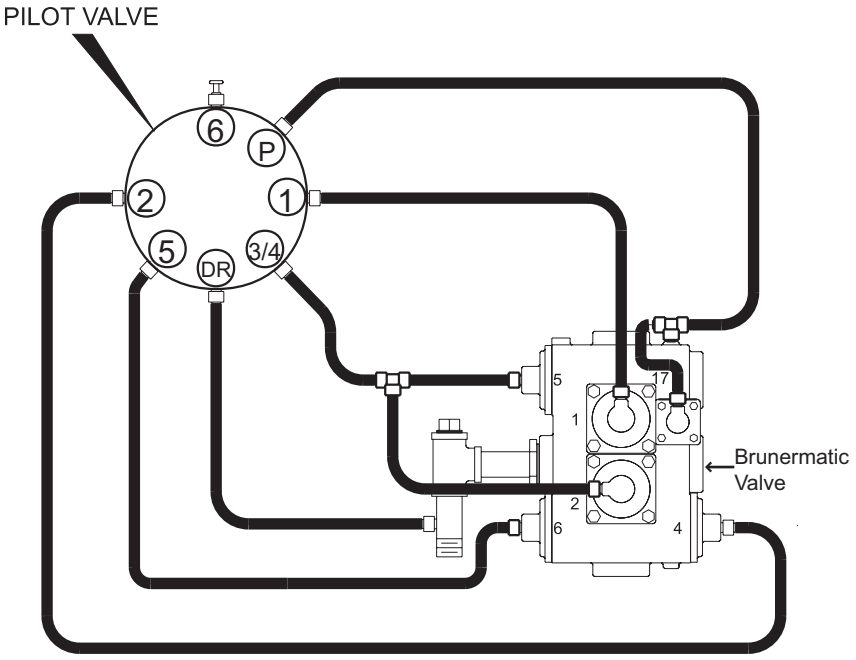


Figure 36. PARALLEL (Non-Progressive Flow) SYSTEM W/PLUGGED BYPASS

Installation and Operation of the Blocking Solenoid Valve FOR Multi-Tank Alternating Operation

NOTE **Proceed to page 27 if your system is a single tank configuration. The solenoid valve is only required for multiple unit alternating or progressive flow systems.**

The purpose of the solenoid valve is to assist the controller in providing automatic alternation of multiple tank systems. Each Brunermatic multiport valve in the system will require its own solenoid valve. These solenoids are tubed as follows:

- From solenoid valve port number 1 to Brunermatic multiport valve port number 4.
- From solenoid valve port number 2, tee into the tubing that attaches to the “IN” port on the pilot valve body.
- From solenoid valve port number 3 to port number 2 on the pilot valve body. The detailed tubing schematic is shown below (Figure 37).
- Wiring is detailed on page 34.

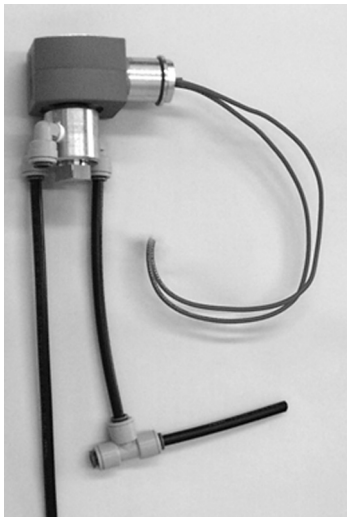


Figure 37. Solenoid Valve Kit

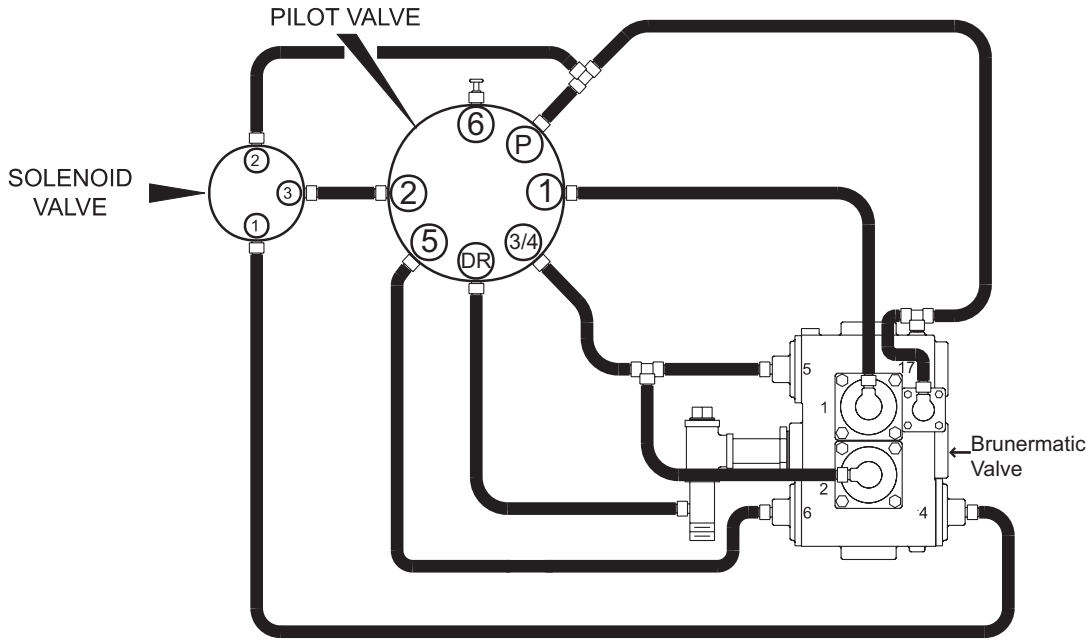


Figure 38. ALTERNATING/PROGRESSIVE FLOW PARALLEL SYSTEM W/PLUGGED BYPASS

Sequence of Operation

When a softener is in standby or a regeneration cycle, the MVP controller sends a signal to the P7 SOL-VIV terminal of the primary circuit board, activating the solenoid valve. The orange LED will be on at this time. When the solenoid valve is electrically activated, ports #1 and #2 of the solenoid (Figure 39) become common. This will direct pressure from the constant IN pressure supply to Brunermatic diaphragm valve #4, which prohibits the flow of water through the outlet of the Brunermatic valve.

Once the controller signals the unit to return to a Service status, the signal from P7Solvlv is removed and the solenoid valve is deactivated. When the solenoid valve is electrically deactivated, ports #1 and #3 of the solenoid become common. The orange LED will not be on at this time. This will vent pressure, from Brunermatic diaphragm valve to port #4 on the pilot valve body and then to drain. Brunermatic valve #4 opens which allows softened water to flow through the outlet of the Brunermatic valve.

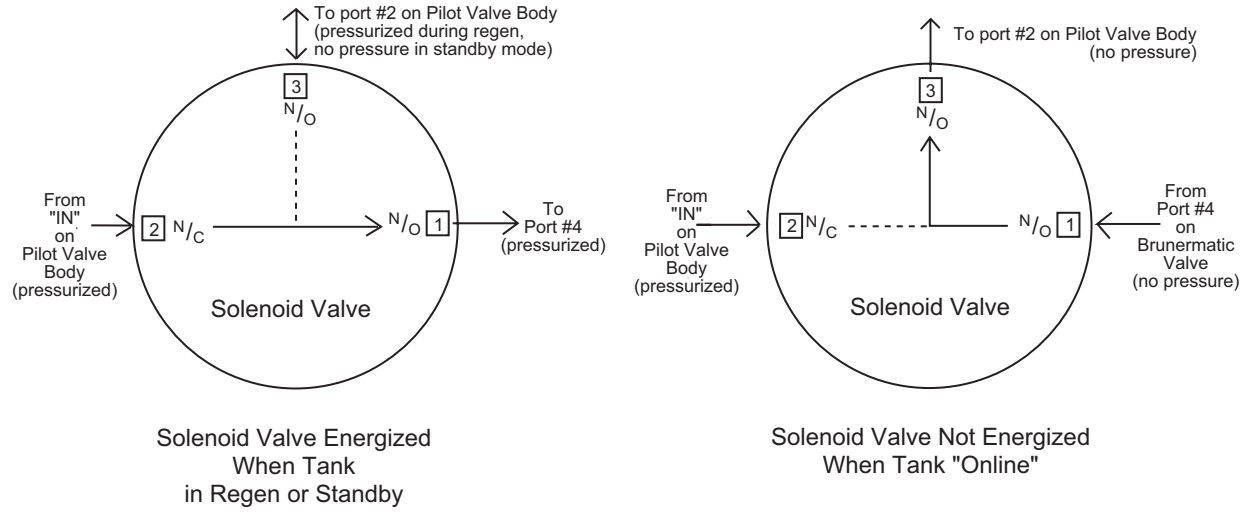


Figure 39.

Electrical Installation

CAUTION! Observe the precautions listed below before electrical installation of your MVP controller. Failure to do so may cause permanent damage to the controller.

- Follow the local electrical code requirements.
- Be sure electrical power is off and disconnected at the source before completing any wiring/cabling connections.
- Provide a dedicated 120-volt circuit for the MVP system to ensure maximum electrical protection.
- DO NOT include the MVP wiring cables in any conduit or raceway containing other 120-volt or higher circuits.
- Maintain a distance of at least 10 feet between the MVP controller and any electrical distribution panels, raceways carrying 300 volts or more, and electrical motors of 1 horsepower or more.
- Use the cabling provided. Failure to do so may effect performance of the MVP controller adversely.

NOTE One transformer is required for each controller in the system. Do not attempt to operate multiple controllers without a dedicated transformer for each or your system will experience operational difficulties.

Wiring Procedures and Diagrams

Preperation:

1. Loosen the two screws securing the controller access cover (Figure 40) on each controller provided.
2. Using a small screwdriver, loosen all the terminal strip binding screws on the main circuit board that do not contain wires by turning counterclockwise until the wire clamp has been fully opened (see Figure 41).

Figure 40.

Figure 41.

Cable Routing

All input and output connections to the circuit board are 24 volt or less. Non-shielded type cable is provided for installation. It is imperative that the correct type of cable is used to reduce the possibility of radiated electrical noise from entering the wiring. This precaution will insure reliable operation of the controller.

Although the cables do not have to be run in conduit, it is necessary that long runs of cable be supported or protected by strapping them to the equipment piping. If conduit will be used to route the shielded cables, three factors must be considered:

- DO NOT share the same conduit or raceway with 120 volt or higher circuits.
- Keep cables at least 6 inches away from 120 volt or higher electrical circuits.
- GROUND the conduit (if metallic) to a known “earth ground” location.

A series of holes are located on the sides of the controller (see Figure 42). Strain relief fittings are provided with the controller enclosure for interconnecting wiring. Install the plastic fittings as needed. Remove the compression nut and rubber sleeve from each fitting. Prior to connection of the shielded cable wires to the circuit board, slide the compression nut and sleeve over the cable for the wiring connections. When wiring is completed, apply a small amount of silicone to the rubber sleeve and reassemble. This will assure all wiring is secure and assist in making the tightening of the fitting easier. Insert the plugs provided to block any holes not used for wiring or other accessories.

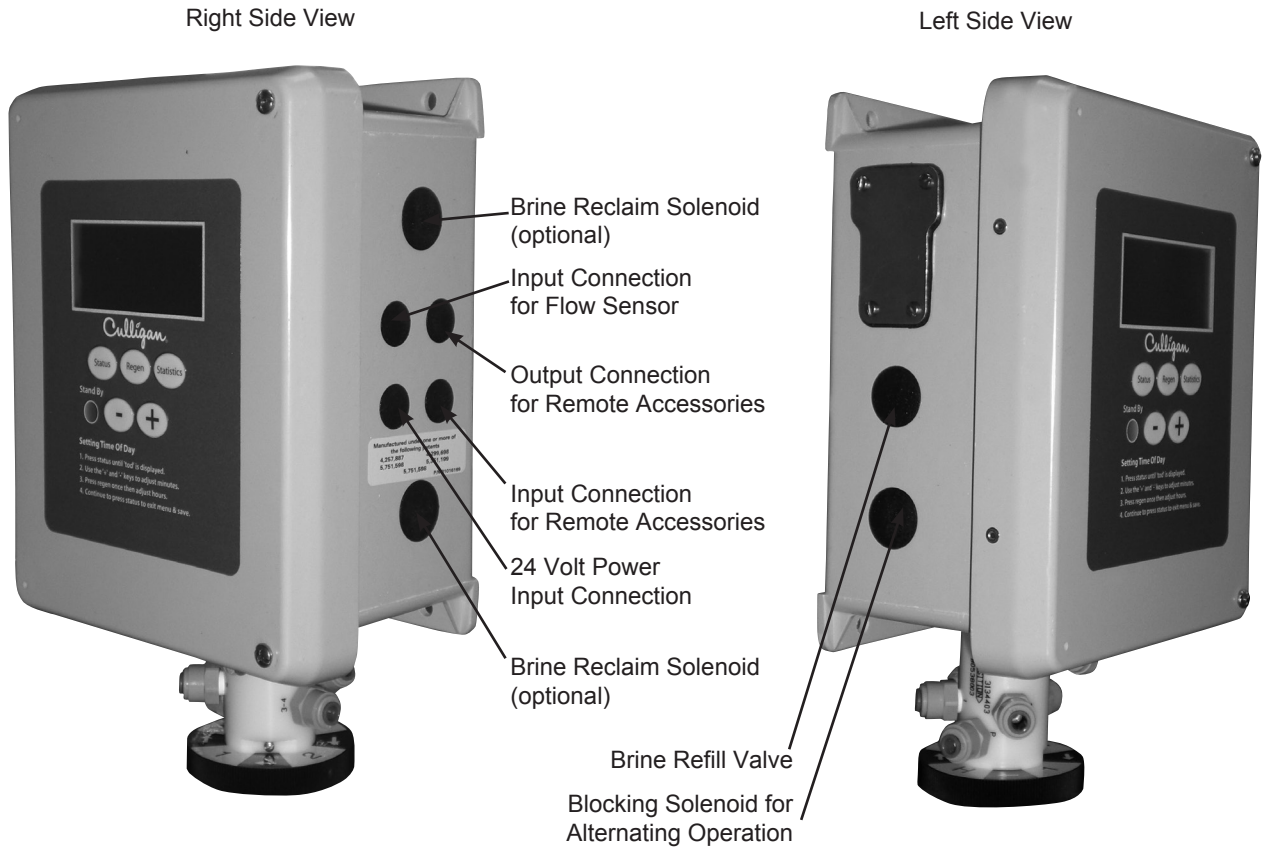


Figure 42.

Schematic

Circuit Board Layout

Outputs

The circuit board supports four outputs:

- Motor control (P6 Motor)
- Blocking valve (P7 Sol Vlv)
- Two programmable auxiliary outputs (P5 Aux 1 and P8 Aux 2)
- Controller interface (communication between multiple controllers) (P3 Comm).

CAUTION! Do not connect the P3 communication cable to the P12 circuit board connection. Doing so will damage the circuit board.

CAUTION! Connecting 24V to the 2.5VAC connection on the circuit board will damage the circuit board.

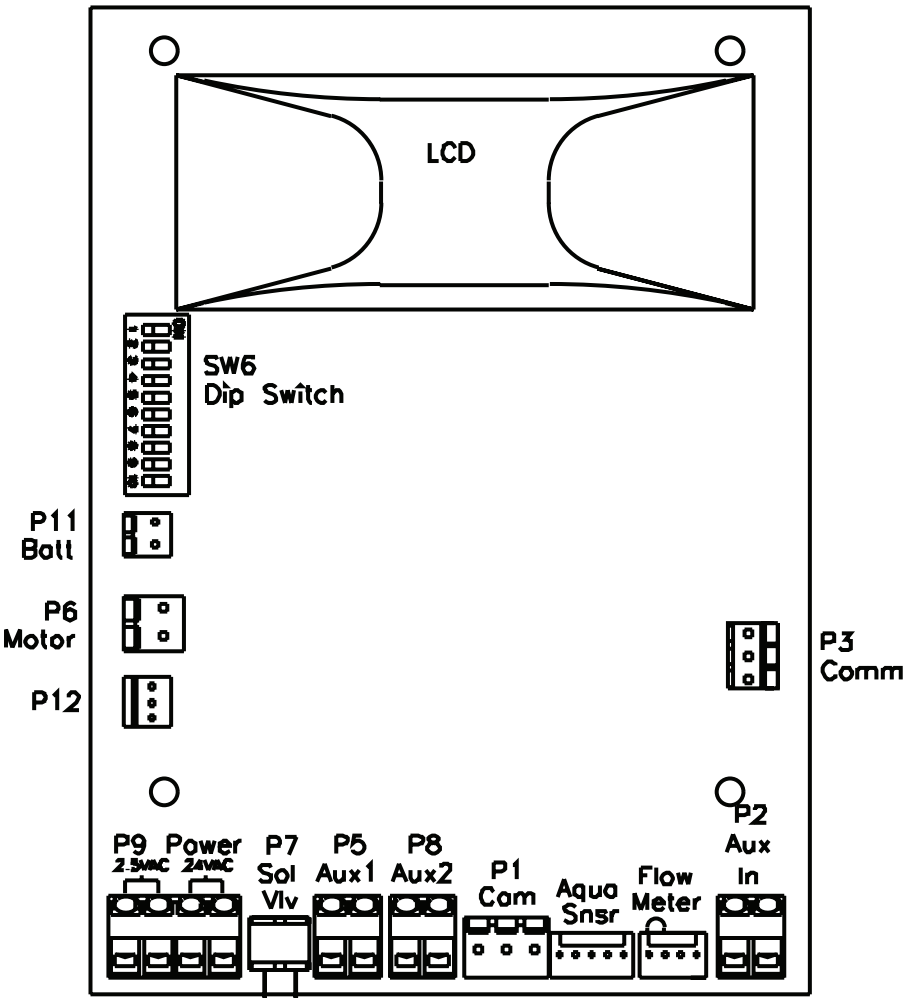


Figure 43.

24V TRANSFORMER

The MVP control is powered by a 24V/50VA transformer. If there are multiple controls in the system being installed, each control will require its own transformer. It is recommended that the transformer be plugged into a dedicated 120V circuit.

CAUTION! Connecting 24V to the 2.5V connection on the circuit board will damage the circuit board

1. Connect one of the wires from the 24V cable to one of the outermost 24V transformer screw terminals (Reference Figure 45). The other end of the wire should be connected to one of the 24 VAC terminals on the MVP control circuit board (Figure 44).
2. Repeat the process for the other 24V power supply cable attaching the second wire to the opposite terminal.

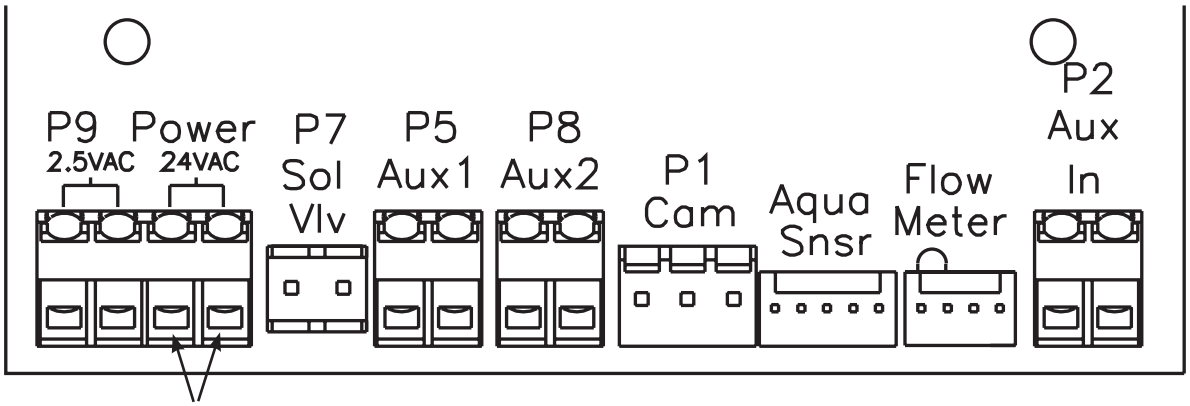


Figure 44.

POWER SUPPLY

ONE transformer is required for each Control

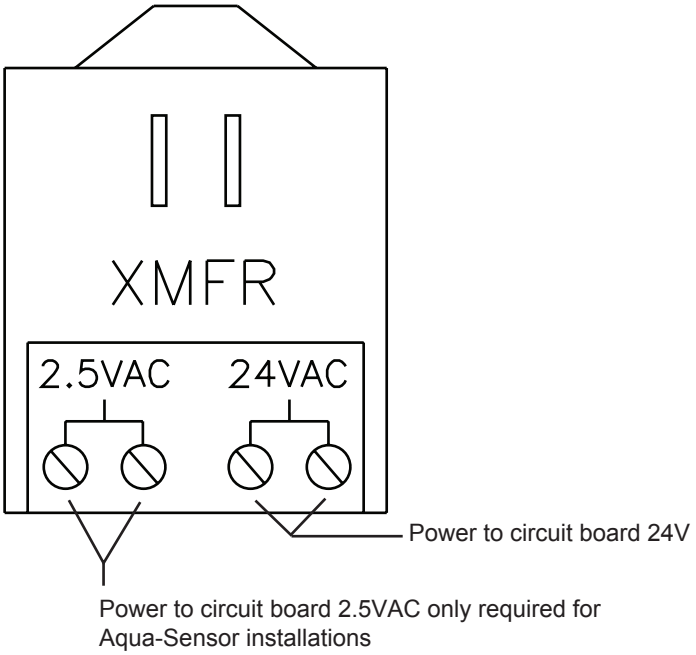


Figure 45.

Brine Refill Valve Wiring

1. Installation of the solenoid coil and connector

Locate the solenoid coil and connector cord. Assemble it to the brine refill valve as shown in Figure 46.

2. Installation of the cord grip

Remove the hole plug from the left side of the MVP controller enclosure. Locate the cord grip fitting and nut. Assemble them through the open hole and thread the solenoid coil cord through the cord grip fitting as shown in Figure 47. Tighten the cord grip onto the cord.

3. Wiring

Wire the circuit as shown in the diagram in Figure 48. The wires can be trimmed to a suitable length.

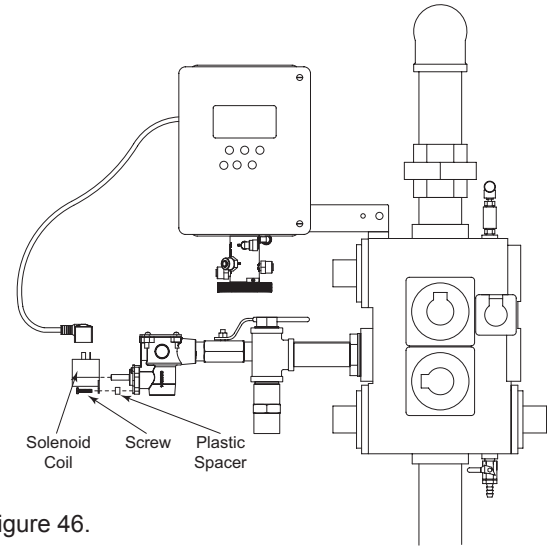


Figure 46.

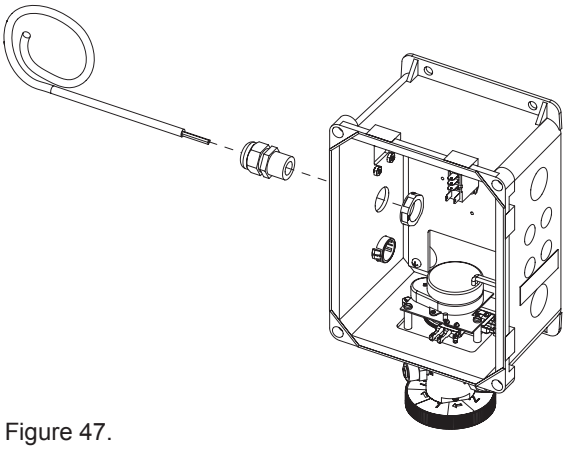


Figure 47.

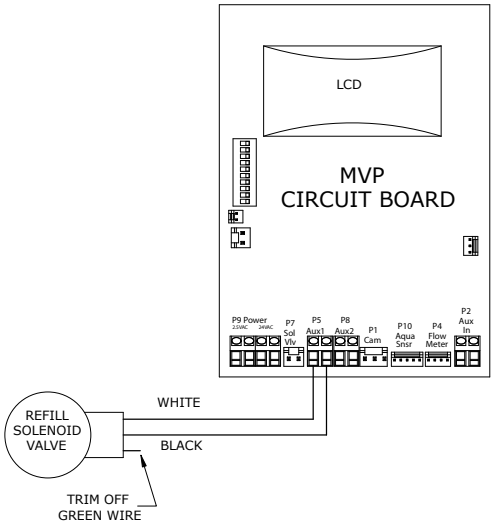


Figure 48.

Communication Cable and Blocking Solenoids - Multiple Units

NOTE **Disregard this information and proceed to flow sensor schematic (optional) information when installing single tank configurations.**

CAUTION! **Do not connect P3 communication cable to P12 circuit board connection. Doing so will damage the circuit board.**

Multiple units will require a communication cable. Refer to the following table for the quantity and cable part number required for your system configuration.

Table 8.

System Configuration	Cable Part Number	Qty. Required
Alternating Duplex	01016342	1
Duplex Parallel/Progressive	01016327	1
Triplex Parallel/Progressive	01016327	2

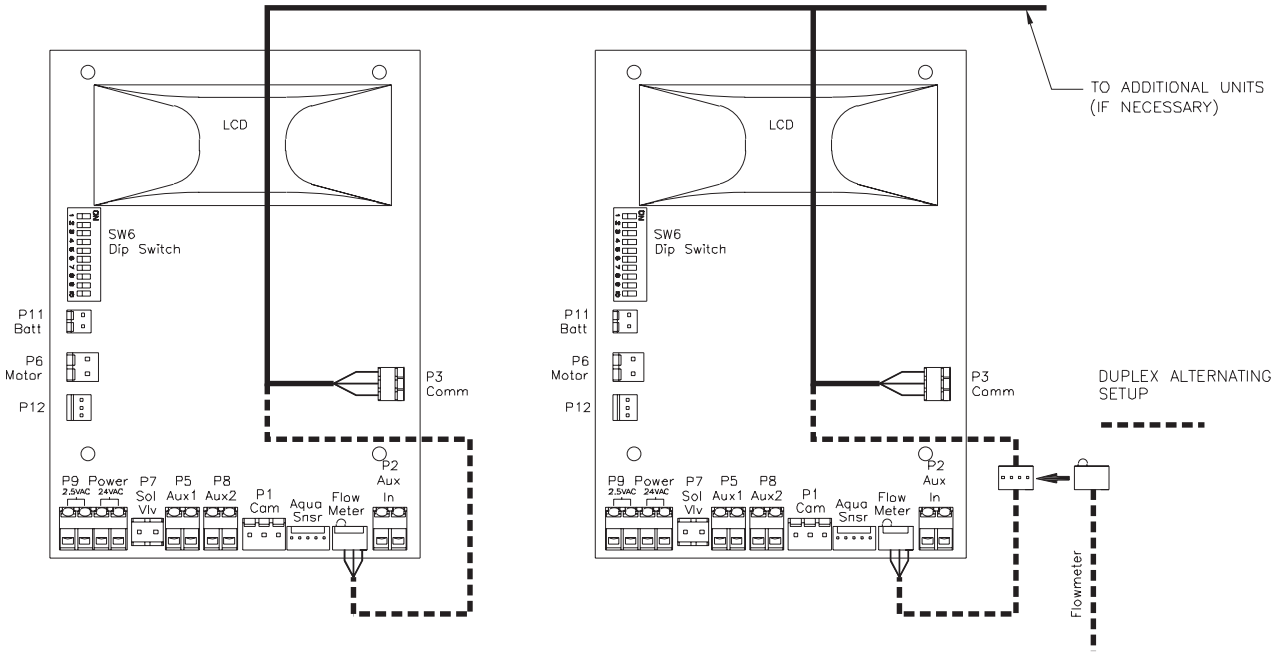


Figure 49.

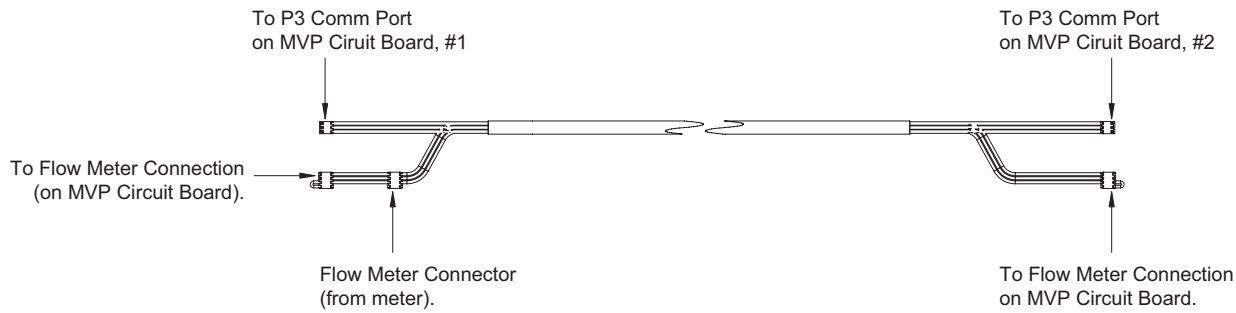


Figure 50. Duplex Alternating Cable (P/N 01016342)

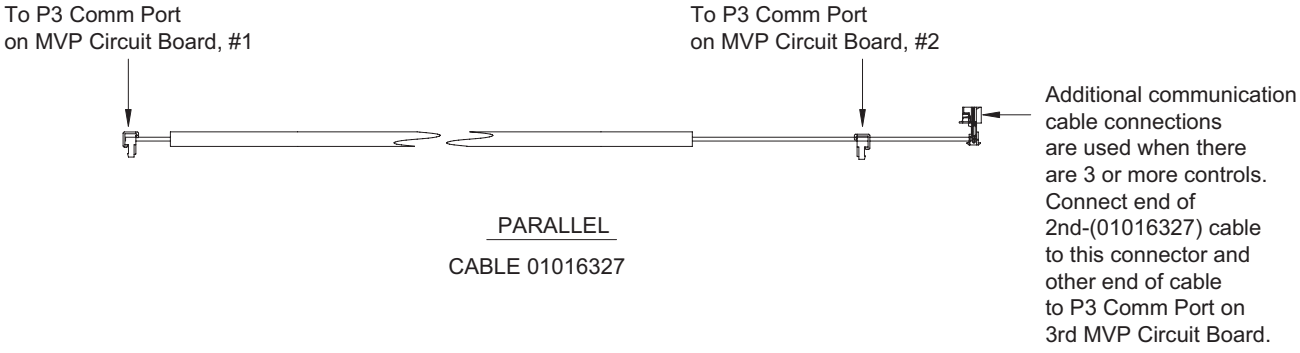


Figure 51. Parallel/Progressive Cable (P/N 01016327)

Blocking Solenoid -Alternating/Progressive Systems

Refer to page 26 for installation of the blocking valve to the MVP controller enclosure.

The end connector on the solenoid valve wiring attaches to the Sol Vlv (P7) output connection on the primary circuit board. See Figure 52.

On twin alternating systems, part number 01016369 duplex installation kit will be required. This kit contains:

- One (1) interconnect cable with end connectors.
- Two (2) solenoid valves with tubing and fittings.

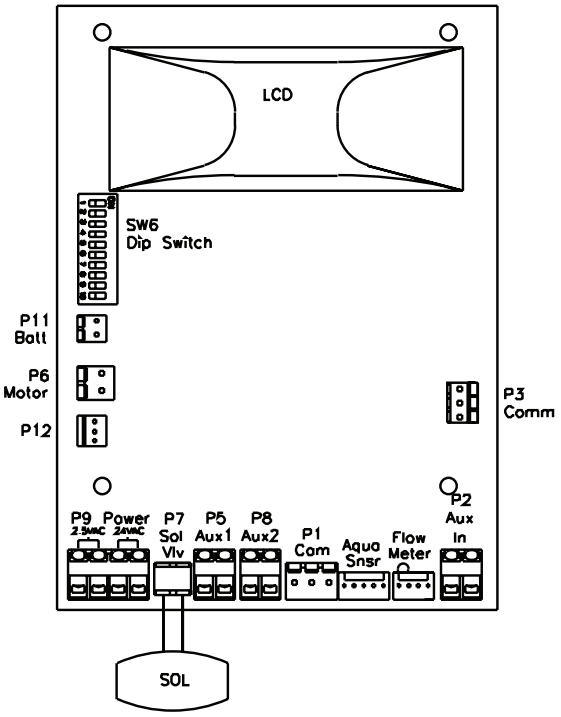


Figure 52.

Flow Sensor Meter Schematic (optional)

The MVP controller is capable of detecting the signal from a Hall effect sensor device to provide flow rate information, totalization and volume based regeneration initiation. The flow meter device is automatically detected when connected to the controller.

There are several different types of flow measuring devices and differences in the wiring of the devices to the MVP circuit board do exist. Refer to the following drawing.

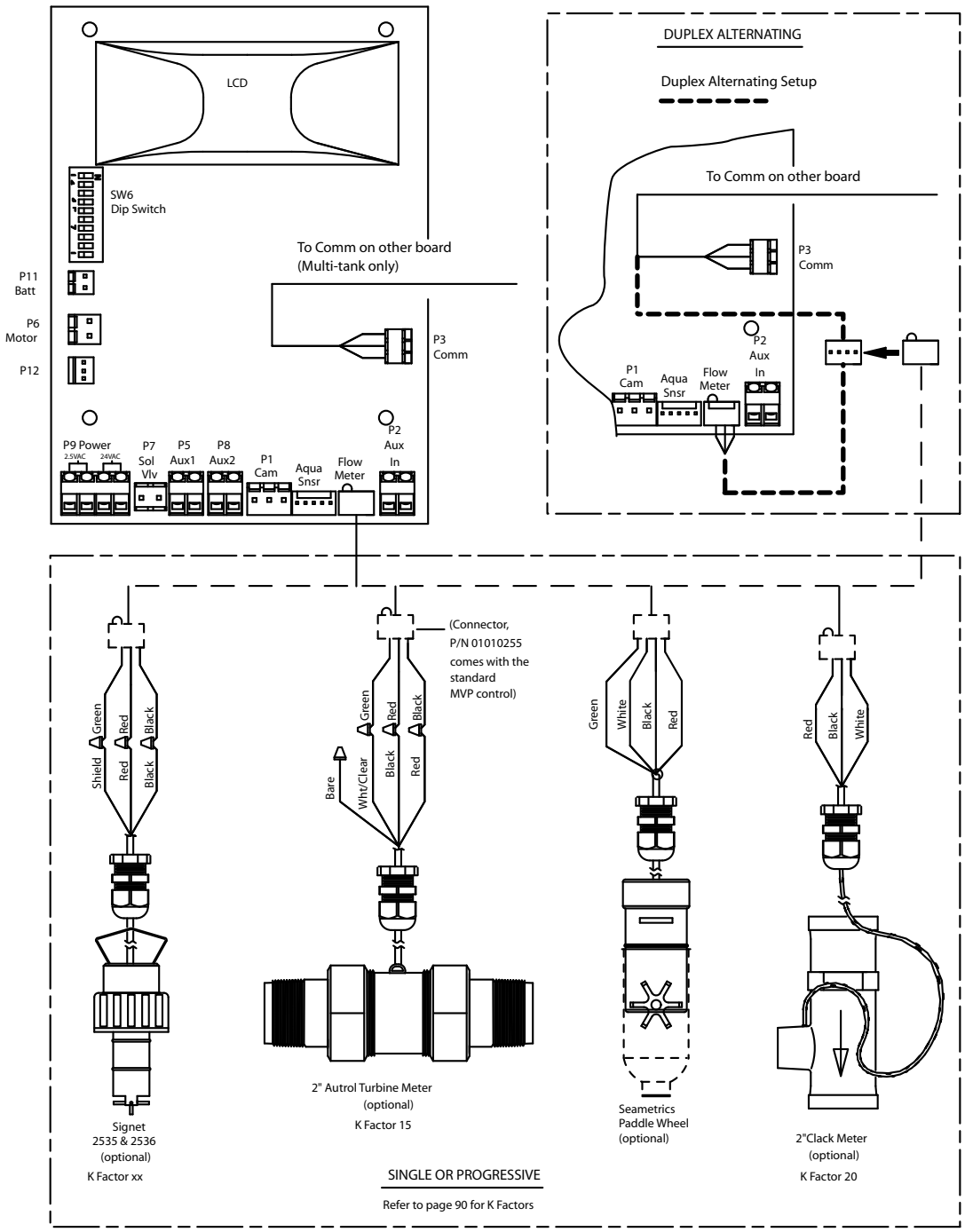


Figure 53.

Aqua-Sensor Schematic (Optional)

The Aqua-sensor device requires a 2.5vac power source. This source is provided via two of the posts on the 24V/2.5V transformer (see Figure 55). Two leads from the transformer must be wired to the 2.5vac terminal (P9) on the MVP circuit board.

The wire connector from the Aqua-Sensor is then simply plugged into the P10 terminal on the MVP circuit board (Aqua Snsr). See Figure 54.

CAUTION! Verify wiring from terminals to circuit board are correct before applying power to control. 24vac power must not be applied to the 2.5vac terminals of the circuit board.

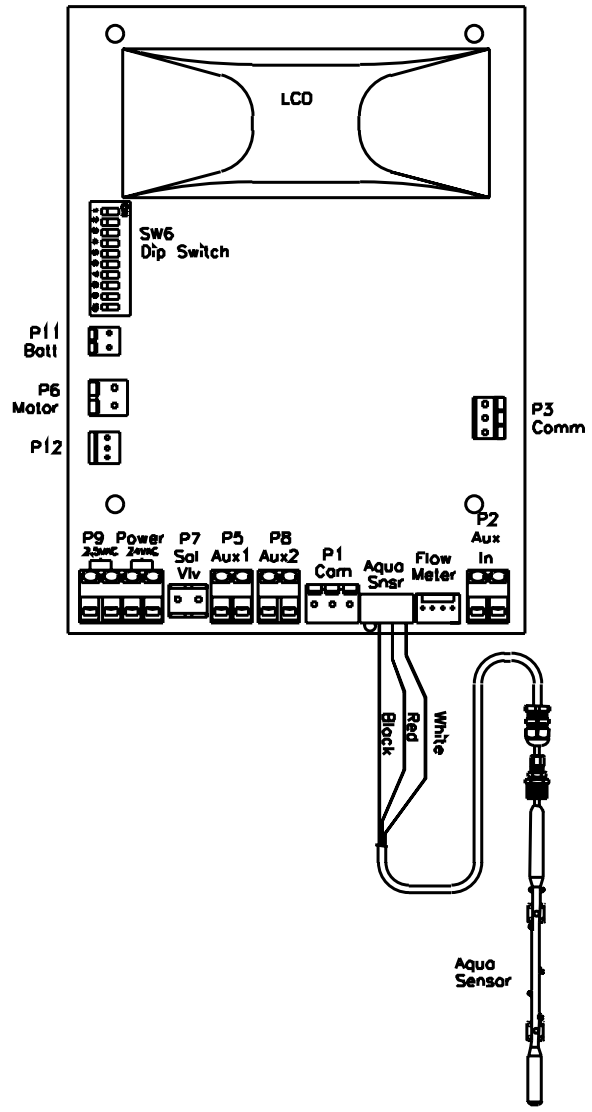
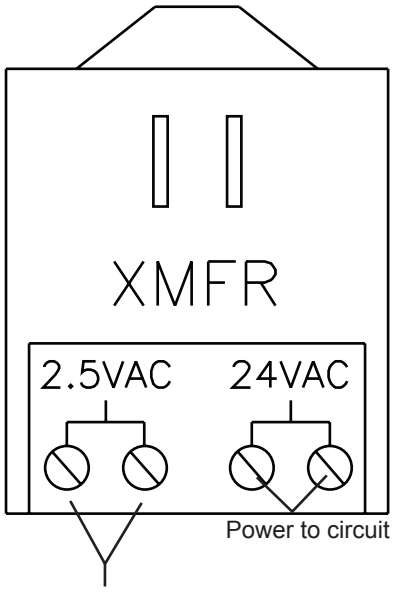


Figure 54.

POWER SUPPLY

ONE transformer is required for each Control



Power to circuit board 24V

Power to circuit board 2.5VAC only required for Aqua-Sensor installations

Figure 55.

CAUTION! Connecting 24V to the 2.5V connection on the circuit board will damage the circuit board.

Auxiliary Output #1 & #2 (Optional)

The Auxiliary Output #1 & #2 (P5 Aux 1 & P8 Aux 2 - reference Figure 56) are output triacs that can be programmed to provide power to a “normally open” (normally no power to auxiliary output until power required) or a “normally closed” contact (user choice). These 24 vac outputs can be used for energizing a relay coil only.

Refer to the section on Programming (page 48) for additional information on the uses of this feature.

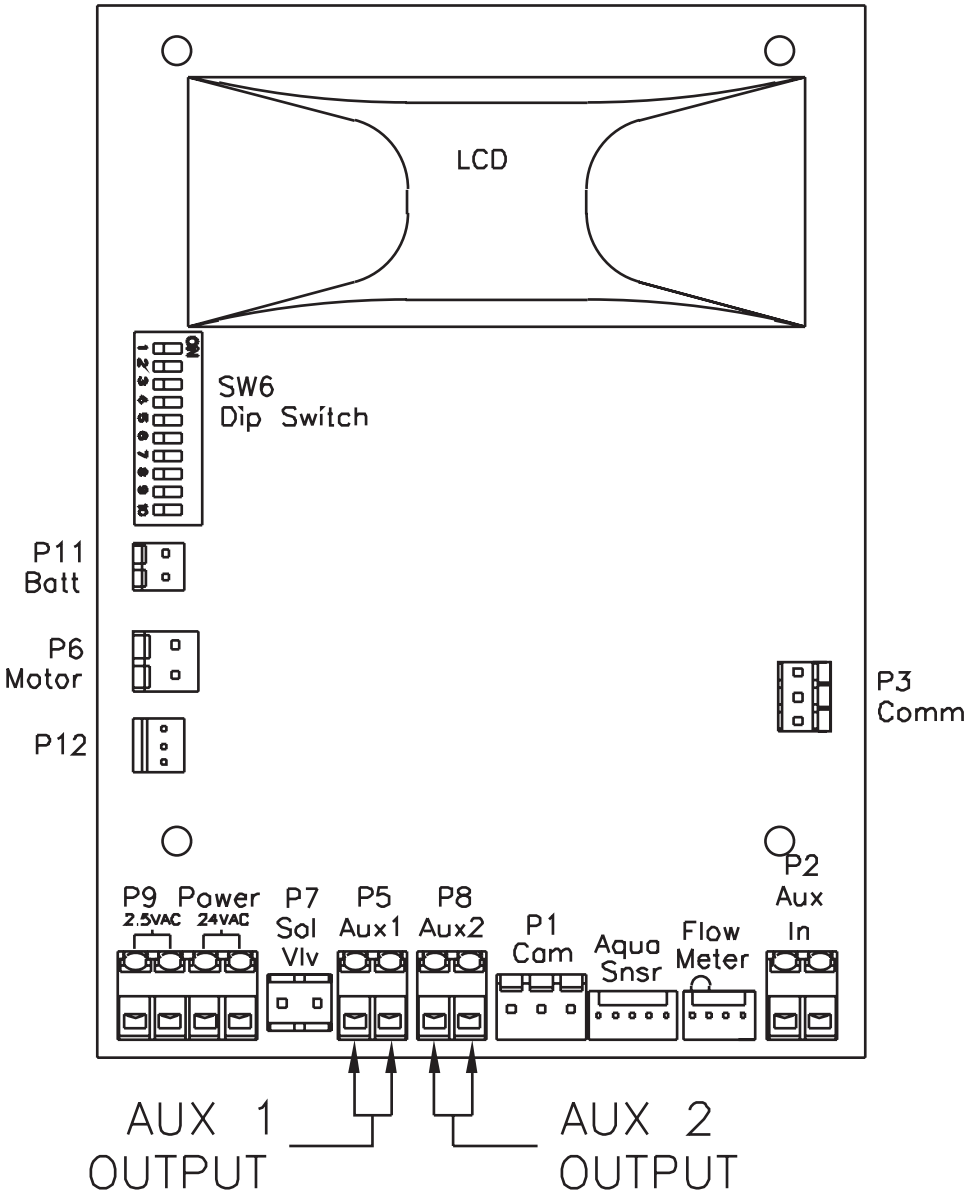


Figure 56.

Auxiliary Input (Optional)

One auxiliary input (P2 Aux In) input is provided for optional signal devices such as remote push buttons, differential pressure switches, hardness monitors, turbid meters, etc. for the purpose of receiving a regeneration signal.

Select an UN-POWERED contact within the remote device that will close when regeneration is desired. The duration of the switch closure can be as low as 0 seconds; 6 seconds is the recommended minimum and default but can be as long as 999 seconds. The contact must automatically open following the start of a regeneration sequence. Connect this contact to the P2 Aux In terminal shown in Figure 57.

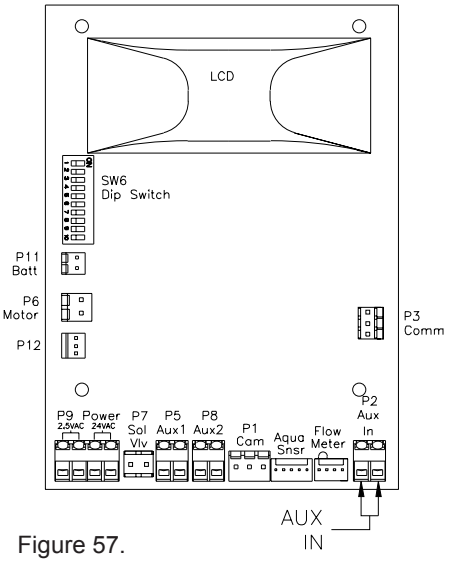
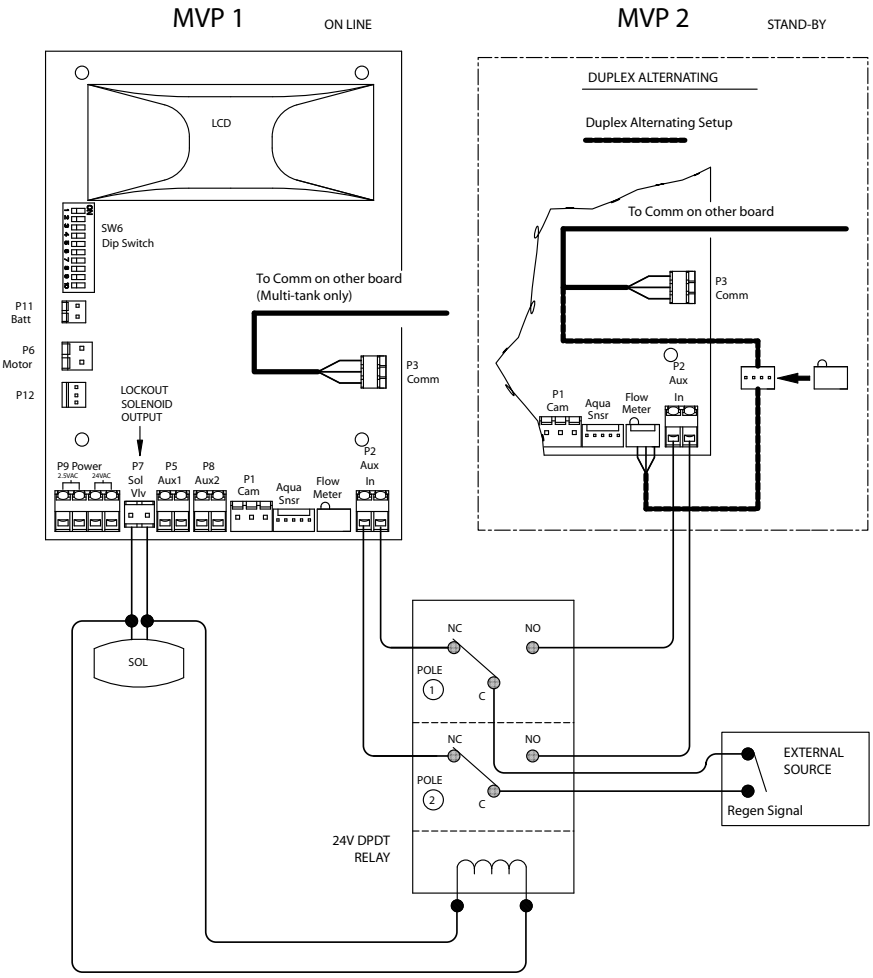


Figure 57.



DUPLEX ALTERNATING WITH EXTERNAL SOURCE

Figure 58.

Programming

NOTE **Do not apply power to the controller(s) until instructed to do so. If power has been applied, simply unplug the controller(s).**

DIP Switches

The Culligan MVP controller uses a series of ten (10) DIP Switches to streamline the programming process. Figure 59 shows the DIP Switch strip placement on the circuit board and the abbreviated text indicating the function of each switch.

DIP SW 7 SHOULD BE OFF FOR SOFTENER APPLICATIONS

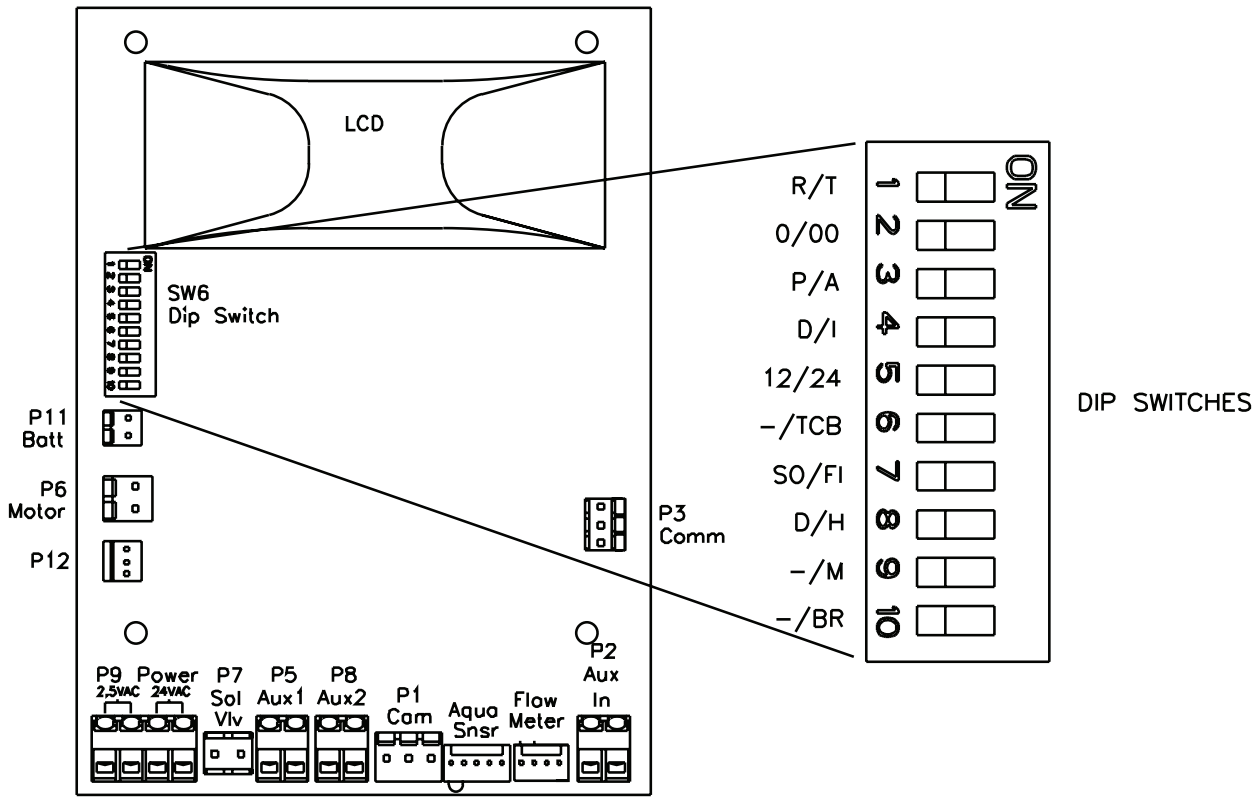


Figure 59.

Switch Definitions

The circuit board is shipped with all DIP switches in the off position. Prior to programming the controller some DIP switches may need to be moved to the ON position. Because each switch serves a specific purpose, please review the following information, moving the required switches to an ON position as necessary for each controller in the system. The definitions and purpose are as follows:

Table 9. Switch Definitions

Switch #	Abbreviation	Definition	Purpose
1	R/T	Run/Test	**Off** - Allows controller to function in a normal, operational mode. **On** - Places controller in test mode to verify operation of the board components.
2	0/00	Times 10/ Times 100	**Off** - The Maximum Capacity (maximum amount of water that can be treated), Batch Sizes (volume of water to be treated), Batch (capacity) remaining and Total Volume of Flow through the unit are displayed and should be multiplied by 10. The X10 icon in the display will be illuminated. On - The Maximum Capacity (maximum amount of water that can be treated), Batch Sizes (volume of water to be treated), Batch (capacity)remaining and Total Volume of Flow through the unit are displayed and should be multiplied by 100. The X100 icon in the display will be illuminated.
3	P/A	Parallel/ Alternating	**Off** - Allows multiple units to be capable of being online simultaneously. This switch must be in the off position if the progressive flow feature is desired or if a parallel mode of operation is required. **On** - Indicates the controller will work with another to place one tank in standby at any given time. If more than 2 units are connected one unit will be offline (standby) at all times.
4	D/I	Delayed/ Immediate	**Off** - Regeneration of a unit will occur at a user-selected time of day. **On** - Regeneration shall occur immediately upon a controller receiving a valid regeneration initiation signal, regardless of the time of day.
5	12/24	12 Hour Clock/ 24 Hour Clock	**Off** - All time keeping functions shall be based on an AM/PM basis. The AM or PM icon shall be lit in the display as appropriate. **On** - Time keeping functions shall work on a 24-hour clock (military time). The AM/PM display icons will be disabled.
6	-/TCB	Time Clock Backup Disabled/ Enabled	**Off** - The time clock backup option is disabled. **On** - Allows the user to enable the time clock function of the control as a backup regeneration initiation option. This feature is used as a back up to a primary device such as a flow meter, Aqua-Sensor or auxiliary input to ensure a regeneration is initiated after a user specified period of time if the primary device does not initiate the regeneration first.
7	SO/FI	Softener/ Filter	**Off** - The unit shall be operated as a softener. Default time programmed for cycle #2 shall be 60 minutes. (If AquaSensor is connected default shall be 99 minutes.) **On** - The unit shall function as a filter. The default time programmed for cycle #2 shall be 2 minutes
8	D/H	Days/Hours	**Off** - Time clock initiated regenerations will be programmed with an interval of days (ranging from 1 to 99). **On** - Time clock initiated regenerations will be programmed with an interval of hours (ranging from 1 to 24). (Day of the week disabled)
9	-/M	Master Off/ Master On	**Off** - Single system operation only. Anytime multiple units are connected, one unit must have the switch set to ON **On** - Enables the progressive flow feature and multiple communication setup. Only one controller in a multiple system should be designated as the Master control.
10	-/BR	Brine Reclaim Off/ On	**Off** - Brine reclaim option not enabled. Cycle two shall have a default value of 60 minutes (if Aqua-Sensor is connected default shall be 99 minutes). **On** - Brine reclaim option is enabled. Cycle two shall be displayed as three sub-cycles; BR1 - Brine Draw/Slow Rinse (10 minute default time); BR2 - Brine Reclaim/ Slow Rinse (10 minute default time); BR3 - Slow Rinse (10 minute default time).

Once the DIP switches have been properly selected for each controller, power may be applied and programming of the control(s) continued.

Programming - Key Pad Familiarization

Once the DIP switch settings have been established the Culligan MVP control is ready to accept user input. User input is done through the keypad on the front of the MVP circuit board. Refer to Figure 60 for a description of the layout of the keypad.

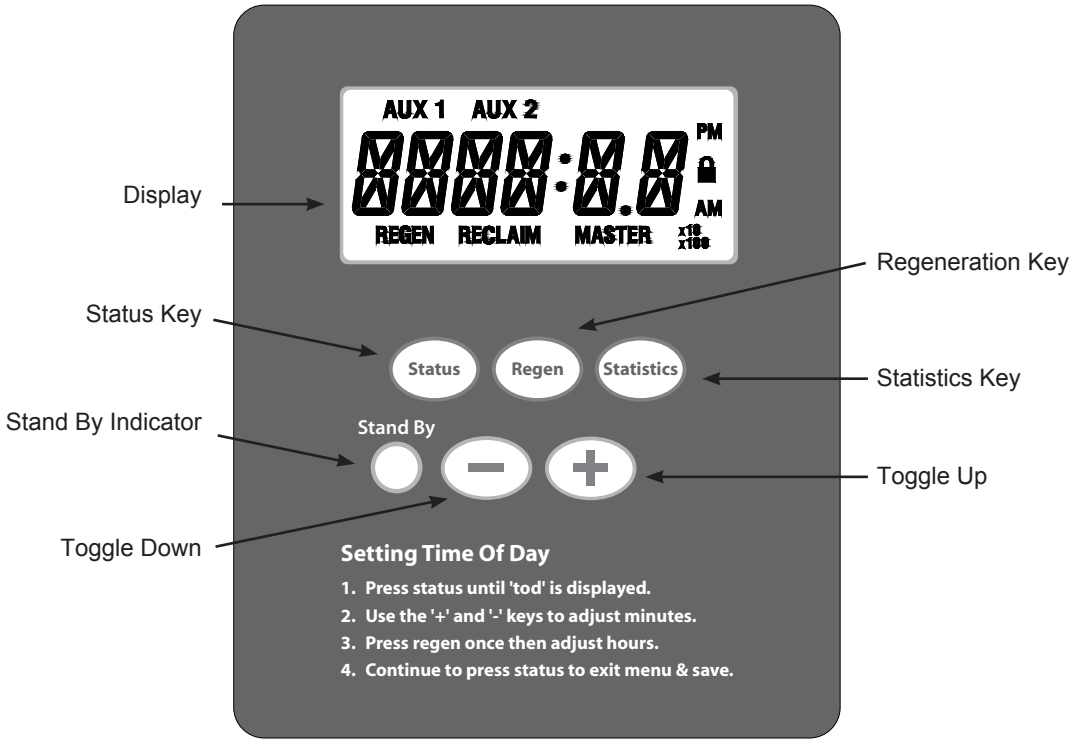


Figure 60.

Table 10.

Display	Back lit LCD display. Six 12 segmented alpha-numeric characters with a decimal separating the first and second character, a colon separating the second and third character positions and AM, PM, REGEN, Lock, x10, x100, RECLAIM, AUX 1, AUX 2, and MASTER icons.
Status Key	Depress to enter and move through the programming steps.
Regeneration Key	Press and hold the key for five (5) seconds to initiate an immediate regeneration. When pressed during programming the time of day or time of regeneration, this key will allow the user to toggle between the hours and minutes setting of timing program segments.
Statistics Key	Each time depressed, the Statistics key will display statistical information such a flow rate, time of day. Use with the Toggle Down key to display other statistical information.
Toggle Down Key	In the programming mode this key will move the user through the programming function in a descending mode. If depressed for greater than three seconds, the rate at which the display scrolls through data will increase.
Toggle Up Key	In the programming mode this key will move the user through the programming function in an ascending mode. If depressed for greater than five seconds, the rate at which the display scrolls through the data will increase. This key will also allow the user to manually step through the cycles of regeneration.
Stand By Indicator	When lit, indicates the controller is in an off line or stand by mode. If lit and the display shows the REGEN icon, then the system is in a regeneration mode of operation.

Multiple Unit Communication Setup

Anytime two or more units are connected, each must have a specific ID # assigned. When new, a circuit board does not have an ID #. Once used, a board will have an ID # assigned and saved in EEPROM. Please refer to the appropriate paragraph concerning the establishment or re-establishment of a board ID#.

Boards With No ID# Established (Initial Programming)

1. Verify communication cable is properly connected to each board in the system.
2. One (and only one) circuit board in the system should have the #9 DIP switch (MASTER) setting turn to the ON position.
3. On the Master unit, press Statistics once and then press "-" until "Unit 1 Master" is displayed. Wait a few seconds for all other units to display, "Set ID". This will be followed by the term "take 2" in the display.
4. Press Status on the second unit. The second unit display will show "ID 2" which indicates it now has a recognized ID#. Once this occurs, the Master unit will display "Unit 2 Master" and all remaining units needing an ID # will display "take 3".
5. Repeat step four for each unit in the system and until all units have ID#'s and the Master unit shows all other units accounted for.
6. When done assigning ID #'s, press Statistics once on the Master unit. This returns all other controllers back to a time clock display.
7. The Master unit can now be programmed.

Establishing a New ID#

When adding a board to a new or existing system follow these steps to re-establish an ID# if the existing ID# matches that of another board. (Multiple boards with identical ID#'s will initiate an error code of "ERR 4" in the display of the offending board).

1. "ERR 4" will be displayed. On this unit, press and hold Status for (10) seconds. This will reset the board, remove the error from the display and erase the ID# from EEPROM.
2. The board can now accept a new ID#.
3. Press Statistics once on the Master unit, then press "-" until "Unit # Master" is displayed ('#' represents how many units are connected). After a few moments all units that require an ID# will display "Set ID" followed by the display, "take #". Those units that have an ID# will display "net ID" followed by "ID#".
4. Pressing Status on the unit that requires an ID# will assign one.
5. Repeat the process for each unit requiring an ID#.
6. When done assigning ID #'s, press Statistics once on the Master unit. This returns all other controllers back to a time clock display.
7. The Master unit can now be programmed.

Single Unit Communication Set Up

Erasing an ID# from a board to be used to operate a single unit.

1. If attached, disconnect communication cable from the desired unit. (If that unit happens to be the one with the #9 DIP switch ON, then switch it off).
2. Wait 60 seconds (If the MASTER icon was indicated in the display, it will disappear).
3. Press the Statistics key once and then press "-" until "Unit 1 MASTER" is displayed.
4. Press and hold the Regeneration key for (3) seconds. The unit will home and the ID# will have been successfully erased.

The programming process requires various types of data input. The following information pertains to calculating the softening capacity of the water softening system and setting the brine refill rate (time).

Capacity Settings

The capacity of a water softener is determined by two factors; resin amount and water chemistry. Appendix A Table 15 on page 93 will define the system capacity for the CSM water softeners at varying salt dosages.

Single Tank Systems

Normally a single tank system has enough resin capacity to soften water for a minimum period of 24 hours. Time of regeneration is usually set to occur very early in the morning or at a time when no softened water is Required. This is because when the softener is regenerating, hard water is typically bypassed through the system and into the facility if a demand for water if present.

If regeneration is desired at a time of day when there is no water usage then the system must have a “reserve”capacity which must last an entire day if the regeneration signal (time clock, Aqua-Sensor and/or meter) occurs at the beginning of the day. Subtract this reserve capacity from the total capacity to determine “capacity to signal”.

NOTE	**If the reserve capacity is more than 1/3 of the total capacity, a meter system may not reduce salt consumption relative to a timeclock system.**

Multiple Tank Systems

Multiple tank systems offer the benefit of continuous soft water supply. When using the Aqua-Sensor to initiate a regeneration sequence, the system capacity may be set for the maximum amount the system is capable of producing. However multiple tank systems using only water meters and or time clock as the basis for regeneration initiation are recommended to be set up with a 10% reserve capacity. The purpose of the reserve capacity in multiple tank systems is to allow for subtle changes in water chemistry.

Determining Batch Set Point

To determine the batch set point for programming the Culligan MVP controller, use the following formula:

$$\text{Gallons} = \frac{\text{Total Capacity - Reserve Capacity}}{\text{Hardness}}$$

Time Refill Valve (AUX 1) Setting

Appendix A, "Table 15. CSM Refill Minutes/Salt Dosage/Capacity" on page 93 provides the suggested refill flow rate and program time for the Aux 1 programming step of the MVP controller (See page 48, Programming Step 14).

Program Data Input

There are a couple of items to note that can make the programming the Culligan MVP control a little easier. They are:

Slew Rates	This term refers to the speed at which the display moves through the input of material. For example, holding down the "+" key for (5) seconds when inputting minutes for Time of Day will cause the minutes to pass in (10) minute blocks of time. Pressing the "+" or "-" keys for shorter periods (less than 5 seconds) will slow the rate. To move through the programming slowly, do not hold down the "+" or the "-" keys.
Beeper	A beeper is available (normally on) to assist the user by providing an audible tone (about 70 decibels) to signify valid (one beep) and invalid (three beeps) key presses. The beeper can be deactivated in the programming mode. (If error occurs, beep will still be ON even if set to "NO" programming.)
Programming Mode Timeout	If there is no keypad activity for a (3) minute period while in the programming mode, the controller will exit the programming mode and return to a Time of Day display. Any setting that was changed prior to the control timing out will revert back to the original value. Pressing the status key saves the setting.
Program Input Acceptance	For programming information to be accepted, the Status key **must** be depressed prior to Programming mode timeout.

NOTE Program steps marked with an asterisk (*) will be saved in EEPROM.

To begin programming, be sure all previous steps have been followed. Be sure power is supplied to the controller. Press the Status key to begin and to move on from one completed programming step to another.

1. **Time of Day*** - (Always available)

   Establishes the current time of day. The display indicates "tod" as shown in Figure 61 before changing to "12:00 PM".

   To adjust the minutes or the hour setting, depress the Regeneration key until the appropriate digits flash (Figure 62) then use the "-" or "+" keys to scroll to the desired time. Pressing the "-" or "+" keys for 5 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

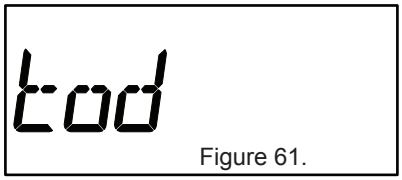


Figure 61.

Figure 62.

2. **Time of Regeneration*** - (Delay mode only, DIP switch 4 off or DIP 4 on when DIP 6 is off.)

   For delayed regeneration purposes. The display indicates "tor" as shown in Figure 63. The default time is 2:00 AM. This function is adjustable in 30-minute increments.

   To adjust the minutes or the hour setting, depress the Regeneration key until the appropriate digits flash then use the "-" or "+" keys to scroll to the desired time. Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

Figure 63.

3. **Meter "K" Factor*** - (Only active when a flow meter is attached)

   Data input is the number of pulses a flow device emits to represents a volume of water (gallons or liters). Initial display is "METEr" (Figure 64). Refer to the information in Appendix B on page 95 for the appropriate "K" factor for the flow-measuring device being used. The default setting is 50.0.

   To adjust the "K" factor setting, depress the Regeneration key until the appropriate digits flash (Figure 65) then use the "-" or "+" keys to scroll to the desired setting. (Adjustable from 0.5 to 500). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

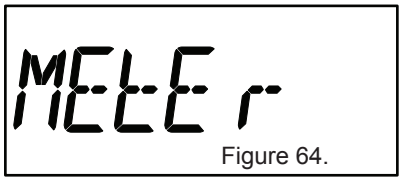


Figure 64.

Figure 65.

4. **Auxiliary Input Delay*** - (All modes)

"AUX IN" (Figure 66) programming is required only if the AUX In terminal is being used. This establishes the uninterrupted period of time (in seconds) that a signal must be received through the auxiliary input before the controller is to react by initiating a regeneration sequence. The default time is (6) seconds. Note that this feature is ignored if nothing is connected to the AUX input terminal.

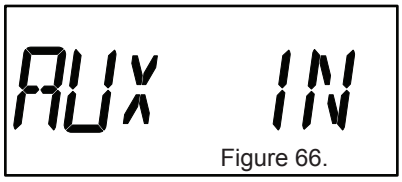


Figure 66.

To adjust the seconds setting, use the "-" or "+" keys to scroll to the desired number of seconds. (Adjustable from 0 to 999 seconds). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

5. **Cycle 1 Time*** - (All modes)

The backwash cycle is represented by "bw 10" (Figure 67) in the display. The default duration of cycle 1 is 10 minutes. To adjust the minutes setting, use the "-" or "+" keys to scroll to the desired number of minutes. (Adjustable from 1 to 99 minutes). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

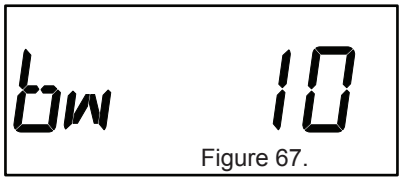


Figure 67.

6. **Cycle 2 Time*** - (All modes except if Brine Reclaim DIP switch 10 is set to ON)

The brine/slow rinse cycle is represented by "br 60" (Figure 68) in the display. The default duration of cycle 2 is 60 minutes if the DIP switch #7 is OFF (softener) or 2 minutes if DIP switch #7 is ON (filter). To adjust the minutes setting, use the "-" or "+" keys to scroll to the desired number of minutes. Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

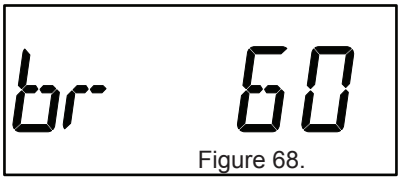


Figure 68.

NOTE The following settings only apply if Brine Reclaim (DIP switch #10 is ON) is being used an is being provided only for informational purposes. This feature requires additional hardware not described in this manual.

a. **Cycle 2A Time*** - "br 1 10" and the RECLAIM icon are shown in the display (Figure 69). This setting is used to program the initial brine draw/slow rinse function. During this cycle wastewater is normally diverted to the drain. The default setting is (10) minutes. (Adjustable from 1 to 99 minutes). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

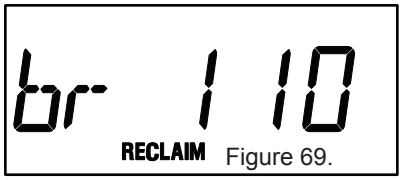


Figure 69.

b. **Cycle 2B Time*** - "br 2 10" and the RECLAIM icon are displayed (Figure 70). This setting is used to establish the brine reclaim phase of the brine draw/slow rinse function. During this cycle wastewater is normally diverted back to the brine tank. The default setting is (10) minutes. (Adjustable from 1 to 99 minutes). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

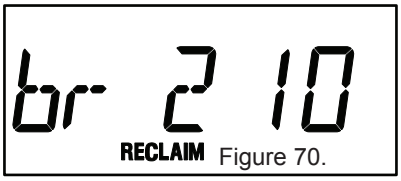


Figure 70.

NOTE AUX2 output will be powered for the length of time this step is programmed for.

c. **Cycle 2C Time*** - "br 3 10" and the RECLAIM icon are displayed (Figure 71). This setting is used to establish the return of the system to the slow rinse cycle During this cycle, waste water is once again sent to the drain. The default setting is (10) minutes. (Adjustable from 1 to 99 minutes). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

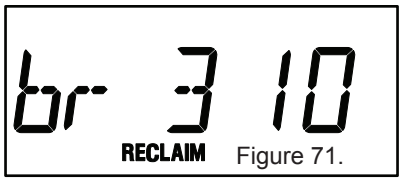


Figure 71.

7. **Cycle 3 Time*** - (All modes)

   The fast rinse cycle is represented by "Fr 10" (Figure 72) in the display. The default duration of cycle 3 is 10 minutes. To adjust the minutes setting, use the "-" or "+" keys to scroll to the desired number of minutes. (Adjustable from 1 to 99 minutes). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

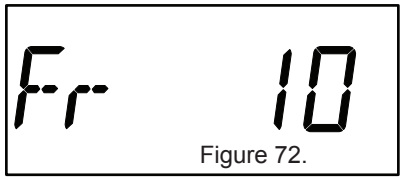


Figure 72.

8. **Cycle 4 Time*** - Because the Brunermatic valve is a four cycle valve, this step will not be displayed but it is described for informational purposes.

   This setting is used to adjust the time, in minutes, for a valve that has a separate refill cycle from the fast rinse cycle.

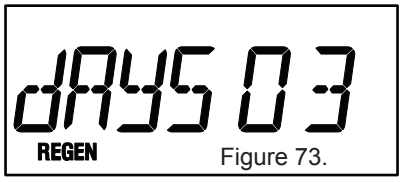


Figure 73.

9. **Regeneration Interval*** - Active only if no meter and/or Aqua-Sensor is detected OR if DIP switch #6 is ON.

   The display will show the REGEN icon and "days 03" (Figure 73) (if DIP switch 8 is OFF) or REGEN and "Hour 12" if DIP switch 8 is ON.

   The default setting for "days" is "03" while the "Hour" default is "12" (Figure 74).

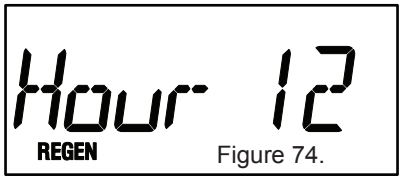


Figure 74.

   To adjust the "day" or "Hour" setting, use the "-" or "+" keys to scroll to the desired setting. (Adjustable from 1 to 99 days or 1 to 24 hours). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

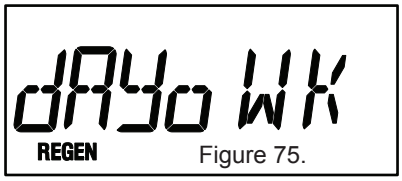


Figure 75.

NOTE **Single systems that are set with DIP switch 8 OFF and without a meter or Aqua-Sensor device connected will offer the following OPTIONAL time clock setting to be displayed. (Figure 75)**

This display will be followed (2) seconds later by Figure 76.

The "+" or "-" keys are used to toggle the display between "yes" or "NO" (the default is "NO"). A "yes" response will indicate that the control is to perform a regeneration on specific days of the week. If this feature is not desired, set the display to "NO" press the Status key and move on to step #9. If the feature is desired, set the display to "yes" and move to program step 9A.

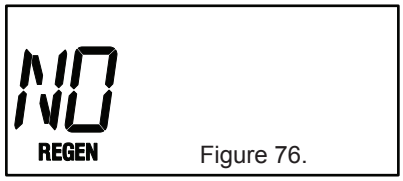


Figure 76.

a. **Specific Day(s) of Week Regeneration*** - (Only for single systems that are set with DIP switch 8 OFF and without a meter or Aqua-Sensor device connected as described in the previous NOTE).

   The display will show "day" and the REGEN icon (Figure 77) for two seconds followed by "SUN N" (Figure 78). The "+" and "-" keys are used to toggle between a "Y" or "N" in the display next to the abbreviated day. To allow a regeneration to occur on the day shown, toggle the display to "Y". If no regeneration is desired, the display should indicate "N".

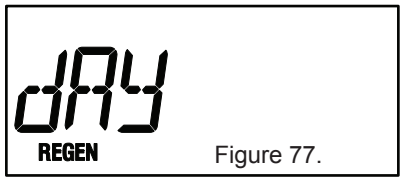


Figure 77.

   To advance to the next day in the program sequence, use the Regeneration key and repeat the steps from the previous paragraph for each day of the week. When complete, press the Status key once to advance to the next step.

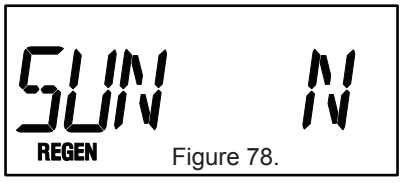


Figure 78.

b. Current Day of the Week* - If any of the days from step 9A. were set to “Y”, the display will show “SetdAY” (Figure 79) followed by “SUN” (Figure 80). Use the “+” or “-” keys to scroll the display to the current day of the week.

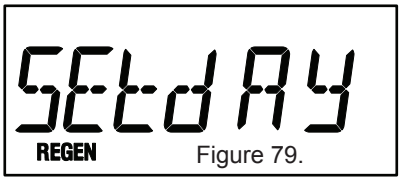


Figure 79.

If all of the days were set to “N” then “days 03” will appear as shown in Figure 80 and the regeneration interval will be established as an interval schedule instead of on selected days.

Figure 80.

Press the Status key to save the setting and advance to the next programming step.

NOTE **If any day of the week is set to “Y”, then the step 9 display “days 03” will no longer appear when scrolling, in the future, through the programming menu. To return to a schedule based on an interval of a specific number of days, chose “NO” after the “dAYoWK” text is displayed.**

NOTE **If a DIP switch is changed anytime after the control has been programmed to regenerate on a specific day, all settings will revert back to default; specific days to regenerate and current day will require reprogramming.**

10. **Batch Set Point*** -(Only active when a flow meter is attached)

Figure 81.

This portion of the program established how many units (e.g. gallons or liters) of water can be treated prior to regeneration being initiated. The amount to be inputted shall be dependent on the setting of DIP switch 2 (multiplied by 10 or 100).

The display will show the “REGEN” icon and “bAtch” (Figure 81) followed (2) seconds later by the “X10” or “X100” icon and “000087” (the default setting) in the display (Figure 82). To adjust the gallons setting, use the “-” or “+” keys to scroll to the desired number. (Adjustable from 0 to 999999). Pressing the “-” or “+” keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

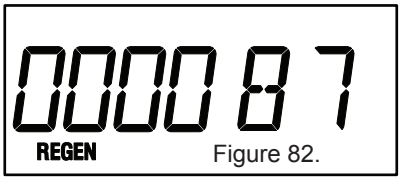


Figure 82.

11. **Maximum Capacity Set Point*** - Only active when a flow meter is attached.

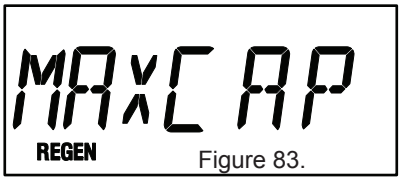


Figure 83.

Program the value that corresponds to the maximum capacity that can be expected from a unit before it is completely exhausted. If the unit reaches this set point, an immediate regeneration will occur even if the control is set to delay mode. The amount to be inputted shall be dependent on the setting of DIP switch 2 (multiplied by 10 or 100).

The display will show the “REGEN” icon and “MAxCAP” (Figure 83) followed (2) seconds later by the “X10” or “X100” icon and “999999” (Figure 84) (the default setting) in the display. To adjust the gallons setting, use the “-” or “+” keys to scroll to the desired number. (Adjustable from 0 to 999999). Pressing the “-” or “+” keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time.

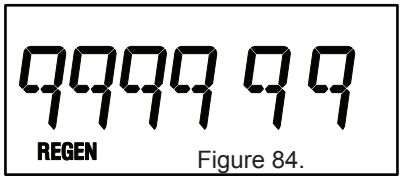


Figure 84.

Pressing the Status key will save the setting and move to the next programming step.

12. **Progressive Trip Point*** - (Only active when a flow meter and communication cable are attached. Will only appear on the controller that has DIP switch 9, Master, set to ON).

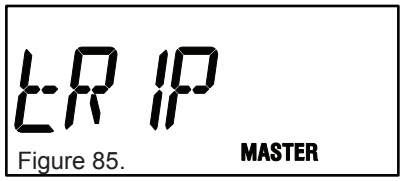


Figure 85.

Figure 86.

This setting establishes a flow rate which, when attained, will cause another unit to come on-line until the total flow rate is less than the established trip point for 30 seconds. Should the flow demand exceed the trip point by a rate equal to or greater than two times the trip point, another unit shall be brought on-line (assuming the system has more than two units in total). Each subsequent equivalent increase in flow demand shall continue to bring additional units on line (up to six total units if the flow demand is six times the "tRIP" amount). Units shall be returned to a stand-by mode in the reverse order as the system flow decreases by a rate equal to or greater than the trip point. Refer to Appendix A, Table 14 on page 92 for suggested trip point levels.

The unit designated as the MASTER unit shall show the MASTER icon in the display along with "tRIP" (Figure 85). This shall be followed (2) seconds later by "0 00" (Figure 86) at which time the display value can be adjusted with the "-" or "+" keys. (Adjustable from 0 to 999). Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time.

NOTE **If the "tRIP" is set to "0 00", all units shall be on line simultaneously. Conversely, setting the "tRIP" to "9 99" will cause the system to operate as an alternating system with only one unit on line at a time (unless the unlikely occurrence that the flow actually reaches 999 units per minute).**

Pressing the Status key will save the setting and move to the next programming step.

13. **Regeneration Start Delay*** - (Always available)

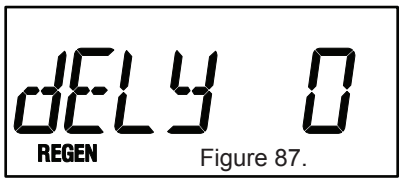


Figure 87.

In the event back to back regenerations must be avoided (as might be the case with multiple units using one brine system or sharing a separate regeneration source) this setting allows a delay to be programmed. The delay prohibits another unit from entering the regeneration process until the delay period has expired.

The display will show the REGEN icon and "dELY 0" (Figure 87). The delay period is based upon hours (ranging from 0 to 9). To adjust the setting, use the "-" or "+" keys to scroll to the desired number of hours. Pressing the "-" or "+" keys for 3 seconds or more will cause the digits to scroll rapidly and at intervals greater than one at a time. Pressing the Status key will save the setting and move to the next programming step.

14. **Auxiliary Output#1 Contact Status/Cycle Number*** (Used only if a device is wired to the AUX 1 terminal on the circuit board).

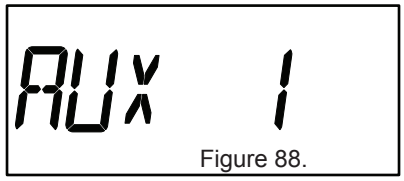


Figure 88.

This setting controls the AUX 1 output. The display will show "AUX 1" for two seconds and then flash the contact status display (Figure 88). The contact cycle status default setting is "OFF" (Figure 89) but can be toggled from "OFF" to "NO" (NO designates the contact as Normally Open) or "NC" (Normally Closed contact) with the "+" or "-" keys.

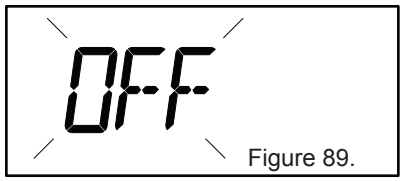


Figure 89.

If programmed to "OFF", the circuit board triac is not powered at any time.

Once the contact status is established, press the REGEN key. If the program indicates a "NO" or "NC" setting, the active cycle setting (Figure 90) will flash H (meaning Home or service), 1 (for cycle 1), 2 (for cycle 2), 3 (for cycle 3) or 4 (only if the valve is a five cycle valve). Whichever cycle is selected means the AUX 1 triac will send a 24vac signal to the device wired to it during the cycle indicated. To change the cycle use the "+" or "-" keys.

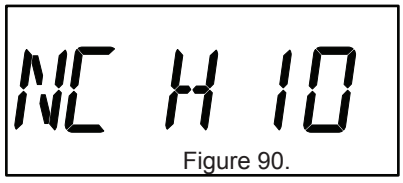


Figure 90.

Example of display showing **Normally Closed**, active in **Home** cycle for 10 minutes.

Once the cycle has been selected, press the REGEN key to adjust the minutes (adjustable from 1 to 99). The minutes setting indicates the period of time, in minutes, that the AUX 1 output triac is powered for "NO" (Nor-

mally Open) or inactive for “NC” (Normally Closed). Press the REGEN key to revert back to the contact status programming or the STATUS key to save the setting and move on to the next programming step. When powered, the AUX 1 icon shall be lit in the display.

Example Of Aux 1 Use - Set the program to “NO 3 15” to activate the brine refill valve. This setting will cause the refill valve to open and allow fresh water refill of the brine system for 15 minutes, starting as soon as the pilot valve rotates to the cycle 3 or Fast Rinse cycle. Refer to Appendix A, Table 15 on page 93 for more information on how long the refill time should last for the system being installed.

NOTE **If the control moves to the next cycle prior to the “AUX” signal timing out, the “AUX” will remain powered until the number of minutes programmed is complete.**

15. **Auxiliary Output#2 Contact Status/Cycle Number*** (Used only if a device is wired to the AUX 2 terminal on the circuit board).

    This programming step is identical to step 14. To program, repeat the process identified in programming step 14.

NOTE **If the system uses the Brine Reclaim option (DIP switch 10 ON), then this step of the programming will not be available. (See step 6B). However, AUX2 will be powered for exactly the amount of time programmed in “Cycle 2B”.**

Press the STATUS key to save the setting and move on to the next programming step.

16. **Beeper Setting*** - (All programs)

    The display will show “bEEP Y” (Figure 91) as the default setting. Changing the setting to “bEEP N” will deactivate the beeper from sounding. When active the beeper is active, the user will hear an audible tone (~70dBA) of one beep for a valid key entry and three beeps for invalid entries.

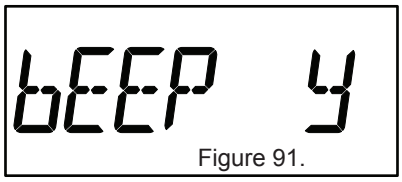


Figure 91.

17. **Screen Blanking & Lock/Unlock** - (All Programs)

    This setting allows the user to chose to have the MVP display turned on/un-blanked (“UbLANK”) or off/blanked (“bLANK”). If set to “bLANK”, the display will go dark after 5 minutes of no keypad activity. If “UbLANK” is chosen, the display will always be active. To chose, toggle between the settings using the “+” or “-” keys.

    This program will also allow the programming of the control to be restricted. Restricting the control will allow only the Time of Day and the lock/unlock features to be accessed without first unlocking the programming restriction.

    To enable the lockout feature, press the “+” and “-” keys simultaneously while in the Screen Blanking mode. When the lockout feature is active the display will show the lock icon (Figure 92).

Lock Icon

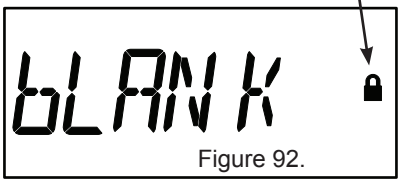


Figure 92.

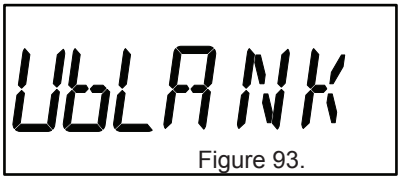


Figure 93.

    To unlock the control, press the Status key. Using the Status key scroll through the program until the “bLANK”/”UbLANK” (Figure 93) screen is displayed. Press the “+” and “-” keys simultaneously until the lock icon is no longer displayed.

NOTE **Pressing the Status key will save the setting, exit the programming mode and return to the current time display. If one control has been designated as the MASTER unit, the programming will continue as described in step 18.**

18. **Programming Connected Controls** - (Multiple Units using Communication Cabling)

If multiple units are connected with the multiple communication cable AND one of the controls is designated as MASTER (DIP switch 9 set ON), the MASTER control shall be able to update the programs of other, connected controls, if the controller ID number's have been established. (See page 42)

Once the Status key is pressed following the Screen Blanking step of the programming, the display will show "UpdAtE" (Figure 94) for 2 seconds and then display a default of "YES". The MASTER icon will also be lit while in these two display screens. The "YES" (Figure 95) and "NO" settings are toggled using the "+" or the "-" keys. If a "YES" response is programmed, the program settings from the MASTER unit will be sent and copied to the other MVP control boards once the status key is pressed to return to the time of day display. A "NO" response followed by a press of the Status key ends the programming mode for that particular controller and returns the control display to a time of day display.

This feature may be used at any time to update the program of all controls in a system. Simply repeat the programming steps (1-17) that apply to your system. If enabled, you will be prompted to update all other controls upon reaching step 17.

Once all programming has been completed, the system is ready to provide treated water.

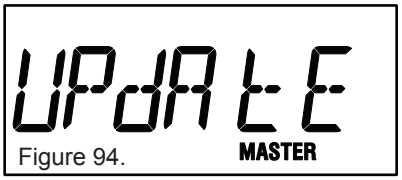


Figure 94.

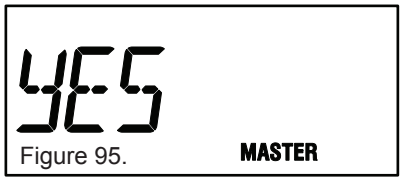


Figure 95.

Program Log

Use this section to record the program settings for this system. It is also suggested that additional copies be made and kept on file near the installation and with the local Culligan dealer.

Program Date:		Installer:		Site Location:	

Dip Switch Settings (circle setting) Board #1		
Switch #	**Abbreviation**	**Setting**
1	R/T	Off / On
2	0/00	Off / On
3	P/A	Off / On
4	D/I	Off / On
5	12/24	Off / On
6	-/TCB	Off / On
7	SO/FI	Off / On
8	D/H	Off / On
9	-/M	Off / On
10	-/BR	Off / On

Other Boards - Use if Multiple Tanks (circle setting)		
Switch #	**Abbreviation**	**Setting**
1	R/T	Off / On
2	0/00	Off / On
3	P/A	Off / On
4	D/I	Off / On
5	12/24	Off / On
6	-/TCB	Off / On
7	SO/FI	Off / On
8	D/H	Off / On
9	-/M	Off / On
10	-/BR	Off / On

Regeneration Initiation (check all that apply): ☐Time Clock ☐ Meter ☐Aqua-Sensor ☐ Other

Program Step	Program Name	Program Setting	Notes
1	Time of Day	Current Time	Dependent on actual Time. Do not record.
2	Time of Regeneration		Only active if DIP switch 4 is off or if 6 is ON.
3	Meter “K” Factor		Only active if flow meter is attached to board
4	Auxiliary Input Delay		Only active if AUX IN is used.
5	Cycle 1 Time		
6	Cycle 2 Time		
6A	Cycle 2A Time		Only active if DIP switch 10 is ON.
6B	Cycle 2B Time		Only active is DIP switch 10 is ON.
6C	Cycle 2C Time		Only active if DIP switch 10 is ON.
7	Cycle 3 Time		
8	Cycle 4 Time		Only active if valve is a 5 cycle valve.
9	Regeneration Interval		Only active if no flow meter and/or Aqua-Sensor is detected OR if DIP switch 6 is ON.
9A	Specific Day(s) of Week Regen		Only active on single units not using a flow meter and/or Aqua-Sensor.
9B	Current Day of Week		Only active if 9A is programmed.
10	Batch Set Point		Only active if a flow meter is detected
11	Maximum Capacity Set Point		Only active if a flow meter is detected.
12	Progressive Trip Point		Only active if a flow meter and communication cable are attached AND DIP switch 9 is ON.
13	Regeneration Start Delay		
14	Auxiliary Output #1 Contact Status/Cycle Number		Only active if a device is wired to AUX 1 terminal.
15	Auxiliary Output #2 Contact Status/Cycle Number		Only active if a device is wired to AUX 2 terminal AND DIP switch 10 is OFF.
16	Beeper Setting		
17	Screen Blanking		

Initiating A Regeneration Cycle

After all programming has been completed, the operator may elect to step each MVP control through a regeneration cycle to verify the proper operation. Perform the following steps, completing one controller at a time before moving on to the next controller (if there are more than one in the system).

NOTE **For Multiple Tank Systems: If the Regeneration Start Delay (Step 12 of the programming) has been programmed, it is advisable to temporarily re-program that portion for zero (0) minutes. Once a regeneration has been initiated, the Regeneration Start Delay cannot be overridden (other than through a loss of power).**

1. While in the service mode press the Statistics key.
2. Press the "+" key to display the current motor position i.e.: "H 00"
3. Press the Regeneration key on the MVP keypad once for five seconds. The Stand By Indicator light will come on and the REGEN icon will blink. The position dial should rotate clockwise to the #1 cycle within 1 minute. There will be a flow of water to drain (Figure 96).
4. If desired, the unit will automatically advance through the regeneration process in about 80 minutes (depending on the total amount of time programmed into the regeneration cycles). To simply move through each cycle of the regeneration sequence, proceed to step five. Otherwise the controller shall automatically display the regeneration step, time remaining of the cycle and, if active (in motion) a hyphen (Figure 97, Figure 99, and Figure 101) to indicate the motor is rotating.

NOTE **The colon (:) between the cycle number and time will only appear if a flow device is present.**

5. To move to cycle #2, press the "+" key one time. The display will change and the pilot will rotate.
6. Once the pilot has completed its rotation, press the "+" key again to move the pilot to cycle #3 of the regeneration sequence.
7. After the pilot stops in cycle #3, one more push of the "+" key will advance the pilot and program back to the home (service) position. If the unit is part of a multiple unit system, the Stand By Indicator light should illuminate until the unit is brought online.

NOTE **If the "-" key is pressed at any time, the control will move back to the first statistics menus. Pressing the "+" key from the Statistics menu will move the display back to the current diagnostic cycle.**

The "+" key will be ignored once the control returns to the H or home position.

Cam advances to backwash position.

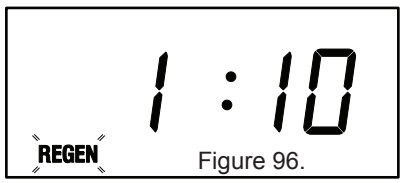


Figure 96.

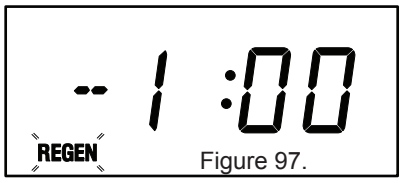


Figure 97.

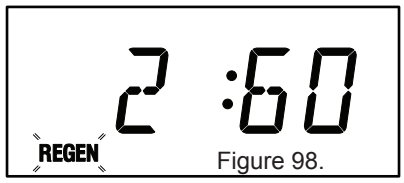


Figure 98.

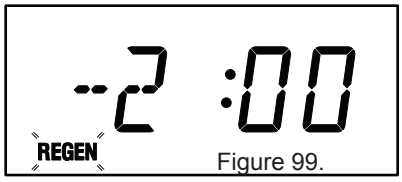


Figure 99.

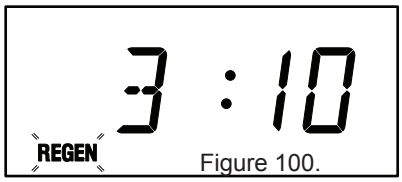


Figure 100.

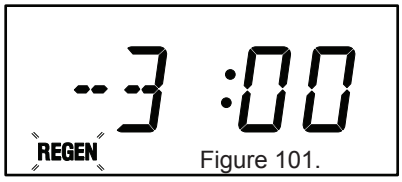
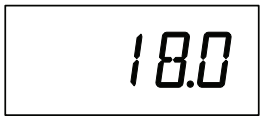
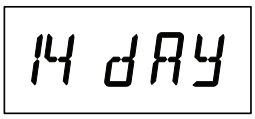
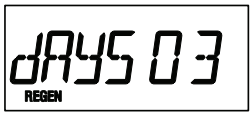
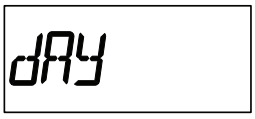
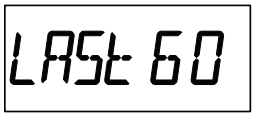


Figure 101.

Culligan MVP Control Statistic Functions

The Culligan MVP control has the ability to provide statistical information about the system. This data is accessed through the Statistics key. To move through the statistical data available, use the "-" key. Each push of the "-" key will display new information. The following table briefly defines the data available while in this mode. The actual data to be displayed will depend on your type of system (for example, flow data is only show on units utilizing a flow meter).

Display One	Display Two (Example)	Display Description
		**Flow rate** of water passing through the unit. Display 1 will be shown for 2 seconds followed for 10 seconds by Display 2. It will repeat this cycle as long as the "-" or Statistics key(s) are not pressed. Flow rate is determined using the following formula: Pulses per minute/ "K" factor per unit = Displayed Flow Rate. **NOTE The MASTER unit will display the total system flow of all online units.**
		Capacity Remaining - The capacity remaining in the batch before regeneration will be initiated. The display will show Display 1 for 2 seconds then show the remaining capacity (Display 2) for 10 seconds. It will repeat this cycle as long as the "-" or Statistics key(s) are not pressed.The X10 or X100 icon shall also be illuminated (depending on DIP switch 2).
		Total Flow Since Installation - The flow totalizer. This shows the total amount of water that has passed through the individual unit since the unit was installed. Display 1 will be shown for 2 seconds followed by the total flow data (Display 2) for 10 seconds. The X10 or X100 icon shall also be illuminated (depending on DIP switch 2). The .0 section of the display will indicate the number of times the counter has rolled over up to 9 times. After 9 rollovers, the counter starts at 0.
		**Number of Regenerations in the Last 14 Days** - Display 1 will illuminate for 2 seconds followed by the number of regenerations that the unit has completed in the last 14 days (Display 2) for 10 seconds. The controller will not count regenerations if stepped past the last cycle manually.
	None	**Number of Days Since Last Regeneration** - Display 1 will illuminate to indicate the number of days that have passed since the last regeneration was completed. There is no Display 2. The controller will not count regenerations if stepped past the last cycle manually.
		Total Number of Regenerations for Life of Unit - Display 1 will illuminate for 2 seconds followed by the number of regenerations that the unit has completed since it was installed (Display 2) for 10 seconds.
		**Current Day of Week** - If operating as a single unit and the unit is programmed to regenerate on a specific day of the week, Display 1 will illuminate for 2 seconds followed by the current day of the week (Display 2).
	None	**Last Slow Rinse Time** - If operating with an Aqua-Sensor Display 1 will illuminate and indicate the number of minutes of the last slow rinse cycle as controlled by the Aqua-Sensor device.
	None	**# Connected Units** - The display indicates the number of controls in the system. It will only be displayed if ID#'s have been assigned and saved in EEPROM, if DIP switch 9 is ON or if the control is the MASTER unit in a multiple control system.
		Progressive Flow Trip Point - This shows the programmed trip point for the progressive flow feature only in a MASTER unit. Display 1 will be shown for 2 seconds followed by the trip point in flow units per minute (Display 2).

Final Start-up

Pressurize the Media Tank

1. Slowly open the manual inlet isolation valve about 1/3 open and allow the media tank to slowly fill with water to the top access opening. Some flow to the drain may occur since the pilot valve is not yet pressurized. Then close the manual inlet isolation valve.
2. Replace the top access opening and secure it closed.
3. Make sure the position dial on the pilot valve is in the H (Home) position. If it is not in the H (Home) position, rotate the position dial by hand to the H (Home) position. Rotate the dial only in the direction indicated on the position dial.
4. Slowly open the manual inlet isolation valve about 1/3 open and allow media tank to pressurize.
5. Check the media tank and piping for leaks. If leaks occur shut the system down and depressurize the unit, following the instructions on page 65 for depressurization procedures. Once the filter has been depressurized and the media tank has been drained, disconnect the piping at the source of the leak and apply either Teflon tape or sealant paste on the piping threads.
6. Re-pressurize the system, per steps 1 through 4 above.
7. Open the manual inlet isolation valve completely. Re-tighten hand-hole or manhole covers that utilize a nut and bolt type attachment, since these fasteners may loosen when the media tank is pressurized.

Bleeding the Air from the System

At start-up, it is desirable to bleed air from the controller pilot valve tubing by loosening the tubing nut (brass fittings) or disconnecting the tubing from the fitting (push-in fittings) at the Brunermatic valve diaphragm caps, while under pressure. When water squirts from the fitting, tighten or reconnect the tubing to the fitting. DO NOT excessively tighten the nuts on the brass fittings.

Bleed the valves in the following sequence:

1. Insure the position dial is in the H (Home) position. Bleed valves 2, 5, 6 and 17.
2. Manually rotate the position dial to position #1. Bleed valves 1 and 4.
3. Manually rotate the position dial back to the H (Home) position.

Initial Backwash of the System

1. Manually rotate the position dial to the #1 position. Backwash the media for 10 minutes or until the drain water is clear.
2. After the backwash is complete, manually rotate the position dial back to the H (Home) position.

Installation Wrap Up

Fill the Salt Storage Container

Before filling the brine tank with salt, refer to Appendix A, "Table 15. CSM Refill Minutes/Salt Dosage/Capacity" on page 93 to find the salt dosage/capacity rating per regeneration

Dry storage

If the salt dosage/capacity rating falls within the non-shaded area, fill the storage container to within a few inches of the top. This is called “dry salt storage”, (Figure 102). When the proper amount of water is returned to the salt storage tank during brine refill, the salt level is higher than the water level.

Wet storage

If the salt dosage/capacity rating falls within the shaded area, the amount of salt that can be put in the salt container is limited. Since the salt level will be below the water level, this is called “wet salt storage”, Figure 103. When the correct amount of water has been returned to the salt storage tank, all the salt is under water.

Refer to refer to Appendix A, Table 16 on page 94 - to determine how much salt can be added.

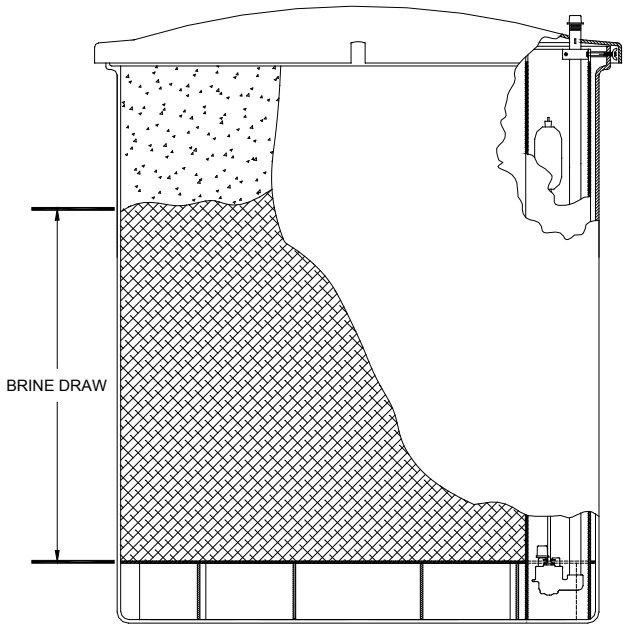


Figure 102.

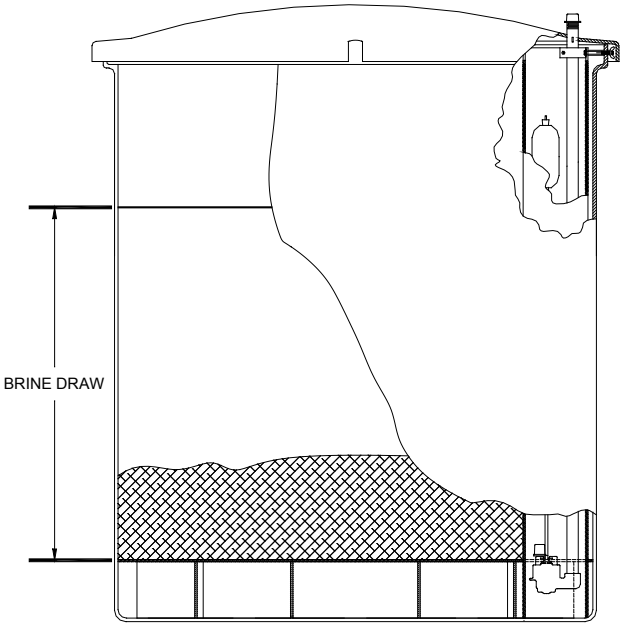


Figure 103.

Creating Brine

Once salt has been added to the brine tank the control valve must be manually cycled to the fast rinse/brine refill cycle to create the required amount of brine for the unit’s first regeneration. Allow the valve to refill for the programmed time.
IF THIS IS NOT DONE THERE WILL BE NO BRINE FOR REGENERATION.

NOTE	**The salt level must be checked frequently, in some cases after each regeneration. After the brine refill step is finished, add salt. To ensure complete brine saturation in wet storage, maintain a salt depth of at least 18 inches.**

Before Leaving the Installation Site

1. Retighten the nuts on all hand-hole covers, if applicable.
2. Clean up the unit and the installation site, removing any soldering or pipe threading residues from the equipment with a damp towel.
3. For units with steel tanks, place the Culligan label (packed with the media tank) on the front of the tank.
4. Explain the operation of the softener and bypass valves to the customer.
5. Advise the customer to check and replenish the salt supply regularly.

Wrap Up Checklist

Once you have completed the installation the system is ready to be placed in service. Prior to placing the system in service review the following checklist to be sure the system is properly installed.

CHECK LIST

- ☐ The media tank(s) has been properly loaded with gravel and media.
- ☐ Retighten the nuts on all hand-hole covers, if applicable. The drain line has been properly installed.
- ☐ All option kits have been properly installed.
- ☐ The system has been properly piped and tubed.
- ☐ Air has been bled from the MVP controller pilot valve tubing and the system has been properly pressurized.
- ☐ Each media tank has been backwashed manually.
- ☐ The MVP controller(s) have been correctly and completely wired, including differential pressure switches if equipped.
- ☐ All MVP controllers have been properly programmed and are active (power on).
- ☐ All manual isolation valves are open and system by-pass valves are closed.
- ☐ Clean up the unit and the installation site, removing any soldering or pipe threading residues from the equipment with a damp towel.
- ☐ For units with steel tanks, place the Culligan label (packed with the media tank) on the front of the tank.
- ☐ Explain the operation of the system and the Suggested Preventative Maintenance Inspection Schedule (page 58) to the customer.

Suggested Preventative Maintenance

Sanitizing Procedure

A water softener in daily use on a potable water supply generally requires no special attention other than keeping the salt tank filled. Occasionally, however, a unit may require sanitization under one of the following conditions:

- At start-up time.
- After standing idle for a week or more.
- On private supplies, the appearance of off-tastes and odors, particularly if musty or “rotten egg” (caused by harmless sulfate-reducing bacteria).

NOTE **If the water supply contains iron, regenerate the softener before sanitizing to remove iron from the resin.**

CAUTION! **HAZARD FROM TOXIC FUMES! CHLORINE BLEACH AND COMMON IRON CONTROL CHEMICALS MAY GENERATE TOXIC FUMES WHEN MIXED.**

- **IF THE UNIT USES CULLIGAN SOFNER-GARD® OR OTHER COMPOUNDS CONTAINING SODIUM HYDROSULFITE, SODIUM BISULFITE, OR ANY OTHER REDUCING AGENT, DISCONNECT THE DEVICE FEEDING THE CHEMICAL(S) AND MANUALLY REGENERATE THE UNIT BEFORE SANITIZING.**
- **DO NOT USE THIS PROCEDURE IF THE SOFTENER SALT CONTAINS IRON CONTROL ADDITIVES.**

1. Remove the brine tank cover.
2. Pour directly into the brine chamber one-cup of common household bleach (5.25% sodium hypochlorite) for each cubic foot of resin in the tank.
3. Manually start recharge. Allow the unit to complete the recharge cycle automatically.

If tastes and odors return frequently, even after sanitization, a continuous chlorination system may be needed. Send a water sample to a qualified laboratory for bacterial analysis.

Analyzing the System

Analyzing the problem involves three basic steps:

1. Check the system in all cycle positions.
2. Compare the data to normal operating data.
3. Determine which component may cause the problem (troubleshooting).
4. If steps 1-3 did not reveal the problem, initiate a regeneration cycle and manually cycle the valve to brine draw (#2 position). Allow the unit to complete the brine draw cycle and observe how the system reacts.

Although it may be possible to solve a specific problem simply by changing a component, analyzing the entire system can reveal additional problems which would otherwise require extra service calls. “Parts changing” is not the same as service.

Check the System

The following tools are needed to collect data:

- Hardness, iron and chlorine test kits
- Thermometer
- Pressure gauge, 0-120 psi
- 5-Gallon bucket and watch
- Calculator

The customer can provide most data. By collecting data prior to a service call, a “first guess” about the cause of the problem can be made and the need for any special parts can be determined. If the problem is as simple as lack of salt in the brine tank, a service call may not be needed at all. At the end of Appendix A is a recommended system data sheet that will assist the troubleshoot process.

Application Problems

Many service problems are not due to equipment malfunction, but rather to misapplication or environmental conditions.

The Operation & Performance Specifications

(page 2 of this manual) provides the limits of water characteristics for the CSM Series water softeners. If the water characteristics fall outside these limits, additional water treatment equipment may be required, or the water characteristics should be brought inside the limits. The system flow rates and exchange capacities are also listed.

Appendix A, "Table 14. CSM Series Water Softeners - Flow Rate Data (GPM)"

The backwash, brine, and slow rinse flows should not differ from those in Appendix A, "Table 14. CSM Series Water Softeners - Flow Rate Data (GPM)" on page 92 by more than 15%.

Appendix A, "Table 15. CSM Refill Minutes/Salt Dosage/Capacity"

This table shows the hardness removal capabilities for each unit as a function of salt dosage and refill time. Multiply the inlet hardness times the maximum daily water usage to determine the daily capacity requirement. If the hardness or water usage has increased, a higher salt dosage, more frequent regeneration, or a larger softener may be needed.

NOTICE	**The rate at which brine is drawn from the brine tank should not differ by more than 5%. The refill rate should be as close as possible to the rate shown in Appendix A, "Table 14. CSM Series Water Softeners - Flow Rate Data (GPM)" on page 92; high or low pressure installations may require the substitution of a different refill flow control.**

If there are no apparent general problems or environmental problems, refer to "Troubleshooting Guide" on page 60.

Suggested Preventative Maintenance Inspection Schedule

The Culligan CSM series commercial water softener has been designed to provide a good, consistent service life. Routinely inspecting the system may help avoid potentially costly breakdowns related to circumstances outside of the control of the dealer and/or user.

Component	Suggested Inspection Frequency	Reason for Maintenance
Entire System	At Start-up, after infrequent use (idle for one week or more) or every 3 - 6 months if on a private water supply.	On private supplies, the appearance of off-tastes and odors, particularly if musty or “rotten egg” (caused by harmless sulfate-reducing bacteria) may indicate a need for the system to be sanitized. See page 57.
Backwash Flow	Every 12 months or every time service is performed on the system.	Build up of sediment, iron and/or other foreign materials (found in some water supplies but not necessarily all) could negatively affect system performance.Monitor item for normal (or unexpected) wear
Controller	Every 6-12 months or every time service is performed on the system.	Build up of sediment, iron and/or other foreign materials (found in some water supplies but not necessarily all) could negatively affect system performance.Monitor item for normal (or unexpected) wear.
Pilot Valve Assembly	Every 6-12 months or every time service is performed on the system.	Build up of sediment, iron and/or other foreign materials (found in some water supplies but not necessarily all) could negatively affect system performance.Monitor item for normal (or unexpected) wear.
Brunermatic Valve	Every 6-12 months or every time service is performed on the system.	Build up of sediment, iron and/or other foreign materials (found in some water supplies but not necessarily all) could negatively affect system performance.Monitor item for normal (or unexpected) wear.
Pilot Strainer	Every 6-12 months or every time service is performed on the system.	Build up of sediment, iron and/or other foreign materials (found in some water supplies but not necessarily all) could negatively affect system performance.
Softening Media	Every 2 - 3 years	Chlorinated water supplies can break down/destroy resin material. Resin material may also perform poorly if subjected to other materials (sediment, iron, alum, etc) found in some water supplies (but not necessarily all).

Diagnostics

Culligan MVP Control Test Functions

The Culligan MVP control has a diagnostic feature that allows the user to verify the operation of the board components. Moving DIP switch 1 from “R” (Run) to “T” (Test) or the ON position enters the test mode. (See Figure 59 on page 39 or Table 9 on page 40).

The program settings and statistical data will be stored in EEPROM. Before proceeding it is recommended that the current DIP switch settings be noted so they can be restored before exiting the test mode.

NOTE	**DIP switch settings can be changed during the test mode to verify their operation. If a flow device and/or Aqua-Sensor device is disconnected DURING the test process, it should be reconnected before exiting the test mode. Moving DIP switch 1 to an ON position begins the test mode. Moving DIP switch 1 to OFF ends the test mode and the program is re-established using the data written to EEPROM (unless a DIP switch setting or board connection is different from when entering the test mode.**

Figure 104 illustrates the various icons and information to be illuminated in the controller display using the test process. Refer to the chart on the following page for specific icons and information to be illuminated during each step of the test process.

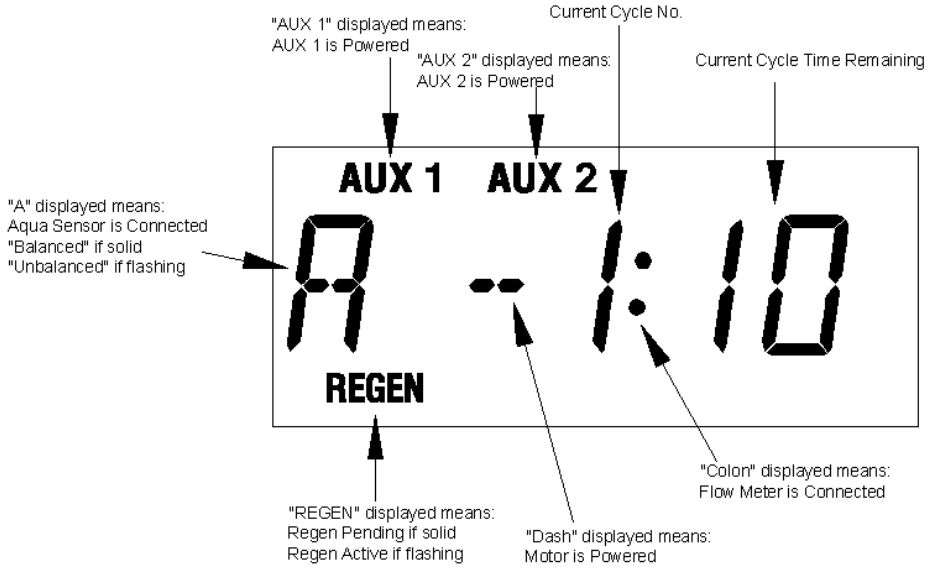


Figure 104.

When testing is complete, the unit will home the control and return to service (on line) or stand by (off line).

The following chart provides a description, display information and the required action to trigger the next step of the test mode.

Test Description	Display Information	Action Trigger
Start Test Mode	All LCD segments lit	DIP switch #1 set to on, all others off
Verify software version	Software version #	Press a key after entering test mode as above
Enter test mode	Blank Display	Press a key after displaying the software version #.
DIP switch #2	Display to show “2”	Turn on DIP switch # 2
	Display to Blank	Turn off DIP switch #2
DIP switch #3	Display to show “3”	Turn on DIP switch # 3
	Display to Blank	Turn off DIP switch #3
DIP switch #4	Display to show “4”	Turn on DIP switch # 4
	Display to Blank	Turn off DIP switch #4
DIP switch #5	Display to show “5”	Turn on DIP switch # 5
	Display to Blank	Turn off DIP switch #5
DIP switch #6	Display to show “6”	Turn on DIP switch # 6
	Display to Blank	Turn off DIP switch #6
DIP switch #7	Display to show “7”	Turn on DIP switch # 7
	Display to Blank	Turn off DIP switch #7
DIP switch #8	Display to show “8”	Turn on DIP switch # 8
	Display to Blank	Turn off DIP switch #8
DIP switch #9	Display to show “9”	Turn on DIP switch # 9
	Display to Blank	Turn off DIP switch #9
DIP switch #10	Display to show “10”	Turn on DIP switch # 10
	Display to Blank	Turn off DIP switch #10
DIP switches #7 & #10 together	Status LED to flash- (COMM TX) - Board transmits a signal	Turn on DIP switches #7 & #10
	Status LED to stay on- (COMM RX) - If board receives a signal the LED will flash	Turn off DIP switches #7 & #10
Status Key	Display to show “11” and motor to run for 15 seconds	Press Status key
+ Key	Display to show “12” and blocking valve triac to power for 15 seconds	Press + key
- Key	Display to show “13” and auxiliary #1 triac to power for 15 seconds	Press - key
Regen Key	Display to show “14” and auxiliary #2 triac to power for 15 seconds	Press Regen key
Statistics Key	Display to show “15”	Press Statistics key
Auxiliary Input	Display to show “16” when auxiliary input is closed	Close Auxiliary Input
	Display to Blank when open	Open Auxiliary Input
Home Switch	Display to show “H” when Home switch closed	Close Home Switch
	Display to Blank when open	Open Home Switch
Position Switch	Display to show “P” when position switch closed	Close Position Switch
	Display to Blank when open	Open Position Switch
Flow Meter	Display to show x10 icon when flow meter is connected	Connect Flow Meter
	Display to blink x10 icon when meter is sending pulses	Spin Flow Meter
Aqua-Sensor	Display to show “REGEN” icon when Aqua-Sensor is connected & balanced	Connect & Balance Aqua-Sensor
	Display to blink “REGEN” icon when unbalanced signal received	Unbalance Aqua-Sensor

Troubleshooting Guide

PROBLEM OR SYMPTOM	CHECK PROCEDURE	CAUSE
Slight Leak to Drain	Disconnect pilot valve tubing at backwash control.	Flow from tubing indicates leaky seal in pilot valve spool.
	If pilot valve is not leaking, use a test kit and check for hard water at the drain.	Possible ruptured diaphragm. If water tests soft then valve #6 is open. If the water tests hard then valve #5 is open.
High Flow to Drain During Service	Check position dial pilot.	If not in the H (Home) position, rotate the dial in the direction of the arrow indicator on the dial to the home position. If the flow stops, check the pilot drive assembly.
	Use a test kit and check the hardness of the water at the drain.	Use a test kit and check the hardness of the water at the drain. soft then valve #6 is open. If the water tests hard then valve #5 is open.
Failure to Draw Brine	Check that the brine line is unrestricted.	Restrictions will not allow the system to draw brine.
	Check the water pressure.	Water pressure must be a minimum of 30 psi during regeneration.
	Verify the pilot is in the #2 (brine draw) position.	If the pilot is not in the proper position for the brine draw/slow rinse cycle, the system will not draw brine. Check the pilot drive assembly.
	Verify there is a vacuum on the brine line. Disconnect the tubing to the brine valve and feel for suction.	If there is a vacuum, the brine valve should be checked for proper operation. No vacuum indicates: • Drain line is too small or discharging at a level too high above the floor. • The pilot strainer is plugged. • Plugged brine injector nozzle. • Valves #1, #2 or #4 are not closing fully. Possible ruptured diaphragm. • Plugged backwash flow controller. • Dirty resin bed. • Valve #6 not opening.
Diaphragm Valve Does Not Close. **CAUTION: make certain that the water pressure is relieved from the system before removing any diaphragm valve cover.**	Loosen the tubing from the valve port cover. Turn off the water pressure and disassemble the diaphragm valve.	If there is no flow from the tubing, the pilot strainer may be plugged. • Seat washer may be dirty, worn or loose. • Seat may be eroded. • Diaphragm may be ruptured.
Diaphragm Does Not Open	Loosen the tubing from the valve port cover.	If there is flow from the tubing the pilot valve spool seal is leaking.If there is no flow, verify that the tubing from the diaphragm valve cover to the pilot body is not plugged.

PROBLEM OR SYMPTOM	CHECK PROCEDURE	CAUSE
Hard Water Leakage Into the Service Lines. **CAUTION: make certain that the water pressure is relieved from the system before removing any diaphragm valve cover.**	Loosen the tubing on the Brunermatic bypass valve #17 Close the inlet and outlet valves and inspect the Brunermatic bypass valve.	If no flow from the tubing the pilot strainer is probably plugged. • Seat washer may be dirty, worn or loose. • Seat may be rough or eroded. • Diaphragm may be ruptured.
	Check that valve #2 is seating.	Build-up on the inside of the valve cavity may be preventing the diaphragm assembly from seating in the guide cage.
Restricted or No Service Flow	Either valves #1 or #4 are not opening fully. To determine which one, turn the pilot to position #1. Observe the flow to the drain. Rotate the pilot to position #3 and compare the flow of water in position #3 to the flow in position #1. Return the pilot to H (Home).	Flow should be the same for both positions but if not: • Valve #4 is not opening properly. • If backwash (position #1) is higher, then valve #1 is not responding properly.
	Potentially clogged distributors or compacted media bed.	Failed distributors. Contamination of resin bed.
Restricted or No Drain Flow During Backwash	Turn the pilot to Position #1 and then to position #3, comparing the rate of flow to the drain. Return the pilot to H (Home).	Flow should be the same. If not: • If the flow in position #3 is low, see Restricted or No Service Flow Check Procedures and causes. • Inlet water pressure may be low. • Backwash flow control may be plugged. • If flow rate in position 3 is greater than position 1 then valves #2 and #5 are not functioning properly
Media to Service	Check tank distribution system	Broken lateral Bad distributor.
Media to Drain	High flow of water to drain.	Check/replace backwash flow control washer(s).
	Air in system	Brine valve did not air check, allowing air into media tank. Air from source other than water softener. Eliminate source or install air vent in top of tank.
Leak From End of Pilot Body	Visually inspect u-cup and seals on pilot valve spool.	Worn or pinched u-cup or a scratch on the pilot valve spool.

PROBLEM OR SYMPTOM	CHECK PROCEDURE	CAUSE
Pilot Does Not Pressurize or Vent Valve Ports Properly	Check Screen on Pilot Strainer	Clogged Screen prevents control pressure from reaching pilot valve (and solenoid valves if applicable).
	1. Manually rotate the pilot (in the proper direction) as required until the valve(s) in question should be closed. (Refer to the valve flow diagrams on page 66). Remove the control tubing from the valve port cover and check for water from the tube. 2. Manually return the pilot to the H (Home) position.	If water flows out of the control tubing, check the fitting in the valve port cover for an obstruction.If water does not flow out of the control tubing, check the control tubing and fitting in the pilot body for an obstruction.
	1. While in the H (Home) position and not in stand by (multiple units with blocking solenoids), remove the control tubing from the valve port covers 1#1 and #4. 2. Reconnect the tubing removed in step #1. Manually rotate the pilot (in the proper direction) to the #1 position. Remove the control tubing from valve port covers #2 and #5. Also remove the control tubing from port #17 on units with the B-brunermatic bypass valve operated by the pilot. 3. Reconnect the tubing removed in step #2. Manually advance the pilot (in the proper direction) to the #2 position. Remove the control tubing from valve port cover #6. 4. Reconnect the tubing removed in step #3. Manually advance the pilot (in the proper direction) to the H (Home) position).	1a. If water flows from the control tubing, perform service on the pilot valve (and/or blocking solenoid valve(s) if used). 1b. If water flows from the valve port cover(s) perform service on the diaphragm valve assembly(ies). 2 & 3a. If water flow from the control tubing, perform service on the pilot valve. 2 & 3b. If water flows from the valve port cover(s) perform service on the diaphragm valve assembly(ies).
Softener Tank Does Not Remain in Stand By Mode or Will Not Provide Water Thru the Outlet of the Brunermatic Valve When in Service (Only systems using blocking valves)	Verify operation of the solenoid valve operation port #4 of the Brunermatic valve.	Solenoid valve may not be properly wired or water hardness scale build-up inside solenoid is causing malfunction.

Problem or Symptom	Error Description	Mode of Detection	Possible Causes/Remedies
MVP Control Display Error ERR1 (The control will not function while an Error is displayed or detected.) To clear an alarm condition after correction, press and hold the Status key for 10 seconds. The control will then cycle the valve to the home position. You may also power down the control for 60 seconds or toggle a DIP switch. If the problem is still present after attempting to clear the error code, the code will remain in the display.	Motor Failure to Start	The error will occur if the valve fails to reach the desired state within 2 minutes of driving the motor. The control will attempt to start the motor 3 times for 2 minutes each time with a 60-second off period between each attempt.The control will power down all triacs until the problem is corrected. The control beeper will sound 3 times per second every 30 seconds until any key is pressed.	1. Poor motor - Replace 2. Bad Cam - Inspect/Replace. 3. Bad/loose wiring-Inspect/Repair. 4. Problem with MVP circuit board - run Test program to verify operation of board components. 5. Pilot spool is bound, prohibiting motor from moving-Inspect/Repair. 6. Micro-switches not functioning/sticking -Inspect/Replace.
MVP Control Display Error ERR2 To clear an alarm condition after correction, press and hold the Status key for 10 seconds. The control will then cycle the valve to the home position. You may also power down the control for 60 seconds or toggle a DIP switch. If the problem is still present after attempting to clear the error code, the code will remain in the display.	Motor Failure to Stop	If the control detects changes in the cam inputs when the motor is not supposed to be turning.	1. Poor motor - Replace 2. Problem with MVP circuit board - run Test program to verify operation of board components. 3. Micro-switches not functioning/sticking -Inspect/Replace.
MVP Control Display Error ERR3 To clear an alarm condition after correction, press and hold the Status key for 10 seconds. The control will then cycle the valve to the home position. You may also power down the control for 60 seconds or toggle a DIP switch. If the problem is still present after attempting to clear the error code, the code will remain in the display.	Incorrect Cycle Position	The control expects to be in a different position than that indicated by the cam switch closures.	1. Poor motor - Replace 2. Bad Cam - Inspect/Replace. 3. Bad/loose wiring - Inspect/Repair. 4. Problem with MVP circuit board - run Test program to verify operation of board components. 5. Pilot spool is bound, prohibiting motor from moving. - Inspect/Repair. 6. Micro-switches not functioning/sticking -Inspect/Replace.
MVP Control Display Error ERR4 To clear an alarm condition after correction, press and hold the Status key for 10 seconds. The control will then cycle the valve to the home position. You may also power down the control for 60 seconds or toggle a DIP switch. If the problem is still present after attempting to clear the error code, the code will remain in the display.	Units Have the Same ID	The error occurs when multiple units are connected and an ID number is shared between multiple controls.	Refer to page 39 and the section on Multiple Unit Communication Setup and re-establish ID's.

Procedure for Depressurizing the Brunermatic Valve and System for Service

Complete shut down procedure is as follows:

1. Disconnect the electrical power to the MVP controller.
2. Make certain that the lines you shut off are for the system you are performing service on.
    a. Open by-pass valve if one is available.
    b. Close the inlet isolation valve.
    c. Close the outlet isolation valve.
    d. Close the manual brine valve (If installed).
    e. Close the separate source isolation valve if one is available.
    f. Any external source of pressure to the pilot valve.
3. Rotate the position dial on the pilot valve to position #1.
4. Open the soft water sample cock.
5. Make certain that there is no pressurized water coming out of the sample cock. If pressurized water is flowing from the sample cock, retrace your steps.
6. Once the tank has been depressurized, open the resin tank cover and allow the tank to drain down so the water level is below the valve height. Be prepared to replace hand-hole O-ring or cover gasket (ASME code tanks) or manhole cover gasket.
7. Proceed with servicing the CSM System.

We suggest the use of “a mild cleaning solvent” and a “silicone lubricant.” We suggest the following brands or their equivalents:

Solvent: Simple Green — water soluble for removing corrosion and dirt.

Lubricant: Dow Corning #111 — silicone grease.

Brunermatic Valve Flow Diagrams & Flow Control Assembly Service

Flow patterns for the regeneration and service cycles are governed by the individual diaphragm valves. These valves close when under pressure and open when pressure is vented. Each is identified by a number cast on the front of the main valve body.

Control tubing connects each numbered valve with the MVP Controller.

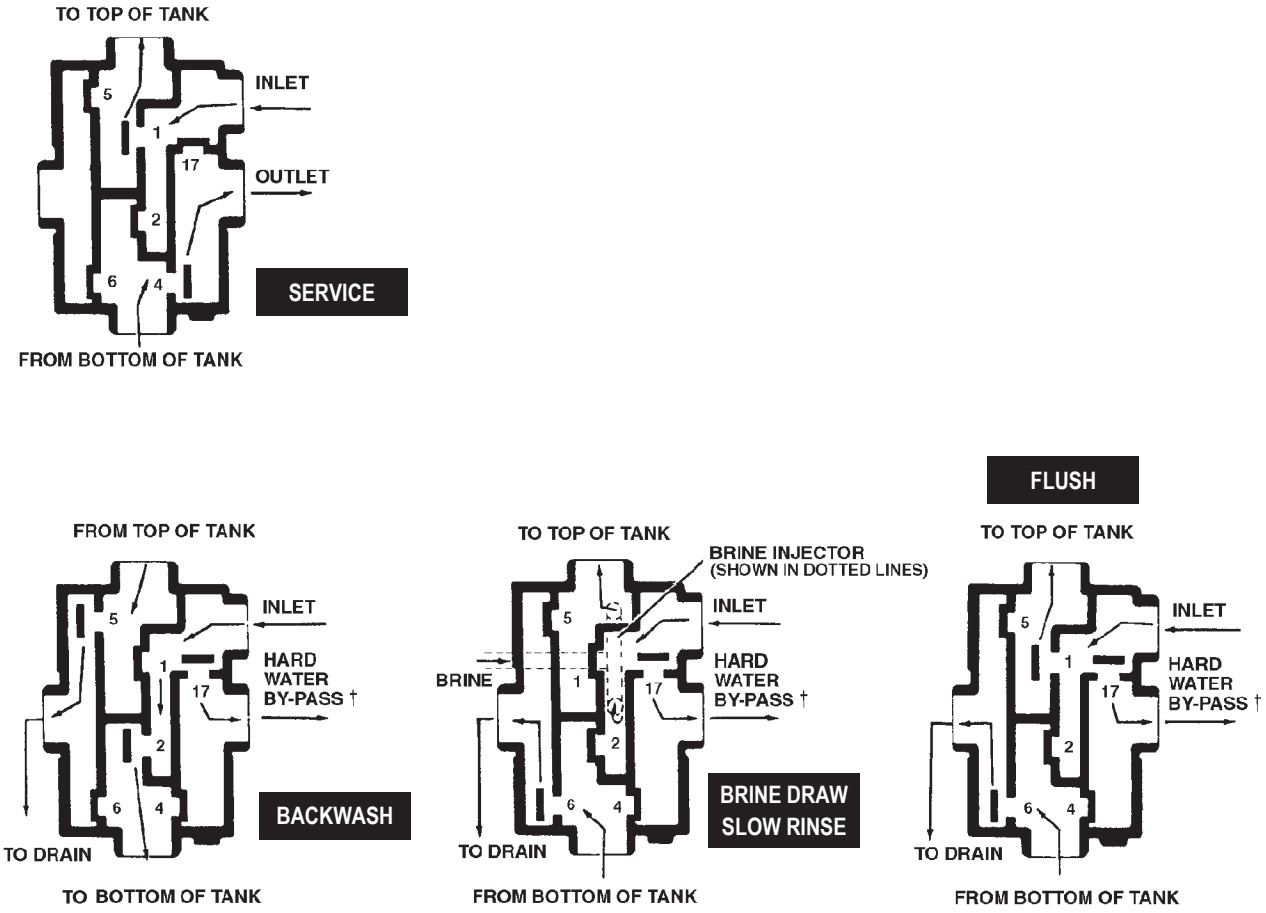


Figure 105.

†Hard water by-pass valve normally used only on single unit.

Table 11.

Position	Valves (Vented)	Valves (Pressurized)
Service	1, 4	2, 5, 6, 17
Backwash	2, 5, 17	1, 4, 6
Brine Draw/ Slow Rinse	6, 17	1, 2, 5, 4
Flush	1, 6, 17	2, 5, 4

Table 12. Port Conversion Chart

Old (Bruner)	New (Culligan)
1	1
2	3
4	2
5	4
6	5
17	6

NOTE #17 is always closed on multiple tank systems. * See note below about port conversion.

NOTE * The system provided may utilize an older version of pilot valve and/or Brunermatic Valve port numbering. Evidence of the old numbering scheme is noted by the use of port number 17 on the pilot valve and/or Brunermatic valve. If the numbering scheme of the pilot valve does not completely match the Brunermatic valve, the following chart should be referred to for conversion purposes.

Backwash Flow Controllers - Theory of Operation and Service

Located on the drain connection of the Brunermatic valve, the purpose of the backwash flow controller is to regulate the up flow backwash required to expand and agitate the resin in the softener. The softener will allow maximum expansion of the resin, while preventing any loss to the drain.

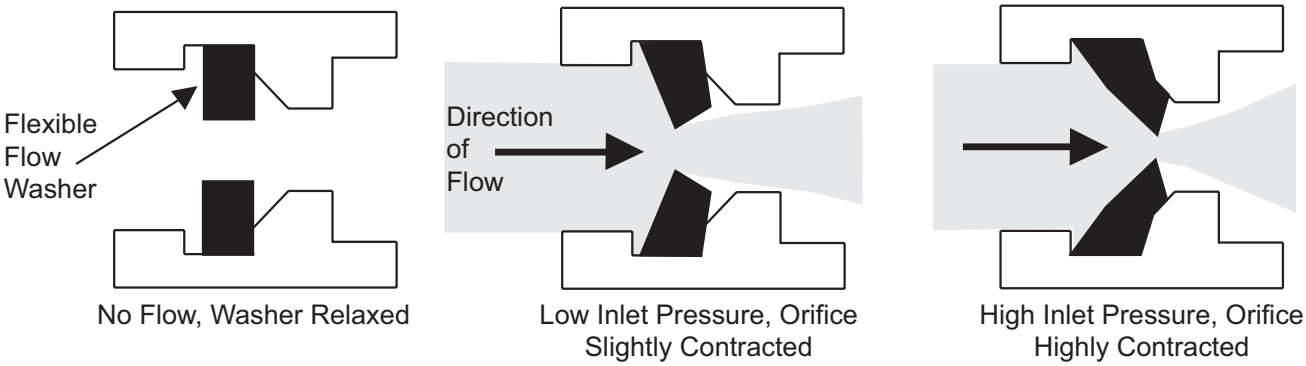


Figure 106.

The flow control principle is simple and trouble free. The specified rate of flow will be constant regardless of inlet pressure variations. This is accomplished by the automatic change in orifice size of the flow washer as inlet pressure varies.

The flow washer pictured above is installed, either in a single or multiple configuration within a special nipple. The selection and the number of flow washers can achieve any desired backwash flow rate.

TYPICAL BACKWASH CONTROL ASSEMBLIES

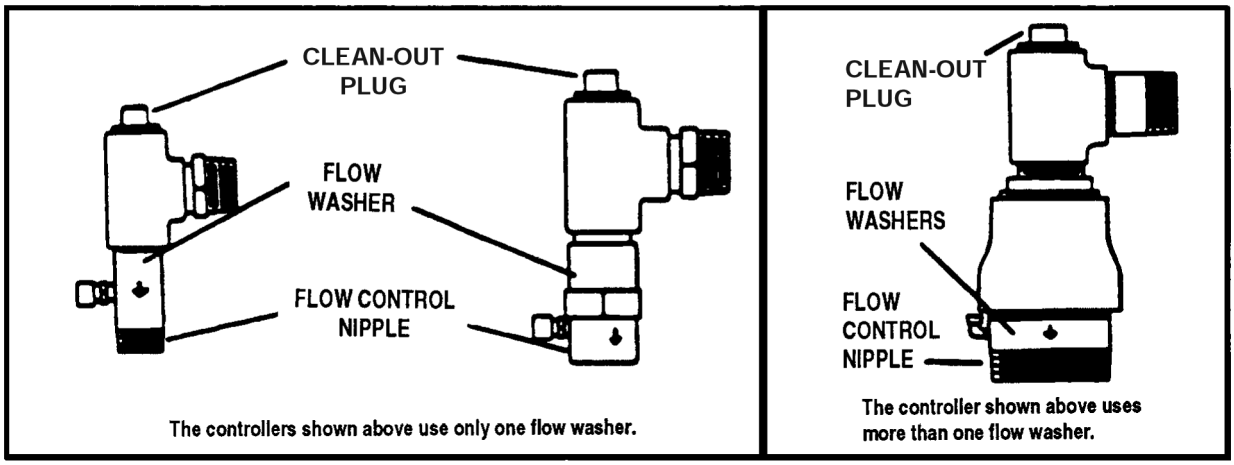


Figure 107.

Occasionally, the Backwash Flow Controller may become plugged with scale, rust, or other foreign material. If this occurs, cleaning is required. This can be done while the softener is in SERVICE and under pressure.

Backwash Flow Controller Disassembly

1. Remove clean-out plug and inspect the flow washer area (Figure 108).
2. Remove any foreign material lodged in or near the flow washer(s) (Figure 109).

NOTE **AVOID USING A SHARP OBJECT WHICH MIGHT CUT OR DAMAGE THE RUBBER FLOW WASHER(S). SHOULD IT NOT BE POSSIBLE TO CLEAR THE CONTROLLER THROUGH THE CLEAN OUT PLUG, REMOVAL OF THE FLOW CONTROL NIPPLE WILL BE REQUIRED TO GAIN BETTER ACCESS TO THE FLOW WASHER AREA.**

If removal of the Backwash Flow Control nipple is necessary, disconnect the flexible tubing from the compression fitting. Carefully separate the nipple from both the drain line and the Brunermatic valve (Figure 110). Inspect and clean flow washer(s) (Figure 111 and Figure 112).

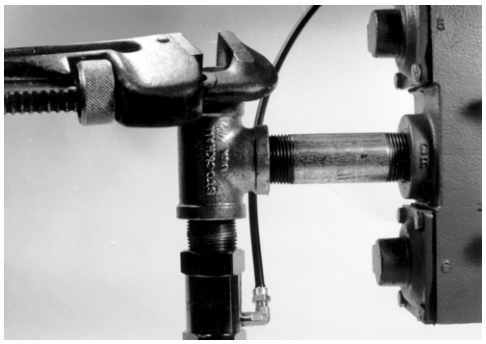


Figure 108.

Figure 109.

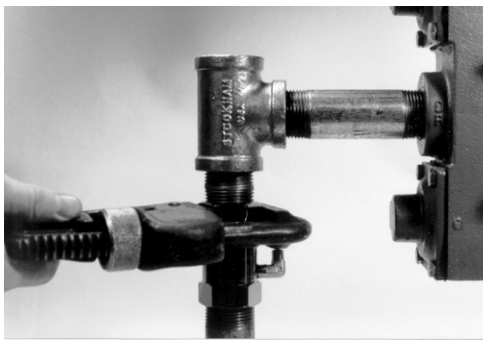


Figure 110.

Backwash Flow Controller Reassembly

1. When replacing the Backwash Flow Control nipple, make certain the compression fitting is downstream of the flow washer.
2. Connect the flexible tubing to the compression fitting located in the side of the Backwash Flow Control nipple.
3. Insert and tighten clean-out plug. (Figure 108)

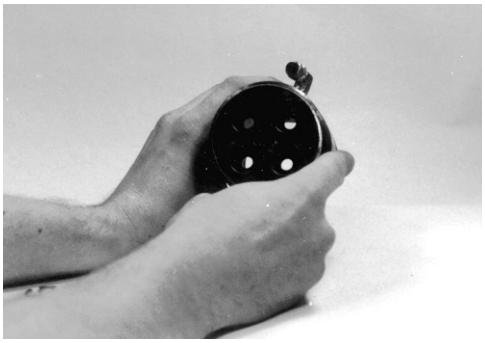


Figure 111.

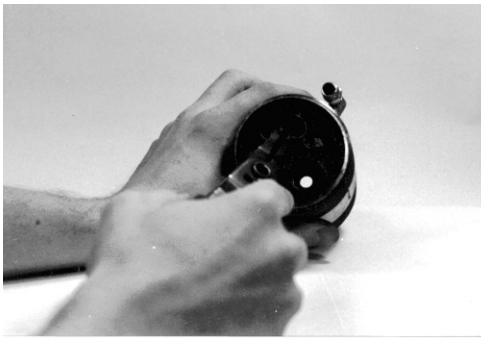


Figure 112.

Aqua-Sensor Probe Resin Test

The Probe Resin Test uses fully regenerated, but previously used, Cullex® resin to simulate a balanced environment.

Run this test only on a circuit board that has passed the Circuit Board Test with simulator device.

Preparation

You will need a container that can hold enough regenerated Cullex resin to completely immerse the probe's electrodes without making contact with the container's sidewall. A section of PVC pipe, either 2" or 3", makes a suitable chamber for testing either residential or commercial probes.

1. Cut a piece of pipe about 18 inches long and close the bottom end with a cap or a flat piece of PVC (which can also serve as a base)
2. Close the other end with a cap that has been drilled and tapped for a 1" PVC pipe plug, or use a reducing adapter and plug.
3. Fill the chamber with used, regenerated Cullex resin and soft water; the water level should be at least one inch above the resin (when not in use, plug the end to prevent spillage of resin and water).

Probe Test

1. Remove the probe from the resin tank. Make sure pressure is relieved on tank before removing probe.
2. Visual inspection
    - Look for discoloration (brown film or blue spots) on electrode fins.
    - If discolored, try cleaning the probe (Sofner-Gard chemical or white vinegar). The fins can be lightly scrubbed with a soft toothbrush.

Resin and Regeneration

If the circuit board and the probe pass all tests, the condition of the resin or the regeneration process may actually be to blame.

1. While the probe is out of the tank, take a sample of resin and examine it for breakage (fines) and fouling.
2. Remove the power to the control.
3. Return the probe to the tank and reconnect it to the circuit board.
4. Power up the control and verify that the program matches the settings recorded at the beginning of the procedure. Also, make sure that the settings are correct for the application. It is recommended that the brine rinse time be left at the default setting of 60 minutes (increase for higher salt dosages or low inlet pressure conditions) to assure adequate rinse time. The Automatic Rinse Time feature will shorten the actual rinse time as it detects the passage of the salt from the tank. Setting the time at too short a value could prevent complete rinse-out and cause daily regeneration.
5. Backwash the unit for 2 – 3 minutes after installing the probe to eliminate any air pockets in the unit.
6. Check the unit for regeneration function (salt dosage, brine draw, rinse and refill).

AQUA-SENSOR Troubleshooting Flowchart

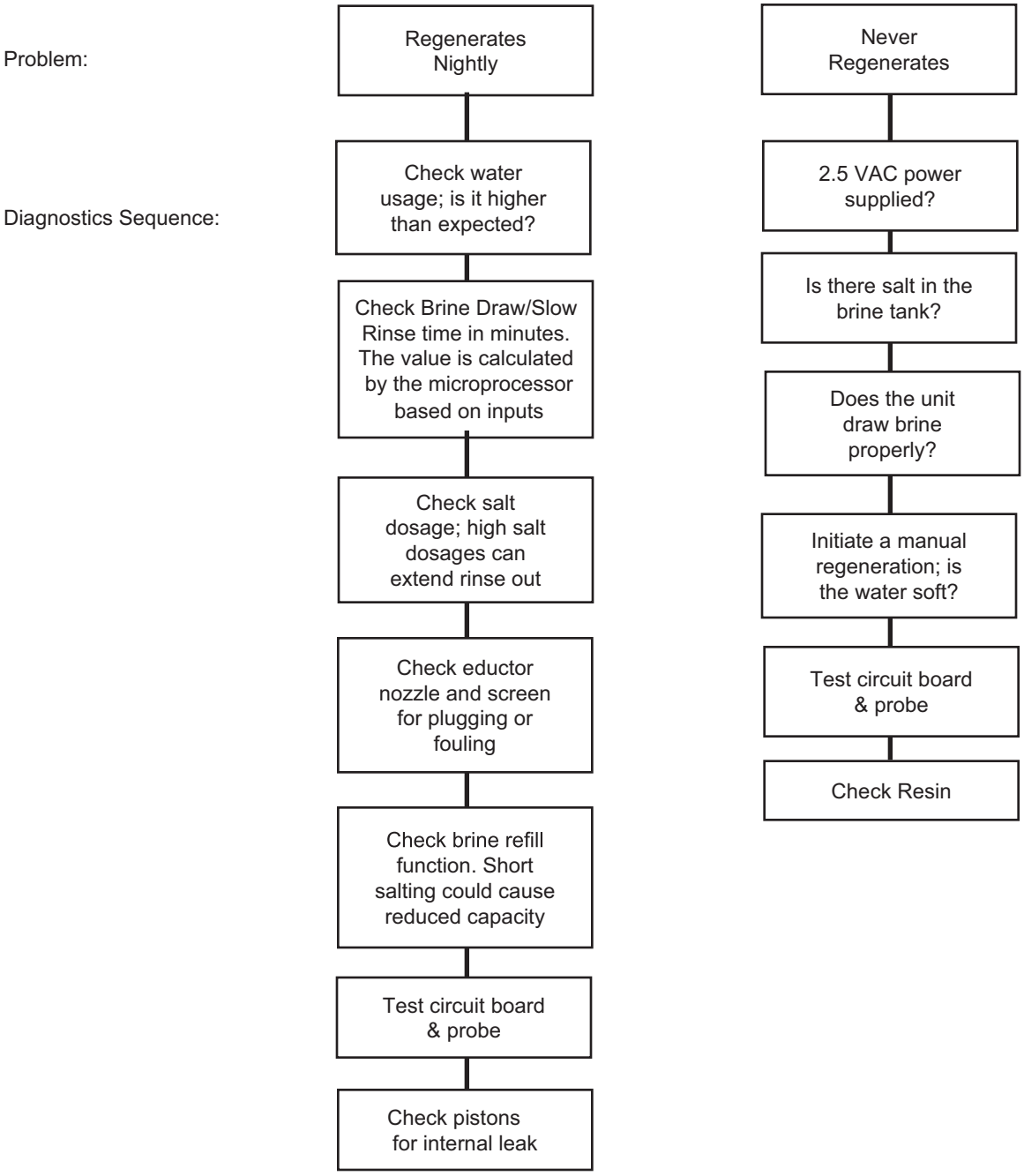


Figure 113.

Pilot Valve Spool Removal & Replacement

1. Close the manual inlet isolation valve, the manual outlet isolation valve, the manual brine valve, and any external source of pressure to the pilot valve assembly. Follow the instructions on page 65 for depressurizing the system before proceeding.
2. Disconnect the power to the MVP controller.
3. Manually rotate the position dial on the pilot valve clockwise to position #1 to relieve pressure. Allow the flow of water to drain to stop before proceeding.
4. Remove the panhead retaining screw located at the bottom front portion of the pilot valve body (refer to Figure 114). Grasp the position dial and pull the pilot valve spool assembly from the pilot valve body.
5. A retaining clip on the rear of the position dial secures the pilot valve spool assembly to the position dial. Using a screw driver, gently pry the retaining clip off of the pilot valve spool.
6. LIGHTLY lubricate all seals on the replacement pilot valve spool with Dow Corning #11 silicone grease and assemble the position dial onto the pilot valve spool assembly.

NOTE **When inserting the pilot valve spool assembly on to the position dial, the larger flat portion of the pilot valve spool assembly must align with the ALIGN TO FLAT indicating arrow.**

7. Insert the new pilot valve spool assembly into the pilot valve body. Make sure that the #1 on the position dial aligns with the pilot valve body position indicator arrow.
8. Replace the small panhead retaining screw to secure the pilot valve spool assembly into the pilot valve body. Open the manual inlet isolation valve.
9. With the pilot in position #1, bleed the air from valves 1 and 4 of the Brunermatic valve. Allow Backwash to continue for 10 minutes.
10. Slowly rotate the position dial clockwise to the H position. Bleed the air from valves 2, 5, 6, and 17 of the Brunermatic valve.
11. Once the system has been repressurized, open the manual outlet isolation valve, manual separate source isolation valve (if installed) and manual brine valve. Close the external by-pass valve and restore power to the MVP controller.

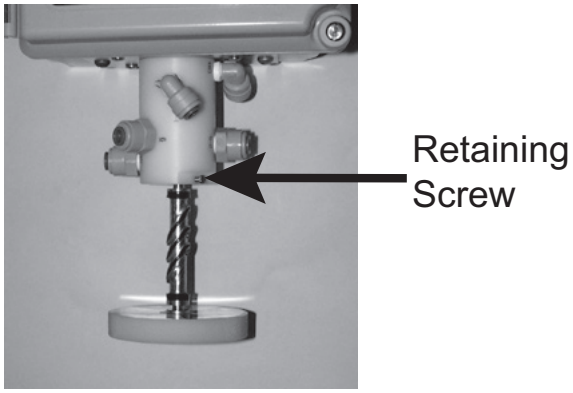


Figure 114.

Pilot Valve Assembly Removal

1. Refer to steps 1 thru 3 under "Pilot Valve Spool Removal & Replacement" on page 71.
2. Mark and remove all pilot valve tube connections from the pilot valve body.
3. Disconnect the four quick connect wire leads from the microswitches. Also disconnect the two motor leads from the circuit board. See Figure 115 and Figure 116.
4. Remove the 2 large panhead screws with nuts located at the bottom of the enclosure that secure the pilot valve body assembly. The pilot body assembly will now separate from the enclosure.
5. Refer to "Pilot Valve Assembly Replacement" on page 73 for reinstallation instructions.

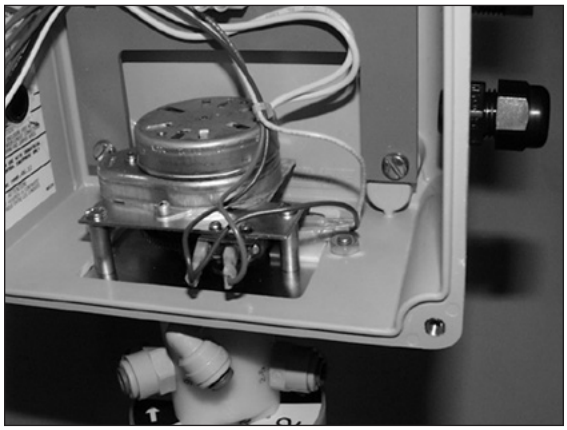


Figure 115.

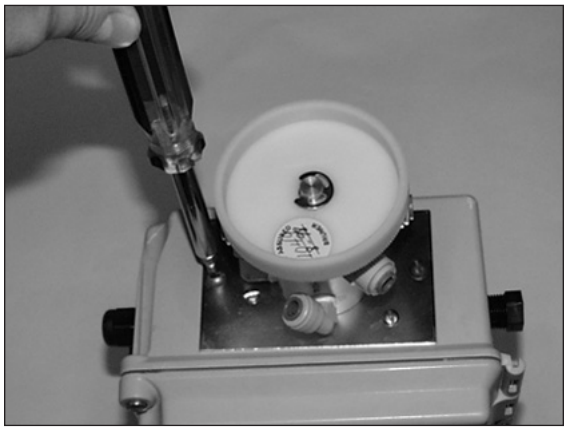


Figure 116.

Pilot Drive Motor Assembly Replacement

1. Refer to steps 1 thru 5 under "Pilot Valve Assembly Removal".
2. The pilot valve drive motor assembly is held in place with 3 panhead screws. Remove the screws and disconnect the motor leads.

NOTE **At this point it is also advisable to visually inspect the cam gear and microswitches for any wear indicating the need for replacement.**

3. Install the replacement pilot valve drive motor assembly making certain that the gears and assembly are properly engaged. Securely tighten the 3 screws and reconnect the motor leads (Figure 116).
4. Reinstall the pilot valve body assembly in the enclosure. Make certain the pilot valve position faces left when viewed from the front of the controller. Reconnect the four quick connect wire leads to the microswitches. Connect the two motor leads to the circuit board. Reconnect all pilot valve tube connections.

Pilot Valve Assembly Replacement

NOTE The cam gear is designed to only be installed one way onto the pilot valve spool.

1. The flat portion of the pilot valve spool must align with the flat side of the cam gear's pilot receptacle. When properly positioned, the cam will snap into place on the pilot valve spool.
2. Replace the pilot drive motor assembly making certain that the gears are properly engaged. Securely tighten the three screws.
3. When installing the replacement pilot valve body to the bottom of the MVP enclosure, make certain the word POSITION faces the left side when viewed from the front. Securely tighten the two panhead machine screws with nuts removed in step 4 of the "Pilot Valve Assembly Removal" on page 72.
4. Reconnect the four quick connect wire leads to the appropriate microswitches and the motor leads to the primary circuit board.
5. Reconnect the pilot valve tubing to the pilot valve body.

NOTE Refer to the appropriate tubing diagram located in this manual.

6. Slowly open the manual inlet isolation valve.
7. Slowly manually rotate the position dial clockwise back to position #1 allowing water to flow to the drain. Bleed the air from valves 1 and 4 of the Brunermatic valve. Allow Backwash to continue for 10 minutes.
8. Rotate the position dial slowly clockwise to the H position. Bleed the air from valves 2, 5, 6, and 17 of the Brunermatic valve.
9. Once the system has been repressurized, open the manual outlet isolation valve, manual separate source isolation valve (if available) and manual brine valve. Close the external by-pass valve and restore power to the MVP controller.

Service Parts

CSM Series Softener Parts List

The following section includes all available replacement parts for the CSM product line.

This list is divided into the following sections:

Section 1 - Replacement Resin Tank and Supporting Parts.

Section 2 - Brunermatic Multiport Valve 2”

Section 3 - Brunermatic Multiport Valve 3”

Section 4 - Brunermatic Valve, Brine Injector Assembly and Automatic Backwash Flow Controller.

Section 5 - Brine Refill Valve.

Section 6 - Culligan MVP Controller.

Section 7 - Brinemaker and Supporting Parts.

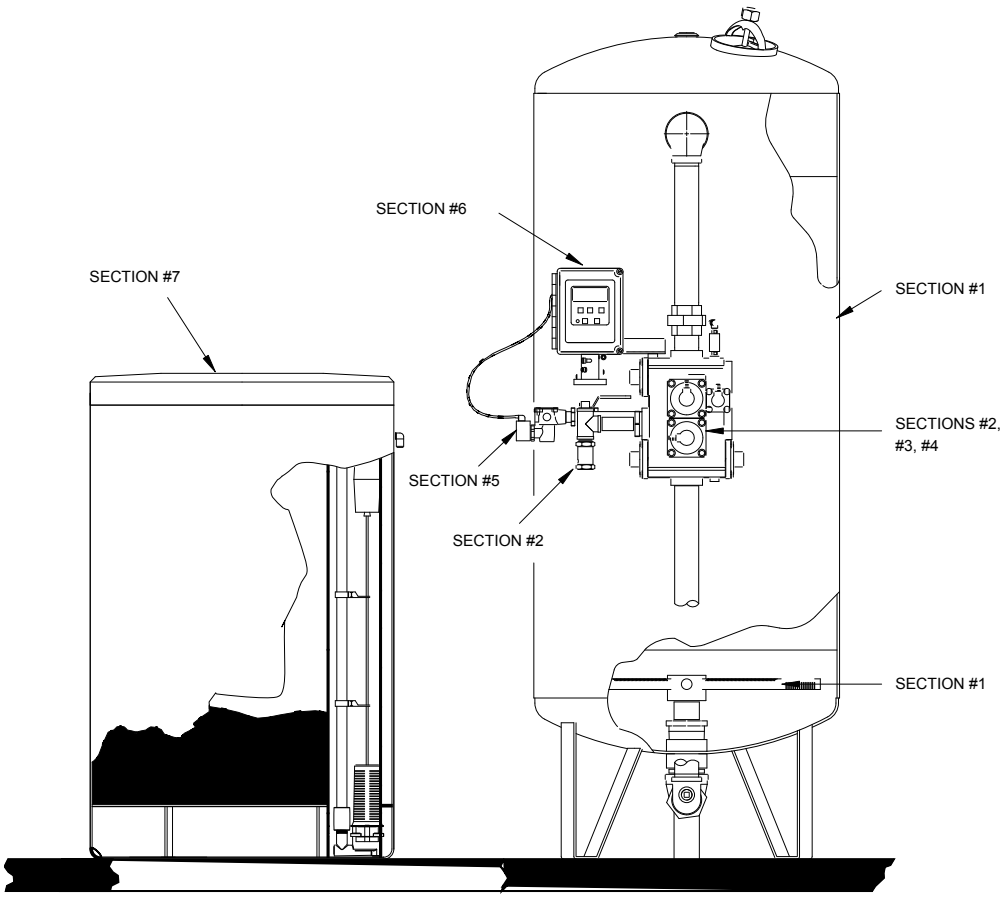


Figure 117.

Section 1

Replacement Resin Tank and Support Parts

Standard Replacement Tank Assembly*

Tanks 20-30” are supplied with a hand-hole in the top and lower sideshell. Tanks 36” diameter and larger are supplied with a manhole in the top and a hand-hole in the side. All tanks are equipped with non-adjustable steel legs welded to tank. The upper distributor and hub lateral lower distributor system must be ordered seperately. Refer to the chart for available tank types.

NOTE *The gravel support bed must be ordered separately and installed on-site. Refer to the chart for the required quantity.

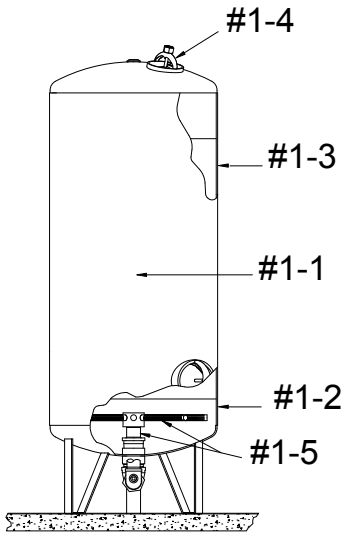


Figure 118.

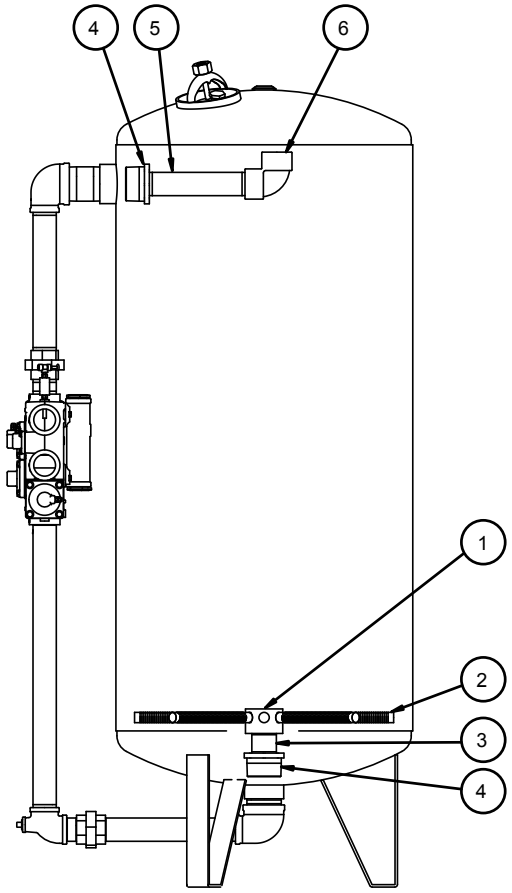
Table 13.

Model	Tank Size/ Valve Size	Tank Type: Non-Code 100 PSI Working Pressure Lined Interior Finish Painted Exterior	Tank Type: ASME Code 125 PSI Working Pressure Lined Interior Finish Painted Exterior	Underbed* - #1-2				Cullex Resin #1-3 Req’d.** cu ft bags
				Non-Code		ASME Code		
		#1-1 Tank Assm. Part No.	#1-1 Tank Assm. Part No.	lbs	bags	lbs	bags	
150-2	20x54-2”	01020120	01020128	100	2	100	2	5
210-2	24x54-2”	01020121	01020129	200	4	200	4	7
300-2	30x60-2”	01020122	01020130	300	6	300	6	10
300-3	30x60-3”	01020122	01020130	300	6	300	6	10
450-2	30x60-2”	01020122	01020130	300	6	300	6	15
450-3	30x60-3”	01020122	01020130	300	6	300	6	15
600-2	36x60-2”	01020124	01020132	400	8	500	10	20
600-3	36x60-3”	01020124	01020132	400	8	500	10	20
750-2	36x60-2”	01020126	01020132	600	12	800	16	25
750-3	36x60-3”	01020126	01020132	600	12	800	16	25
900-2	42x60-2”	01020126	01020134	600	12	800	16	30
900-3	42x60-3”	01020126	01020134	600	12	800	16	30

* Gravel is supplied in 50 lb bags. Part #00162310 is for a 50 lb bag.

** Resin is supplied in a 1 cubic foot bag. Part #00156001 is for a 1 cubic foot bag.

Item # 1-4 Tank Closures and Gaskets					
Applications		Part Number	Size	Description	Qty on Tank
20”-24” Diameter Non-Code Tanks	Top	01019556	4 x 6	Handhole Cover Lined w/0.75” hole	1
	Side	00770092	4 x 6	Handhole Cover Lined No Hole	1
	Both	00770102	4 x 6	Gasket	2
		00770106	4 x 6	Yoke	2
		00402716	4 x 6	Nut	2
30” Diameter Non-Code Tanks	Top	00770092	4 x 6	Handhole Cover Lined No Hole	1
		00770102	4 x 6	Gasket	1
		00770106	4 x 6	Yoke	1
		00402716	4 x 6	Nut	1
	Side	00440783	6 x 8	Handhole Cover Lined No Hole	1
		00440780	6 x 8	Gasket	1
		00440779	6 x 8	Yoke	1
		00770072	6 x 8	Bolt w/Nut 3/4-10 x 3-1/2”	1
20”-30” Diameter ASME Tanks	Top	01019552	4 x 6	Handhole Cover Lined w/0.75” hole	1
		00770102	4 x 6	Gasket	1
		00770106	4 x 6	Yoke	1
		00402716	4 x 6	Nut	1
	Side	00440783	6 x 8	Handhole Cover Lined No Hole	1
		00440780	6 x 8	Gasket	1
		00440779	6 x 8	Yoke	1
		00770072	6 x 8	Bolt w/Nut 3/4-10 x 3-1/2”	1
36”-42” Diameter Non -Code Tanks	Top	01020300	11 x 15	Manhole Cover Lined w/0.75” Hole	1
		01020301	11 x 15	Gasket	1
		01020302	11 x 15	Yoke	2
		01020303	11 x 15	Bolt 1”-8 x 4-1/2”	2
		–	11 x 15	Nut	2
	Side	00440783	6 x 8	Handhole Cover Lined No Hole	1
		00440780	6 x 8	Gasket	1
		00440779	6 x 8	Yoke	1
		00770072	6 x 8	Bolt w/Nut 3/4-10 x 3-1/2”	1
36”-42” Diameter ASME Tanks	Top	01020300	11 x 15	Manhole Cover Lined w/0.75” Hole	1
		01020301	11 x 15	Gasket	1
		01020302	11 x 15	Yoke	2
		01020303	11 x 15	Bolt 1”-8 x 4-1/2”	2
		–	11 x 15	Nut	2
	Side	00440783	6 x 8	Handhole Cover Lined No Hole	1
		00440780	6 x 8	Gasket	1
		00440779	6 x 8	Yoke	1
		00770072	6 x 8	Bolt w/Nut 3/4-10 x 3-1/2”	1



Item # 1-5 Internals							
Model	**Tank Size/ Valve Size**	**Hub Item 1**	**Laterals- Qty Item 2**	**Nipple - Lower NC/ASME Item 3**	**Bushing Item 4**	**Inlet Pipe Item 5**	**Upper Elbow Item 6**
150-2	20x54-2”	01020100	01020032-8	A1696004	NR	01020360	00X10836
210-2	24x54-2”	01020100	01020033-8	A1696004	NR	01020361	00X10836
300-2	30x60-2”	01020100	01020034-8	A1696004/ A1696006	A1527021	01020362	00X10836
300-3	30x60-3”	01020101	01020034-16	00442521/ 00402562	NR	01020378	A1940014
450-2	30x60-2”	01020100	01020034-8	A1696004/ A1696006	A1527021	01020362	00X10836
450-3	30x60-3”	01020101	01020034-16	00442521/ 00402562	NR	01020378	A1940014
600-2	36x60-2”	01020100	01020035-8	A1696004/ A1696006	A1527021	01020363	00X10836
600-3	36x60-3”	01020101	01020035-16	00442521/ 00402562	NR	01020379	A1940014
750-2	36x60-2”	01020100	01020035-8	A1696004/ A1696006	A1527021	01020363	00X10836
750-3	36x60-3”	01020101	01020035-16	00442521/ 00402562	NR	01020379	A1940014
900-2	42x60-2”	01020100	01020036-8	A1696006/ 00442519	A1527021	01020364	00X10836
900-3	42x60-3”	01020101	01020036-16	00402562/ 01014402	NR	01020380	A1940014

Section 2

Brunermatic® D-180 Multiport Valve 2”

The Brunermatic® D-180 Multiport Valve assemblies that are covered in this section are listed below. All valve assemblies listed are for cold water application only.

VALVE PART NO.	THREAD SIZE	TYPE OF THREAD
01017241	2”	NPT

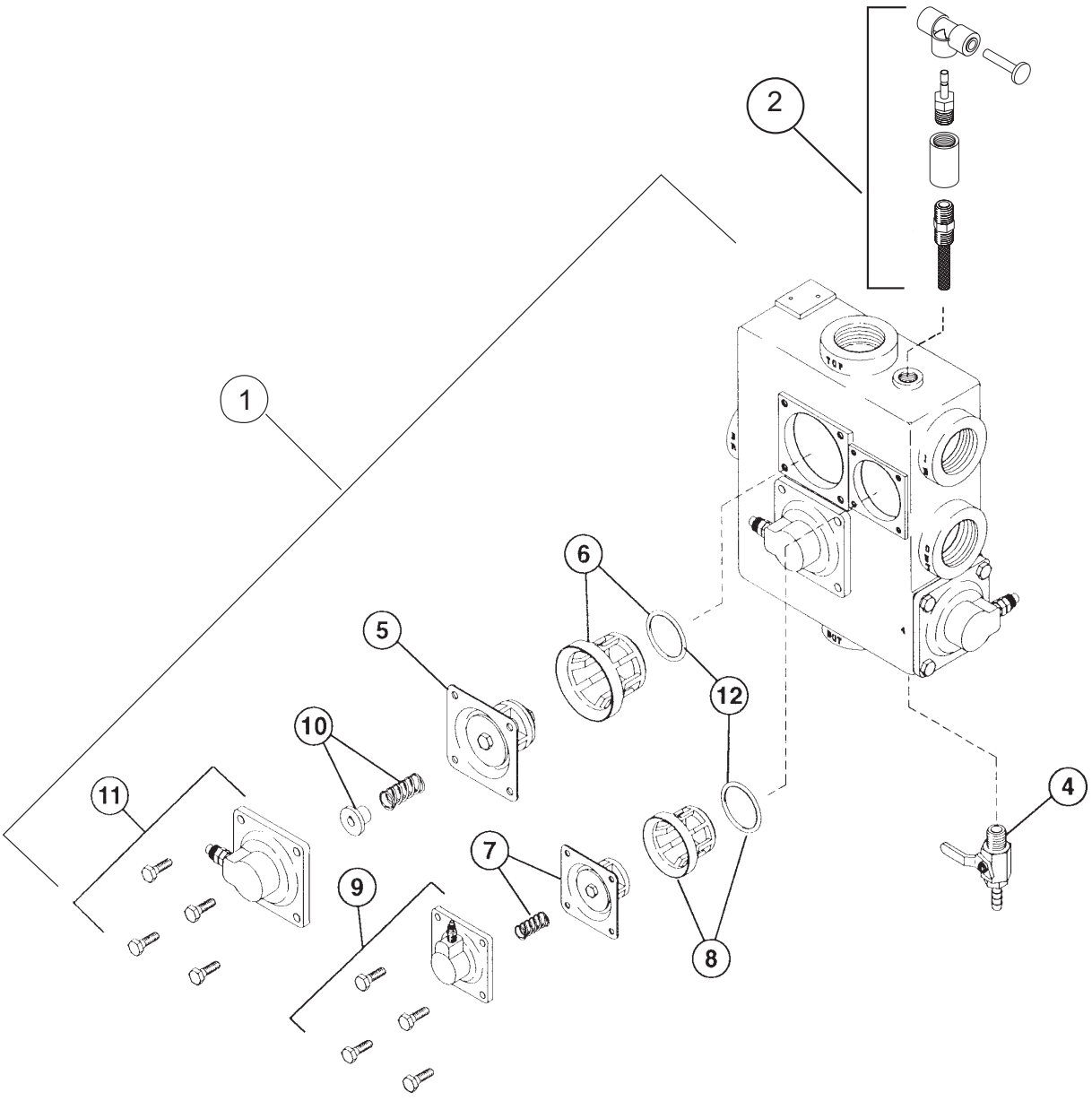


Figure 119. 2” Valve Assembly

Replacement Parts and Repair Kits - 2” Brunermatic® D-180 Multiport Valve Assembly

ITEM	QTY. NEEDED PER VALVE	DESCRIPTION	REPLACEMENT KIT		COMBINATION REPLACEMENT KIT	
			PART NO.	QTY. PER PKG.	PART NO.	QTY. PER PKG.
1	1	2” Brunermatic Valve Assembly Injector Assembly or Pilot Strainer Assembly without	01017241	1	N/A	
2	1	Pilot Strainer Assembly, Universal	A1013390	1		
4	1	Soft Water Sample Cock	A1013389	1		
5	5	Diaphragm Assembly	A1013354	1	A1013355	5
6	5	Kit, Guide Cage Assembly Includes Cage and O-Ring	A1013360	1	A1013361	5
7	1	Kit, By-pass Valve Port Diaphragm Includes 1 ea. Diaphragm Assembly and Spring	A1013379	1	N/A	
8	1	Kit, By-pass Guide Cage Assembly Includes Cage and O-Ring	A1013380	1		
9	1	Kit, By-pass Diaphragm Cover Includes Cover, Fitting and Hardware	01017406	1		
10	1	Kit, Guide and Springs for Diaphragm Assemblies. Includes 4 Springs for ports 1, 2, 4, 5 and Spring for port 6. Also, 5 Spring Guides.	A1013369	1		
11	5	Kit, Diaphragm Cover. Includes Cover, Fitting and Hardware	01017403	1	01017407	5
12	1	Kit, O-Ring Replacement, Guide Cage Includes 5 ea. O-Rings for Diaphragm Guide Cages and 1 ea. O-Ring for the By-pass Guide Cage.	A1013387	1	N/A	

Section 3

Brunermatic® D-180 Multiport Valve 3”

The Brunermatic® D-180 Multiport Valve assemblies that are covered in this section are listed below. All valve assemblies listed are for cold water application only.

VALVE PART NO.	THREAD SIZE	TYPE OF THREAD
01017242	3”	NPT

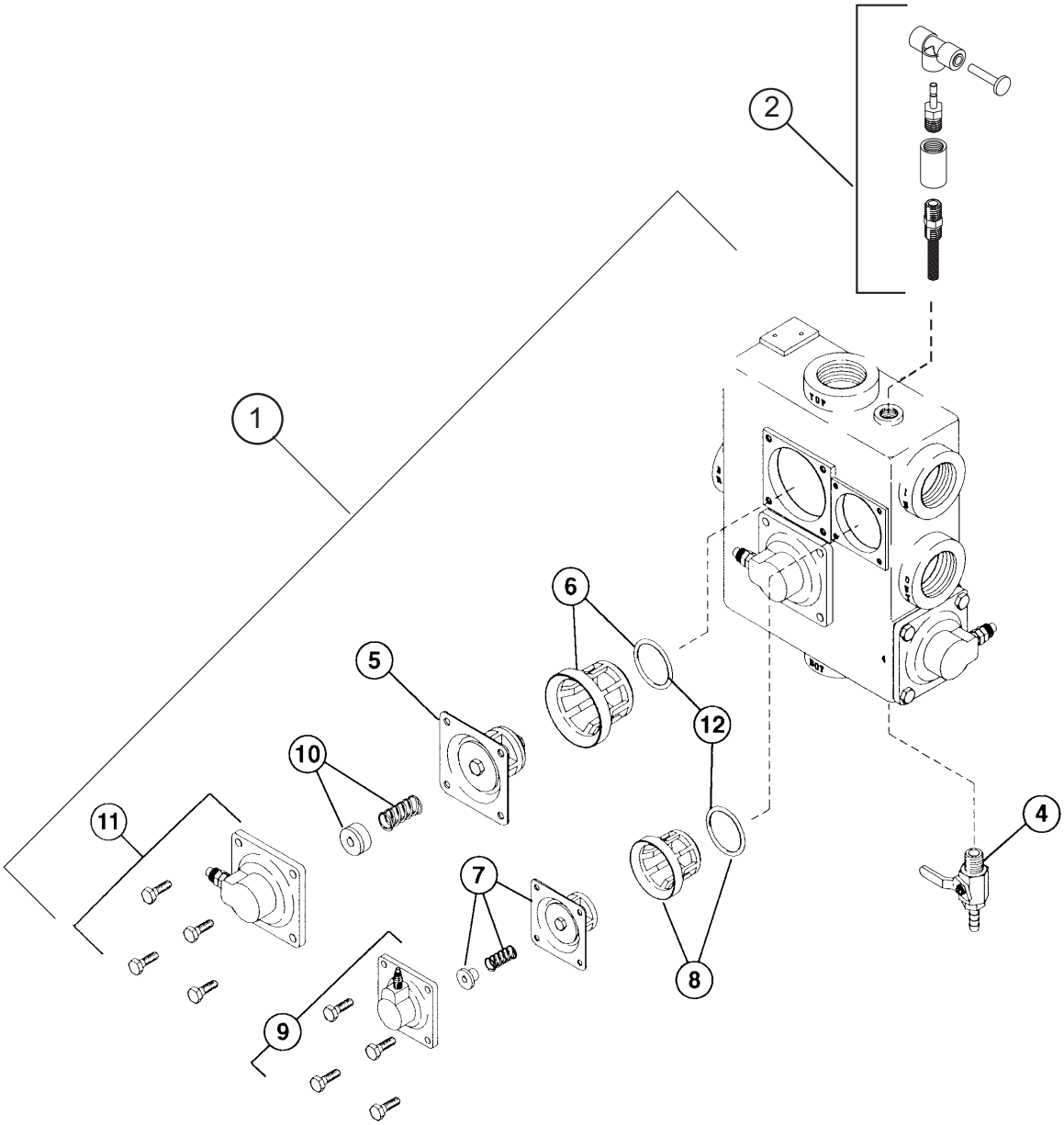


Figure 120. 3” Valve Assembly

Replacement Parts and Repair Kits - 3” Brunermatic® D-180 Multiport Valve Assembly

ITEM	QTY. NEEDED PER VALVE	DESCRIPTION	REPLACEMENT KIT		COMBINATION REPLACEMENT KIT	
			PART NO.	QTY. PER PKG.	PART NO.	QTY. PER PKG.
1	1	3” Brunermatic Valve Assembly without Injector Assembly or Pilot Strainer Assembly	01017242	1	N/A	
2	1	Pilot Strainer Assembly, Universal	A1013390	1		
4	1	Soft Water Sample Cock	A1013389	1		
5	5	Diaphragm Assembly - 2 1/2” and 3”	A1013356	1	A1013357	5
6	5	Kit, Guide Cage Assembly Includes Cage and O-Ring - 2 1/2” and 3”	A1013362	1	A1013363	5
7	1	Kit, By-pass Valve Port Diaphragm Includes 1 ea. Diaphragm Assembly, Spring and Guide - 2 1/2” and 3”	A1013382	1	N/A	
8	1	Kit, By-pass Guide Cage Assembly Includes Cage and O-Ring - 2 1/2” and 3”	A1013383	1		
9	1	Kit, By-pass Diaphragm Cover Includes Cover, Fitting and Hardware - 2”	01017403	1		
10	1	Kit, Guide and Springs for Diaphragm Assemblies. Includes 4 Springs for ports 1, 2, 4, 5 and Spring for port 6. Also, 5 Spring Guides - 2 1/2” and 3”	A1013370	1		
11	5	Kit, Diaphragm Cover. Includes Cover, Fitting and Hardware - 3”	01017404	1	01017405	5
12	1	Kit, O-Ring Replacement, Guide Cage Includes 5 O-Rings for Diaphragm Guide Cages and 1 O-Ring for the Bypass Guide Cage - 2 1/2” and 3”	A1013388	1	N/A	

Section 4
Injector Assemblies 1”

All injector assemblies listed are for cold water applications only.

Model	TANK SIZE/ VALVE SIZE	INJECTOR ASSEMBLY #	NOZZLE FLOW RATE (GPM)	ITEM #2 THROAT ASSEMBLY KIT*	ITEM #4 NOZZLE ASSEMBLY KIT*	ITEM #5 FLOW WASHERS KIT*
150-2”	20 X 54-2”	01017396	2.4	A1013397	A1013404	A1013414
210-2”	24 X 54-2”	01017397	3.5	A1013397	–	A0708003
300-2”	30 X 60-2”	01017398	5.0	A1013398	A1013406	A1013416
300-3”	30 X 60-3”	01017398	5.0	A1013398	A1013406	A1013416
450-2”	30 X 60-2”	01017398	5.0	A1013398	A1013406	A1013416
450-3”	30 X 60-3”	01017398	5.0	A1013398	A1013406	A1013416
600-2”	36 X 60-2”	01017394	7.0	A1013425	A1013407	A1013417
600-3”	36 X 60-3”	01017394	7.0	A1013425	A1013407	A1013417
750-2”	42 X 60-2”	01017394	10.0	A1013426	A1013408	A1013418
750-3”	42 X 60-3”	01017394	10.0	A1013426	A1013408	A1013418
900-2”	42 X 60-2”	01017395	10.0	A1013426	A1013408	A1013418
900-3”	42 X 60-3”	01017395	10.0	A1013426	A1013408	A1013418

*See next page for included parts quantities and descriptions.

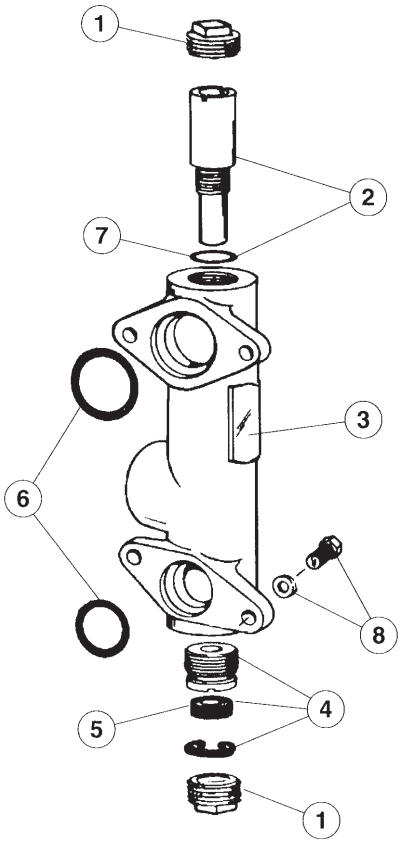
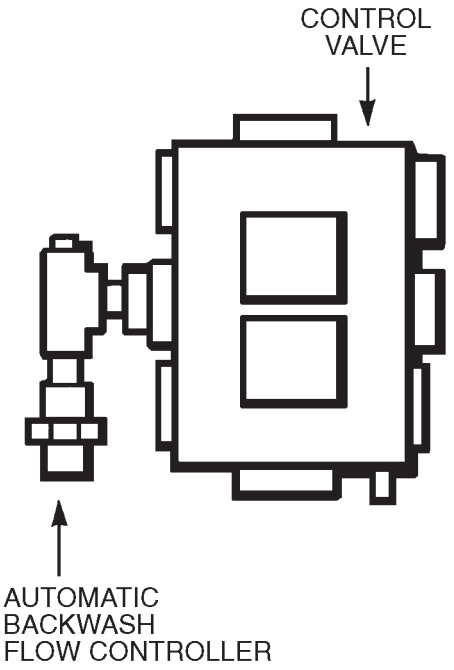


Figure 121. 1” Injector Assembly

Replacement Parts and Repair Kits - B544 Injector Assembly 1”

ITEM	QTY. NEEDED PER VALVE	DESCRIPTION	REPLACEMENT KIT		COMBINATION REPLACEMENT KIT	
			PART NO.	QTY. PER PKG.	PART NO.	QTY. PER PKG.
1	2	Plug 1-1/2” End Cap	N/A		01012803	2
2	1	Kit, Throat Assembly. Includes Throat and O-Ring. Contains 2 each of 6 throat sizes and 12 O-Rings.	See Previous Page	1	N/A	
3	1	Injector Valve Body, 1”	01016665	1		
4	1	Kit, Nozzle Assembly. Includes Nozzle, Flow Washer and Snap Ring Retainer.	See Previous Page	1		
5	1	Kit, Flow Washers.	See Previous Page	5		
6	1	Kit, Upper and Lower 1” Injector Body Seals. Includes 1 each of the Upper and Lower Body Seals.	A1013420	1		
7	1	Kit, O-Ring Injector Throat Seal. Includes 5 ea. O-Ring.	A1013421	5		
8	4	Kit, Hardware Injector Mounting. Includes 4 ea. Washers and 4 ea. Screws.	A1013422	1		

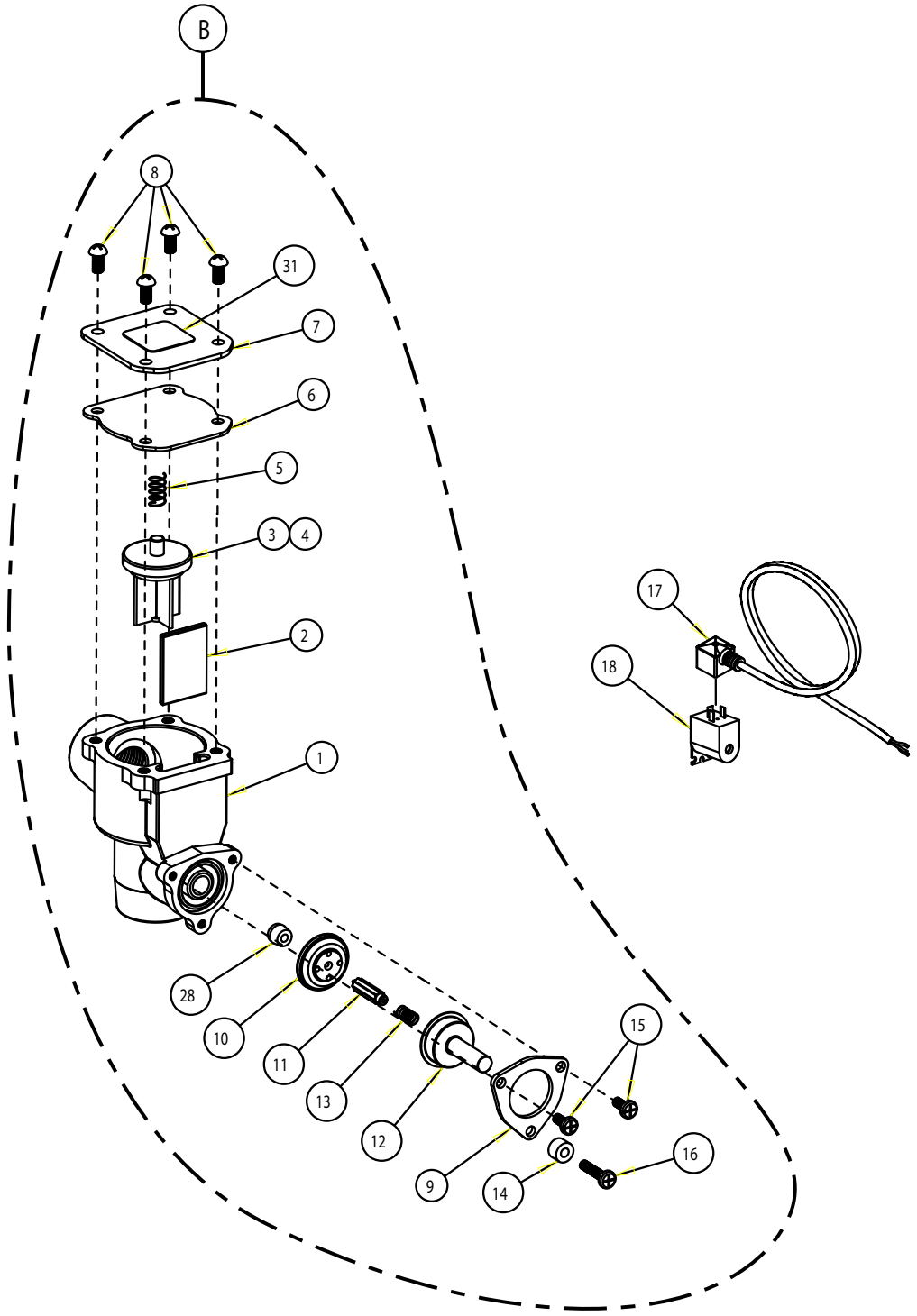
Item #2 Automatic Backwash Flow Controller*		
Model	**Flow Controller Part #**	**Backwash Rate (gpm)**
150-2	A1451014	10
210-2”	A1127002	13.5
300-2”	A1127004	20
300-3”	A1127004	20
450-2”	A1127004	20
450-3”	A1127004	20
600-2”	A1127006	30
600-3”	A1127006	30
750-2”	A1128020	45
750-3”	A1128020	45
900-2”	A1128020	45
900-3”	A1128020	45



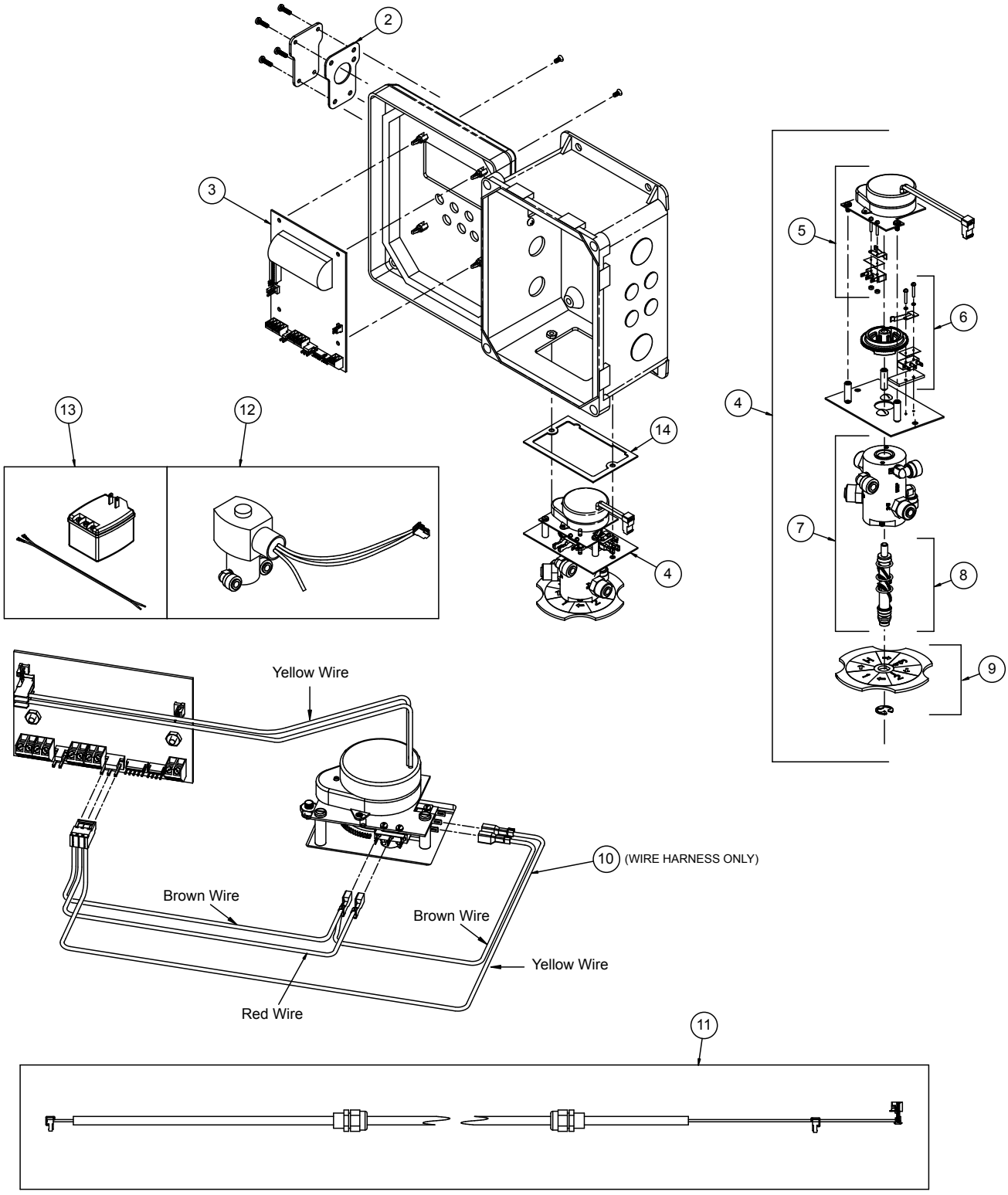
Section 5

Brine Refill Valve

Item #	Part #	Description	Qty	Unit
A	01019576	MVP™ Softener Kit - Includes brine refill valve, coil, connector & fittings		EA
B	01003059	Brine Refill Valve - Replacement - Includes 1-16, 28		EA
C	01020714	Kit Refill Valve internals, incl items 2 to 6 & 9 to 16		EA
1		BODY VALVE BRINE REFILL IMPREG,	1	EA
2	C	SCREEN REFILL BODY ,	1	EA
3	C	VALVE, CHECK, BRINE REFILL VALVE	1	EA
4	C	O-RING ARP#117 EPDM .812”X1.00,0 X .093”	1	EA
5	C	SPRING - CHECK VALVE	1	EA
6	C	GASKET COVER PLATE	1	EA
7		COVER PLATE (BRINE REFILL VAL VE)	1	EA
8		SCREW,MACH,#10-32x3/8,BRASS,RD HD PHIL	4	EA
9	C	SPACER SOLENOID ,	1	EA
10	C	DIAPHRAGM - SOLENOID (P0331693-10 pk)	1	EA
11	C	ARMATURE PLUNGER SS434 W/ VITON TIP (P0332046-10PK)	1	EA
12	C	GUIDE SOLENOID STAIN STL (P0331080-25 pk)	1	EA
13	C	SPRING-SOLENOID (P0331694-10 Pack)	1	EA
14	C	SPACER, SOLENOID COIL	1	EA
15	C	SCREW,MACH,#8-32x3/8,18-8 SS,PAN HD PHIL	2	EA
16	C	SCREW,#8-32 X .750, PHILLIPS ,PAN HEAD, 18-8 SS	1	EA
17	01018722	CONNECTOR, DIN SOLENOID COIL	1	EA
18	01018721	SOLENOID COIL, 24VAC, DIN	1	EA
28	01003058	REPL PARTS PACK TIME FILL, Incl 0.5, 2.0 & 3.0 gpm	1	EA
		Flow controls		


B
8
31
7
6
5
3
4
2
1
28
10
11
13
12
9
14
15
16
17
18

Section 6


2
3
13
12
14
4
5
6
4
7
8
9
Yellow Wire
10 (WIRE HARNESS ONLY)
Brown Wire
Brown Wire
Yellow Wire
Red Wire
11

Culligan MVP Valve Mounted Controller

Item #	Qty. Needed Per Controller	Description	Replacement Kit	
			Part #	Qty. Per Package
1	–	Controller - Complete (Does not include items 11 or 12)	01016170	1
2	1	Gasket, Time Fill	00772964	1
3	1	Circuit Board	01016367	1
4	1 1	Pilot Drive Assembly	A1013634	1
5	1	Pilot Drive Motor Assembly with Homing Switch	A1013635	1
6	1	Cam Gear & Microswitch	A1013636	1
7	1	Pilot Valve Body & Spool Assembly	A1013637	1
8	1	Pilot Valve Spool Assembly w/ Seals (1 Piece / 6 Piece)	A1013516 / A1013517	1 / 6
9	1	Position Dial w/ Retaining Clip	01020619	1
10	1	Motor to Board Wire Harness	01015087	1
11a	*	Communication Cable - for Multiple, Parallel Systems	01016327	1
11b	*	Communication Cable - for Duplex, Alternating Systems	01016342	1
12	1	Blocking Solenoid w/ Fittings	01016331	1
13	1	Transformer	A1013642	1
14	1	Gasket	A0710007	1

* See page 33 for more information about communication cables

Section 7
24”, 30”, 39” and 42” Brine Systems

Item No.	Part No.	Description	Qty Req.
	01024800	24” x 50” Brine System Complete	
	01024801	30” x 50” Brine System Complete	
	01024802	39” x 48” Brine System Complete	
	01024803	42” x 48” Brine System Complete	
1		Tank	1
2		Cover	1
3	01019623	Salt Plate Repl 24”	1
	01019624	Salt Plate Repl 30”	1
	01019625	Salt Plate, Screen & Supports 39”	1
	01019626	Salt Plate, Screen & Supports 42”	1
4	01019621	Brine Well	1
5	01019622	Brine Well Cap – 10 pack	1
6	01019627	Brine Valve Repl 24” to 42 (3/4”)	1

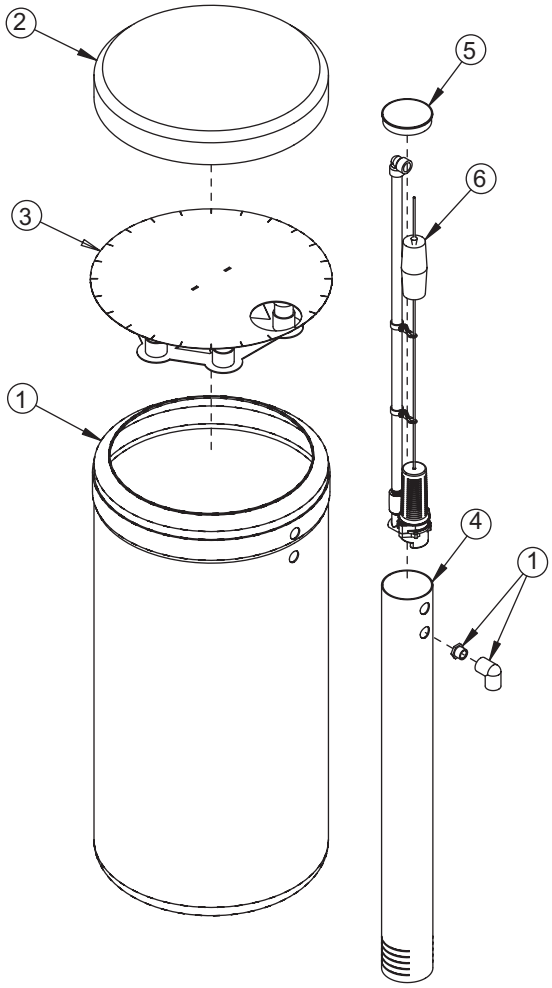


Figure 122. 24” and 30” Brine Systems

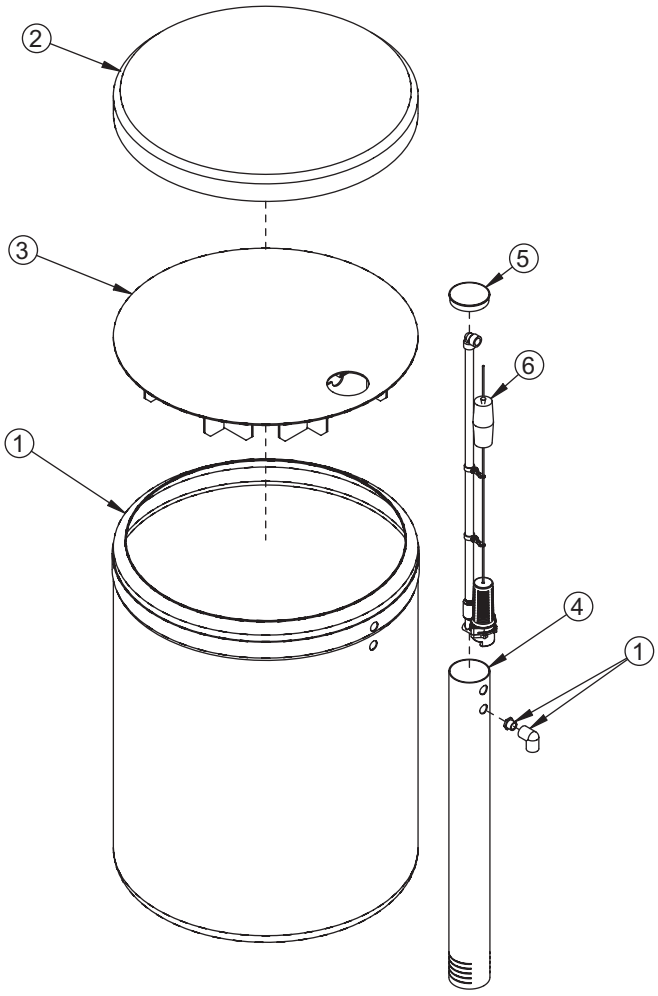
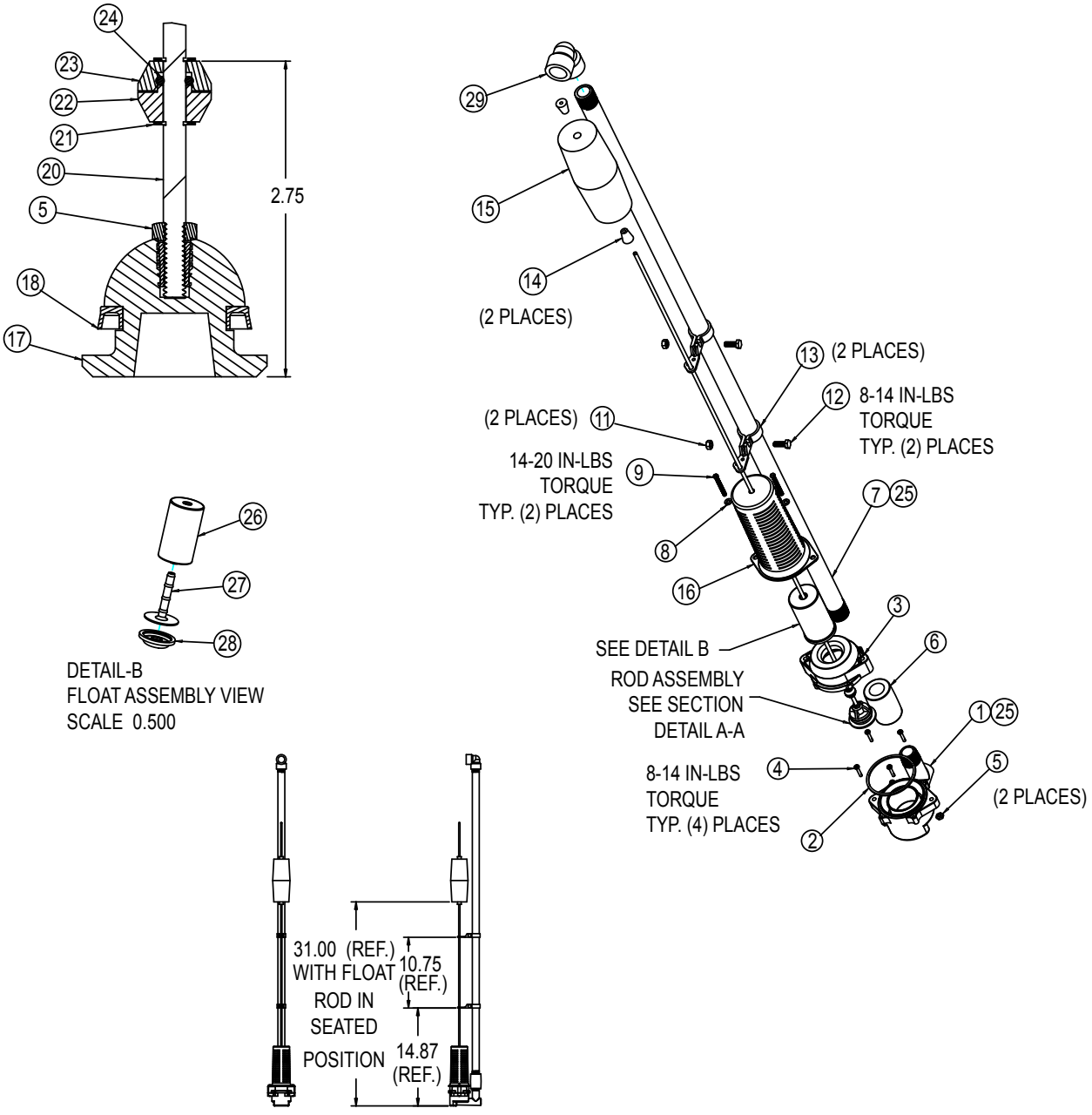


Figure 123. 39” and 42” Brine Systems


24
23
22
21
20
5
18
17
2.75
29
15
14
(2 PLACES)
13 (2 PLACES)
12 8-14 IN-LBS
TORQUE
TYP. (2) PLACES
(2 PLACES) 11
14-20 IN-LBS
TORQUE
TYP. (2) PLACES
9
7 25
8
16
3
SEE DETAIL B
6
ROD ASSEMBLY
SEE SECTION
DETAIL A-A
1 25
4
5
8-14 IN-LBS
TORQUE
TYP. (4) PLACES
2
(2 PLACES)
26
27
28
DETAIL-B
FLOAT ASSEMBLY VIEW
SCALE 0.500
31.00 (REF.)
WITH FLOAT
ROD IN
SEATED
POSITION
10.75
(REF.)
14.87
(REF.)

Item #	Part #	Description	Qty	Unit
A	01019627	Brine Valve, Repl, 24”-42” systems w/elbow		EA
B	01020618	Brine Valve Repair Kit - includes items below listed w/”B”		EA
1		BASE ASSEMBLY, 3/4” BRINE	1	EA
2	B	GASKET	1	EA
3		CAP,BRINE VALVE	1	EA
4	B	SCREW,#6X3/4,PHILLIPS PAN HD	4	EA
5	B	NUT,10-32,HEX,18-8SS	3	EA
6		COUPLING,3/4”,TXT,PVC SCH.80	1	EA
7		PIPE PVC 0.75”NPTX46.750”SCH80	1	EA
8	B	WASHER, #10, TYPE B, SERIES N	2	EA
9	B	SCREW,MACH,#10-32x1-5/8,18-8SS,HEX HD SLT	2	EA
11	B	NUT,1/4-20,HEX,18-8SS	2	EA
12	B	SCREW,CAP,1/4-20 X 3/4,18-8SS	2	EA
13	B	GUIDE FLOAT ROD	2	EA
14		STOPPER RUBBER BLACK ONE HOLE	2	EA
15		FLOAT	1	EA
16		STRAINER	1	EA
17	B	REFILL SEAT ASSEMBLY	1	EA
18	B	SEAL,U-CUP,7/8IDX1-1/4OD	1	EA
20		FLOAT ROD, BRINE VALVE	1	EA
21		E-CLIP, STAINLESS STEEL	2	EA
22		EDUCTOR SEAT BOTTOM	1	EA
23		EDUCTOR SEAT TOP	1	EA
24		O-RING,ARP#008 NITRILE	1	EA
26	B	FLOAT WITH 3/8” DIA. HOLE	1	EA
27	B	STEM,DIAPHRAGM,BRINE VALVE	1	EA
28	B	DIAPHRAGM,NEOPRENE,#783A	1	EA
29		ELBOW,3/4”,TXT,PVC SCH.80	1	EA

Appendix A System Data

Table 14. CSM Series Water Softeners - Flow Rate Data (GPM)

Model	Service			Suggested Progressive Flow Trip Point* (gpm)	Drain		
	Minimum	Continuous	Peak		Backwash* (Cycle 1)	Brine Draw Slow Rinse (Cycle 2)	Fast Rinse (Start during Cycle 3)
150-2	4.4	67	94	65	10	2.4	10
210-2	6.2	76	102	75	13.5	3.5	13.5
300-2	9.8	84	112	80	20	5.0	20
300-3	9.8	152	210	150	20	5.0	20
450-2	9.8	79	106	75	20	5.0	20
450-3	9.8	135	192	130	20	5.0	20
600-2	14.2	94	125	90	30	7.0	30
600-3	14.2	183	252	180	30	7.0	30
750-2	19.2	97	129	95	45	10.0	45
750-3	19.2	201	267	200	45	10.0	45
900-2	19.2	96	127	95	45	10.0	45
900-3	19.2	193	259	190	45	10.0	45

*The suggested Progressive Flow Trip Point is simply a suggested flow rate at which point an additional tank will be brought on-line if facility flow demands meet this rate. The Culligan MVP Controller will not remove tank brought on-line by attaining the Trip Point unless the flow is <95% of the Trip Point amount for a 60 second period. In the event additional units are not brought on-line or off-line when desired, simply adjust the programmed Trip Point. Refer to the system instruction manual operation and programming sections for more information about the progressive flow mode of operation.

Table 15. CSM Refill Minutes/Salt Dosage/Capacity

Resin Vol (FT^3)	5			7			10			15			20			25			30		
Refill Flow Washer Size (GPM)	0.5			2			2			2			3			3			3		
Resin Tank Dia (in.)	20			24			30			30			36			42			42		
Refill Min	lbs/ ftΔ	Dos-age	Capac-ity	lbs/ ftΔ	Dos-age	Capac-ity	lbs/ ftΔ	Dos-age	Capacity	lbs/ ftΔ	Dos-age	Capacity	lbs/ ftΔ	Dos-age	Capacity	lbs/ ftΔ	Dos-age	Capacity	lbs/ ftΔ	Dos-age	Capacity
5	1.5	8		4.3	30		3.0	30		2.0	30		2.3	45		1.8	45		1.5	45	
6	1.8	9		5.1	36		6.3	36		2.4	36		2.7	54		2.2	54		1.8	54	
7	2.1	11		6.0	42	140,000	4.2	42		2.8	42		3.2	63		2.5	63		2.1	63	
8	2.4	12		6.9	48		4.8	48		3.2	48		3.6	72		2.9	72		2.4	72	
9	2.7	14		7.7	54		5.4	54		3.6	54		4.1	81		3.2	81		2.7	81	
10	3.0	15		8.6	60		6.0	60	200,000	4.0	60		4.5	90		3.6	90		3.0	90	
11	3.3	17		9.4	66		6.6	66		4.4	66		5.0	99		4.0	99		3.3	99	
12	3.6	18		10.3	72	175,000	7.2	72		4.8	72		5.4	108		4.3	108		3.6	108	
13	3.9	20		11.1	78		7.8	78		5.2	78		5.9	117	400,000	4.7	117		3.9	117	
14	4.2	21		12.0	84		8.4	84		5.6	84		6.3	126		5.0	126		4.2	126	
15	4.5	23		12.9	90		9.0	90		6.0	90	300,000	6.8	135		5.4	135		4.5	135	
16	4.8	24		13.7	96		9.6	96		6.4	96		7.2	144		5.8	144		4.8	144	
17	5.1	26		14.6	102		10.2	102	250,000	6.8	102		7.7	153		6.1	153	500,000	5.1	153	
18	5.4	27		15.4	180	210,000	10.8	108		7.2	108		8.1	162		6.5	162		5.4	162	
19	5.7	29					11.4	114		7.6	114		8.6	171		6.8	171		5.7	171	
20	6.0	30	100,000				12.0	120		8.0	120		9.0	180		7.2	180		6.0	180	600,000
21	6.3	32					12.6	126		8.4	126		9.5	189		7.6	189		6.3	189	
22	6.6	33					13.2	132		8.8	132		9.9	198	500,000	7.9	198		6.6	198	
23	6.9	35					13.8	138		9.2	138		10.4	207		8.3	207		6.9	207	
24	7.2	36					14.4	144		9.6	144		10.8	216		8.6	216		7.2	216	
25	7.5	38					15.0	150	300,000	10.0	150	375,000	11.3	225		9.0	225		7.5	225	
26	7.8	39								10.4	156		11.7	234		9.4	234		7.8	234	
27	8.1	41								10.8	162		12.2	243		9.7	243		8.1	243	
28	8.4	42								11.2	168		12.6	252		10.1	252	625,000	8.4	252	
29	8.7	44								11.6	174		13.1	261		10.4	261		8.7	261	
30	9.0	45								12.0	180		13.5	270		10.8	270		9.0	270	
31	9.3	47								12.4	186		14.0	279		11.2	279		9.3	279	
32	9.6	48								12.8	192		14.4	288		11.5	288		9.6	288	
33	9.9	50	125,000							13.2	198		14.9	297		11.9	297		9.9	297	750,000
34	10.2	51								13.6	204		15.3	306	600,000	12.2	306		10.2	306	
35	10.5	53								14.0	210					12.6	315		10.5	315	
36	10.8	54								14.4	216					13.0	324		10.8	324	
37	11.1	56								14.8	222					13.3	333		11.1	333	
38	11.4	57								15.2	228	450,000				13.7	342		11.4	342	
39	11.7	59														14.0	351		11.7	351	
40	12.0	60														14.4	360		12.0	360	
41	12.3	62														14.8	369		12.3	369	
42	12.6	63														15.1	378	750,000	12.6	378	
43	12.9	65																	12.9	387	
44	13.2	66																	13.2	396	
45	13.5	68																	13.5	405	
46	13.8	69																	13.8	414	
47	14.1	71																	14.1	423	
48	14.4	72																	14.4	432	
49	14.7	74																	14.7	441	
50	15.0	75	150,000																15.0	450	900,000

= Wet Storage

Table 16. CSM Brinemaker Selection

Mineral Tank		Brinemaker Size							
Cubic Ft.	Tank Dia.	24		30		36		42	
		Total lbs.	lbs./ft³	Total lbs.	lbs./ft³	Total lbs.	lbs./ft³	Total lbs.	lbs./ft³
5	20	61.7	12.3	96.4	19.3	138.8	27.8	188.9	37.8
7	24	61.7	8.8	96.4	13.8	138.8	19.8	188.9	27.0
10	30	61.7	6.2	96.4	9.6	138.8	13.9	188.9	18.9
15	30	N/A	N/A	96.4	6.4	138.8	9.3	188.9	12.6
20	36	N/A	N/A	N/A	N/A	138.8	6.9	188.9	9.4
25	42	N/A	N/A	N/A	N/A	N/A	N/A	188.9	7.6
30	42	N/A	N/A	N/A	N/A	N/A	N/A	188.9	6.3

*Chart shows max salt dosage for DRY storage in total lbs and lbs/ft³

Mineral Tank	Brine Dia.	24		30		36		42	
	Max Load lbs	800		1200		1800		2400	
Cubic Ft	lbs./ft³	Max Load	# regens	Max Load	# regens	Max Load	# regens	Max Load	# regens
5	6	800	26.7	1200	40.00	1800	60.00	2400	80.0
	10	800	16.0	1200	24.00	1800	36.00	2400	48.0
	15	500	6.7	1200	16.00	1800	24.00	2400	32.0
7	6	800	19.0	1200	28.60	1800	42.90	2400	57.1
	10	524	7.5	1200	17.10	1800	25.70	2400	34.3
	15	352	3.4	841	8.00	1800	17.10	2400	22.9
10	6	800	13.3	1200	20.00	1800	30.00	2400	40.0
	10	376	3.8	866	8.70	1800	18.00	2400	24.0
	15			619	4.10	1217	8.10	2400	16.0
15	6	426	4.7	1200	13.30	1800	20.00	2400	26.7
	10			619	4.10	1217	8.10	2400	16.0
	15			249	1.10	847	3.80	1554	6.9
20	6	278	2.3	767	6.40	1800	15.00	2400	20.0
	10			372	1.90	970	4.90	1677	8.4
	15					477	1.60	1183	3.9
25	6			619	4.10	1217	8.10	2400	16.0
	10					723	2.90	1430	5.7
	15							813	2.2
30	6			471	2.62	1069	5.94	2400	13.3
	10					477	1.59	1184	3.9
	15								

=Wet Storage

Appendix B Flow Device K-Factor Data

Figure 124. Clack

Figure 125. Autotrol

Figure 126. Signet/Seametrics

Meter Type	Installation Fitting Type (if applicable)	Pipe Size	Flow Range (Gal. Per Min.)[1]	K-Factor -Gallons
Clack	Brass Tee	1.5”	0.75 to 75	37
Clack	Stainless Steel Tee	2.0”	1.5 to 150	20
Autotrol	Plastic Body w/SS ends	1.5”	7 to 250	15
Autotrol	Plastic Body w/SS ends	2”	7 - 250	15
SeaMetrics Paddlewheel	All	2”	3.1 - 195.8	18
	All	3”	6.6 - 440.6	11
	All	4”	11.74 - 783.2	6.5
Signet Paddlewheel (Blue Nut)	Sch. 80 PVC Tee	1”	0.6 - 42	352.4
		1.25”	1.2 - 77	177.2
		1.5”	1.6 - 106	117.9
		2”	2.7 - 179	66.7
		2.5”	3.8 - 256	43.0
		3”	6.0 - 401	26.7
	Sch. 40 Galvanized Tee	1”	0.7 - 44	213.0
		1.25”	1.2 - 80	127.7
		1.5”	1.7 - 110	94.4
		2”	2.8 - 184	58.4
	Type K Copper Tee	1”	0.7 - 48	256.4
		1.25”	1.1 - 75	176.4
		1.5”	1.6 - 107	115.7
		2”	2.8 - 187	63.4
	Type L Copper Tee	1”	0.8 - 51	241.6
		1.25”	1.2 - 78	170.9
		1.5”	1.7 - 110	112.0
		2”	2.9 - 192	61.7
	Sch. 40 Steel Pipe Saddle	2.5”	4.5 - 298	37.6
		3”	6.9 - 460	23.2
		4”	11.9 - 793	13.3
	Sch. 80 PVC Saddle	2.5”	3.9 - 256	43.0
		3”`	6.0 - 401	26.7
		4”	10.5 - 701	15.0
	Brazolet -Sch 40 Copper Pipe -Sch 40 Bronze Pipe -Sch 40 Brass Pipe Weldolet -Sch 40 Steel Pipe	2.5”	4.0 - 264	37.6
		3”	6.2 - 411	24.3
		4”	10.8 - 716	13.9

Appendix C Aqua-Sensor Guidelines

Aqua-Sensor Application Guidelines

Parameter	Value
Hardness (gpg as $CaCO^3$)	7 - 99 (See Notes 1 and 2)
Solube iron (ppm as Fe)	< 2 (See Note 3)
Manganese (ppm as Mn)	< 0.5 (See Note 4)
Hardness vs Salt Dosage	See Table 17 and Note 2
TDS to Hardness Index	TDS hardness (as $CaCO^3$) < 10 (i.e. hardness must be at least 10% of TDS; see Note 5)
Temperature, °F	Any within equipment's operating range
Alum and phosphate	Anecdotal evidence indicates potential foulant; effect has not been confirmed experimentally
Commercial cell: distance betwen sensing and reference cell pairs	6 inches (See Note 2)

Table 17. Hardness vs. Salt Dosage

Hardness (as $CaCO^3$)	Recommended Salt Dosage (lbs/ft^3)
7 - 10	5 - 6
10 - 15	6 - 8
15 - 25	8 - 9
25 - 50	9 - 11
50 - 75	11 - 12
75 - 99	12 - 16

Table 18. Resin Bed Depths and Estimated Capacity per Inch at Various Salt Dosages

Model	Tank Size	Resin Qty.	Depth of Resin (in.)	Grains Capacity per inch (10 lbs/ft^3 salt dosage)	Grains Capacity per inch (6 lbs/ft^3 salt dosage)	Reserve Capacity @ 10 lb Salt Dosage (grains)[6]	Reserve Capacity @ 6 lb Salt Dosage (grains)[6]
150	20x54	5	27.5	4545	3636	27270	21816
210	24x54	7	26.7	6554	5243	39324	31458
300	30x60	10	24.4	10227	8181	61359	49087
450	30x60	15	36.7	10227	8181	61359	49087
600	36x60	20	34.0	14726	11781	88357	70686
750	42x60	25	31.2	20044	16035	120264	96211
900	42x60	30	37.4	20044	16035	120264	96211

Notes:

1. Although the Aqua-Sensor device has been used successfully on water with hardness as low as 3 gpg, there is an increased risk of missed signal (no regeneration) when the hardness is less than 6 gpg.
2. For each tank diameter, there is a specific volume of resin in the space between the cell pairs. The capacity of that resin is influenced by hardness and salt dosage. Any combination of flow rate and hardness that causes the hardness front to pass through that volume of resin in less than 6 minutes will result in the sensor failing to detect the need to regenerate. In general, the volume of resin between the cell pairs on commercial units will permit a proper signal at or below the continuous flow rating when raw water hardness is less than 50 gpg. At higher hardness levels, it may be necessary to reduce the flow rate to assure adequate sensor signal duration.
3. If precipitated or bound iron is present it must be removed before the softener.
4. Manganese can deposit on the sensor electrodes, particularly on the upper pair, causing missed signals (no regeneration). Periodic cleaning may be needed to maintain satisfactory performance.
5. Adequate signal strength has been demonstrated at ratios as high 14 but signal strength diminishes with decreasing TDS to hardness index.
6. Amount shown is based on the distance between the referencing cell pairs. Reserve capacity at salt dosages less than 15 lbs per cubic foot are shown for reference purposes only and may not provide adequate representation of actual capacity per inch of bed depth for operational purposes.

Operation Log

Use the log provided to maintain a record of the system operation. This can be very helpful in identifying any operation problems or maintenance requirements.

Date	Time	Results of Soft Water Test	Last Regeneration	Next Scheduled Regeneration	Totalizer Reading (Gallons)	Lbs. Salt

Notes