

Water Specialist

1 " Control Valve Series

Model: WS1

Operation and Instruction Manual for OEM Only.

Please Note: This operation and instruction manual is for the training of the OEM and for the OEM to use to train their customers. This document is not to be used as the complete system manual.

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Introduction

This manual is about a control valve to be used on water softeners or water filters. The manual is designed to aid water treatment equipment manufacturers in the selection of the various control valve options. Information in this manual is different than what is needed for installation and servicing of a particular water treatment system. This manual is not intended to be used as a manual for a complete water softener or filter. Certain parts of the manual will serve as aids to manufacturers in the writing and layout of the manuals for installers and service personnel.

General Warnings *(Must appear in OEM's manual)*

The following general warnings and the specifications in Table 1 must appear in the OEM's System Manual.

The control valve, fittings and/or bypass are designed to accommodate minor plumbing misalignments but are not designed to support the weight of a system or the plumbing.

Do not use Vaseline, oils, other hydrocarbon lubricants or spray silicone anywhere. A silicon lubricant may be used on black o-rings but is not necessary. **Avoid any type of lubricants, including silicone, on red or clear lip seals.**

The nuts and caps are designed to be unscrewed or tightened by hand or with the special plastic wrench. If necessary a pliers can be used to unscrew the nut or cap. Do not use a pipe wrench to tighten or loosen nuts or caps. Do not place screwdriver in slots on caps and/or tap with a hammer.

Do not use pipe dope or other sealants on threads. Teflon tape must be used on the threads of the 1" NPT elbow or the ¼" NPT connection and on the threads for the drain line connection. Teflon tape is not necessary on the nut connection or caps because of o-ring seals.

After completing any valve maintenance involving the drive assembly or the drive cap assembly and pistons, press and hold NEXT and REGEN buttons for 3 seconds or unplug power source jack from the printed circuit board (black wire) and plug back in. This resets the electronics and establishes the service piston position. The display should flash all wording, then flash the software version (e.g. 181) and then reset the valve to the service position.

All plumbing should be done in accordance with local plumbing codes. The pipe size for the drain line should be a minimum of ½". Backwash flow rates in excess of 7 gpm or length in excess of 20' require ¾" drain line.

Solder joints near the drain must be done prior to connecting the drain line flow control fitting. Leave at least 6" between the drain line control fitting and solder joints when soldering pipes that are connected on the drain line control fitting. Failure to do this could cause interior damage to the drain line flow control fitting.

When assembling the installation fitting package (inlet and outlet), connect the fitting to the plumbing system first and then attach the nut, split ring and o-ring. Heat from soldering or solvent cements may damage the nut, split ring or o-ring. Solder joints should be cool and solvent cements should be set before installing the nut, split ring and o-ring. Avoid getting primer and solvent cement on any part of the o-rings, split rings, bypass valve or control valve.

Plug into an electrical outlet. Note: All electrical connections must be connected according to local codes. (Be certain the outlet is uninterrupted.)

Install grounding strap on metal pipes.

Table 1
Specifications which must be included in OEM's Manual

Minimum/Maximum Operating Pressures	20 psi (138 kPa) -125 psi (862 kPa)
Minimum/Maximum Operating Temperatures	40°F (4°C) -110°F (43°C)
Transformer:	
Supply Voltage	120 V AC Other voltage and frequency options available.
Supply Frequency	60 Hz
Power Consumption	9.5 W
Output Voltage	12 V AC
Output Current	500 mA

Table 2 contains a summary of specifications for the control valve and bypass valve.

Table 2
Quick Reference Specifications

Service flow rate (includes bypass)	27 gpm (102.2 lpm) @ 15 psig (103 kPa) drop
Backwash flow rate (includes bypass)	27 gpm (102.2 lpm) @ 25 psig (172 kPa) drop
Minimum/Maximum Operating Pressures	20 psi (138 kPa) -125 psi (862 kPa)
Minimum/Maximum Operating Temperatures	40°F (4°C) -110°F (43°C)
Transformer:	
Supply Voltage	120 V AC Other voltage and frequency options available.
Supply Frequency	60 Hz
Power Consumption	9.5 W
Output Voltage	12 V AC
Output Current	500 mA
Regenerant Refill Rate	0.5 gpm (1.9 lpm)
Injectors	See Injector Graphs
Drain Line Flow Controls	See Table 11
Inlet / Outlet Fitting Options	(a) 1" NPT elbow which has a unique drill out feature to allow a 1/4" NPT connection to the inlet and/or outlet (b) 3/4" & 1" PVC solvent weld fitting (c) 1" straight brass sweat fitting (d) 3/4" straight brass sweat fitting (e) 1" plastic male NPT fitting (f) 1 1/4" plastic male NPT fitting (g) 1" plastic male BSPT fitting
Distributor Tube Opening	1.05" Diameter (3/4" U.S. PVC Pipe Size)
Tank Thread	2-1/2" – 8 NPSM
Control Valve Weight	4.5 lbs 2.0 kg
PC Board Memory	Nonvolatile EEPROM (electrically erasable programmable read only memory)
Compatible with regenerants/chemicals	Sodium chloride, potassium chloride, potassium permanganate, sodium bisulfite, sodium hydroxide, hydrochloric acid, chlorine and chloramines

Control Valve Function and Cycles of Operation

This glass filled Noryl¹ fully automatic control valve is designed as the primary control center to direct and regulate all cycles of a water softener or filter. When the control valve is set up as a softener, the control valve can be set to perform down flow or up flow regeneration. When the control valve is set up as a filter, the control valve can be set to perform down flow regeneration or simply backwash. The control valve can be set to regenerate on demand (consumption of a predetermined amount of water) and/or as a time clock (passage of a particular number of days). The control valve can be set so that a softener can meet the Water Quality Association (WQA) Standard S100 or NSF/ANSI Standard 44 efficiency rating.

The control valve is compatible with a variety of regenerants and resin cleaners. The control valve is capable of routing the flow of water in the necessary paths to regenerate or backwash water treatment systems. The injector regulates the flow of brine or other regenerants. The control valve regulates the flow rates for backwashing, rinsing, and the replenishing of treated water into a regenerant tank, when applicable.

The control valve is designed to deliver high service (27 gpm @ 15 psig) and backwash (27 gpm @ 25 psig) flow rates when the bypass has straight fittings. The control valve uses no traditional fasteners (e.g. screws), instead clips, threaded caps and nuts and snap type latches are used. Caps and nuts only need to be firmly hand tightened because radial seals are used. Tools required to service the valve include one small blade screw driver, one large blade screw driver, pliers and a pair of hands. A plastic wrench is available which eliminates the need for screwdrivers and pliers. Disassembly for servicing takes much less time than comparable products currently on the market. Control valve installation is made easy because the distributor tube can be cut 1/2" above to 1/2" below the top of tank thread. The distributor tube is held in place by an o-ring seal and the control valve also has a bayonet lock feature for upper distributor baskets.

The transformer power pack comes with a 15 foot power cord and is designed for use with the control valve. The transformer power pack is for dry location use only. The control valve remembers all settings for two hours if the power goes out. After two hours, the only item that needs to be reset is the time of day, all other values are permanently stored in the nonvolatile memory. The control valve does not need batteries.

Table 3 shows the order of the cycles when the valve is set up as a softener. When the control valve is used as a down flow softener, two backwashes always occur. When the control valve is used as an up flow softener, only one backwash occurs after brining. The OEM has the option of having the regenerant refill after the rinse cycle or have the regenerant prefill before regeneration. If the OEM chooses to have the regenerant prefill before regeneration, the prefill starts two hours before the regeneration time set. During the 2-hour period in which the brine is being made, treated (softened) water is still available. For example: regeneration time = 2:00 am, prefill option selected, downflow softener. Fill occurs at 12:00 a.m., start of backwash cycle occurs at 2:00 a.m.

When set up as a softener the backwash and rinse cycles automatically increase with increasing salt dosage. Backwashes can be set to be NORMAL or LONGER. The option selected will apply to all backwashes. Tables 4 and 5 show the length of the cycles when the valve is set up as a softener.

Table 3
Regeneration Cycles Softening

Down flow Regenerant Refill After Rinse	Down flow Regenerant Prefill	Up flow Regenerant Refill After Rinse	Up flow Regenerant Prefill
1 st Cycle: Backwash	1 st Cycle: Fill/Dissolve	1 st Cycle: Regenerate	1 st Cycle: Fill/Dissolve
2 nd Cycle: Regenerate	2 nd Cycle: Backwash	2 nd Cycle: Backwash	2 nd Cycle: Regenerate
3 rd Cycle: Backwash	3 rd Cycle: Regenerate	3 rd Cycle: Rinse	3 rd Cycle: Backwash
4 th Cycle: Rinse	4 th Cycle: Backwash	4 th Cycle: Fill/Dissolve	4 th Cycle: Rinse
5 th Cycle: Fill/Dissolve	5 th Cycle: Rinse	5 th Cycle: Service	5 th Cycle: Service
6 th Cycle: Service	6 th Cycle: Service		

¹ Noryl is a trademark of General Electric.

Table 4
Backwash Normal Length Softener
Cycle Times in Minutes

Grains Capacity/lb NaCl lbs NaCl/cu ft resin ²		Down Flow Softener			Up Flow Softener		
		6000 to 3501	3500 to 2501	2500 to 1700	6000 to 3501	3500 to 2501	2500 to 1700
Cycle Time in minutes	Backwash Normal	6	8	8			
	Regenerate	45	60	75	45	60	75
	Backwash Normal	3	8	10	6	10	12
	Rinse	3	4	6	3	4	6
	Total ³	57	80	99	54	74	93

Table 5
Backwash Longer Length Softener
Cycle Times in Minutes

Grains Capacity/lb NaCl lbs NaCl/cu ft resin ²		Down Flow Softener			Up Flow Softener		
		6000 to 3501	3500 to 2501	2500 to 1700	6000 to 3501	3500 to 2501	2500 to 1700
Cycle Time in minutes	Backwash Longer	8	10	12			
	Regenerate	45	60	75	45	60	75
	Backwash Longer	8	10	12	6	12	14
	Rinse	4	6	8	3	4	6
	Total ³	65	86	107	54	76	95

Table 6 shows the order of the cycles when the valve is set up as a filter. When the control valve is used as a down flow regenerating filter, the OEM has the option to specify one backwash or two backwashes. If the control valve is set to regenerate for a filter, the OEM has the option of having the regenerant refill after the rinse cycle or have the regenerant prefill before regeneration. If the OEM chooses to have the regenerant prefill before regeneration, the prefill starts two hours before the regeneration time set. During the 2-hour period in which the regenerant is being made, treated water is still available. For example: regeneration time = 2:00 am, prefill option selected, downflow filter. Fill occurs at 12:00 a.m., start of backwash cycle occurs at 2:00 a.m. There is only one rinse. Backwashes can be set to normal or longer. The option selected will apply to all backwashes. Tables 7 and 8 show the length of the cycles when the valve is set up as a filter.

When the control valve is used as a non-regenerating filter, the OEM has the option to specify one backwash or two backwashes. If two backwashes are specified, two rinses occur. Tables 7 and 8 show the length of the cycles when the valve is set up as a filter. When used as a non-regenerating filter, the down flow piston must be installed, the regenerant piston removed, injector plugs must be installed in both the DN and UP injector locations and the refill elbow must be replaced with a refill port plug.

² These are reference numbers that approximate the amount of salt needed. The actual capacity in grains per pound of salt is used in calculations.

³ Total time does not include fill time, which is dependent upon the amount of salt needed. When in the fill mode the system is providing treated water.

**Table 6
Regeneration Cycles Filtering**

Down flow Regenerant Refill After Rinse	Down flow Regenerant Prefill	No Regeneration
1 st Cycle: Backwash 2 nd Cycle: Regenerate 3 rd Cycle: <i>Second Backwash*</i> 4 th Cycle: Rinse 5 th Cycle: Fill 6 th Cycle: Service	1 st Cycle: Fill 2 nd Cycle: Backwash 3 rd Cycle: Regenerate 4 th Cycle: <i>Second Backwash*</i> 5 th Cycle: Rinse 6 th Cycle: Service	1 st Cycle: Backwash 2 nd Cycle: Rinse 3 rd Cycle: <i>Second Backwash*</i> 4 th Cycle: <i>Second Rinse**</i> 5 th Cycle: Service

* Second Backwash is Optional

** Second Rinse only occurs if Second Backwash option is selected.

**Table 7
Regenerating Filter
Cycle Times in Minutes**

	Single Backwash		Double Backwash	
	Normal	Longer	Normal	Longer
Backwash	14	16	8	12
Regenerate	60	60	60	60
2 nd Backwash			10	12
Rinse	8	10	8	10
Total ⁴	82	86	86	94

**Table 8
Non-Regenerating Filter
Cycle Times in Minutes**

	Single Backwash		Double Backwash	
	Normal	Longer	Normal	Longer
Backwash	14	16	8	12
Rinse	8	10	6	6
2 nd Backwash			10	12
2 nd Rinse			8	10
Total	22	26	32	40

The control valve with a water meter can be set for Demand Initiated Regeneration (DIR) only, Time Clock operation only or DIR and Time Clock which ever comes first, depending upon what settings are selected for Day Override and Gallon Capacity.⁵ See Table 9.

If a control valve does not contain a meter, the valve can only act as a time clock, and day override should be set to any number and gallon capacity should be set to off.

⁴ Total time does not include fill time, which is dependent upon the amount of fill needed. When in the fill mode the system is providing treated water.

⁵ See Installer Displays/Settings Step 3I, OEM Softener Setup Step 6S and OEM Filter Setup Step 5F for explanations of Day Override and Gallon Capacity.

Table 9
DIR/Time Clock Options

DIR	Time Clock	Reserve Capacity	Softener	Filter		Settings ⁶	
				Regenerant	Backwash Only	Day Override	Gallon Capacity
Yes		Automatically calculated	Yes			Off	Auto
Yes		If desired enter a value less than estimated capacity	Yes	Yes	Yes	Off	Any Number
Yes	Yes	Automatically calculated	Yes			Any Number	Auto
Yes	Yes	If desired enter a value less than estimated capacity	Yes	Yes	Yes	Any Number	Any number
	Yes	None	Yes	Yes	Yes	Any Number	Off

For DIR Softeners, there are two options for setting the Gallons Capacity. The Gallons Capacity is automatically calculated if set to AUTO. Reserve Capacity is automatically estimated based on water usage if AUTO is used. The other option is to set the Gallons Capacity to a specific number. If a specific number is set, reserve capacity is zero, unless the value is manually set (i.e. the manufacturer intentionally sets the gallon capacity number below the calculated capacity of the system).

The control valve can also be set to regenerate immediately or at the next regeneration time by changing the Regeneration Time Option. There are three choices for settings:

1. "NORMAL" means regeneration will occur at the preset regeneration time.
2. "on 0" means regeneration will occur when the gallons capacity reaches zero.
3. "NORMAL" and "on 0" means the regeneration will occur at the preset regeneration time unless the gallons capacity reaches zero. If the gallons capacity reaches zero the regeneration will begin 10 minutes after no water usage.

The user can initiate manual regeneration. The user has the option to request the manual regeneration at the delayed regeneration time or to have the regeneration occur immediately:

1. Pressing and releasing the REGEN button. "Regen Today" will flash on the display and the regeneration will occur at the delayed regeneration time. The user can cancel the request by pressing and releasing the REGEN button. This method of manually initiating regeneration is not allowed when the system is set to immediately regenerate when the gallon capacity reaches zero.
2. Pressing and holding the REGEN button for approximately 3 seconds will immediately start the regeneration. The user cannot cancel this request, except by resetting the control by pressing NEXT and REGEN buttons simultaneously for 3 seconds.

The control valve consists of the following components:

1. Drive Assembly
2. Drive Cap Assembly, Main Piston and Regenerant Piston
3. Spacer Stack Assembly
4. Injector Cap, Screen, Injector Plug and Injector
5. Refill Flow Control Assembly or Refill Port Plug
6. Drain Line Flow Control and Fitting Assembly
7. Water Meter or Meter Plug
8. Installation Fitting Assemblies
9. Bypass Valve (optional)

⁶ Day Override and Gallon Capacity can not both be set to "OFF" at the same time.

Drive Assembly

The drive assembly consists of the following parts:

- Drive Bracket
- Printed Circuit (PC) Board
- Motor
- Drive Gears
- Drive Gear Cover

The drive bracket holds the PC board, the motor, the drive gears and the drive gear cover in place.

The PC board receives and retains information, displays the information, determines when to regenerate and initiates regeneration. The display shows different types of information in the initial system set up (for softeners or filters), installer displays/settings, diagnostics, valve history or user displays/settings. For a complete list of information see Table 14.

The PC board powers the motor. The PC board's two-prong jack connects wires to the direct current (DC) motor. The motor is held in place on the drive bracket by a spring-loaded clip and a small bulge in the plastic, which fits in one of the slots on the motor housing. The motor turns drive gears that drive the piston to cycle positions for backwashing, regeneration, rinsing, refill or service. The motor is fully reversible (turns both ways) and changes direction of rotation to change the direction of piston motion. The motor is easily replaced if necessary.

There are three drive gears held in place by the drive gear cover. All three drive gears are the same size. A reflective coating is applied to the gears. As the center drive gear turns a light shines on the coating and a light sensing diode determines if a light pulse was returned. The PC board counts the pulses and determines when to stop driving the motor.

Drive Cap Assembly, Main Piston and Regenerant Piston

The drive gears turn the main gear of the drive cap assembly, which moves the piston. The screw-driven, horizontally moving piston stops at specific positions to direct the flow of water to backwash, regenerate, rinse or refill. The PC board determines the position of the piston by counting pulses produced when the piston is moved. An optical sensor looking at one of the reduction drive gears generates these pulses. Each cycle position is defined by a number of pulses. The counter is zeroed each time the valve goes to the service position. The PC board finds the service position by noting the increase in current delivered to the motor when the mechanical stop at the service position is reached. This method of controlling piston position allows for greater flexibility and requires no switches or cams (U.S. Patent 6444127).

One of two main pistons is always used:

1. the down flow piston which is used when the control valve is used as a down flow softener, regenerating filter or non-regenerating filter; or
2. the up flow piston which is used when the control valve is used as an up flow softener.

If the control valve is used as a softener or a regenerating filter, a regenerant piston must be attached to the main piston. If the control valve is to be used on system that does not require a regenerant to be added the regenerant piston must be removed.

Spacer Stack Assembly

The spacer stack assembly provides the necessary flow passage for water during the different cycles. The all plastic spacer stack assembly (U.S. Patent 6402944) is a one-piece design which allows the stack to be removed using your fingers.

The exterior of the stack is sealed against the body bore with self lubricating EPDM o-rings while the interior surface is sealed against the piston using slippery self cleaning directional (one-way) silicone lip seals. The lip seals are red or clear in color and have a special slippery coating so that the piston does not need to be coated or lubricated.

Injector Cap, Screen, Injector Plug and Injector

The screen, injector and/or injector plug(s) are installed under the injector cap in an easy to access location on top of the valve. The injector cap contains four slots so no water accumulates in the cap. The injector cap is designed to be hand tightened.

Under the injector cap there is an easy to clean removable screen to prevent fouling of the injector. There are two holes under the injector cap labeled “DN” and “UP”. The holes will be filled with a plug or an injector.

The plug (Order # V3010-1Z) prevents water from traveling a certain pathway. The injector lets water pass through the pathway. The self-priming injector increases the velocity of the water, creating a zone of negative pressure that draws in the concentrated liquid regenerant, such as sodium chloride (brine), potassium permanganate, sodium hydroxide, hydrochloric acid, etc. The regenerant blends with the stream of water, which passes through the media to regenerate the bed.

The injector provides a consistent regenerant/water mixture ratio over the entire operating pressure range of the control valve. The injector provides good performance in a variety of applications, which may involve elevated drain lines and long regenerant draw lengths. Injectors are chosen by knowing the type, amount, and regenerant flow rate for a particular type of media. Guidelines can be found in the media manufacturer’s literature. The color coded injectors give different regenerant draw, slow rinse and total flow rates over the pressure range. See Table 10 for color codings and injector graphs for total, slow rinse and draw flow rates.

Table 10
Injector Order Information

Injector Order Number	Injector Color	Typical Tank Diameter ⁷	
		Down	Up
V3010-1A	Black	6”	8”
V3010-1B	Brown	7”	9”
V3010-1C	Violet	8”	10”
V3010-1D	Red	9”	12”
V3010-1E	White	10”	13”
V3010-1F	Blue	12”	14”
V3010-1G	Yellow	13”	16”
V3010-1H	Green	14”	18”
V3010-1I	Orange	16”	22”
V3010-1J	Light Blue	18”	
V3010-1K	Light Green	22”	

The control valve has been designed so that the OEM can rapidly change the control valve to allow for the following options:

- regeneration down flow (for softeners or regenerating filters install injector in DN location, plug in Up location)
- regeneration up flow (up flow option is for softeners only, install injector in UP location, plug in DN location)
- no regeneration (both the DN and UP holes have injector plugs installed) and plug installed for the refill elbow

Refill Flow Control Assembly or Refill Port Plug

The refill flow control assembly consists of a refill flow elbow, refill flow control retainer assembly, refill flow control, polytube insert and nut assembly. The refill flow control retainer fits in the refill elbow. The refill flow control retainer houses the refill flow control which controls the flow rate when the regenerant tank is being refilled. The refill flow control is a flexible washer-like part with a small orifice and a precision molded contour that delivers a steady 0.5 gpm regenerant tank refill rate at varying inlet pressures. Refill is accomplished with treated water.

⁷ Actual tank size used may vary depending on the design and application of the system. Tank diameter is an approximation for the following:

1. downflow softener using standard mesh synthetic cation exchange media regenerating with sodium chloride.
2. upflow softener using standard mesh synthetic cation exchange media regenerating with sodium chloride, an inlet water pressure of 30 to 50 psi and water temperature of 60°F water or warmer. Higher pressures or lower temperatures would need smaller injectors to avoid lifting the bed.

The actual tank size used may vary depending on the design and application of the system.

The refill flow control assembly is installed in an easy to access refill elbow located on top of the control valve. The refill flow control assembly is attached to the control valve with a locking clip. The locking clip allows the elbow to rotate 270 degrees so the outlet can be orientated towards the regenerant tank.

The control valve has a standard refill elbow to which a 3/8" flexible tube can be connected. An optional elbow can be ordered which accommodates a 1/2" flexible tube for a high regenerant draw rate situation (G injectors and larger). Both elbows use the same refill flow control and retainer.

If the control valve is to be used as a non-regenerant filter control valve, the refill elbow is removed and replaced with a refill port plug.

Drain Line Flow Control and Fitting Assembly

The drain line flow control assembly includes a drain line flow control and a fitting. The drain line flow control allows proper media bed expansion by regulating the flow rate to the drain. The drain line flow control is a flexible washer-like part with an orifice and a precision molded contour. The flow rates are within $\pm 10\%$ over the pressure range of 20 psi to 125 psi.

The flexible washer-like parts are identified with three numbers, which correspond to the flow rate in gallons per minute. See Table 11.

Table 11
Drain Line Flow Control and Fitting Assembly Information

Drain Line Fitting	Drain Line Flow Control Order No.	Number on Drain Line Flow Control	Backwash Flow Rate (gpm)	Backwash Flow Rate (lpm)
3/4"	V3162-007	007	0.7	2.6
3/4"	V3162-010	010	1.0	3.8
3/4"	V3162-013	013	1.3	4.9
3/4"	V3162-017	017	1.7	6.4
3/4"	V3162-022	022	2.2	8.3
3/4"	V3162-027	027	2.7	10.2
3/4"	V3162-032	032	3.2	12.1
3/4"	V3162-042	042	4.2	15.9
3/4"	V3162-053	053	5.3	20.1
3/4"	V3162-065	065	6.5	24.6
3/4"	V3162-075	075	7.5	28.4
3/4"	V3162-090	090	9.0	34.1
3/4"	V3162-100	100	10.0	37.9
1"	V3190-090	090	9.0	34.1
1"	V3190-100	100	10.0	37.9
1"	V3190-110	110	11	41.6
1"	V3190-130	130	13	49.2
1"	V3190-150	150	15	56.8
1"	V3190-170	170	17	64.3
1"	V3190-200	200	20	75.7
1"	V3190-250	250	25	94.6

The drain line flow control and fitting are located on top of the control valve and replaceable without the use of special tools.

The drain line flow control can be installed in the standard 3/4" drain line elbow, which accommodates 5/8" polytube or 3/4" NPT drain line connections. The optional nut and polytube insert for the 3/4" drain line elbow is designed for use with flexible polytube only. The 3/4" drain line elbow can be rotated 180 degrees so the outlet can be orientated to the nearest drain. The same retainer is used for all drain line flow controls for the 3/4" fitting. Drain line flow controls designed for the 3/4" fitting are available for flow rates ranging from 0.7 to 10 gpm.

An optional 1" straight drain line fitting is available to accommodate drain line flow rates ranging from 9 to 25 gpm. This fitting is straight but still connects to the control valve using the same locking clip. The drain line flow control is located between two fitted parts (i.e. the fitting acts as the retainer). The nut is unscrewed to access the drain line flow control.

Water Meter or Meter Plug

The water meter is installed on the outlet side of the control valve. The water meter uses a turbine to total gallons of treated water. The turbine rotates with the flow of water and reports its rate of rotation through Hall-effect⁸ circuitry to the printed circuit (PC) board. This rotation permits the PC board to record the total volume of treated water and the flow rate. The small centrally located magnet is shielded from water, which reduces substantially iron-fouling problems with the turbine.

The turbine is accurate to within $\pm 5\%$ over a wide operating flow rate range (0.25 gpm up to control valve maximums) and has a very low pressure drop. Water used for regeneration is not metered. If the control valve is set to prefill the regenerant, water used between the prefill cycle up to the start of the regeneration cycle is metered. If the control valve is in regeneration mode (e.g. a backwash cycle) and there is a water demand that water usage is not metered.

When facing the front of the control valve, the water meter is positioned on the left-hand side of the control valve. Allow sufficient clearance to clean and repair the water meter with out disconnecting the plumbing or disassembling any other parts of the control valve.

Control valves can be ordered with a meter plug (i.e. no electronics or turbine) rather than a water meter if desired. Control valves without meters should only be set up for time clock operation (i.e. no water meter, no demand-initiated regeneration). Control valves with water meters provide a wider variety of useful information (see OEM General Instructions for list of information).

A unique feature of this control valve is the ability to display actual water usage for the last 63 days. The values are initially stored as “----”. This means the value is unknown. As days pass values are stored as “0” for no flow or the actual number of gallons. The counting of the gallons starts at the regeneration time. If no regeneration time can be set (i.e. when the valve is set for immediate regeneration) the counting of gallons starts at 12 a.m. Day 1 is yesterday, day 2 the day before yesterday, etc. As new values are added the oldest history disappears.

Another unique feature is that the valve automatically calculates a reserve capacity when set up as a softener with “Gallons Capacity” set to “AUTO” and the “Regeneration Time Option” set to “Normal” or “Normal + on 0”. The actual reserve capacity is compared to the gallons capacity remaining immediately prior to the preset regeneration time. A regeneration will occur if the actual reserve capacity is less than the gallons capacity remaining. The actual reserve capacity is calculated by using the estimated reserve capacity and adjusting it up or down for actual usage.

The estimated reserve capacity for a given day of the week is the maximum value stored for the last three non-trivial water usages (i.e. more than 20 gallons/day) in seven day intervals.

Installation Fitting Assemblies

The installation fittings are used to connect the optional bypass or the control valve to the plumbing system. There are four installation fitting assemblies available:

1. 1” NPT elbow assembly
2. 3/4” & 1” PVC solvent weld elbow fitting assembly
3. 1” straight brass sweat fitting assembly⁹
4. 3/4” straight brass sweat fitting assembly⁹
5. 1” plastic male NPT fitting assembly
6. 1 1/4” plastic male NPT fitting assembly
7. 1” plastic male BSPT fitting assembly

The installation fitting assemblies are sold in pairs and consist of two fittings, two nuts, two split rings and two o-rings. The installation fitting assemblies and the bypass valve are sold separately from the control valve.

Both elbow fittings have a unique drill out feature to allow a 1/4” NPT connection to the inlet and/or outlet which can be used for a RO feed, test ports, pressure tap ports, etc.

⁸ Some semiconductor materials exhibit a phenomenon in the presence of a magnetic field that is adaptable to sensing devices. When a current is passed through one pair of wires attached to a semiconductor, another pair of wires properly attached and oriented with respect to the semiconductor will develop a voltage proportional to the magnetic field present and the current in the other pair of wires. Holding the exciting current constant and moving a permanent magnet near the semiconductor produces a voltage output proportional to the movement of the magnet. Hall-effect devices provide a high speed response, excellent temperature stability, and no physical contact.

⁹ Has not been tested for compliance with California Proposition 65, so this fitting should not be installed in California.

Bypass Valve

The bypass valve is typically used to isolate the control valve from the plumbing system's water pressure in order to perform control valve repairs or maintenance. The WS1 bypass valve is particularly unique in the water treatment industry due to its versatility and state of the art design features. The 1" full flow bypass valve incorporates four positions including a diagnostic position that allows service personal to work on a pressurized system while still providing untreated bypass water to the facility or residence. Its completely non-metallic, all plastic design allows for easy access and serviceability without the need for tools.

The bypass body and rotors are glass filled Noryl and the nuts and caps are glass filled polypropylene. All seals are self-lubricating EPDM to help prevent valve seizing after long periods of non-use. Internal o-rings can easily be replaced if service is required.

The bypass consists of two interchangeable plug valves that are operated independently by red arrow shaped handles. The handles identify the flow direction of the water. The plug valves enable the bypass valve to operate in four positions.

- 1. Normal Operation Position:** The inlet and outlet handles point in the direction of flow indicated by the engraved arrows on the control valve. Water flows through the control valve during normal operation and this position also allows the control valve to isolate the media bed during the regeneration cycle. (See Figure 1)
- 2. Bypass Position:** The inlet and outlet handles point to the center of the bypass, the control valve is isolated from the water pressure contained in the plumbing system. Untreated water is supplied to the plumbing system. (See Figure 2)
- 3. Diagnostic Position:** The inlet handle points in the direction of flow and the outlet handle points to the center of bypass valve, system water pressure is allowed to the control valve and the plumbing system while not allowing water to exit from the control valve to the plumbing. (See Figure 3)
- 4. Shut Off Position:** The inlet handle points to the center of the bypass valve and the outlet handle points in the direction of flow, the water is shut off to the plumbing system. If water is available on the outlet side of the softener it is an indication of water bypass around the system (i.e. a plumbing connection somewhere in the building bypasses the system). (See Figure 4)

BYPASS VALVE OPERATION

Figure 1

NORMAL OPERATION

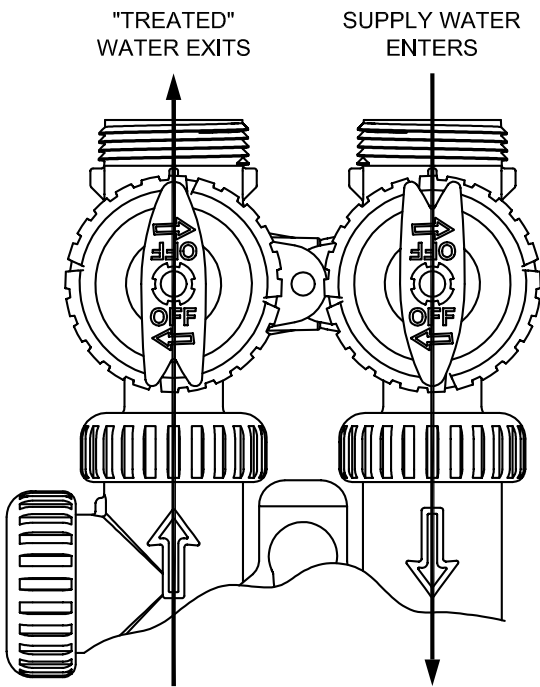


Figure 2

BYPASS OPERATION

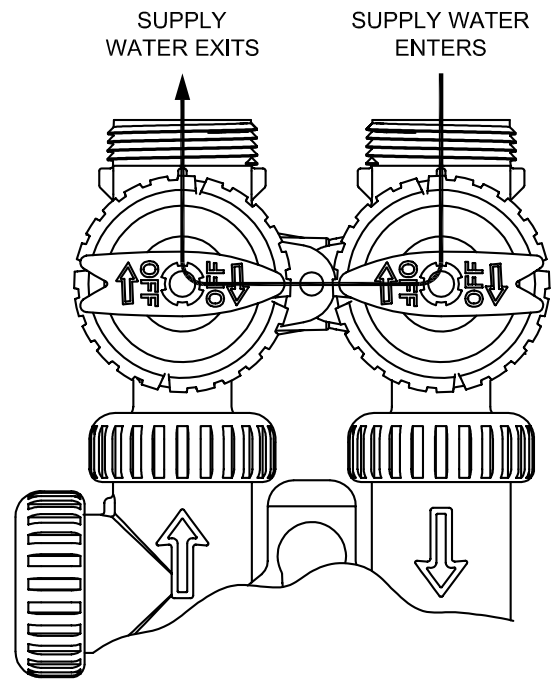


Figure 3

DIAGNOSTIC MODE

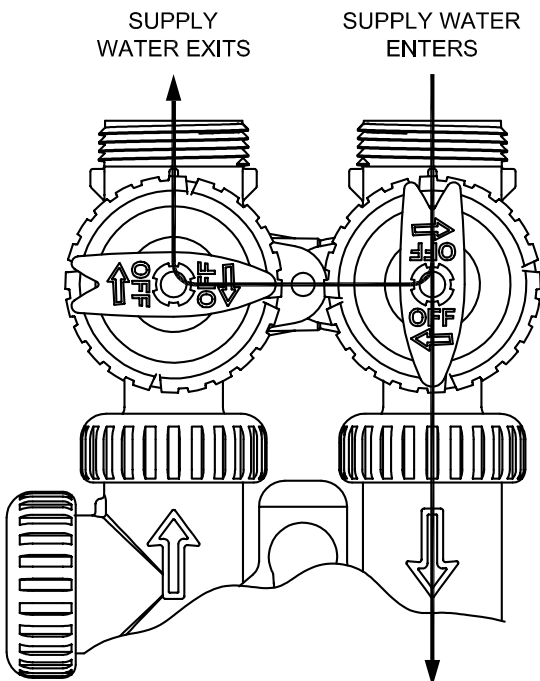
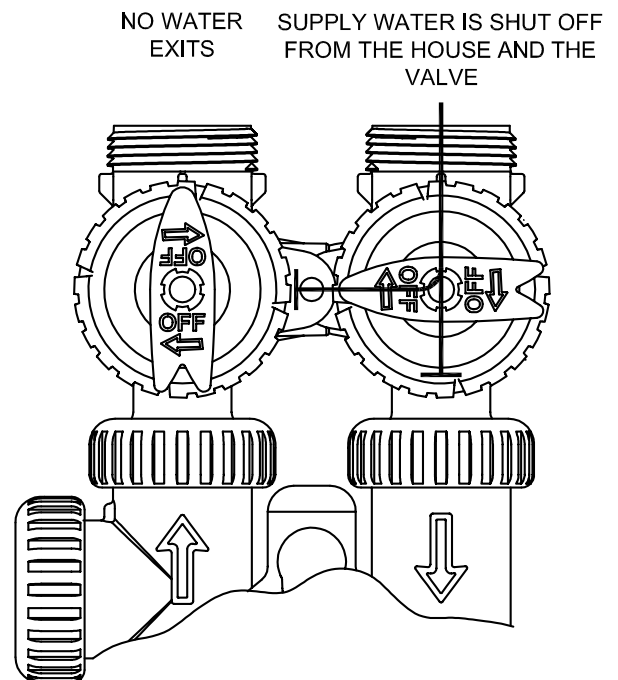


Figure 4

SHUT OFF MODE



OEM General Instructions

The control valve offers multiple procedures that allow the valve to be modified to suit the needs of the installation. These procedures are:

- OEM Softener Setup
- OEM Filter Setup
- Installer Displays & Settings
- User Displays & Settings
- Diagnostics
- Valve History

These procedures can be accessed in any order. Details on each of the procedures are provided on the following pages. Table 14 lists all information that may be displayed, where to find additional instructions about the information or instructions on how to access or change the information.

At the discretion of the manufacturer, the field technician can access all settings. To “lock out” access to diagnostic and valve history displays and modifications to settings except hardness, day override, time of regeneration and time of day by anyone but the manufacturer, press ∇ , NEXT, Δ , and SET CLOCK in sequence after settings are made. To “unlock”, so other displays can be viewed and changes can be made, press ∇ , NEXT, Δ , and SET CLOCK in sequence.

When in operation normal user displays such as time of day, gallons remaining or days remaining before regeneration are shown. When stepping through a procedure if no buttons are pressed within five minutes the display returns to a normal user display. Any changes made prior to the five minute time out are incorporated. The one exception is current flow rate display under the diagnostic procedure. The current flow rate display has a 30 minute time out feature.

To quickly exit OEM Softener Setup, OEM Filter Setup, Installer Displays/Settings, Diagnostic or Valve History press SET CLOCK. Any changes made prior to the exit are incorporated.

When desired (e.g. when the valve is installed in a new location) certain information on the valve can be reset to zero. Table 14 identifies which information can be reset. To reset to zero, press NEXT and ∇ buttons simultaneously for 3 seconds and release. Press Δ and ∇ simultaneously for 3 seconds to reset diagnostic values to zero.

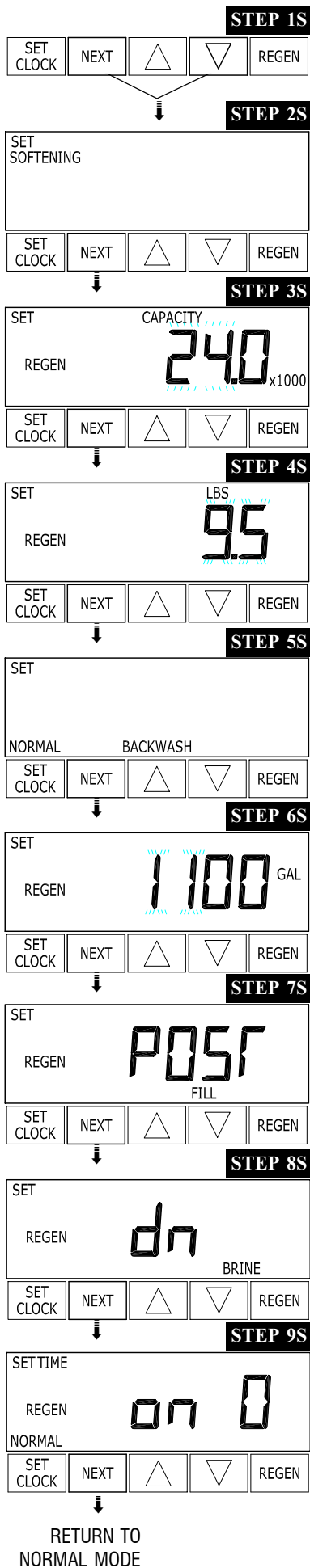
Sometimes it is desirable to have the valve initiate and complete two regenerations within 24 hours and then return to the preset regeneration procedure. It is possible to do a double regeneration if the control valve is set to “NORMAL” or “NORMAL + on 0” in Step 9S or Step 7F. To do a double regeneration:

1. Press the “REGEN” button once. REGEN TODAY will flash on the display.
2. Press and hold the “REGEN” button for three seconds until the valve regeneration initiates.

Once the valve has completed the immediate regeneration, the valve will regenerate one more time at the preset regeneration time.

OEM Softener System Setup Quick Reference

This is a quick reference setup procedure. See OEM Softener System Setup Detail for more information on available settings.



STEP 1S – Press NEXT and ∇ buttons simultaneously for 3 seconds. If screen in step 2S does not appear in 5 seconds the lock on the valve is activated. To unlock press ∇ , NEXT, Δ , and SET CLOCK in sequence, then press NEXT and ∇ simultaneously for 3 seconds.

STEP 2S – Choose Softening using ∇ or Δ buttons. Press NEXT to go to Step 3S. Press REGEN to exit OEM Softener System Setup.

STEP 3S – Enter the ion exchange capacity in grains of hardness as calcium carbonate for the system based on test data using ∇ or Δ buttons. Press NEXT to go to Step 4S. Press REGEN to return to previous step.

STEP 4S – Enter the pounds of salt per regeneration using ∇ or Δ buttons. Press NEXT to go to Step 5S. Press REGEN to return to previous step.

STEP 5S – Backwash: Select “NORMAL” or “LONGER” using ∇ or Δ buttons. See Tables 4 or 5 for backwash times. Press NEXT to go to Step 6S. Press REGEN to return to previous step.

- STEP 6S** – Set Gallons Capacity using ∇ or Δ buttons:
- “AUTO” (reserve capacity automatically estimated and gallons capacity automatically calculated from grains capacity and water hardness);
 - “oFF” (regeneration based on day override); or
 - number of gallons (20 to 50,000).

See Table 12 for more detail. Press NEXT to go to Step 7S. Press REGEN to return to previous step.

- STEP 7S** – Set Refill option using ∇ or Δ buttons:
- “PoST” to refill the brine tank after the final rinse; or
 - “PrE” to refill the brine tank two hours before the regeneration time set.
- Press NEXT to go to Step 8S. Press REGEN to return to previous step.

- STEP 8S** – Set regenerant down flow or up flow using ∇ or Δ buttons:
- “dn” if the regenerant is to flow downward through the media; or
 - “UP” if the regenerant is to flow upward through the media.
- Press NEXT to go to Step 9S. Press REGEN to return to previous step.

- STEP 9S** – Set Regeneration Time Option using ∇ or Δ buttons:
- “NORMAL” means regeneration will occur at the preset time;
 - “on 0” means regeneration will occur immediately when the gallons capacity reaches 0 (zero); or
 - “NORMAL + on 0” means regeneration will occur at one of the following:
 - the preset time when the gallons capacity falls below the reserve or the specified number of days between regenerations is reached whichever comes first; or
 - immediately after 10 minutes of no water usage when the gallon capacity reaches 0 (zero).

See Table 12 for more detail. Press NEXT to exit OEM Softener System Setup. Press REGEN to return to previous step. To lock settings press ∇ , NEXT, Δ , and SET CLOCK in sequence.

Table 12

Gallons Capacity	Regeneration Time Option	Day Override	Result ¹⁰
AUTO	NORMAL	oFF	Reserve capacity automatically estimated. Regeneration occurs when gallons capacity falls below the reserve capacity at the next Regen Set Time.
AUTO	NORMAL	Any number	Reserve capacity automatically estimated. Regeneration occurs at the next Regen Set Time when gallons capacity falls below the reserve capacity or the specified number of days between regenerations is reached.
Any number	NORMAL	oFF	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs at the next Regen Set Time when gallons capacity reaches 0.
oFF	NORMAL	Any number	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs at the next Regen Set Time when the specified number of days between regenerations is reached.
Any number	NORMAL	Any number	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs at the next Regen Set Time when gallons capacity reaches 0 or the specified number of days between regenerations is reached.
AUTO	On O	oFF	Reserve capacity not automatically estimated. Regeneration occurs immediately when gallons capacity reaches 0. Time of regeneration will not be allowed to be set because regeneration will always occur when gallons capacity reaches 0.
Any number	On O	oFF	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs immediately when gallons capacity reaches 0. Time of regeneration will not be allowed to be set because regeneration will always occur on 0.
AUTO	NORMAL on 0	oFF	Reserve capacity automatically estimated. Regeneration occurs when gallons capacity falls below the reserve capacity at the next Regen Set Time or regeneration occurs immediately after 10 minutes of no water usage when gallon capacity reaches 0.
AUTO	NORMAL on 0	Any number	Reserve capacity automatically estimated. Regeneration occurs at the next Regen Set Time when gallons capacity falls below the reserve capacity or the specified number of days between regenerations is reached or regeneration occurs immediately after 10 minutes of no water usage when gallon capacity reaches 0.
Any number	NORMAL on 0	Any number	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs at the next Regen Set Time when the specified number of days between regenerations is reached or regeneration occurs immediately after 10 minutes of no water usage when gallon capacity reaches 0.

¹⁰Reserve capacity estimate is based on history of water usage.

OEM Softener System Setup Detail

STEP 1S – Press NEXT and ∇ simultaneously for 3 seconds. If screen in step 2S does not appear in 5 seconds the lock on the valve is activated. To unlock press ∇ , NEXT, Δ , and SET CLOCK in sequence, then press NEXT and ∇ simultaneously for 3 seconds.

STEP 2S - Softening or Filtering: First the OEM must set the valve for use as a softener. Press ∇ or Δ to choose softening. Press NEXT to go to Step 3S. Press REGEN to exit OEM Softener System Setup.

STEP 3S – Grains Capacity: Enter the ion exchange capacity in grains of hardness as calcium carbonate for the system based on the pounds of salt that will be set in the next step. The allowable range varies from 5,000 to 200,000 grains.¹¹ The increment increase is 500 for the range from 5000 to 30,000; 1000 for the range of 30,000 to 100,000; and 2000 for the range of 100,000 to 200,000. Press NEXT to go to Step 4S. Press REGEN to return to previous step.

STEP 4S – Pounds Salt: Enter the pounds of salt per regeneration. The range varies from a low of 0.8 to a high of 117. Press NEXT to go to Step 5S. Press REGEN to return to previous step.

STEP 5S – Backwash: Select “NORMAL” or “LONGER”. Selection effects the length of all backwashes. The actual duration of backwash automatically increases with higher salt dosages (see Tables 4 and 5 for additional details). Press NEXT to go to Step 6S. Press REGEN to return to previous step.

STEP 6S – Gallons Capacity: If value is set to:

- “AUTO” gallon capacity will be automatically calculated and reserve capacity will be automatically estimated;
- “oFF” regeneration will be based solely on the day override set (see Installer Display/Settings step 3I); or
- as a number (allowable range 20 to 50,000) regeneration initiation will be based off the value specified.

Increment increase is 20 for the range of 20 to 1000; 50 for the range of 1000 to 10,000 and 100 for the range of 10,000 to 50,000. If “oFF” or a number is used, hardness display will not be allowed to be set in Installer displays/settings.¹² See Table 12 for more detail. Press NEXT to go to Step 7S. Press REGEN to return to previous step.

STEP 7S – Refill: Select “PoST” to refill the brine tank after the final rinse or select “PrE” to refill the brine tank two hours before the regeneration time set. Press NEXT to go to Step 8S. Press REGEN to return to previous step.

STEP 8S – Down flow or up flow: Select “dn” if the regenerant is to flow downward through the media. Select “UP” if the regenerant is to flow upward through the media.¹³ Press NEXT to go to Step 9S. Press REGEN to return to previous step.

STEP 9S – Regeneration Time Option: Three choices for settings are available “NORMAL”, “on 0” and “NORMAL + on 0”. See Table 12 for more detail. Press NEXT to exit OEM Softener System Setup. Press REGEN to return to previous step. To lock settings press ∇ , NEXT, Δ , and SET CLOCK in sequence.

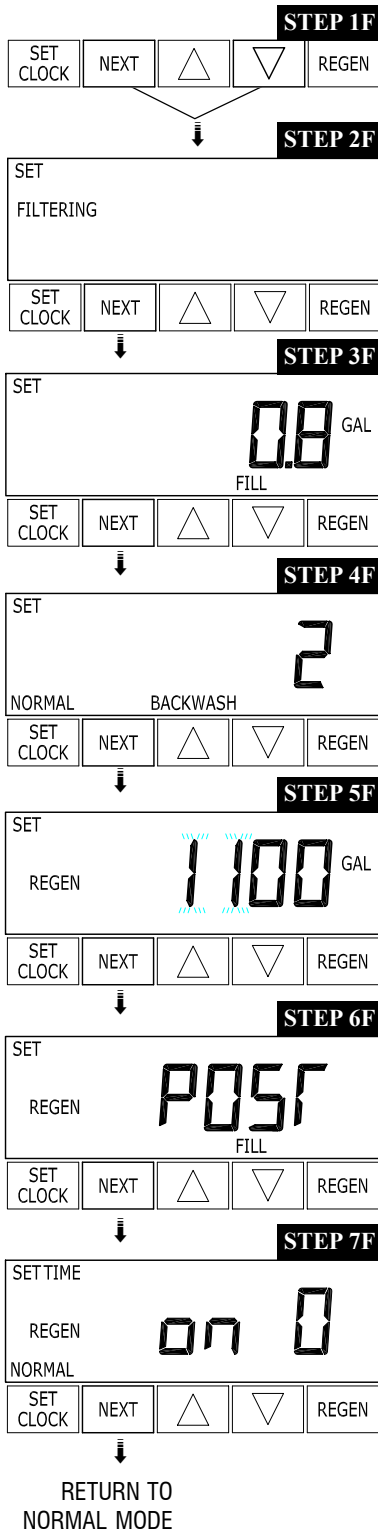
¹¹ Grains of capacity is affected by the salt dose setting. The capacity for that salt dosage should be confirmed by OEM testing. The capacity and hardness levels entered are used to automatically calculate reserve capacity when gallon capacity is set to AUTO.

¹² It is suggested the “AUTO” setting be used in order to insure a proper reserve capacity.

¹³ Check to insure the main piston and injector location correspond to the down flow or up flow selection. For “dn” the main piston is entirely black and the injector is in the hole labeled “dn”. For “UP” the main piston is gray and black and the injector is in the hole labeled “UP”. The color of the piston can be viewed by shining a flashlight through the drain port.

OEM Filter System Setup Quick Reference

This is a quick reference setup procedure. See OEM Filter System Setup Detail for more information on available settings.



STEP 1F – Press NEXT and ∇ simultaneously for 3 seconds. If screen in step 2F does not appear in 5 seconds the lock on the valve is activated. To unlock press ∇ , NEXT, Δ , and SET CLOCK in sequence, then press NEXT and ∇ simultaneously for 3 seconds.

STEP 2F – Choose Filtering using ∇ or Δ buttons. Press NEXT to go to step 3F. Press REGEN to exit OEM Filter System Setup.

STEP 3F – Enter “oFF” if regenerant is not used (i.e. backwash only) or enter the refill volume (in gallons) using ∇ or Δ buttons. Press NEXT to go to step 4F. Press REGEN to return to previous step.

STEP 4F – Backwash: Select using ∇ or Δ buttons:

- “NORMAL” for one “NORMAL” backwash (14 minutes);
- “NORMAL 2” for two “NORMAL” backwashes (8 minutes each);
- “LONGER” for one “LONGER” backwash (16 minutes); or
- “LONGER 2” for two “LONGER” backwashes (12 minutes each).

See Tables 7 and 8 for additional details. Press NEXT to go to step 5F. Press REGEN to return to previous step.

STEP 5F – Set Gallons Capacity using ∇ or Δ buttons:

- “oFF” (regeneration based on day override); or
- number of gallons (20 to 50,100).

See Table 13 for more detail. Press NEXT to go to step 6F. Press REGEN to return to previous step.

STEP 6F – Set Refill option using ∇ or Δ buttons:

- “PoST” to refill the brine tank after the final rinse; or
- “PrE” to refill the brine tank two hours before the regeneration time set.

Press NEXT to go to step 7F. Press REGEN to return to previous step.

STEP 7F – Set Regeneration Time Option using ∇ or Δ buttons:

- “NORMAL” means regeneration will occur at the preset time;
- “on 0” means regeneration will occur immediately when the gallons capacity reaches 0 (zero); or
- “NORMAL + on 0” means regeneration will occur at one of the following:
 - the preset time when the specified number of days between regenerations is reached; or
 - immediately after 10 minutes of no water usage when the gallon capacity reaches 0 (zero).

See Table 13 for more detail. Press NEXT to exit OEM Filter System Setup. Press REGEN to return to previous step. To lock settings press ∇ , NEXT, Δ , and SET CLOCK in sequence.

Table 13

Gallons Capacity	Regeneration Time Option	Day Override	Result
oFF	NORMAL	Any number	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs at the next Regen Set Time when the specified number of days between regenerations is reached.
Any number	NORMAL	oFF	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs at the next Regen Set Time when gallons capacity reaches 0.
Any number	NORMAL	Any number	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs at the next Regen Set Time when gallons capacity reaches 0 or the specified number of days between regenerations is reached.
Any number	On 0	oFF	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs immediately when gallons capacity reaches 0. Time of regeneration will not be allowed to be set because regeneration will always occur on 0.
Any number	NORMAL on 0	Any number	Reserve capacity <u>not</u> automatically estimated. Regeneration occurs at the next Regen Set Time when the specified number of days between regenerations is reached or regeneration occurs immediately after 10 minutes of no water usage when gallon capacity reaches 0.

OEM Filter System Setup Detail

STEP 1F – Press NEXT and ∇ simultaneously for 3 seconds. If screen in step 2F does not appear in 5 seconds the lock on the valve is activated. To unlock press ∇ , NEXT, Δ , and SET CLOCK in sequence, then press NEXT and ∇ simultaneously for 3 seconds.

STEP 2F - Softening or Filtering: First the OEM must set the valve for use as a filter. Press ∇ or Δ to choose filtering. Press NEXT to go to step 3F. Press REGEN to exit OEM Filter System Setup.

STEP 3F – Fill Volume: If the filter design does not require a regenerant the value is set to “oFF”. If a regenerant is required, the volume of refill (in gallons) can be set to the desired value. The default value is 0.8 and the value ranges from 0.1 to 100.0. The increment increase is 0.1 for the range of 0.1 to 10.0; 0.5 for the range of 10.0 to 50.0 and 1.0 for the range of 50.0 to 100.0. Press NEXT to go to step 4F. Press REGEN to return to previous step.

STEP 4F – Backwash: Select “NORMAL” for one “NORMAL” backwash, “NORMAL 2” for two “NORMAL” backwashes, “LONGER” for one “LONGER” backwash or “LONGER 2” for two “LONGER” backwashes. Selection effects the length of all backwashes. The actual duration of one NORMAL backwash is 14 minutes, one LONGER backwash is 16 minutes, NORMAL 2 backwashes are 8 minutes each, and LONGER 2 backwashes are 12 minutes each (see Tables 7 and 8 for additional details). Press NEXT to go to step 5F. Press REGEN to return to previous step.

STEP 5F – Gallons Capacity: If value is set to:

- “oFF” regeneration will be based solely on the day override set (see Installer Display/Settings step 31); or
- as a number (allowable range 20 to 50,100) regeneration initiation will be based off the value specified.

Increment increase is 20 for the range of 20 to 1000; 50 for the range of 1000 to 10,000 and 100 for the range of 10,000 to 50,100. Hardness display will not be allowed to be set in the Install displays/settings. See Table 13 for more detail. Press NEXT to go to step 6F. Press REGEN to return to previous step.

STEP 6F – Refill: Select “PoST” to refill the brine tank after the final rinse or select “PrE” to refill the brine tank two hours before the regeneration time set. If “oFF” is selected in Step 3F the display can be left on “PoST” or “PrE” because no refill occurs. Press NEXT to go to step 7F. Press REGEN to return to previous step.

STEP 7F – Regeneration Time Option: Three choices for settings are available “NORMAL”, “on 0” and “NORMAL + on 0”. See Table 13 for more detail. Press NEXT to exit OEM Filter System Setup. Press REGEN to return to previous step. To lock settings press ∇ , NEXT, Δ , and SET CLOCK in sequence.

Installer Displays/Settings



STEP 11 - Press NEXT and Δ simultaneously for 3 seconds.

STEP 21 – Hardness: Set the amount of hardness in grains of hardness as calcium carbonate per gallon using the ∇ or Δ buttons. The default is 20 with value ranges from 1 to 150 in 1 grain increments. Note the grains per gallon can be increased if soluble iron needs to be reduced. This display will show “-nA-” if “FILTER” is selected in Step 2F or if ‘AUTO’ is not selected in Step 6S. Press NEXT to go to step 3I. Press REGEN to exit Installer Displays/Settings.

STEP 31 – Day Override: When gallon capacity is set to off, sets the number of days between regenerations. When gallon capacity is set to AUTO or to a number, sets the maximum number of days between regenerations. If value set to “oFF” regeneration initiation is based solely on gallons used. If value is set as a number (allowable range from 1 to 28) a regeneration initiation will be called for on that day even if sufficient number of gallons were not used to call for a regeneration. Set Day Override using ∇ or Δ buttons:

- number of days between regeneration (1 to 28); or
- “oFF”.

See Table 12 for more detail on softener setup and Table 13 for more detail on filter setup. Press NEXT to go to step 4I. Press REGEN to return to previous step.

STEP 4I – Next Regeneration Time (hour): Set the hour of day for regeneration using ∇ or Δ buttons. AM/PM toggles after 12. The default time is 2:00 a.m. This display will show “REGEN on 0 GAL” if “on 0” is selected in Step 9S or Step 7F. Press NEXT to go to step 5I. Press REGEN to return to previous step.

STEP 5I – Next Regeneration Time (minutes): Set the minutes of day for regeneration using ∇ or Δ buttons. This display will not be shown if “on 0” is selected in Step 9S or Step 7F. Press NEXT to exit Installer Displays/Settings. Press REGEN to return to previous step.

To initiate a manual regeneration immediately, press and hold the “REGEN” button for three seconds. The system will begin to regenerate immediately. The control valve may be stepped through the various regeneration cycles by pressing the “REGEN” button.

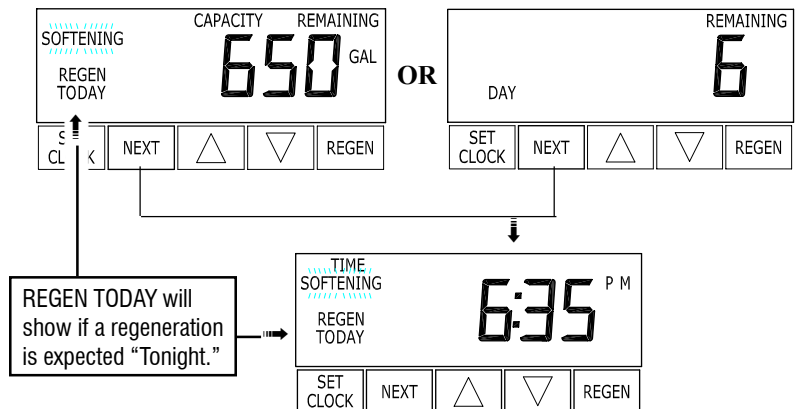
General Operation

When the system is operating one of two displays will be shown. Pressing NEXT will alternate between the displays. One of the displays is always the current time of day. The second display is one of the following: days remaining or gallons remaining. Days remaining is the number of days left before the system goes through a regeneration cycle. Capacity remaining is the number of gallons that will be treated before the system goes through a regeneration cycle. The user can scroll between the displays as desired.

If the system has called for a regeneration that will occur at the preset time of regeneration, the words REGEN TODAY will appear on the display.

When water is being treated (i.e. water is flowing through the system) the word “Softening” or “Filtering” flashes on the display if a water meter is installed.

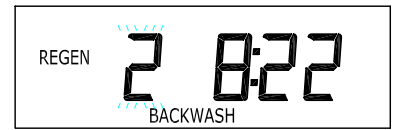
User Displays/Settings



REGEN TODAY will show if a regeneration is expected “Tonight.”

Regeneration Mode

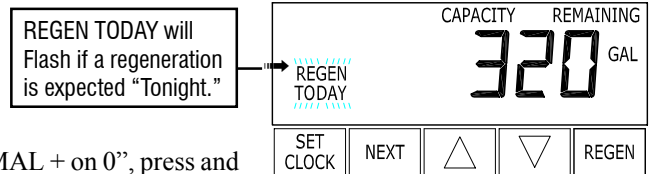
Typically a system is set to regenerate at a time of low water usage. An example of a time with low water usage is when a household is asleep. If there is a demand for water when the system is regenerating, untreated water will be used.



When the system begins to regenerate, the display will change to include information about the step of the regeneration process and the time remaining for that step to be completed. The system runs through the steps automatically and will reset itself to provide treated water when the regeneration has been completed.

Manual Regeneration

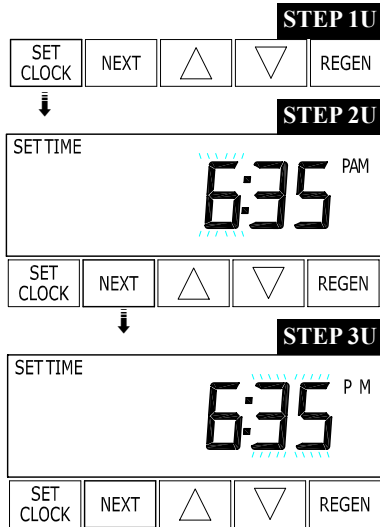
Sometimes there is a need to regenerate the system, sooner than when the system calls for it, usually referred to as manual regeneration. There may be a period of heavy water usage because of guests or a heavy laundry day.



To initiate a manual regeneration at the preset delayed regeneration time, when the regeneration time option is set to "NORMAL" or "NORMAL + on 0", press and release "REGEN". The words "REGEN TODAY" will flash on the display to indicate that the system will regenerate at the preset delayed regeneration time. If you pressed the "REGEN" button in error, pressing the button again will cancel the request. Note: If the regeneration time option is set to "on 0" there is no set delayed regeneration time so "REGEN TODAY" will not activate if "REGEN" button is pressed.

To initiate a manual regeneration immediately, press and hold the "REGEN" button for three seconds. The system will begin to regenerate immediately. The request cannot be cancelled.

Note: For softeners, if brine tank does not contain salt, fill with salt and wait at least two hours before regenerating.



Set Time of Day

The user can also set the time of day. Time of day should only need to be set after extended power outages or when daylight saving time begins or ends. If an extended power outage occurs, the time of day will flash on and off which indicates the time of day should be reset.

STEP 1U – Press SET CLOCK.

STEP 2U - Current Time (hour): Set the hour of the day using ∇ or Δ buttons. AM/PM toggles after 12. Press NEXT to go to step 3U.

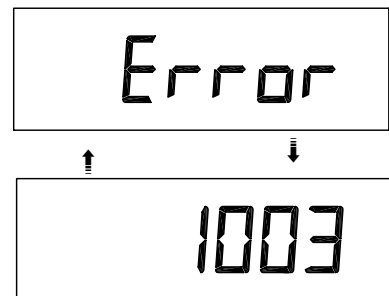
STEP 3U - Current Time (minutes): Set the minutes of the day using ∇ or Δ buttons. Press NEXT to exit Set Clock. Press REGEN to return to previous step.

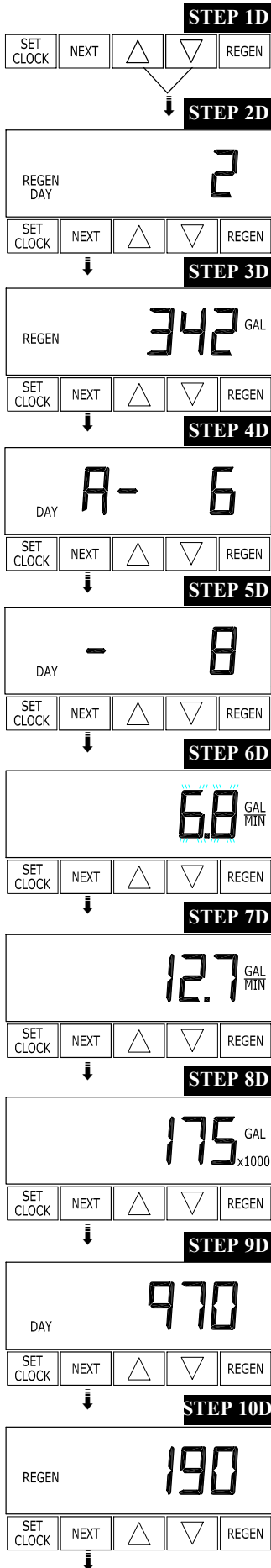
Power Loss

If the power goes out for less than two hours, the system will automatically reset itself. If an extended power outage occurs, the time of day will flash on and off which indicates the time of day should be reset. The system will remember the rest.

Error Message

If the word "ERROR" and a number are alternately flashing on the display contact the OEM for help. This indicates that the valve was not able to function properly.





RETURN TO
NORMAL MODE

Diagnostics

STEP 1D – Press Δ and ∇ simultaneously for three seconds. If screen in step 2D does not appear in 5 seconds the lock on the valve is activated. To unlock press ∇ , NEXT, Δ , and SET CLOCK in sequence, then press NEXT and ∇ simultaneously for 3 seconds.

STEP 2D¹⁴ – Days, since last regeneration: This display shows the days since the last regeneration occurred. Press the NEXT button to go to Step 3D. Press REGEN to exit Diagnostics.

STEP 3D – Gallons, since last regeneration: This display shows the number of gallons that have been treated since the last regeneration. This display will equal zero if a water meter is not installed. Press the NEXT button to go to Step 4D. Press REGEN to return to previous step.

STEP 4D – Gallons, reserve capacity used for last 7 days: If the valve is set up as a softener, a meter is installed and Set Gallons Capacity is set to “Auto,” this display shows 0 day (for today) and flashes the reserve capacity. Pressing the Δ button will show day 1 (which would be yesterday) and flashes the reserve capacity used. Pressing the Δ button again will show day 2 (the day before yesterday) and the reserve capacity. Keep pressing the Δ button to show the gallons for days 3, 4, 5 and 6. The ∇ button can be pressed to move backwards in the day series. Press the NEXT button at any time to go to Step 5D. Press REGEN to return to previous step.

STEP 5D - Gallons, 63 day usage history: This display shows day 1 (for yesterday) and flashes the number of gallons treated yesterday. Pressing the Δ button will show day 2 (which would be the day before yesterday) and flashes the number of gallons treated on that day. Continue to press the Δ button to show the maximum number of gallons treated for the last 63 days. This display will show dashes if a water meter is not installed. Press the NEXT button at any time to go to Step 6D. Press REGEN to return to previous step.

STEP 6D – Flow rate, current: Turn the water on at one or more taps in the building. The flow rate in gallons per minute will be displayed. If flow stops the value will fall to zero in a few seconds. This display will equal zero if a water meter is not installed. Press the NEXT button to go to Step 7D. Press REGEN to return to previous step.

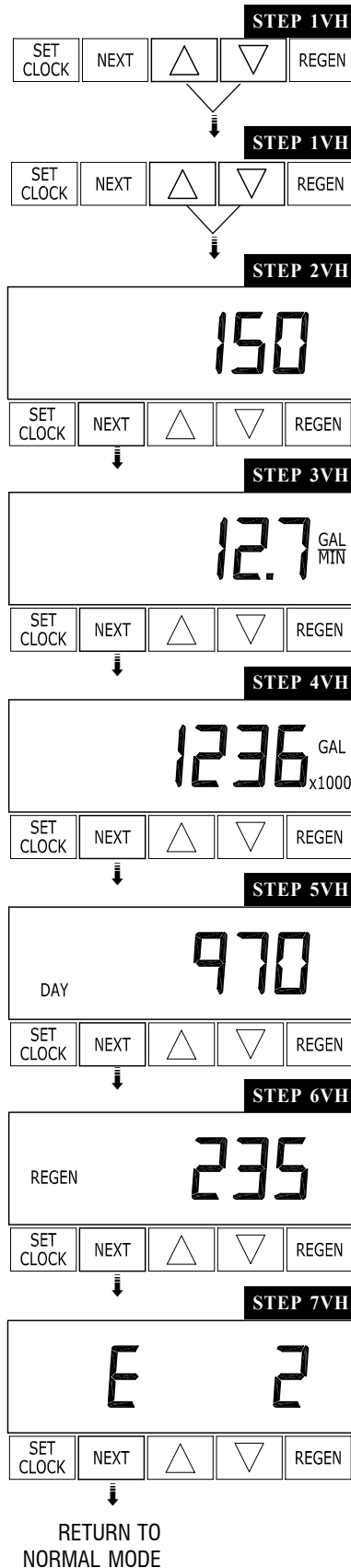
STEP 7D – Flow rate, maximum last seven days: The maximum flow rate in gallons per minute that occurred in the last seven days will be displayed. This display will equal zero if a water meter is not installed. Press the NEXT button to go to Step 8D. Press REGEN to return to previous step.

STEP 8D – Gallons, total used since last reset: The total number of gallons used since last reset will be displayed. This display will equal zero if a water meter is not installed. Press the NEXT button to go to Step 9D. Press REGEN to return to previous step.

STEP 9D – Days, total number since last reset: The total number of days the control valve has been in service since last reset will be displayed. Press the NEXT button to go to Step 10D. Press REGEN to return to previous step.

STEP 10D – Regenerations, total number since last reset: The total number of regenerations that have occurred since last reset will be displayed. Press the NEXT button to exit Diagnostics. Press REGEN to return to previous step. To lock settings press ∇ , NEXT, Δ , and SET CLOCK in sequence.

¹⁴ The values in steps 2D through 5D and 7D through 10D can be reset to zero. See Table 14, Reset Diagnostic Settings for procedure. Resetting one value resets them all.



Valve History

STEP 1VH – Press Δ and ∇ simultaneously for three seconds and release. Then press Δ and ∇ simultaneously and release. If screen in step 2VH does not appear in 5 seconds the lock on the valve is activated. To unlock press ∇ , NEXT, Δ , and SET CLOCK in sequence, then press Δ and ∇ simultaneously for 3 seconds and release. Then press Δ and ∇ simultaneously and release.

STEP 2VH – Software Version: This display shows the software version of the valve. Press the NEXT button to go to Step 3VH. Press REGEN to exit Valve History.

STEP 3VH¹⁵ – Flow rate, maximum since startup: This display shows the maximum flow rate in gallons per minute that has occurred since startup. This display will equal zero if a water meter is not installed. Press the NEXT button to go to Step 4VH. Press REGEN to return to previous step.

STEP 4VH – Gallons, total used since start-up: This display shows the total gallons treated since startup. This display will equal zero if a water meter is not installed. Press the NEXT button to go to Step 5VH. Press REGEN to return to previous step.

STEP 5VH – Days, total since start-up: This display shows the total days since startup. Press the NEXT button to go to Step 6VH. Press REGEN to return to previous step.

STEP 6VH – Regenerations, total number since start-up: This display shows the total number of regenerations that have occurred since startup. Press the NEXT button to go to Step 7VH. Press REGEN to return to previous step.

STEP 7VH – Error, number of occurrences since start-up: This display shows E and the total number of errors that have occurred since startup. Press the NEXT button to exit Valve History. Press REGEN to return to previous step. To lock settings press ∇ , NEXT, Δ , and SET CLOCK in sequence.

¹⁵ Values in steps 3VH through 7VH cannot be reset.

Table 14
Summary of Data Inputted or Information Available

Data Inputted or Information available ¹⁶	OEM General Instructions	OEM Softener Setup	OEM Filter Setup	Installer Displays & Settings	User Displays & Settings	Diagnostics	Valve History
Access to Setup		Step 1S	Step 1F	Step 1I		Step 1D	Step 1VH
Backwash Options		Step 5S	Step 4F				
Capacity, Gallon		Step 6S	Step 5F				
Capacity, Ion Exchange		Step 3S					
Capacity, remaining until regeneration					X		
Day Override				Step 3I			
Days, remaining until regeneration					X		
Days, since last regeneration						Step 2D	
Days, total number since last reset						Step 9D	
Days, total since start-up							Step 5VH
Error ¹⁷					X		
Error, number of occurrences since startup							Step 7VH
Exit Set-up, Diagnostic or Valve History steps	Press Set Clock						
Fill Volume			Step 3F				
Flow rate, current ¹⁸						Step 6D	
Flow Rate, maximum last seven days ¹⁸						Step 7D	
Flow rate, maximum since startup ¹⁸							Step 3VH
Gallons, 63 day usage history ¹⁸						Step 5D	
Gallons, reserve capacity used for last 7 days ¹⁸						Step 4D	
Gallons, since last regeneration ¹⁸						Step 3D	
Gallons, total used since last reset ¹⁸						Step 8D	
Gallons, total used since start-up ¹⁸							Step 4VH
Hardness				Step 2I			
Lock/Unlock	Press ∇ , NEXT, Δ , and SET CLOCK in sequence						
Pounds Salt per regeneration		Step 4S					
Refill, Pre or Post		Step 7S	Step 6F				
Regeneration Down flow/Up flow		Step 8S					
Regeneration Step and Time Remaining					X		
Regeneration Time Option, Delayed or Immediate		Step 9S	Step 7F				
Regeneration, Manual Initiation, delayed	Press and release REGEN						
Regeneration, Manual Initiation, immediate	Press and hold REGEN for 3 seconds						
Regenerations, total number since last reset						Step 10D	

¹⁶ Gray shading indicates that the values can be reset to zero. To reset the values press NEXT and ∇ simultaneously for 3 seconds and then press Δ and ∇ for 3 seconds.

¹⁷ See the trouble shooting guide for help diagnosing error codes.

¹⁸ A water meter is necessary for this information to be collected.

Data Inputted or Information available ¹⁶	OEM General Instructions	OEM Softener Setup	OEM Filter Setup	Installer Displays & Settings	User Displays & Settings	Diagnostics	Valve History
Regenerations, total number since start-up							Step 6VH
Reinitialize Valve	Press NEXT and REGEN for 3 seconds OR unplug power source plug (black wire) and plug back in						
Reset Diagnostic Settings	Press NEXT and V simultaneously for 3 seconds and then press Δ and V for 3 seconds						
Softening/Filtering		Step 2S	Step 2F				
Software Version	Press NEXT and REGEN for 3 seconds or unplug power source jack (black wire) and plug back in						Step 2VH
Time of Day					Step 2U and 3U		
Time of Day, Regeneration				Step 4I and 5I			

Installation

Refill Flow Control Assembly or Refill Port Plug

Control valves that are setup for backwash only come equipped with a refill port plug. The refill port plug has no regenerant line connection.

Control valves that use a regenerant, come equipped with a 3/8" refill flow control assembly. To switch to the 1/2" refill flow control assembly, remove the refill flow control and retainer (from the 3/8" refill elbow) by twisting and pulling out. Insert the refill flow control and retainer into the 1/2" refill elbow.

To complete the regenerant line connection, orientate the outlet in the desired direction and push the plastic insert into the polytube. Push the polytube into the nut. Do not use pipe dope or other sealants on threads. The threads for the compression nut do not need Teflon tape. Tighten the nut securely to create a pressure tight connection. A pliers or crescent wrench may be used to tighten or unscrew the nut. The nut, gripper and retainer sleeve is a 3 piece assembly that can come apart if removed from the elbow body. Parts must be reassembled exactly as shown in refill flow control assembly drawing to function properly. If the nut is completely removed from the body, slip the nut, plastic gripper and retainer sleeve on to the tube then tighten on to the fitting.

Drain Line Flow Control and Fitting Assembly

To determine which drain line flow control to use, obtain media bed expansion tables from the media manufacturer, choose a water temperature and look up the desired backwash rate per square foot of bed area. Then calculate the backwash rate using the desired tank diameter. Using table 11 pick the drain line flow control that has the backwash flow rate closest to the calculated backwash rate. If a manufacturer chooses to use an external drain line flow control, use an elbow fitting that does not contain a hole.

If the drain line is a 5/8" flexible polytube, slide the nut onto the polytube, then place the polytube insert into the end of the polytube and tighten the nut on to the 3/4" drain line fitting. The nut is only designed for use with flexible polytube. Use other nuts if attaching different materials.

To access the drain line flow control remove the locking clip by pulling it straight out. Pull fitting out and replace the locking clip so that it is not misplaced. The drain line fitting is pressed in and has an o-ring seal.

In the 3/4" elbow, the white flow control retainer is pressed in and has an o-ring seal. The retainer can be removed by rotating and pulling. The flow control can be removed by prying upward with a small blade flat screwdriver in one of the slots on the side. The drain line flow control and retainer can be chemically cleaned in dilute sodium bisulfite or vinegar or replaced. Do not use a wire brush to clean the flow control or the washer. The washers are identified with three numbers, which correspond to the flow rate. When reinstalling make sure the identifying number and the rounded inside diameter on the washer is visible when seated in the retainer. The white flow control washer retainer can also be removed and cleaned. Push retainer in firmly when reinstalling.

In the 1" straight fitting, the retainer is the fitting. Unscrew the nut to access the flow control. The drain line flow control and the fitting can be chemically cleaned or replaced. Do not use a wire brush to clean the flow control or the fitting.

Do not use Vaseline, oils, or other unacceptable lubricants on o-rings. A silicon lubricant may be used on the black o-ring. Use a pliers or crescent wrench to tighten or unscrew the nut. Do not use a pipe wrench to tighten or loosen nut. Do not use pipe dope or other sealants on threads. Use Teflon tape on the threads of the drain line control fitting when installing 3/4" NPT or 1" straight fitting.

Installation Fitting Assemblies

The installation fittings connect to the control valve or the bypass valve using nuts that only require hand tightening. Hand tighten nut connections between control valve and installation fittings, control valve and bypass valve, and bypass valve and installation fittings allow for easy serviceability. Do not use a pipe wrench to tighten nuts on installation fittings. Hand tighten only.

Split ring retainer design holds the nut on and allows load to be spread over the entire nut surface area reducing the chance for leakage. The split ring design, incorporated into the installation fittings allows approximately 2 degrees off axis alignment to the plumbing system. The installation fittings are designed to accommodate minor plumbing misalignments but are not designed to support the weight of a system or the plumbing.

When assembling the installation fitting package, connect the fitting to the plumbing system first and then attach the nut, split ring and o-ring. Heat from soldering or solvent cements may damage the nut, split ring or o-ring. Solder joints should be cool and solvent cements should be set before installing the nut, split ring and o-ring. Avoid getting primer and solvent cement on any part of the o-rings, split rings, bypass valve or control valve. Solvent cements and primers should be used in accordance with the manufacturer's instructions.

Slip the nut onto the fitting first, then the split ring second and the o-ring last. Hand tighten the nut. If the fitting is leaking tightening the nut will not stop the leak. Remove the nut, remove the fitting, and check for damage or misalignment of the o-ring.

Do not use pipe dope or other sealant on threads. Teflon tape must be used on the threads of the 1" NPT elbow and the 1/4" NPT connection and on the threads for the drain line connection. Teflon tape is not necessary on the nut connection or caps because of o-ring seals.

Do not use Vaseline, oils, or other unacceptable lubricants on o-rings. A silicon lubricant may be used on black o-rings.

Bypass Valve

The bypass valve easily connects to the control valve body using nuts that only require hand tightening. Hand tighten nut connections between control valve and fittings, control valve and bypass valve, and bypass valve and installation fittings allow for easy serviceability. The split ring retainer design holds the nut on and allows load to be spread over the entire nut surface area reducing the chance for leakage. The split ring design, incorporated into the bypass, allows approximately 2 degrees off axis alignment to the plumbing system. The bypass is designed to accommodate minor plumbing misalignments but is not designed to support the weight of a system or the plumbing.

Avoid getting primer and solvent cements on any part of the o-rings or split rings, bypass valve or control valve. Do not use pipe dope or other sealant on threads. Teflon tape is not necessary on the caps because of o-ring seals.

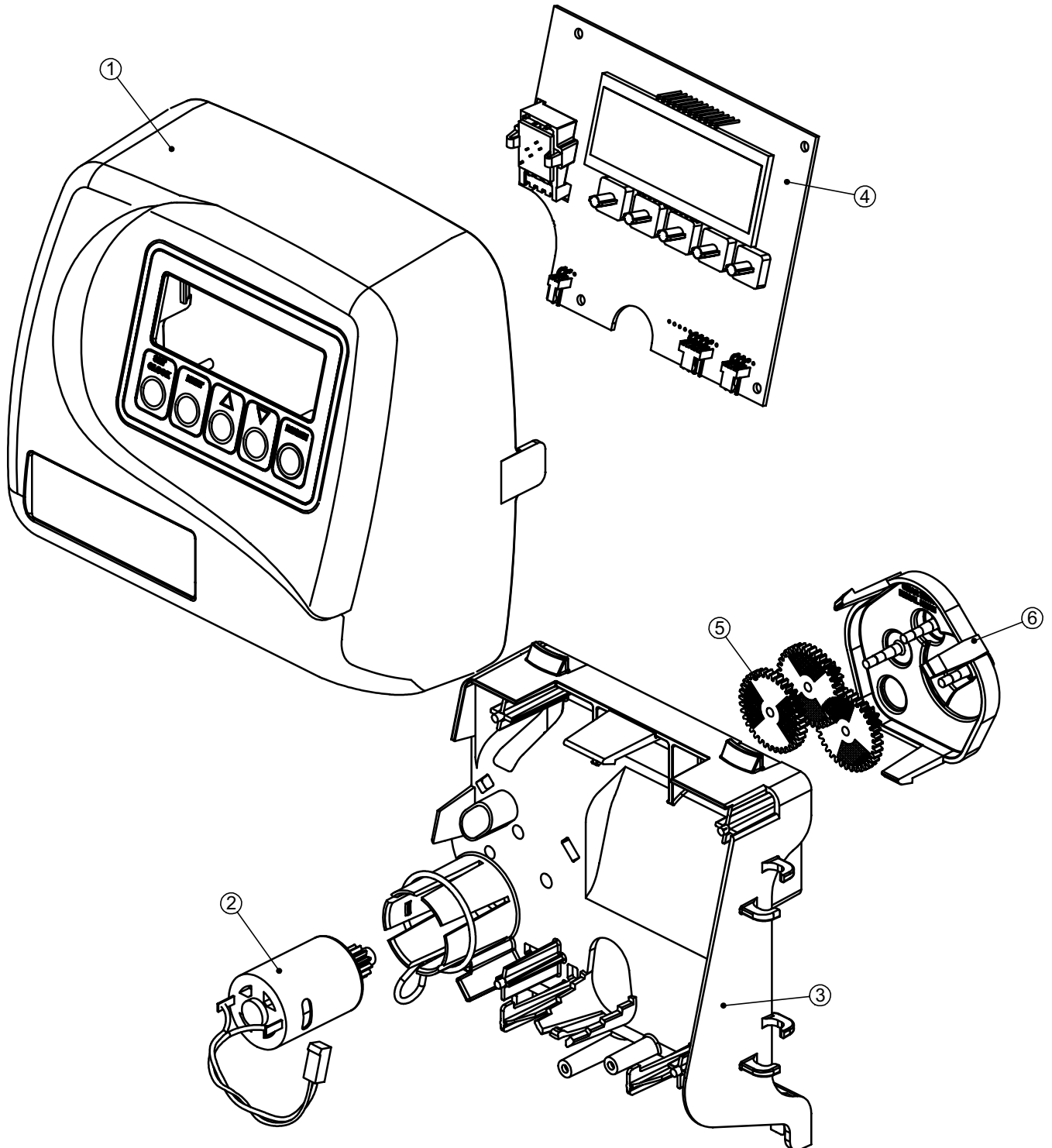
Do not use Vaseline, oils, or other unacceptable lubricants on o-rings. A silicon lubricant may be used on black o-rings.

Drawings and Part Numbers

Front Cover and Drive Assembly

Drawing No.	Order No.	Description	Quantity
1	V3175-01	WS1 Front Cover ASY	1
2	V3107-01	WS1 Motor	1
3	V3106-01	WS1 Drive Bracket&Spring Clip	1
4	V3108	WS1 PC Board	1
5	V3110	WS1 Drive Gear 12x36	3
6	V3109	WS1 Drive Gear Cover	1
	V3002	WS1 Drive ASY	*
Not Shown	V3186	WS1 Transformer 110V-12V	1

* Drawing number parts 2 through 6 may be purchased as a complete assembly, part V3002.

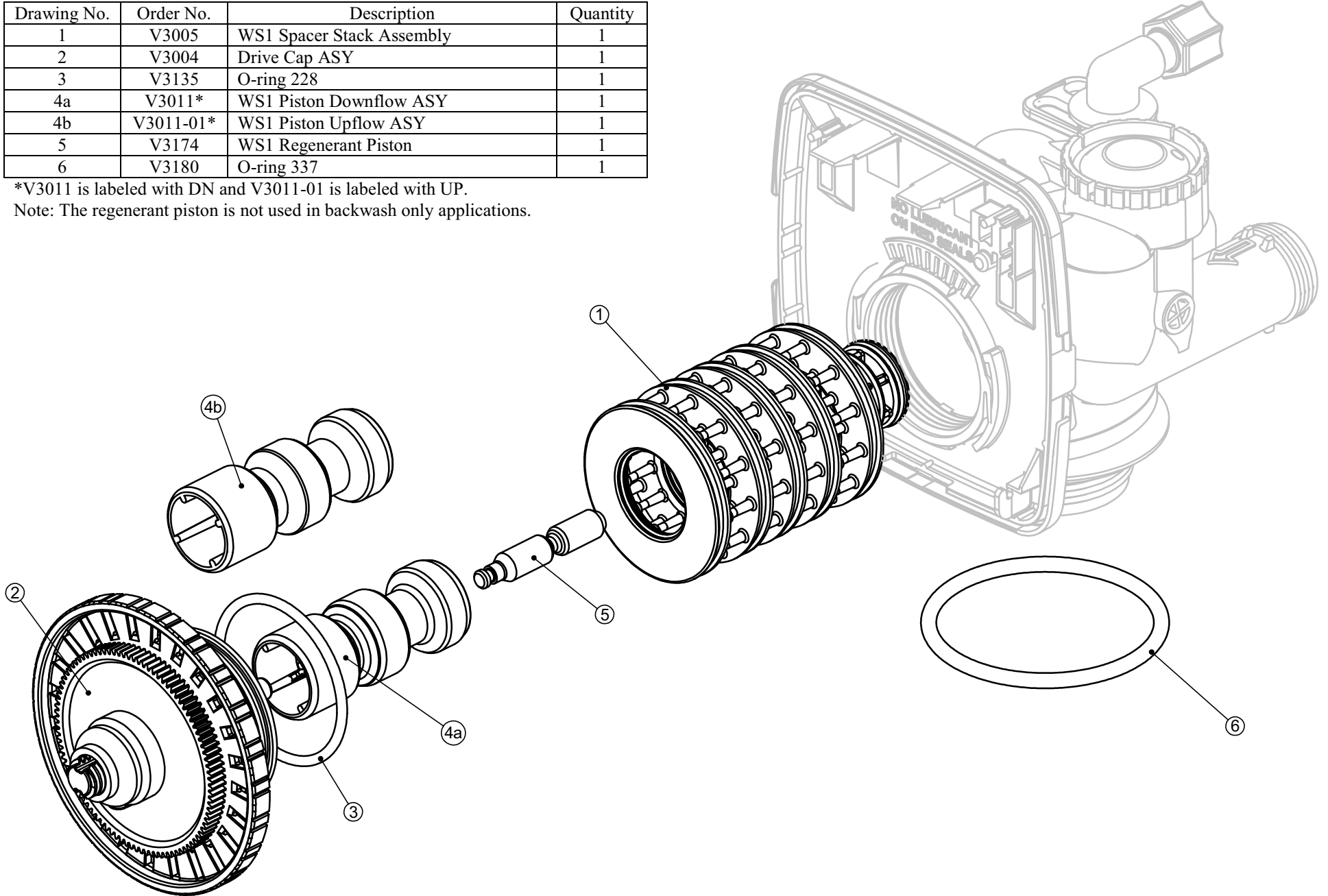


Drive Cap Assembly, Downflow Piston, Upflow Piston, Regenerant Piston and Spacer Stack Assembly

Drawing No.	Order No.	Description	Quantity
1	V3005	WS1 Spacer Stack Assembly	1
2	V3004	Drive Cap ASY	1
3	V3135	O-ring 228	1
4a	V3011*	WS1 Piston Downflow ASY	1
4b	V3011-01*	WS1 Piston Upflow ASY	1
5	V3174	WS1 Regenerant Piston	1
6	V3180	O-ring 337	1

*V3011 is labeled with DN and V3011-01 is labeled with UP.

Note: The regenerant piston is not used in backwash only applications.

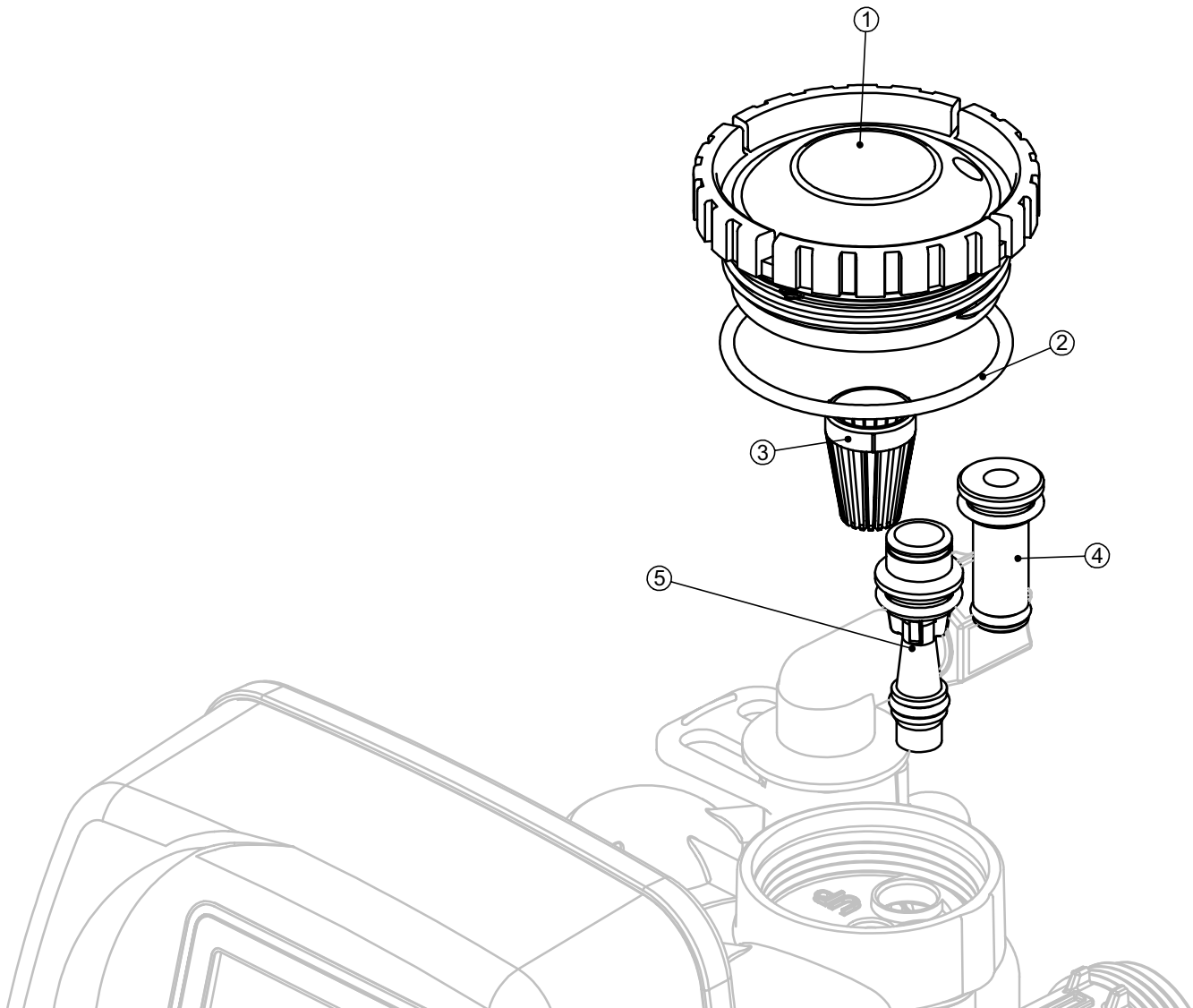


Injector Cap, Injector Screen, Injector, Plug and O-Ring

Drawing No.	Order No.	Description	Quantity
1	V3176	Injector Cap	1
2	V3152	O-ring 135	1
3	V3177	Injector Screen	1
4	V3010-1Z	WS1 Injector ASY Z Plug	1
5	V3010-1A	WS1 INJECTOR ASY A BLACK	1
	V3010-1B	WS1 INJECTOR ASY B BROWN	
	V3010-1C	WS1 INJECTOR ASY C VIOLET	
	V3010-1D	WS1 INJECTOR ASY D RED	
	V3010-1E	WS1 INJECTOR ASY E WHITE	
	V3010-1F	WS1 INJECTOR ASY F BLUE	
	V3010-1G	WS1 INJECTOR ASY G YELLOW	
	V3010-1H	WS1 INJECTOR ASY H GREEN	
	V3010-1I	WS1 INJECTOR ASY I ORANGE	
	V3010-1J	WS1 INJECTOR ASY J LIGHT BLUE	
	V3010-1K	WS1 INJECTOR ASY K LIGHT GREEN	
Not Shown	V3170	O-ring 011	*
Not Shown	V3171	O-ring 013	*

*The injector plug and the injector each contain one 011 (lower) and 013 (upper) o-ring.

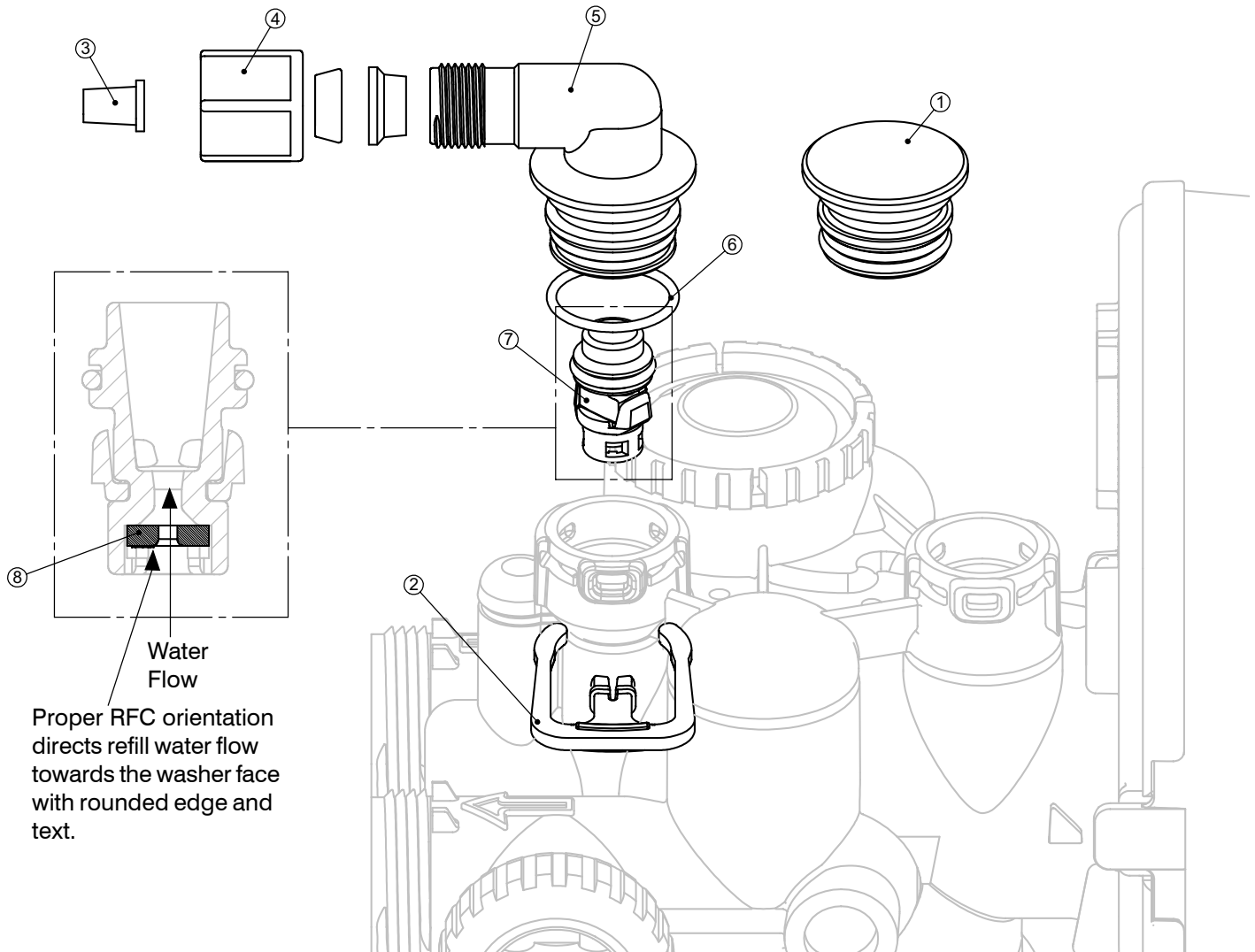
Note: For upflow position, injector is located in the up hole and injector plug in the down hole. For a filter that only backwashes injector plugs are located in both holes.



Refill and Refill Port Plug

Drawing No.	Order No.	Description	Quantity
1	V3195-01	WS1 Refill Port Plug ASY	This part is required for backwash only systems
2	H4615	Elbow Locking Clip	1
3	JCP-P-6	Polytube insert 3/8	1
4	JCPG-6PBLK	Nut 3/8	1
5	H4613	Elbow Cap 3/8	1
6	V3163	O-ring 019	1
7	V3165-01*	WS1 RFC Retainer ASY	1
8	V3182	WS1 RFC	1
Not Shown	H4650	Elbow 1/2" with nut and insert	Option

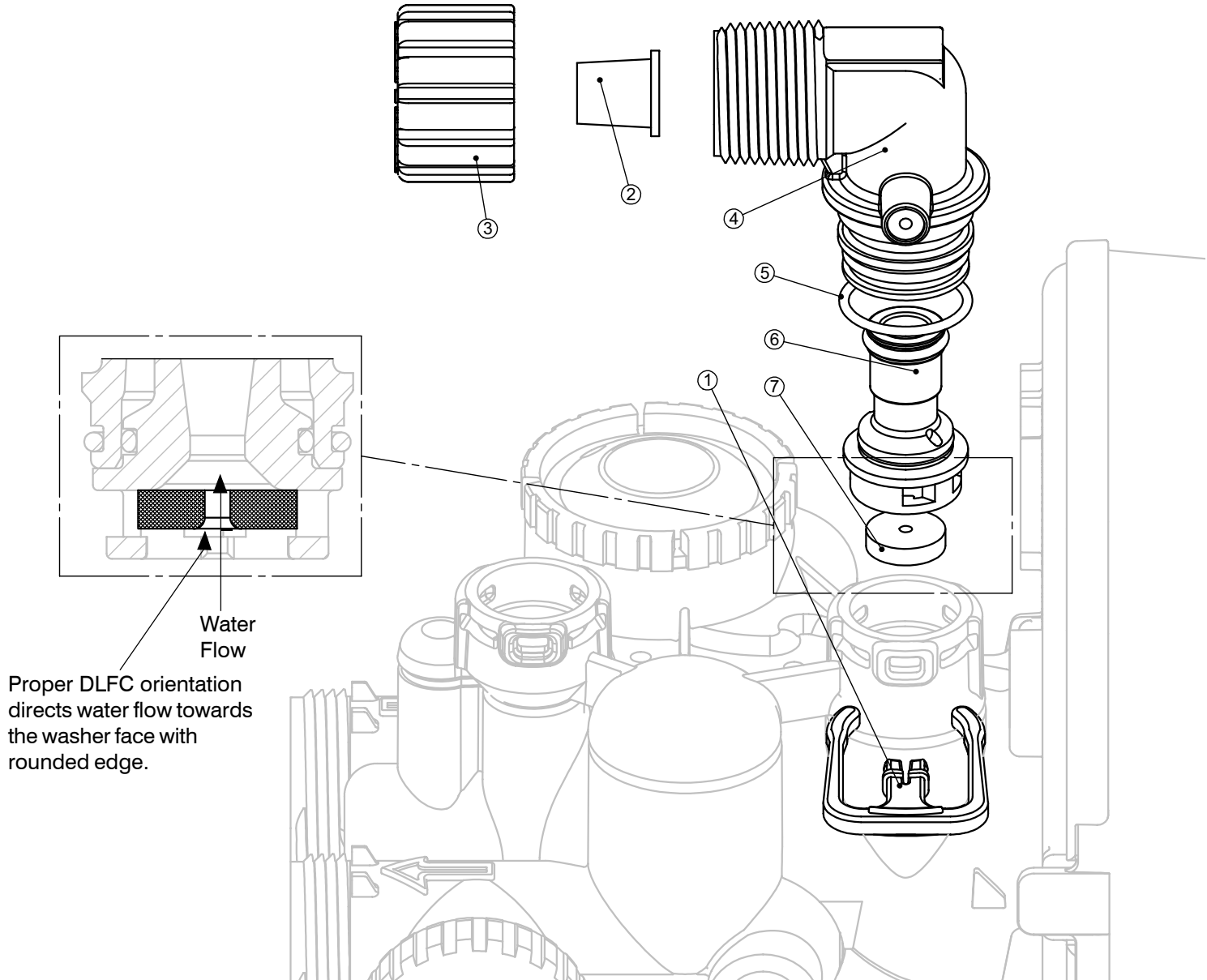
*Assembly includes WS1 RFC.



Drain Line – 3/4”

Drawing No.	Order No.	Description	Quantity
1	H4615	Elbow Locking Clip	1
2	PKP10TS8-BULK	Polytube insert 5/8	Option
3	V3192	WS1 Nut ¼ Drain Elbow	Option
4	V3158-01	WS1 Drain Elbow ¼ Male ASY	1
5	V3163	O-ring 019	1
6	V3159-01	WS1 DLFC Retainer ASY	1
7	V3162-007	WS1 DLFC 0.7 gpm for 3/4	One DLFC must be used if ¼” fitting is used
	V3162-010	WS1 DLFC 1.0 gpm for 3/4	
	V3162-013	WS1 DLFC 1.3 gpm for 3/4	
	V3162-017	WS1 DLFC 1.7 gpm for 3/4	
	V3162-022	WS1 DLFC 2.2 gpm for 3/4	
	V3162-027	WS1 DLFC 2.7 gpm for ¼	
	V3162-032	WS1 DLFC 3.2 f gpm or 3/4	
	V3162-042	WS1 DLFC 4.2 gpm for 3/4	
	V3162-053	WS1 DLFC 5.3 gpm for 3/4	
	V3162-065	WS1 DLFC 6.5 gpm for 3/4	
	V3162-075	WS1 DLFC 7.5 gpm for 3/4	
V3162-090	WS1 DLFC 9.0 gpm for 3/4		
V3162-100	WS1 DLFC 10.0 gpm for 3/4		

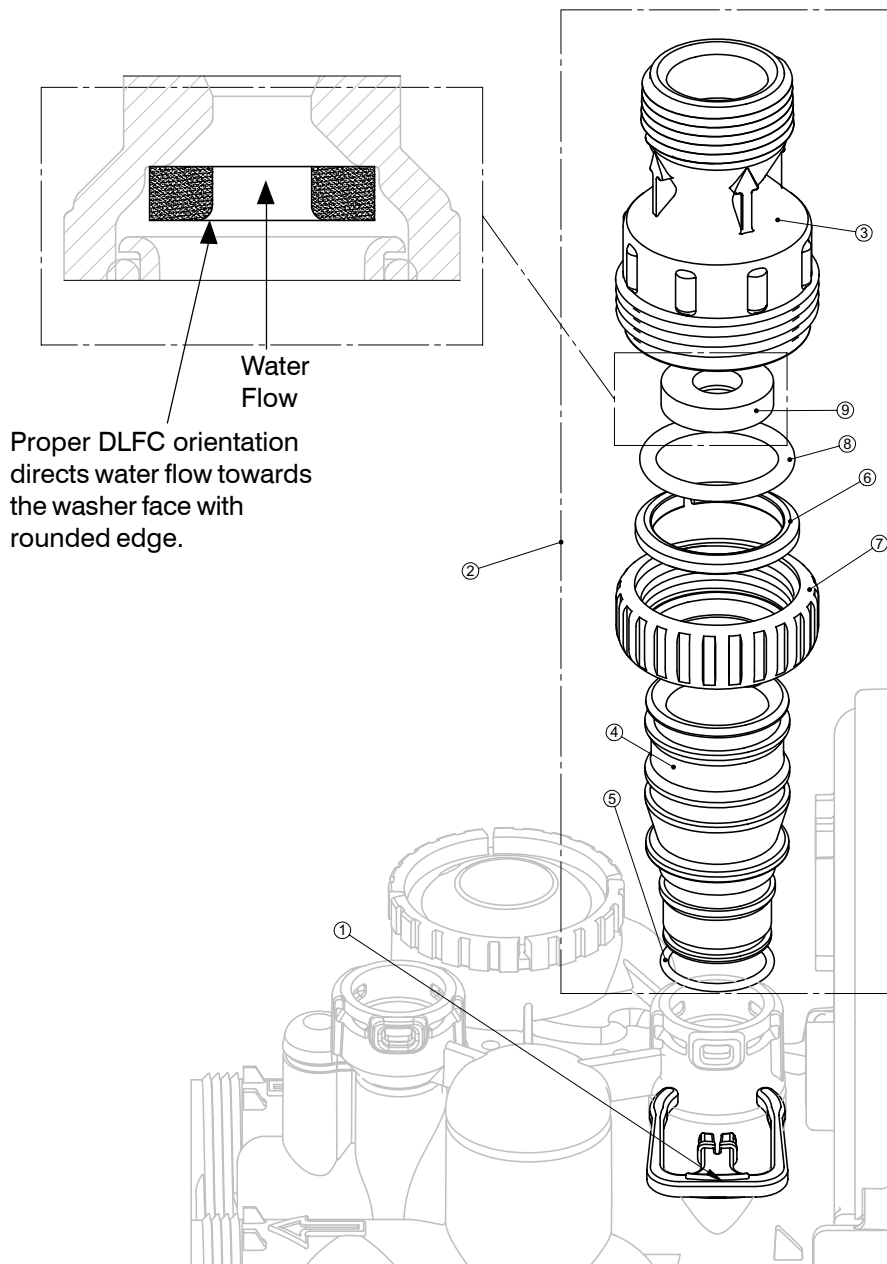
Valves are shipped without drain line flow control (DLFC) – install DLFC before using. Valves are shipped without ¼” nut for drain elbow (polytube installation only) and 5/8” polytube insert (polytube installation only).



Drain Line – 1”

Drawing No.	Order No.	Description	Quantity
1	H4615	Elbow Locking Clip	1
2	V3008-02	WS1 Drain FTG 1 Straight	1
3*	V3166	WS1 Drain FTG Body 1	1
4*	V3167	WS1 Drain FTG Adapter 1	1
5*	V3163	O-ring 019	1
6*	V3150	WS1 Split Ring	1
7*	V3151	WS1 Nut 1" QC	1
8*	V3105	O-ring 215	1
9	V3190-090	WS1 DLFC 9.0 gpm for 1	One DLFC must be used if 1" fitting is used
	V3190-100	WS1 DLFC 10.0 gpm for 1	
	V3190-110	WS1 DLFC 11.0 gpm for 1	
	V3190-130	WS1 DLFC 13.0 gpm for 1	
	V3190-150	WS1 DLFC 15.0 gpm for 1	
	V3190-170	WS1 DLFC 17.0 gpm for 1	
	V3190-200	WS1 DLFC 20.0 gpm for 1	
	V3190-250	WS1 DLFC 25.0 gpm for 1	

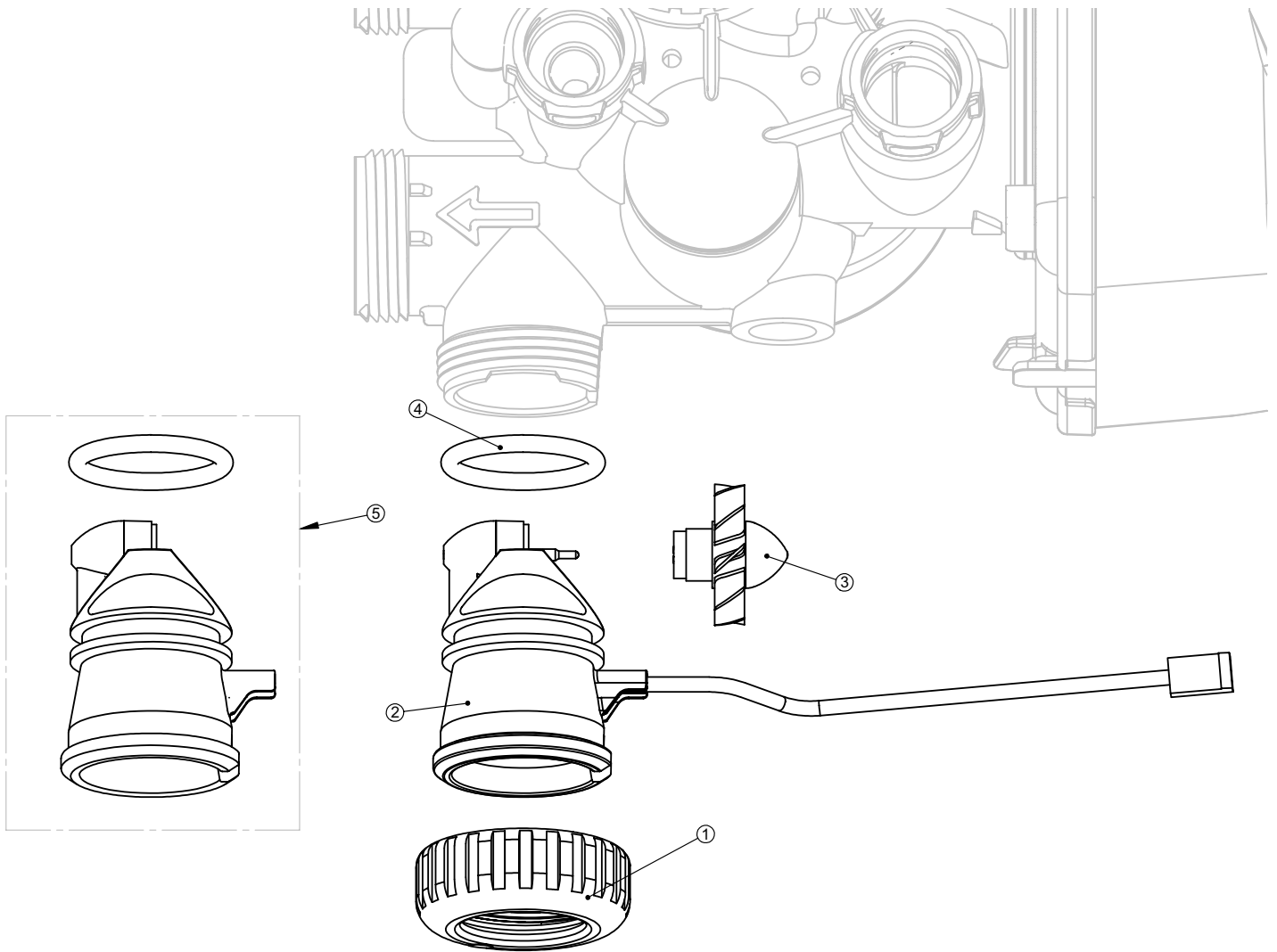
* Can be ordered as a set order number V3008-02, description: WS1 Drain FTG 1 Straight.



Water Meter and Meter Plug

Drawing No.	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" QC	1
2	V3003*	WS1 Meter ASY	1
3	V3118-01	WS1 Turbine ASY	1
4	V3105	O-ring 215	1
5	V3003-01	WS1 Meter Plug ASY	1

*Order number V3003 includes V3118-01 and V3105.

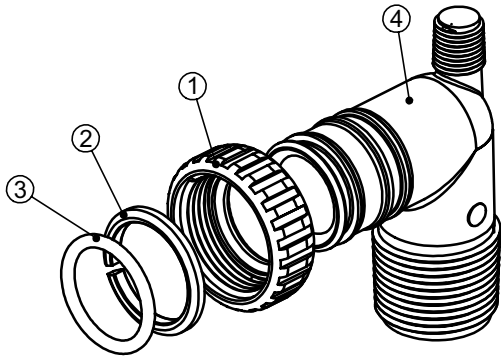


Installation Fitting Assemblies

Order No: **V3007**

Description: **WS1 Fitting 1" PVC Male NPT Elbow Assembly**

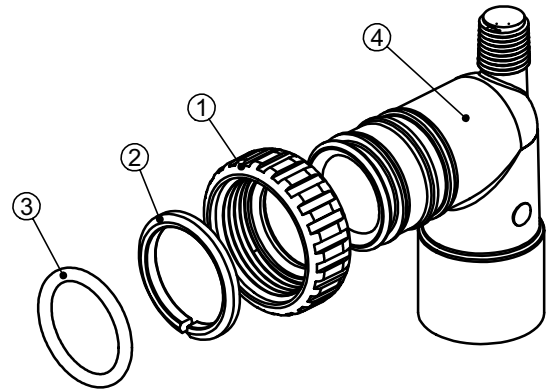
Drawing No	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" Quick Connect	2
2	V3150	WS1 Split Ring	2
3	V3105	O-Ring 215	2
4	V3149	WS1 Fitting 1 PVC Male NPT Elbow	2



Order No: **V3007-01**

Description: **WS1 Fitting 3/4" & 1" PVC Solvent 90° ASY**

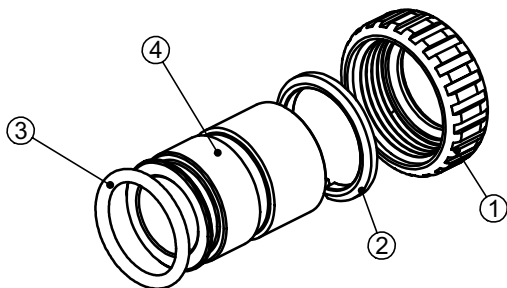
Drawing No.	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" Quick Connect	2
2	V3150	WS1 Split Ring	2
3	V3105	O-Ring 215	2
4	V3189	WS1 Fitting 3/4" & 1" PVC Solvent 90	2



Order No: **V3007-02**

Description: **WS1 Fitting 1" Brass Sweat Assembly**

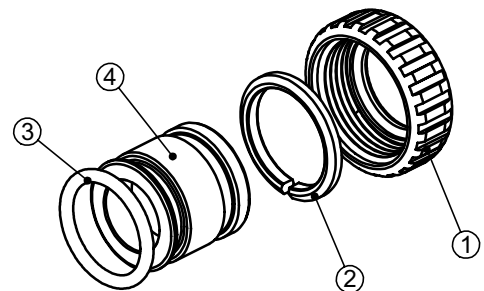
Drawing No.	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" Quick Connect	2
2	V3150	WS1 Split Ring	2
3	V3105	O-Ring 215	2
4	V3188	WS1 Fitting 1 Brass Sweat	2



Order No: **V3007-03**

Description: **WS1 Fitting 3/4" Brass Sweat Assembly**

Drawing No.	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" Quick Connect	2
2	V3150	WS1 Split Ring	2
3	V3105	O-Ring 215	2
4	V3188-01	WS1 Fitting 3/4" Brass Sweat	2

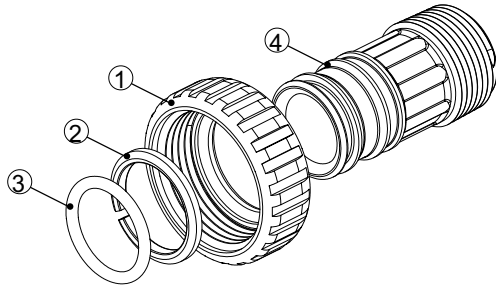


Installation Fitting Assemblies

Order No: **V3007-04**

Description: **WS1 Fitting 1" Plastic Male NPT Assembly**

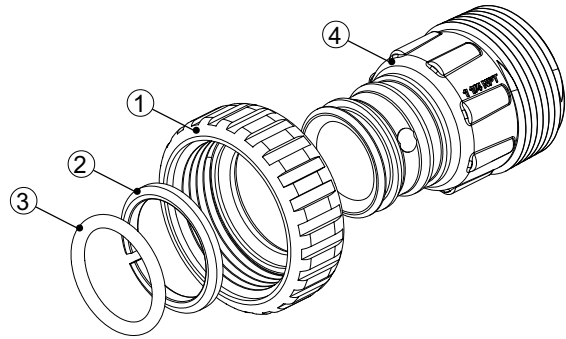
Drawing No.	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" Quick Connect	2
2	V3150	WS1 Split Ring	2
3	V3105	O-Ring 215	2
4	V3164	WS1 Fitting 1" Plastic Male NPT	2



Order No: **V3007-05**

Description: **WS1 Fitting 1-1/4" Plastic Male NPT Assembly**

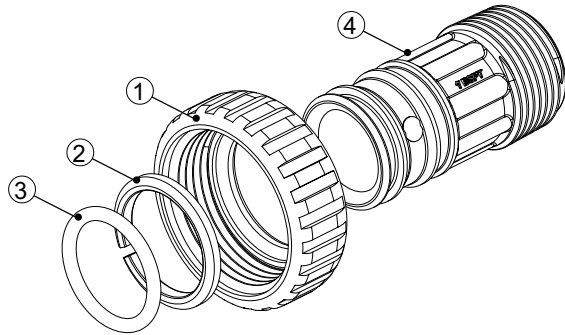
Drawing No.	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" Quick Connect	2
2	V3150	WS1 Split Ring	2
3	V3105	O-Ring 215	2
4	V3317	WS1 Fitting 1-1/4" Plastic Male NPT	2



Order No: **V3007-06**

Description: **WS1 Fitting 1" Plastic Male BSPT Assembly**

Drawing No.	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" Quick Connect	2
2	V3150	WS1 Split Ring	2
3	V3105	O-Ring 215	2
4	V3316	WS1 Fitting 1" Plastic Male BSPT	2

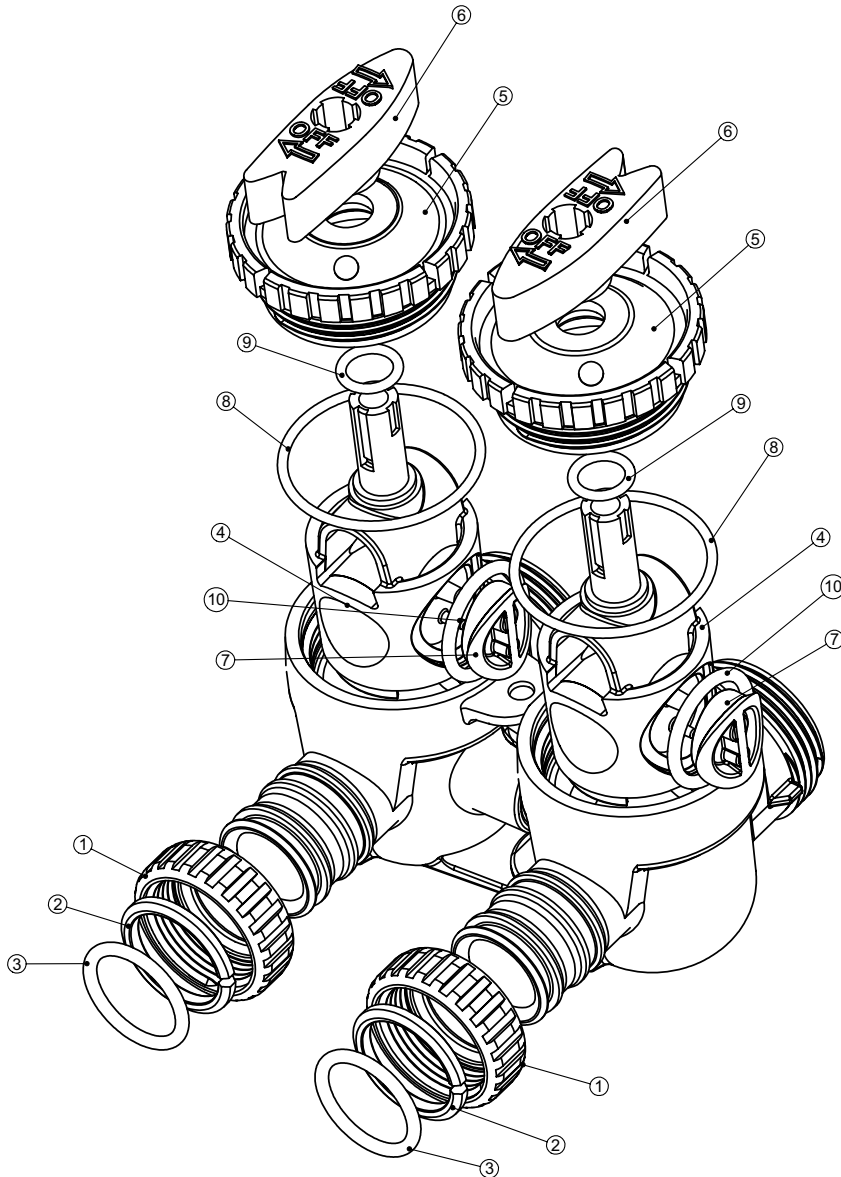


Bypass Valve

Drawing No.	Order No.	Description	Quantity
1	V3151	WS1 Nut 1" Quick Connect	2
2	V3150	WS1 Split Ring	2
3	V3105	O-Ring 215	2
4	V3145	WS1 Bypass 1" Rotor	2
5	V3146	WS1 Bypass Cap	2
6	V3147	WS1 Bypass Handle	2
7	V3148	WS1 Bypass Rotor Seal Retainer	2
8	V3152	O-ring 135	2
9	V3155	O-ring 112	2
10	V3156	O-ring 214	2

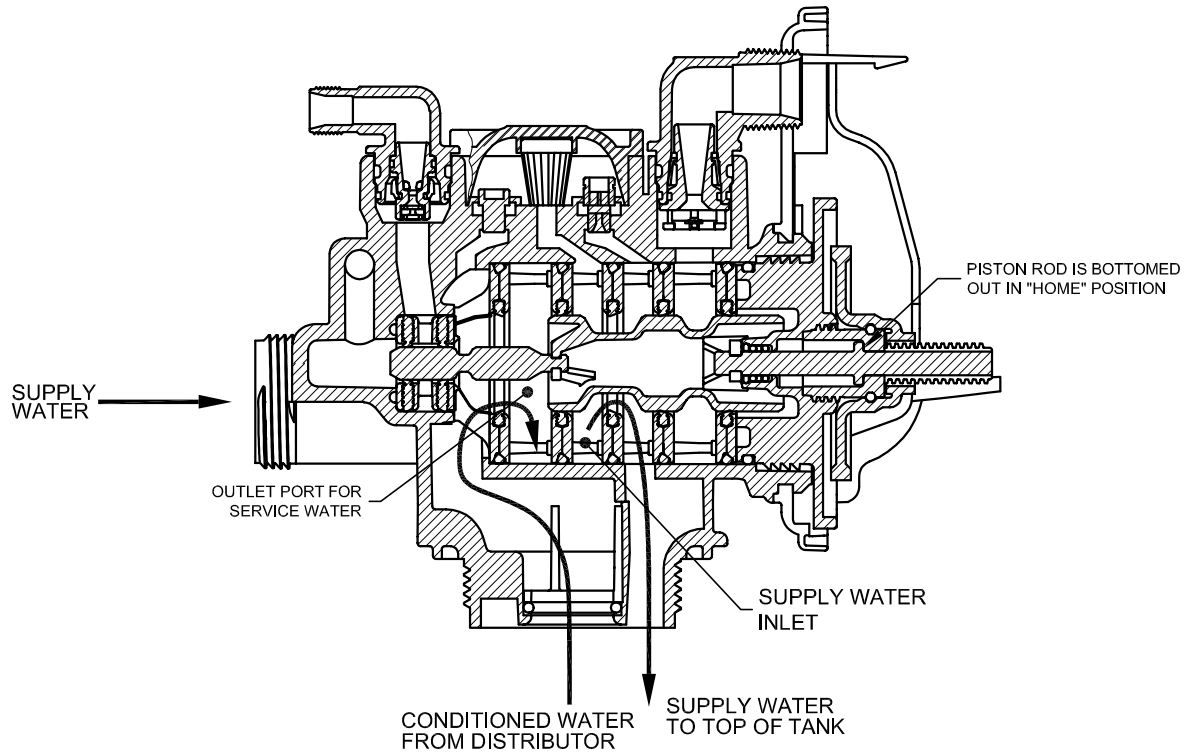
(Not Shown) Order No. V3191-01, Description: WS1 Bypass Vertical Adapter Assembly

Order No.	Description	Quantity
V3151	WS1 Nut 1" Quick Connect	2
V3150	WS1 Split Ring	2
V3105	O-Ring 215	2
V3191-01	WS1 Bypass Vertical Adapter Assembly	2

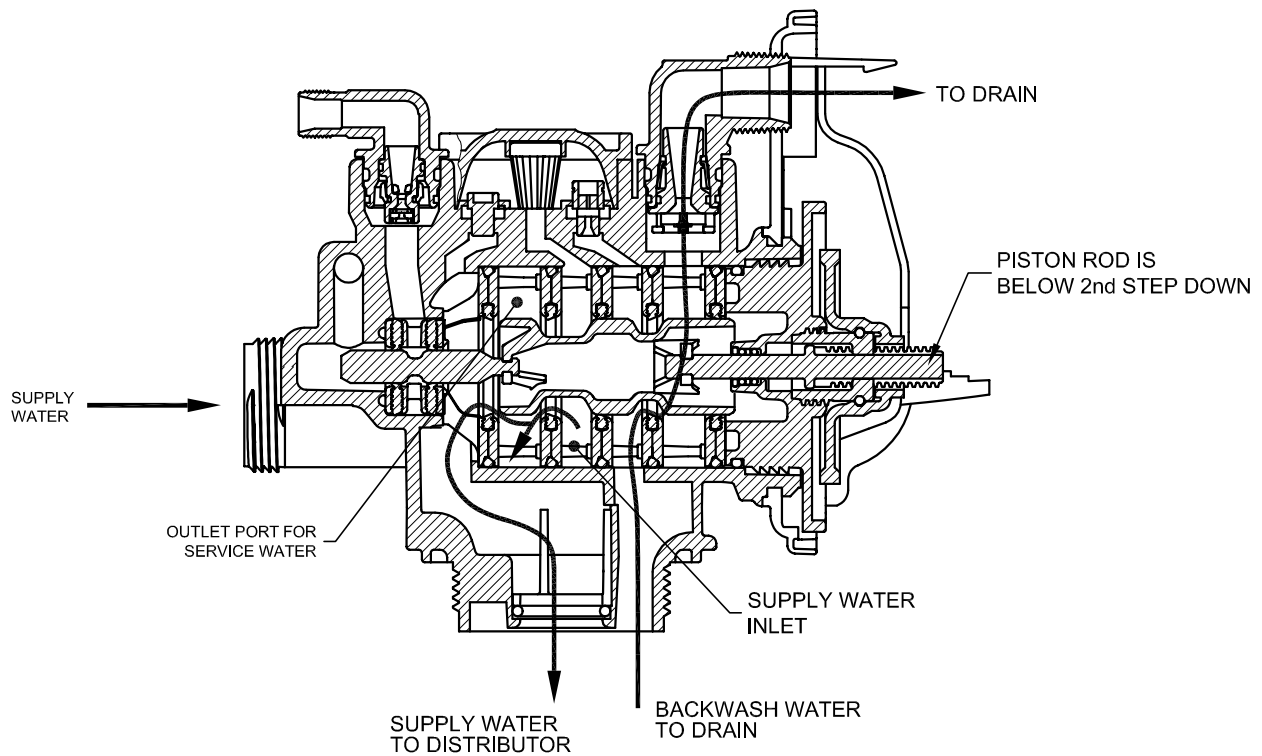


Flow Diagrams – Service and Backwash

flow diagram...service

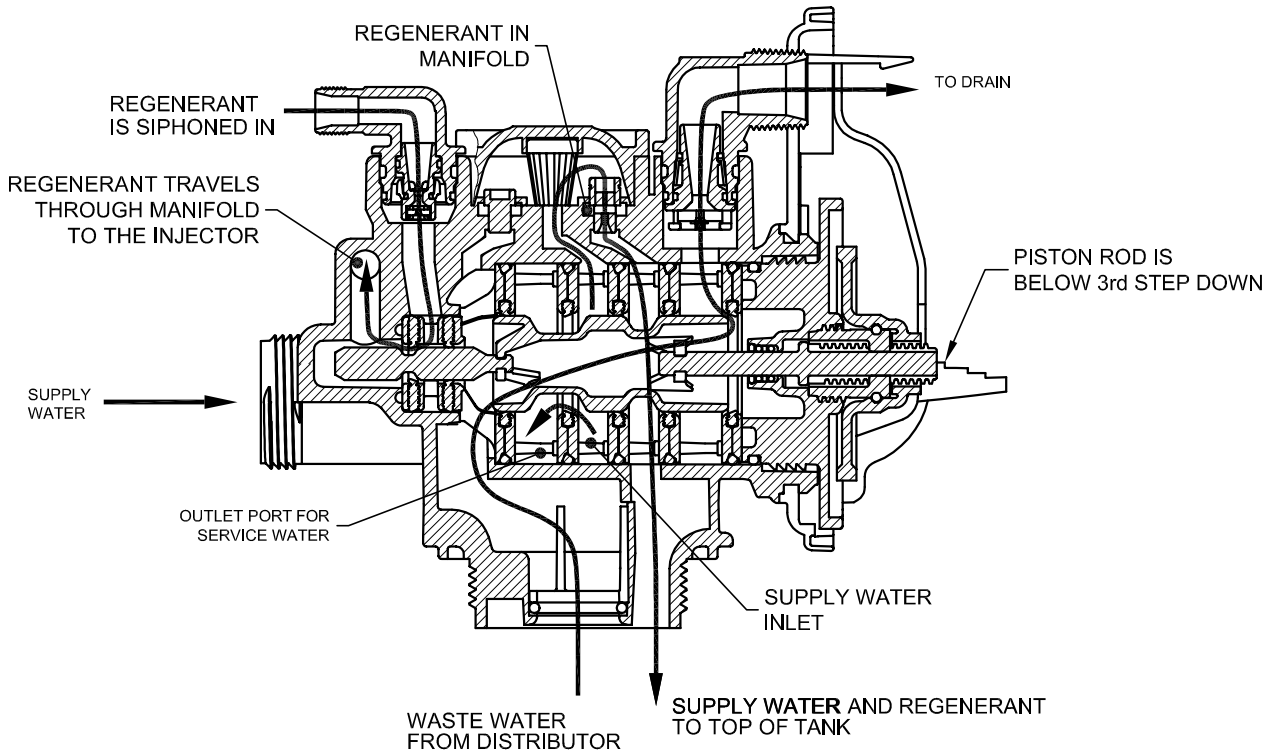


flow diagram...backwash

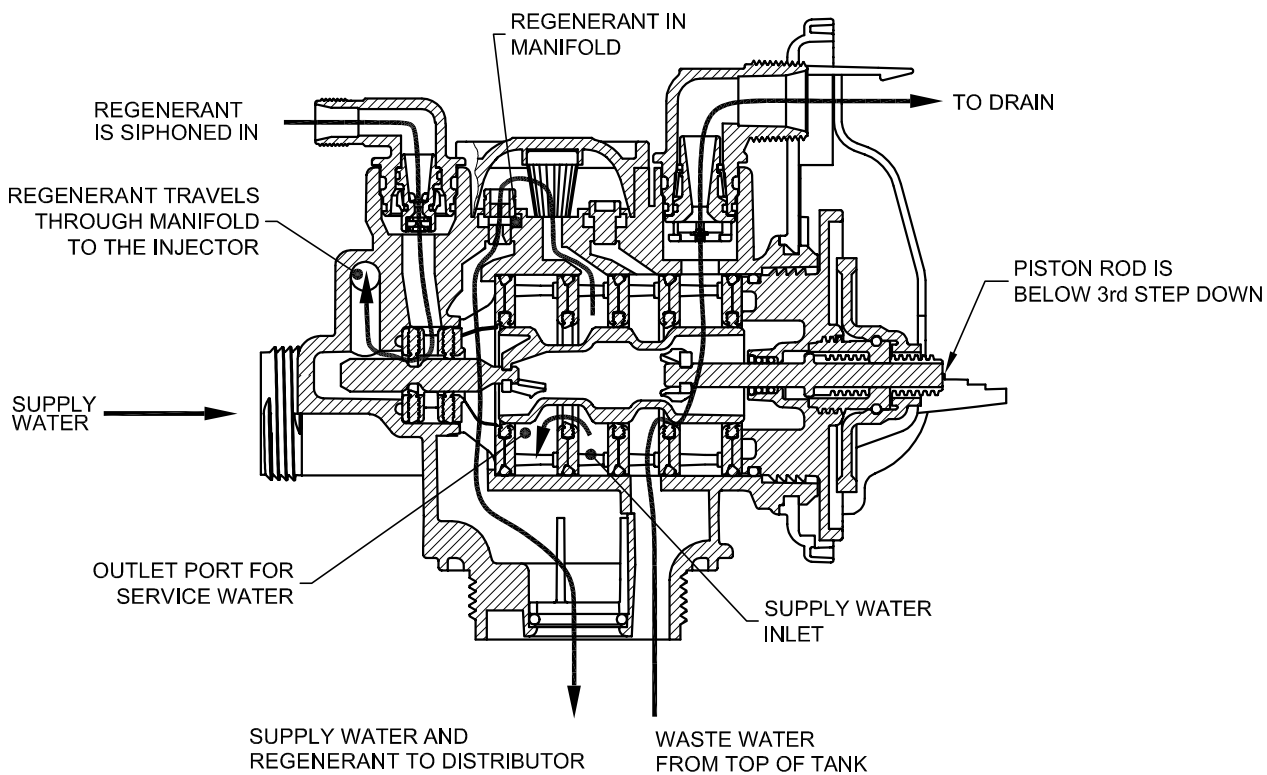


Flow Diagrams – Downflow and Upflow

flow diagram...downflow brine

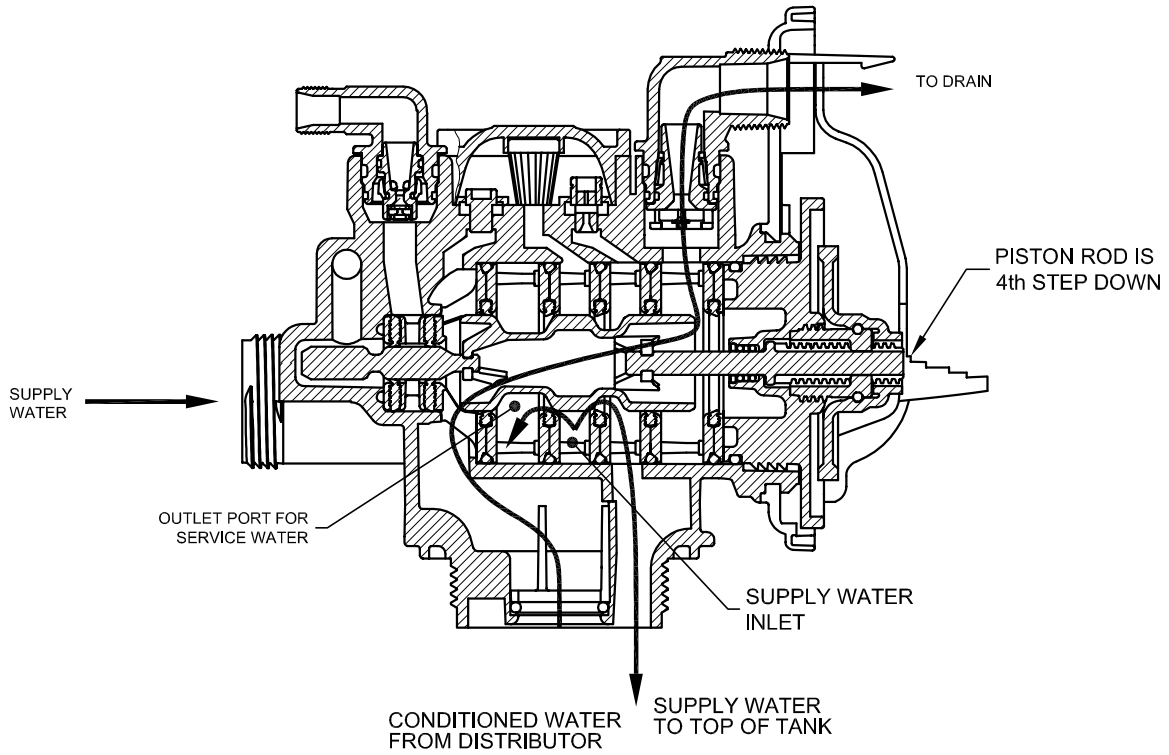


flow diagram...upflow brine

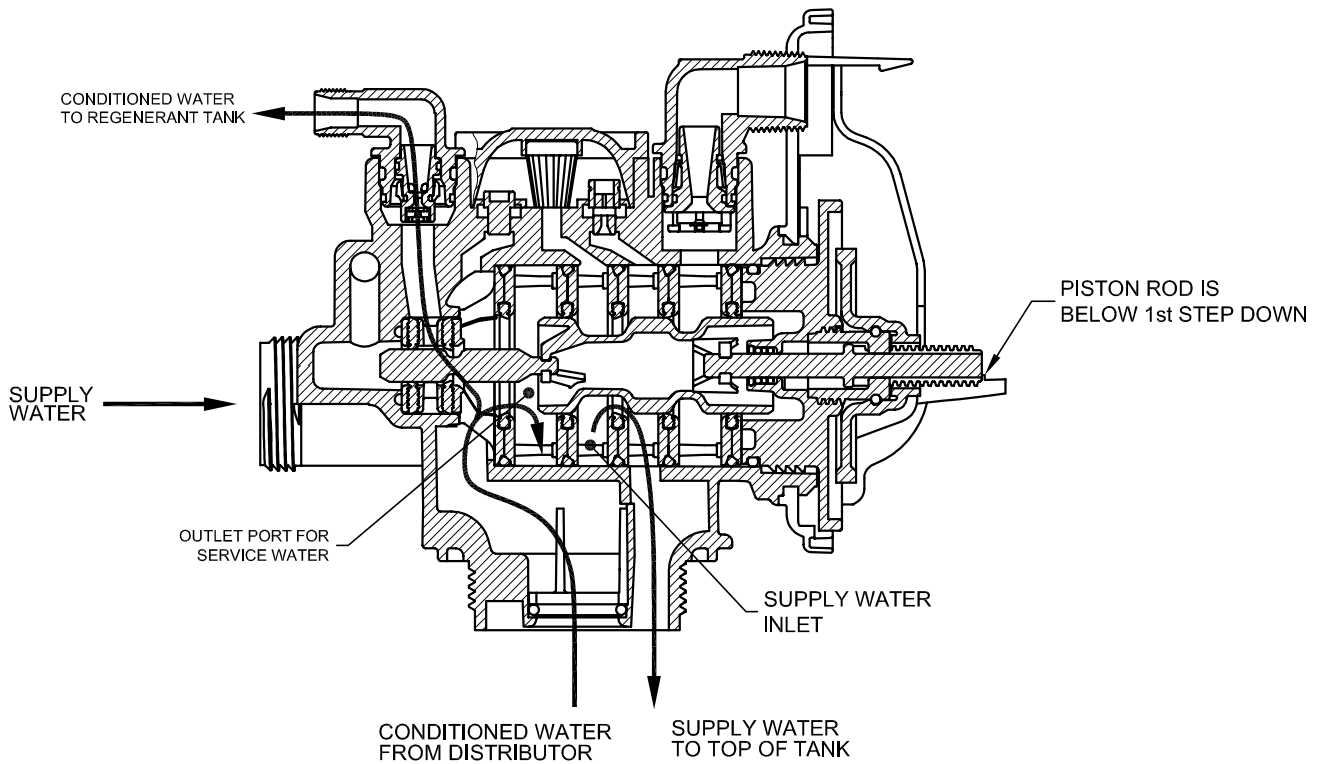


Flow Diagrams – Rinse and Fill

flow diagram...rinse

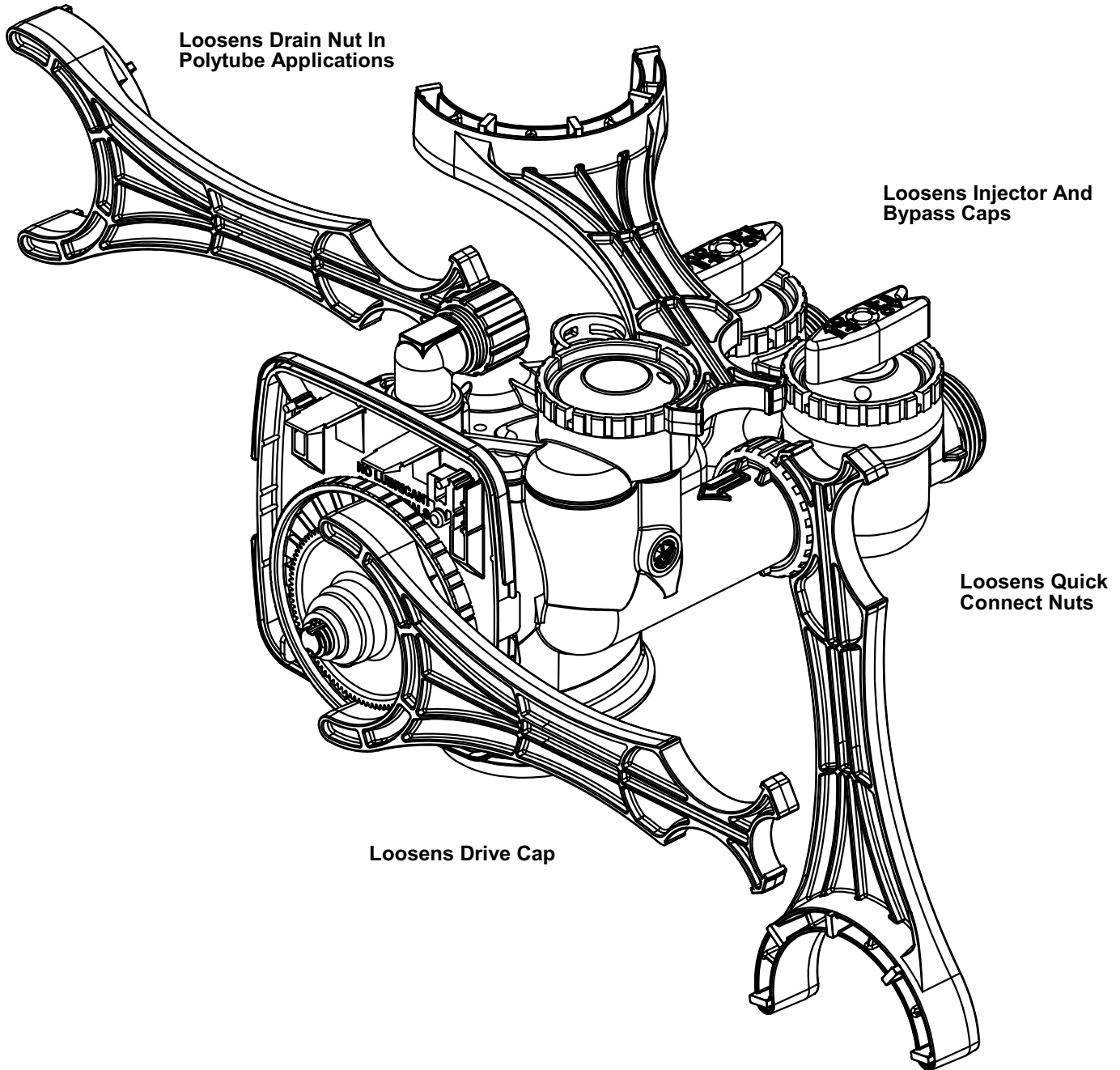


flow diagram...fill



WS1 Wrench (Order No. V3193)

Although no tools are necessary to assemble or disassemble the valve, the WS1 wrench (shown in various positions on the valve) may be purchased to aid in assembly or disassembly.



Service Instructions

Drive Assembly

Remove the valve cover to access the drive assembly.

Disconnect the power source plug (black wire) from the PC board prior to disconnecting the motor or water meter plugs from the PC board. The motor plug connects to the two-pin jack on the left-hand side of the PC board. The power source plug connects to the four-pin jack. The four-pin jack is between the two-pin and three-pin jacks. The water meter plug (gray wire) connects to the three-pin jack on the far right-hand side of the PC board.

The PC board can be removed separately from the drive bracket but it is not recommended. Do not attempt to remove the display panel from the PC board. Handle the board by the edges. To remove the PC board from the drive bracket, unplug the power, water meter and motor plugs from the PC board. Lift the middle latch along the top of the drive bracket while pulling outward on the top of the PC board. The drive bracket has two plastic pins that fit into the holes on the lower edge of the PC board. Once the PC board is tilted about 45° from the drive bracket it can be lifted off of these pins. To reinstall the PC board, position the lower edge of the PC board so that the holes in the PC board line up with the plastic pins. Push the top of the PC board towards the valve until it snaps under the middle latch, weave the power and water meter wires into the holders and reconnect the motor, water meter and power plugs.

The drive bracket must be removed to access the drive cap assembly and pistons or the drive gear cover. It is not necessary to remove the PC board from the drive bracket to remove the drive bracket. To remove the drive bracket start by removing the plugs for the power source and the water meter. Unweave the wires from the side holders. Two tabs on the top of the drive back plate hold the drive bracket in place. Simultaneously lift the two tabs and gently ease the top of the drive bracket towards your body. The lower edge of the drive bracket has two notches that rest on the drive back plate. Lift up and outward on the drive bracket to disengage the notches.

To reassemble seat the bottom of the drive bracket so the notches are engaged at the bottom of the drive back plate. Push the top of the drive bracket towards the two latches. The drive bracket may have to be lifted slightly to let the threaded piston rod pass through the hole in the drive bracket. Maintain a slight engaging force on top of the drive bracket while deflecting the bracket slightly to the left by pressing on the side of the upper right corner. This helps the drive gears mesh with the drive cap assembly. The drive bracket is properly seated when it snaps under the latches on the drive back plate. If resistance is felt before latching, then notches are not fully engaged, the piston rod is not in hole, the wires are jammed between the drive bracket and drive back plate, or the gear is not engaging the drive cap assembly.

To inspect drive gears, the drive gear cover needs to be removed. The drive gear cover is held in place on the drive bracket by three clips. The largest of the three clips is always orientated to the bottom of the drive bracket. Before trying to remove the drive gear cover, the drive bracket must be removed from the drive back plate. The drive gear cover can be removed from the drive bracket without removing the motor or the PC board. Simultaneously, push in and down on the large clip at the bottom and the clip on the left-hand side of the drive bracket behind the PC board. Keep your other fingers behind the drive gear cover so the drive gears do not drop on the ground.

Replace broken or damaged drive gears. Do not lubricate any of the gears. Avoid getting any foreign matter on the reflective coating because dirt or oils may interfere with pulse counting.

The drive gear cover only fits on one way, with the large clip orientated towards the bottom. If all three clips are outside of the gear shroud on the drive bracket the drive gear cover slips easily into place.

The drive bracket does not need to be removed from the drive plate if the motor needs to be removed. To remove the motor, disconnect the power and motor plugs from the jacks on the PC board. Move the spring clip loop to the right and hold. Rotate the motor at least a ¼ turn in either direction before gently pulling on the wire connectors to remove the motor. Pulling directly on the wires without rotating the motor may break the wires off the motor.

Replace the motor if necessary. Do not lubricate the motor or the gears. When reinstalling the motor gently turn the motor while inserting so that the gear on the motor meshes with the gears under the drive gear cover and the small plastic bulge engages one of the slots on the motor housing. Reconnect the motor plug to the two pronged jack on the lower left hand side of the PC board. If motor will not easily engage with drive gear when reinstalling, lift and slightly rotate motor before reinserting.

Replace the valve cover. After completing any valve maintenance, press and hold NEXT and REGEN buttons for 3 seconds or unplug power source jack (black wire) and plug back in. This resets the electronics and establishes the service piston position. The display should flash all wording, then flash the soft ware version (e.g. 154) and then reset the valve to the service position.

Drive Cap Assembly, Main Piston and Regenerant Piston

The drive assembly must be removed to access the drive cap assembly. The drive cap assembly must be removed to access the piston(s). The drive cap assembly is threaded into the control valve body and seals with an o-ring. To remove the drive cap assembly use the special plastic wrench or insert a ¼" to ½" flat bladed screwdriver into one of the slots around the top 2" of the drive cap assembly so it engages the notches molded into the drive back plate around the top 2" of the piston cavity. See Figure 5. The notches are visible through the holes. Lever the screwdriver so the drive cap assembly turns counter clockwise. Once loosened unscrew the drive cap assembly by hand and pull straight out.

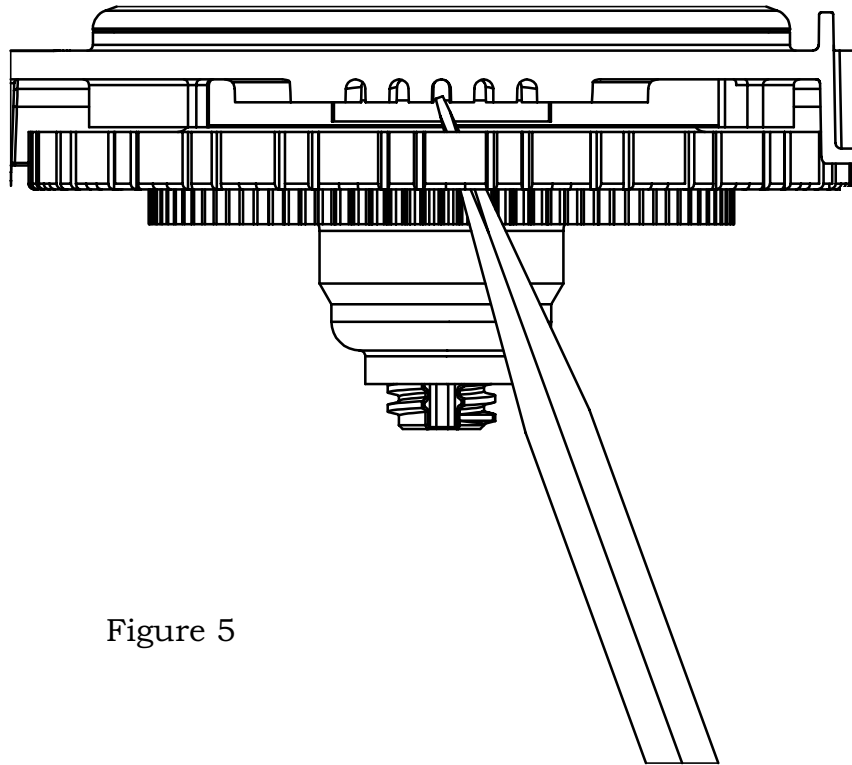


Figure 5

The drive cap assembly contains the drive cap, the main drive gear, drive cap spline, piston rod and various other parts that should not be dissembled in the field. The only replaceable part on the drive cap assembly is the o-ring. Attached to the drive cap assembly is the main piston (down flow or up flow) and if a regenerant is used, a regenerant piston.

The regenerant piston (the small diameter one behind the main piston) is removed from the main piston by unsnapping it from its latch. Chemically clean in dilute sodium bisulfite or vinegar or replace the regenerant piston if needed. To remove the main down flow or up flow piston fully extend the piston rod and then unsnap the main piston from its latch by pressing on the side with the number. Chemically clean in dilute sodium bisulfite or vinegar or replace the main piston.

Reattach the main piston to the drive cap assembly. Reattach the regenerant piston (if needed) to the main piston. Do not lubricate the piston rod, main piston or regenerant piston. Lubricant will adversely affect the red or clear lip seals. Reinsert the drive cap assembly and piston into the spacer stack assembly and hand tighten the drive cap assembly. Continue to tighten the drive cap assembly using a screwdriver as a ratchet until the black o-ring on the spacer stack assembly is no longer visible through the drain port. Excessive force can break the notches molded into the drive back plate. Make certain that the main drive gear still turns freely. The exact position of the piston is not important as long as the main drive gear turns freely.

Reattach the drive assembly to the control valve and connect all plugs. After completing any valve maintenance, press and hold NEXT and REGEN buttons for 3 seconds or unplug power source jack (black wire) and plug back in. This resets the electronics and establishes the service piston position. The display should flash all wording, then flash the soft ware version (e.g. 181) and then reset the valve to the service position.

Spacer Stack Assembly

To access the spacer stack assembly remove the drive assembly, drive cap assembly and piston. The spacer stack assembly can be removed easily without tools by using thumb and forefinger. Inspect the black o-rings and red or clear lip seals for wear or damage. Replace the entire stack if necessary. The spacer stack assembly has been 100% tested at the factory to insure proper orientation of one way seals. Do not disassemble the stack.

The spacer stack assembly may be chemically cleaned (dilute sodium bisulfite or vinegar) or wiped with a soft cloth.

The spacer stack assembly can be pushed in to the control valve body bore by hand. Since the spacer stack assembly can be compressed it is easier to use a blunt object (5/8" to 1-1/8" in diameter) to push the center of the assembly into the control valve body. The assembly is properly seated when at least four threads are exposed (approximately 5/8"). Do not force the spacer stack assembly in. The control valve body bore interior can be lubricated with silicone to allow for easy insertion of the entire stack. Do not use silicone or any other type of lubricant on the red or clear lip seals or the piston.

Reattach the drive cap assembly and piston(s) and the drive assembly.

After completing any valve maintenance, press and hold NEXT and REGEN buttons for 3 seconds or unplug power source jack (black wire) and plug back in. This resets the electronics and establishes the service piston position. The display should flash all wording, then flash the soft ware version (e.g. 181) and then reset the valve to the service position.

Injector Cap, Screen, Injector Plug and Injector

Unscrew the injector cap and lift off. Loosen cap with special plastic wrench or pliers if necessary. Attached to the injector cap is a screen. Remove the screen and clean if fouled.

The plug and/or injector can be pried out with a small screwdriver. The plug can be wiped clean. If the plug leaks replace the entire plug. The injector consists of a throat and a nozzle. Chemically clean the injector with vinegar or sodium bisulfite. The holes can be blown out with air. Both pieces have small diameter holes that control the flow rates of water to insure that the proper concentration of regenerant is used. Sharp objects, which can score the plastic, should not be used to clean the injector. Scoring the injector or increasing the diameter of the hole could change the operating parameters of the injector.

Two holes are labeled DN and UP. Check for compliance with one of the following:

- a. for down flow systems, the appropriate size injector is located in the “DN” hole, a plug is in the “UP” hole and that the piston is a combination of the down flow main piston and the regenerant piston;
- b. for up flow systems, the appropriate size injector is located in the “UP” hole, a plug is in the “DN” hole and that the piston is a combination of the up flow main piston and the regenerant piston; or
- c. for backwash only systems, a plug is in the “DN” hole and in the “UP” hole, and that the piston only has a down flow main piston (the regenerant piston must be removed) and a plug is in the refill flow control position.

Push the plug(s) and/or injectors firmly in place, replace the screen and hand tighten the injector cap.

Refill Flow Control Assembly or Refill Port Plug

To clean or replace the refill flow control, pull out the elbow-locking clip and then pull straight up on the elbow. Replace the elbow locking clip in the slot so that it is not misplaced. Twist to remove the white flow control retainer. The flow control can be removed by prying upward through the side slots of the retainer with a small blade flat screwdriver.

Chemically clean the flow control or the white flow control retainer using dilute sodium bisulfite or vinegar. Do not use a wire brush. If necessary, replace the flow control, o-ring on the flow control retainer, or the o-ring on the elbow.

Reseat the flow control so the rounded end is visible in the flow control. Reseat the white flow control retainer by pushing the retainer into the elbow until the o-ring seats. Remove locking clip, push down on elbow to reseat and insert locking clip.

Do not use Vaseline, oils, or other unacceptable lubricants on o-rings. A silicon lubricant may be used on the o-ring on the elbow or the white retainer.

Water Meter or Meter Plug

The water meter assembly is connected to the PC board by a wire. If the entire water meter assembly is to be replaced, remove the control valve cover and remove the power source and water meter plugs from the PC board. Unlatch the drive assembly and lean it forward. Unthread the water meter wire from the side of the drive assembly and through the drive back plate. To reinstall, rethread the water meter wire through the drive back plate and the side of the drive assembly. Reattach the drive assembly and the water meter and power plugs.

If no water meter wire is visible, then a plug is installed not a water meter.

The water meter wire does not need to be removed from the PC board if the water meter is only being inspected and cleaned. To remove the water meter assembly, unscrew the meter cap on the left side of the control valve. Pliers may be used to unscrew the nut if necessary.

With the nut removed, a slot at the top of the water meter is visible. Twist a flat blade screwdriver in the slot between the control valve body and the meter. When the meter is part way out it is easy to remove the water meter from the housing. Once the water meter is removed from the control valve body, use your fingers to gently pull forward on the turbine to remove it from the shaft.

Do not use a wire brush to clean. Wipe with a clean cloth or chemically clean in dilute sodium bisulfite or vinegar. The turbine can be immersed in the chemical. Do not immerse electronics. If the turbine is scored or damaged or the bearings on the turbine are worn replace the turbine.

Do not lubricate the turbine shaft. The turbine shaft bearings are prelubricated. Do not use Vaseline, oils, or other unacceptable lubricants on the o-ring. A silicon lubricant may be used on the black o-ring.

Snap the turbine on the shaft and reinsert the water meter into the side slot. Hand tighten the nut. Do not use a pipe wrench to tighten nut.

Bypass Valve

The working parts of the bypass valve are the rotor assemblies that are contained under the bypass valve caps. Before working on the rotors, make sure the system is depressurized. Turn the red arrow shaped handles towards the center of the bypass valve and back to the arrow direction several times to ensure rotor is turning freely.

The nuts and caps are designed to be unscrewed or tightened by hand. If necessary a pliers can be used to unscrew the nut or cap. Do not use a pipe wrench to tighten or loosen nuts or caps. Do not place screwdriver in slots on caps and/or tap with a hammer. To access the rotor, unscrew the cap and lift the cap, rotor and handle out as one unit. Twisting the unit as you pull it out will help to remove it more easily. There are three o-rings: one under the rotor cap, one on the rotor stem and the rotor seal. Replace worn o-rings. Clean rotor. Reinstall rotor.

When reinstalling the red arrow handles be sure that:

1. O-rings on both rotors face to the right when being viewed from the front of the control valve when the handle pointers are lined up with the control valve body arrows; or
2. Arrows point toward each other in the bypass position.

Since the handles can be pulled off, they could be accidentally reinstalled 180° from their correct orientation. To install the red arrow handles correctly, keep the handles pointed in the same direction as the arrows engraved on the control valve body while tightening the bypass valve caps.

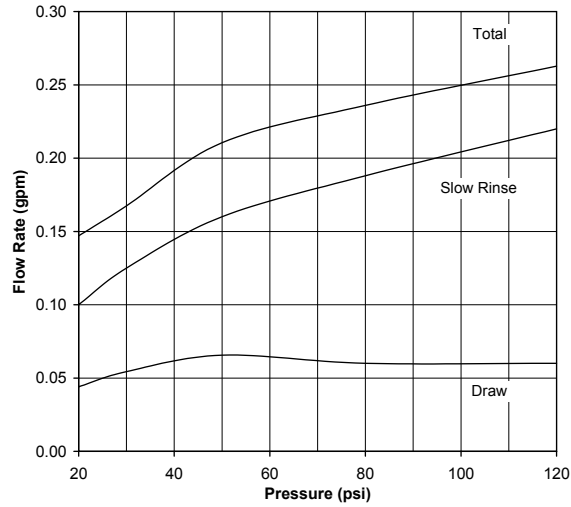
After completing any valve maintenance, press and hold NEXT and REGEN buttons for 3 seconds or unplug power source jack (black wire) and plug back in. This resets the electronics and establishes the service piston position. The display should flash all wording, then flash the software version (e.g. 181) and then reset the valve to the service position.

Table 15
Troubleshooting Procedures

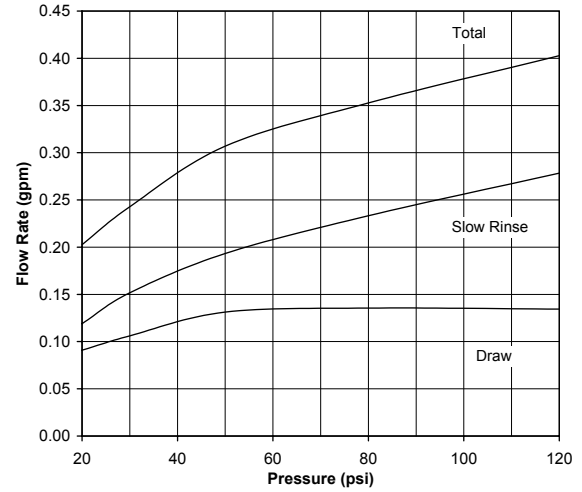
Problem	Possible Cause	Solution
1. Timer does not display time of day	a. Transformer unplugged	a. Connect power
	b. No electric power at outlet	b. Repair outlet or use working outlet
	c. Defective transformer	c. Replace transformer
	d. Defective PC board	d. Replace PC board
2. Timer does not display correct time of day	a. Switched outlet	a. Use uninterrupted outlet
	b. Power outage	b. Reset time of day
	c. Defective PC board	c. Replace PC board
3. No softening/filtering display when water is flowing	a. Bypass valve in bypass position	a. Put bypass valve in service position
	b. Meter connection disconnected	b. Connect meter to PC board
	c. Restricted/stalled meter turbine	c. Remove meter and check for rotation or foreign material
	d. Defective meter	d. Replace meter
	e. Defective PC board	e. Replace PC board
4. Control valve regenerates at wrong time of day	a. Power outages	a. Reset control valve to correct time of day
	b. Time of day not set correctly	b. Reset to correct time of day
	c. Time of regeneration incorrect	c. Reset regeneration time
	d. Control valve set at "on 0" (immediate regeneration)	d. Check control valve set-up procedure regeneration time option
	e. Control valve set at NORMAL + on 0	e. Check control valve set-up procedure regeneration time option
5. ERROR followed by code number Error Code 1001 -Unable to recognize start of regeneration Error Code 1002 – Unexpected stall Error Code 1003 – Motor ran to long, timed out trying to reach next cycle position Error Code 1004 - Motor ran to long, timed out trying to reach home position If other Error Codes display contact the factory.	a. Control valve has just been serviced	a. Press NEXT and REGEN for 3 seconds or unplug power source jack (black wire) and plug back in to reset control valve
	b. Foreign matter is lodged in control valve	b. Check piston and spacer stack assembly for foreign matter
	c. High drive forces on piston	c. Replace piston(s) and spacer stack assembly
	d. Control valve piston not in home position	d. Press NEXT and REGEN for 3 seconds or unplug power source jack (black wire) and plug back in to reset control valve
	e. Motor not inserted fully to engage pinion, motor wires broken or disconnected, motor failure	e. Check motor and wiring. Replace motor if necessary
	f. Drive gear label dirty or damaged, missing or broken gear	f. Replace or clean drive gear
	g. Drive bracket incorrectly aligned to back plate	g. Reseat drive bracket properly
	h. PC board is damaged or defective	h. Replace PC board
	i. PC board incorrectly aligned to drive bracket	i. Ensure PC board is correctly snapped on to drive bracket

Problem	Possible Cause	Solution
6. Control valve stalled in regeneration	a. Motor not operating	a. Replace motor
	b. No electric power at outlet	b. Repair outlet or use working outlet
	c. Defective transformer	c. Replace transformer
	d. Defective PC board	d. Replace PC board
	e. Broken drive gear or drive cap assembly	e. Replace drive gear or drive cap assembly
	f. Broken piston retainer	f. Replace drive cap assembly
	g. Broken main or regenerant piston	g. Replace main or regenerant piston
7. Control valve does not regenerate automatically when REGEN button is depressed and held	a. Transformer unplugged	a. Connect transformer
	b. No electric power at outlet	b. Repair outlet or use working outlet
	c. Broken drive gear or drive cap assembly	c. Replace drive gear or drive cap assembly
	d. Defective PC board	d. Replace PC board
8. Control valve does not regenerate automatically but does when REGEN button is depressed	a. By-pass valve in bypass position	a. Put bypass valve in normal operation position
	b. Meter connection disconnected	b. Connect meter to PC board
	c. Restricted/stalled meter turbine	c. Remove meter and check for rotation or foreign matter
	d. Defective meter	d. Replace meter
	e. Defective PC board	e. Replace PC board
	f. Set-up error	f. Check control valve set-up procedure
9. Time of day flashes on and off	a. Power has been out more than two hours, the transformer was unplugged and then plugged back into the wall outlet, the transformer plug was unplugged and then plugged back into the board or the NEXT and REGEN buttons were pressed to reset the valve.	a. Reset the time of day

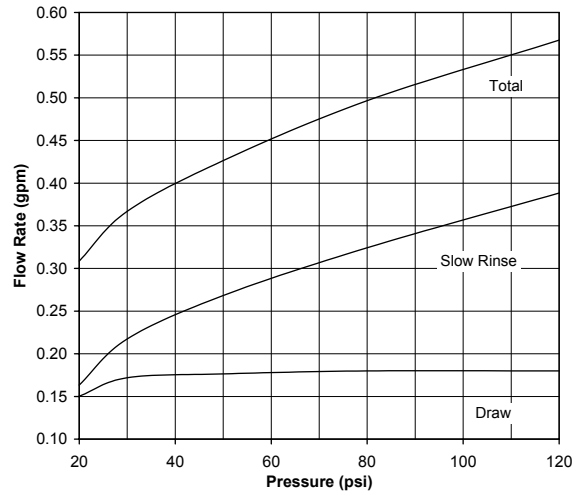
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US Units**



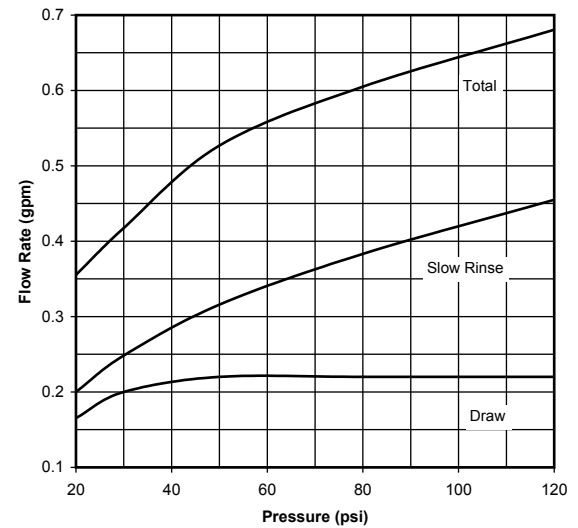
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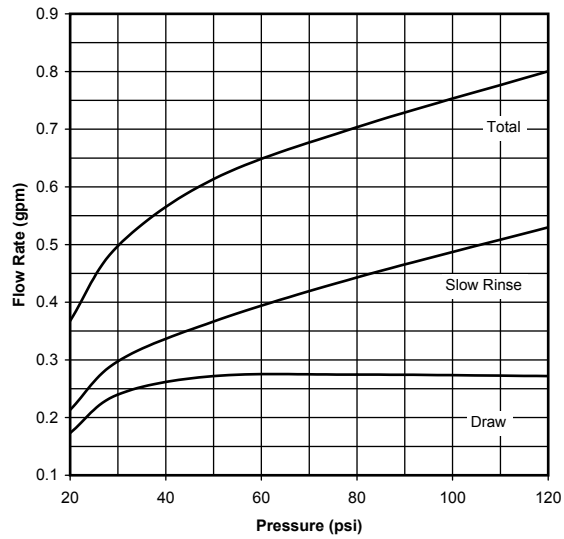
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US Units**



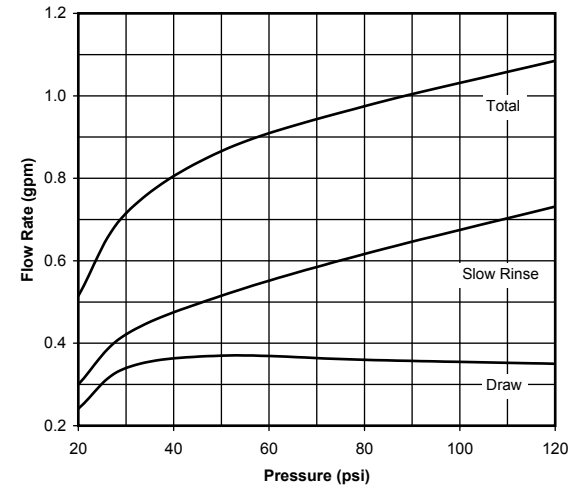
**RED, ORDER NO. V3010-1D
US Units**



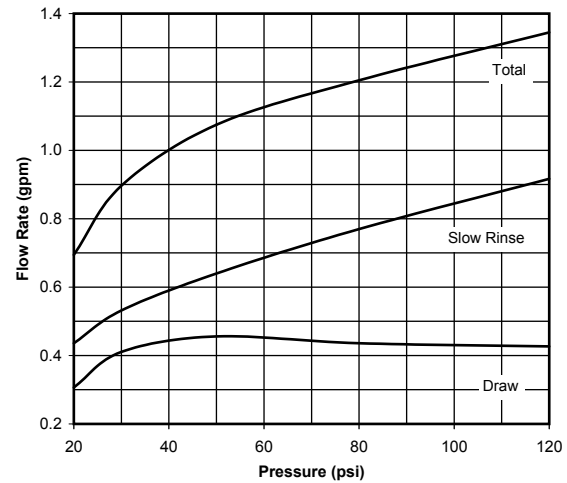
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US Units**



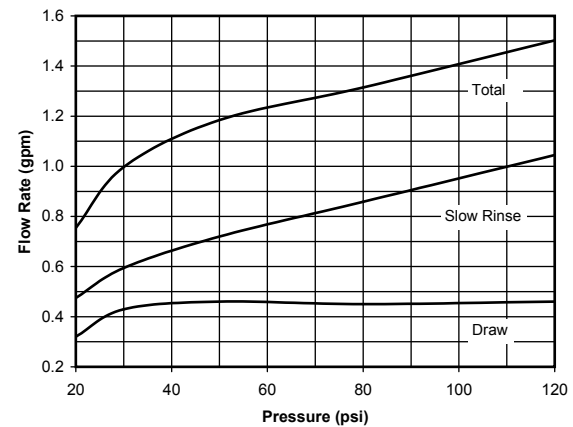
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US Units**



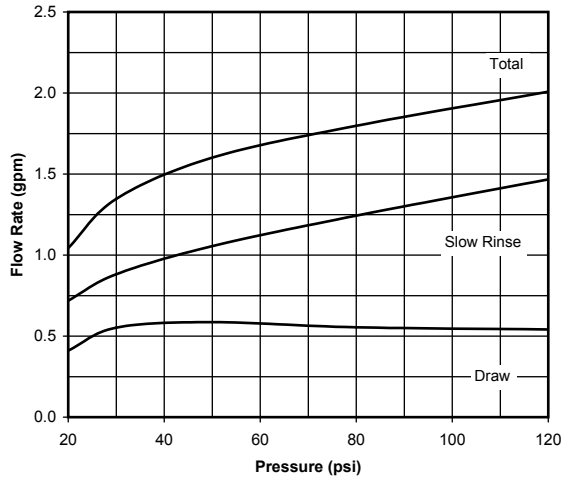
**YELLOW, ORDER NO. V3010-1G
US Units**



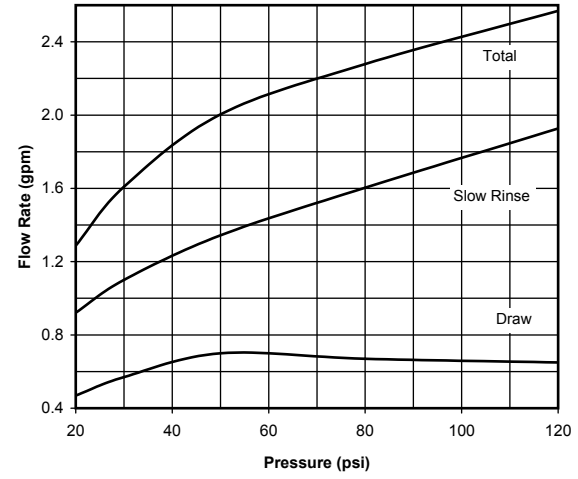
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US Units**



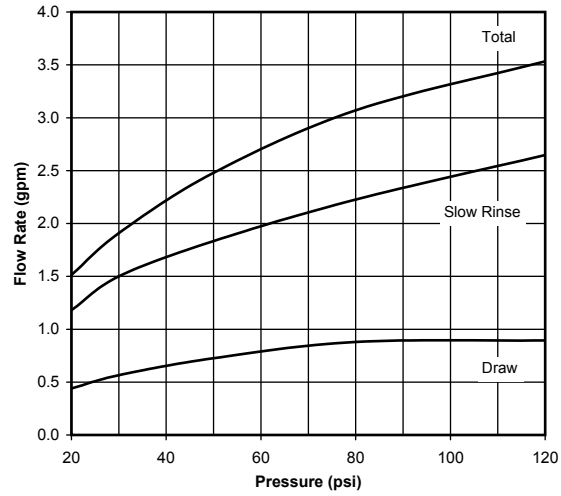
**ORANGE, ORDER NO. V3010-1I
US Units**



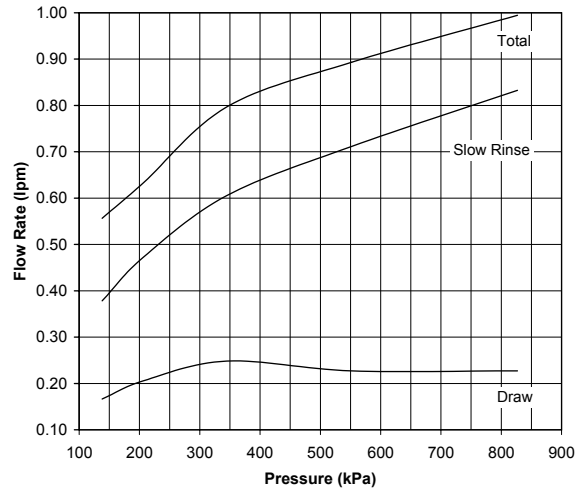
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US Units**



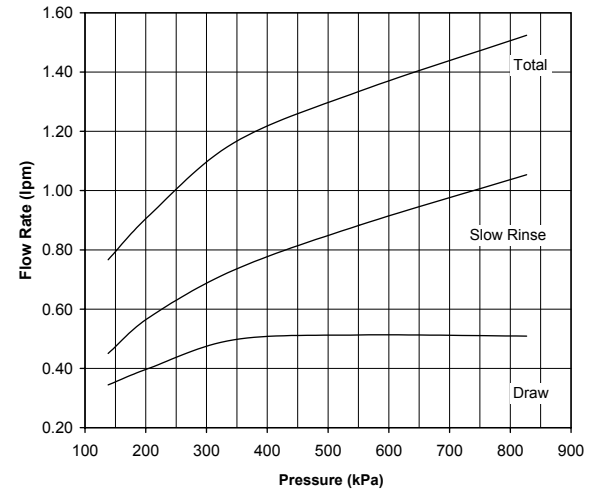
**LIGHT GREEN, ORDER NO. V3010-1K
US Units**



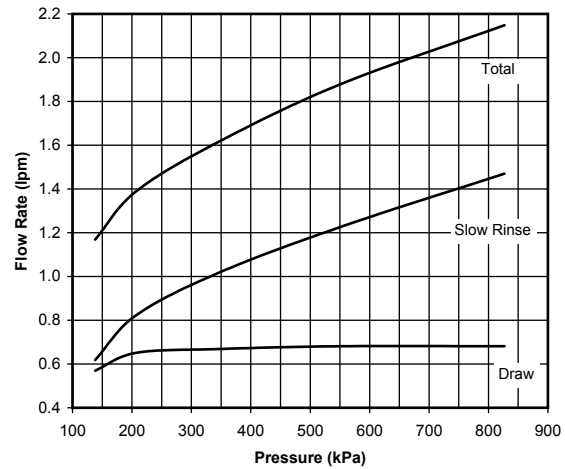
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Metric Units



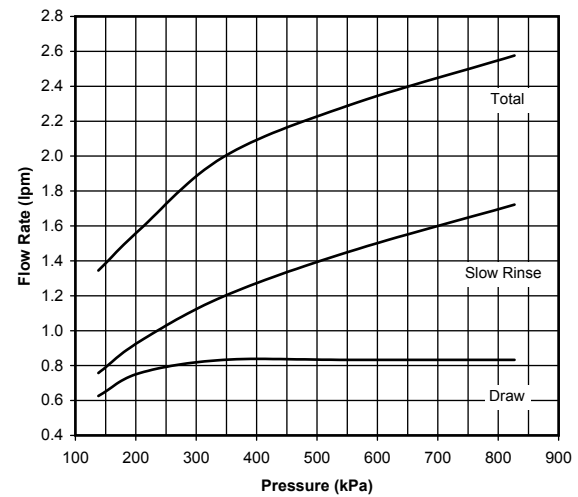
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Metric Units



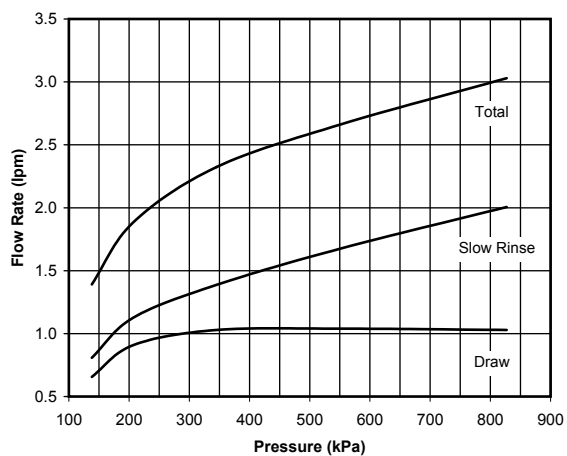
VIOLET, ORDER NO. V3010-1C
Metric Units



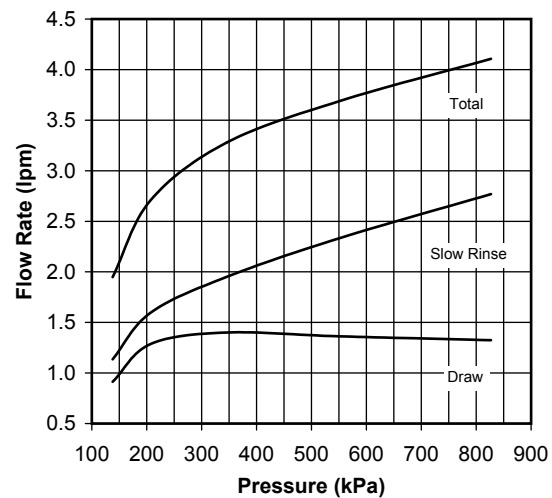
RED, ORDER NO. V3010-1D
Metric Units



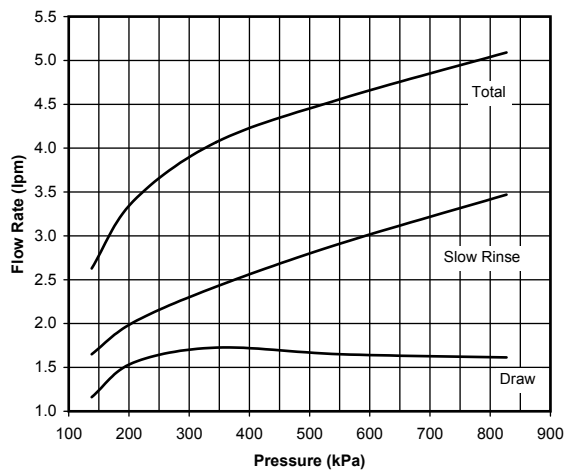
WHITE, ORDER NO. V3010-1E
Metric Units



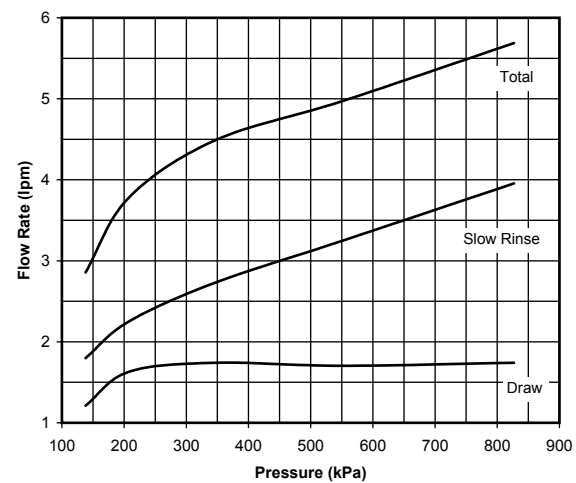
BLUE, ORDER NO. V3010-1F
Metric Units



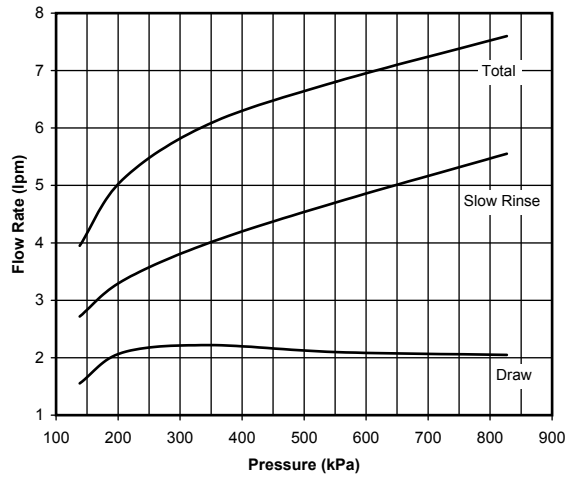
YELLOW, ORDER NO. V3010-1G
Metric Units



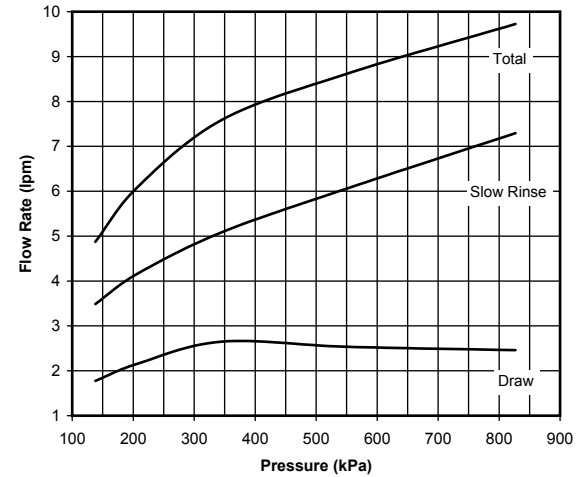
GREEN, ORDER NO. V3010-1H
Metric Units



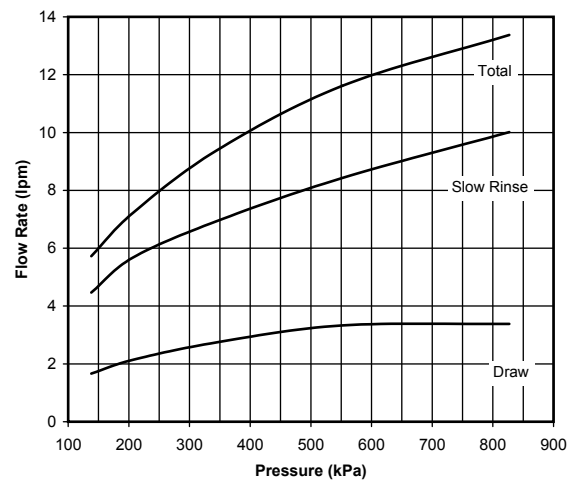
ORANGE, ORDER NO. V3010-1I
Metric Units



LIGHT BLUE, ORDER NO. V3010-1J
Metric Units



LIGHT GREEN, ORDER NO. V3010-1K
Metric Units



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FIVE-YEAR SOFTENER AND FILTER CONTROLS
LIMITED WARRANTY**

Clack Corporation (“Clack”) warrants to OEM that its Softener and Filter Control Valves will be free from defects in material and workmanship under normal use and service for a period of five years from the date of shipment of such Valves from Clack’s plant in Windsor, Wisconsin when installed and operated within recommended parameters. No warranty is made with respect to defects not reported to Clack within the warranty period and/or defects or damages due to neglect, misuse, alterations, accident, misapplication, physical damage, or damage caused by fire, acts of God, freezing or hot water or similar causes. For outdoor installations where the Softener and Filter Control Valves are not under cover, the weather cover must be utilized for the warranty to be valid.

Clack’s obligation to OEM under this Limited Warranty shall be limited, at its option, to replacement or repair of any Softener and Filter Control valve covered by this Limited Warranty. Prior to returning a Control Valve, OEM must obtain a return goods authorization number from Clack and return the Control Valve freight prepaid. If any Control Valve is covered under this Limited Warranty, Clack shall return the Control Valve repaired, or its replacement, prepaid to the original point of shipment.

CLACK GIVES THIS WARRANTY TO OEM IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND HEREBY EXPRESSLY DISCLAIMS ALL OTHER SUCH WARRANTIES. CLACK’S LIABILITY HEREUNDER SHALL NOT EXCEED THE COST OF THE PRODUCT. UNDER NO CIRCUMSTANCES WILL CLACK BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OR FOR ANY OTHER LOSS, DAMAGE OR EXPENSE OF ANY KIND, INCLUDING LOSS OF PROFITS, ARISING IN CONNECTION WITH THE INSTALLATION OR USE OR INABILITY TO USE THE CONTROL VALVES OR ANY WATER TREATMENT SYSTEM THE CONTROL VALVE IS INCORPORATED INTO.