

GRANT-DILLING-HARRIS INC.

WATER SOFTENER THEORY OF OPERATION

WATER SOFTENER: The Water Softener requires a 120VAC 2 AMP electrical service and the Water lines in and out need to be sized to the Softener. You require a Water Softener in the Car Wash to protect the equipment and allow your cleaning agents to be more effective. Water hardness is Calcium and Magnesium in the water supply as measured in parts per million. If your hardness measures 3 grains or more you need a water softener. Hard water allows a plating to take place in heaters, the RO and pumps causing damage to them. One of the main causes of detergents not cleaning well is hardness.

The water softener is an ION EXCHANGE unit. It exchanges hard ions, such as calcium and magnesium, and releases soft ions such as sodium. Most softeners for Car Washes are two tank alternating systems. The twin tank softener can exceed its capacity, at any time of day, switch over to the one on standby, and continue washing cars with soft water. The main components are the tanks, brine tank and control head.

TANKS: The tanks each contain a distributor tube, the tubes inlet is at the bottom of the tank, the top end connects to the head. There is gravel in the bottom of the tank to allow the distributor head to sit in. The resin is above the gravel. The amount of resin depends on the softener size. One (1) cubic foot is rated at 30,000 grain.

BRINE TANK: This is the tank that holds the salt pellets and some water. You can fill the brine tank all of the way to the top with salt.

HEAD: This is the controls and valves for all functions of the softener.

OPERATION: Remove the cover from the head and the front panel is exposed. On the front panel is a dial that tells you how much more water, in hundreds of gallons, can be used before regeneration. You use the same dial to set the softener capacity. If you have a tank rated at 90,000 grain and your incoming water supply is 10 grains then that tank could soften 9,000 gallons. However we will set the softener up for efficiency operation. We will use 66% of its capacity at only 50% of the salt usage. Now the tank, 90,000 grain, is derated to 66% or 59,400 grain. We will use the number of 59,000 grain. At 10 grains hardness, coming in, the tank could soften 5,900 gallon. We gave up 3,100 gallons of capacity but gained 50% of the salt usage. Not a bad trade off. You would pull out the knob and rotate the pointer to 59 because the dial is times 100. Remove the cable from the meter assembly, on the inlet manifold. Open the front panel by pulling on the right hand side. This exposes the cycle program wheel, has pins in it. As you view the program wheel you will observe a numbered area, 0 through 160. in this area will be three sets of pins. The program wheel should be at its home position, switch arm located between 160 and 0. Each number

represents 2 minutes. When the softener calls for regeneration the wheel will rotate counter clockwise, as seen from the rear. This will allow the softener to cycle.

SOFTENER CYCLE: To track the operation, of the cycle, there are two gears to the right, upper and lower. On the far right side of the head are two dials with arrows. The arrows will rotate with the two gears. The lower arrow dial points at tank 1 or tank 2. This tells you which tank you are operating on, tank 1 is the tank with the head on it. The upper dial will point at SERVICE, BRINE & WASH, RAPID RINSE and BRINE FILL. This indicates, to you, what mode the softener is in. As the softener capacity depletes the softener will call for regeneration. This will start the timer motor causing the program wheel to rotate, counter clockwise, the inside switch, homing switch, arm comes out of the home détente. This will allow the timer motor to run a complete cycle, until the homing switch arm drops into the détente again. This allows the program wheel to rotate 360 degrees in about 5-1/2 hours. The program wheel rotates, advancing the pins, located at "0", toward the switch. The program switch will control the cycle by the action of the switch arm, caused by the pins or lack of pins. When the first set of pins, 0 through 8, reaches the switch arm, it rises, closing a set of contacts. This will activate the valve drive motor. The two (2) gears, on the right, upper and lower, are controlled by the valve drive motor. The first set of pins, 0-8, are for Backwash.

BACKWASH: As the program switch makes, on the first set of pins (0), the valve motor energizes. This will cause the bottom gear to rotate first. This gear will move the change over valve, switching the out put of the softener, from tank 1 to 2. This allows the Car Wash to continue to have soft water. This gear will rotate 180 degrees and stop. The upper gear will now rotate, changing the program valve, until it is in the Back Wash position. When it reaches, the Back Wash position, a cam will open the valve motor circuit causing it to stop. The timer motor continues to run. During the Back Wash cycle water is fed into the softener in the reverse direction. Water flows down the distributor tube, up through the gravel and resin, and out the drain fitting. This will flush particles, trapped on top of the resin bed, and loosen up, "FLUFF", the resin. This will allow the brine to reach all of the resin during its cycle. The softener will remain in this mode for about 10 minutes, each pin is two minutes. Because the timer motor continues to run the program wheel rotates. At the end, of the Back Wash cycle, the program switch arm will drop off of the pins. This closes another set of contacts, activating the valve drive motor. The upper gear will rotate until it is in the Brine & Rinse position.

BRINE & RINSE: The Brine and Rinse cycle lasts about two (2) hours. The BRINE WATER (super saturated salt water) is drawn from the Brine Tank into the

softener. It enters at the top of the tank, is forced down through the fluffed resin bed, and exits out the distributor tube to the drain. This action causes the

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resin to regenerate. Some understanding of how the resin functions will be needed to understand this action.

RESIN: This is a synthetic material that has unique properties. The resin holds soft ions, the sodium of the brine water, until hard ions, calcium or magnesium, come in contact with it. At this point it will hold on to the hard ion and release a soft ion to replace it. This process is called ION EXCHANGE. This action will continue until the resin's soft ions are depleted. At this point it must be regenerated. This is accomplished by the brine. It will come in contact with the resin causing it to release the hard ion's and replace them with soft ion's. The resin is then ready to do an ion exchange again. The hard ion's and, saturated salt water, are flushed to the drain. It takes about one hour, of the two hour cycle, to draw all of the brine into the tank. The softener then continues, with a slow flow of water, through the resin bed, flushing the excess brine to drain, for about one hour. The program wheel has now advanced to another set of pins. This is the RAPID RINSE position.

RAPID RINSE: The Program switch closes a set of contacts, causing the valve drive motor, to rotate the upper gear into the RAPID RINSE position. This will last about 10 minutes. During this time, a higher flow, of water will enter the tank at the top. This water passes down, through the Resin bed, and does two things. It flushes any excess brine out and packs the resin bed down. The resin bed must be packed to keep the water from "channeling" a hole through it. At the end, of this period, the program switch will drop off the set of pins causing the program valve to advance to BRINE FILL.

BRINE FILL: During the Brine Rinse cycle we depleted the salt water in the Brine Tank. It must now be replenished to get ready for the next cycle. The time period for Brine Fill has been set, at the factory, for efficiency, 66% capacity at 50% of salt usage. This time period will vary with the type of Brine Tank and the Softener size. The water flows into the Brine Tank for a set period of time. The water will absorb the salt until it is saturated, about 3 pounds per gallon, and will absorb no more. This takes a time period of about 2 hours. When your distributor sized your softener, he took this into consideration. You would not want to recycle before the water was saturated. The program wheel advanced to the next set of pins that will shut off the Brine Fill water flow to the tank. As the program switch drops off, of this last set of pins, it will put the softener tank, that was just regenerated, into the standby mode. The timer motor continues to run until, the homing switch arm drops into the détente, shutting off the timer motor, about 2 hours. The softener is then ready for another cycle. The water softener is a very dependable, and necessary piece of equipment. You may fill the brine tank, all the way to the top, with salt.

SINGLE TANK SYSTEM: A single tank system works the same EXCEPT. You do not have a second tank to keep the Car Wash on soft water. The single tank will by-pass the hard water into the system. That is why most are set to regenerate at 2 AM, minimum water usage.

DIAGNOSIS AND MAINTENANCE

PROBLEM	<u>WATER SOFTENER</u> PROBABLE CAUSE	CORRECTION
1. Softener fails to regenerate	A. Electrical service to unit has been interrupted	A. Assure permanent electrical service to the softener. Check plug, switch and circuit breaker.
	B. Timer is defective	B. Replace timer
2. Hard water	A. By-pass valve is open	A. Close By-pass valve
	B. No salt in Brine Tank	B. Add salt to Brine tank. Maintain the salt level above the water level. It may be filled to the top.
	C. Injector screen plugged	C. Clean the screen
	D. Insufficient water in the Brine tank	D. Check Brine fill time and clean Brine flow control if plugged
	E. Internal valve leak	E. Replace seals, spacers and/or pistons
3. Unit uses too much salt.	A. Improper salt setting	A. Check hardness of incoming water and the regeneration point.
	B. Excessive water in the brine tank.	B. See problem #7

PROBLEM	PROBABLE CAUSE	CORRECTION
4. Loss of water pressure	A. Iron build-up in line to water softener.	A. Clean the line to the water softener.
	B. Iron build-up in softener tank	B. Clean controls and add cleaner to the mineral bed. Increase frequency of regeneration and/or backwash time. If this is caused by Iron build up you should discuss this with your distributor and add an Iron filter.
	C. Inlet of controls are plugged due to foreign materials	C. Remove pistons and clean controls
5. Loss of mineral through drain	A. Air in the water system	A. Assure that well has proper air eliminator control. Check for dry well condition.
6. Iron in conditioned water.	A. Fouled mineral bed	A. Check backwash, brine draw and brine tank fill. Increase frequency of regeneration.
7. Excessive water in brine tank	A. Plugged injection system.	A. Clean injector and screen.
	B. Timer not cycling	B. Replace timer
	C. Foreign material in brine valve	C. Replace brine valve seat and clean brine valve.
	D. Foreign material in	D. Clean brine line

brine line flow control

flow control.

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PROBLEM	PROBABLE CAUSE	CORRECTION
7. Excessive water in brine tank	E. Power loss during brine fill	E. Check power source
8. Softener fails to draw brine	A. Drain line flow control is plugged	A. Clean drain line flow control.
	B. Injector is plugged	B. Clean injector
	C. Injector screen is plugged	C. Clean injector screen
	D. Line pressure is low	D. Increase pressure to 25PSI minimum.
	E. Internal control leak	E. Change seals, spacers and piston assemblies.
9. Control cycles continually	A. Broken or shorted switch	A. Determine if timer or drive motor are faulty or service program switch or cycle switch are faulty and replace. Replace complete head.
10. Drain flows continually.	A. Valve is not programming correctly.	A. Check timer program and positioning of control. Replace power head assembly if not positioning properly.
	B. Foreign material in controls.	B. Remove power head assembly and inspect bore. Remove foreign materials and check control in various re-generation positions.

C. Internal control leak.

C. Replace seals and piston assembly.

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GENERAL SERVICE HINTS

PROBLEM	PROBABLE CAUSE	CORRECTION
11. Softener delivers hard water	A. Reserve capacity has been exceeded.	A. Incoming water hardness has changed. Check and reset program wheel.
	B. Program wheel is not rotating with meter output.	B Pull cable out of the meter cover and rotate manually. Program wheel must rotate without binding and cycle actuator must start the cycle before the clutch releases.
	C. Meter is not measuring flow	C. Observe rotation of small gear on front of timer. Note: Program wheel must not be against regeneration stop for this test. Each tooth is approx. 75 gallons. If not performing properly, replace meter.
	D. Trip dog on program wheel is beyond cycle actuator arm.	D. If power failed during regeneration, reset program wheel and cycle manually. If exceeding system capacity before re-

generation was complete, either increase capacity or restrict flow rate. If defective timer then replace timer.

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A water softener is a simple device, but very necessary, and most problems are caused by the obvious. Take time to look and remember this simple statement.

BRING BACK THE TOOLS

"B" = BY-PASS VALVE

Check it. Some one may have opened it.

"B" = BRINE

If there is no salt in the brine tank the softener can not regenerate.

"T" = TEST

Test the incoming hardness. It may have changed.

"T" = TIMER

Is there power to the timer and is it working.

You will cure 90% of softener problems by checking these four basic things.

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WATER SOFTENER INSTALLATION

The electrical requirement is 120VAC and 2 AMP service. The water line size requirement will vary with the size of water softener you have. NEVER undersize your water line. The water pressure must be at least 25 PSI and no more than 120 PSI. Water temperature must never exceed 100 degrees Fahrenheit and can not be subject to freezing conditions. The softener requires a drain for the water flushed to drain. You should have a by-pass valve provision, valve to turn off incoming water. Valve to turn off outgoing water and a valve to allow hard water to pass from the incoming line to the outgoing line, so there is no interruption during service of the softener. The Softener should be placed next to a wall for physical support of the by-pass manifold.

If the softener head is not installed do the following. Use an DOW CHEMICAL RTV-11, or equivalent, lubricant on all "O" rings. Do not use Vaseline or any petroleum product as it will cause the "O" rings to deteriorate. Put the head on and then couple the tanks together using the 2 pipe manifold.

Place softener in the location you want and level it.

Plumbing must be accordance with local codes.

Drain line must be as large as the "drain line flow control". NOTE: A restriction on the drain line will cause the softener to fail to draw brine during regeneration. Solder joints must be done prior to connecting to the drain line flow control or damage could result.

Teflon tape is the only sealant to be used on the drain fitting.

Place about 1 inch of water, above the grid plate, if used, in the brine tank.

Fill the brine tank with salt.

To place the softener in service requires washing down the resin. Be sure the cable is unplugged from the inlet manifold. open the door revealing the program wheel. Insure that the program switch arm is between 160 and 0. If not, rotate the program wheel counter clockwise until it is. Plug the softener in. Rotate the program wheel until the, program switch, arm comes up onto the first set of pins, 0 on the program wheel. Watch the two gears on the right side, the bottom one should rotate 180 degrees and stop, the upper one should then rotate and stop in the BACK WASH position. Unplug the softener. Open the incoming water supply valve about 1/3rd. Allow the water to run to drain until it is clear. Plug the softener back in and rotate the program wheel, counter clockwise, until the switch arm falls off of the pins, about 10 on the dial. This is the Brine & Rinse position. Open the water valve all of the way. Allow the softener to run here about 10 minutes. Rotate the program wheel, counter

clockwise, until the switch arm goes up on the next set of pins, about 70 on the wheel. This is the Rapid Rinse position. Allow the softener to run here about 10 minutes. Rotate the program wheel until the arm falls off of this set of pins. About 80 on the dial. This is the Brine Fill position. Allow it to run here about 5 minutes. Rotate the program wheel, counter clockwise, to the last set of pins. Leave it there 5 minutes and the arm should come off by itself. When the arm is down, rotate the program wheel, counter clockwise, back to 0 and start over. This will flush the second tank. Open the outlet valve all the way. Be sure the bypass valve is closed. The softener is now in service.

DILLING HARRIS INC.

WATER SOFTENER

Almost all Car Washes require a Water Softener. Water Hardness is a measurement of Calcium and Magnesium in parts per million. 17 parts equal 1 grain of hardness. Most water test kits measure the hardness in grains. If your incoming water supply is 3 grains, or more, you need a softener.

A water softener removes the Calcium and Magnesium and replaces it with sodium. This is called ION EXCHANGE. Do not confuse water softening with Spot Free as the two are totally different. The softener removes the hardness but the total dissolved solids remain the same or increase slightly.

Hard water is very destructive of equipment. The hot water heater will start plating on the inside, where you can't see it, and reduce the efficiency of the heater. It also will start plating the impeller blades of the circulating pump, causing premature failure and will build up in the water lines. The hardness is also very detrimental to the Reverse Osmosis system causing premature failure of the membranes. The High and Low pressure pumps will have problems with the build up on the valves and pumping parts. This is just to name a few of the problems created by hard water. It is not worth it. Get a softener.

The Softener is one of the most reliable pieces of equipment you have. It rarely fails, and when it does, is simple to repair. If you will check your water softness once a week you will keep up with it just fine. You can usually tell if you are having problems just watching your various soap applications. Hard water deteriorate the effectiveness of soap in a hurry.