INSTALLATION & SERVICE MANUAL FOR THE *CHC* WATER TREATMENT SYSTEM

Foreword

EcoWater CHC would like to thank you for choosing EcoWater for your water treatment provider.

Please read this manual carefully before installing and/or using the equipment. Familiarize yourself with the features, methods of use precautions and warnings. This manual should be kept for future reference in a safe and convenient place.

This manual contains information that is generalized for all Skids, as well as information that is specific to your installation.

 EcoWater maintains the right to change or modify this manual without prior notice. If you have any questions about the information presented in this manual or about the equipment, please contact us at:

EcoWater CHC
5850 Corridor Parkway
Schertz, TX 78154
(800) 722-0476
(210) 910-6462
www.ecowaterchc.com

NOTE: For specific specifications of your treatment system, review the supplied Installation Concept Drawings that includes specific specifications on the skid that was confirmed for your usage.

This product and/or its components comply with UL Standards BF803801 and E247258.

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Limited Warranty

Purchased Units:
EcoWater CHC warrants that each System sold to the original owner hereunder shall be, upon delivery and for a period of twelve months thereafter, free from defects in material and workmanship, and fit for its intended use, unless otherwise specified in the Purchasing Contract. Seller further warrants that the CHC Chamber within each System sold hereunder shall be free from defects in material and workmanship and fit for its intended uses.

Rental Units:
EcoWater CHC warrants that each System sold hereunder shall be, upon delivery and for the period of rental agreement or term, free from defects in material and workmanship, and fit for its intended use, unless otherwise specified in the Purchasing Contract.

EcoWater CHC reserves the right to make changes or improvements in design or manufacturing without assuming any obligation to change or improve products previously manufactured and / or sold.

What Is Not Covered Within This Warranty:
EcoWater CHC will not warranty any parts or connections to the CHC treatment system that were provided by the customer. This includes any damage to the CHC system caused by said, attached, customer supplied, product. The customer is required to supply electrical service to the CHC treatment system as well as provide adequate protection from all natural elements as be appropriate for their environment which could be but limited to freeze protection. Any damage to the CHC system caused by the failure of the customer supplied items will void the CHC treatment system's Warranty. Upon repair, the CHC system will be inspected and if found to be within specification, the Warranty may be reinstated.

The CHC system's warranty does not cover failure of the CHC treatment system as the result of any unusual force of nature such as, but not limited to, flood, hurricane, tornado or earthquake, EcoWater CHC Systems is excused if failures to perform its warranty obligations are the result of strikes, government regulations, materials shortages, or other circumstances beyond its control.

For all warranty claims call EcoWater CHC at 1-888-316-7680 and ask for service department, a representative will be happy to assist with all warranty requests.

Some states do not allow limitations on how long an implied warranty lasts or exclusions or limitations of incidental or consequential
Damage, so the limitations and exclusions in this warranty may not apply to you. This warranty gives you specific legal
Rights and you may have other rights which vary from state to state. This warranty applies to consumer-owned installations only.

NOTWITHSTANDING ANYTHING TO THE CONTRARY CONTAINED WHEREIN OR ELSEWHERE, SELLER'S RESPONSIBILITY FOR LOSSES OR LIABILITIES ARISING OUT OF, IN CONNECTION WITH, OR RELATING TO THE SYSTEMS COVERED HEREUNDER SHALL BE FOR THE REPLACEMENT OF PARTS (AND LABOR FOR THE FIRST 90 DAYS AFTER INSTALLATION) ONLY AND SHALL NOT EXCEED THE PURCHASE PRICE HEREUNDER. SELLER'S OBLIGATION WITH REGARD TO EFFECTIVE PRODUCTS SHALL BE LIMITED TO REPLACEMENT OF SUCH PRODUCTS OR ISSUANCE OF A CREDIT THEREFOR. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY CHARACTER, WHETHER SUFFERED BY BUYER OR THIRD PARTY RELATING TO THE SUBJECT OF THIS AGREEMENT, INCLUDING, WITHOUT LIMITIATION, CLAIMS FOR PROPERTY DAMAGES, PERSONAL INJURY, OR LOSS OF USE,

BUSINESS, REVENUE, PRODUCTION OR PROFITS. EXCEPT AS OTHERWISE SPECIFICALLY PROVIDED IN WRITING FROM THE SELLER TO BUYER, SELLER MAKES NO WARRANTIES WITH RESPECT TO THE PRODUCTS COVERED HEREUNDER, AND SELLER EXPRESSLY DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS, STATUTORY OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE.

RECEIVING

The System is shipped with all major components in place. Each unit is inspected, tested and calibrated at EcoWater CHC before being shipped.

CAUTION

Upon arrival, inspect the unit for damage. If damage is evident, notify the freight company immediately and file a damage report.

Your unit has been prepared for shipment so that it will arrive undamaged. At the time of shipment, the carrier accepts responsibility for any damage that may occur in transit. All claims for shipping damage must be made to the carrier alone. Upon receiving a shipment, carefully inspect all cartons and pallets for visible damage. If damage exists, a notation to that effect must be made on the Bill of Lading and a claim must be filed with the carrier.

WARNINGS & PRECAUTIONS

Main Electrical Service is 480 VAC
Control Voltage is 24VDC

WARNING **Use Caution When Servicing This Unit ONLY Qualified Electricians Should Attempt Any ELECTRICAL Service.**

WARNING **Always disconnect electrical service before attempting service on any items found within this skid.**

WARNING **Servicing of equipment should be completed only in a well ventilated area.**

WARNING **Most Items located on the skid are Very Heavy. Use all appropriate lifting methods and safety precautions while lifting or moving items.**

WARNING **In case of Fire, use appropriate notification methods of local fire departments. Turn OFF all power sources immediately.**

WARNING **DO NOT operate the pump motor if the safety guard has been removed from its fan.**

WARNING **DO NOT operate any motor or electrical device on this skid in the presence of standing water.**

WARNING **DO NOT operate any motor on this skid in reverse for any length of time. Severe Pump Damage can occur.**

WARNING **When working with chemicals make sure to follow recommended handleing and storage measures. Refer to appropriate MSDS sheets for each chemical**.

Shutting Down the CHC System Skids upon an EMERGENCY.

1. Turn the power disconnect OFF on the CHC's Motor Controller. Verify the pump has stopped operation (look for motor rotation, and listen for the discontinuation of the standard CHC operational sound and loss of filtration pressures).
2. Close one of the Isolation valves found on either side of the basket strainer.
3. If a leak is in progress, the isolation valve(s) up on the tower must also be closed.

STANDARD SERVICE REQUIREMENTS

Daily verification of operation is the key to continued operation of the CHC system.

Each Day the following should be verified:

Operational pressure of the Pump(s)
Operational differential pressures of the Filtration system.
Functionality of the Filter's Back Wash ability.
Review of Control Station Messages
Visual system check for water leaks, water clarity, water smell

Every Quarter the following should be verified:

Calibration of Conductivity Meter
Pump Amperage Verification

Every Six Months the following should be conducted:

Lubrication of Motors and O-Rings

As needed the following should be conducted:

Cleaning of Basket Strainers (The frequency of cleaning will depend upon the amount of debris in the system. Upon Start Up the baskets should be cleaned at least three times a day for the first week, and then cleaned as needed depending upon debris level.)

CAUTION

The use of the CHC Treatment system is in no way intended, to replace or diminish your required service as specified by the manufacturer of your tower or heat exchanger. Please refer to the appropriate manuals and continue the required maintenance as specified therein. The lack of appropriate system maintenance may result in the premature failure of our cooling system.

All cooling systems require appropriate, timely service. It is your responsibility to make sure these service requirements are met to ensure appropriate system operation.

INSTALLATION

Prior to making any external plumbing or electrical connections, the Skid should be placed on a level, stable foundation. Verify with EcoWater CHC that your foundation is adequate for installation.

The electrical service should be installed according to applicable local and state regulations. A main power disconnect was supplied with the Skid and should be utilized to disconnect power as required for service.

Be certain to connect all safety ground (GREEN) wires to the common grounding lug inside the box on the back panel.

Plumbing connections should be made in accordance with supplied installation drawings. External plumbing should be mounted in such a manner to adequately support the pipe and the extra weight of the water that will be flowing through the pipe during operation. All plumbing should be insulated and/or heat traced as required by your environmental conditions throughout the year.

EcoWater CHC recommends the use of Schedule 80 PVC or metal, and does not recommend the use of Schedule 40 PVC. If the customer has specified the use of piping other than Schedule 80 PVC, this will be noted in the installation drawings.

EcoWater CHC recommends all hardware used for the connection and support of the piping be galvanized carbon steel or stainless steel.

Spacing around skids should address required access of the electrical control panels, basket strainers and any other maintenance needs during operation.

Once the piping is complete, the piping should be verified for leaks, make sure that all leaks are corrected and the valves are left in the open position for use in commissioning of the equipment.

INITIAL START-UP

This Section should only be completed by an Authorized EcoWater CHC Representative (estimation 4 hrs without training)

1. Verify all plumbing and electrical connections have been constructed to meet applicable design and local regulations.
2. Verify that the supplied power to the skid on each leg of the supply is appropriate.
3. Install all required filtration elements that may have been shipped separately.
4. Lubricate all O-rings associated with the basket strainers and filtration housings with Silicone Lubricant.
5. With all power turned OFF from the skid, verify all electrical connections on the pump, and motor start boxes are tight.
6. Momentarily, turn ON each motor control and verify that the power ON/OFF switch control will initiate and halt motor operation.
7. Verify the direction of rotation is correct for all pumps and or motors. If the rotation is not correct, transpose any two pump power wires to reverse the motor.
8. Verify that the correct Units of Measure and Language are selected on the PLC. At this time you may want to set or check those VCS settings as described at the end of this procedure. Your system has been preprogrammed at the factory and some changes may be required.
9. With Power turned ON and the pumps OFF, remove the conductivity probe from its piping. Make sure that the conductivity on the front of the CHCCS reads 0 uS/cm. If it does not Press the Cal (F2 key), Press the Conductivity box on the screen, and then press the Air Cal box on the bottom of the screen. The Current Value as shown on the screen should indicate 0 uS/cm.
10. With Power turned ON and the pumps OFF, read the pressures for the CHC and Filter Transducers as shown on the CHCCS screen. All of the values should indicate 0 PSI. If it does not Press the Cal (F2 key), Press the Pressures box on the screen, Press the corresponding transducer box, and then press the Zero Cal box on the bottom of the screen. The Current Value as shown on the screen should indicate 0 PSI for each transducer.
11. Open all Isolation valves (slowly as to not overwhelm the makeup's ability to maintain the basin level) and allow water to flow into the pumps.
12. Verify that all piping connections from the tower are not leaking.
13. Turn ON the motor and verify that no leaks are present on the skid or in the pipes as they return to the tower.
14. Verify that no abnormal noise or vibration is present during motor operation.
15. After 5 minutes of operation. Turn the system's power OFF and clean the basket from the basket strainer.
16. Turn ON the system again, and verify and adjust any required flows or pressures.
    a. The CHC pressure should indicate 84 PSI-100PSI.
    b. Close down the CHC discharge so that 3-5 psi back pressure is found on the discharge gauge.
    c. Close the flow regulation valve on the output on the screen filter.
    d. Adjust the output valve of the Filter > Tower so that minimally 35 psi is shown on the outlet of the filter, now initiate a back wash of the filter. If you have a side stream screen filter make sure that during a filter backwash at least 20 psi (25 – 30 is preferred) is present at the inlet of the screen filter, if the screen filter is the primary filter, then the pressure during a back wash must maintain a minimum 32 psi during a back wash). If the pressures

are below the 20 or 32, increase the back pressure on the filter by closing the outlet valve until the pressures are reached during a back pressure.

e. Verify that during a back wash of the screen filter, that water is discharged down the drain and stops as the back wash stops.
f. Verify that the CHC pressure remains with tolerance. Adjust if necessary.

17. Select a Bleed Test function and make sure the blow down valve changes appropriately. (Main screen, press Bleed F3, press Bleed Test F1 key)
18. Verify that during an open blow down valve, water is discharged to the drain and that as the valve closes, and the flow to the drain stops.
19. Adjust the flow control valves to achieve 5-8 gpm flow through the flow meter and corrosion coupon rack. If your unit does not have a flow meter, open the valve 1/3 or to the mark as set by the manufacturing group (indicated with permanent marker)
20. Calibrate the conductivity meter probe and select the units that is familiar to the customer, the user can select from µS/cm or ppm. Adjust the bleed set point to the desired level against the makeup water conductivity as specified within the quote.
21. Close down the Forsta filter discharge valve and the Separator discharge valve, so that the pressure on the separator increases to above 50 psi, but not above the range as shown on the discharge gauge of the filter.
22. Calibrate the pressure transducers at this time as shown in the manual for HI Cal pressures.
23. Turn OFF the skid's pump and verify the transducer pressure values, drop back to Zero, turn the pump power back ON and verify the reading return to a value representative of the gauge pressure.
24. Open the Auto Screen filter's discharge valve (valve that goes back to pump suction from the screen filter discharge connection) so that the outlet pressure of the separator decreases by 5 PSI.
25. Open the filter discharge valve so that the normal operating pressure is reached on the separator.
26. Initiate a Filter Back Wash and verify that the filter inlet pressure stays within its operation range (see step 11.e) make adjustments as needed.
27. Record the normal operation pressure of the screen filter's outlet. This value minus 8 psi must be entered into the Trip Pressure set point within the CHCCS setting screens.
28. Mark with a permanent marker all valves, and flow meters so that the current settings are noted as well as any ranges that are appropriate.
29. Turn OFF the pump, Turn OFF the Main Power Disconnect Switch. Verify that power has been removed from all systems, inspect the motor connectors, as well as electrical control panel components for arcing or heating. If no indications are noted continue with operation. If any indications of electrical issues are noted, contact the appropriate electrician to correct any issues. Turn the power back on and record the Pump amperages from each leg of power.
30. Mark all Gauges with a permanent marker to show the initial pressure settings.
31. Verify that the Blow down duty cycle setting or blow down flow regulation valve settings are appropriate. (you should never blow down more water than their makeup system is capable of replacing at any one time). A good starting point is a Duty Cycle of 50%.
32. Review the hidden screen and verify the settings of the VCS. If changes are need, make those changes and then return to this screen and take a picture of the screen information.
33. All data should be entered into Ulysses at this point and call made to EcoWater CHC engineering to notify them of the Start Up CSR being created for their approval and processing.
34. Return back into the CHCSC system settings and initiate a Save to User Defaults the current configuration.

35. Complete the Installation Certificate and have it signed by the customer.
36. Conduct all required training sessions for the local EcoWater CHC representative as well as any service personnel specified by the customer. (Pass out and discuss Operation Manual, Instruct Personnel on Service Requirements, Instruct Personnel on required troubleshooting as shown in manual. (This section normally takes 1 hr per training session. Verify that all customer personnel requiring training are given a class, some personnel may require training for multiple shifts, consult customer.)
37. Take good pictures of the current condition of the tower, any tubes or piping that would be good for our records.

Things to check in the CHCCS Settings:

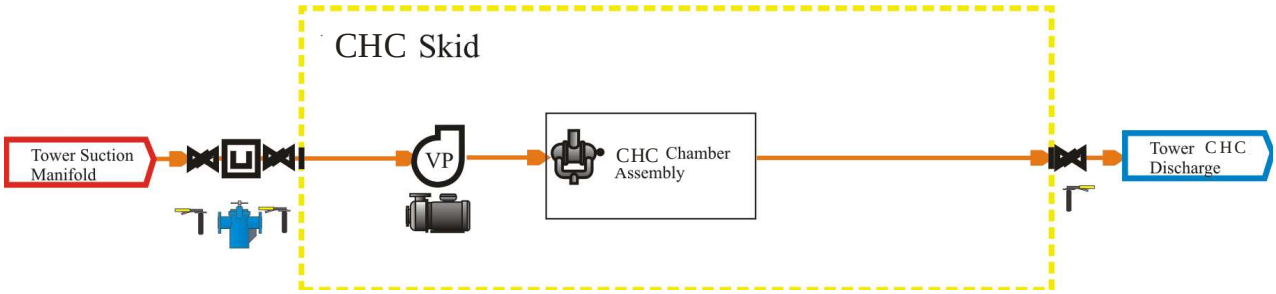
- Language and units are correctly selected
- Contact phone number is correctly shown on the screen.
- The selection of filter type is correct (normally set to Sep/Auto)
- The Sep settings should normally be 18 seconds Open and 3-6 hours Closed (if the tower is dirty select on off time of three hours while if the basin is clean, select the 6 hours setting)
- The Auto Screen Settings should be 13-16 seconds Rinse time, 300 seconds Delay, and 60-360 Auto, 60 if the tower is extremely dirty and 360 if it is clean with little debris.
- The Trip pressure is set 8 psi below the normal operating pressure as shown on the screen, unless otherwise specified.
- Power Saver should be OFF unless required.
- Safety Valve should be OFF unless required.
- All Calibrations correctly entered
- The blow down set points and duty cycle settings are correct as specified.
- The User Defaults are saved.
- Enter Passcode 2000 to clear the back wash counts on the screen
- Make sure a formatted micro SD card is installed on the PLC
- You have taken a picture of hidden screen #2.

If you have any questions, contact the EcoWater CHC Engineering Department (210)-910-6463.

THEORY OF OPERATION

EcoWater CHC supplies both water treatment and filtration systems.

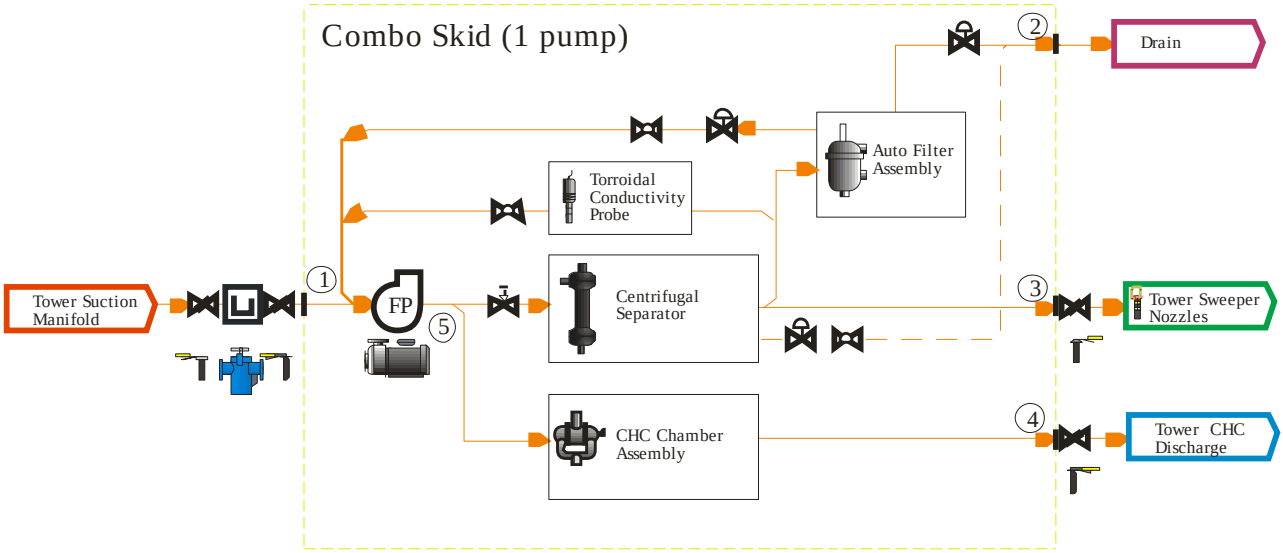
CHC Water Treatment System-
The CHC Water Treatment System consists of a pump and treatment chamber. As water enters into the main suction pipe it passes through the basket strainer. The basket strainer is designed to remove any large particles from the water before it enters the CHC pump. Isolation valves are located at both the inlet and outlet of the basket strainer and are used to isolate the basket strainer from the water flow during servicing. The pump utilizes a centrifugal pump to pressurize the water to the required pressure for the Hydrodynamic Cavitation to occur in the CHC treatment chamber. The CHC treatment chamber consists of two proprietary nozzles that create a high speed water stream that are aimed directly at the opposing water stream. As these two streams collide, a vortex is created, it is within this vortex that the Hydrodynamic Cavitation cloud is created. The pressure regulation valve located on the discharge of the CHC chamber is used to control the required 2-5 psi back pressure for appropriate operation of the chamber. As water leaves the chamber it then passes through the discharge pipe and back to the tower's sump. A vent may be provided at the top of the discharge pipe, to break any vacuum that could be created as the water suddenly drops into the sump.



Refer to the CHC web site (www.ecowaterchc.com) for more information regarding the CHC chamber's configuration and the technology behind its operation.

Filtration System-
As water is drawn in from the basin it passes through the main suction pipe and passes through the basket strainer. The basket strainer is designed to remove any large particles from the water before the water passes to the pump. Isolation valves are placed on both the inlet and outlet of the basket strainer to allow for isolation of the basket strainer during the required servicing. The water then enters the skid pump. The skid pump utilizes a centrifugal pump that delivers water to the filtration system. As the water leaves the pump it passes through a centrifugal separator that removes all heavier than water particles. A timed purge cycle, removes the debris from the separator and passes it to the drain as needed. Once past the separator, water then flows back towards the tower while a portion is pulled through a side stream, automated screen filtration unit. This second stage filter, utilizes a fine screen to filter out any particulate out of the water stream that may be lighter than water. As the filter's screen becomes clogged, the

differential pressure between Inlet and Outlet increases causing the PLC to initiate a back wash of the filter. When a back wash is initiated, water is driven into the rinse piston at the end of the filter. The rinse piston opens the back wash drain valve, and as water passes out of the drain it crease a Venturi effect that is used to suck off any debris from the filter's screen. Once the back wash is complete, the controller will cease all water flow to the rinse piston and the filter will return to a home position. At the end of the filtration back wash cycle, the PLC verifies filter cleanliness, and if the filter did not clean it's screen appropriately, a second back wash may begin. The filter's back wash cycle is also controlled by a timer, the timer has been set to automatically clean the filter at least once every 6 hours of operation. All operational failures are shown within the Control Station's Filter Alert Area.



Toroidal Conductivity-
EcoWater has chosen to utilize a Toroidal Conductivity Sensor. Conductivity is a measurement of the dissolved solids within water. This sensor is utilized to help control the overall maximum conductivity of the system water.

The advantage of this technology is measurement without any electrical contact between the electrode and the process fluid. The probe uses two toroidal transformers which are inductively coupled side by side and encased in a plastic sheath. The controller supplies a high frequency reference voltage to the first toroid or drive coil which generates a strong magnetic field. As the liquid containing conductive ions passes thru the hole of the sensor, it acts as a one turn secondary winding. The passage of this fluid then induces a current proportional to the voltage induced by the magnetic field. The conductance of the one turn winding is measured according to Ohm's law. The conductance is proportional to the specific conductivity of the fluid and a constant factor determined by the geometry and installation of the sensor. The second toroid or receiving coil also is affected by the passage of the fluid in a similar fashion. The liquid passing thru the second toroid also acts as a liquid turn or primary winding in the second toroidal transformer. The current generated by the fluid creates a magnetic field in the second toroid. The induced current from the receiving coil is measured as an output to the instrument. The controller converts the signal from the sensor to specific conductivity of the process liquid. Although the toroidal probe is less subject to calibration errors or buildups on the sensor, it is still important that the

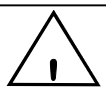
probe be cleaned and calibrated at least once every three months. Please refer to the appropriate sections of this manual for further information.

pH Monitoring (Optional)-

Ecowater has chosen to utilize an industrial pH probe for this measurement. A pH meter is an electronic instrument used for measuring the pH (acidity or alkalinity) of a liquid. The pH probe measures pH as the activity of hydrogen cations surrounding a thin-walled glass bulb at its tip. The probe produces a small voltage (about 0.06 volt per pH unit) that is measured and displayed as pH units by the CHC Control Station (CHCCS). The pH probe is a combination electrode, which combines both the glass and reference electrodes into one body. It is important that this probe be clean and calibrated at regular intervals, please refer to the appropriate sections of this manual for specific information.

GENERAL OPERATION

WARNING



Before the system can be placed in service, the INITIAL START-UP Checklist must be completed. Refer to Section "Standard Service Requirements" for frequency.

NOTE: This Section has been created to instruct you on the normal use and service of the CHC system. Some parts of this section refer to options that your system may not contain.

Initiation of CHC System

1. Verify that the Suction Isolation Valves (at tower, and either side of basket strainer) are open.
2. Verify that the CHC Chamber and Filtration Discharge Valves (at Skid and Tower) are open.
3. Turn ON the power of the CHC unit, by rotating the pump switch(s) into the "Auto or ON" position. As the controller is activated, the corresponding pump should start.
4. Verify the pressure on the CHC pressure gauge exceeds 75 psi.

Initiation of Filtration System

1. If your CHC treatment system contains two separate skids (one for CHC and one for the Filter you may need to repeat the before mentioned procedure for the second skid.

Shutting Down the CHC System to Clean the Basket Strainer.

1. Turn the pump power OFF by rotating the Pump Switch to "OFF". Verify that the unit has stopped operation (look for motor rotation, and listen for the discontinuation of the standard CHC operational sound, loss of pump pressure will also be noted, If the skid also contains a filter, make sure that if a second filter pump is used that its power is also turned OFF).
2. Move to the Basket Strainer and close both of the Isolation Valves located on each side of the basket strainer.
3. Loosen and remove to the side, the basket strainer lid mount.
4. Lift and move to the side the Basket Strainer lid.
5. Remove the basket and clean basket of debris.
6. Replace basket and reverse steps 1 through 4.

Cleaning the Flow meter (Optional)

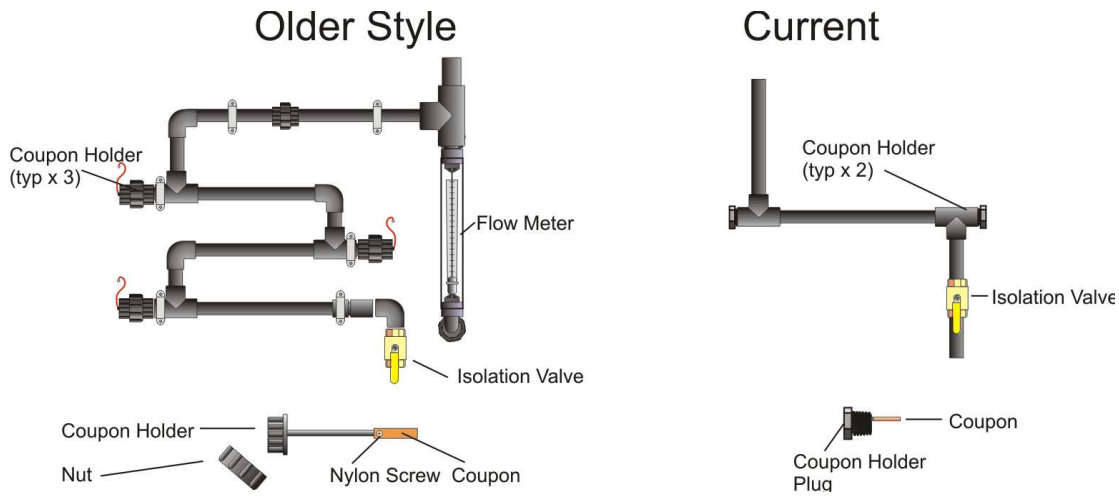
The Flowmeter must be clean and free of debris to remain accurate.

1. Isolate the Flowmeter plumbing from the flow stream by closing the isolation valves at the inlet and outlet of the flowmeter.
2. Unscrew the split pipe clamps that are holding the Flowmeter in place. Remove the Flowmeter.
3. The Flowmeter may be disassembled without tools. Be careful to note where the rubber washers and internal parts come from.
4. Clean the inside of the Flowmeter taking care not to damage the float, rod or inside of the Flowmeter. Re-assemble in reverse order.

5. Verify that the float will move from one extreme of the flowmeter to the other, this step verifies that the float and rod have been relocated correctly.
6. If the Flowmeter does not have a cover to prevent Algae growth, order a cover from CHC. (PN # 100000020)

Installing the Corrosion Coupons (Optional)
Most systems includes the provision for conducting Corrosion Coupon Testing. To conduct this test you will first need to request coupons from EcoWater CHC.

These coupons will be installed for no less than 60 days before they are removed and weighed. The coupons can be installed up to 120 days before removal. This installation requires the use of Nitrile Gloves to insure no contamination of the coupons occur. Place the coupon envelopes in a location whereas they can be used as the coupons are removed.



To install the Corrosion Coupons follow these steps:

1. Acquire the coupons, you will receive one Galvanized coupon, one Stainless Steel or mild Steel coupon and one Copper coupon (Normal Configuration, other coupons are available if requested).
2. The coupons are placed so that the Copper coupon will be first coupon that the water will come in contact with, the Stainless Steel coupon will then be placed next and followed by the Galvanized coupon.
3. Turn off the two isolation valves at the rack to stop all water flow.
4. Loosen the nut securing the coupon holder.
5. Remove the coupon holder rod from the coupon rack.
6. Remove the coupon installation screw from the coupon holder.
7. Place a coupon over the holder and secure with the installation screw.
8. Place the holder back into the rack so that the coupon is extended into the water flow tube in a vertical position. Do not place the orientation of the coupon in a horizontal position, if horizontal, the coupon can act like a shelf and support debris that maybe detrimental to your test results.
9. Secure the holder into place by tightening the holder nut.
10. Open the rack's isolation valves.
11. Verify that the flow across the coupons is between five and eight GPM as shown on the flow meter.
12. Mark the coupon envelopes with the date of installation and place in a secure location for use upon the completion of the testing.

Removing the Corrosion Coupons (Optional)

1. Turn off the isolation valves at the rack to stop all water flow.
2. Loosen and remove the holder nuts.
3. Slide out the holders, exposing the coupons.
4. Remove the coupon retention screws.
5. Remove the coupons, wipe them clean with a damp cloth.
6. Place each coupon back in its original envelope.
7. Place the retention screws back into the coupon holder rods.
8. Slide the coupon holder rods back into the rack.
9. Secure all rods by tightening their corresponding nuts.
10. Open the isolation valves and make sure no leaks are present.
11. Adjust the flow meter until the five to eight GPM flow rate is achieved.
12. Return the coupons to EcoWater CHC for examination and analysis.
13. A report will be generated and returned to you with the results.

Cleaning and Calibrating the Conductivity Controller

The filtration systems may have been provided with a toroidal conductivity probe. Once the Air calibration is completed, the Hi Calibration can be set to match the verified conductivity of the system water. Cleaning of the probe is required on a quarterly basis.

From the Main Screen, press the F2 "Cal" button.

The screen will change and press the "Conductivity" square on the Display.

The screen will change. Isolate the skid from the tower water by closing off the isolation valves.

Remove the conductivity probe from its tee and clean with a soft brush to remove any loose debris.

Allow the probe to stay in the air for a period of 1 minute to allow for signal stabilization. Press the Air Cal "Save" button as shown as #1 to the right. The Current value should change to 0.

Install the probe back into the sample tee and open all isolation valves closed earlier. Turn the CHC system pumps back ON.

Measure the system's water with a calibrated conductivity meter. Enter the measured value in the "Value" box as shown in #2 to the right.

Press the Hi Cal "Save" button as shown in #3 to the right. The Current value should change to match your input measured value.

Verifying the operation of the Blow Down Actuator

1. Enter into the Bleed screen by pressing the F3 soft key on the Control Station. The Bleed screen will appear, and then press the Bleed Test button (F1). This will force the blow down actuator to reverse its control for a period of 20 seconds.
2. Verify the actuator opens and closes the valve for the specified time. If the draining water is visible, verify that water is expelled during the opening of the blow down.

Verifying the operation of the Automatic Screen Filtration system

1. With the system ON, Press the Manual Back Wash (Man BW (F1 key on the Main screen) button on the filter's Control Station. The Filter should automatically complete a back wash sequence and increase the back wash counts by 1. If the filter is constructed with a second filter element, the second filter should back wash within 40 seconds of initiation of the back wash.
2. Verify that the pressure on the filter's output gauge is at least 30 PSI.
3. Verify that the pressure on the CHC pressure Gauge is not over 105 PSI.
4. Verify that No filtration Alarms are shown.
5. At the completion of a back wash the filter's differential pressure switch gauge should return to 0 psi.

Calibrating the Filter Pressure Transducers

1. With the system's power ON, but the pump OFF, Press the Cal (F2) key as indicated on the main screen of the Control Station. The screen will change and you will then Press the Pressures soft key on the screen. You will notice that the screen again changes allow you to select which transducer (Pump or Outlet) you wish to calibrate.
2. Select the Filter Pump Transducer soft key. The calibration screen will appear and then press the Zero Cal Save button, Press the Main (F4 key) and then go back to the Calibration screens.
3. Select the Filter Outlet Transducer soft key. The calibration screen will appear and then press the Zero Cal Save button.
4. Turn the pump's power ON, wait 30 seconds and then record the pressures from the pump pressure gauge.
5. Select the Filter Pump Transducer soft key. The calibration screen will appear and then press the Value within the HI Cal area on the screen. A numeric entry screen will appear and press the corresponding keys that correspond with your recorded pump pressures. Press the Return key (Arrow like on keyboard) and then press the HI Cal Save button, Press the Main (F4 key) and then go back to the Calibration screens.
6. Select the Filter Pump Transducer soft key. The calibration screen will appear and then press the Value within the HI Cal area on the screen. A numeric entry screen will appear and press the corresponding keys that correspond with your recorded pump pressures. Press the Return key (Arrow like on keyboard) and then press the HI Cal Save button, Press the Main (F4 key) and then go back to the Calibration screens.
7. Verify that the pressures as shown on the main screen correspond with those pressures entered within this section.

CHC Control Station

The Control Station has been designed to monitor and control the CHC treatment system. Its screen layout has been designed to minimize the need for customer interaction as well as minimize confusion in screen function and layout. There are User Screens as well as Set Up screens. The Set Up screens will be configured at the installation and do not require configuration by the user, for this reason, the Set Up screens are Password protected. The control station continuously monitors the following items:

Conductivity- The conductivity of the system is monitored continuously with the use of the supplied Toroidal conductivity probe placed in a continuous water flow on the filtration skid that bypasses the filter. Allows for control of conductivity based blow down as well as HI and LO alarms placed around the normal conductivity levels. The Control Station's range of measurement is 0-8,000 uS. Functions have been added to allow the calibration of the conductivity sensor to AIR as well as to a higher known conductivity value liquid.

Blow Down Control- The blow down is controlled by a blow down set point that is selectable within the user screens. The blow down utilizes the conductivity valve against the selected blow down settings to control and maintain the conductivity within the system water. A dead band (found within the Set Up screens) is utilized to reduce valve opening and closing frequency to lengthen valve life. A simple test has been added to the Bleed screen that allows for the easy verification of Blow Down Valve operation.

Filter Control- The filters are monitored continuously and their cleaning routines are controlled by the Control Station. The number of back washes are shown on the main screen for easy viewing. A Manual Back Wash initiate feature has been added to the main screen to allow your testing of the back wash ability of the filter. The filter's control interfaces with a inlet and outlet pressure transducer as well as the back flush solenoids to aid in the control and monitoring of the filter.

Pump Monitoring- The control station can be configured to monitor the power system of the pump, this includes the power status of the pump, its thermal overload condition as well as monitor the Power Phase condition of incoming power. The system can be configured to monitor the CHC's pump's pressure if required.

Alarm Indication- Alerts are shown under their corresponding labels, the alarms have been prioritized to minimize nuisance alarms. Upon an alarm activation, an output relay of the controller closes to identify the alarm condition to other customer connected devices.

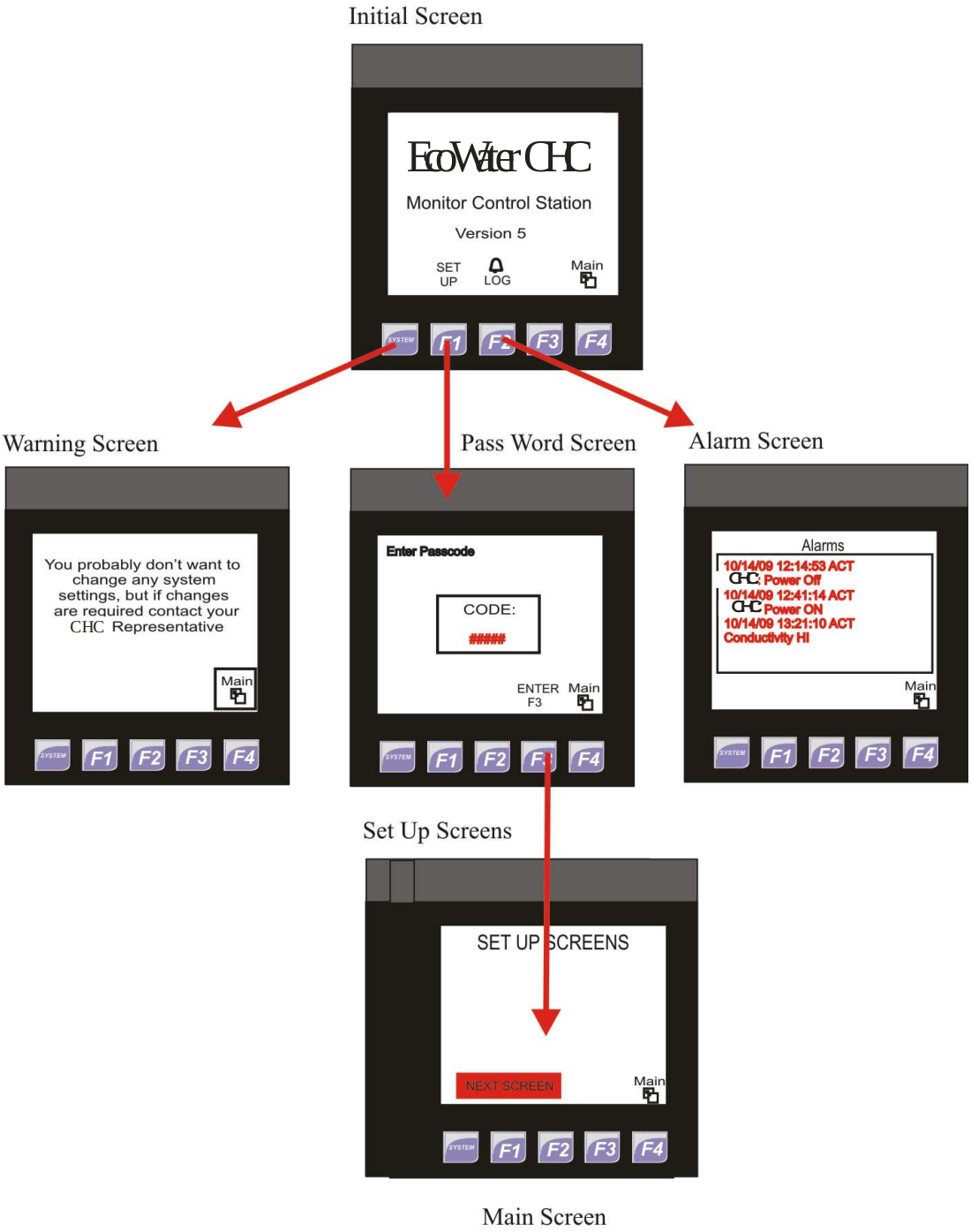
Alarm Storage- As alarms occur, they are stored in the control station's memory for future use. They can also be stored continuously onto a Micro SD memory card if it is installed in the controller.

Optional Features- As shown above many of the monitoring features of the pumps can be turned ON and OFF as required. The station has the ability to communicate in other ways with building control systems and other communication systems, contact CHC for further information about the communication abilities. Other features including power control and pH monitoring are also available.

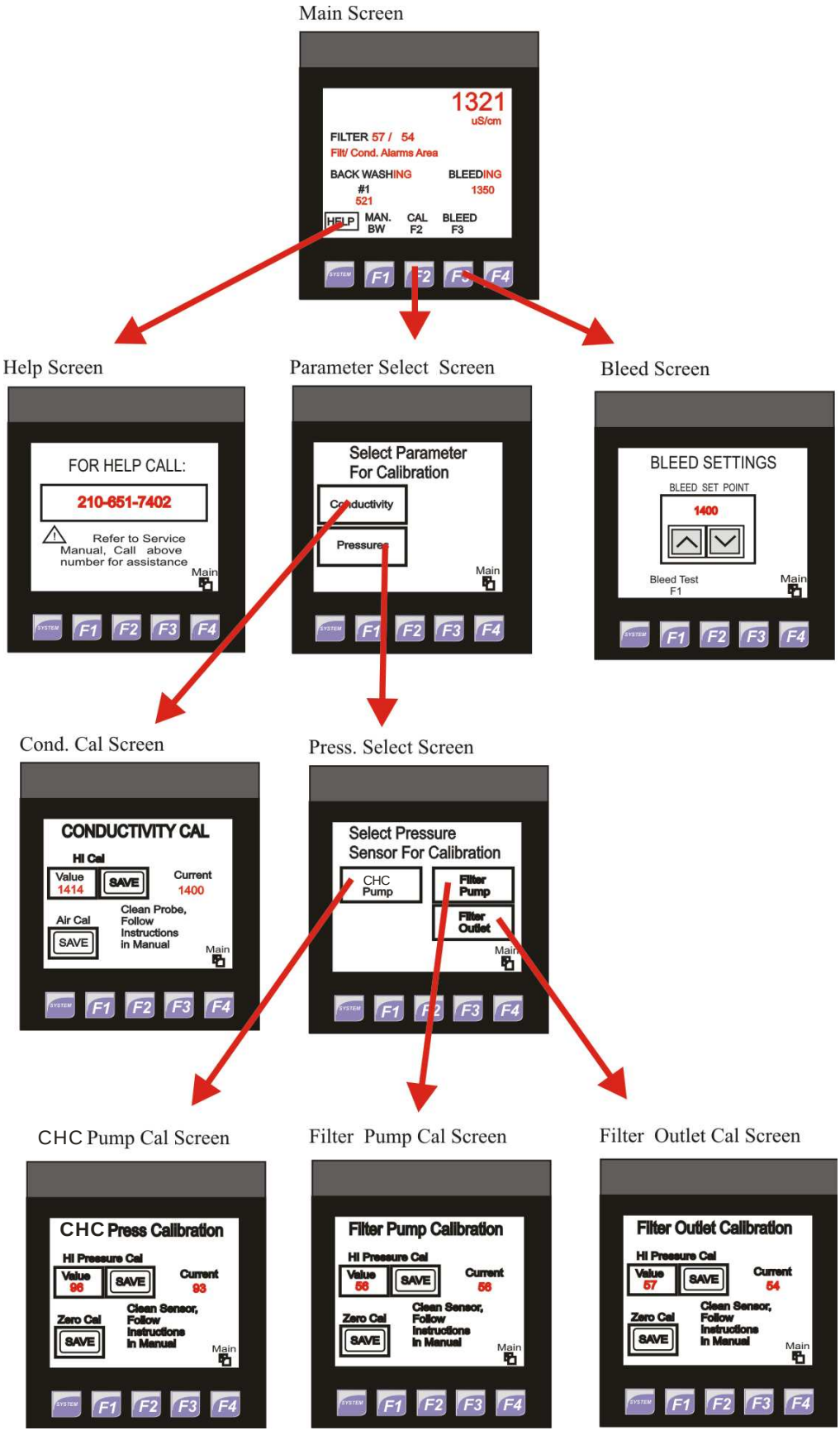
Set UP Screens- The Set up screens contain the basic system settings needed to configure the operation of the system. If this system is Purchased, please refer to the supplied Control Station Technical Reference that will be supplied for your use. Upon failures these passwords can be of help:

Factory Default – (Call EcoWater) User Defaults- 112 or 911

User Screen Structure-



Note: By pressing the Main button, the screens selection will revert back to the Main Screen


Main Screen
1321
uS/cm
FILTER 57 / 54
Filt/ Cond. Alarms Area
BACK WASHING
#1
521
BLEEDING
1350
HELP
MAN. BW
CAL F2
BLEED F3
SYSTEM F1 F2 F3 F4
Help Screen
FOR HELP CALL:
210-651-7402
Refer to Service Manual, Call above number for assistance
Main
Parameter Select Screen
Select Parameter For Calibration
Conductivity
Pressure
Bleed Screen
BLEED SETTINGS
BLEED SET POINT
1400
Bleed Test F1
Cond. Cal Screen
CONDUCTIVITY CAL
HI Cal
Value 1414
SAVE
Current 1400
Air Cal
SAVE
Clean Probe, Follow Instructions in Manual
Press. Select Screen
Select Pressure Sensor For Calibration
CHC Pump
Filter Pump
Filter Outlet
CHC Pump Cal Screen
CHC Press Calibration
HI Pressure Cal
Value 96
Current 93
Zero Cal
Clean Sensor, Follow Instructions In Manual
Filter Pump Cal Screen
Filter Pump Calibration
Value 56
Current 56
Filter Outlet Cal Screen
Filter Outlet Calibration
Value 57
Current 54

TROUBLESHOOTING

This section is supplied for reference only, if your system is a Rental, contact EcoWater technical service personnel before attempting any complex troubleshooting. This section only includes the most common types of failures. Some failures may not be listed here and require you to contact EcoWater's technical service personnel for aid in troubleshooting.

Gauge Problems- If the gauge is reading high or low turn off all power to the device the gauge is connected to and allow the pressure to stabilize. The gauge should return to 0 psi. If it does not, open the vent at the top of the gauge and allow it to return to 0 psi (this may take several minutes). If the pressure still remains above or below 0 psi, replace the gauge.

Low Pump (s) Pressures- Verify that the gauges are operating and return to 0 psi as the pump is stopped. Verify the strainer basket is clean. You will have to verify the sides of the basket are clean, and not just the bottom. If the pressure remains low, verify that the isolation valves around the pump as well as the towers are open. If the pressure remains low, verify that no blockage exists within the tubing to the gauge. If the pressure remains low, rebuild or replace the pump or motor.

High Pump Pressures- Verify that the gauges are operating and return to 0 psi as the pump is stopped. Verify the isolation valves at the unit as well as the towers are open. High pump pressures, if not caused by a defective gauge, are normally caused by an obstruction to flow. If all the valves are open, the obstruction will have to be located and removed.

Non-Active Pump- Verify that the Motor Controller is applying power to the pump. If the Motor Controller is not applying power, see Motor Controller Failure. If the power is available to the motor, verify all electrical connections at the motor. If no failures are noted, replace motor.

Motor Controller Failure- Verify all fuses are intact and pass the continuity test, replace any failed fuses. If fuses continue to fail, replace the pump motor. If fuses are complete, verify that the Thermal Overload is set to 1.25 times the maximum motor amperage. The Thermal Overload has a reset button, once changes are made, make sure to reset the Thermal Overload. If the Controller still will not function, replace the Controller.

O-Ring Leaks or Failure- Replace defective O-Ring, and lubricate with appropriate silicone lubricant. CHC will supply this lubricant if requested.

Plumbing Leaks or Failure- Contact the appropriate personnel to make corrections to plumbing.

Valve Leaks or Failure- Contact the appropriate EcoWater personnel to make corrections to plumbing.

Other Electrical Failures- Contact the appropriate EcoWater personnel to make corrections.

Actuator Failure- Most actuator failures are caused by the failure of the actuated valve. As the actuator is removed for servicing, make sure the valve is easily opened and closed. Some valves can become to difficult to move by the actuator and can cause actuator failure. Verify that the fuse or breaker controlling the timer circuit is still functional, If the fuse and/or breaker is still good, the failure could be related to the

actuator itself, timer, relay and/or the conductivity controller. Refer to EcoWater CHC personnel to aid in the identification of the failure and troubleshooting techniques for your specific application.

No Filter Backwash (BW Failure shown on Control Panel's screen)- When the Filter's Backwash has failed this indication will be shown, there are several possible causes:

Screen Plugged- If the filtration screen becomes plugged the outlet pressure of the filter will be below 20 psi after a Backwash. If you continue to manually initiate a back wash and the differential pressure never falls, then the screen may need to be removed and cleaned. Refer to Filtration Screen Cleaning.

Solenoid Failure- If the solenoid fails, the controller will try to initiate the Backwash cycle, but no Backwash will occur. To verify disconnect the tubing from the end of the rinse piston and initiate a back wash. Water should flow (strongly) from the tubing. If no water flows to the Rinse piston, then verify the solenoid is being energized, if it is the valve must be replaced or cleaned. Without water being directed to the Rinse piston, the Backwash will not be completed. This failure could be caused by debris clogging up the screen in front of the solenoid or a failure of the solenoid itself. If the solenoid has failed, it is recommended that the screen be cleaned.

DP Switch Failure- If the filter's back wash can be initiated with the Manual BW button but does not respond to the DP switch, then it is possible that the switch within the DP switch has failed. With a volt meter, verify that the switches within the DP switch are closed during operation (this requires the DP switch gauge to be indicating over 8 psi. If power is not applied to the skid, the pressure will be reduced and each DP switch should be open as tested with a conductivity meter.

Screen Cleaning Required Message- This message indicates that the filter has completed 8000 Backwashes and it is recommended at that point to remove the screen from the filter, clean it and inspect the screen and suction manifold for damage. To clear this message, Turn ON the power disconnect, and as the initial screen is indicated on the Control Station, press the F1 (Set UP) button. A password screen will appear, press the screen where the password is shown and a numerical keypad will appear. Enter 1000 and press the Enter/Return button, the screen will revert back to the Password screen and then press the F3 button to clear the memory. Press the Main button (F4) to return to the main screen. You will notice that all counters will be cleared with this action.

Control Panel Message of "Power OFF"- No action required, this indicates that the motor controller's HOA power switch is in the OFF position.

Control Panel Message of "Pressure LO"- This indication is shown when the pressures of the Filter or CHC have not reached the appropriate pressures. Verify that the strainer baskets are clean, and that no isolation valves are closed. Other problems may be associated with a pump failure or clog in suction piping. Contact EcoWater Service for further assistance.

Control Panel Message of "Power Failure"- This indication is shown when the motor starter has recognized a loss of a Supply Phase, or the motor as caused the failure of the thermal overload. Turn off the power to the motor starter by turning OFF the power disconnect. Open the motor controller and reset the Contactor's Reset knob. Close the motor starter and try to initiate the pump again. If the pump fails to start, contact the appropriate personnel to verify the power phases as well as monitor the motor's amperage. In many cases, problems with the power system due to weather may cause the thermal overload to fail, if resetting the overload works, please verify the pump motor's amperage, if it is within range, monitor the function of the system to see if the failure continues. Contact EcoWater Service for further assistance.

Control Panel Message of "Conductivity HI"- This indication is shown when the conductivity value is exceeding the upper alarm limits as set in the Set Up screens. This is normally an indication that the blow down or its piping is plugged or non-functional. It can also be an indication that the makeup water source has lost is supply pressure and make up is not being added to the system fast enough to keep up with the blow down rate. If the water supply system has failed, take appropriate actions with regard to the supply, and you may need to turn the Filter skid's power OFF while the tower's water level increases.

Control Panel Message of "Conductivity LO"- This indication is shown when the conductivity value is below the lower alarm limits as set in the Set Up screens. This is normally an indication that a problem with the blow down or filter back wash system has occurred. Please verify the operation of the blow down valves and filter back wash functions. This message could also be shown if low load conditions with the water system are occurring (as in winter) if the load to the system is too low, the conductivity of the water system may not cycle up to the appropriate COC levels. This message may continue until the load increases on the water system. Monitor the system routinely to verify that this condition is associated with the load.

Control Panel Message of "BW Solenoid Fail"- This indication is shown when the main Back Wash Solenoid has failed to open and back wash the filter. The PLC monitors the pressure and determines if a failure has occurred and will automatically initiate the use of the backup BW Solenoid . By replacing the failed component and inserting a passcode of 0000 into the password screen the alarm will be removed and the use of the main solenoid will be resumed. See Back Wash Failure for more information.

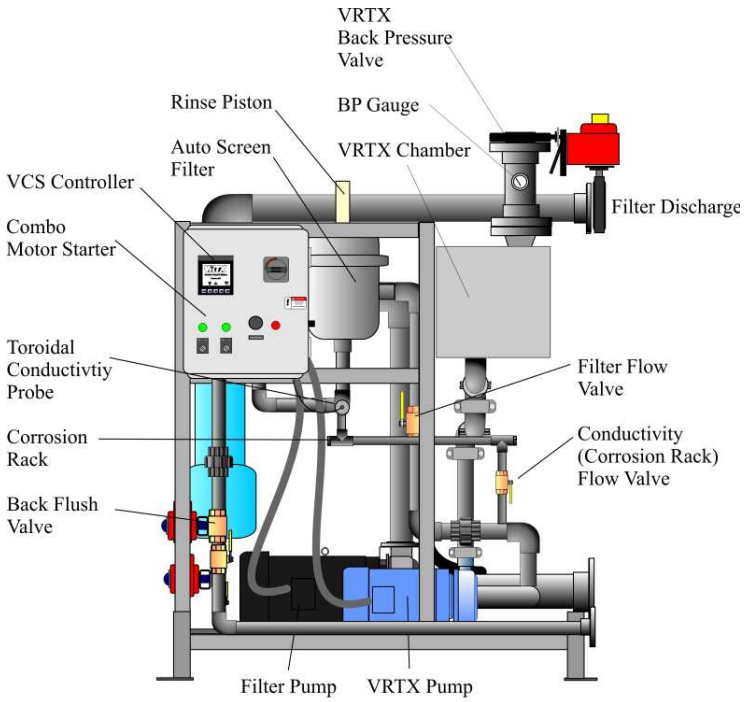
Control Panel Message of "Blow Down Fail"- This indication is shown when the PLC has determined that the blow down actuator has failed to open or close upon command. The front most actuated valve (closest to the Control Panel) is the primary valve. If this failure occurs the PLC will automatically use the secondary actuator as needed. If the Primary valve has failed in the Open position, then close the flow restriction valve downstream of the actuated valve until the repair has been made. Once the valve has been fixed and its function is verified by the PLC, the message will disappear and the use of the primary valve will continue.

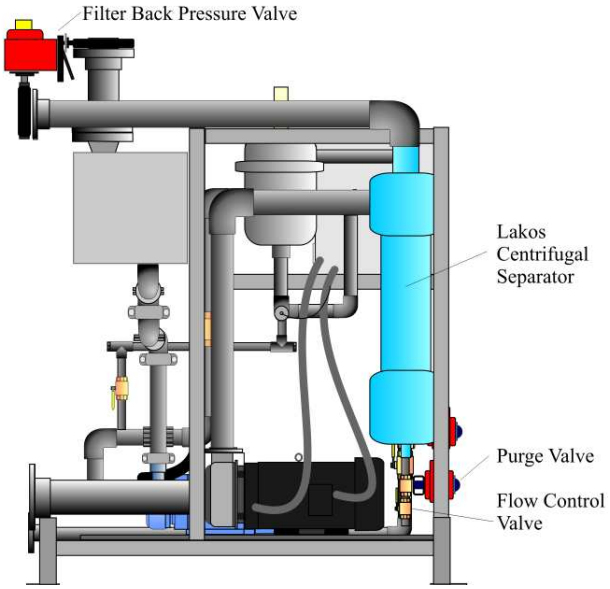
Algae growing in tower in sunlit areas- This is not a failure. The CHC system can only retard water-borne algaes, The use of a chemical algaecide to treat the algae is recommended. You can also recommend covering the affected areas with a sun screen to reduce the algae growth rate.

Scale on Fill- The CHC system is designed to make the scale forming molecules start to crystallize before they reach the condenser or other heated surfaces. This keeps the harder layered scale from forming. It is normal to see a cotton like build up on the fill of a tower when treated by the CHC system, however, it is formed in a manner that allows it to be easily removed with a light touch. Normal cleaning of the CHC treated towers is still required as specified by your tower manufacturer. However, when the CHC system includes an appropriately constructed filtration and sweeper nozzle system, the amount of debris removed during cleaning should be greatly diminished as compared to a chemically treated tower.

Equipment Views

F80/F300 Skid





PARTS

CHC Skid Parts

Gauge, Vacuum –	PN# 704041004-F
Gauge, 0-160GPM –	PN# 704041007-F
Mechanical Seal –	PN# 801629001
80 Pump –	PN# PU10080E001
Motor Contactor –	PN# Call EcoWater
Strainer Basket-	PN# 4” Hayward
Strainer O-ring	PN# 4” Hayward
O-ring Lubricant-	PN# 100051002
Misc. Hardware-	Call EcoWater

Filtration Skid Parts

Gauge, 0-60 PSI	PN# 704041001
Mechanical Seal –	PN# 801429001
300 Pump-	PN# PU030300E001
Motor Starter –	PN# Call EcoWater
Control Station PLC	PN# 700034004
Toroidal Conductivity Probe	PN# 100000085
Pressure Transducer	PN# 104040004
Actuated Valves (Valworks)	PN# Call EcoWater
Blow Down Actuator 1 ½”	PN# 305623002
¾” Isolation Ball Valve	PN# 303923001
Sample Port Valve	PN# 300023001
Conductivity Calibration Solut.	PN# 900049001
Misc. Hardware-	Call EcoWater

TECHNICAL ASSISTANCE

For technical assistance, contact the EcoWater CHC Field Service Department at:

1-210-910-6462

References

CYCLES OF CONCENTRATION

What are **Cycles of Concentration**? Cycles are not the flow cycles of water in the system. It is a comparison of the concentrations of dissolved salts in makeup water and basin water. Because of evaporation, H_2O left water to evaporate and leave the dissolved salts in cooling water. So the concentration of the dissolved salts in the cooling tower water will increase. Cycles of 2 means the concentration of certain species (like sodium or chlorides) in the cooling tower water is 2 times the concentration in the makeup water.

How do you calculate cycles? The easy, and most popular method is to use TDS (Total Dissolved Solids). Cycles are equal to the TDS (or conductivity) ratio of basin to makeup. This is based on the assumption that all dissolved constituents in makeup will still be in basin water. The evaporation is the only source for changes in concentration. This is true for systems with a successful chemical treatment. But for water treated by CHC, parts of the dissolved calcium and bicarbonate are transformed into calcium carbonate solids. TDS is only good for estimating the cycles, EcoWater CHC recommends the use of chloride concentrations to calculate the actual cycles.

If the makeup and blow down rates are known, cycles can also be calculated by the ratio of makeup volume to blow down volume. This method will give an average cycles over a certain time period, instead of a snap shot value when using TDS or chloride.

TDS vs. cycles: When we tell customers we are going to reduce blow down significantly, the customers may think there will be a huge bump up in cycles and TDS. Yes, cycles will go up, but not necessarily TDS. Let's look at this in detail:

When using chemical treatment, acids or scale inhibitors are used to prevent the precipitation of calcium carbonate, so all the dissolved solids from makeup will stay in the water. Therefore the TDS of the cooling water is linearly proportional to the makeup TDS and cycles:

*TDS (basin) = TDS (makeup) * cycles*

Actually, the TDS (basin) may be even higher, **because** of the addition of treatment chemicals. This is usually negligible; but for some water having very low TDS, such as water from the Pacific North West, the contribution could be noticeable.

When water is treated by CHC, reactions in the CHC chamber will force some dissolved Calcium and bicarbonate to form $CaCO_3$ colloids. These colloids are very small and are still suspended in water, but they are not dissolved anymore. They are in a solid state, instead of a dissolved state. All other species, such as chloride, sulfate and potassium will not be affected by CHC. Formed $CaCO_3$ may also contain a small percentage of Mg, but most of Mg will be in water. So the TDS (basin) will not linearly increase with cycles. The increase of TDS (basin) will be slower with cycles than in chemical treatment. Let's look at an example:

The is the makeup water analysis:

Calcium =100 ppm as $CaCO_3$
Magnesium =30 ppm as $CaCO_3$
Sodium =7 ppm as ion
Bicarbonate = 100 ppm as $CaCO_3$ (for most water, alkalinity = bicarbonate)
Chloride = 25 ppm as ion
Sulfate = 10 ppm as ion
The TDS of this water is 89 ppm

When using chemical treatment, at a cycles of 3, the water chemistry will be like this:

Calcium = 300 ppm as CaCO3
Magnesium = 90 ppm as CaCO3
Sodium = 21 ppm as ion
Bicarbonate =300 ppm as CaCO3
Chloride = 75 ppm as ion
Sulfate =30 ppm as ion

So everything is increased 3 times, including TDS: TDS = 267 ppm.

However, when one uses CHC treatment, some Calcium and bicarbonate are converted to $CaCO_3$ colloids, so at a cycles of 3, the water chemistry will be the same **except** Calcium will be ~ 150 ppm as $CaCO_3$ and bicarbonate will be ~ 150 ppm as $CaCO_3$. e.g., magnesium, sodium, chloride, sulfate increase 3 time, but calcium and bicarbonate increase less. This water has a TDS of 208 ppm. See the difference? TDS only increased to 2.3 times. So cycles measured from conductivity is 2.3 whereas the real cycles are 3.0. Substantially less water was blown down than what the conductivity based cycles indicate.

Basic Water Chemistry and Understanding the Water Analysis Results

The water analysis provided by EcoWater can be difficult to understand. However, by understanding the terms shown in that analysis, you can make sense of your water analysis.

Example of Water Analysis provided by EcoWater

Water Analysis Results for

VRTX 40 gpm unit started 12/27/05

Sample #	Sample Date	T (°C) (Field)	pH (Field)	pH (Lab)	Alkalinity ($mgCaCO_3/L$)	Hardness ($mgCaCO_3/L$) Total	Ca	Mg	Chloride (mg/L)	TDS (mg/L)	Conductivity (microseimens/cm)	Cycles of Concentration (Cl)	Bacteria CFUs/mL
make up	06/20/06	28.0	8.5	7.45	91	216	171	45	138	757	1136		
sump	06/20/06	27.5	9.3	8.32	110	631	385	246	415	2190	3285	3.0	

Laboratory Comments and Recommendations

A standard water analysis includes pH, alkalinity, total hardness, calcium hardness, magnesium hardness, chloride, TDS, conductivity, cycles of concentration and bacteria population. Other analyses, such as silica, zinc, copper, iron are also performed for some cases.

Terminology

pH: The pH is a measure of acidity or alkalinity of water. pH < 7 is acidic, pH > 7 is alkaline and pH of 7 is neutral. As pH increases, water becomes less corrosive but the scaling tendency of some insoluble salts, such as calcium carbonate and calcium phosphate, increases. Each time you descend a whole number (for example: from 7.0 to 6.0), the acidity of solution increases by a factor of 10. Thus, a pH of 6 is 1000 times more acidic than a pH of 9.

The pH Scale

Range	pH	H^+ Concentration	OH^- Concentration	Substance Examples
Acid	0	1	0.00000000000001	
	1	0.1	0.0000000000001	Battery acid
	2	0.01	0.000000000001	Lemon juice
	3	0.001	0.00000000001	Vinegar
	4	0.0001	0.0000000001	Orange juice
	5	0.00001	0.000000001	Coffee
	6	0.000001	0.00000001	Normal rain water
Neutral	7	0.0000001	0.0000001	Distilled water
Alkaline	8	0.00000001	0.000001	Milk
	9	0.000000001	0.00001	Salt brine
	10	0.0000000001	0.0001	Baking soda
	11	0.00000000001	0.001	Milk of magnesia
	12	0.000000000001	0.01	Ammonia
	13	0.0000000000001	0.1	Chlorine bleach
	14	0.0000000000001	1	Lye

Alkalinity (Alk.): Alkalinity is a measurement of the buffering capability of water with the addition of acid. With the addition a certain amount of acid, pH can lower dramatically for water with low alkalinity, but pH only decreases slightly when its alkalinity is high. The main contributors of alkalinity are carbonate ions, bicarbonate ions, hydroxide ions, and dissolved CO_2 present in water. For most of waters, bicarbonate (HCO_3^-) is the dominant contribution to alkalinity. Alkalinity affects both corrosion and scaling tendencies.

Calcium Hardness (Ca): Calcium is one of the principle elements making up the earth's crust. Calcium normally gets into water when rain water causes calcium carbonate to leach from limestone deposits in the soil. It is the major contribution to water hardness. Calcium aids in the formation of soap curds during cleaning and in some instances can form hard scale.

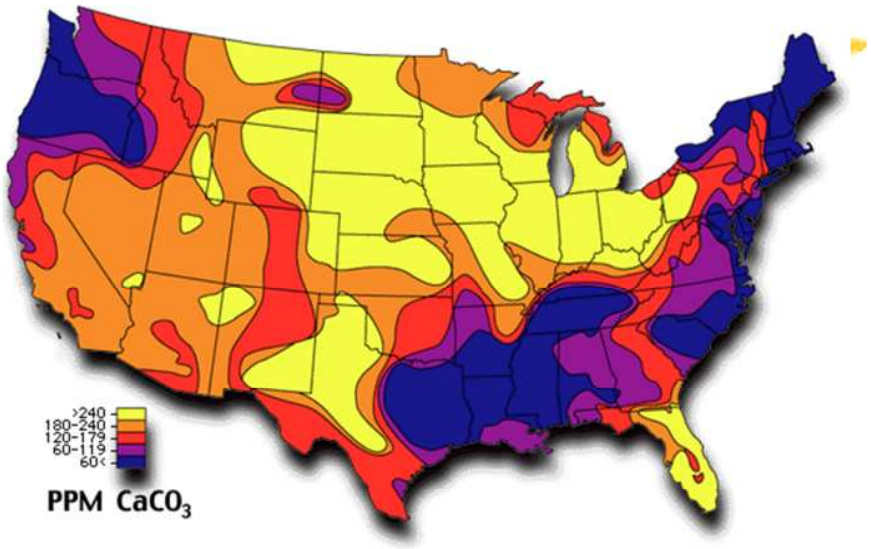
Magnesium hardness (Mg): Mg, like Ca, is leached from the soil by rainwater. It contributes to the total hardness but is generally present at much lower levels than Ca. Magnesium hardness is a calculated number based on measured total hardness and calcium hardness:

Magnesium hardness = Total hardness - Calcium hardness

Total hardness: This is the sum of Ca and Mg hardness. Fe (Iron), Mn (Manganese), Al (Aluminum) and other metals also contribute to the total hardness but these substances are usually present in such small quantities that they can be ignored. Hard waters are generally considered to be those waters that require considerable amounts of soap to produce a foam or lather, and that also produce scale in hot water pipes, heaters, boilers, and other units in which temperature of water is increased materially.

The hardness of water varies considerably from place to place. In general, surface waters are softer than ground waters. The hardness of water reflects the nature of the geological formations with which it has been in contact. The following illustration shows the general character of the water supplies in the United States. The softest waters are found in the New England, South Atlantic, and Pacific Northwest states. Iowa, Illinois, Indiana, Arizona, New Mexico, and the Great Plains states have the hardest waters.

Groundwater Hardness Map



Waters are commonly classified in terms of the degree of hardness. There are different standards, as listed in the following Table:

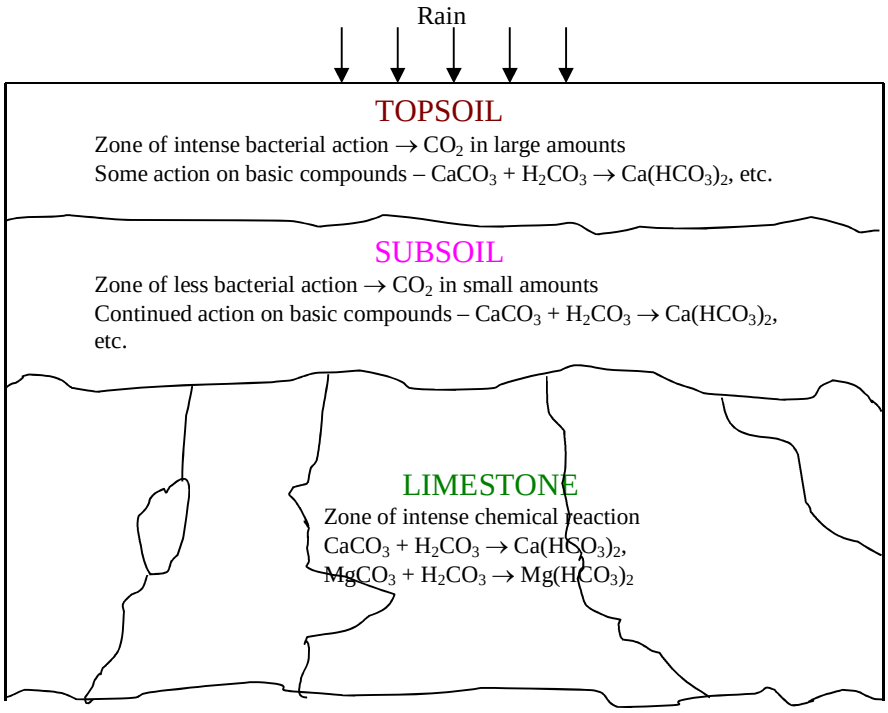
Table: Water hardness Classification

Developed by Water Quality Association

Term	ppm as $CaCO_3$
Soft	< 17.1
Slightly hard	17.1 – 60
Moderately hard	60 – 120
Hard	120 –180
Very hard	> 180

The hardness of water is derived largely from contact with the soil and rock formations. Rain water as it falls upon the earth is incapable of dissolving the tremendous amounts of solids found in many natural waters. The ability to dissolve is gained in the soil where carbon dioxide is released by bacterial action. The soil water becomes highly charged with CO_2, which, of course, exists in equilibrium with carbonic acid. Under the low pH conditions that develop, basic materials, particularly limestone formations, are dissolved. The Figure below shows where this originates and how it attacks carbonate minerals. Since limestone is not pure carbonate but includes impurities such as sulfates, chlorides, and silicates, these materials become exposed to the solvent action of water as the carbonates are dissolved, and they pass into solution too.

In general, hard waters originate in areas where the topsoil is thick and limestone formations are present. Soft waters originate in areas where the topsoil is thin and limestone formation is sparse or absent.



Chloride (Cl^-): Like Sodium (Na), most chloride salts are very soluble in water. They can cause corrosion at high levels. Chloride is used to calculated cycles of concentration because it is stable in cooling water systems.

Total Dissolved Solid (TDS): TDS is the total concentration of dissolved components, such as salts and sugar. Salts, like NaCl, dissociate into ions; while some organic matters, like sugar, do not break up into ions when dissolved in water. There are different approaches to determine TDS, but it is commonly estimated from conductivity.

Conductivity: Conductivity is defined as the ability of an aqueous solution to carry an electric current and can be easily measured by a conductivity meter. It is used to estimate Total Dissolved Solids (TDS).

Cooling water problems

Scale - Minerals such as calcium and magnesium are relatively insoluble in water and can form scale deposits when exposed to conditions commonly found in cooling water systems. A layer of scale as thin as 1/64 inch can reduce heat exchanger efficiency by 15%. Scale formation can be controlled by scale inhibitors such as threshold inhibition chemicals and scale conditioners. Chemical treatments include acids, polymers and polyphosphates which prevent scale formation by keeping the scale-forming minerals in solution to prevent deposits from forming.

Corrosion - Most metals used in cooling water systems are very susceptible to corrosion. Keeping surfaces clean is the most important aspect of preventing corrosion, since under-deposit corrosion can take place and result in serious damage. Corrosion can be uniformly distributed throughout the system or it can be localized, causing severe pitting and rapid equipment failure. There are various corrosion inhibitors used in chemical treatment.

Microbiological deposits - More cooling water treatment programs fail due to lack of microbiological control than any of the other two problems mentioned above. Scale, corrosion, and fouling often are symptoms of an unsuccessful program, but the root cause is inadequate microbiological control. Makeup water and wind can carry microorganisms into a cooling water system. Uncontrolled microbiological fouling can lead to problems at every point in the cooling water system. Corrosion occurs under the bacterial slime layer. Inorganic foulants are trapped in this slime layer, compounding the problem. Microbiological chemicals often used include chlorine, chlorine alternatives, and appropriate biocides

Rarely do corrosion, scale and fouling occur independently of one another. Usually two or all three develop together to cause loss of heat transfer and premature metal loss. For example, microbial fouling can cause scaling and corrosion to occur; corrosion can contribute to iron fouling and encourage more corrosion to occur. To break this cycle, proper problem identification is important for selecting and applying a practical, economical solution to any deposit problem.

Indicators for concern

1. Cycles of concentration are too high or too low: For each installation, there is a recommended cycles of concentration. This is achieved by properly setting the blow down conductivity point. If cycles are too high, water quality deteriorates and may exceed the treatment capability, causing performance problems. If cycles are too low, there will be too much blow down, thus reduced water saving. Also, cooling water may not get enough CHC treatment at low cycles.

   Examples of causes for changes in cycles of concentration: a). Conductivity meter is out of calibration and not working properly. The Conductivity meter should be cleaned and calibrated for each visit. b). Changes in evaporation rate due to system load or weather. c). Changes in makeup water chemistry.

2. Changes in makeup water chemistry: This is usually caused by changes in the source of makeup water. Well water (ground water) is generally quite stable for each well but could change significantly from other wells nearby. Surface water changes with seasons. Some cities use a combination of different water sources for municipal water.

3. Changes in hardness and alkalinity in makeup water will changes the scaling tendency. Changes in chloride also changes water's corrosivity. Changes in conductivity (TDS) directly affect cycles of concentration. Therefore, conductivity set-point may need to be adjusted.

4. Relative calcium concentrations of sump water and makeup: When makeup water chemistry and cycles of concentration are stable, changes in sump water calcium hardness may indicate changes in the performance of the CHC system.

5. Significant increase in bacteria population: Often this is caused by contamination. Follow-up sample is recommended. Survey the system and find out the cause.

INSTALLATION CERTIFICATE

The undersigned hereby certifies that all items described below, leased/rented to the undersigned pursuant to the lease/rental agreement between the Lessor/Seller and the undersigned (the "Equipment"), have been delivered, and that this Equipment has been accepted by the undersigned and is now operational.

DESCRIPTION

Unit Serial #: _____ **Chamber Serial #:** _____

Equipment Located at _____

In the City of _____ **County of** _____ **State of** _____

Company Name _____

INSTALLATION INFORMATION

SUBCONTRACTOR INFORMATION

Plumbing/Installation Contractor: _____

Telephone #: _____ **Date:** _____

Electrical Contractor (if applicable): _____

Telephone #: _____ **Date:** _____

OPERATIONAL INFORMATION

Date System Operational: _____ **Customer Representative Signature**

_____

(CHC Technician/Representative Signature)

_____

Water Sampling - Field Instructions

When collecting samples, you must follow these steps:

- Water samples should be collected from the following locations if accessible:
  Make-up water, basin, and any other points of interest.

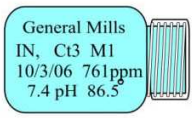
- Normally one make-up sample should be taken for each site, each tower being treated should have its own basin sample taken.

- Make sure the collected sample represents real water chemistry. When you collect samples from non-flowing lines, open the valve and let the water flow for a few minutes before you fill the bottle.

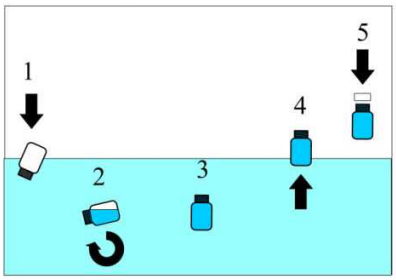
- Always rinse sample bottles, if it is a new bottle, two rinses will be fine. However, if it is a used bottle, three or more rinses are recommended.

- Sample bottles should be completely filled to the top (no air space left), tightly seal the lid and make sure the bottle is marked correctly.

- A correctly marked bottle will include the customer's name, state, sampling date, location, pH, TDS and temperature.



- If sampling a basin, you will want to remove the lid, turn the bottle upside down and then emerge the bottle at least two inches below the water level. Then turn the bottle over, allowing it to fill completely, and then remove the bottle and place and tighten the lid.



- The collected samples should be shipped in the provided padded envelope back to EcoWater CHC. Attn: Chemistry Lab, 5850 Corridor Parkway, Schertz, TX 78154. If this sample is for bacteria testing, please follow the proper guidelines for submitting, which can be found on Bacterial Water Sampling-Field Instructions.

- If sample bottles or padded envelopes are needed, contact CHC Customer Service with quantity needed.

Dip Slide Testing - Field Instructions

When collecting samples, you **must** follow these steps:

You will need One Dip Slide per tower being treated by EcoWater CHC.

Open Dip Slide and remove the Test Strip (dip) from the bottle. .

Submerge the Test Strip in the water from the tower for three seconds being careful not to submerge in high turbulence stream, this could damage the test strip.

Remove the Test Strip from the water and sling off any excess water by waving the strip from side to side.

DO NOT ALLOW TEST STRIP TO TOUCH ANYTHING AT THIS POINT!!!!

Place Test Strip back into the supplied bottle and tighten lid.

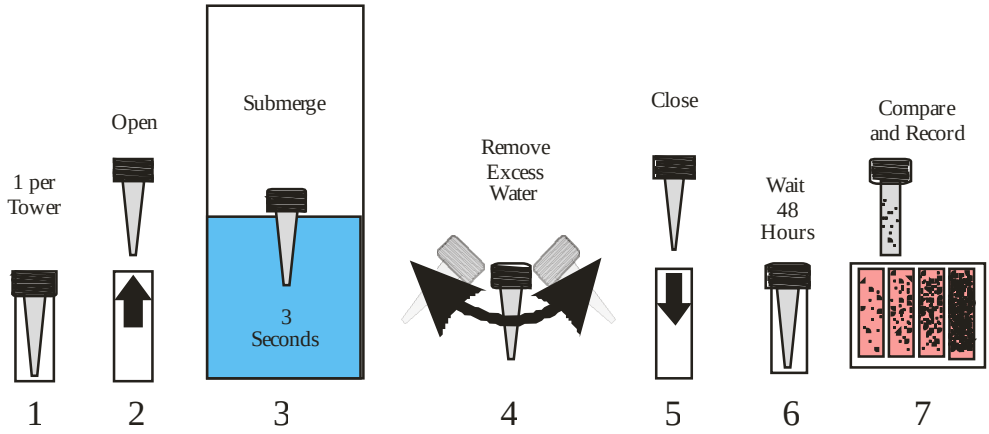
Place the test in a location out of direct sunlight for a period of 48 hours. This location must have a stable temperature in the appropriate range (77-95 degrees F).

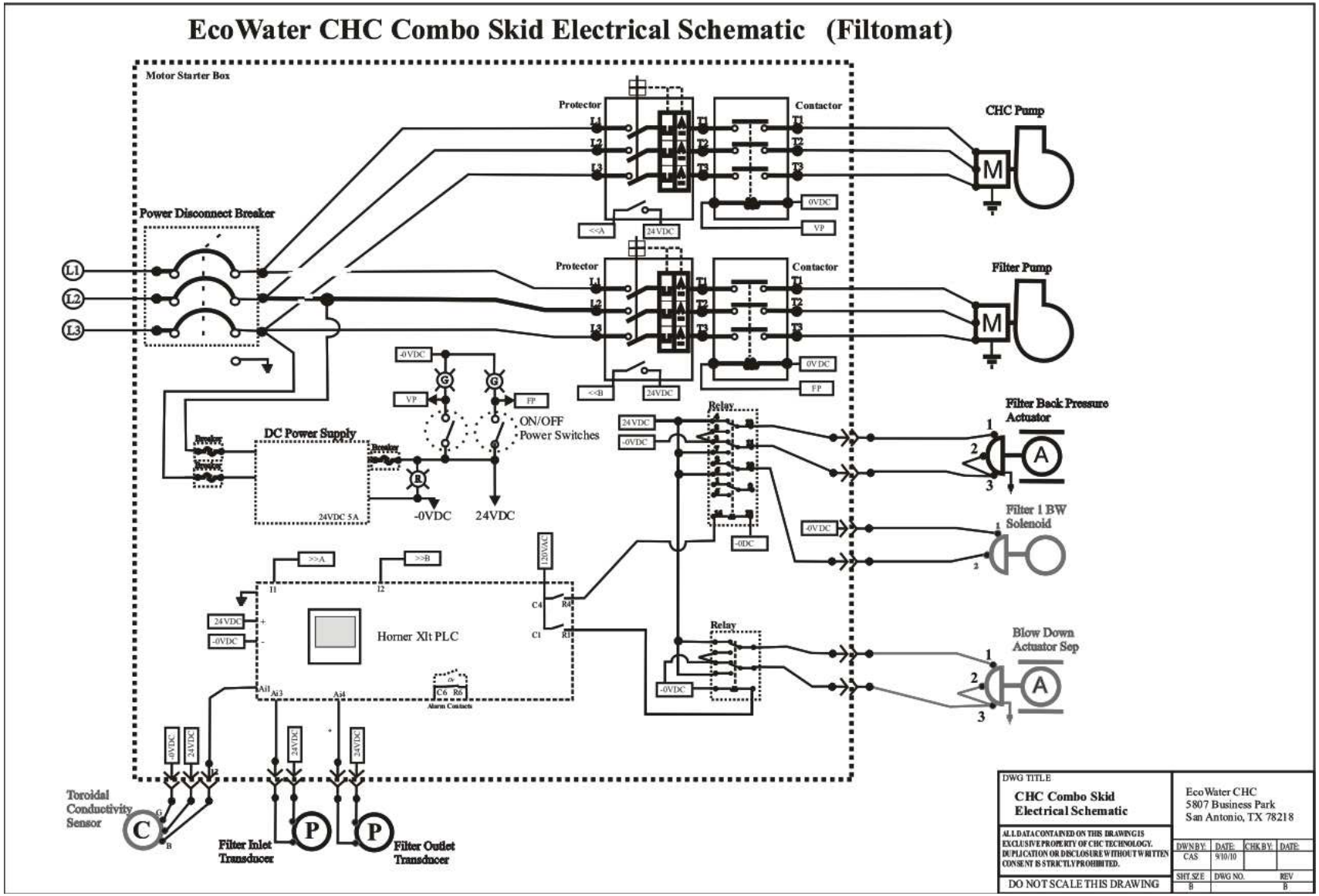
After 48 hours, compare both sides of the Test Strip to the Results comparison page supplied in the Dip Slide box.

Record the test results on the Customer Service Report and Send the report to EcoWater CHC.

Dispose of the dip Slide.

Order More Slides as required for each month.




EcoWater CHC Combo Skid Electrical Schematic (Filtomat)
Motor Starter Box
Power Disconnect Breaker
L1
L2
L3
Protector
Contactor
CHC Pump
Filter Pump
0VDC
VP
24VDC
<<A
<<B
FP
DC Power Supply
24VDC 5A
-0VDC
24VDC
ON/OFF
Power Switches
Relay
Filter Back Pressure
Actuator
Filter 1 BW
Solenoid
Blow Down
Actuator Sep
Horner Xlt PLC
>>A
>>B
120VAC
Alarm Contacts
Toroidal
Conductivity
Sensor
Filter Inlet
Transducer
Filter Outlet
Transducer
DWG TITLE
CHC Combo Skid
Electrical Schematic
EcoWater CHC
5807 Business Park
San Antonio, TX 78218
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DATE:
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REV: B