Operation Manual

Recirculation system for holding of live blue mussel

Mads Dorenfeldt Jenssen
Alex Keay
Henrik Grundvig
Gyda Christophersen
Sara Barrento
Ingrid Lupatsch
INDEX

- System Layout 3
- PLC layout 4
- Starting System 5
- Adjusting the system 7
- Adjusting the protein skimmer 8
- Daily routines 11
- Weekly routines 12
- Shutting down the system and between cycling routines 13
- Appendix

MusselsAlive | Development of best practice and new technology for grading, handling, transportation, conditioning and storage of mussels for SMEs in the European mussel industry
Figure 1 Main components of the recirculation system

**Recirculation system, main parts**

1. Pump 1
2. Pump 2
3. Heater/Cooler
4. Protein Skimmer
5. Skimmer pump
6. Outlet from skimmer
7. UV
8. Inlet valves holding tanks
9. Inlet pipes holding tanks
10. Outlets holding tanks
11. Sump 2
12. Bag filter (particle filter)
13. Sump 1
14. Ballcock valve
15. Makeup water
16. Overflow, Sump 1&2
17. Holding tanks

**Flow direction**

New water enters the system through the makeup water Ballcock valve (15) into Sump 1 (13), cleaned recirculated water also enters Sump 1 from the Protein skimmer (4). Water is then pumped from Sump 1 through the Heater/Cooler (3), then through the UV (7) before entering the Holding tanks (17). After passing through the mussel holding tanks the water gravitates into the Bag filter (12) for the first cleaning step, in Sump 2 (11). From Sump 2, the water is pumped into the Protein skimmer for the second cleaning step, where waste is removed from the system, in the form of foam, through the Outlet from the protein skimmer (6). The cleaned water then enters Sump 1 again, completing the cycle.
Figure 2 Showing the PLC layout for the holding system.

1. **PU01** Pump 1
2. **HEAT PUMP** Heater/Cooler
3. **PT01** Pressure sensor main supply line
4. **UV FILTER**
5. **T-101 – T104** Mussel holding tanks 1 to 4
6. **OG1-OG4** Oxygen sensors in outlets from mussel holding tanks 1 to 4
7. **PH1 & PH3** PH sensors in outlets from mussel holding tanks 1 & 3
8. **SUMP2**
9. **TTO2** Temperature sensor Sump2
10. **PU02** Pump 2
11. **SKIMMER** Protein skimmer
12. **PU03** Skimmer sump
13. **SUMP1**
14. **OG05** Oxygen sensor sump 1
15. **TT01** Temperature sensor sump 2
16. **Login/Logout**
17. **LS101** Level switch sump 2, turns pump 2 off if low level in sump 2
18. **LS104** Level switch sump 1, turns pump 1 off if low level in sump 1
**STARTING THE SYSTEM**

1. Start filling up Sumps 1& 2 with new clean water from the makeup water line.
2. Switch on the PLC system by turning the switch on the right hand side of the PLC in the ON position.
3. Press the logon button as indicated in figure 2 and enter the appropriate logon code (444).
4. When the sumps are full make sure the pumps are flooded with water. If they are not slowly unscrew the lid at the top of each pump (Picture 1) until you see the water level is close to the top of the pump.

---

> Figure 3 Showing the active tabs on the PLC screen for Pump 1&2, Heater/ Cooler, UV and Protein skimmer.

> Figure 4 Picture showing the lid at the top of the pump.
5. When the first tank containing mussels is placed in the system open the valve corresponding to that tank, make sure the outlet is firmly connected to the tank (pic 2). At this point you need to make sure that the correct valves for the main line are open. The open position is illustrated in in picture 2. When a valve is open it is inline with the direction of the pipe, as indicated by the black arrow in picture 2. Subsequently, when closed, the valve will be in the position indicated by the red arrow in picture 2, bisecting the direction of the pipe. Following the flow direction in the system, start by opening the valve in front of and after pump 1. Then make sure the valves on the pipe entering and exiting the Heater/Cooler are fully open, then do the same for the UV. Then move to pump 2, and follow the same steps as for pump 1. Follow the pipe from pump 2 to the protein skimmer and make sure this is fully opened, as seen in picture 3. Also make sure that the valve on the outlet pipe from the protein skimmer is fully opened, more on valves in relation to the protein skimmer under point 15, Adjusting the system. When the above steps are completed you can start the system.

6. First you start the 2 circulation pumps (Pump 1 and 2) PU01 & PU02, this is done by pressing the icon for PU01 on the PLC screen (Figure 3). You will get up a new menu, Press Auto/Man and then A:01. This will start first P01 and then PO2, these two pumps are programmed to run in sync, where the speed of pump 2 is controlled by the speed of pump 1. Pump 1 is in turn controlled by the pressure sensor PT01 Fig 2. We will come back to the details in this under Running the system.

7. Then we start the skimmer pump, again press the icon for the skimmer pump PU03 (Fig 2), then in the popup menu, press Auto/Man and then M01, this will start the skimmer pump. We will address the issue of adjusting the protein skimmer separately.

8. Next you will want to start the UV, press the UV icon on the PLC screen, then in the popup menu, press Auto/Man and then M01, this will start the UV.

9. Last you start the Heater/Cooler by pressing the HEAT PUMP icon on the PLC screen, and then Auto/Man and then M01 to start it. The temperature of this unit has to be set manually for this system, how to operate the Heater/Cooler can be seen in detail in Appendix 1.
The system should now be running, circulating water through the recirculation system and one of the mussel holding tanks. When that holding tank is full of water, water flows from its outlet into sump 2, and both of the sumps are full of water, the system has enough water to run 1 tank. To completely fill the system you need to follow the following steps.

10. Add the remaining 3 mussel holding tanks to the system, making sure that the outlets are secured to the tanks and to the bag filter in sump 2. Make sure the inlet pipes are properly placed on top of the mussels in each of the holding tanks.

11. Start by opening the inlet valve for the next mussel tank, and the valve for new (makeup water) and continue running the system until this second mussel tank is full of water, do not open additional inlet valves until the second tank is full of water.

12. Repeat this process, opening one valve and filling one mussel tank at a time until all four mussel holding tanks and the two sumps are full of water. When this is done stop “free flow” of the makeup water and put it back to regulation by the ballcock valve. The system is now fully topped up.

**ADJUSTING THE SYSTEM**

You have now successfully started the system, and are circulating water through the system, what remains now is adjusting the system to acquire the desired total flow, individual tank flows, and achieving optimal cleaning by the protein skimmer.

Adjusting the system to deliver the desired total flow. This is done by adjusting the pressure that P01 should deliver. Selecting the working pressure for P01 is done by pressing the icon for P01, and then insert the desired pressure. It’s recommended to have the valves to the individual mussel tanks fully opened at this stage, and to start with a low pressure, and gradually increase it until you reach the desired total flow in the system. The total flow in the system is monitored by a flow meter located next to the pressure sensor (Picture 4).

*Figure 7 Flow meter showing the total flow for the system*
When you have reached the desired total flow of the system it's time to adjust the flows for the individual mussel holding tanks. This is done by adjusting the inlet valves to each of the tanks, while at the same time keeping an eye at the flow meter for that tank, as seen in picture 5. Acquiring the correct flow for each tank may take a bit of time, as adjusting one tank will influence the others, however as we know the total flow in the system it is fairly easy to get the flows right.

**Figure 8** Flow meter and inlet valve for one holding tank.

## Adjusting the Protein Skimmer

In order to adjust the Protein skimmer correctly the first thing that needs to be done is to balance the water level inside the skimmer. The water level inside the skimmer should be somewhere in the upper 3/4 of the transparent column at the top of the skimmer, indicated by the red line in the picture below (Figure 6).

The grey cylinder with the transparent top is the protein skimmer.

1. This is the inlet pipe to the skimmer. Pump 2 moving dirty water from Sump 2 into the skimmer.
2. This is the outlet pipe from the skimmer, moving the cleaned water into Delivery Sump.

**Figure 9** Picture showing the protein skimmer, main inlet and outlet. The water level inside the skimmer is shown by the red line.
To adjust the water level inside the skimmer start by slowly closing the outlet valve (2 in the picture below) of the skimmer, this will make the water level inside the skimmer rise. It can be difficult to see where the water ends and the foam starts. The water fraction is where there are tiny micro bubbles, and the foam fraction will contain larger bubbles. It will also help to keep an eye on the consistency of the foam leaving the top of the skimmer. If this seems to have a wet consistency you are removing too much water and should lower the water level in the skimmer.

To adjust the water level inside the skimmer start by slowly closing the outlet valve (1 in Figure 7) of the skimmer, this will make the water level inside the skimmer rise.

**Figure 10** Outlet valve, controlling water level in the skimmer

It can be difficult to see where the water ends and the foam starts. The water fraction is where there are tiny micro bubbles, and the foam fraction will contain larger bubbles. It will also help to keep an eye on the consistency of the foam leaving the top of the skimmer. If this seems to have a wet consistency you are removing too much water and should lower the water level in the skimmer. When the water level is balanced and stable it is time to start adjusting the air flow into the skimmer. Air is forced into the system by the skimmer pump (1), this pump creates a huge amount of micro bubbles that are then forced into the bottom of the protein skimmer column.

**Figure 11** Diagram showing the valves controlling air into the skimmer, and the skimmer pump (green) pumping air into the bottom of the skimmer.

All four valves (4) indicated in Figure 9 should all be open, this will maximize the air flow into the venturi, and air bubbles pumped into the skimmer. The blue valve (2) will manipulate the characteristics of the foam produced by the micro bubbles. The micro bubbles created this way will give the water in the transparent column a milky appearance, as seen in Figure 10.

**Figure 12** Diagram showing the valve controlling water for the wash down system.
Lastly, removing the foam from the skimmer.

In order to remove the foam that accumulates at the top of the protein skimmer there is mounted a wash down kit in the top lid of the skimmer (Picture 10). It is strongly recommended to use fresh water for washing down the foam, as using salt water can create even more foam, making it difficult to remove from the protein skimmer. The water enters through 4 spray nozzles mounted in the top lid. The amount of water used for removing foam can be controlled by the blue valve as indicated in picture 11. It can also be controlled by connecting the “wash down water” to a timer controlled automatic valve. The system should now be correctly adjusted and fully operational.
1. Look at the mussels in each tank, and make sure the water level is correct, the inlet hose is free of mussels, and that the outlet is securely fitted.

2. Inspect the bag filters in sump 2, make sure that they are not clogged up with waste from the mussels.

3. Check the O₂ levels in each of the mussel tanks, should be >80% saturation. These probes should be regularly calibrated and maintained, see the manufacturers guidelines for details.

4. Check that the temperature levels are within required set point range.

5. Check total flow of the system, if this is within 5% of your set point OK. If the flow is more than 5% below set point there may be a clogging in issue in the pump filters and/or clogging of the inlet pipes in the holding tanks.

6. Check amount of new water that has entered the system every day, and keep a log of this. If there is a sudden increase in new water this means that there is either a leak in the system, or that you are loosing water through a sudden increase in foam production. To find leaks follow the flow of the water through the system, also checking the outlets from each tank, making sure they are securely fitted (point 1), make sure the inlet pipes are in place inside the tanks (point1). If the reason for water loss is due to a sudden increase in foam production it is likely that there is a problem with the mussels and may result in an increased mortality in one or more of the mussel tanks.

7. Visually inspect the quality of the water in Sump 1, if there is a collection of foam in this sump it may be necessary to readjust the protein skimmer.

8. Visually inspect the filters in pumps 1&2 for particle clogging; clean or replace as necessary.]

9. Visually inspect the UV to make sure all the lights are on, as indicated in Figure 11.

Figure 14 Picture showing the UV unit, light at the blue ends if UV lights are functioning
1. Bag filters are to be replaced with clean filters, and the removed filters are to be cleaned.
2. All holding tanks are to be flushed, this is done by removing the inner standpipe in each outlet. Flush one holding tank at a time to avoid Sump 2 from overflowing.
3. Clean the walls and bottom of each sump using a long handled brush/broom, waste cleaned this way will be removed from the system, either by the skimmer or the bag filters.
4. Protein skimmer, open the valve for the wash down water to maximum for 10 minutes to remove particles from the inner wall of the foam chamber.
SHUTTING DOWN THE SYSTEM & BETWEEN CYCLE ROUTINES

- When shutting down the system, first turn off Pump 1, this will also automatically turn off pump 2. Then turn off the UV, skimmer and heater/chiller. This is done the same way as when turning them on via the PLC touch screen.
- When that is done, remove the outlet from each of the holding tanks, letting them drain completely.
- When the mussel holding tanks are disconnected from the system add one clean tank back to the system, and start it up again, bar the heater/chiller, and let it run with clean water for 1 hour. This will remove most of the waste products from the system that are not easily accessible, such as the inside of UV, Skimmer and Heater/Cooler.
- When the system has run with clean water for 1 hour, stop it again.
- When the system is stopped drain the 2 sumps, this is done by opening a valve at the bottom of the sumps. The 2 sumps should then be cleaned.
- Then drain the UV, this is done by opening the 2 valves located at the bottom of the UV as indicated by the arrow in picture 9.
- The UV lamps should be replaced every 4000 hrs (approx. 6 months). Quartz glass sleeves should be cleaned at during lamp replacement. See manufacturer’s instructions for full details.
- Take out and clean the filters of the 2 pumps, this is done by unscrewing the lid on each of the pumps and removing the filter by hand. Reinsert the filters when clean.
- To clean the protein skimmer; disconnect the pipework that connects to the top of the skimmer, unscrew the screws that hold the upper transparent foam collection cup in place and remove this upper cup. The cup can now be cleaned and a brush can be used to clean the inside of the skimmer.
- The inlets to the mussel holding units should be taken off, cleaned and put back in place.
- The outlets should be disassembled, cleaned and reassembled, and made ready for use.
- The bag filters should be removed from the filter housing and cleaned, and likewise with the filter housing. The filter housing should be put back into Sump 2, and fitted with clean bag filters.

The system is now ready for the next batch of mussels.
Appendix
Use and Care Guide

Heat & Cool

Heat Pump Swimming Pool Heater

www.waterco.ca
# Table of Contents

**A Note to You** ................................................................. 3  
Heat&Cool ................................................................. 3  

**General Safety Instructions** ........................................ 4  

**Installation Instructions** .............................................. 5  
Location of Heat&Cool .................................................. 5  

**Operation of Your Pool Heater** ..................................... 6-10  
  Operation of Multifunction Electronic Control Panel ............ 6  
  To start-up the unit ................................................... 6  
  To stop the unit ....................................................... 6  
  To raise or lower desired water temperature ..................... 6  
  Defrost cycle .......................................................... 7  
  To select Pool or Spa mode ....................................... 7  
  Automatic Pool Spa Mode and Remote ............................ 7  
  Heating & Cooling mode ......................................... 8  
  Initial Heating ....................................................... 9  
  Heater runing time ............................................... 9  
  Pool Solar Blanket ............................................... 9  
  Winterizing ........................................................... 9  
  Service Analyser Codes ....................................... 10  

**Troubleshooting** .......................................................... 11  

---  

Printed in Canada
A heat pump pool heater is a highly efficient, cost effective method of pool heating. Heat-Cool units have a unique reversing valve that allows the heat pump pool heater to cool the pool water during the hot summer months. Intelligent operation and care will result in many years of enjoyment and pleasure. Please note that this handbook is a complement to the general user handbook, therefore this does not replace it.

**Heat & Cool**

Our Waterco Heat/Cool units are a range of units specifically developed for heating and cooling pools where ambient temperatures may fluctuate between 10°C and 55°C. Not to be confused with converted condensing units or modified heat pumps originally designed for a different purpose, every aspect of Waterco heat/cool units is designed to give optimum performance and reliability even in the toughest climates.

Available as heat/cool or cooling-only and in sizes to meet even the biggest pool needs, the heat/cool units feature:

✓ A refrigeration circuit designed from first principles to reliably, efficiently operate in ambient temperatures from 10°C to 55°C
✓ Automatic thermostatically controlled changeover from heat to cool and visa versa
✓ Titanium heat exchanger
✓ Comprehensive protection circuit with visual indication of machine status
General Safety Instructions

⚠️ WARNING

To ensure your safety and the adequate functioning of your heat pump, **all electrical work should be performed by a fully qualified and licensed electrician in accordance with local electrical codes.**

An adequate circuit breaker and copper wiring must be used. Refer to the electrical installation diagram found on the inside of the access panel. It may be necessary to install a ground circuit breaker.

---

⚠️ IMPORTANT

**DO NOT STOP WATER FLOW TO THE HEATER FOR MORE THAN 8 HOURS WITHOUT DRAINING IT.**

---

⚠️ WARNING

DEFROSTING IN LOW AMBIENT AIR TEMPERATURE CAN PROVIDE THE FORMATION OF ICE AROUND THE HEAT PUMP.

---

⚠️ VITAL

MAKE SURE THE INSTALLATION IS DONE ACCORDING TO THE INSTRUCTIONS OF THIS MANUAL. SEE “INSTALLATION” SECTION.

MAKE SURE YOUR HEATER WAS PROPERLY GROUNDED AND BONDED. SEE “BONDING” AND “BONDING DIAGRAM” SECTIONS IN THE GENERAL OWNER MANUAL.

---

⚠️ WARNING

THE UNIT MUST BE DISCONNECTED BEFORE OPENING THE ACCESS PANEL.

---

⚠️ WARNING

The power cable ground must be connected to the electrical panel and to the ground lug of the heat pump. An improper installation may be a potential cause of fire, electrical shock or injury.
Installation Instructions

Location of the Electroheat Heat&Cool
The location of the pool heater is very important in keeping installation costs to a minimum, while providing for maximum efficiency of operation as well as allowing adequate service and maintenance access.

**IMPORTANT**
Mount the unit on a sturdy base, preferably a concrete slab or blocks which are elevated from the ground. For the concrete slab, it is necessary to support the drainage of water by establishing a gravel tank of 8 inches in width by 5 inches in depth.

The base should be completely isolated from the building foundation or wall to prevent the possibility of sound or vibration transmission into the building. The size of the base should not be less than the base of the pool heater.

**Your Heat Pump will accumulate condensed water (approx. 1 to 1.5 Gallons or 4 to 6 Litres per hour), therefore causing water to drain out of the unit base.**

**Air is pulled through the evaporator coil and discharged through the top grill. Clearance should be allowed in front and around the unit for unrestricted air discharge and service access. See Figure 1.**

**Top Discharge Models**

![Figure 1](Image)

24” to 36” (60 to 91 cm) min.

5’ (1.5 m) min.

24” to 36” (60 to 91 cm) min.

24” to 36” (60 to 91 cm) min.

24” (60 cm) min.
Operation of Multi-Function Electronic Control Panel
The display of the control panel is factory set to show pool water temperature in degrees FAHRENHEITS. See “To select temperature in °C or °F” section in the general user handbook.

To start-up the unit
When the unit is turned “ON” or after a power shut down, the panel lights up to indicate “OFF” or the temperature of the pool water circulating inside the heater. Program the desired pool water temperature.

Once programmed, the fan starts and the compressor will start after a 3 to 5 minute delay.

NOTE: The fan motor and the compressor may start at the same time when the unit has been stopped for a long period.

To stop the unit
The unit can be stopped by switching off the electrical power supply or by programming the desired water temperature below actual pool water temperature. The unit will be "OFF" if the temperature set point is below 60°F (15°C). The display indicates "OFF".

To raise or lower desired water temperature (Pool or Spa mode)
Push the SET key until you see POL or SPA. Press the UP or DOWN arrow only once and the programmed temperature is displayed. Press the UP or DOWN arrow to increase or decrease the temperature setting by one degree at a time. Once the control has been programmed to the desired pool water temperature, the programmed temperature will be displayed for approximately 5 seconds, then the digital display will return to the actual pool water temperature.
Defrost Cycle

The interval time between the defrost cycle depends on the temperature of the ambient air and of the humidity. During the defrost cycle, the ventilator stops functioning and the hot refrigerant is injected into the evaporator in order to melt the frost. The defrost cycle last from 3 to 4 minutes.

If the heat pump carries out 5 consecutive short heating cycles (i.e. defrost cycles at every 15 minutes or less), the heat pump is then put into protection mode. These short cycles mean that the conditions of the temperature and humidity do not make it possible to heat the swimming pool. The heat pump is put into protection mode in order to preserve the consumer of a non-effective use of electrical energy. In protection mode, the digital will display **FS4**.

**FS4:** During the protection mode, the ventilator turns ON for 30 minutes in order to cool the evaporator. The heat pump restarts automatically when the external temperature is of $42^\circ$F. **Press any key to restart the unit.**

To select Pool or Spa mode

The electronic board has the capability of memorizing two different programmed temperature settings as follows:

- **For a pool maximum 95$^\circ$ F (35$^\circ$C)**
- **For a spa maximum 104$^\circ$ F (40$^\circ$C)**

To have access to either one of these programs, press the SET key until you see P-S and, then pressing the UP or DOWN key; you can switch to POL or SPA. Once the heating mode is programmed, it will be displayed for approximately 5 seconds, then the digital display will return to the actual pool water temperature. The light on the right side of the display indicates the chosen heating mode (See touch pad description on previous page).

Automatic Pool or Spa mode and Remote control

The digital control has the possibility to switch from Pool to Spa mode automatically using an external water pressure switch connected to the Spa water line or a remote control. See the general user handbook for installation instruction. For remote control operation, you will need to set the Spa temperature to maximum (104°F) and the Pool setting to “OFF” so that when the remote control calls for heat it will activate the Spa mode and start the heater.

Contact us for more details on this feature.
Getting to know your Pool Heater

Heat & Cool mode (HEATING & COOLING)

The heat pump Heat & Cool can be programmed in three modes: heating HEA, cooling COL or in Automatic mode Aut.

To access the operating modes press the SET key until you see HC and by pressing the up or down you can switch to HEA, COL or Aut. When the operation mode is selected, it will be displayed for about 5 seconds, then the digital display will return to the actual temperature of the pool water.

In Automatic mode, the change in water temperature must be 2.5° F before the cooling cycle is activated. So if the desire temperature is 80°F, the heat pump will start at 82.5°F in order to perform the cooling of the water.

Heating and cooling of the water depend on the operating mode (HC) and Pool and Spa setting (PS). Adjusting these parameters determines the availability of functions of the heat pump Heat & Cool.

<table>
<thead>
<tr>
<th>P-S</th>
<th>H-C</th>
<th>HEATING AVAILABLE</th>
<th>COOLING AVAILABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>POL - (pool)</td>
<td>HEA (heating)</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>POL - (pool)</td>
<td>COL (cooling)</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>POL - (pool)</td>
<td>Aut (automatic)</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>SPA</td>
<td>HEA (heating)</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>SPA</td>
<td>COL (cooling)</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>SPA</td>
<td>Aut (automatic)</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>
Operation of Your Pool Heater

Initial heating
The speed of heating is dependent upon five basic factors:
1. Size of the pool
2. How many degrees the water is to be heated.
3. Ambient air temperature - the warmer the air, the less time required to heat.
4. Use of a solar blanket (see the following section)
5. The size of the heater

To achieve initial heating your pool heater and pool pump may work up to 24 hours per day until desired temperature is achieved. The initial heating time may vary depending upon the above five factors. After initial heating, operating time may be reduced to match daily heat loss.

Pool solar blanket
A pool solar blanket should be used whenever possible. Blankets minimize heat loss and conserve heat in your pool. Like a jacket holds body heat in on a chilly day, or closed doors and windows hold heat in a home, the blanket controls heat losses. Un-blanketed pools lose 2-3 times more heat than a blanketed pool.

Heater running time
Most units should be sized to operate during the pool filtering cycle time of 8-12 hours daily, providing an even, steady flow of warm water. On warmer days the heater will run less because the heat loss will be less. The Time Clock Eliminator feature manages the pool pump and it will keep it on when needed to ensure the required pool water temperature is maintained.

Winterizing
If the unit is stored in a place where the temperature drops below the freezing point of 32°F (0°C), it is mandatory that the water accumulated in the unit be drained completely before freezing weather prevails. The water piping MUST be disconnected to drain the heat exchanger in preparation for winter. Once the piping is disconnected, the unit MUST be emptied by tilting it (75°) until all the water is out. It is recommended to rinse the inside of the heat exchanger with a garden hose and to drain the unit once more. With the help of pool return winter plugs, block the water Inlet and Outlet connections to prevent access by vermins. DO NOT leave the water piping connected to the unit for the winter.

It is also possible to fill the heat exchanger with pool anti-freeze only, but ensure that the anti-freeze contains an elevated pH to prevent corrosion. This is optional and requires appropriate hardware.
Operation of Your Pool Heater

Service Analyser Codes
Most problems will be detected by the service analyser and a code will be displayed on the digital display of your heater.

<table>
<thead>
<tr>
<th>Display</th>
<th>Meaning of Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>The desired programmed temperature point is lower than 60° F (15°C).</td>
</tr>
<tr>
<td>LP &amp; LP3</td>
<td>Shortage of refrigerant gas in the unit or faulty low pressure control. The digital display will show LP3 after 3 LP faults and shut down your pool heater. The pool pump will also be stopped for protection*. See also FS code. If LP3 occurs, you should call for service.</td>
</tr>
<tr>
<td>HP &amp; HP3</td>
<td>Low water flow to the unit or faulty high pressure control. Check water flow. Adjust bypass valves to allow full water flow. Backwash filter. The unit will show HP3 after 3 HP faults. This will stop your heater and the pool pump for protection.*</td>
</tr>
<tr>
<td>Psd</td>
<td>Pool Sensor Defective. The water temperature probe is open or defective. Verify connections.</td>
</tr>
</tbody>
</table>
| FLO & FL3| Possible causes:  
- FIL parameter must be set to activate pool pump*.  
- The filter is in backwash position.  
- The filter pump is stopped.  
- The filter is dirty.  
- Shortage of water to pool pump.  
- Water pressure switch must be adjusted or it is defective.  
- The unit is in the protection mode and will show FL3, press any key to restart the unit. FL3 code will stop your heater for protection. It will also stop the pool pump to protect it from overheating.* |
| dPd     | Defrost Probe Defective. Suction temperature probe is open or defective. Verify connections. |
| FS & FS4| Unit in the defrosting cycle. (The fan works but the compressor is stopped). This is normal operation when outside temperatures are cold.  
After unit stop with "FS4" message, the unit is lockout for 30 minutes; after this period, frost sensor temperature needs to reach 34°F to start back the unit (over 34°F the "FS4" counter is reset). Pressing any button will also reset this lockout condition. |

* If unit’s internal time clock feature is used.
The Pool Heater is Not Running
- Heat pump control set to "OFF". Raise temperature set point above 60° F (15°C).
- Desired water temperature is reached. Unit will automatically re-start when the water temperature goes below the set point.
- Main breaker is tripped. Reset it.

The Heater is Showing FLO and it Will Not Start
- Pool pump is not running. Turn the pool pump on.
- If EvenHeat Time Clock feature is used you will have to set the FIL parameter on the electronic board. This parameter is factory set to OFF.
- Filter is dirty restricting the water flow. Backwash and clean filter.

The Fan is Running But Not the Compressor
- The unit is in its 5 minutes time delay protection mode.
- The unit is on defrost cycle. Digital display should show "FS". The compressor will start again automatically a few minutes after the display stops showing "FS".

There is Water Around the Unit.
- While your Smart Energy System pool heater is in the heating mode, a large quantity of warm and humid air passes over the evaporator and causes condensation.
  **It is normal to see condensation dripping under the heater.**
  To verify that the water is really a water leak you will need to stop the heater and leave the pool pump running for over 5 hours. If water is still coming out of your heater after this period you should call your dealer for service.

The Heater is Running But Desired Water Temperature Cannot be Reached
- Heat loss is too great for the heater; cover your pool as often as you can.
- Evaporator is dirty. Clean it.
- Evaporator restricted due to improper location.
- The bypass valves are not properly adjusted.

**NOTE:** If your pool heater does not operate for reasons other than those mentioned above, see section on “Requesting Assistance or Service”.

11