Maritime Geothermal Ltd.

NORDIC® models PC-45-55-65

Installation Manual

Revision 2.5 January , 1999

"PC" Heat Recovery Pool Conditioners

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LR 56328

Dehumidifies the Pool Room
Reheats Pool Water & Pool Air

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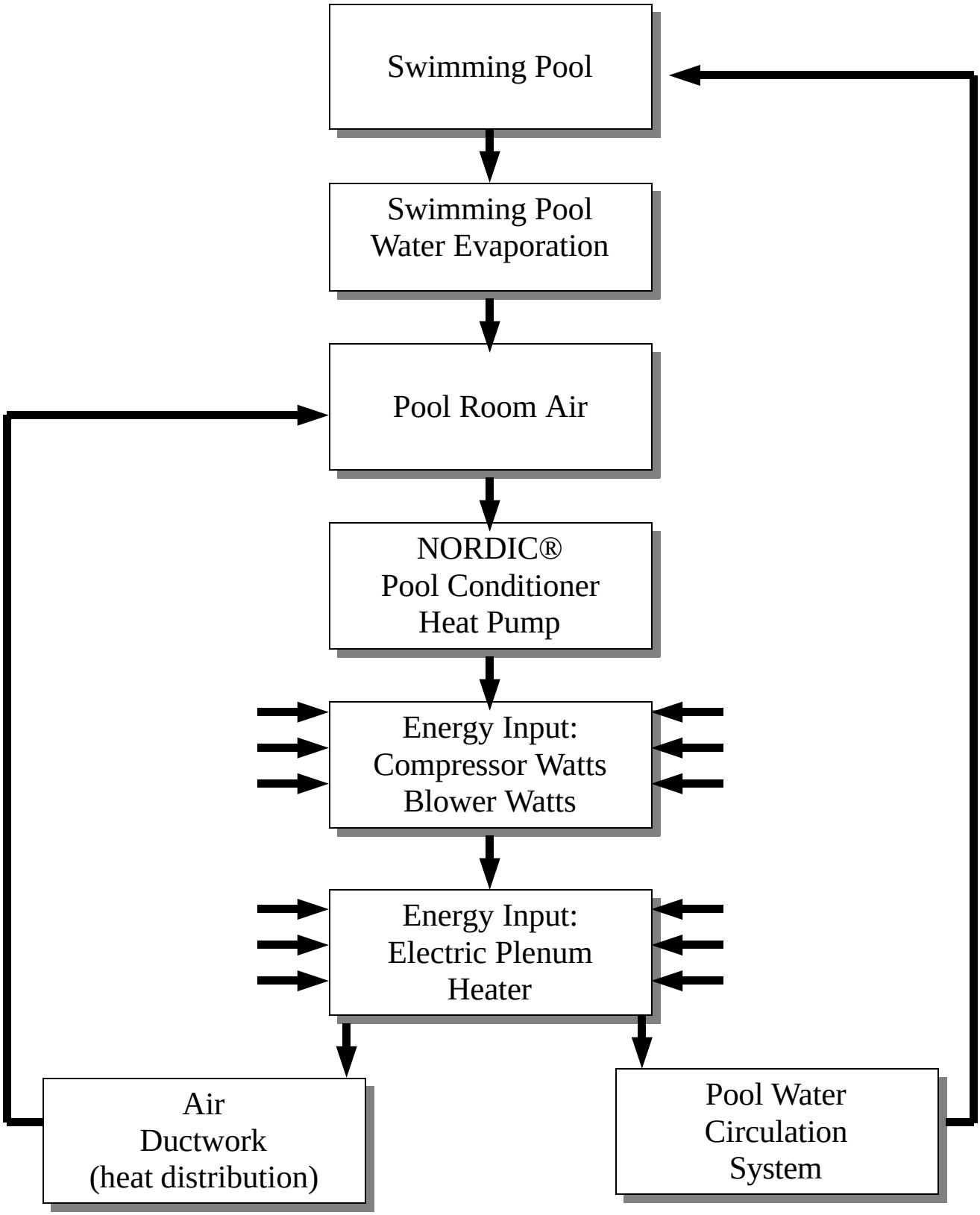
A NORDIC® Pool Conditioner System



NORDIC® Pool Conditioner Installation Manual

Unpacking

When the heat pump reaches it's destination it should be unpacked to determine if any damage has occurred during shipment. Any visible damage should be noted on the carrier's freight bill and a suitable claim filed at once.

The heat pump is well constructed and every effort has been made to insure that it will arrive intact, however it is in the customer's best interest to examine the unit thoroughly when it arrives.

General

The Nordic Pool Conditioner is designed to maintain the humidity level in a pool area by dehumidifying the air in the pool room and depositing the energy absorbed into the pool water.

The pool conditioner will normally be placed in or near the pool room area since a supply and return duct system is required for proper operation. One common location is in the mechanical room where the pool circulator pump and filter are located. Since we will be using the pool circulation system to deliver heat to the water, piping can be kept as short as possible. The mechanical room is also commonly located in or adjacent to the pool area which further facilitates the use of the shortest duct system possible for the unit.

Horizontal style units can be easily suspended from the ceiling with a suitable hanger assembly. Care should be taken to insure that the unit is installed in a level position from front to back and from side to side. The condensate drain which will flow a steady stream of water (gravity flow) when the unit is in operation, should be piped back into the swimming pool via a separate 3/4" line to reduce the amount of make-up water required for the pool.

Storage of pool chemicals in the mechanical room is not recommended since their presence will generally cause premature corrosion problems with any metal equipment located therein.

Accessory Equipment Included

1. (2) Ranco® 2-stage thermostats.
2. (1) de-humidistat
3. An electric 15 Kw auxiliary plenum heater.

Although the Ranco® thermostats are physically identical we will reference the ***air*** thermostat as a ***thermostat*** and the pool ***water*** thermostat as an ***aquastat.*** The thermostat controls the temperature of the air in the pool room and the aquastat maintains the pool water temperature. Both Ranco® thermostats are required since they interact with each other during all aspects of control in the pool environment.

Recommended Additional Equipment

To professionally complete the system you will also need to arrange for a suitable exhaust fan to remove excess heat during times when both the pool air and pool water requirements are satisfied and there remains excess heat in the pool room or when outside conditions allow cost free conditioning of the pool room air.

System Operation

The prime purpose of the Nordic pool conditioner unit is to maintain proper humidity levels in the pool room. During this operation the unit also supplies heat to the pool room and the pool water.

The PC unit can be activated in one or both of the following manners:

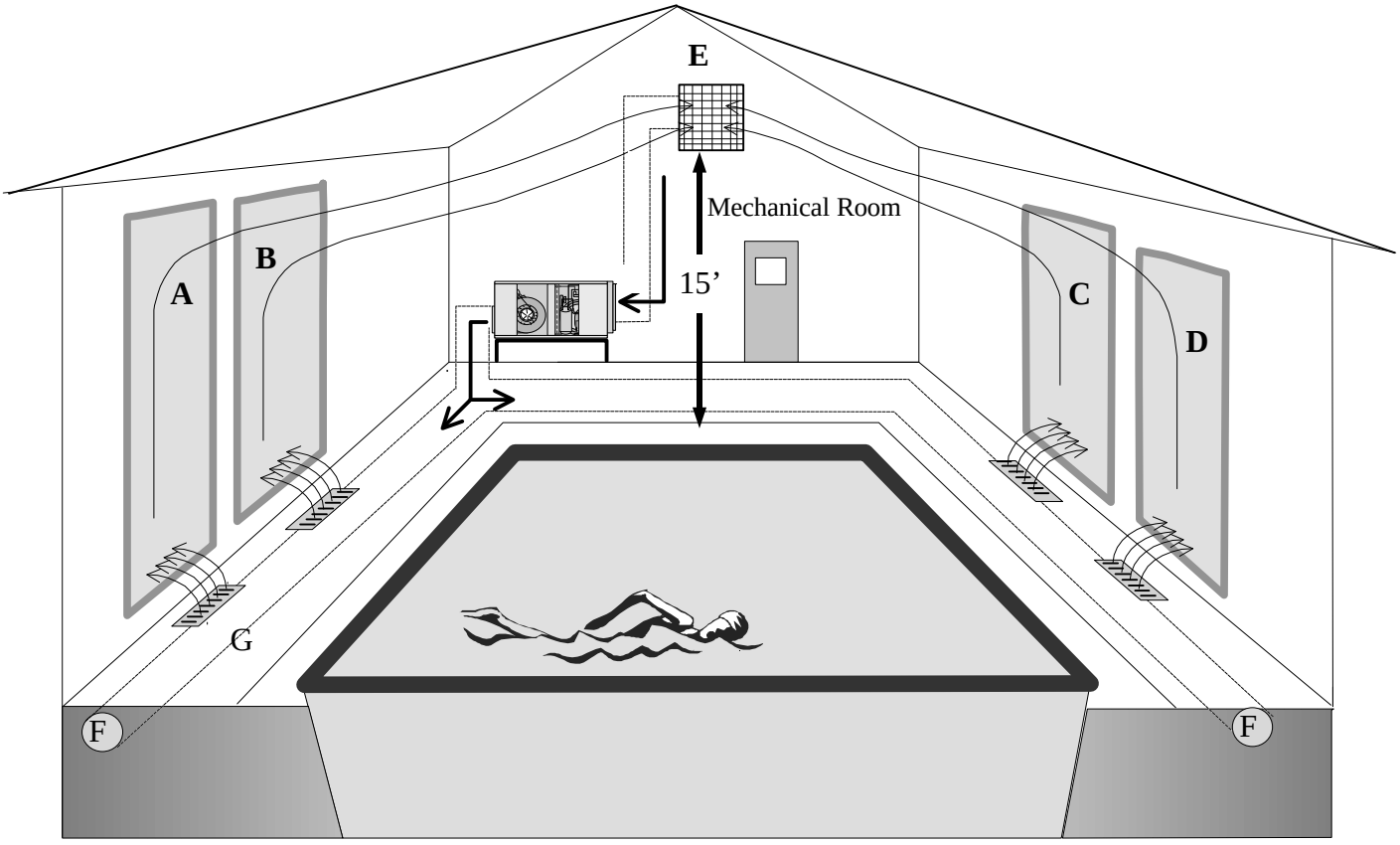
- by a signal from the de-humidistat whenever the humidity in the room is above the setpoint.
- by the aquastat whenever the pool water temperature falls below stage-1 setpoint.

There are several modes in which your PC unit can function. Below is an explanation of the control sequence.

When the de-humidistat or aquastat calls for operation, the PC activates in what is essentially a water cooled air conditioner mode. Heat and moisture are extracted from the air and rejected to the pool water. This operation warms the pool water but cools the air as part of the process, therefore heat must be added to the air or the room will cool down. When the pool room temperature falls below the stage1 setpoint of the thermostat it puts the PC unit into air reheat mode until the air temp rises above the thermostat stage1 setpoint. Dehumidification will continue to take place and the unit will alternate back and forth between air heating and water heating with the air having priority and the pool water as the recipient of additional heat that the room does not require.

- A typical initial air temperature setpoint for stage1 might be 82°F with a 1°F differential. Of course the air temperature setting can be at whatever your desired requirement however it is recommended you keep stage1 and

Recommended Air Flow Pattern



Example 1.

Under floor Supply Ducts with Elevated Return Air

The diagram above shows a common technique for installing supply ducts in the pool room area. Dry air is directed upward over the windows A, B, C and D . As the air picks up moisture from the pool room it is drawn towards the return air grill E where it renters the pool conditioner once more. Air is released over the glass and drawn to the return air grill of the PC with as little travel as possible over the pool surface.

Supply ducts "F" are located below the concrete pool decking and insulated with waterproof closed cell or Styrofoam insulation so that the distribution air is relatively the same temperature throughout the entire length of the building.

Floor diffusers "G" should be placed close to the windows and be wide enough to direct air over the entire glass surface to ensure that no condensation occurs in corners or on the lower levels of the glass.

(Continued from page 3)

stage2 setpoints no more than 3° apart with a 1° differential on stage2 and no more than 2° differential on stage1. Stage2 of the thermostat might be set at 80°F with a 1°F differential. *(Reference the programing procedure provided in the Ranco® documentation for exact instructions on how to set the thermostats).*

- With these settings, stage1 would activate when the room temperature falls to 81°, stage2 would activate if the room falls to 79°. If there is a heat loss in the room (greater than 20,000 Btu) then the PC unit will not be able to keep up to the loss in the room. The temperature will eventually fall to 79°F activating the stage2 of the thermostat which brings on the 15Kw electric plenum heater. NOTE: The electric heater can only activate when stage2 of the thermostat calls for heat. This electric plenum heater will prevent any further decline in temperature since it's output is 50,000 Btu's. As long as air-

reheating via the PC unit (stage1) can maintain the air temperature the plenum heater will be off.

When the air temperature rises above the thermostat stage2 setpoint the plenum heater will be disengaged. During the time the PC unit is operating in ***air reheat mode*** there is no heat being added to the pool water and therefore, depending on the heat requirements of the room, if a large percentage of time is spent in air reheat mode, after a period of time the water temperature will fall a degree or two.

Aquastat Function

When the pool water temperature falls below the stage1 setpoint of the aquastat it will cause the PC unit to operate in a similar fashion to that just described for the de-humidistat and begin switching between air reheat and water heating mode.

- Typical settings for the aquastat might be 80°F for stage1 setpoint and 78° for stage2 setpoint with 1°F differential settings as with the air thermostat. The closer the differential settings the closer the pool water and air will be maintained to your desired temperature (1°F is the minimum differential allowed with these controls)
- When the pool water drops below the stage2 setpoint it means that the 15 to 20,000 Btu's generated by the PC operation is not sufficient to maintain both the pool air (priority) and the pool water. (You will also see this condition occur when the pool is initially being brought up to temperature.) A fall in temperature below the stage2 setpoint on the aquastat locks the PC from going into air reheat mode and thus directs the full output (60,000+ Btu's) into the pool water. Of course, since the PC is now cooling the air, the room temperature will quickly fall to stage2 of the thermostat which activates the plenum heater. The 15 kw plenum heater has greater capability than the sensible cooling ability of the PC therefore the unit will cycle on and off supplying the additional heat required by the pool as required until the pool is nearly up to temperature and stage2 of the aquastat is satisfied.

All the losses in the pool area through evaporation can be recovered. During this process there are 4000 to 5500 watts additional heat, equal to the amount of watts that the compressor & blower in the system consume, which can be added to either the pool water or pool air as required. Therefore the only losses which will have to be made up electrically by the plenum heater are typically those from the pool room shell which exceed the input watts (converted to heating Btu's) of the conditioner.

Supply Duct System

The care and attention devoted to setting up the air distribution can make or break any indoor pool conditioning system. Important factors to consider are listed below:

1. Sufficient air must be moved within the pool enclosure to satisfy the requirements of the both the occupants of the room and the heat pump system with maximum flow directed over the outside windows and doors and minimum flow directly over the exposed surface of the pool itself.
2. To prevent air stagnation and stratification the system must provide at least 4 to 8 room air changes per hour.
3. The PC supply air ductwork must be adequately sized to handle 1600 to 2000 cfm of air (depending on the model) with no more than .15" H_2O of external static pressure. A duct sizing guide is included in the appendix of this manual to help in selecting adequate duct sizes.
4. An in-floor duct system is usually the most effective method of supplying air to the room. Distribution of the conditioned air will be most effective if the air is released from the floor and allowed to rise upwards over the glass surface. It is important to try and blanket the entire surface of glass windows and metal doors with a film of dry air from the pool conditioner so that the corners or bottom of the glass will not accumulate condensation. If a ceiling ducted system is chosen then the supply air should be of sufficient velocity to insure that air flows down over the glass surfaces all the way to the bottom of the window.
5. Linear supply grills should be placed near all glass areas exposed to outside temperatures for optimum operation.
6. Additional care should be taken to see that air flow is not directed across the pool surface since moisture loss from the pool water will be greatly increased under these conditions.
7. If a floor distribution system is not possible then ceiling ducts should be positioned to blow down over the exposed glassed areas of the room perimeter. It may be necessary to increase the rate of air delivery by adjusting the pulley size on the pool conditioner to accommodate the more difficult job of forcing air exiting the PC, down over the glass.

Return Duct System

The air inlet of the return duct system should ideally be placed 10 to 15 ft above the pool level. Placing this duct inlet in an elevated position will insure that air movement travels in an upward fashion if it is introduced from the floor. An air flow pattern which causes a minimum air flow across the pool surface should be constructed to insure minimum evaporation from the pool surface. (See duct diagram layout.)
Minimum evaporation from the pool for a given set of conditions will insure the shortest run cycles and therefore the most efficiency from your pool conditioning system Large volumes of air travelling near the pool surface will also cause bathers to feel cool whenever they emerge from the water.

Sizing the Pool Conditioner

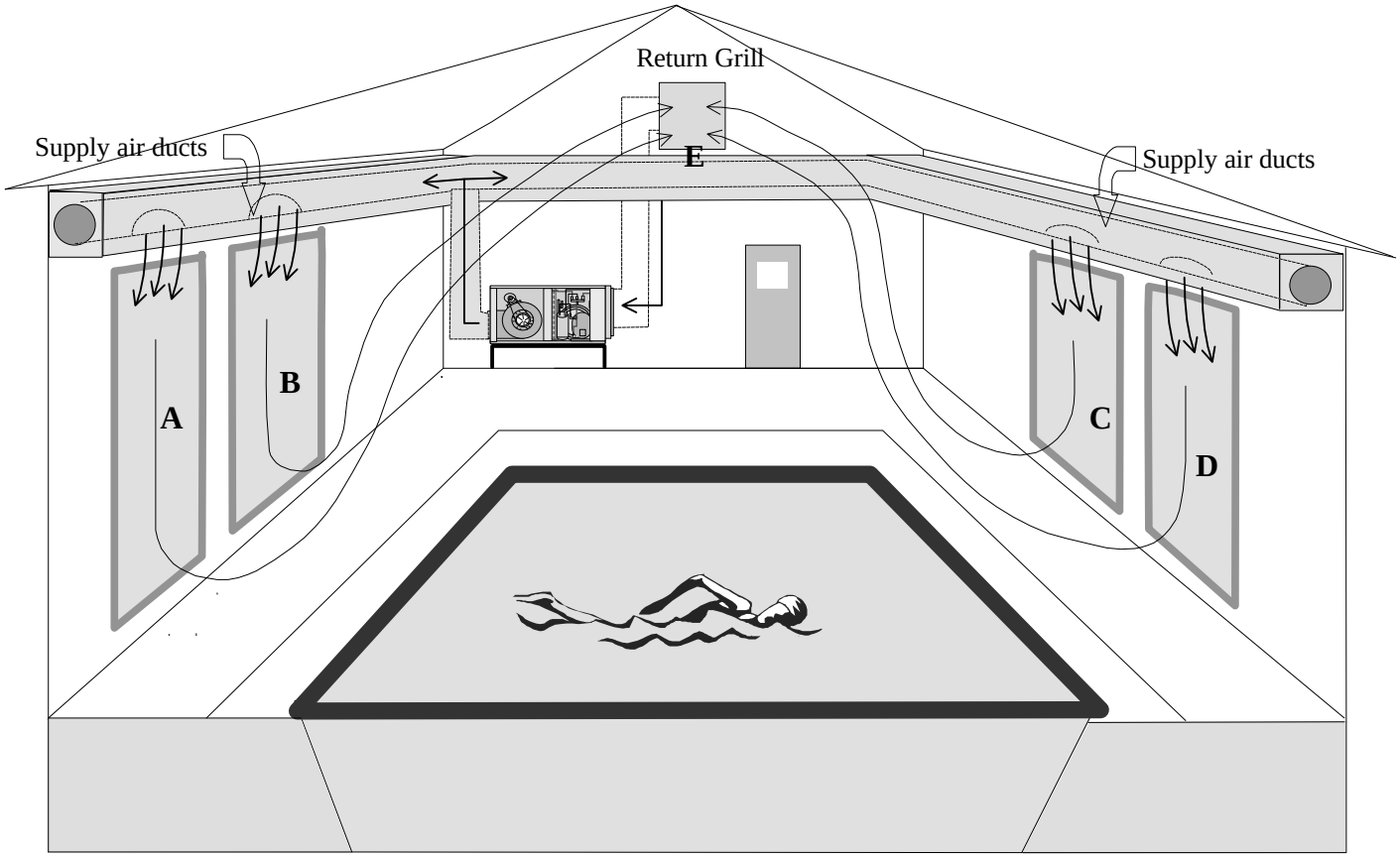
Selection of the capacity of the pool conditioner is influenced by several factors which are connected to the evaporation rate from the pool itself. These factors are listed below:

⇒ **Square footage of the pool surface.**

As the square footage of the pool increases the evaporation rate will increase proportionally. The depth, shape and total volume of the pool do not affect the evaporation rate.

⇒ **Wetted floor area during pool use.**

During pool use, water will be drawn out of the pool by the action of swimmers leaving and re-



Elevated Supply Ducts with Elevated Return Air

The diagram above shows another possible technique for installing supply ducts in the pool room area. Dry air is directed downward over the windows A, B, C and D . As the air picks up moisture from the pool room it is drawn towards the return air grill E where it renters the pool conditioner once more. In each case air is released over the glass and drawn to the return air grill of the PC with as little travel as possible over the pool surface.

entering the pool during diving or through other normal activities. This water will accumulate on the floor surrounding the pool and will contribute to the overall surface exposed to the air for evaporation purposes. If the pool floor is heated then the evaporation rate will exceed that of the pool itself and this extra wetted area should be considered in sizing the pool conditioner.

⇒ **Pool water temperature.**

The temperature of the pool water in relation to the air temperature is one of the most deciding factors in determining overall evaporation rate from the pool. As the room air temperature decreases in relation to the pool water, the evaporation rate will increase dramatically. The normal temperature range for private pool use is from 78° F. to 82° F. The air temperature should be preferably kept 1° to 2° F. above the water temperature for the most economical operation of the pool conditioner.

⇒ **Pool room air temperature.**

As mentioned above the pool room temperature is normally kept slightly above the water temperature to minimize the amount of evaporation taking place.

⇒ **Required relative humidity.**

The relative humidity setpoint for most pool areas is from 50% to 60%. Lowering the relative humidity setpoint will increase the evaporation rate from the pool thus causing the pool conditioner to run longer but may be necessary to prevent condensation on some glass surfaces during cold weather. Relative humidity should be set only low enough to prevent condensation from occurring on windows and doors.

⇒ **Air flow over water surface.**

Reducing the air flow over the pool surface will decrease the evaporation rate from the pool.

Duct design should be such that air flow is directed over glass surfaces from the floor and returned to the pool conditioner via a high return so that the area of highest air velocity is as far away from the pool surface as possible. Some possible configurations are shown in diagrams in the engineering section of this manual..

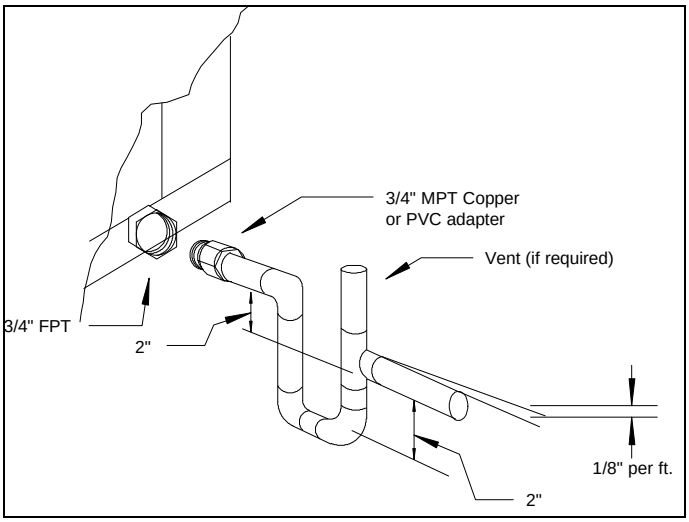
⇒ **Water agitation.**

The amount of surface agitation also influences the amount of water vapor being transferred to the air. High activity rates from diving, splashing etc. will cause the pool conditioner to work harder to keep the humidity level within setpoint conditions.

Pool Conditioner Features

Condensate Drain

You will notice in the piping diagram that there is a small drain pipe to the left of the front door. This drain allows the condensed water vapor which forms during the pool-conditioning cycle to escape to a suitable area of your selection. Normally this condensate is routed back into the pool to reduce the amount of make-up water required. Care should be taken to insure that this pipe is not plugged with dust that has collected during the winter since the water formed will overflow into the bottom of the heat pump.



Typical Condensate Drain connection

Safety Controls

The NORDIC® heat pump has two built in safety controls which are designed to protect the unit from situations which could damage it.

1. LOW PRESSURE / TEMPERATURE CONTROL

The low refrigerant pressure / temperature control is designed to shut the unit down if the refrigerant evaporating pressure becomes too low thus risking the danger of freezing conditions in the evaporator.

There are only (4) reasons why this control would activate and they are:

1. Low air flow. (See requirements for each model)
2. Low air temperature. (Below 60°F.)
3. Dirty air filter or fouled air heat exchanger.
4. Low refrigerant charge.

2. HIGH PRESSURE CONTROL The second safety control is a high pressure safety limit which monitors compressor discharge pressure. This device will not normally trip unless there is an interruption in air flow in the air reheat mode or an interruption in water flow in pool heating mode. Such a situation could occur if the blower motor or fan belt failed or if the heat pump had an extremely dirty air filter. If loss of water flow or a restriction in water flow occurs during pool heating mode then the high pressure control would also open.

If either of these controls trips it will activate a **TIMER** which prevents the unit from restarting until 10 minuites have elapsed.

If one of these controls trips there may be a serious problem with the system and it must be rectified if the unit is to maintain good service.

Electrical - (PC) models

The NORDIC® unit is supplied with an opening for 3/4" conduit nipple on the top left side of the unit. An additional knockout (1/2") is provided to facilitate connection of the plenum heater blower control wire. To the right there is another 3/8" hole for the thermostat wire. A wiring diagram is located inside the electrical box cover for quick reference and although the connections to be made are quite simple, Maritime Geothermal Ltd. recommends that a properly qualified electrician be retained to make the connections and wire the thermostat. Using an (18 gauge) class 2 thermostat wire suitable for the job, connect the terminals in the heat pump electrical box to the appropriate terminals on the thermostat, the humidistat and the pool aquastat.

Starting the Heat Pump

BEFORE starting the heat pump the following areas should be rechecked to assure proper operation.

1. Check all high voltage field wiring and electrical connections inside the control box for good connection.
2. Check the low voltage thermostat, aquastat and humidistat to make sure they are connected properly.

Turn on the main power switch. Allow the power to remain **ON** without starting the unit for a period of 4 hours. Refrigerant migrates to the compressor oil when the compressor is unheated. A crankcase heater is standard equipment on your heat pump and it will warm the compressor, dispelling the liquid refrigerant. Compressor damage can occur if the heat pump has been brought in from a cold location and immediately started up.

3. If installed, open valves on the condenser (pool circulator) water supply and check all plumbing for leaks.
4. Make sure the air filter is clean and in place.
5. Vacuum out any dust and debris that may have collected in the unit during installation. Check the condensate drain to be sure that it is free of obstruction.
6. Make sure the unit is sitting level so that condensate water will not overflow the catch pan.
7. Make sure the proper time-delay fuse has been installed in the fuse box.
8. Have the following tools on hand and know how to use them.
   A. A refrigeration gauge set.
   B. An electronic or other accurate thermometer.
   C. An amprobe.
   D. A water flow meter.
9. Connect your refrigeration gauge set.
10. After the 4 hour warm-up period, lower the humidistat switch. The compressor, blower and will start. If the aquastat is calling for pool heat then the unit will be in pool heating mode.
11. Observe the readings on the high and low pressure gauge set. When the pool room reaches a temperature of 75 to 85° F. the suction pressure (blue gauge) should be approximately 60 to 75 psig. while the head or discharge pressure (red gauge) should be in the area of 225 to 275 psig. Record this information on the warranty test card.

12. Using an electronic thermometer or other accurate thermometer, record the supply water temp. "IN" and the water temperature ``OUT". The outlet water temperature should be from 6 to 12°F. warmer than the inlet water temperature.
13. Record the supply water flow in gpm.
14. Record the return air temperature by drilling a small hole in the return air plenum approximately 2 ft. from the filter rack and inserting the thermometer's sensing device.
15. Similarly record the discharge air temp. There should be a drop across the air exchanger of 15 to 20°F.
16. At the electrical disconnect switch place the amprobe jaws around the supply wires and record the current in each.
17. Set the aquastat so that the pool is NOT calling for heat. The 3-way valve should move to direct hot discharge gas to the air reheat coil. The outlet air should be approx. 5°F. warmer than the incoming air.
18. Adjust the humidistat to a higher setting until the unit shuts off.
19. Check the plenum heater operation by adjusting it's thermostat up until it is calling for room heat. The plenum heater should come on along with the blower.

General Maintenance

As with any piece of equipment there will eventually be some maintenance to be done on the heat pump. Several areas will need attention and they are as follows:

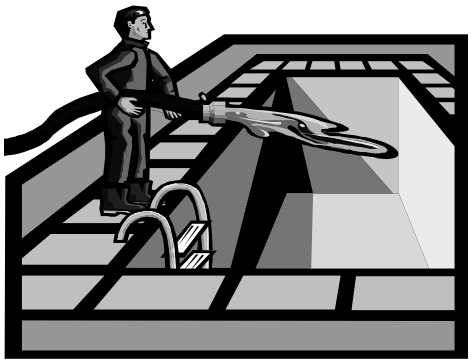
1. Change the air filter when required.
2. Oil the blower motor once a year.
3. Inspect the blower belt for cracks & wear.
4. Insure the condensate drain is clean.
5. Check the water exchanger for scale build-up.

Hot Water Condenser Maintenance

The hot water condenser side of a PC unit is equipped with a cupro-nickel heat exchanger which is normally connected to the water filtration system of the pool or spa. In any open loop application where constant new supplies of water and consequently new sources of minerals etc. are introduced to the heat pump, the condenser heat exchanger should be examined periodically to determine whether it is becoming corroded. An easy method of determining whether the heat exchanger is fouled is to have your serviceman keep a record of the output water temperature and corresponding heat pump discharge pressure at start-up each time he visits the unit over the years. After several seasons of operation, if the pressure becomes higher for a given output temperature then the heat exchanger may require cleaning.

These heat exchangers are not manually cleanable however they can be cleaned with a sulfamic acid solution commonly marketed under the trade name ***"Iron-Out".*** If you suspect that the water being pumped through the unit is of a poor quality or you notice a decrease in performance after several years of use it may be necessary to have the liquid heat exchanger chemically cleaned.

Maritime Geothermal Ltd. recommends that a qualified serviceman be retained to carry out this procedure since the chemical solution involved is highly corrosive.



Ranco® ETC Thermostat Controls

The Ranco® ETC is a microprocessor-based electronic temperature control designed to handle the OFF/ON functions of the NORDIC® PC unit. The ETC is equipped with an LCD display which provides a constant readout of the sensed temperature and a touch keypad that allows the user to easily and accurately select the setpoint temperatures and differentials for the first and second stages of operation.

Programming Steps and Display

Step 1– To start programming, press the **SET** key once to access the Fahrenheit/ Celsius mode. The display will show the current status, either F for degrees Fahrenheit or C for degrees Celsius. Then press either the **UP** arrow or **DOWN** arrow key to toggle between the F° or C° designation. For closer regulation of your PC temperatures we recommend you program in the Fahrenheit mode.

STAGE 1

Step 2– Press the **SET** key again to access the stage1 setpoint. The LCD will display the current setpoint and the S1 annunciator will be blinking on and off to indicate that the control is in the setpoint mode. Then press either the **UP** arrow key to increase or the **DOWN** arrow key to decrease the setpoint to the desired temperature.

Step 3– Press the **SET** key again to access the stage1 differential. The LCD will display the current differential and the **Dif 1** annunciator will be blinking on and off to indicate that the control is in the differential mode. Then press either the **UP** arrow key to increase or the **DOWN** arrow key to decrease the differential to the desired setting.

Step4– Press the **SET** key again to access the stage1 cooling or heating mode. The LCD will display the current mode, either **C1** for cooling or **H1** for heating. Then press the **UP** or **DOWN** key to toggle between the **C1** or **H1** designation.

(NOTE: For PC purposes all stages of both the thermostat and aquastat are set to the H1 or H2 designation.)

STAGE 2

Step 5– Press the SET key again to access the stage 2 setpoint. The LCD will display the current setpoint and the **S2** annunciator will be blinking on and off to indicate the control is in the setpoint mode. Then press either the **UP** key to increase or the **DOWN** key to decrease the setpoint to the desired temperature.

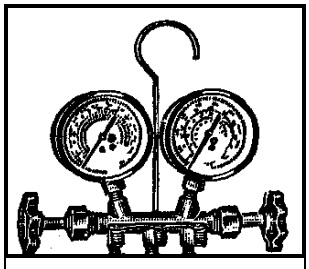
Step 6– Press the **SET** key again to access the stage2 differential . The LCD will display the current differential and the **DIF 2** annunciator will be blinking on and off to indicate that the control is in the differential mode. Then press either the **UP** arrow key to increase or the **DOWN** arrow key to decrease the differential to the desired setting.

Step 7– Press the **SET** key again to access the stage 2 cooling or heating mode. The LCD will display the current mode, either **C2** for cooling or **H2** for heating. Then press either the up or down key to toggle between the **C2** and **H2** designation. Press the **SET** key once more and programming is complete.

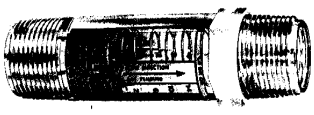
NOTE: The ETC will automatically end programming if no keys are depressed for a period of 30 seconds. Any settings that have been input to the control will be accepted at that point.

All control settings are retained in non-volatile memory if power to ETC is interrupted for any reason. Re-programming is not necessary after power outages or disconnects unless different control settings are required.

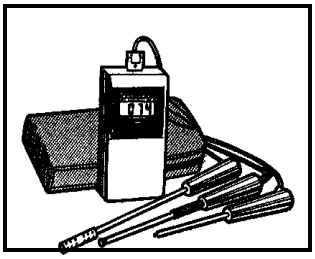
Service Tools



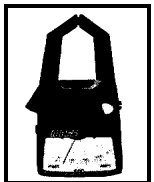
Refrigeration Gauges



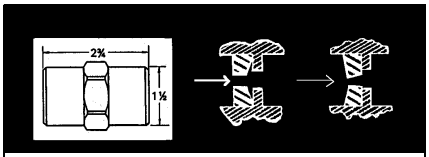
In-line Flowmeter



Digital Thermometer



Amprobe



Dole flow control Valve

The Dole® flow control is a simple, self-cleaning device designed to deliver a constant volume of water from any outlet whether the pressure is 15 psig or as high as 125 psig. The controlling mechanism consists of a flexible orifice that varies it's area inversely with pressure so that a constant flow is maintained.

Evaporation Rate Charts

Evaporation Rate Chart
(50% RH)

Water Temp	Air Temperature										
	86	85	84	83	82	81	80	79	78	77	76
78	0.017	0.018	0.019	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026
80	0.021	0.022	0.023	0.023	0.024	0.025	0.025	0.026	0.027	0.028	0.029
82	0.024	0.025	0.026	0.026	0.027	0.028	**0.029**	0.030	0.031	0.032	0.033
84	0.028	0.029	0.030	0.030	0.031	0.032	0.033	0.034	0.035	0.035	0.036
86	0.031	0.033	0.034	0.034	0.035	0.036	0.037	0.038	0.038	0.039	0.040
88	0.036	0.037	0.038	0.038	0.039	0.040	0.041	0.042	0.043	0.043	0.044
90	0.040	0.041	0.042	0.042	0.043	0.044	0.045	0.046	0.047	0.048	0.049
92	0.045	0.046	0.047	0.047	0.048	0.049	0.050	0.050	0.051	0.052	0.053
94	0.049	0.051	0.052	0.052	0.053	0.054	0.054	0.055	0.056	0.057	0.058
96	0.055	0.056	0.057	0.057	0.058	0.059	0.060	0.060	0.061	0.062	0.063
98	0.060	0.061	0.062	0.062	0.063	0.064	0.065	0.066	0.067	0.068	0.069
100	0.066	0.067	0.068	0.068	0.069	0.070	0.071	0.072	0.073	0.074	0.074
102	0.072	0.073	0.074	0.074	0.075	0.076	0.077	0.078	0.079	0.079	0.080
104	0.078	0.079	0.080	0.080	0.081	0.082	0.083	0.084	0.085	0.086	0.087

Evaporation Rate Chart
(60% RH)

Water Temp	Air Temperature										
	86	85	84	83	82	81	80	79	78	77	76
78	0.010	0.011	0.013	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021
80	0.013	0.015	0.016	0.017	0.018	0.019	0.020	0.022	0.023	0.024	0.025
82	0.017	0.018	0.019	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028
84	0.020	0.022	0.023	0.024	0.025	0.027	0.028	0.029	0.030	0.031	0.032
86	0.024	0.026	0.027	0.028	0.030	0.030	0.032	0.033	0.034	0.035	0.036
88	0.029	0.030	0.031	0.032	0.033	0.035	0.036	0.037	0.038	0.039	0.040
90	0.033	0.034	0.035	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044
92	0.037	0.039	0.040	0.041	0.042	0.044	0.045	0.046	0.047	0.048	0.049
94	0.042	0.044	0.045	0.046	0.047	0.048	0.049	0.050	0.052	0.053	0.054
96	0.047	0.049	0.050	0.051	0.052	0.053	0.055	0.056	0.057	0.058	0.059
98	0.053	0.054	0.056	0.057	0.058	0.059	0.060	0.061	0.062	0.063	0.064
100	0.059	0.060	0.061	0.062	0.064	0.065	0.066	0.067	0.068	0.069	0.070
102	0.065	0.066	0.067	0.068	0.070	0.071	0.072	0.073	0.074	0.075	0.076
104	0.071	0.072	0.073	0.075	0.076	0.077	0.078	0.079	0.080	0.081	0.082

Sizing a Pool Conditioner

The amount of evaporation occurring in a pool enclosure is governed by the temperatures at which the air and water are maintained.
To size the PC for the correct moisture removal capability first select the air and water temperatures at which you wish to maintain your pool area.

Step 1.
Using either the 50% or 60% chart (depending on the humidity level you wish to maintain) on the previous page, follow the column and row until they cross.
This cell is the **evaporation rate factor.**

The lower the air temperature in comparison to the water temperature the higher the evaporation rate.

Step 2.
Multiply the square footage of your pool surface area by the evaporation rate factor to arrive at the actual rate of evaporation in lbs. of water per hour as shown in Table 3. Which uses an example of an 800 sq. ft. pool

Step 3.
Select a PC unit which has a water removal capability equal to or greater than the required lbs./hour indicated in step 2 above.

800 Sq. Ft. Pool Example
Rate of Evaporation - (lbs. of water/hr)

Air (°F) Temp	Water Temperature (°F) 78	80	82	84	86	88	90
92	9.1	11.8	14.5	17.4	20.6	23.8	27.3
90	10.1	12.7	15.5	18.4	22.5	25.8	29.3
88	12.0	14.6	17.4	20.3	23.4	26.7	30.2
86	13.8	16.4	19.2	22.2	25.2	28.5	32.0
84	15.4	18.1	20.9	23.8	26.9	30.2	32.8
82	16.2	18.9	21.7	24.6	27.7	31.0	34.4
80	17.8	20.5	**23.2**	26.2	29.3	32.5	36.0
78	19.3	21.8	24.6	27.6	30.7	34.0	37.4
76	20.6	23.2	26.0	29.0	32.1	35.4	38.8

Assuming Uncovered Private Pool - Relative Humidity of 50%

Example Pool surface Area = 800 Sq. ft. x .029 = 23.2 lbs./hr.

Rating Conditions:	Model	CFM	Moisture Removal @ 50 % RH	Moisture Removal @ 60% RH	Total Watts	Typical Pool Surface Area*
EWT. 80°F EAT. 82°F	PC-45	1600	16 lbs./hr	19 lbs. / hr	3600	600 sq. ft.
	PC-55	1800	20 lbs./hr	24 lbs. / hr	4700	800 sq. ft.
	PC-65	2000	25 lbs./hr	30 lbs. / hr.	5500	1000 sq. ft.

EWT = Entering Water Temp °F EAT = Entering Air Temperature °F RH = % Relative Humidity

NORDIC® "PC" Series Trouble Shooting Guide

Fault	Possible Cause	Verification	Recommended Action
Compressor not operating	Power Failure	Electric circuit test shows no voltage on the line side of compressor contactor.	Check for blown fuse at heat pump's disconnect box or blown fuse
	Disconnect switch open	Voltmeter shows no voltage on the line side of the compressor contactor.	Determine why the disconnect switch was opened, if all is OK close the switch.
	Fuse blown	At heat pump disconnect box, voltmeter shows voltage on the line side but not on the load side.	Replace fuse with proper size and type. (Time-delay) type "D" Check total load on system.
	Low voltage	Voltmeter shows abnormally low voltage (Below 210 v) at heat pump disconnect switch.	Call power company.
	Burned out motor	Ohmmeter shows no resistance between common and run terminals or between common and start terminals. Note: Be sure compressor overload has had a chance to reset. If comp. is hot this may take several hours.	Determine cause and replace motor.
	Thermal overload on compressor tripped.	Ohmmeter shows reading when placed across R and S terminals and infinity between C & R or C & S. Make sure the internal overload has had time to reset.	If windings are open or overload is faulty, replace compressor.
	Faulty compressor contactor.	Voltage on line side with contactor held closed, but no voltage on one or both terminals on the load side. Points pitted or burned.	Replace contactor.
	Seized compressor due to locked or damaged mechanism.	Compressor attempts to start but trips it's internal overload after a few seconds.	Attempt to "rock" compressor free. If normal operation cannot be established, replace compressor.
	Faulty run capacitor.	Check with ohmmeter for shorts, open etc.	Replace if faulty.

Fault	Possible Cause	Verification	Recommended Action
Compressor not operating	Open control circuit.	Aquastat not calling for pool heat. High or low pressure limit open. Humidistat not calling for operation	Locate open control and determine cause. Replace faulty control if necessary.
Compressor "short cycles" on 10 minute intervals.	• Intermittent contact in electrical control circuit. • "High" or "Low" safety control opening.	Normal operation except too frequent starting and stopping.	Check air and water flow. When "hi" or "low" pres. ctrl trips unit stays off 10 minutes on it's timer then restarts automatically if ctrl has reset.
Unit trips off on "LOW" suction pressure control.	Low air flow.	Manually check filters and blower motor and belt. Measure air flow with a magnehelic, etc.	Replace filters, belt or motor if faulty.
	Supply air too cold.	Measure temperature of return air. Should be above 60° F. Check flow rate with spec. sheet to determine if proper CFM is available.	Increase air temperature to proper level with plenum heater.
	Faulty low pressure ctrl.	Refrigerant pressure control should open on drop at approx. 45 psig. And close on rise at 60 psig.	Control should reset automatically. If it remains "open" with refrigerant pressure over 70 psig., replace control.
	Low refrigerant charge.	Check air temp. and flow. Clean air heat exchangers. If suction is still low check return air temp. Normal suction is 55-80 psig.	Check for possible leaks. Repair leak and recharge.
Unit trips off on "hi" pres. safety control in pool heating mode	No or low water flow. Discharge pres. exceeding 350 psig.	Check flow with flowmeter or other method.	Check water pump operation. Check all valves for possible restrictions
	Supply water temperature too warm.	Check temperature against performance chart in engineering section. Should enter below 105`F	Increase water flow to compensate for warmer water temperatures.
	Fouled or corroded heat exchanger.	Check temperature rise vs. water flow from	Chemically clean the water heat exchanger.

Ranco® ETC PC Thermostats

Cover screws (4)

Circuit board

Mounting Holes

Conduit Opening

8 ft. extension cable

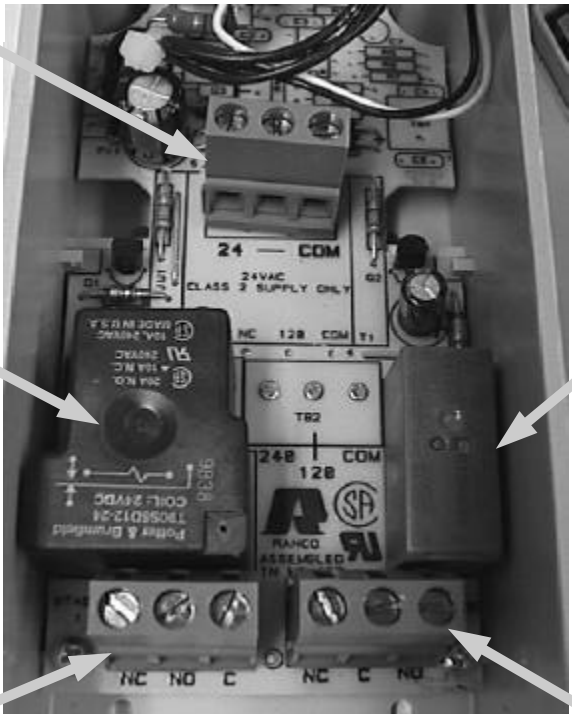
Temperature sensor

Locking switch

NOTE:
The temperature "sensor" can be extended up to 400 ft. by cutting the sensor extension cable and splicing 22 gauge (2 conductor) copper wire in place.
Regular telephone wire can be used for this operation.

24v Power Connection

Stage 1 relay



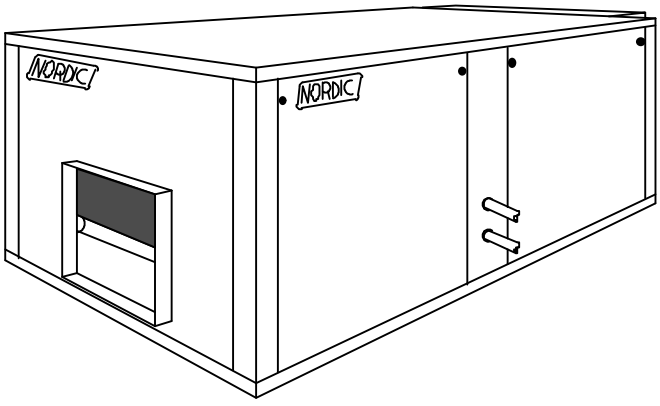
Stage 2 relay

Stage 1
NC NO C

Stage 2
NC C NO

NORDIC® Pool Conditioner PC-45-55-65

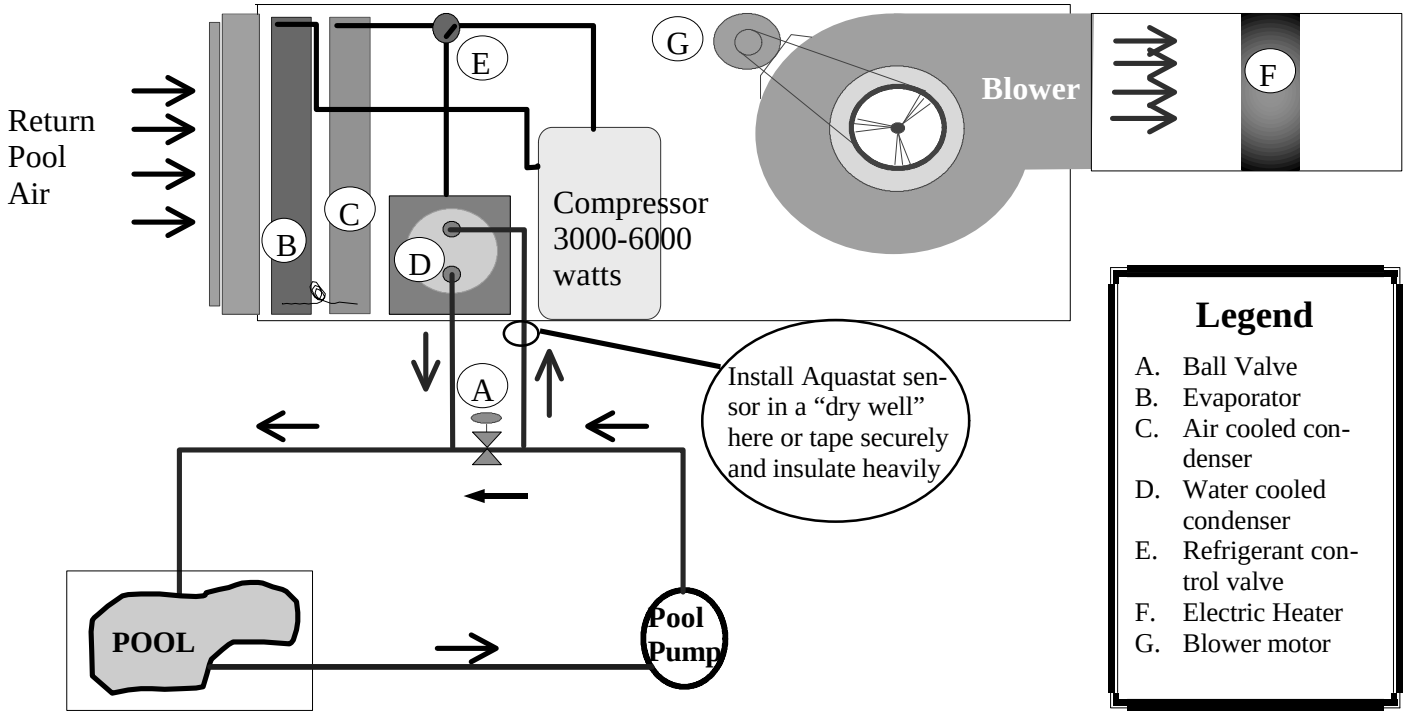
Engineering and Performance Data



January 1999

"PC" Pool Conditioner System

Schematic of PC Functions



Legend

A. Ball Valve
B. Evaporator
C. Air cooled condenser
D. Water cooled condenser
E. Refrigerant control valve
F. Electric Heater
G. Blower motor

Theory of Operation

The **Nordic® PC** unit performs (3) functions in an enclosed pool area.

1. Dehumidify pool area - returning all latent heat plus compressor & blower motor heat to the pool or to the air as the situation requires.

2. Heat the pool water.

3. Heat the pool air.

The pool area and the pool water have a Btu loss on a continuous basis during winter.

Most of the heat loss from the pool water is through evaporation, assuming the walls of the pool are insulated.

The Nordic® "PC" will recover all the latent heat lost through evaporation and return it to the water via it's internal water cooled condenser and the pool's circulation system.

There will always be additional heat available to heat the pool equal to the amount of electricity consumed by the compressor and blower of the conditioning unit.

Do NOT inject pool conditioning chemicals into the line BEFORE the PC water INLET line.

Equation:

Heat available from the operation of the PC unit = Total watts of power used to operate the heat pump.

Total heat added to the room and water will be from 3500 watts to 6500 watts depending on the unit size (3-5.75 HP). This power consumed in watts converted to Btu's is from 12,000 to 22,000 Btu's.

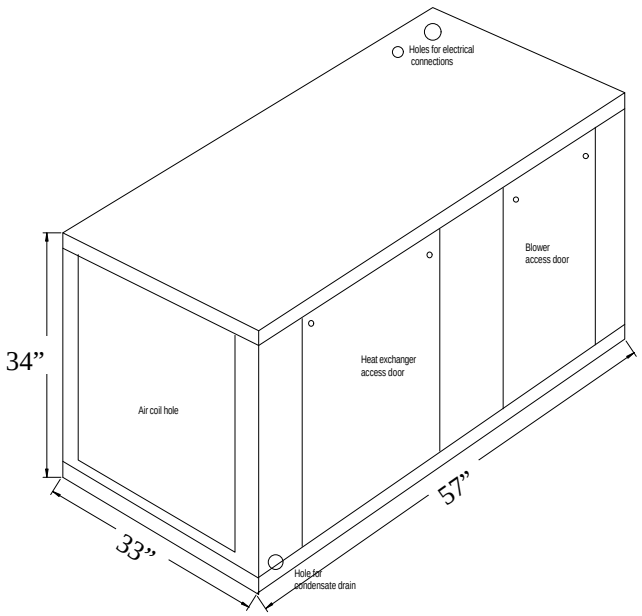
If less than this amount of heat is needed to maintain the pool temperature, then the remainder is diverted back to the pool air. If the combination of pool loss + pool room loss through walls and glass etc. are less than the 12 to 22,000 Btu produced by the "PC" unit while it is dehumidifying then no additional heat will be required by either the pool water or the pool room air.

An electric plenum heater can be used in conjunction with the "PC" unit to make up a complete package which can bring a cold pool up to temperature.

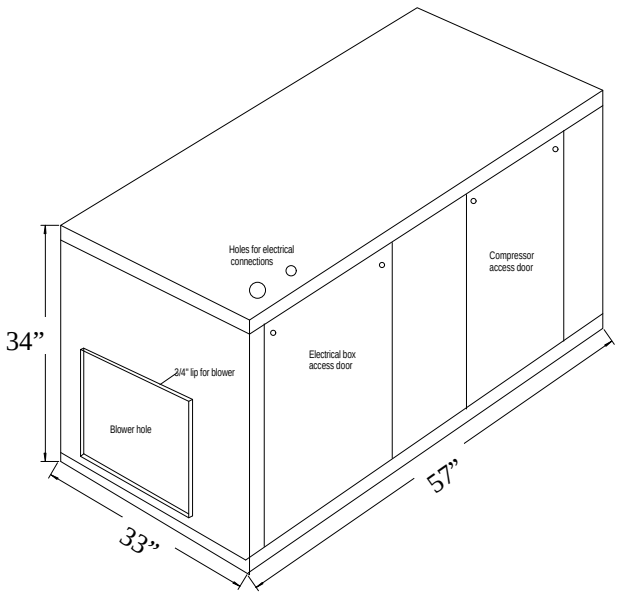
Once the pool is up to temperature the plenum heater will not have to operate unless there are large heat losses in the pool room during winter operation.

PC Dimensions 45-55-65 models

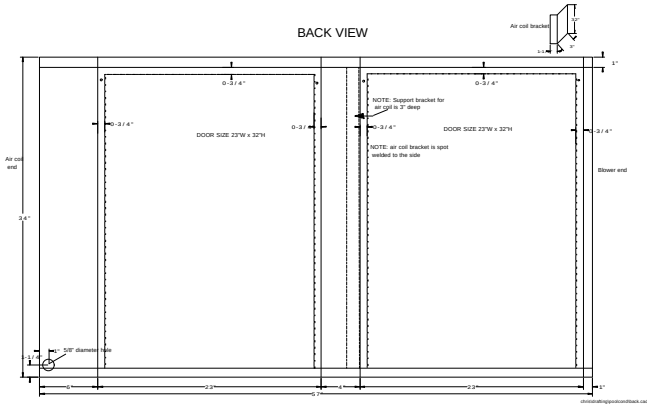
BACK



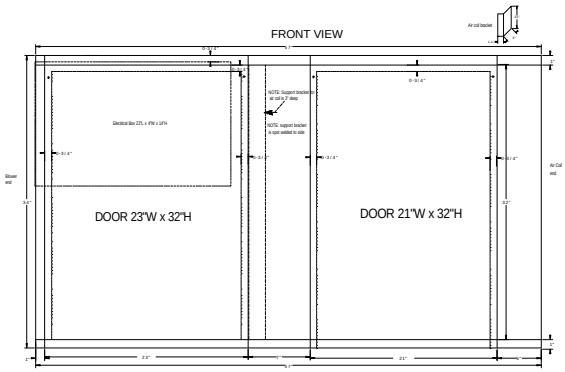
FRONT



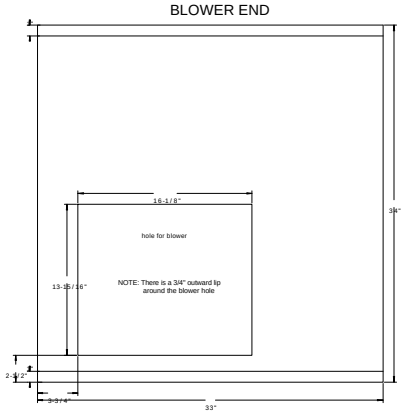
BACK VIEW



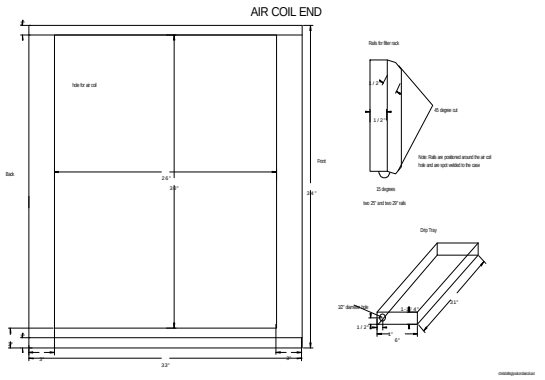
FRONT VIEW



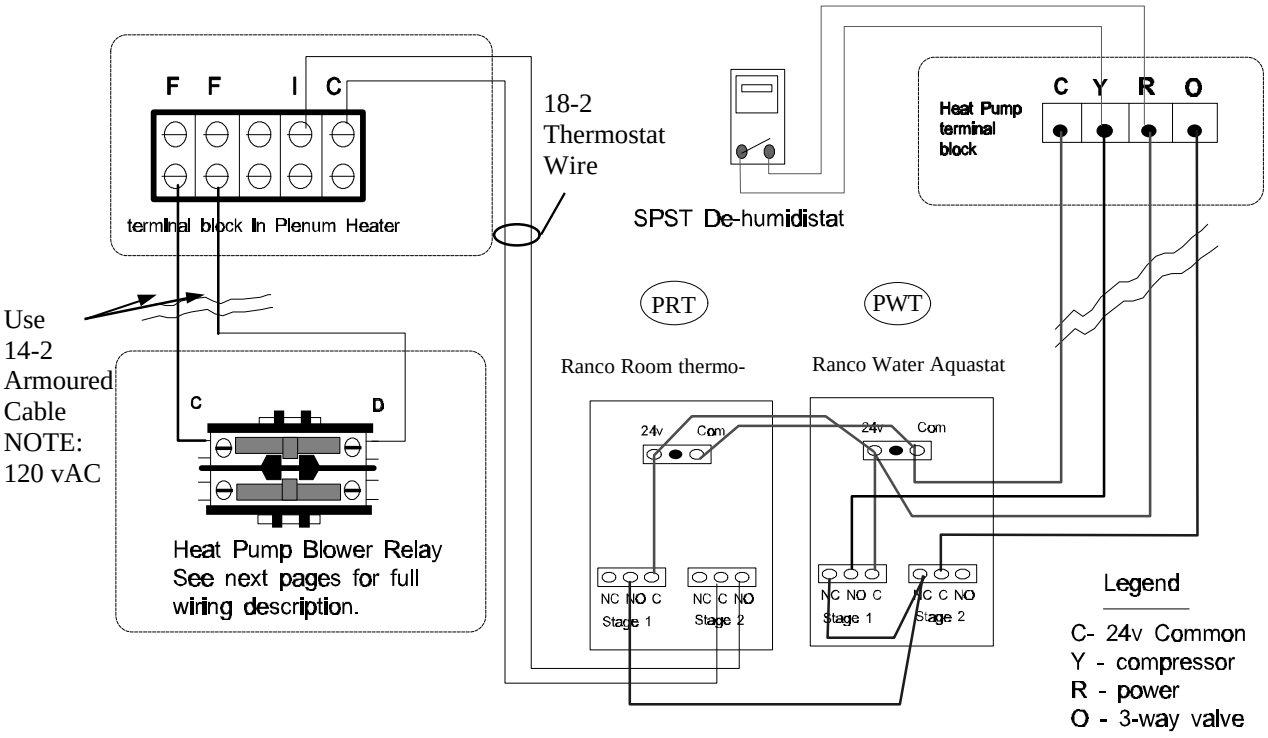
BLOWER END



AIR COIL END



PC Control Wiring

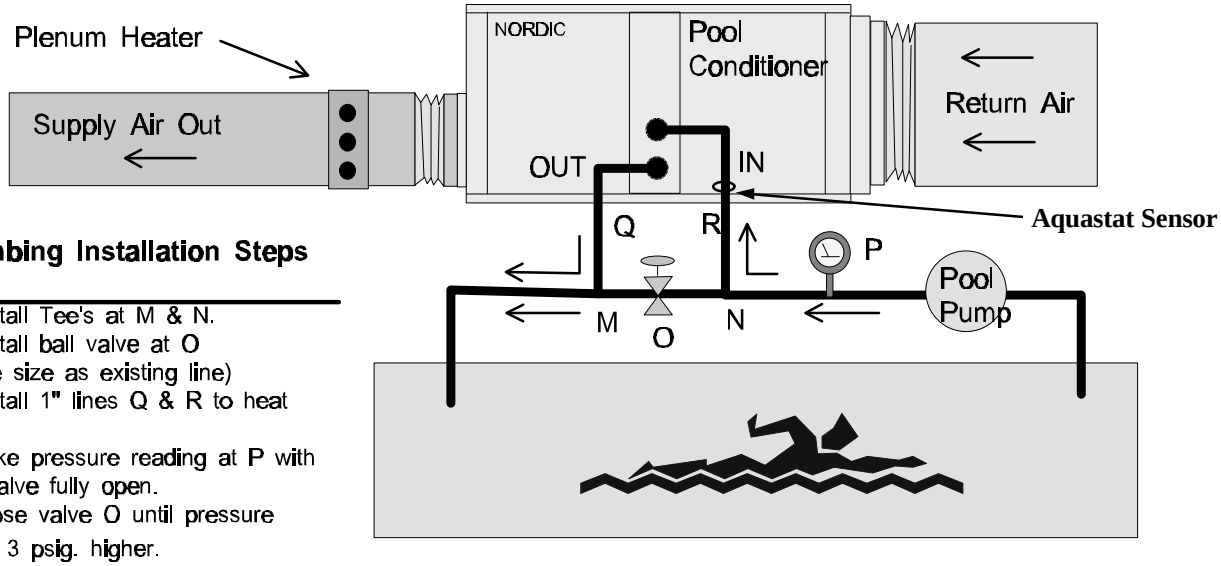


24v Control Wiring Procedure (Use 18 gauge class 2 thermostat wire)

Mount the two Ranco® thermostats in a convenient location near the pool conditioner. Mount the sensor of the pool room t'stat (PRT) in a suitable location which will indicate your average room temperature. Install the PWT sensor in a dry well located in the pool water return line or tape securely to the water line and insulate so that it will not be affected by ambient air temperature.

NOTE: do NOT immerse the sensor of the pool water t'stat (PWT) directly in the water.

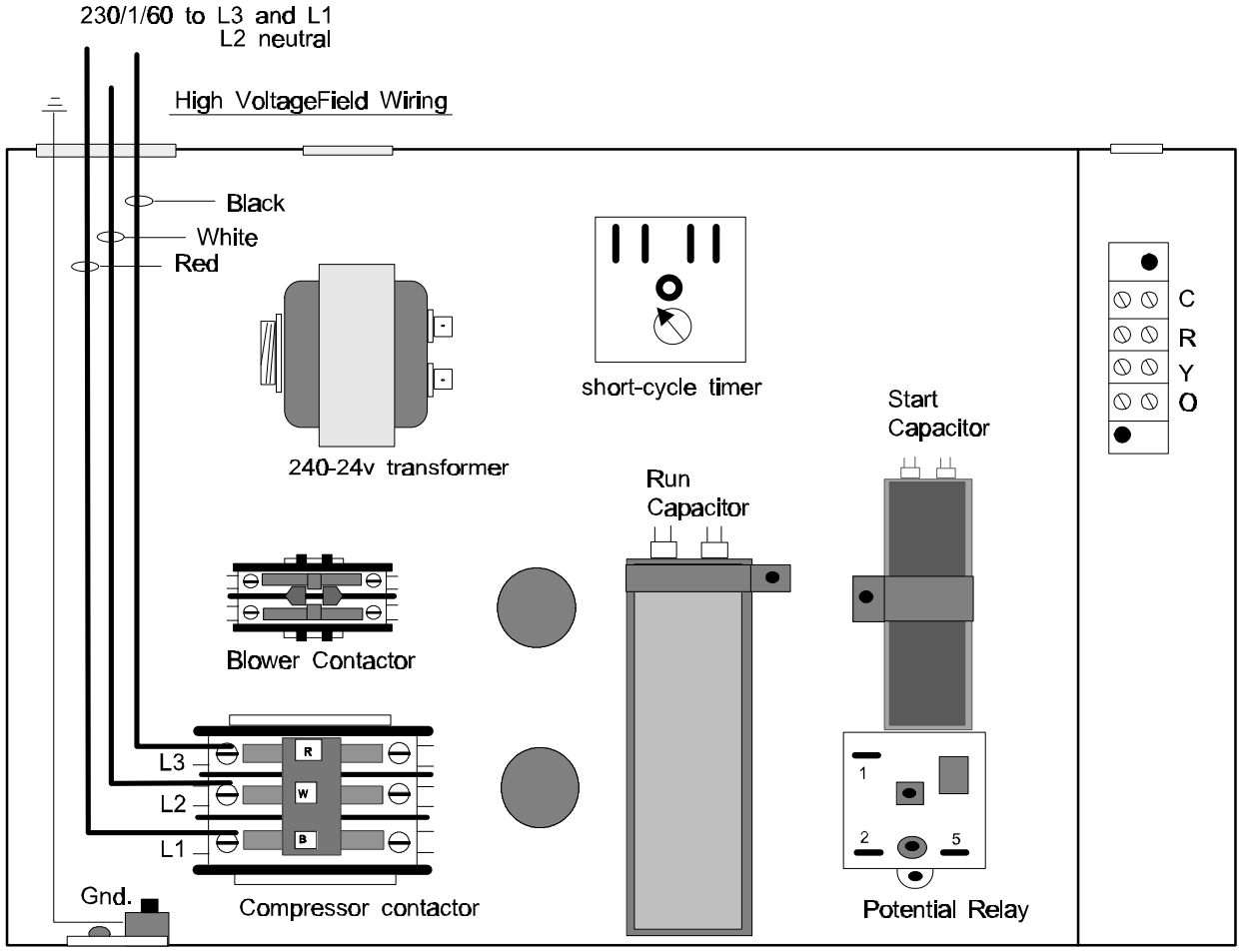
1. Connect "Y" and "R" in the PC control box to the "make-on-rise" terminals of the de-humidistat supplied.
2. Connect "C" in the PC control box to "Com" in both the Ranco® (PRT) and the Ranco® (PWT).
3. Connect "R" in the PC control box to "24v" in both the Ranco® t'stats and also to "C" on stage1 of both the (PRT) and (PWT).
4. Connect "O" on the PC control box to "C" on stage2 of the PWT.
5. Connect "Y" in the PC control box to the "NO" terminal of PWT stage1.
6. Connect "NO" of PRT stage1 to "NC" of PWT stage1 **and** stage2.
5. Connect "C" and "NO" of PRT stage2 to "C" and "1" in the plenum heater.



Plumbing Installation Steps

1. Install Tee's at M & N.
2. Install ball valve at O (same size as existing line)
3. Install 1" lines Q & R to heat pump.
4. Take pressure reading at P with ball valve fully open.
5. Close valve O until pressure reads 3 psig. higher.

PC Electrical Box Connections

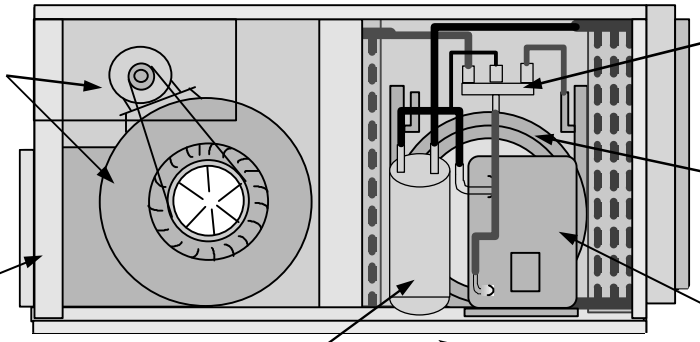


PC Features and Component Layout

Blower
Belt Drive
Variable Speed Pulley
High Efficiency PSC motor.

Cabinet
Uniweld construction with baked enamel finish. Satin galvanized and epoxy painted for corrosion protection.

Hard start kits standard on all single phase models.



Change over valve
Instant change over from pool heating to air heating.

Turbotec® Expanded Surface **cupro-nickel** coaxial heat exchanger on pool water side.

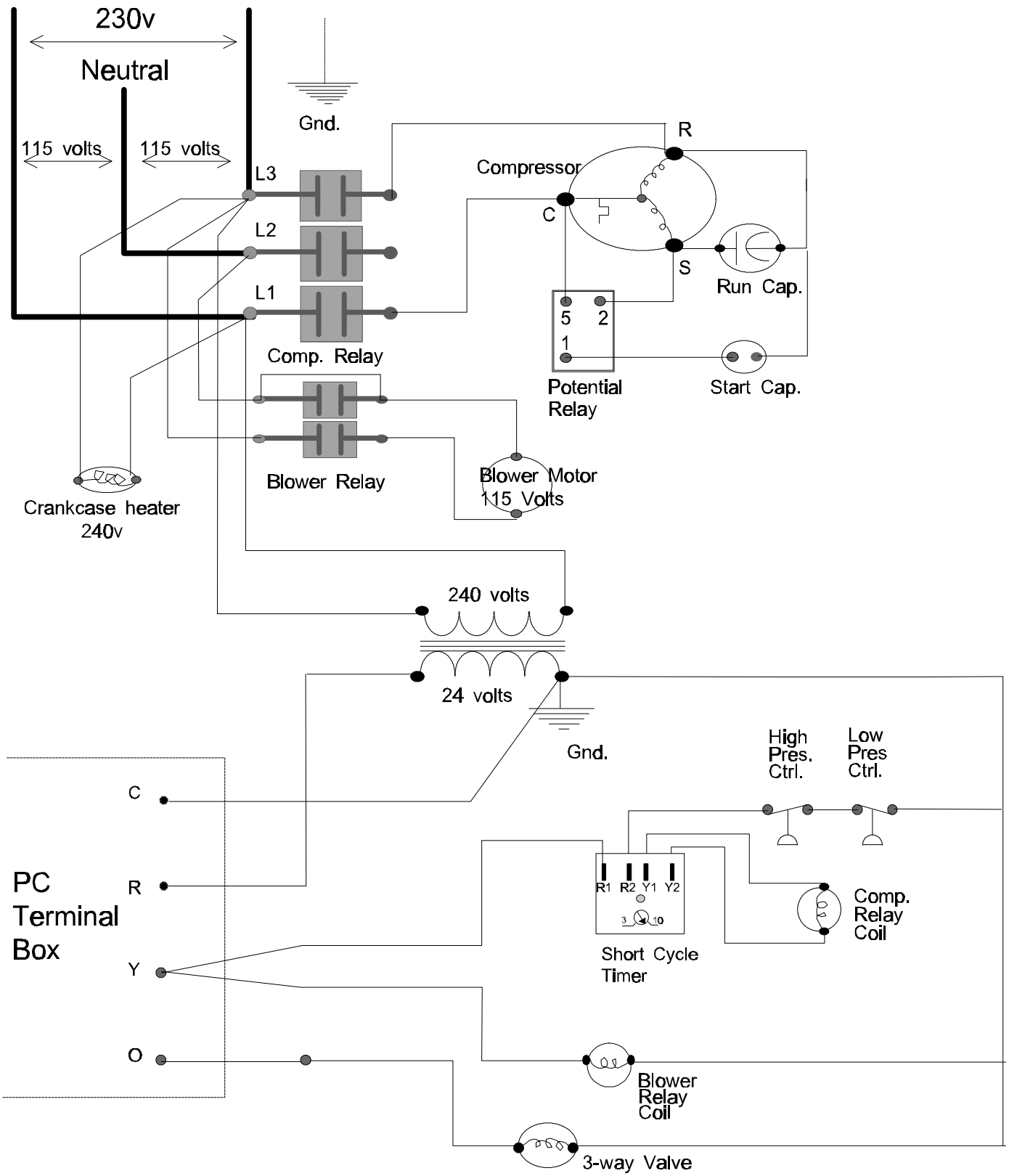
Compressor
High Efficiency trouble fee reciprocating design.

Accumulator
Prevents liquid slugging during start-up.

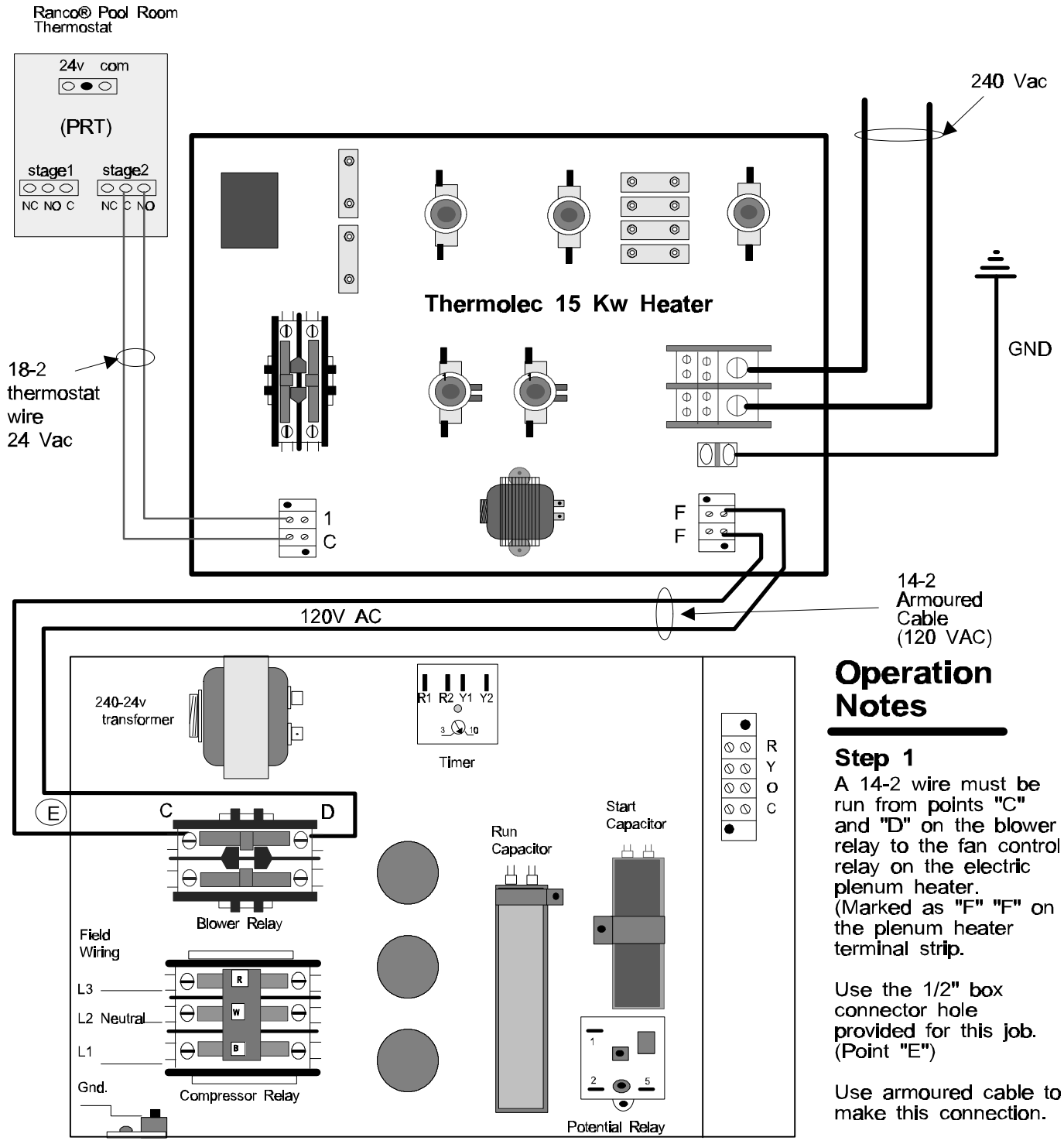
Thermostatic expansion valve
system assures optimum performance under all load conditions.

Air coils
Large coil face area to compressor ratio. Sized for maximum humidity removal under a wide range of operating conditions.

PC Schematic Diagram



Plenum Heater Connections



Operation Notes

Step 1

A 14-2 wire must be run from points "C" and "D" on the blower relay to the fan control relay on the electric plenum heater. (Marked as "F" "F" on the plenum heater terminal strip.

Use the 1/2" box connector hole provided for this job. (Point "E")

Use armoured cable to make this connection.

This method of operating the blower motor provides line voltage control of the blower motor independent of the heat pump. The only requirement is that the heat pump main breaker be on since the heat pump circuit is actually supplying power to the blower motor.

Duct Sizing Guide

Required CFM	Diameter in inches	Rectangular Equivalents						Return Air Diameter	Required CFM
37	5	2.25 x 10	3 x 8	3.5 x 6	4 x 5.5	5 x 5	`	5	37
63	5	2.25 x 10	3 x 8	3.5 x 6	4 x 5.5	5 x 5		6	63
100	6	3.25 x 10	4 x 8	5 x 6	5.5 x 5.5	6 x 6		7	100
152	7	3.25 x 14	4 x 11	5 x 8.5	6 x 7	6.5 x 6.5		8	152
212	8	4 x 15	5 x 12	6 x 10	7 x 8	8 x 8		9	212
226	8	4 x 15	5 x 12	6 x 10	7 x 8	8 x 8		10	226
277	9	5 x 15	6 x 12	7 x 10	8 x 9	8.5 x 8.5		10	277
304	9	5 x 15	6 x 12	7 x 10	8 x 9	8.5 x 8.5		12	304
393	10	6 x 15	7 x 13	8 x 11	9 x 10	9.5 x 9.5		12	393
411	12	7 x 18	8 x 16	9 x 14	10 x 12	11 x 11		12	411
655	12	7 x 18	8 x 16	9 x 14	10 x 12	11 x 11		14	655
680	14	8 x 22	9 x 19	10 x 17	11 x 15	12 x 14	13 x 13	14	680
995	14	8 x 22	9 x 19	10 x 17	11 x 15	12 x 14	13 x 13	16	995
1325	16	8 x 30	10 x 22	12 x 18	14 x 16	15 x 15		18	1325
1450	16	8 x 30	10 x 22	12 x 18	14 x 16	15 x 15		20	1450
1750	18	8 x 40	10 x 30	12 x 24	14 x 20	16 x 17	16.5 x 16.5	20	1750
2000	18	8 x 40	10 x 30	12 x 24	14 x 20	16 x 17	16.5 x 16.5	22	2000
2250	20	10 x 38	12 x 30	14 x 26	16 x 22	18 x 19	18.5 x 18.5	22	2250
2600	20	10 x 38	12 x 30	14 x 26	16 x 22	18 x 19	18.5 x 18.5	24	2600
2900	22	12 x 36	14 x 30	16 x 26	18 x 23	20 x 20		24	2900
3400	22	12 x 36	14 x 30	16 x 26	18 x 23	20 x 20		26	3400
3600	24	14 x 38	16 x 32	18 x 28	20 x 25	22 x 22		26	3600
4300	24	14 x 38	16 x 32	18 x 28	20 x 25	22 x 22		28	4300
5250	26	16 x 38	18 x 32	20 x 30	22 x 24	24 x 24		30	5250
6125	28	18 x 38	20 x 34	22 x 30	24 x 28	26 x 26		32	6125
6500	28	18 x 38	20 x 34	22 x 30	24 x 28	26 x 26		34	6500
7250	30	20 x 40	22 x 38	24 x 32	26 x 30	28 x 28		34	7250
7800	30	20 x 40	22 x 38	24 x 32	26 x 30	28 x 28		36	7800
8500	32	22 x 40	24 x 38	26 x 34	28 x 32	30 x 30		36	8500
9200	32	22 x 40	24 x 38	26 x 34	28 x 32	30 x 30		38	9200
9800	34	24 x 42	25 x 40	26 x 38	28 x 34	30 x 32	31 x 31	38	9800
10900	34	24 x 42	25 x 40	26 x 38	28 x 34	30 x 32	31 x 31	40	10900
		28 x 40	30 x 36	32 x 34	33 x 33				
		30 x 42	32 x 38	34 x 36	35 x 35				
		30 x 45	34 x 40	36 x 38	37 x 37				

L I M I T E D W A R R A N T Y

MARITIME GEOTHERMAL LTD. warrants that the heat pumps manufactured by it shall be free from defects in materials and workmanship for a period of (1) ONE YEAR after the date of installation or for a period of (1) ONE YEAR AND (60) SIXTY DAYS after the date of shipment, whichever occurs first. In addition MARITIME GEOTHERMAL LTD. warrants that the compressor shall be free of defects in materials and workmanship for an additional period of (48) FORTY-EIGHT MONTHS from said date.

MARITIME GEOTHERMAL LTD. shall, at it's option repair or replace any part or parts covered by this warranty which shall be returned to MARITIME GEOTHERMAL LTD., transportation charges prepaid, which, upon examination proves to be defective in materials or workmanship. Replacement or repaired parts and components are warranted only for the remaining portion of the original warranty period.

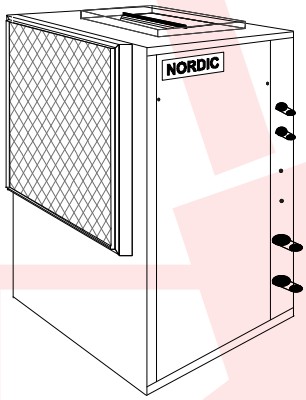
This warranty is subject to the following conditions:

1. The NORDIC® heat pump must be properly installed and maintained in accordance with MARITIME Geothermal LTD.'s installation and maintenance instruct ions.
2. The installer must complete the "**Installation Data Sheet**", have it endorsed by the owner and return it to Maritime Geothermal Ltd. within 21 days after the installation of the unit.

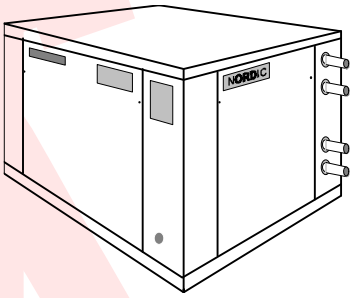
3. It is the responsibility of the building or general contractor to supply temporary heat to the structure prior to occupancy. These heat pumps are designed to provide heat only to the completely finished and insulated structure. Start-up of the unit shall not be scheduled prior to completion of construction and final duct installation for validation of this warranty.
4. It is the customer's responsibility to supply the proper quantity and quality of water.

If the heat pump, manufactured by MARITIME GEOTHERMAL LTD. fails to conform to this warranty, MARITIME GEOTHERMAL LTD. 's sole and exclusive liability shall be, at it's option, to repair or replace any part or component which is returned by the customer during the applicable warranty period set forth above, provided that (1) MARITIME Geothermal LTD. is promptly notified in writing upon discovery by the customer that such part or component fails to conform to this warranty. (2) The customer returns such part or component to MARITIME GEOTHERMAL LTD., transportation charges prepaid, within (30) thirty days of failure, and (3) MARITIME GEOTHERMAL LTD. 's examination of such component shall disclose to it's satisfaction that such part or component fails to meet this warranty and the alleged defects were not caused by accident, misuse, neglect, alteration, improper installation, repair or improper testing.

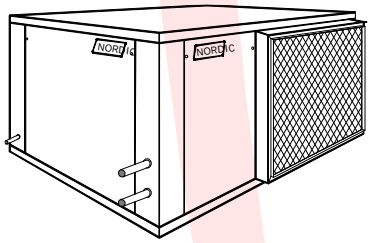
Maritime Geothermal Ltd.
has the solution for all your
heating and cooling projects



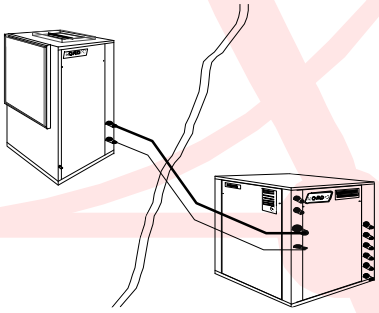
Vertical
Liquid-to-Air



Liquid-to-Liquid



Horizontal Slim
Liquid-to-Air



Split Systems

NORDIC® – Environmentally sound solutions to today's Heating and Cooling needs.