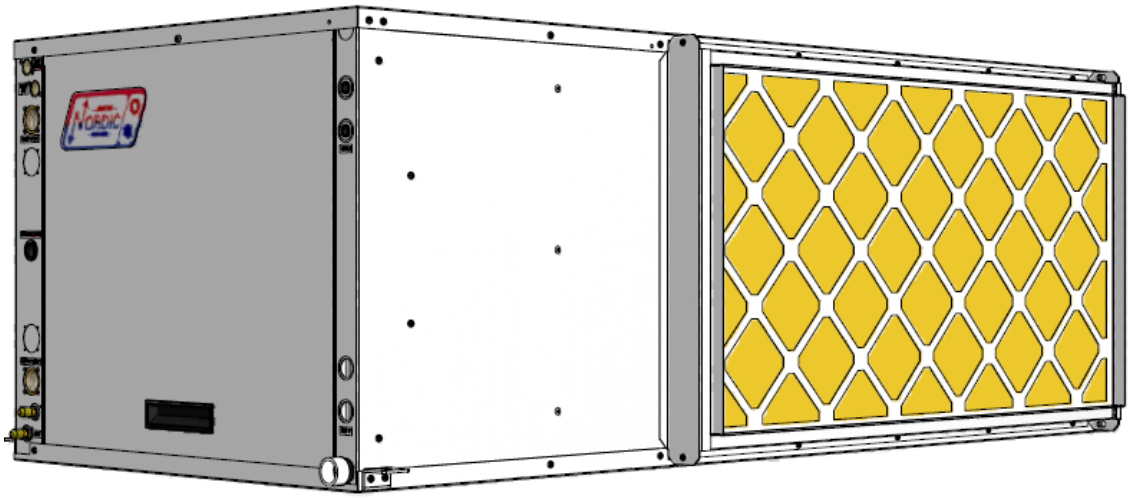
MARITIME GEOTHERMAL LTD.

Installation and Service Manual

NORDIC® RH-Series

Horizontal Two-Stage R410a
Model Sizes 25-80

Horizontal Liquid to Air Geothermal Heat Pumps



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SAFETY PRECAUTIONS

WARNING: **Ensure all access panels are in place and properly secured before applying power to the unit. Failure to do so may cause risk of electrical shock.**

WARNING: **Before performing service or maintenance on the heat pump system, ensure all power sources are DISCONNECTED. Electrical shock can cause serious personal injury or death.**

WARNING: **Heat pump systems contain refrigerant under high pressure and as such can be hazardous to work on. Only qualified service personnel should install, repair, or service the heat pump.**

CAUTION: **Safety glasses and work gloves should be worn at all times whenever a heat pump is serviced. A fire extinguisher and proper ventilation should be present whenever brazing is performed.**

CAUTION: **Venting refrigerant to atmosphere is illegal. A proper refrigerant recovery system must be employed whenever repairs require removal of refrigerant from the heat pump.**

MODEL NOMENCLATURE

RH—65—HACW—P—1T—C—SDELF—xx

Series:
RH = Horizontal Slim-Line
Active Cooling Liquid to Air

Nominal Size:
25 = 2 Ton
45 = 3 Ton
55 = 4 Ton
65 = 5 Ton
75 = 6 Ton
80 = 6 Ton Single Stage

Functions:
H = Heating
AC = Active Cooling
W = Domestic Hot Water

Refrigerant:
P = R410a

Voltage Code:
1 = 230-1-60 VAC
2 = 208-3-60 VAC
6 = 220-1-50 VAC
7 = 380-3-50 VAC

Compressor Stages*:
S = 1 Stage
T = 2 Stage
* 2 stage unless unavailable due to voltage code, refer to the **Electrical Tables**.

Outdoor Loop Exchanger:
C = Copper
Z = Cupro-Nickel (CuNi)

Air Coil:
S = Standard

Fan Type:
D = Direct Drive

Fan Motor:
E = ECM (Variable Speed)

Fan Return Orientation:
L = Left Return
R = Right Return

Fan Outlet Orientation:
F = Field Configurable

Revision:
01, 02 etc.

APPLICATION TABLE

SIZE	FUNCTION	REFRIGERANT	VOLTAGE	STAGES	OUTDOOR COIL	FAN/CASE	REVISIONS				
25	HAC	P	1	T	C or Z	SDELF or SDERF	05	04	03		
			2	S			05	04	03		
			6	S			05	04	03		
			7	S			05	04	03		
	HACW		1	T			05	04	03		
			2	S			05	04	03		
			6	S			05	04	03		
			7	S			05	04	03		
45	HAC	P	1	T	C or Z	SDELF or SDERF	05	04	03		
			2	T			05	04	03		
			6	S			05	04	03		
			7	T			05	04	03		
	HACW		1	T			05	04	03		
			2	T			05	04	03		
			6	S			05	04	03		
			7	T			05	04	03		
55	HAC	P	1	T	C or Z	SDELF or SDERF	05	04	03		
			2	T			05	04	03		
			6	S			05	04	03		
			7	T			05	04	03		
	HACW		1	T			05	04	03		
			2	T			05	04	03		
			6	S			05	04	03		
			7	T			05	04	03		
65	HAC	P	1	T	C or Z	SDELF or SDERF	05	04	03		
			2	T			05	04	03		
			6	S			05	04	03		
			7	T			05	04	03		
	HACW		1	T			05	04	03		
			2	T			05	04	03		
			6	S			05	04	03		
			7	T			05	04	03		
75	HAC	P	1	T	C or Z	SDELF or SDERF	05	04	03		
			2	S			05	04	03		
			6	S			05	04	03		
			7	S			05	04	03		
	HACW		1	T			05	04	03		
			2	S			05	04	03		
			6	S			05	04	03		
			7	S			05	04	03		
80	HAC	P	1	S	C or Z	SDELF or SDERF	05	04	03		
	HACW		1	S			05	04	03		

This manual applies only to the models and revisions listed in this table

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DIAGRAMS

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Installation Information

UNIT DESCRIPTION

The RH-Series unit is a high efficiency two-stage geothermal heat pump with environmentally friendly R410a refrigerant. Two-stage units offer a significant efficiency increase over single stage units when operating in the reduced capacity mode (stage 1).

The RH-Series has a compact horizontal case design with corner mounts allowing it to be suspended from the ceiling if desired. The fan is mounted to an access panel and can easily be switched from straight through to end discharge configuration.

An electrically commutated (ECM) fan with several speed options is standard. The motor has a soft start function for improved efficiency and reduced wear.

The unit has several key features that are described in the specifications document for the particular heat pump. Please request a copy if desired or visit **www.nordicghp.com**

UNPACKING THE UNIT

When the heat pump reaches its 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 ensure that it will arrive intact, however it is in the customer's best interest to examine the unit thoroughly when it arrives.

OPTIMUM PLACEMENT

For liquid to air units, to achieve the greatest efficiency, the heat pump should be centrally located in the home with respect to the conditioned space. This design provides the utmost in economy and comfort and usually can be accomplished in harmony with the design of the home. A heating system cannot be expected to produce an even warmth throughout the household when it is located at one end of the structure and the warm air is transmitted with uninsulated metal ductwork.

If possible the access panels should remain clear of obstruction for a distance of **two feet** to facilitate servicing and general maintenance. **DO NOT STACK UNITS ON TOP OF EACH OTHER**. The cases are not designed to hold the weight of another unit. Stacking should only be done with a proper rack system able to hold a minimum of **2x** the weight of the unit.

Raising the heat pump off the floor a few inches is generally a good practice and also helps prevent rusting of the bottom panel of the unit. We recommend that the heat pump be placed on a piece of 2" thick styrofoam. The styrofoam will smooth out any irregularities in the cement floor and deaden any compressor noise emitted from the bottom of the cabinet.

If the unit is to be suspended ensure that the mounting system can hold at least **2 times** the weight of the unit for safety reasons.

NORDIC® heat pumps have an air-filter rack which can be installed with the removable end (where the filter is inserted) on either side to facilitate changing the filter.

ELECTRICAL CONNECTIONS

The heat pump has a concentric 1.093" / 0.875" knockout for power supply connection to the electrical box, as well as one for connection to the circulator pump module for ground loop applications. There are two 1/2" openings with plastic grommets (grommet hole is 3/8") in the upper section of the electrical box, one for the thermostat connections, and one for the optional plenum heater connections.

A schematic diagram and electrical box layout diagram (ELB) can be found inside the electrical box cover of the unit as well as in the Model Specific section of this manual. The Electrical Tables in the Model Specific section and the ELB diagram contain information about the size of wire for the connections, as well as the recommended breaker size. **A properly qualified electrician should be retained to make the connections to the heat pump and associated controls. The connections to the heat pump MUST CONFORM TO LOCAL CODES.**

CIRCULATOR PUMP MODULE WIRING (GROUND LOOP ONLY)

The heat pump has provisions for connecting the circulator pump module so that the pumps will be turned on whenever the compressor operates. Connect the circulator pump module to the appropriate two terminals of the terminal strip marked **OUTDOOR CIRCULATORS** in the heat pump, as per the voltage of the circulator pump module. Ensure that the total current draw does not exceed the value indicated on the label in the heat pump electrical box. Refer to the electrical box drawing on the electrical box cover for more information.

THERMOSTAT REQUIREMENTS

The RH-Series unit requires a three-stage heating and two stage cooling thermostat for proper operation. The stages are S1 = Stage 1 compressor, S2 = Stage 2 compressor and S3 = electric auxiliary (heating only). One can be purchased with the unit, or other thermostats with the same number of stages can be used. The electrical box diagram on the electrical box cover provides a description of the signal connections as in **TABLE 1**.

TABLE 1 - Control Signal Description

Signal	Description
C	**24VAC Common (Ground)**
G	**Fan low speed (for air circulation)**
Y_1	**Heat Pump Stage 1**
R_H	**24VAC Hot**
L	**Fault (24VAC when fault condition)**
W_2/E	**Heat Pump Stage 3 (auxiliary heat) / Emergency Heat**
O/B/W_1	**Cooling Mode (reversing valve)**
Y_2	**Heat Pump Stage 2**
AR_1	**Airflow Reduction***
AR_2	**Airflow Reduction***
I	**Plenum Heater dry contact**
1	**Plenum Heater dry contact**

***** Connect AR_1 to AR_2 with a dry contact to reduce the airflow by 15%. Refer to the Fan Motor sub-section for more information.

NOTE: Some three phase units are not available in two-stage at the present time. The Y2 signal is not used for these units.

FAN MOTOR

The unit is equipped with a direct drive ECM fan motor for maximum efficiency. The motor features a soft start which further improves efficiency by eliminating inrush current and provides a smooth, quiet ramp up to speed . The motor will maintain the programmed air flow up to the maximum external static value. Refer to the **APPENDIX B: ECM Fan Airflow Tables.**

The air flow can be set to four different levels by changing the position on the Air Flow board located in the electrical box. The four levels are indicated in **TABLE 2**. The actual air flow values can be found in **APPENDIX B**.

TABLE 2 - Airflow Selections

Position	Airflow
LOW	-6%
MED	Nominal
HIGH	+6%
MAX	+12%

Units are shipped with the **MED** position selected for nominal air flow. The air flow can be further reduced by 15% by making a dry contact across AR_1 and AR_2 on the terminal strip. This can be used for applications that have multiple zones, or retrofits with undersized ductwork, to help reduce air flow noise in the ductwork. It is recommended that airflow reduction only be used with the High or Max air flow setting. Care should be taken to ensure that the unit does not trip a safety control in heating or cooling mode if the 15% reduction is used in conjunction with the MED or LOW air flow setting.

FAN RETURN ORIENTATION

The RH-Series heat pump can be ordered as a left or right hand return from the factory. This must be specified at time of order as the physical construction of the two configurations is different. Refer to the specification documents for more details.

FAN OUTLET ORIENTATION

The RH-Series heat pumps have a field configurable fan. It's default location from the factory is in the end of the unit, providing a "ninety" in the airflow. It can easily be placed in the side of the unit for straight through airflow.

To switch the location of the fan outlet follow these simple steps:

1. Turn the power of to the unit.
2. Remove the screw that holds the side access panel in place and remove the access panel by pulling up on the handle and then outward from the bottom.
3. Repeat for the access panel with the fan mounted in it. Ensure the wire harnesses are free while removing the fan.
4. Disconnect the two wire harnesses and ground wire from the fan motor.
5. Place the fan in front of the new location and reconnect both harnesses and the ground wire.
6. Install the fan and secure with the screw.
7. Install the remaining access panel and secure with the remaining screw.

CONTROL TRANSFORMER

The low voltage controls are powered by a 75VA class II transformer. The transformer has a resettable breaker on the secondary side for circuit protection. Should the breaker trip, locate and correct the problem and then reset the breaker by pressing in on it.

SAFETY CONTROLS

The heat pump has two built in safety controls which are designed to protect the unit from situations which could damage it should the operation of the refrigeration circuit fall outside the allowable operating range.

A. Low Pressure Control

The low pressure control monitors the compressor suction pressure and will shut the compressor down if the refrigerant evaporating pressure becomes too low, risking the danger of freezing conditions in the evaporator.

There are (3) main reasons why this control would activate in response to the operating conditions of the unit while operating in heating mode:

1. Low or no Outdoor loop flow.
2. Low Outdoor loop entering liquid temperature.
3. Dirty or fouled Outdoor loop heat exchanger.

B. High Pressure Control

The high pressure safety control monitors the compressor discharge pressure and will shut the compressor down if the condensing pressure becomes too high.

There are (3) main reasons why this control would activate in response to the operating conditions of the unit while operating in heating mode:

1. Low or no airflow.
2. High return air temperature.
3. Dirty air coil due to poor filter maintenance.

The unit contains a control board that monitors the safety controls and operates the compressor accordingly. Refer to **APPENDIX A** for control board specifications. The low pressure control is connected to LP1 and LP2. The high pressure control is connected to HP1 and HP2.

The control board also has provisions for a flow switch. The flow switch is unused from the factory and a jumper wire is placed across the FLOW SWITCH terminals. If a flow switch is desired, the jumper can be removed and the two leads from the flow switch can be connected to the FLOW SWITCH terminals on the safety board. The flow switch is ignored for 30 seconds on compressor startup to allow time for flow to be established. The high and low pressure controls are monitored at all times. The compressor will not be able to start if either of them has a fault.

The control board has an on-board LED and a FAULT pin with a 24VAC output. An external indicator or relay can be connected across the FAULT pin and ground if external signaling is desired. Should a fault occur, the LED will flash the code of the fault condition while the safety control in question is open. The codes are shown in **TABLE 3.** The control board will lock out the compressor for five minutes when a fault occurs. Three retries per fault condition are allowed within a 60 minute period. If the fault condition occurs a fourth time the control board will permanently lock out the compressor and energize the FAULT pin. This can only be reset by powering down the unit. The LED will flash the fault code until the unit is reset.

If the control board enters permanent lockout mode there is a serious problem with the system and it must be rectified if the unit is to maintain good service.

TABLE 3 - Control Board Fault Codes	
Fault	**Code**
High Pressure	**1**
Low Pressure	**2**
Flow	**3**

WARNING: REPEATED RESETS OF A LOW PRESSURE LOCKOUT COULD CAUSE THE HEAT EXCHANGER TO FREEZE AND RUPTURE, DESTROYING THE HEAT PUMP AND VOIDING THE WARRANTY.

DOMESTIC HOT WATER CONNECTIONS (HACW ONLY)

A typical piping diagram for a pre-heat tank (two-tank) configuration can be found in **drawing 000970PDG** at the end of this section. Be sure to note the position of the check valve and the direction of water flow. Other configurations are possible, and there may be multiple units tied together in larger buildings.

WARNING: USE ONLY COPPER LINES TO CONNECT THE DESUPERHEATER. TEMPERATURES COULD REACH 200F SHOULD THE DHW CUTOUT SWITCH FAIL, POTENTIALLY RUPTURING PEX PIPING.

Ensure the tank is filled with water and under pressure before activating the heat pump. Slightly loosen the boiler drain on the DHW Out pipe to allow air to escape from the system before the unit is started. This step will make certain that the domestic hot water circulator in the unit is flooded with water when it is started.

CAUTION: the domestic hot water pump is water lubricated; damage will occur to the pump if it is run dry for even a short period of time.

Connect the brown wire with the blue insulated terminal to L1 of the compressor contactor. **Ensure the power is off when connecting the wire.**

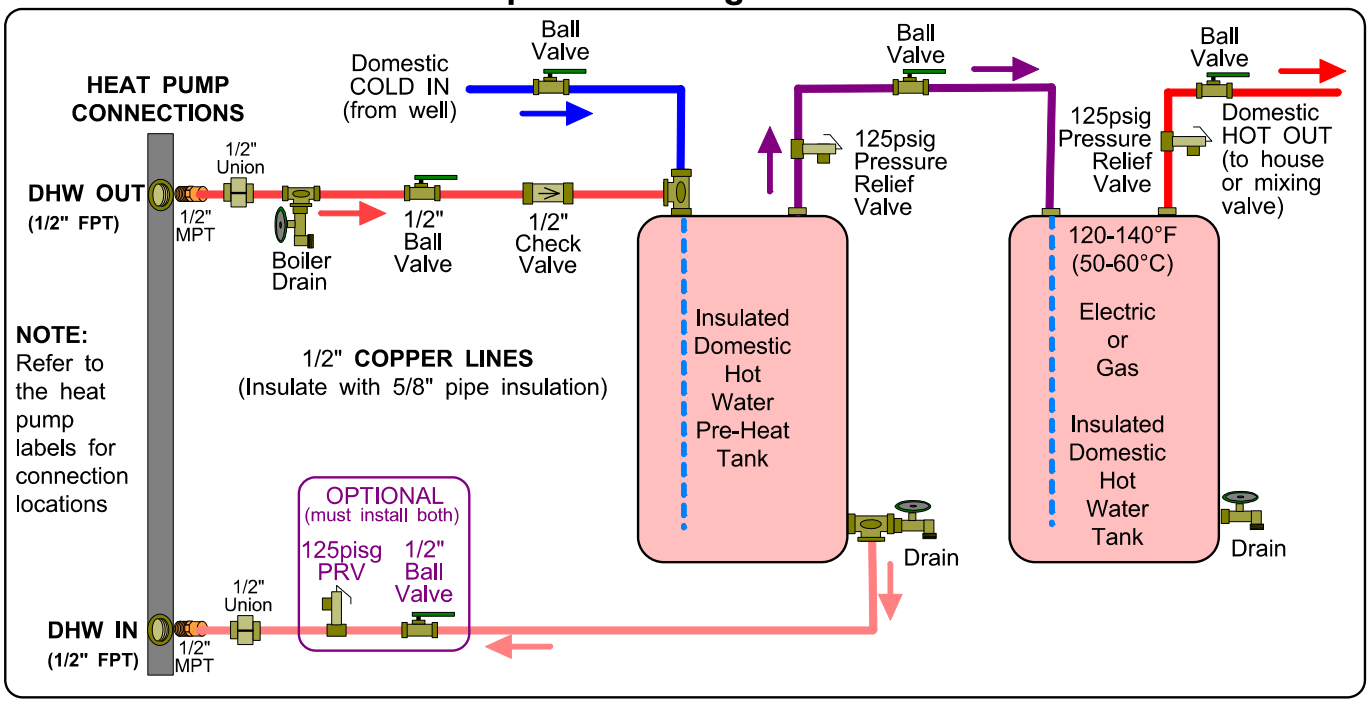
The DHW loop may have to be purged of air several times before good circulation is obtained. A temperature difference between the DHW In and DHW Out can be felt by hand when the circulator pump is operating properly.

For the pre-heat tank setup, the final tank should be set to **140°F(60°C),** unless local code requires a higher setting. The pre-heat tank does not require electric elements. This setup takes full advantage of the desuperheater as it is the sole heat provider to the pre-heat tank. The desuperheater remains active during the compressor runtime until the pre-heat tank has been completely heated by the desuperheater alone. This setup is more energy efficient than a single tank setup.

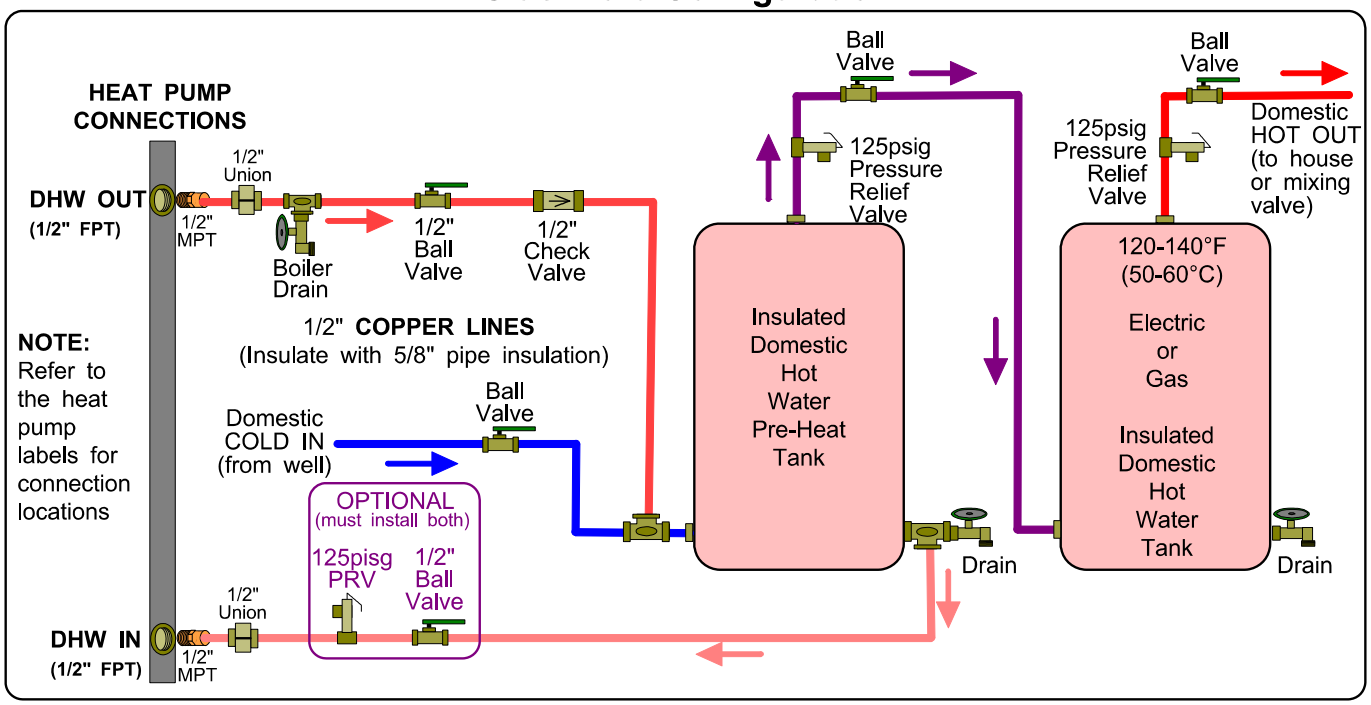
CAUTION: If two (2) shut-off valves are located on the domestic hot water ines as shown in the diagram, a pressure relief valve must be installed to prevent possible damage to the domestic hot water circulator pump should both valves be closed.

Single Unit Connection to Domestic Hot Water Pre-Heat Tank (Brass FPT)

Top Port Configuration



Side Port Configuration



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01	Initial Release	C. GEDDES	C. GEDDES	10 MAR 09

Drawn By: Chris Geddes	Date: 10 MAR 09	
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Approved By (MFG):	Date:	
Approved By:	Date:	

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Drawing Name: Single Unit Connection to DHW Pre-Heat Tank (Brass FPT)

Size	Drawing Number	REV	SHEET
A	000970PDG	01	1 of 1

HEAT PUMP SIZING

TABLE 4 depicts a rough guideline as to the size of home each heat pump size can handle for **ground loop** installations.

TABLE 4 - Heat Pump Size vs. Heated Area for a Ground Loop System

Model	Size (tons)	Sq.ft.	Sq.m.
25	2	800	75
45	3	1,400	130
55	4	2,000	185
65	5	2,600	240
75	6	3,100	290
80	6	3,500	325

TABLE 5 depicts a rough guideline as to the size a home each heat pump size can handle for **ground water** installations.

TABLE 5 - Heat Pump Size vs. Heated Area for a Ground Water System

Model	Size (tons)	Sq.ft.	Sq.m.
25	2	1,000	95
45	3	1,800	165
55	4	2,500	230
65	5	3,200	295
75	6	3,800	355
80	6	4,200	390

THE TABLES ABOVE ARE FOR INFORMATION ONLY, THEY SHOULD NOT BE USED TO SELECT A UNIT SIZE. They simply show on average what size unit is required for a typical two-level home (main level and below grade basement) with R-20 walls, R-40 ceiling and average size and number of windows. The Heated Area is the area of the main level, The tables account for a basement the same size as the heated area.

MARITME GEOTHERMAL LTD. HIGHLY RECOMMENDS THAT A PROPER HEAT LOSS/GAIN ANALYSIS BE PERFORMEDE BY A PROFESSIONAL INSTALLER WITH CSA APPROVED SOFTWARE BEFORE SELECTING THE SIZE OF UNIT REQUIRED FOR THE APPLICATION. For heating dominant areas, we recommend sizing the unit to 100% of the heating design load for maximum long term efficiency with minimal supplementary heat. The unit should be installed as per CSA 448.2-02. For ground loop applications, the ground exchanger should be designed using suitable software with a multi-year analysis.

There are many factors to consider when sizing the heat pump. Some of these factors include the number of levels, the size of the windows, the orientation of the home, attached garage, bonus rooms, walk-in basement, coldest outdoor temperature, etc. The heat loss program will take all of these factors into consideration in its calculations. An undersized installation will require not be as efficient and will required expensive supplemental heat to maintain a comfortable temperature in the home, and the cost savings of having a geothermal heat pump are greatly reduced.

Once the total heat loss has been calculated, the unit can be sized using the performance tables (from the specifications document) in conjunction with the minimum expected entering liquid temperature of the ground loop (well water temperature for ground water system). The heat pump output must be able to match the total heat loss at the selected entering water temperature in order to provide a comfortable environment with minimal auxiliary heat.

DUCT SYSTEMS - GENERAL

Ductwork layout for a NORDIC® heat pump will differ from traditional hot air furnace design in the number of leads and size of main trunks required. Air temperature leaving the heat pump is normally **95º -105ºF (35-40ºC)**, much cooler than that of a conventional warm air furnace. To compensate for this, larger volumes of lower temperature air must be moved and consequently duct sizing must be able to accommodate the greater air flow without creating a high static pressure or high velocity at the floor diffusers.

A duct system capable of supplying the required air flow is of utmost importance. Maritime Geothermal Ltd. recommends that the static pressure be kept below 0.2 inches of water total. In some instances the number of floor diffusers will actually double when compared to the number that would be used for a hot air oil-fired furnace. Refer to **TABLE 8** at the end of this section.

1. Generally allow **100 cfm** for each floor grill.
2. All leads to the grills should be 6" in diameter (28sq.in. each).
3. The main hot air trunks should be at least 75% of the square surface area of leads being fed at any given point.
4. Return air grills should have a minimum of the same total square surface area as the total of the supply grills.
5. The square surface area of the return trunks should equal the square surface area of the grills being handled at any given point along the trunk.

It is ***VERY IMPORTANT*** that all turns in both the supply trunks and the return trunks be made with ***TURNING RADII***. Air acts like a fluid and pressure drop is increased when air is forced to change direction rapidly around a sharp or irregular corner.

It is recommended that flexible collars be used to connect the main trunks to the heat pump. This helps prevent any vibrations from travelling down the ductwork. If a plenum heater is installed, the collar should be at least 12” away from the heater elements.

The first 5-10 feet of the main supply trunks should be insulated with acoustical duct insulation to further inhibit any noise from the unit from travelling down the ductwork. If a plenum heater is installed, insulation should not be placed within 12” of the heater elements.

Drawing 000822CDG shows a typical installation.

DUCT SYSTEMS - GRILL LAYOUT

Most forced air heating systems in homes have the floor grills placed around the perimeter of the room to be heated. Supply grills should be placed under a window when possible to help prevent condensation on the window. As mentioned in the previous sub-section, supply grill leads should be 6" in diameter (28 sq.in. each) to allow **100cfm** of air flow.

In a typical new construction, there should be one supply grill for every 100sq.ft. of area in the room. When rooms require more than one grill, they should be placed in a manner that promotes even heat distribution, such as one at each end of the room. It is always a good idea to place a damper in each grill supply or place adjustable grills so that any imbalances in the heat distribution can be corrected.

The total number of supply grills available is based on the heat pump nominal airflow. **TABLE 6** shows the number of grills available per heat pump size.

TABLE 6 - Heat Pump Size vs. Hot Air Grills

Model	Size (tons)	# of Grills (@100cfm)
25	2	8
45	3	12
55	4	15
65	5	29
75	6	21
80	6	24

Return grills should be mounted on the floor. At minimum they should be the same size as the supply grill, **it is highly recommended that they be 25% to 50% larger than the total supply.** They should be placed opposite the supply grills when possible to ensure distribution across the room. For rooms requiring more than one supply grill, it may be possible to use one larger return grill if it can be centrally positioned opposite of the supply grills, however it is preferred to have one return for each supply to maximize heat distribution across the room.

THERMOSTAT LOCATION

Most homes are a single zone with one thermostat. The thermostat should be centrally located within the home, typically on the main floor. It should be placed away from any supply grills, and should not be positioned directly above a return grill. Most installations have the thermostat located in a hallway, or in the inner wall of the living room. It should be noted that most homes do not have any supply ducts in the hallway. This can lead to a temperature lag at the thermostat if there is very little air movement in the hallway, causing the home to be warmer than indicated by the thermostat.

PLENUM HEATER (OPTIONAL)

For installations that do not already have a backup heat source such as electric baseboard, wood stove, propane etc, it is recommended that a plenum heater be installed. This provides two functions.

The first function of the plenum heater is to act as an auxiliary heat source. As such it will provide additional heat on extremely cold days if the heat pump is unable to bring the home temperature up quickly enough, eliminating any discomfort to the homeowner.

The second function of the plenum heater is to provide emergency heat should a problem occur that causes the heat pump to be locked out. This can be engaged by setting the thermostat to emergency heat, allowing the plenum heater to function while preventing the heat pump from operating. Should the heat pump fail while the home is vacant, the auxiliary function of the thermostat will maintain the temperature setting of the thermostat.

The plenum heater is powered separately from the heat pump. Only two control wires are needed to connect the plenum heater to the heat pump. Refer to the label on the plenum heater or the electrical box diagram on the inside of the electrical box cover of the unit for details on the connections.

The plenum heater should be mounted in the supply duct in a manner that allows all of the airflow to pass through it to prevent any hot spots in the heater elements.

TABLE 7 shows the recommended size plenum heater, as well as the wire size and breaker size needed to provide power to the plenum heater.

TABLE 7 - Plenum Heater Sizing

Heat Pump		Plenum Heater (230-1-60)			
Model	Size (Tons)	Size (kW)	Current (A)	Breaker (A)	Wire Size
25	2	5	21	40	#10
45	3	10	42	60	#6
55	4	15	62	100	#3
65	5	20	84	125	#3
75	6	20	84	125	#3
80	6	20	84	125	#3

CONDENSATE DRAIN

The unit comes equipped with a 3/4" PVC socket fitting (female) labeled "Condensate Drain". This drain allows the condensate which forms during the air-conditioning cycle to be removed from the unit. The drain should be connected as per local codes. During high humidity weather, there could be as much as 25 gallons of water formed per day.

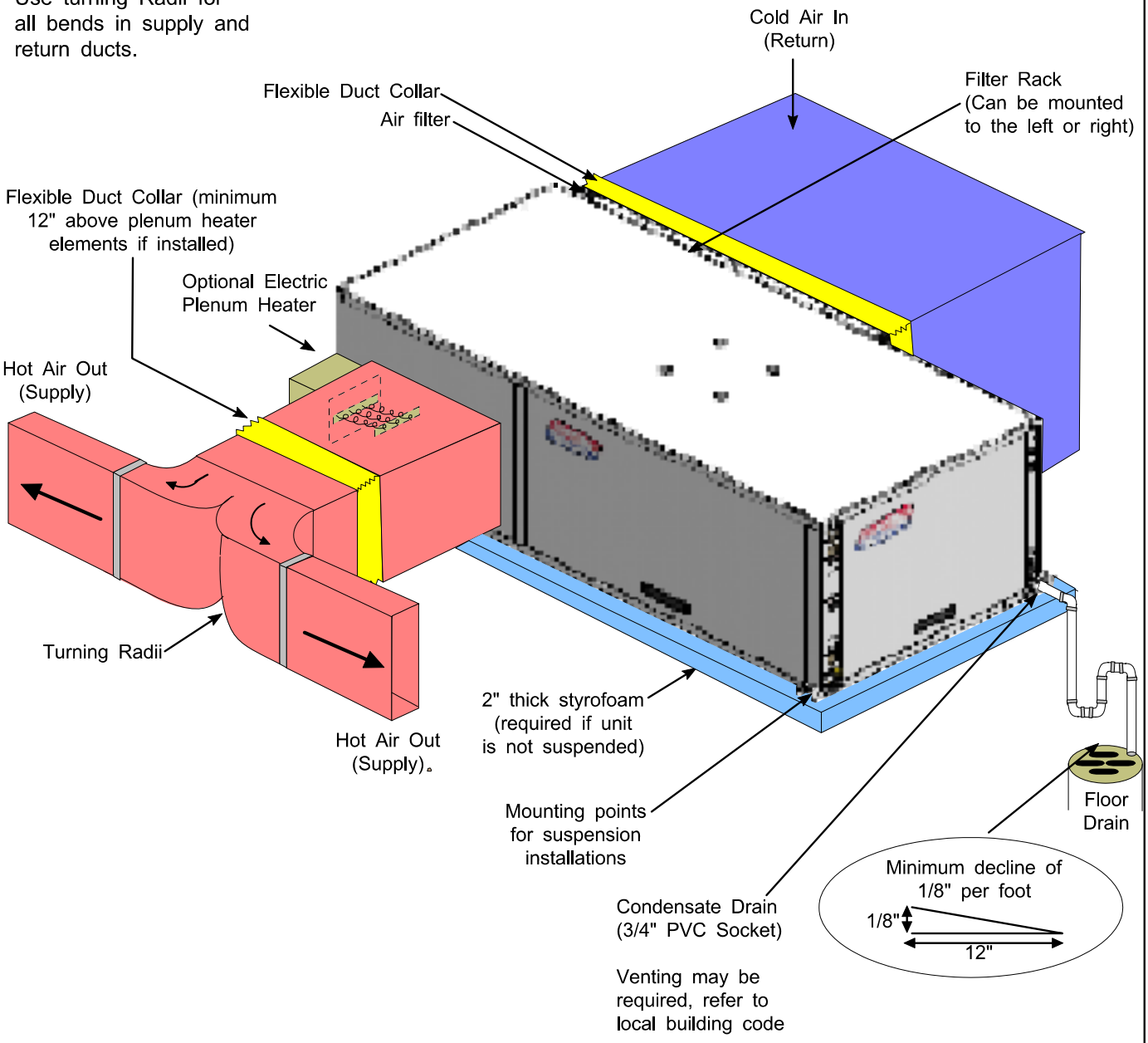
Care should be taken in the spring to ensure that this pipe is not plugged with dust that has collected during the winter causing the condensate to overflow into the bottom of the heat pump and onto the floor. **The condensate drain must be externally trapped and proper venting is required external to the heat pump as well. Refer to local codes to ensure the installation is done properly.**

Drawing 000822CDG shows a typical installation.

Typical Duct and Condensate Connections (Horizontal Case)

Ducts should be sized as per the Duct Sizing table in this manual

Use turning Radii for all bends in supply and return ducts.



Accoustic insulation may be used inside the ducts near the unit to dampen any air noise that may be present. Ensure there is no insulation within 12" of the plenum heater if installed.

REV	ECO #	IMPL BY	APVD BY	DATE
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Drawn By	Chris Geddes	Date 02 SEP 08
Checked By	Chris Geddes	Date 02 SEP 08
Approved By (ENG)	Chris Geddes	Date 02 SEP 08
Approved By (MFG)		Date
Approved By		Date

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Drawing Name: Typical Duct and Condensate Connections (Horizontal Case)

Size	Drawing Number	REV	SHEET
A	000822CDG	01	1 of 1

TABLE 8 - Duct Sizing Guide (external static of 0.20"H2O)

Airflow (CFM)	Minimum Duct Area (sq.in)	Diameter (in)	Rectangular Equivalents (in)						Return Air Diameter (in)	Airflow (L/s)
37	20	5	2.25 x 10	3 x 8	3.5 x 6	4 x 5.5	5 x 5		5	17
63	20	5	2.25 x 10	3 x 8	3.5 x 6	4 x 5.5	5 x 5		6	30
100	28	6	3.25 x 10	4 x 8	5 x 6	5.5 x 5.5	6 x 6		7	47
152	38	7	3.25 x 14	4 x 11	5 x 8.5	6 x 7	6.5 x 6.5		8	72
212	50	8	4 x 15	5 x 12	6 x 10	7 x 8	8 x 8		9	100
226	50	8	4 x 15	5 x 12	6 x 10	7 x 8	8 x 8		10	107
277	64	9	5 x 15	6 x 12	7 x 10	8 x 9	8.5 x 8.5		10	131
304	64	9	5 x 15	6 x 12	7 x 10	8 x 9	8.5 x 8.5		12	143
393	79	10	6 x 15	7 x 13	8 x 11	9 x 10	9.5 x 9.5		12	185
411	113	12	7 x 18	8 x 16	9 x 14	10 x 12	11 x 11		12	194
655	113	12	7 x 18	8 x 16	9 x 14	10 x 12	11 x 11		14	309
680	154	14	8 x 22	9 x 19	10 x 17	11 x 15	12 x 14	13 x 13	14	321
995	154	14	8 x 22	9 x 19	10 x 17	11 x 15	12 x 14	13 x 13	16	470
1325	201	16	8 x 30	10 x 22	12 x 18	14 x 16	15 x 15		18	625
1450	201	16	8 x 30	10 x 22	12 x 18	14 x 16	15 x 15		20	684
1750	254	18	8 x 40	10 x 30	12 x 24	14 x 20	16 x 17	16.5 x 16.5	20	826
2000	254	18	8 x 40	10 x 30	12 x 24	14 x 20	16 x 17	16.5 x 16.5	22	944
2250	314	20	10 x 38	12 x 30	14 x 26	16 x 22	18 x 19	18.5 x 18.5	22	1062
2600	314	20	10 x 38	12 x 30	14 x 26	16 x 22	18 x 19	18.5 x 18.5	24	1227
2900	380	22	12 x 36	14 x 30	16 x 26	18 x 23	20 x 20		24	1369
3400	380	22	12 x 36	14 x 30	16 x 26	18 x 23	20 x 20		26	1605
3600	452	24	14 x 38	16 x 32	18 x 28	20 x 25	22 x 22		26	1699
4300	452	24	14 x 38	16 x 32	18 x 28	20 x 25	22 x 22		28	2029
5250	531	26	16 x 38	18 x 32	20 x 30	22 x 24	24 x 24		30	2478
6125	616	28	18 x 38	20 x 34	22 x 30	24 x 28	26 x 26		32	2891
6500	616	28	18 x 38	20 x 34	22 x 30	24 x 28	26 x 26		34	3068
7250	707	30	20 x 40	22 x 38	24 x 32	26 x 30	28 x 28		34	3422
7800	707	30	20 x 40	22 x 38	24 x 32	26 x 30	28 x 28		36	3681
8500	804	32	22 x 40	24 x 38	26 x 34	28 x 32	30 x 30		36	4012
9200	804	32	22 x 40	24 x 38	26 x 34	28 x 32	30 x 30		38	4342
9800	908	34	24 x 42	25 x 40	26 x 38	28 x 34	30 x 32	31 x 31	38	4625
10900	908	34	24 x 42	25 x 40	26 x 38	28 x 34	30 x 32	31 x 31	40	5144
			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				

GENERAL REQUIREMENTS

1. The temperature of the well water should be a minimum of **39°F (4°C),** and should normally be **45+°F (7°C)**
2. The well system must be able to supply the required water flow as listed under the Total Flow column in **TABLE 9**.

TABLE 9 - Required Flow and Air Tank Sizing

Heat Pump Model Size	Heat Pump Flow* IGPM (USGPM)	Home Flow IGPM (USGPM)	Total Flow IGPM (USGPM)	Minimum Air Bladder Tank** IGal (USgal)
25	6 (7.2)	3 (3.6)	9 (10.8)	18(22)
45	8 (9.6)	3 (3.6)	11(13.2)	22(26)
55	10 (12.0)	3 (3.6)	13(15.6)	26(31)
65	12 (14.4)	3 (3.6)	15(18.0)	30(36)
75	14 (16.8)	3 (3.6)	17(20.4)	34(41)
80	14 (16.8)	3 (3.6)	17(20.4)	34(41)

* These are minimum water requirements based on an entering water temperature of 46° F.

**Based on two-minute well pump run time. Use next size larger tank if there is not a match for the value indicated. A larger tank may be used if a longer run time is desired.

PLUMBING THE HEAT PUMP

Plumbing lines, both supply and discharge, must be of adequate size to handle the water flow necessary for the heat pump. A 1" copper or plastic line should be run to the Outdoor IN (Supply IN) pipe of the heat pump. Similarly, a 1"' line should be run from the Outdoor OUT (Supply Out) pipe to the method of disposal. P/T plugs should be installed at each port. See **Diagram A** in the Ground Loop section for a description of P/T plugs. The water valve should be installed in the discharge line. **Refer to drawing 000907CDG at the end of this section** for the recommended setup. Placing the water valve in the discharge line ensures that the heat exchanger inside the heat pump remains full of water when the unit is not running. Unions or some other form of disconnect should be used so that the coaxial heat exchanger may be accessed should it required cleaning.

The heat pump has an electrical connector for the water valve just inside the case. After the water valve is installed, run the valve harness into the case through the hole provided. Remove the jumper plug from the Valve Connector and connect the harness in its place.

Ideally there will be water flow available in excess of the requirement of the heat pump. In such a situation the proper pump can be selected to maintain a pressure of 30 to 40 psig. on the lines when the heat pump is operating. However in some cases a well can supply a heat pump only if the minimum requirement for water is used.

Water flow to the heat pump can be controlled very accurately by the installation of a reverse action refrigeration pressure valve in the discharge line of the unit.

Another more common method of regulating the flow is by the use of a **DOLE** Valve. This valve will automatically control the amount of water flowing through it by varying the diameter of a flexible rubber orifice through which the water passes. This minimizes the water usage of the unit and also prevents excessively low discharge pressure when in cooling mode. Dole valves can be noisy, it is recommended that they be installed outside if possible.

Optionally a water flow meter can be installed in the discharge line so that the exact amount of water flowing can be determined at a glance. It should be placed between the Outdoor OUT (Supply OUT) pipe of the heat pump and the water valve.

With Proper flow, there should be **5-7°F (3-4°C)** delta T between the IN and OUT water temperatures of the heat pump when operating in the heating mode.

All water line valves on both the supply and discharge lines should be either BALL or GATE valves. GLOBE valves have a higher pressure drop, meaning more pumping power to maintain the required flow to the heat pump.

PIPE INSULATION

All ground water piping to and from the Outdoor Loop ports on the heat pump should be insulated with 3/8" closed cell pipe insulation, to prevent condensation and dripping onto floors or walls.

WATER DISCHARGE METHODS

Water disposal methods vary from area to area. However, some consideration should be made to prevent the cooled discharge water from immediately coming in contact with the supply source. Attempting to return the water to the source well will eventually cool the water so much that the heat pump will shut off on its low pressure safety control.

Acceptable methods for disposing of the waste water are listed below. The waste water is clean, the heat pump has no other effect than reducing the temperature of the water. **Refer to the Ground Water Disposal methods diagram** for typical disposal method diagrams.

- Second well (return well)
- Percolation (Drain, ditch, leaching field)
- Pond, river or stream.

ENSURE SELECTED METHOD CONFORMS TO LOCAL CODES.

A return well should be a minimum of **80 ft.** from the supply well for residential applications. The water returned to the well will not necessarily be pumped into the same aquifer, depending on underground conditions. The return well must be able to supply at least the same quantity of water as the amount you wish to recharge into it. If the static level (level when not being pumped) of a well is high (10 to 20 ft. from the surface) it may be necessary to place a well cap on the well to keep the return water from flowing out the top of the well. This cap is commonly required since a certain amount of pressure is needed to force the return water back down the well if the static level is high.

Water discharged by percolation will generally soak into the ground within a distance of 50 to 100 ft. If suitable care is taken to ensure that the drain pipe runs downhill and the end of the pipe is protected by a bale of hay or spruce bows etc. the end of the pipe will not freeze as the pipe will empty out when the heat pump shuts off and the water valve closes.

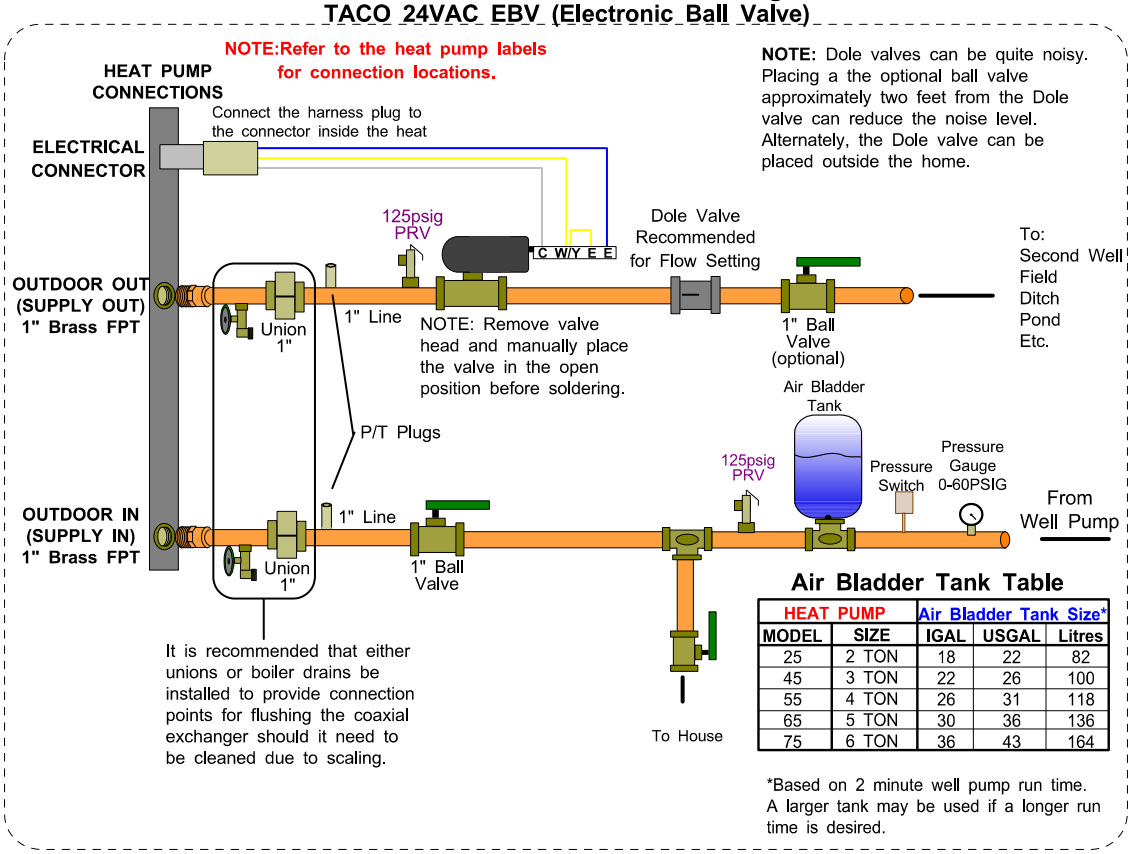
When snow comes it will usually cover the entire process much like a small spring. It is recommended that the pipe be below the frost line when possible for maximum freeze protection.

When discharging into a river or stream, or above the surface of a pond, the same guidelines should be followed as described in the paragraph above for the percolation method.

When discharging the waste water below the surface of a pond, the discharge pipe should be placed below the frost line to prevent the pipe from freezing. As opposed to the percolation method, water will remain in the end of the pipe. It is recommended that the surface of the pond be lower than the installation location of the heat pump where practical. This reduces the back pressure generated by the weight of the water in the

Typical Ground Water Installation for Size 25-75 Heat Pumps for Units With Brass FPT Fittings

TACO 24VAC EBV (Electronic Ball Valve)

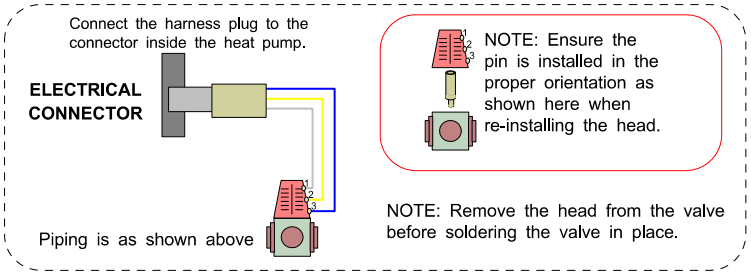


Air Bladder Tank Table

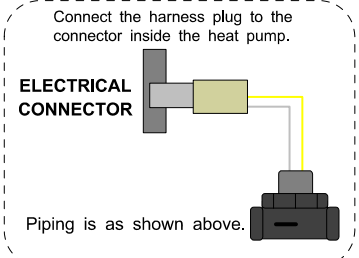
HEAT PUMP		Air Bladder Tank Size*		
MODEL	SIZE	IGAL	USGAL	Litres
25	2 TON	18	22	82
45	3 TON	22	26	100
55	4 TON	26	31	118
65	5 TON	30	36	136
75	6 TON	36	43	164

*Based on 2 minute well pump run time. A larger tank may be used if a longer run time is desired.

TACO 24VAC Slow Close Water Valve



Generic 24VAC Solenoid Water Valve



REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	C. GEDDES	C. GEDDES	10 DEC 08

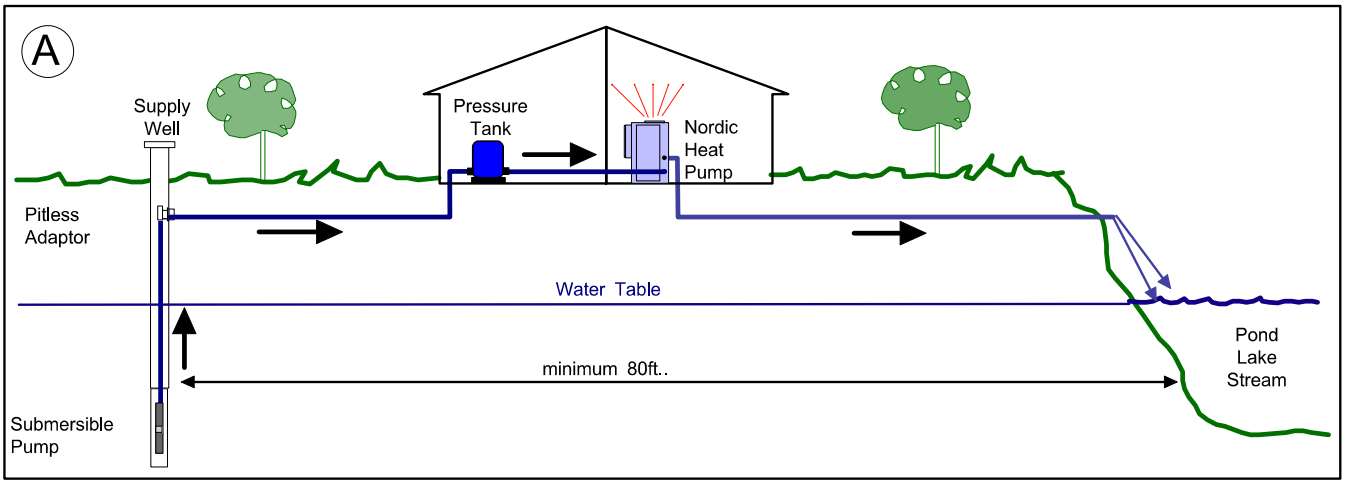
Drawn By: Chris Geddes — Date: 10 DEC 08
Checked By: Chris Geddes — Date: 10 DEC 08
Approved By (ENG): Chris Geddes — Date: 10 DEC 08
Approved By (MFG): — Date:
Approved By: — Date:

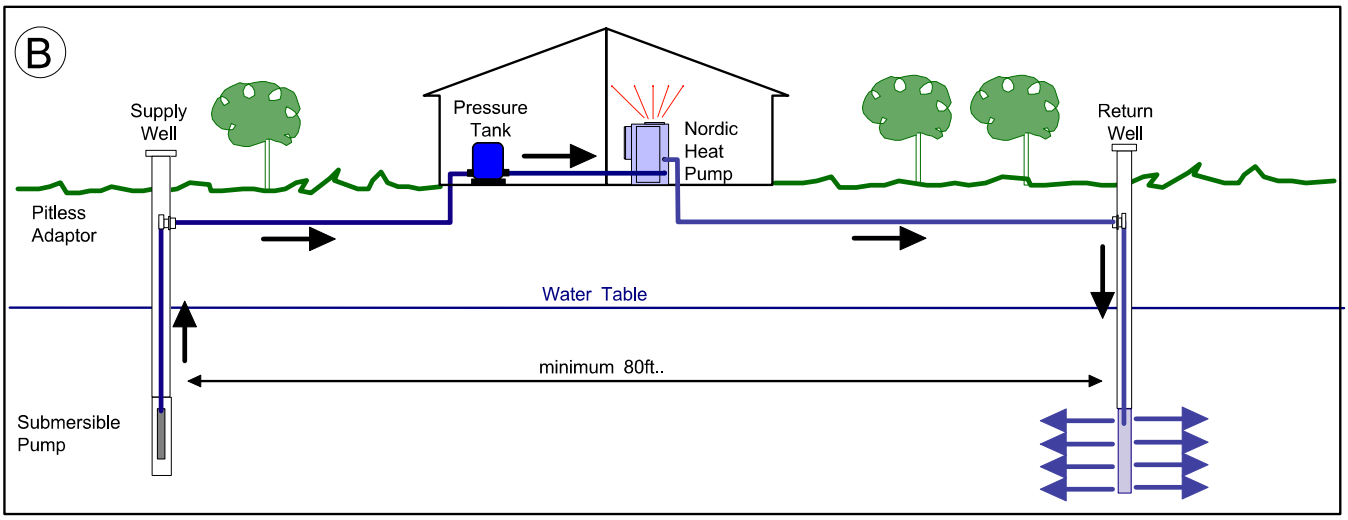
MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4

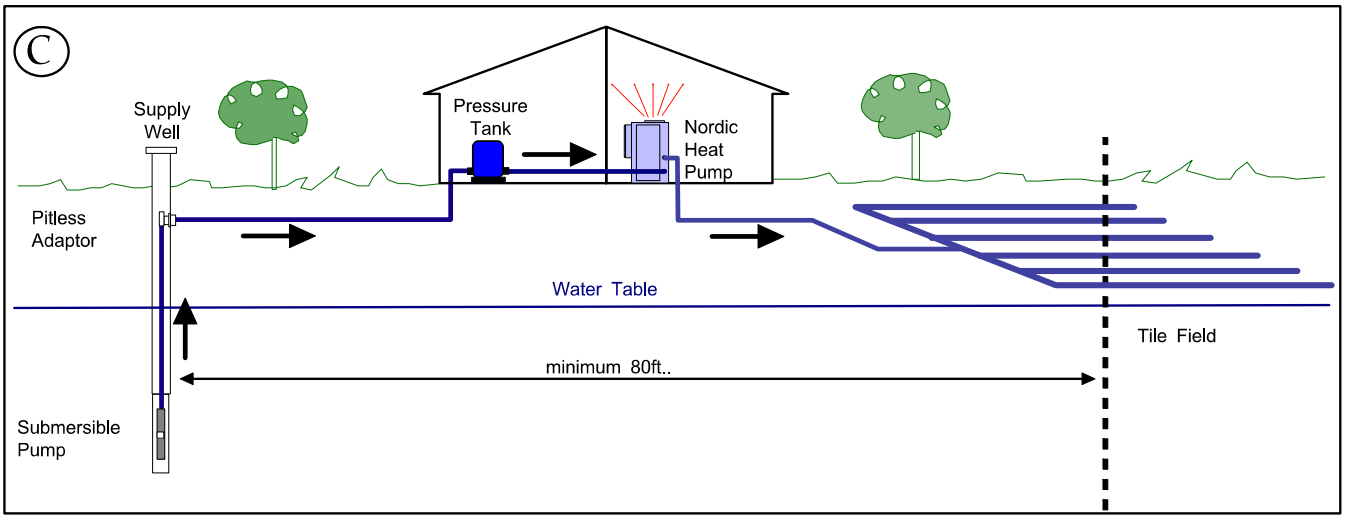
Drawing Name: Typical Ground Water Installation for Size 25-75 Heat Pumps (Brass FPT)

Size	Drawing Number	REV	SHEET
A	000907CDG	01	1 of 1

GROUND WATER DISPOSAL METHODS







01	Initial Release	C. GEDDES	C. GEDDES	04 FEB 08
REV	ECO #	IMPL BY	APVD BY	DATE

Drawn By	Chris Geddes	Date	04 FEB 08
Checked By	Chris Geddes	Date	04 JAN 08
Approved By (ENG)	Chris Geddes	Date	04 FEB 08
Approved By (MFG)		Date	
Approved By		Date	

MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

Drawing Name: Ground Water Disposal Methods

Size	Drawing Number	REV	SHEET
A	000619INF	01	1 of 1

Once the ground loop has been pressure tested and the header pipes have been connected to the circulator pump module, the heat pump can be connected to the circulator pump module.

CIRCULATOR PUMP MODULE

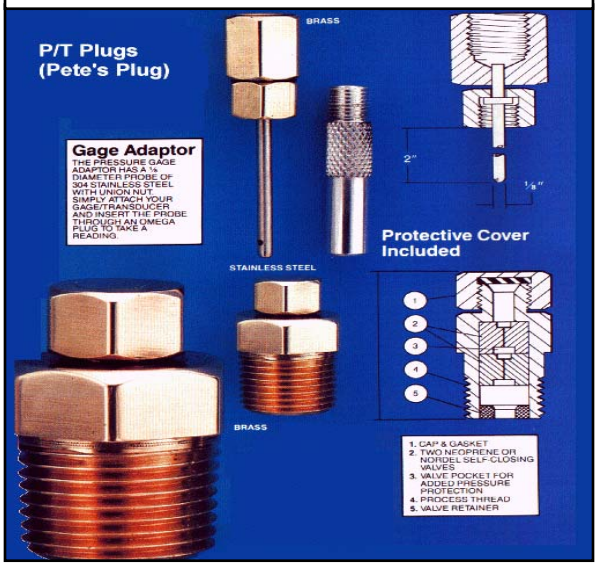
Maritime Geothermal Ltd. has compact pump modules with built in three way valves to facilitate filling and purging the ground loop. **Refer to drawing 000906CDG at the end of this section.** Alternatively, Grundfoss® Model UPS 26-99 or Taco® Model 0011 pumps or other brands with similar pumping capability may be used. The single pump module will typically handle systems up to 3 tons (model sizes 25 - 45); the two pump module will typically handle 4 to 6 ton systems (model sizes 55, 65, 75). This is based on a typical parallel system with one circuit per ton.

Maritime Geothermal recommends calculating the total pressure drop of the ground loop (including headers, indoor piping and heat pump exchanger drop) based on the antifreeze type and concentration at the desired minimum loop temperature. A pump module that can deliver the flow required for the unit at the calculated total pressure drop should be selected. **Refer to the Model Specific Information section** for unit flow requirements.

Loop pressure drops can be calculated using software such as those mentioned in the Horizontal Ground loops section, or can be calculated in a spreadsheet using the pipe manufacturer's pressure drop tables for pipe diameter and fittings.

The circulator pump module must be connected to the heat pump Outdoor Loop ports with a lineset suitable for the flow required with minimum pressure drop. 1" rubber or plastic lines should be used. The installation of P/T plugs (pressure / temperature, pronounced "*Pete's plugs"*) is recommended on both the entering and leaving lines at the heat pump **(see Diagram A).**

DIAGRAM A - Typical P/T (Pete's) Plug & Thermometer Stems



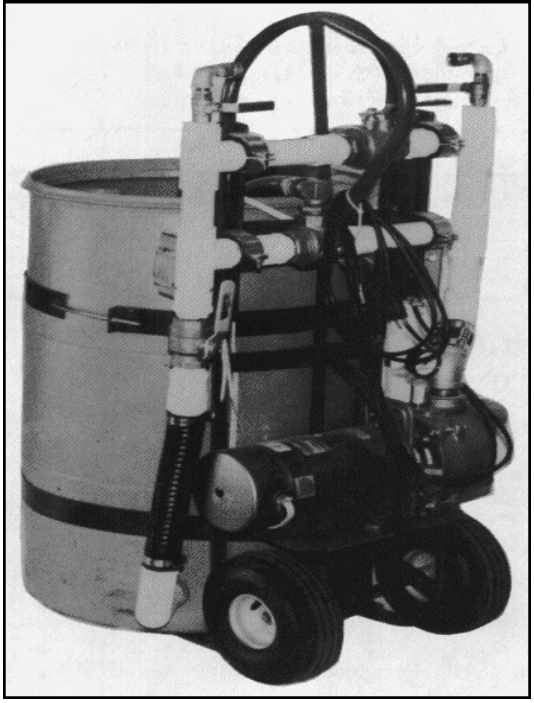
The P/T plug will allow the installer or homeowner to check water flow through the loop by measuring the pressure difference through the heat exchanger and comparing it to that listed in the **Model Specific Information section**, or the specifications document. Optional fittings with P/T ports are available for the circulator pump modules sold by Maritime Geothermal Ltd..

FLUSHING & PURGING THE GROUND LOOP

Once the groundloop has been installed and all connections are completed between the heat pump, circulator pump module and ground loop, the entire ground loop system should be **pressure tested with air to 100 PSIG** to make sure there are no leaks on any of the inside fittings. Soap all joints and observe that the pressure remains constant for 1 hour.

When satisfied that all connections are leak free, release the air pressure and connect a purge cart **(see Diagram B)** to the flushing access ports at the pump module **(refer to drawing 000906CDG)**. A temporary flushing system can alternately be constructed using a 45 gal. barrel and a pump with sufficient volume and head capability to circulate fluid at a **velocity of at least 2 ft./min.** through all parts of the loop.

DIAGRAM B - Typical Purge Cart



Adjust the circulator pump module valves to connect the purge cart to the ground loop. Begin pumping water through the ground loop, ensuring that the intake of the pump stays submerged at all times by continuously adding water. Water flowing back from the return line should be directed below the water level in the barrel or flush tank to prevent air being mixed with the outgoing water.

Once the lines have been filled and no more air bubbles are appearing in the line, adjust the circulator pump module valves to circulate water through the heat pump using the same technique as described above. When all air is removed reverse the flow of water through the lines by interchanging the flush cart lines and purge again. You will be able to visibly tell when all air is removed.

ADDING ANTIFREEZE SOLUTION

In most mid and northern areas of the US and in all of Canada it is necessary to condition the loop fluid by the addition of some type of antifreeze solution so that it will not freeze during operation in the winter months. This antifreeze is required because the loop fluid will normally reach a low entering temperature of **28°F to 32°F (-2°C to 0°C)** and refrigerant temperatures inside the heat pump's heat exchanger may be as low as **20°F (11°C)** cooler. See **TABLE 10** for details of freeze protection provided by different concentrations.

TABLE 10 - Antifreeze Percentages

BY VOLUME				
Protection to:	**10°F**	**15°F**	**20°F**	**25°F**
Methanol	25%	21%	16%	10%
Propylene Glycol	38%	30%	22%	15%
BY WEIGHT				
Protection to:	**10°F**	**15°F**	**20°F**	**25°F**
Methanol	16.8%	13.6%	10%	6.3%
Propylene Glycol	30%	23.5%	18.3%	12.9%

NOTE: Add enough antifreeze to allow for a temperature 20°F (11°C) lower than the expected lowest loop fluid temperature entering the heat pump.

Although many different antifreeze solutions have been employed in geothermal systems, the alcohols such as methanol or ethanol have the most desirable characteristics for groundloop applications. The overall heat transfer characteristics of these fluids remain high although care must be taken when handling pure alcohols since they are extremely flammable. Once mixed in a typical 25% by volume ratio with water the solution is not flammable. In situations where alcohols are not allowed as a loop fluid due to local regulations then propylene glycol is a non-toxic alternative which can be substituted . Propylene glycol should only be used in cases where alcohols are not permitted since the heat transfer characteristics are less desirable and it becomes more viscous at low temperatures, increasing pumping power.

The volume of fluid that your loop system holds can be closely estimated by totaling the number of ft. of each size pipe in the system and referencing **TABLE 11** the for approximate volume per 100 ft.

When the volume of the loop has been calculated and the appropriate amount of antifreeze is ready for addition by referencing **TABLE 10** , drain the equivalent amount of water from the flush cart or mixing barrel and replace it with the antifreeze.

When using alcohols, be sure to inject below the water line to reduce initial volatility of the pure antifreeze. If the loop is large it may be necessary to refill the tank with antifreeze several times to get all the antifreeze into the loop. Pump the loop for 5 to 10 minutes longer to ensure the remaining fluid has been well mixed.

TABLE 11 - Volume of fluid per 100 ft. of pipe

		Volume /100ft.		
Type of Pipe	**Diameter**	**Igal**	**USgal**	**L**
Copper	**1"**	**3.4**	**4.1**	**15.5**
	1-1/4"	**5.3**	**6.4**	**24.2**
	1-1/2"	**7.7**	**9.2**	**34.8**
Rubber Hose	**1"**	**3.2**	**3.9**	**14.8**
Polyethylene	**3/4" IPS SDR11**	**2.3**	**2.8**	**10.6**
	1" IPS SDR11	**3.7**	**4.5**	**17.0**
	1-1/4" IPS SDR11	**6.7**	**8.0**	**30.3**
	1-1/2" IPS SDR11	**9.1**	**10.9**	**41.3**
	2" IPS SDR11	**15.0**	**18.0**	**68.1**
Other Item Volumes				
Heat Exchanger	**Average**	**1.2**	**1.5**	**5.7**
Purge Cart Tank	**See cart manual**	**TBD**		

INITIAL PRESSURIZATION

At this point open all valves in the flow circuit and slowly close off the supply and return flush cart valves in a manner that leaves about **20-30 psig**. on the system. If an air bladder expansion tank is used it should be charged to the above pressure before actual water pressure is put on the system . Systems without an expansion tank will experience greater fluctuations in pressure between the heating and cooling seasons, causing pressure gauges to have different values as the loop temperature changes. This fluctuation is normal since expansion and contraction of the loop fluid must be handled by the elasticity of the plastic loop.

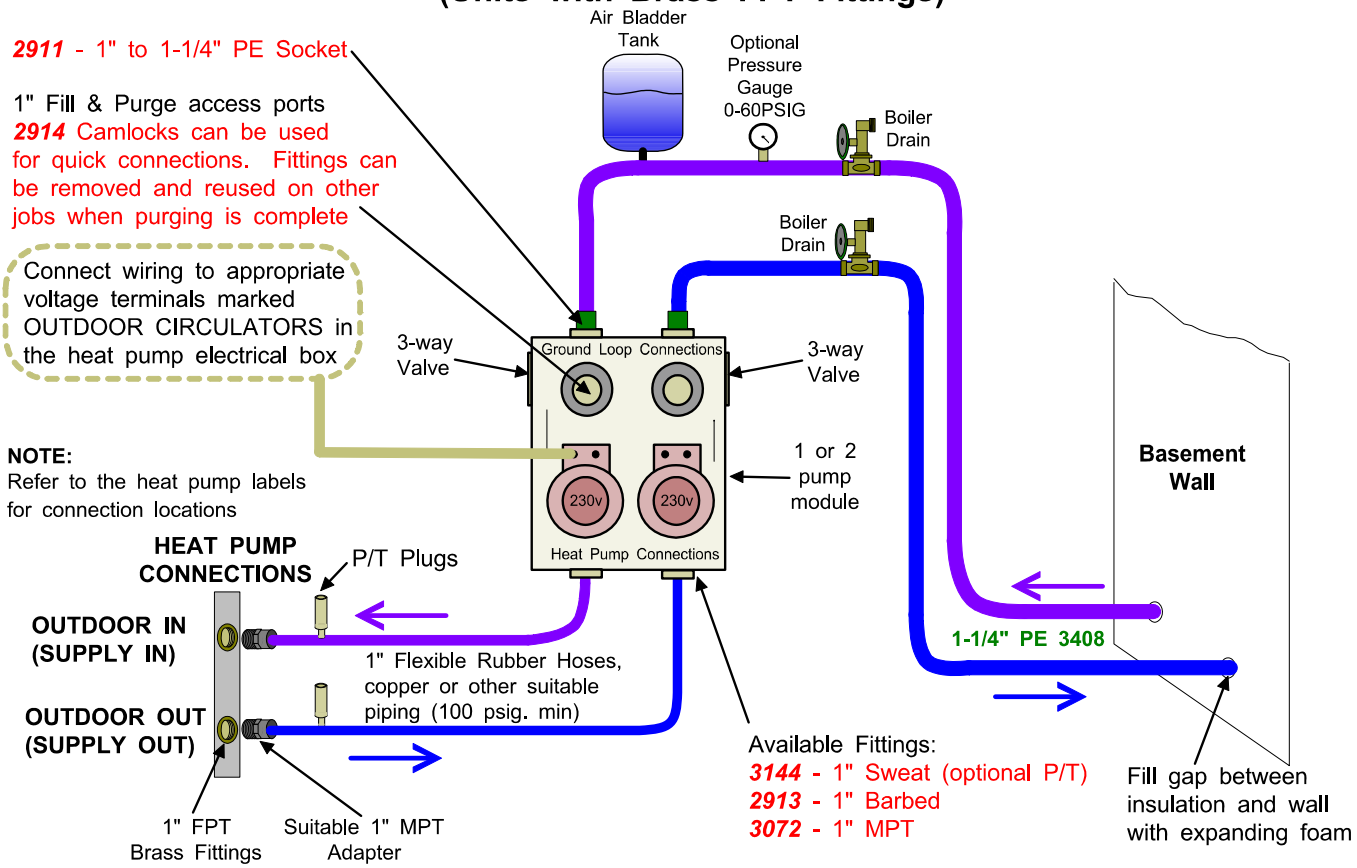
- Pressurize the loop to a static pressure of **45 psig**. when installing a system in the fall going into the heating season.
- Pressurize the loop to a static pressure of **25 psig**. when installing a system in the spring or summer going into the cooling season.

After operating the heat pump for a period of time, any residual air in the system should be bled off and the static pressure should be verified and adjusted if necessary. Add additional water / antifreeze mix with the purge cart to bring the pressure back to the original setting if required.

PIPE INSULATION

All ground loop piping inside the structure (between the structure entry point and the heat pump) should be insulated with 3/8" thick closed cell pipe insulation to prevent condensation and dripping onto floors or walls.

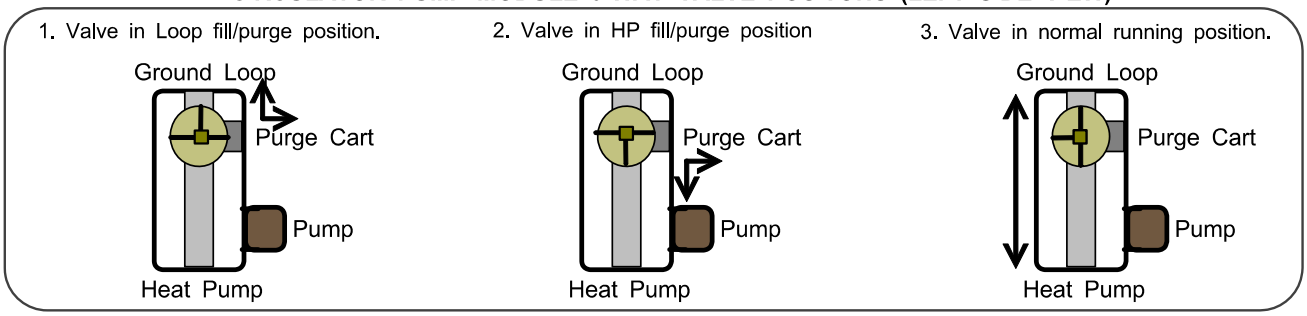
Geo-Flo Circulator Pump Module Installation
(Units with Brass FPT Fittings)



NOTES:

- Circulator Pump Module should be mounted vertically to minimize the possibility of air locking the circulators.
- All lines inside the structure and through the wall should be insualted with 3/8" to 1/2" thick closed cell pipe insulation.
- Holes through the foundation / structure should be filled with expanding foam from both sides to prevent leakage.
- Proper drainage material should be used on the outside of the wall to prevent water buildup.
- Pump module fittings are available from Maritime Geothermal Ltd., Geo-Flo Part Numbers are indicated above (italics).
- A pressure gauge is recommended if P/T plugs are not installed.
- The air bladder tank should be pressurized to the desired static pressure of the ground loop before installation.
- For most applications, a 1 pump module will accomodate NORDIC models sizes 25 and 45, and a 2 pump module will accomodate sizes 55, 65 and 75. The total loop pressure drop including the headers, inside piping and heat exchanger drop should be calculated based on the antifreeze mixture and lowest desired entering water temperature. The pump module selected must provide the required flow at this calculated pressure drop value.

CIRCULATOR PUMP MODULE 3-WAY VALVE POSITONS (LEFT SIDE VIEW)



REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	C. GEDDES	C. GEDDES	09 DEC 08

Drawn By	Chris Geddes	Date 09 DEC 08
Checked By	Chris Geddes	Date 09 DEC 08
Approved By (ENG)	Chris Geddes	Date 09 DEC 08
Approved By (MFG)		Date
Approved By		Date

MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

Drawing Name: Geo-Flo Circulator Pump Module Installation (Brass FPT)

Size	Drawing Number	REV	SHEET
A	000906PDG	01	1 of 1

Startup Procedure

The following steps describe how to perform the startup procedure of the geothermal heat pump.

The RH-Series Two-Stage R410a Startup Record located in this manual is used in conjunction with this startup procedure to provide a detailed record of the installation. A completed copy should be left on site, a copy kept on file by the installer and a copy should be sent to Maritime Geothermal Ltd.

Check the boxes or fill in the data as each step is completed. For data boxes, circle the appropriate units. Fill in the top section of all three copies, or one copy if photocopies can be made after the startup has been completed.

PRE-START INSPECTION

Ductwork:

1. Verify that all ductwork has been completed and is firmly attached to the unit. Verify that any dampers or diverters are properly set for operation of the heat pump.
2. Verify that all registers are open and clear of any objects that would restrict the airflow.
3. Verify that a new air filter is installed and the cover is secured.
4. Verify the condensate drain is connected, properly vented and free of debris.
5. If a plenum heater has been installed, verify that it is securely fastened to the ductwork.

Outdoor Loop (Ground Loop):

1. Verify that all shutoff valves are fully open and there are no restrictions in the piping from the heat pump to the ground loop, and that full flow is available to the heat pump.
2. Verify that the entire system has been flooded and all the air has been purged as much as possible. Further purging may be required after the system has been operating for a while.
3. Verify that the loop contains the proper mix of antifreeze for the intended application. Record the type of antifreeze and the mixture value on the startup sheet; circle % Vol. or % Weight.
4. Record the static loop pressure on the startup sheet.

Outdoor Loop (Ground Water):

1. Verify there are no leaks in the connections to the unit. Verify the water valve is installed and properly oriented in the return line.
2. Verify that there is flow control in the return line.

Domestic Hot Water (if equipped):

1. Verify that all shutoff valves are fully open and there are no restrictions in the piping from the heat pump to the domestic hot water tank.
2. Verify that the entire system has been flooded and all the air has been purged as much as possible. Further purging may be required after the system has been operating for a while.
3. Verify that the brown wire with the insulated terminal is disconnected in the electrical box. Refer to the schematic diagram for more information.

Electrical:

1. **Ensure the power to the unit is off. Ensure the power to the plenum heater is off if equipped.**
2. Verify all high voltage connections. Ensure that there are no stray wire strands, all connections are tight and the ground wire is connected tightly to the ground connector for the heat pump and plenum heater.
3. Record the fuse / circuit breaker size and wire gauge for the heat pump. Record the fuse / circuit breaker size, wire gauge and size of the plenum heater if installed.
4. Verify that the control connections to the thermostat and plenum heater (if installed) are properly connected and all control signals are off, so that the unit will not start up when the power is turned on.
5. Ensure all access panels except the lower one that provides access to the electrical box are in place.

UNIT STARTUP

The unit is now ready to be started. The steps below outline the procedure for starting the unit and verifying proper operation of the unit. **It is recommended that safety glasses be worn during the following procedures.**

Preparation:

1. Remove the caps from the service ports and connect a refrigeration manifold set to the unit.
2. Turn the power on to the heat pump and set the thermostat to OFF. Set up the thermostat as per the instructions provided with it so that it will function properly with the heat pump system (set for heat pump, not for heating and cooling). The O signal should be set to active in cooling mode.
3. Measure the following voltages on the compressor contactor and record them on the startup sheet: L1-L2, L2-L3, L1-L3.

Heating Mode:

1. Set the thermostat to heating mode and adjust the setpoint to activate Stage 1 and Stage 2. The fan should slowly ramp up to speed after the time delay of the thermostat expires (if applicable) and the compressor will start (allow 30-60 seconds for the water valve to open for ground water systems)
2. Check the refrigeration gauges. The suction and discharge pressures will depend on the loop temperatures, but they should be about **90-110PSIG** and **260-360PSIG** respectively for a typical start-up.
3. Monitoring the refrigeration gauges while the unit runs. Record the following after 10 minutes of runtime:
    1. Suction pressure
    2. Discharge pressure
    3. Duct Return temperature (poke a small hole in the flex collar and insert probe in airstream)
    4. Duct Supply temperature (poke a small hole in the flex collar and insert probe in airstream)
    5. Duct Delta T (should be between **20-30°F, 11-17°C**)
    6. Outdoor Loop In (Supply In) temperature
    7. Outdoor Loop Out (Supply Out) temperature
    8. Outdoor Delta T (should be between **5-8°F, 3-4°C**)
    9. Outdoor flow (if available)
    10. Compressor L1(C) current (black wire, place meter between electrical box and compressor)
4. Adjust the thermostat setpoint to the desired room temperature and let the unit run through a cycle. Record the setpoint and the discharge pressure when the unit shuts off.
5. For units with a desuperheater, turn the power off to the unit. Connect the brown wire with the blue insulated terminal to the compressor contactor as shown in the electrical box diagram. Turn the power to the unit on.
6. Remove the electrical cover from the plenum heater. Place a current clamp meter around one of the supply wires. Turn on the power to the plenum heater. Adjust the thermostat setpoint to **85°F (29°C)**. Verify that the current draw increase as each stage is activated. (10kW has 2 stages, 15kW has 3 stages and 20kW has 4 stages).
7. Verify the DHW IN and DHW OUT temperatures (if applicable) by hand **(caution: pipes get hot).** If the DHW OUT line does not become hotter than the DHW IN line the circulator is air locked. Bleed the air from the system and check the temperature differential again to ensure there is flow from the circulator.

Cooling Mode:

1. Set the thermostat to cooling mode and adjust the setpoint to activate Stage 1 and Stage 2.
2. Monitoring the refrigeration gauges while the unit runs. Record the following after 10 minutes of runtime:
    1. Suction pressure
    2. Discharge pressure
    3. Duct Return temperature
    4. Duct Supply Out temperature
    5. Duct Delta T
    6. Outdoor Loop In (Supply In) temperature
    7. Outdoor Loop Out (Supply Out) temperature
    8. Outdoor Delta T
3. Adjust the thermostat setpoint to the desired room temperature if possible, otherwise set it just low enough to allow the unit to run (ie 1°F (0.5°C) less than room temperature) and let the unit run through a cycle. Record the thermostat setpoint and the suction pressure when the unit shuts off.

Final Inspection:

1. Turn the power off to the unit (and plenum heater if installed) and remove all test equipment.
2. Install the electrical box cover and the access panel on the heat pump. Install the service port caps securely to prevent refrigerant loss. Install the electrical cover on the plenum heater if applicable.
3. Do a final check for leaks in the ground water / ground loop system and ensure the area is clean.
4. Turn the power on to the unit and the plenum heater if installed. Set the thermostat to the final settings.

Startup Record:

1. The startup personnel shall sign and date the Startup Record and have the startup witness or appropriate site personnel sign as well. The startup personnel shall leave the Startup Record with the homeowner, retain a copy for filing and send a copy to Maritime Geothermal Ltd. for warranty registration.

Startup Record —RH-Series Size 25-75 Two-Stage R410a

Installation Site		**Startup Date**	**Installer**	
City			**Company**	
Province			**Model**	
Country			**Serial #**	

Check boxes unless asked to record data. Circle data units.

PRE-START INSPECTION

Ductwork	Ductwork is completed, dampers/ diverters are adjusted							
	Registers are open and clear of objects							
	Air filter and end cap are installed							
	Condensate Drain is connected, properly vented and free of debris							
	Plenum heater is securely fastened (if applicable)							
Ground Loop System	All shut-off valve are open (full flow available)							
	Loop is full and purged of air							
	Antifreeze type							
	Antifreeze concentration		% Volume		% Weight			
	Loop static pressure		PSI	kPa				
Ground Water System	Water Valve installed in return line							
	Flow control installed in return line							
Domestic Hot Water	All shut-off valves are open							
	Lines are full and purged							
	Desuperheater pump wire is disconnected							
Electrical	High voltage connections are correct and securely fastened							
	Circuit breaker (or fuse) size and wire gauge for Heat Pump		A		Ga.			
	Circuit breaker (or fuse) size, wire gauge, and Plenum Heater size		A		Ga.		kW	
	Low voltage connections are correct and securely fastened							

STARTUP DATA

Preparation	Voltage across L1 and L2, L1 and L3, L2 and L3							VAC
Heating Mode (10 minutes)	Suction Pressure / Discharge Pressure					psig	kPa	
	Duct Return, Duct Supply, and Delta T		In		Out		°F	°C
	Outdoor In (Supply In), Outdoor Out (Supply Out), and Delta T		In		Out		°F	°C
	Outdoor Flow		Igpm	USgpm		L/s		
	Compressor L1 (black wire) current		A					
	Domestic Hot Water functioning							
	Thermostat setpoint and discharge pressure at cycle end		°F	°C		psig	kPa	
Cooling Mode (10 minutes)	Suction Pressure / Discharge Pressure					psig	kPa	
	Duct Return, Indoor Out, and Delta T		In		Out		°F	°C
	Outdoor In (Supply In), Outdoor Out (Supply Out), and Delta T		In		Out		°F	°C
	Thermostat setpoint and suction pressure at cycle end		°F	°C		psig	kPa	

Date:		**Startup Personnel Signature:**		**Witness/Site Signature:**	

A total of three copies are required, one for the site, one for the installer/startup and one to be sent to Maritime Geothermal Ltd.

General Maintenance

GENERAL MAINTENANCE SCHEDULE		
Item	**Interval**	**Procedure**
Air Filter	6 months	Inspect for dirt. Replace if necessary.
Contactor	1 year	Inspect for pitted or burned points. Replace if necessary.
Condensate Drain	1 year	Inspect for clogs. Remove and clean if necessary.
Heat exchanger	As required*	Clean as per HEAT EXHCANGER FLUSING PROCEDURE below.
***Generally not required for closed loop systems. Whenever system performance is reduced for open loop.**		

COAXIAL HEAT EXCHANGER FLUSHING PROCEDURE—GROUNDWATER	
STEP 1	Isolate the heat exchanger by closing the valves in the IN and OUT ports to the heat exchanger.
STEP 2	Blow out the heat exchanger into a clean 5 gallon bucket using compressed air.
STEP 3	If a purge cart is not available, use a 5 gallon plastic bucket, a circulator and some plastic piping to create a makeshift pump system. Connect a the inlet and outlet to the heat exchanger ports.*
STEP 4	Place 2 gallons of RYDLYME in the purge cart (or bucket). Circulate the fluid through the heat exchanger for at least 2 hours (3 recommended).
STEP 5	Disconnect the purge system dispose of the solution. RYDLYME is non-toxic and biodegradable and as such can be poured down a drain.
STEP 6	Connect fresh water and a drain to the heat exchanger ports and flush the exchanger for several minutes.
STEP 7	Return the plumbing to its original configuration and open the IN and OUT valves. Operate the system and check for improved performance.
***Depending on the plumbing, there should be either unions or boiler drains for to access the heat exchanger.	

COAXIAL HEAT EXCHANGER FLUSHING PROCEDURE—GROUND LOOP	
STEP 1	Isolate the heat exchanger by placing the pump module valves in the exchanger flushing position.
STEP 2	Connect a compressed air and a drain pipe to the pump module purge ports and blow the anti-freeze solution into a clean 5 gallon bucket.
STEP 3	Connect a purge cart to the pump module purge ports.
STEP 4	Place 2 gallons of RYDLYME in the purge cart. Circulate the fluid through the heat exchanger for at least 2 hours (3 recommended).
STEP 5	Disconnect the purge cart and dispose of the solution. RYDLYME is non-toxic and biodegradable and as such can be poured down a drain. Clean the purge cart thoroughly.
STEP 6	Connect fresh water and a drain to the pump module purge ports and flush the exchanger for several minutes.
STEP 7	Blow the heat exchanger out with compressed air as per STEP 2 and dump the water down a drain.
STEP 8	Connect the purge cart to the pump module purge ports. Re-fill and purge the heat exchanger with as per standard procedures (the anti-freeze from STEP 2 can be re-used).
STEP 9	Disconnect the purge cart and set the pump module valves back to the original positions.
STEP 10	Operate the system and check for improved performance.
***Depending on the plumbing, there should be either unions or boiler drains for to access the heat exchanger.	

Troubleshooting Guide

The following steps are for troubleshooting the geothermal heat pump. If the problem is with the domestic hot water or the plenum heater, proceed to those sections at the end of the troubleshooting guide. Repair procedures and reference refrigeration circuit diagrams can be found at the end of the troubleshooting guide.

STEP 1: Verify that the display is present on the thermostat. If it is not, proceed to POWER SUPPLY TROUBLE SHOOTING, otherwise proceed to STEP 2.

STEP 2: Remove the door and electrical box cover and check to see if there is a fault code on the control board. If there is, record the fault code. Turn the power off, wait 10 seconds and turn the power back on. Set the thermostat to call for heating or cooling depending on the season.

STEP 3: If a 24VAC signal does not appear across Y1 and C of the terminal strip within 6 minutes, proceed to the THERMOSTAT TROUBLESHOOTING section, otherwise proceed to STEP 4.

STEP 4: If a fault code appears once a signal is present at Y1 and the compressor does not attempt to start, proceed to the FAULT CODE TROUBLESHOOTING section, otherwise proceed to STEP 5.

STEP 5: If no fault codes appear and the compressor does not attempt to start, attempts to start but cannot, starts hard, or starts but does not sound normal, proceed to the COMPRESSOR TROUBLESHOOTING section, otherwise proceed to STEP 6.

STEP 6: If the compressor starts and sounds normal, this means the compressor is OK and the problem lies elsewhere. Proceed to the OPERATION TROUBLESHOOTING section.

NOTE: To speed up the troubleshooting process, the Test Jumper on the safety board can be placed to the YES position to change the anti-short cycle timer to 5 seconds. **Be sure to set it back to NO when servicing is complete**.

POWER SUPPLY TROUBLESHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
No power to the heat pump	Disconnect switch open (if installed)	Verify disconnect switch is in the ON position.	Determine why the disconnect switch was opened, if all is OK close the switch.
	Fuse blown / Breaker Tripped.	At heat pump disconnect box, voltmeter shows 230VAC on the line side but not on the load side.	Reset breaker or replace fuse with proper size and type. (Time-delay type “D”)
No display on thermostat.	Transformer breaker tripped.	Breaker on transformer is sticking out.	Push breaker back in. If it trips again locate cause of short circuit and correct.
	Faulty transformer	Transformer breaker is not tripped, 230VAC is present across L1 and L3 of the compressor contactor but 24VAC is not present across R_H and C of the terminal strip.	Replace transformer.
	Faulty wiring between heat pump and thermostat.	24VAC is not present across C and R(R_H) of the thermostat.	Correct the wiring.
	Faulty Thermostat.	24VAC is present across C and R (R_H) of the thermostat but thermostat has no display.	Replace thermostat.

THERMOSTAT TROUBLESHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
No Y1 signal to heat pump (after 6 minutes)	Incorrect thermostat setup.	Thermostat does not indicate a call for heat. No 24VAC signal present across C and Stage 1 of the thermostat	Correct the setup.
	Faulty thermostat to heat pump wiring.	24VAC signal present across Stage 1 and C of the thermostat but not present across Y1 and C of the terminal strip.	Correct or replace wiring
	Faulty thermostat.	No 24VAC between Stage 1 and C of the thermostat when a call is indicated on the thermostat.	Replace thermostat.

FAULT CODE TROUBLESHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Fault Code 1 (High Pressure Control)	Faulty High Pressure Control (open). * Must be a signal present on Y1 for this test. *HP pressures must be at static levels.	Verify if there is 24VAC across HP1 on the control board and C of the terminal strip, as well as HP2 and C.	Replace high pressure control if voltage is present on HP1 but not on HP2.
	Faulty control board.	24VAC is present across HP1 and C1, and HP2 and C, but no voltage is present across CC on the control board and C.	Replace control board.
Fault Code 2 (Low Pressure Control)	Faulty Low pressure control (open). * Must be a signal present on Y1 for this test. *HP pressures must be at static levels.	Verify if there is 24VAC across LP1 on the control board and C of the terminal strip, as well as LP2 and C.	Replace high pressure control if voltage is present on LP1 but not on LP1.
	Faulty control board.	24VAC is present across LP1 and C, and LP2 and C, but no voltage is present across CC on the control board and C.	Replace control board.
	Unit out of refrigerant.	Check static refrigeration pressure of the unit for a very low value.	Locate the leak and repair it. Spray nine, a sniffer and dye are common methods of locating a leak.
Fault Code 3 (Flow Switch)	Flow switch jumper removed or faulty.	Verify jumper is in place between pins marked FLOW SWITCH.	Place a jumper if missing.
	Flow switch faulty. (Only if installed)	Verify 24VAC is present between each flow switch pin on the control board and the C terminal of the terminal strip while there is flow through the unit.	Replace flow switch if signal is not present at both terminals on the control board.
	Faulty control board.	24VAC is present across each FLOW SWITCH terminal and C, but not voltage is present across CC on the control board and C.	Replace control board.

COMPRESSOR TROUBLESHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Compressor will not start	Faulty control board.	Measuring from C on the terminal strip, verify there is voltage at Y, HP1, HP2, LP1, LP2, and both flow pins but no voltage present at CC.	Replace control board.
	Faulty run capacitor. (Single phase only)	Check value with capacitance meter. Should match label on capacitor. Compressor will hum while trying to start and then trip its overload.	Replace if faulty.
	Loose or faulty wiring.	Check all compressor wiring, including inside compressor electrical box.	Fix any loose connections. Replace any damaged wires.
	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. Or, 24VAC across coil but contactor will not engage.	Replace contactor.
	Thermal overload on compressor tripped.	Ohmmeter shows reading when placed across R and S terminals and infinity between C & R or C & S. A valid resistance reading is present again after the compressor has cooled down.	Proceed to Operation Troubleshooting to determine the cause of the thermal overload trip.
	Burned out motor. (open winding)	Remove wires from compressor. Ohmmeter shows infinite resistance between any two terminals Note: Be sure compressor overload has had a chance to reset. If compressor is hot this may take several hours.	Replace the compressor.
	Burned out motor. (shorted windings)	Remove wires from compressor. Resistance between any two terminals is below the specified value.	Replace the compressor.
	Motor shorted to ground.	Remove wires from compressor. Check for infinite resistance between each terminal and ground.	If any terminal to ground is not infinite replace the compressor.
	Seized compressor due to locked or damaged mechanism.	Compressor attempts to start but trips its internal overload after a few seconds. (Run capacitor already verified)	Attempt to “rock” compressor free. If normal operation cannot be established, replace compressor.
Compressor starts hard	Start capacitor faulty. (Single phase only)	Check with capacitance meter. Check for black residue around blowout hole on top of capacitor.	Replace if faulty. Remove black residue in electrical box if any.
	Potential Relay faulty. (Single phase only)	Replace with new one and verify compressor starts properly.	Replace if faulty.
	Compressor is “tight” due to damaged mechanism.	Compressor attempts to start but trips its internal overload after a few seconds. Run capacitor has been verified already.	Attempt to “rock” compressor free. If normal operation cannot be established, replace compressor.
Compressor Stage 2 will not activate	Faulty Stage 2 module.	Verify if 24VAC is present across Y2 and C of the terminal strip.	Replace module if signal is present. Check wiring if signal is not present.

OPERATION TROUBLESHOOTING - HEATING MODE			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
High Discharge Pressure	Air Flow	See Fan Troubleshooting section	Correct the problem.
	TXV adjusted too far closed.	Verify superheat. It should be between 8-12°F (3-6°C). Superheat will be high if TXV is closed too far.	Adjust TXV to obtain 8-12°F (3-6°C) superheat.
	TXV stuck almost closed or partially blocked by foreign object.	Adjusting the TXV does not affect the superheat or the suction pressure.	Adjust the TXV all the way in and out a few times to loosen it. Replace TXV if this does not work.
	Filter-drier plugged	Feel each end of the filter- drier, it should be the same temperature. If there is a temperature difference then it is plugged. Also causes low suction pressure.	Replace filter-drier.
	Unit is overcharged. (Only possible if unit has been opened in the field and incorrectly charged).	High sub-cooling, low delta T across air coil.	Remove 1/2lb of refrigerant at a time and verify that the discharge pressure reduces.
Low Suction Pressure	Low or no Outdoor liquid flow	Delta T across the Outdoor Loop ports should be between 5-7°F (3-4°C), or compare pressure drop to the tables for the unit.	Determine the cause of the flow restriction and correct it. Verify pumps are working and sized correctly for ground loop systems. Verify well pump and water valve is working for ground water systems.
	Entering liquid temperature too cold.	Measure the entering liquid temperature. Most likely caused by undersized ground loop.	Increase the size of the ground loop.
	Dirty or fouled coaxial heat exchanger. (typically for ground water, unlikely for ground loop)	Disconnect the water lines and check the inside of the pipes for scale deposits.	Have a qualified service technician backflush the coaxial exchanger.
	Return air too cold	Measure return air temperature. Should be above 60°F (15°C).	Restrict air flow temporarily until room comes up to temperature.
	TXV stuck almost closed or partially blocked by foreign object.	Adjusting the TXV does not affect the superheat or the suction pressure. TXV may be frosting up.	Adjust the TXV all the way in and out a few times to loosen it. Replace TXV if this does not work.
	Low refrigerant charge.	Entering liquid temperature, flow and entering air temperature are good but suction is low. Check static refrigeration pressure of the unit for a very low value.	Locate the leak and repair it. Spray nine, a sniffer and dye are common methods of locating a leak.
	Faulty compressor, not pumping.	Pressures change only slightly from static values when compressor is started.	Replace compressor.

OPERATION TROUBLESHOOTING - HEATING MODE			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
High Suction Pressure (may appear to not be pumping)	Leaking reversing valve.	Reversing valve is the same temperature on both ends of body, common suction line is warm, compressor is running hot.	Replace reversing valve.
	TXV adjusted too far open.	Verify superheat. It should be between 8-12°F (3-6°C). Superheat will be low if TXV is open too far.	Adjust TXV to obtain 8-12°F (3-6°C) superheat.
	TXV stuck open.	Adjusting the TXV does not affect the superheat or the suction pressure. Low super heat and discharge pressure.	Adjust the TXV all the way in and out a few times to loosen it. Replace TXV if this does not work.
Compressor frosting up	See Low Suction Pressure in this section.		
TXV frosting up	TXV stuck almost closed or partially blocked by foreign object.	Adjusting the TXV does not affect the superheat or the suction pressure.	Attempt to adjust the TXV all the way out and all the way in a few times to loosen it. Replace TXV if this does not work.
Random high pressure trip (does not occur while on site)	Faulty compressor contactor.	Points pitted or burned. Contactor sometimes sticks causing the compressor to run without the fan, tripping the high pressure control.	Replace contactor.
	Intermittent fan.	See Fan Troubleshooting section.	Correct the problem.

OPERATION TROUBLESHOOTING - COOLING MODE			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Heating instead of cooling	Thermostat not set up properly.	Verify that there is 24VAC across O/B/W1 and C of the terminal strip when calling for cooling.	Correct thermostat setup. Change to a different thermostat.
	Faulty reversing valve solenoid coil.	Verify solenoid by removing it from the shaft while the unit is running. There should be a loud “whoosh” sound when it is removed.	Replace solenoid if faulty.
	Faulty reversing valve.	A click can be heard when the coil is energized but the unit continues to heat instead of cool.	Replace reversing valve.
High Discharge pressure	Low or no Outdoor liquid flow	Delta T across the Outdoor Loop ports should be between 8-12°F (4-7°C), or compare pressure drop to the tables for the unit.	Determine the cause of the flow restriction and correct it. Verify pumps are working for ground loop systems. Verify well pump and water valve is working for ground water systems.
	Entering liquid temperature too warm.	Most likely caused by undersized ground loop.	Verify the ground loop sizing. Increase the size of the ground loop if undersized.
	Dirty or fouled coaxial heat exchanger. (typically for ground water, unlikely for ground loop)	Disconnect the water lines and check the inside of the pipes for scale deposits.	Have a qualified service technician backflush the coaxial exchanger.

OPERATION TROUBLESHOOTING - COOLING MODE			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
High Discharge pressure	Unit is overcharged. (Only possible if unit has been opened in the field and incorrectly charged).	High sub-cooling, low delta T across water coil.	Remove 1/2lb of refrigerant at a time and verify that the discharge pressure reduces.
High Suction Pressure (may appear to not be pumping)	TXV adjusted too far open.	Verify superheat. It should be between 8-12°F (3-6°C). Superheat will be low if TXV is open too far.	Adjust TXV to obtain 8-12°F (3-6°C) superheat.
	TXV stuck open.	Adjusting the TXV does not affect the superheat or the suction pressure. Low super heat and discharge pressure.	Adjust the TXV all the way in and out a few times to loosen it. Replace TXV if this does not work.
	Leaking reversing valve.	Reversing valve is the same temperature on both ends of body, common suction line is warm, compressor is running hot.	Replace reversing valve.
Low Suction Pressure	Air Flow	See Fan Troubleshooting section. **Note:** low airflow will cause the air coil to ice up once the suction drops below **90PSIG**.	Correct the problem.
	TXV stuck almost closed or partially blocked by foreign object.	Adjusting the TXV does not affect the superheat or the suction pressure. TXV may be frosting up.	Adjust the TXV all the way in and out a few times to loosen it. Replace TXV if this does not work.
	Low or no refrigerant charge.	Entering air temperature and airflow are good but suction is low. Check static refrigeration pressure of unit for very low value.	Locate the leak and repair it. Spray nine, a sniffer and dye are common methods of locating a leak.
	Faulty compressor, not pumping.	Pressures change only slightly from static values when compressor is started.	Replace compressor.
Compressor frosting up	See Low Suction Pressure in this section.		
TXV frosting up	TXV stuck almost closed or partially blocked by foreign object.	Adjusting the TXV does not affect the superheat or the suction pressure.	Adjust the TXV all the way in and out a few times to loosen it. Replace TXV if this does not work.
Random Low Pressure trip (does not occur while there)	Faulty compressor contactor.	Points pitted or burned. Contactor sometimes sticks causing the compressor to run without the fan, tripping the low pressure control.	Replace contactor.
	Intermittent fan.	See Fan Troubleshooting section.	Correct the problem.

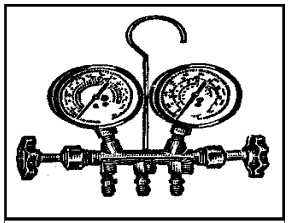
FAN TROUBLESHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Low Airflow	Dirty air filter	Inspect.	Replace.
	Dirty air coil.	Inspect.	Clean.
	Poor Ductwork	Measure delta T between supply and return ducts at the unit, it in heating mode, it should not be above 30°F(17°C).	The ECM fan will provide proper airflow up to 0.5 inH2o for 1/2HP motors and 0.7 inH2o for 1HP motors. The ductwork is poorly designed or greatly undersized if the fan motor cannot provide the required airflow.
	Air flow selected on Tap Board is too low.	Check selection on Air Flow Tap Board.	Select a higher setting.
	Air flow reduction is enabled.	AR1 and AR2 are connected with a dry contact.	Air flow reduction may not be feasible with poor ductwork, and/or lower Air Flow selections. Increase settings until unit operates properly.
Fan operating on wrong Stage speed	Fan Control Signal Harness is loose.	Verify that the connector is properly inserted into the fan motor. Gently tug on each wire to verify it is properly inserted into the connector.	Repair any loose connections.
	Faulty Control Signal Harness or faulty motor head.	Measure 24VAC between White (pin 3) and the following at the fan control signal harness (insert probes in connector where wire is inserted, do not unplug the connector): Circulation = Grey (pin 15) Stage 1 = Yellow (pin 6) Stage 2=Yellow/Black (pin14) Stage 3 = Violet (pin 2)	If proper signal isn't present, replace Fan Control Signal Harness. If proper signal is present, replace fan motor head.
Fan not operating or operating intermittently	Fan Control Signal Harness and/or Fan Power Harness is loose.	Verify that the connector is properly inserted into the fan motor. Gently tug on each wire to verify it is properly inserted into the connector.	Repair any loose connections.
	Faulty Control Signal Harness or; Faulty motor head.	Measure 24VAC between White (pin 3) and the following at the fan control signal harness (insert probes in connector where wire is inserted, do not unplug the connector): Circulation = Grey (pin 15) Stage 1 = Yellow (pin 6) Stage 2=Yellow/Black (pin14) Stage 3 = Violet (pin 2)	If proper signal isn't present, replace Fan Control Signal Harness. If proper signal is present, replace fan motor head.
	Fan Power Harness faulty or; Faulty motor.	Insert the tips of the voltmeter probes into the back of the connector at the fan to measure the voltage across the red and black wires, value should be 230VAC	Replace Power Harness if 230VAC is not present, replace motor if 230VAC is present

PLENUM HEATER TROUBLE SHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
No 230VAC across plenum heater L1 and L2	Disconnect switch open. (if installed)	Verify disconnect switch is in the ON position.	Determine why the disconnect switch was opened, if all is OK close the switch.
	Fuse blown / Breaker Tripped.	At plenum heater disconnect box (if installed), voltmeter shows voltage on the line side but not on the load side. Check if breaker is tripped.	Reset breaker or replace fuse at plenum heater disconnect box. Replace fuse with proper size and type. (Time-delay type “D”)
	Same “Line” to L1 and L2	Measuring L1 to ground and L2 to ground both yield 115VAC, but L1 to L2 yields 0VAC.	Correct wiring.
No W2 signal at Heat pump terminal strip	No call for auxiliary or emergency heat from thermostat.	Verify that the thermostat is indicating that auxiliary or emergency heat should be on.	Set thermostat to engage auxiliary or emergency heat (note some thermostats require a jumper between auxiliary and emergency. Check the thermostat manual).
	Faulty thermostat.	Thermostat doesn’t indicate a call for auxiliary or emergency when it should.	Replace thermostat.
	Faulty thermostat.	Thermostat indicates auxiliary or emergency but no 24VAC signal present across C and the auxiliary and/or emergency pin at the thermostat.	Replace thermostat.
	Faulty thermostat wiring.	24VAC signal is present across C and the auxiliary and/or emergency pin at the thermostat but no 24VAC signal is present across W2 and C at the heat pump terminal strip.	Correct wiring.
No 24VAC signal from C to ground at the plenum heater control connector	Plenum Heater transformer is burned out.	Voltmeter does not show 24VAC across transformer secondary winding.	Replace transformer.
	Plenum heater control board is faulty.	Transformer tested OK in previous step.	Replace control board.
No 24VAC signal from 1 to ground at the plenum heater control connector	Faulty wiring.	24VAC present across C and ground at the plenum heater, but not across ground of the plenum heater and I of the heat pump terminal strip	Correct wiring.
	Faulty wiring.	If previous step tested OK, 24VAC is present across ground of the plenum heart and 1 of the heat pump terminal strip, but not across ground of the plenum heater and 1 of the plenum heater.	Correct wiring.

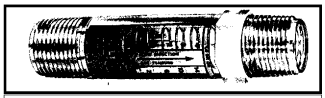
PLENUM HEATER TROUBLE SHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
No 24VAC signal from 1 to ground at the plenum heater control connector	Faulty Plenum Heater Relay in heat pump	24VAC is present across pin 1 and pin 3 of the relay, 24VAC is present from heat pump terminal strip I to plenum heater ground, but not from heat pump terminal strip 1 to plenum heater ground.	Replace relay.
Thermal overload is tripped.	Fan not operating	See Fan Not Operating section	Correct problem. Reset thermal overload.
	Faulty overload	Reset thermal overload	Replace if faulty.

DOMESTIC HOT WATER (DHW) TROUBLE SHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Insufficient hot water (Tank Problem)	Thermostat on hot water tank set too low. Should be set at 120°F. (140°F if required by local code)	Visually inspect the setting.	Readjust the setting to 120°F. (140°F if required by local code)
	Breaker tripped, or fuse blown in electrical supply to hot water tank.	Check both line and load sides of fuses. If switch is open determine why.	Replace blown fuse or reset breaker.
	Reset button tripped on hot water tank.	Check voltage at elements with multimeter.	Push reset button.
Insufficient hot water (Heat Pump Problem)	Circulator pump not operating.	Visually inspect the pump to see if shaft is turning. Use an amprobe to measure current draw.	Replace if faulty.
	Blockage or restriction in the water line or hot water heat exchanger.	Check water flow and power to pump. Check water lines for obstruction	Remove obstruction in water lines. Acid treat the domestic hot water coil.
	Faulty DHW cutout (failed open).	Check contact operation. Should close at 120°F and open at 140°F.	Replace DHW cutout if faulty.
	Heat pump not running enough hours to make sufficient hot water.	Note the amount of time the heat pump runs in any given hour.	Temporarily turn up the tank thermostats until colder weather creates longer run cycles.
Water is too hot.	Faulty DHW cutout (failed closed).	Check contact operation. Should close at 120°F and open at 140°F.	Replace DHW cutout if faulty.
	Thermostat on hot water tank set too high. Should be set at 120°F. (140°F if required by local code)	Visually inspect the setting.	Readjust the setting to 120°F. (140°F if required by local code)

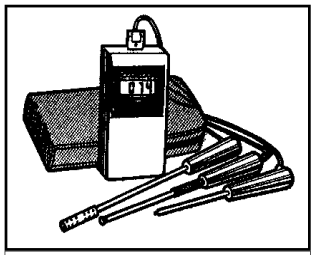
Trouble Shooting Tools



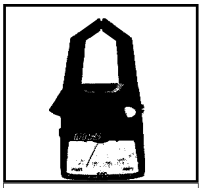
Refrigeration Gauges



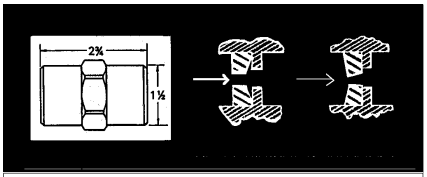
In-line Flowmeter



Digital Thermometer



Multimeter - Voltmeter / 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 psi. The controlling mechanism consists of a flexible orifice that varies its area inversely with pressure so that a constant flow is maintained.

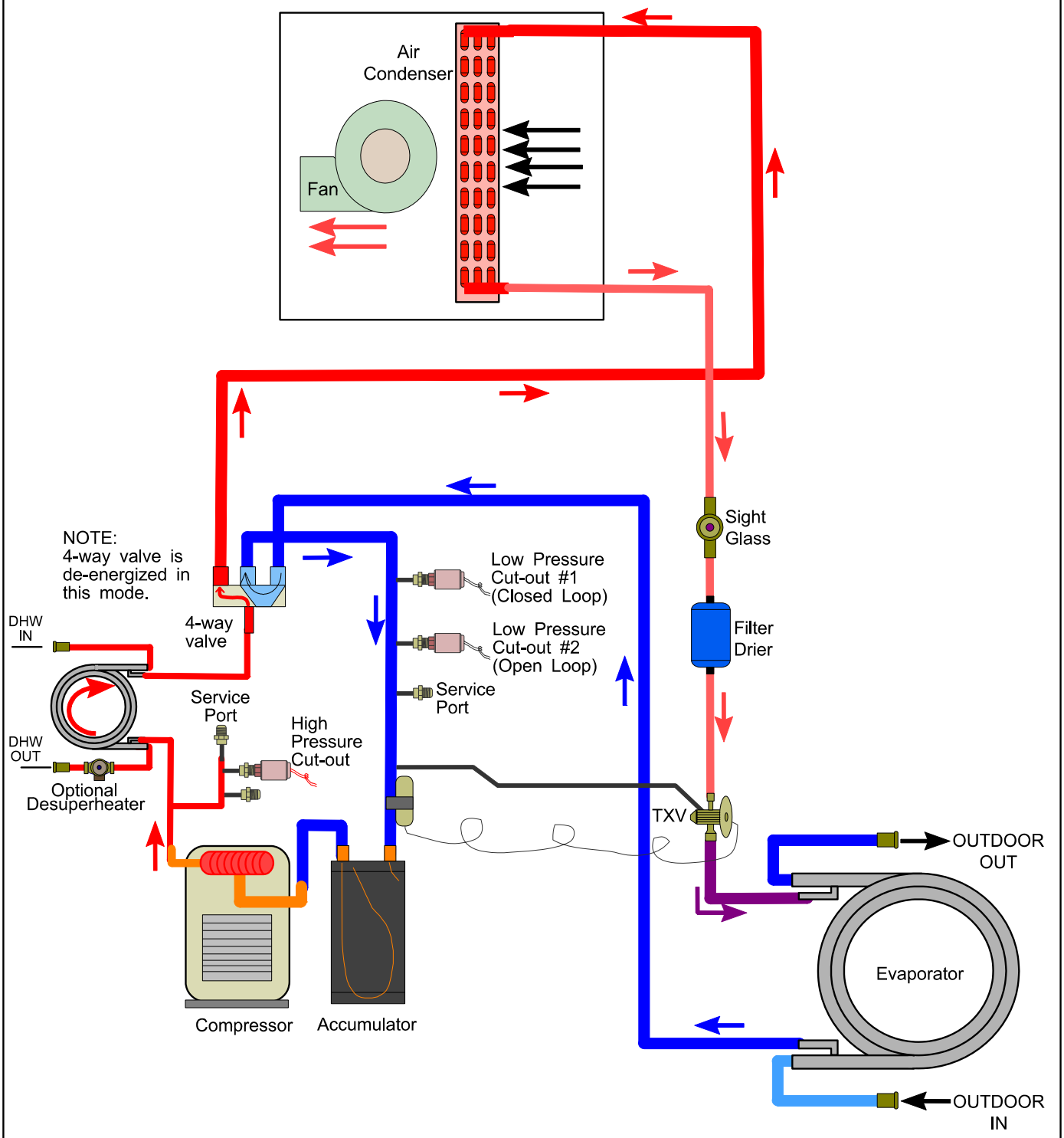
REPAIR PROCEDURES

PUMP DOWN PROCEDURE	
STEP 1	Connect the refrigerant recovery unit to the heat pump service ports via a refrigeration charging manifold and to a recovery tank as per the instructions in the recovery unit manual. **If there was a compressor burn out, the refrigerant cannot be reused and must be disposed of according to local codes.**
STEP 2	All water coil heat exchangers must either have full flow or be completely drained of fluid before recovery begins. Failure to do so can freeze and rupture the heat exchanger, voiding its warranty. (Note that this does not apply to double wall domestic hot water exchangers (desuperheater coils)
STEP 3	Ensure all hose connections are properly purged of air. Start the refrigerant recovery as per the instructions in the recovery unit manual.
STEP 4	Allow the recovery unit suction pressure to reach a vacuum. Once achieved, close the charging manifold valves. Shut down, purge and disconnect the recovery unit as per the instructions in its manual. Ensure the recovery tank valve is closed before disconnecting the hose to it.
STEP 5	Connect a nitrogen tank to the charging manifold and add nitrogen to the heat pump until a positive pressure of 5-10PSIG is reached. This prevents air from being sucked into the unit by the vacuum when the hoses are disconnected.
STEP 6	The heat pump is now ready for repairs. Always ensure nitrogen is flowing through the system during any soldering procedures to prevent soot buildup inside the pipes. Maritime Geothermal Ltd. recommends replacing the liquid line filter-drier anytime the refrigeration system has been exposed to the atmosphere.

VACUUM AND CHARGING PROCEDURE	
STEP 1	After completion of repairs and nitrogen pressure testing, the refrigeration circuit is ready for vacuuming.
STEP 2	Release the refrigerant circuit pressure and connect the vacuum pump to the charging manifold. Start the vacuum pump and open the charging manifold valves. Vacuum until the vacuum gauge remains at less than 500 microns for at least 1 minute with the vacuum pump valve closed.
STEP 3	Close the charging manifold valves then shut off and disconnect the vacuum pump. Place a refrigerant tank with the proper refrigerant on a scale and connect it to the charging manifold. Purge the hose to the tank.
STEP 4	Weigh in the appropriate amount of refrigerant through the low pressure (suction) service port. Refer to the label on the unit or **TABLE 12 - Refrigerant Charge Chart** for the proper charge amount.
STEP 5	If the unit will not accept the entire charge, the remainder can be added through the low pressure service port after the unit has been restarted.

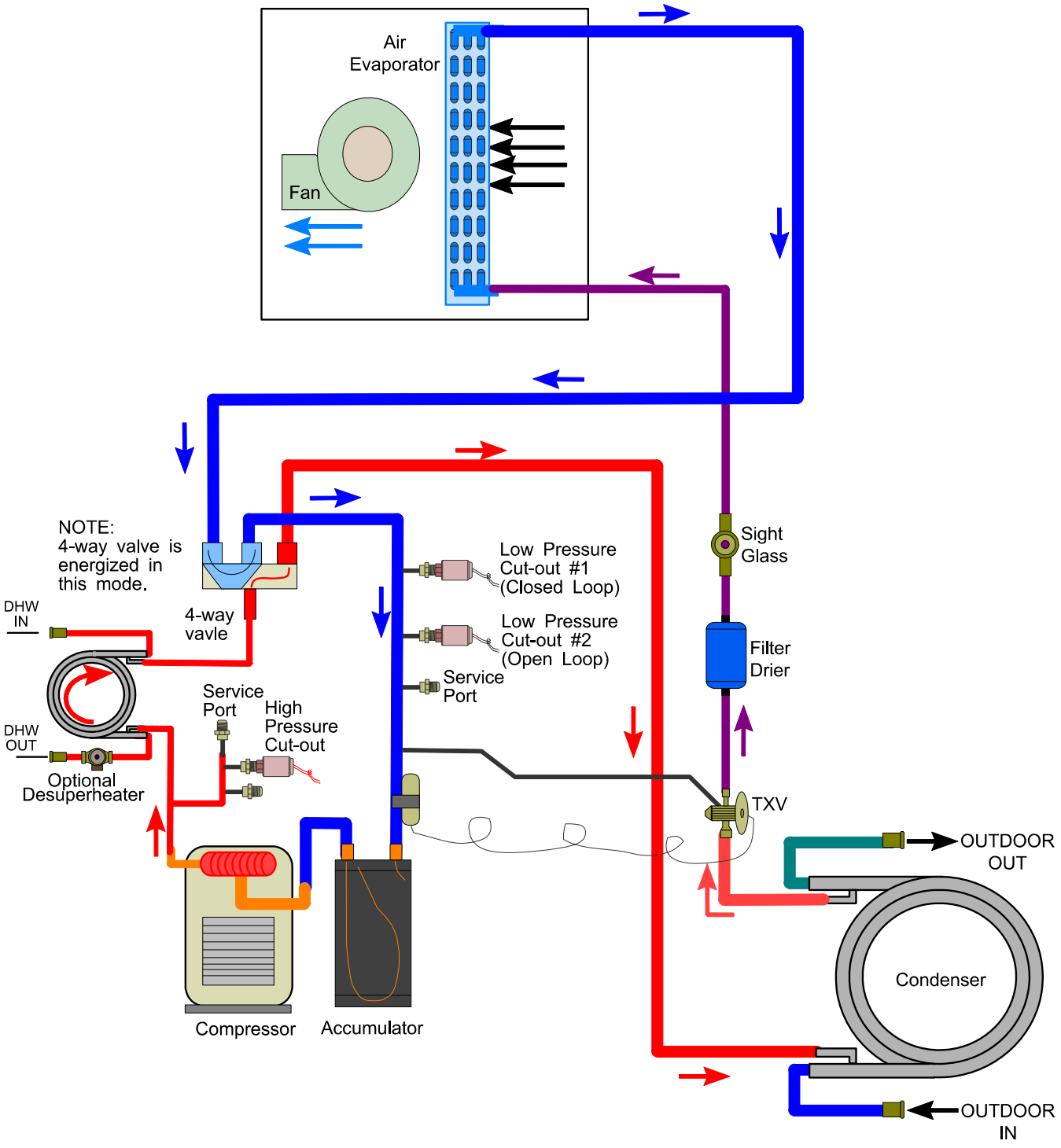
REPLACMENT PROCEDURE FOR A COMPRESSOR BURN-OUT	
STEP 1	Pump down the unit as per the Pump Down Procedure above.
STEP 2	Replace the compressor. Replace the liquid line filter-drier.
STEP 3	Vacuum the unit until it remains under 500 microns for several minutes with the vacuum pump valve closed.
STEP 4	Charge the unit and operate it for continuously for 2 hours. Pump down the unit and replace the filter-drier. Vacuum the unit until it remains under 500 microns for several minutes with the vacuum pump valve closed.
STEP 5	Charge the unit (refrigerant can be re-used) and operate it for 2-3 days. Pump down the unit and replace the filter-drier.
STEP 6	Charge the unit (refrigerant can be re-used) and operate it for 2 weeks. Pump down the unit and replace the filter-drier.
STEP 7	Charge the unit a final time. Unit should now be clean and repeated future burn-outs can be avoided.

Modular R(H)-Series Refrigeration Circuit - Heating Mode



					Drawn By Chris Geddes	Date 25 JAN 10	MARITIME GEOTHERMAL LTD.	170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Chris Geddes	Date 25 JAN 10	Drawing Name	Modular R(H)-Series Refrigeration Circuit Diagram - Heating Mode
					Approved By (ENG) Chris Geddes	Date 25 JAN 10	Size A	Drawing Number 001207RCD
01	Initial Release	C. GEDDES	C. GEDDES	25 JAN 10	Approved By (MFG)	Date	REV 01	SHEET 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date		

Modular R(H)-Series Refrigeration Circuit - Cooling Mode



					Drawn By Chris Geddes	Date 25 JAN 10	MARITIME GEOTHERMAL LTD.	170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Chris Geddes	Date 25 JAN 10	Drawing Name	Modular R(H)-Series Refrigeration Circuit Diagram - Cooling Mode
					Approved By (ENG) Chris Geddes	Date 25 JAN 10	Size	Drawing Number
01	Initial Release	C. GEDDES	C. GEDDES	25 JAN 10	Approved By (MFG)	Date	A	001208RCD
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date	REV 01	SHEET 1 of 1

Model Specific Information

This section provides general information particular to each model. For complete specifications please see the specifications

REFRIGERANT CHARGE CHART

Table 12 - Refrigerant - R410a

SIZE	Lbs.	kg
25	5.0	2.3
45	5.5	2.5
55	8.0	3.6
65	8.5	3.9
75	8.5	3.9
80	9.0	4.1
System contains POE oil.		

SHIPPING INFORMATION

Table 13 - Shipping Information

MODEL	WEIGHT	DIMENSIONS in (cm)		
	Lbs. (kg)	L	W	H
25	325 (147)	60 (152)	30 (76)	28 (71)
45	420 (191)	60 (152)	30 (76)	28 (71)
55	463 (210)	70 (178)	36 (91)	29 (74)
65	511 (232)	70 (178)	36 (91)	29 (74)
75	550 (249)	70 (178)	36 (91)	29 (74)
80	558 (253)	70 (178)	36 (91)	29 (74)

STADARD CAPACITY RATINGS

The tables below depict the results of standard capacity rating tests according to C13256-1, which is identical to ISO13256-1. Stage 1 values do not apply to single stage units. Refer to the Electrical Tables to determine which models are single stage.

Table 14 - Standard Capacity Ratings - Ground Loop Heating* 60Hz

EAT 68°F (20°C) — STAGE 1 - ELT 41°F (5°C); STAGE 2 - ELT 32°F (0°C)

Model	Size	Liquid Flow			Pressure Drop		Mode	Airflow		Input Energy	Capacity		COP_H
	Tons	IGAL	USG	L/s	PSI	kPA		CFM	L/s	Watts	BTU/Hr	kW	W/W
25	2	6	7.2	0.45	3.4	23.4	Stage 1	850	401	1,085	14,900	4.4	4.03
							Stage 2	1000	472	1,465	17,600	5.2	3.52
45	3	8	9.6	0.61	3.7	25.5	Stage 1	1200	566	1,435	22,800	6.7	4.66
							Stage 2	1400	661	2,190	29,100	8.5	3.89
55	4	10	12.0	0.76	5.0	34.5	Stage 1	1400	661	2,310	33,100	9.7	4.21
							Stage 2	1700	802	3,120	39,700	11.6	3.73
65	5	12	14.4	0.91	4.2	29.0	Stage 1	1700	802	2,690	39,700	11.6	4.32
							Stage 2	2100	991	3,670	48,000	14.1	3.83
75	6	14	16.8	1.06	4.6	31.7	Stage 1	1900	897	3,375	44,900	13.1	3.90
							Stage 2	2400	1133	4,530	53,700	15.7	3.47
80	6	14	16.8	1.06	4.6	31.7							
							Stage 1	2400	1133	5,420	63,500	18.6	3.43

* 15% NaCl by Weight Ground Loop Fluid

Table 15 - Standard Capacity Ratings - Ground Water Heating 60Hz

EAT 68°F (20°C) — ELT 50°F (10°C)

Model	Size	Liquid Flow			Pressure Drop		Mode	Airflow		Input Energy	Capacity		COP_H
	Tons	IGAL	USG	L/s	PSI	kPA		CFM	L/s	Watts	BTU/Hr	kW	W/W
25	2	6	7.2	0.45	2.5	17.2	Stage 1	850	401	1,110	16,800	4.9	4.43
							Stage 2	1000	472	1,625	23,800	7.0	4.28
45	3	8	9.6	0.61	3.3	22.8	Stage 1	1200	566	1,465	25,800	7.6	5.16
							Stage 2	1400	661	2,465	37,200	10.9	4.43
55	4	10	12.0	0.76	3.3	22.8	Stage 1	1400	661	2,350	38,500	11.3	4.80
							Stage 2	1700	802	3,370	49,900	14.6	4.34
65	5	12	14.4	0.91	3.1	21.4	Stage 1	1700	802	2,755	45,600	13.3	4.83
							Stage 2	2100	991	4,105	61,100	17.9	4.36
75	6	14	16.8	1.06	3.7	25.5	Stage 1	1900	897	3,415	50,500	14.8	4.33
							Stage 2	2400	1133	4,815	69,000	20.2	4.18
80	6	14	16.8	1.06	3.7	25.5							
							Stage 1	2400	1133	5,770	81,500	23.9	4.14

Table 16 - Standard Capacity Ratings - Ground Loop Cooling* 60Hz

EAT 80.6°F (27°C)

STAGE 1 - ELT 68°F (20°C)
STAGE 2 - ELT 77°F (25°C)

Model	Size	Liquid Flow			Pressure Drop		Mode	Airflow		Input Energy	Capacity		COP_c
	Tons	IGAL	USG	L/s	PSI	kPA		CFM	L/s	Watts	BTU/Hr	kW	W/W
25	2	6	7.2	0.45	2.3	15.9	Stage 1	850	401	925	21,700	6.3	6.87
							Stage 2	1000	472	1,615	26,200	7.7	4.76
45	3	8	9.6	0.61	2.9	20.2	Stage 1	1200	566	980	28,400	8.3	8.49
							Stage 2	1400	661	1,965	37,200	10.9	5.54
55	4	10	12.0	0.76	3.5	24.1	Stage 1	1400	661	1,760	42,800	12.5	7.12
							Stage 2	1700	802	2,990	51,800	15.2	5.08
65	5	12	14.4	0.91	3.2	22.1	Stage 1	1700	802	2,205	47,600	14.0	6.33
							Stage 2	2100	991	3,980	59,900	17.6	4.41
75	6	14	16.8	1.06	3.9	26.9	Stage 1	1900	897	2,995	57,300	16.8	5.61
							Stage 2	2400	1133	4,975	70,000	20.5	4.12
80	6	14	16.8	1.06	3.9	26.9							
							Stage 1	2400	1133	5,850	81,000	23.7	4.05

* 15% NaCl by Weight Ground Loop Fluid

Table 17 - Standard Capacity Ratings - Ground Water Cooling 60Hz

EAT 80.6°F (27°C)

ELT 59°F (15°C)

Model	Size	Liquid Flow			Pressure Drop		Mode	Airflow		Input Energy	Capacity		COP_c
	Tons	IGAL	USG	L/s	PSI	kPA		CFM	L/s	Watts	BTU/Hr	kW	W/W
25	2	6	7.2	0.45	2.1	14.5	Stage 1	850	401	805	22,500	6.6	8.15
							Stage 2	1000	472	1,310	29,500	8.6	6.59
45	3	8	9.6	0.61	2.5	17.2	Stage 1	1200	566	835	30,100	8.8	10.52
							Stage 2	1400	661	1,670	40,000	11.7	7.01
55	4	10	12.0	0.76	3.1	21.4	Stage 1	1400	661	1,575	45,500	13.3	8.45
							Stage 2	1700	802	2,625	58,300	17.1	6.50
65	5	12	14.4	0.91	2.7	18.6	Stage 1	1700	802	1,965	50,800	14.9	7.58
							Stage 2	2100	991	3,465	67,200	19.7	5.68
75	6	14	16.8	1.06	3.4	23.4	Stage 1	1900	897	2,725	58,500	17.1	6.29
							Stage 2	2400	1133	4,440	74,700	21.9	4.93
80	6	14	16.8	1.06	3.4	23.4							
							Stage 1	2400	1133	5,100	85,500	25.1	4.91

CAPACITY RATINGS

Heating Mode

RH-25-HACW-P-1T — **Nominal 2 ton** — **R410a 60 Hz**

Source Data (Outdoor Loop)						Power Consumption					Sink Data (Indoor Loop)					
ELT	Evap. Temp	Flow	LLT	Delta T	HAB	Compressor		Fan*	Effective	COPh	EAT	Cond. Temp.	Air Flow	LAT	Delta T	Net Output
°F	°F	USGPM	°F	°F	BTU/Hr	Watts	Amps	Watts	Watts	W/W	°F	°F	CFM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts						°C	°C	L/s	°C	°C	Watts
22.0	15	7.2	18.1	3.9	11,143	1,275	5.4	97	1,365	**3.36**	68	91	1,000	82.4	14.4	**15,637**
-5.6	-9.4	0.454	-7.7	2.2	3,265						20.0	32.8	472	28.0	8.0	**4,581**
28.0	20	7.2	23.8	4.2	12,164	1,332	5.6	97	1,422	**3.47**	68	94	1,000	83.6	15.6	**16,854**
-2.2	-6.7	0.454	-4.6	2.3	3,564						20.0	34.4	472	28.6	8.6	**4,938**
34.0	25	7.2	29.4	4.6	13,333	1,372	5.8	97	1,462	**3.64**	68	96	1,000	84.8	16.8	**18,159**
1.1	-3.9	0.454	-1.5	2.6	3,907						20.0	35.6	472	29.3	9.3	**5,320**
40.0	30	7.2	35.0	5.0	14,493	1,431	6.0	97	1,521	**3.76**	68	99	1,000	86.0	18.0	**19,522**
4.4	-1.1	0.454	1.6	2.8	4,246						20.0	37.2	472	30.0	10.0	**5,720**
44.0	35	7.2	38.5	5.5	16,931	1,487	6.2	97	1,565	**4.15**	68	101	1,000	88.5	20.5	**22,149**
6.7	1.7	0.454	3.6	3.1	4,961						20.0	38.3	472	31.4	11.4	**6,490**
50.0	40	7.2	44.0	6.0	18,325	1,550	6.5	97	1,628	**4.28**	68	104	1,000	89.9	21.9	**23,758**
10.0	4.4	0.454	6.7	3.3	5,369						20.0	40.0	472	32.2	12.2	**6,961**
56.0	45	7.2	49.5	6.5	19,921	1,594	6.7	97	1,672	**4.47**	68	106	1,000	91.5	23.5	**25,504**
13.3	7.2	0.454	9.7	3.6	5,837						20.0	41.1	472	33.1	13.1	**7,473**
62.0	50	7.2	55.0	7.0	21,470	1,662	7.0	97	1,740	**4.60**	68	109	1,000	93.2	25.2	**27,284**
16.7	10.0	0.454	12.8	3.9	6,291						20.0	42.8	472	34.0	14.0	**7,994**

Compressor: ZPS20K4E-PFV

* @ 37.3Pa (0.15inH2o) Ext. Static

Cooling Mode

RH-25-HACW-P-1T — **R410a 60 Hz**

Source Data (Indoor Loop)								Power Consumption					Sink Data (Outdoor Loop)					
EAT	Evap. Temp	Airflow	LAT	Delta T	Latent	Sensible	HAB	Compressor		Fan*	Effective	Effi-ciency	ELT	Cond. Temp.	Flow	LLT	Delta T	Rejection
°F	°F	CFM	°F	°F	BTU/Hr	BTU/Hr	BTU/Hr	Watts	Amps	Watts	Watts	EER	°F	°F	USGPM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts	Watts	Watts					COPc	°C	°C	L/s	°C	°C	Watts
80.6	47	1,000	59.5	21.1	7,628	22,885	**30,513**	1,106	4.3	100	1,182	**25.8**	52	75	7.2	61.6	9.6	34,628
27.0	8.3	472	15.3	11.7	2,235	6,705	**8,940**					**7.56**	11.1	23.9	0.454	16.5	5.3	10,146
80.6	47	1,000	60.0	20.6	7,441	22,322	**29,763**	1,198	4.7	100	1,274	**23.4**	57	80	7.2	66.5	9.5	34,192
27.0	8.3	472	15.5	11.5	2,180	6,540	**8,720**					**6.85**	13.9	26.7	0.454	19.2	5.3	10,018
80.6	48	1,000	60.1	20.5	7,385	22,156	**29,542**	1,293	5.0	100	1,369	**21.6**	62	85	7.2	71.5	9.5	34,296
27.0	8.9	472	15.6	11.4	2,164	6,492	**8,656**					**6.32**	16.7	29.4	0.454	22.0	5.3	10,049
80.6	48	1,000	60.7	19.9	7,188	21,564	**28,753**	1,390	5.4	100	1,466	**19.6**	67	90	7.2	76.4	9.4	33,838
27.0	8.9	472	15.9	11.1	2,106	6,318	**8,424**					**5.75**	19.4	32.2	0.454	24.7	5.2	9,914
80.6	49	1,000	61.8	18.8	6,791	20,374	**27,166**	1,412	5.8	100	1,492	**18.2**	71	95	7.2	80.0	9.0	32,327
27.0	9.4	472	16.5	10.5	1,990	5,970	**7,959**					**5.33**	21.7	35.0	0.454	26.7	5.0	9,472
80.6	49	1,000	62.3	18.3	6,593	19,779	**26,373**	1,512	6.2	100	1,592	**16.6**	76	100	7.2	84.9	8.9	31,875
27.0	9.4	472	16.9	10.1	1,932	5,795	**7,727**					**4.85**	24.4	37.8	0.454	29.4	4.9	9,339
80.6	50	1,000	62.6	18.0	6,511	19,534	**26,045**	1,618	6.6	100	1,698	**15.3**	81	105	7.2	89.9	8.9	31,908
27.0	10.0	472	17.0	10.0	1,908	5,723	**7,631**					**4.49**	27.2	40.6	0.454	32.1	4.9	9,349
80.6	50	1,000	63.1	17.5	6,302	18,907	**25,210**	1,729	7.1	100	1,809	**13.9**	86	110	7.2	94.7	8.7	31,452
27.0	10.0	472	17.3	9.7	1,847	5,540	**7,386**					**4.08**	30.0	43.3	0.454	34.9	4.9	9,215

Compressor: ZPS20K4E-PFV

* @ 37.3Pa (0.15inH2o) Ext. Static

CAPACITY RATINGS (continued)

Heating Mode

RH-45-HACW-P-1T — **Nominal 3 ton** — **R410a 60 Hz**

Source Data (Outdoor Loop)						Power Consumption					Sink Data (Indoor Loop)					
ELT	Evap. Temp	Flow	LLT	Delta T	HAB	Compressor		Fan*	Effective	COPh	EAT	Cond. Temp.	Air Flow	LAT	Delta T	Net Output
°F	°F	USGPM	°F	°F	BTU/Hr	Watts	Amps	Watts	Watts	W/W	°F	°F	CFM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts						°C	°C	L/s	°C	°C	Watts
26.0	15	9.6	21.8	4.2	20,108	1,993	9.2	135	2,136	**3.72**	68	103	1,400	85.9	17.9	**27,106**
-3.3	-9.4	0.606	-5.6	2.3	5,891						20.0	39.4	661	29.9	9.9	**7,942**
32.0	20	9.6	27.5	4.5	21,898	2,050	9.5	135	2,193	**3.89**	68	105	1,400	87.2	19.2	**29,091**
0.0	-6.7	0.606	-2.5	2.5	6,416						20.0	40.6	661	30.7	10.7	**8,524**
38.0	25	9.6	33.1	4.9	23,818	2,107	9.7	135	2,250	**4.06**	68	107	1,400	88.6	20.6	**31,207**
3.3	-3.9	0.606	0.6	2.7	6,979						20.0	41.7	661	31.4	11.4	**9,144**
44.0	30	9.6	38.7	5.3	25,701	2,192	10.2	135	2,335	**4.19**	68	110	1,400	90.0	22.0	**33,382**
6.7	-1.1	0.606	3.7	3.0	7,530						20.0	43.3	661	32.2	12.2	**9,781**
47.0	35	9.6	41.2	5.8	28,591	2,242	10.4	135	2,381	**4.48**	68	112	1,400	92.0	24.0	**36,436**
8.3	1.7	0.606	5.1	3.2	8,377						20.0	44.4	661	33.4	13.4	**10,676**
53.0	40	9.6	46.8	6.2	30,756	2,332	10.9	135	2,471	**4.61**	68	115	1,400	93.7	25.7	**38,907**
11.7	4.4	0.606	8.2	3.4	9,011						20.0	46.1	661	34.3	14.3	**11,400**
59.0	45	9.6	52.3	6.7	33,262	2,395	11.2	135	2,534	**4.81**	68	117	1,400	95.5	27.5	**41,627**
15.0	7.2	0.606	11.3	3.7	9,746						20.0	47.2	661	35.3	15.3	**12,197**
65.0	50	9.6	57.8	7.2	35,919	2,460	11.5	135	2,599	**5.02**	68	119	1,400	97.4	29.4	**44,506**
18.3	10.0	0.606	14.3	4.0	10,524						20.0	48.3	661	36.3	16.3	**13,040**

Compressor: ZPS30K4E-PFV

* @ 37.3Pa (0.15inH2o) Ext. Static

Cooling Mode

RH-45-HACW-P-1T — **R410a 60 Hz**

Source Data (Indoor Loop)								Power Consumption					Sink Data (Outdoor Loop)					
EAT	Evap. Temp	Airflow	LAT	Delta T	Latent	Sensible	HAB	Compressor		Fan*	Effective	Effi-ciency	ELT	Cond. Temp.	Flow	LLT	Delta T	Rejection
°F	°F	CFM	°F	°F	BTU/Hr	BTU/Hr	BTU/Hr	Watts	Amps	Watts	Watts	EER	°F	°F	USGPM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts	Watts	Watts					COPc	°C	°C	L/s	°C	°C	Watts
80.6	40	1,400	60.3	20.3	10,271	30,813	**41,083**	1,381	5.9	150	1,528	**26.9**	53	70	9.6	62.6	9.6	46,309
27.0	4.4	661	15.7	11.3	3,009	9,028	**12,037**					**7.88**	11.7	21.1	0.606	17.0	5.4	13,568
80.6	40	1,400	60.7	19.9	10,039	30,116	**40,155**	1,497	6.4	150	1,644	**24.4**	58	75	9.6	67.5	9.5	45,775
27.0	4.4	661	16.0	11.0	2,941	8,824	**11,765**					**7.16**	14.4	23.9	0.606	19.7	5.3	13,412
80.6	41	1,400	60.8	19.8	9,982	29,945	**39,927**	1,614	6.9	150	1,761	**22.7**	63	80	9.6	72.6	9.6	45,949
27.0	5.0	661	16.0	11.0	2,925	8,774	**11,699**					**6.64**	17.2	26.7	0.606	22.5	5.3	13,463
80.6	42	1,400	61.0	19.6	9,914	29,743	**39,657**	1,734	7.4	150	1,881	**21.1**	68	85	9.6	77.6	9.6	46,088
27.0	5.6	661	16.1	10.9	2,905	8,715	**11,619**					**6.18**	20.0	29.4	0.606	25.3	5.3	13,504
80.6	43	1,400	61.9	18.7	9,444	28,332	**37,777**	1,749	7.9	150	1,891	**20.0**	74	90	9.6	83.2	9.2	44,256
27.0	6.1	661	16.6	10.4	2,767	8,301	**11,068**					**5.85**	23.3	32.2	0.606	28.5	5.1	12,967
80.6	43	1,400	62.4	18.2	9,191	27,573	**36,763**	1,869	8.4	150	2,011	**18.3**	79	95	9.6	88.1	9.1	43,654
27.0	6.1	661	16.9	10.1	2,693	8,079	**10,772**					**5.36**	26.1	35.0	0.606	31.2	5.1	12,791
80.6	44	1,400	62.6	18.0	9,095	27,285	**36,381**	1,995	9.0	150	2,137	**17.0**	84	100	9.6	93.1	9.1	43,703
27.0	6.7	661	17.0	10.0	2,665	7,995	**10,659**					**4.99**	28.9	37.8	0.606	33.9	5.1	12,805
80.6	44	1,400	63.1	17.5	8,827	26,482	**35,309**	2,128	9.6	150	2,270	**15.6**	89	105	9.6	98.0	9.0	43,083
27.0	6.7	661	17.3	9.7	2,586	7,759	**10,346**					**4.56**	31.7	40.6	0.606	36.7	5.0	12,623

Compressor: ZPS30K4E-PFV

* @ 37.3Pa (0.15inH2o) Ext. Static

Heating Mode

RH-55-HACW-P-1T — **Nominal 4 ton** — **R410a 60 Hz**

Source Data (Outdoor Loop)						Power Consumption					Sink Data (Indoor Loop)					
ELT	Evap. Temp	Flow	LLT	Delta T	HAB	Compressor		Fan*	Effective	**COPh**	EAT	Cond. Temp.	Air Flow	LAT	Delta T	**Net Output**
°F	°F	USGPM	°F	°F	BTU/Hr	Watts	Amps	Watts	Watts	**W/W**	°F	°F	CFM	°F	°F	**BTU/Hr**
°C	°C	L/s	°C	°C	Watts						°C	°C	L/s	°C	°C	**Watts**
25.0	15	12.0	20.9	4.1	25,964	2,737	12.5	285	3,056	**3.45**	68	103	1,700	87.5	19.5	**35,943**
-3.9	-9.4	0.757	-6.2	2.3	7,607						20.0	39.4	802	30.8	10.8	**10,531**
31.0	20	12.0	26.5	4.5	28,831	2,807	12.8	285	3,126	**3.66**	68	105	1,700	89.2	21.2	**39,050**
-0.6	-6.7	0.757	-3.1	2.5	8,447						20.0	40.6	802	31.8	11.8	**11,442**
37.0	25	12.0	32.0	5.0	31,913	2,877	13.2	285	3,196	**3.88**	68	107	1,700	91.0	23.0	**42,371**
2.8	-3.9	0.757	0.0	2.8	9,350						20.0	41.7	802	32.8	12.8	**12,415**
43.0	30	12.0	37.4	5.6	35,215	2,948	13.5	285	3,267	**4.12**	68	109	1,700	92.9	24.9	**45,914**
6.1	-1.1	0.757	3.0	3.1	10,318						20.0	42.8	802	33.9	13.9	**13,453**
48.0	35	12.0	41.9	6.1	37,095	3,079	13.9	285	3,358	**4.21**	68	111	1,700	94.2	26.2	**48,239**
8.9	1.7	0.757	5.5	3.4	10,869						20.0	43.9	802	34.6	14.6	**14,134**
54.0	40	12.0	47.3	6.7	40,699	3,153	14.2	285	3,432	**4.45**	68	113	1,700	96.3	28.3	**52,095**
12.2	4.4	0.757	8.5	3.7	11,925						20.0	45.0	802	35.7	15.7	**15,264**
60.0	45	12.0	52.7	7.3	44,533	3,229	14.6	285	3,508	**4.69**	68	115	1,700	98.5	30.5	**56,189**
15.6	7.2	0.757	11.5	4.1	13,048						20.0	46.1	802	37.0	17.0	**16,463**
66.0	50	12.0	58.0	8.0	48,604	3,307	14.9	285	3,586	**4.94**	68	117	1,700	100.9	32.9	**60,527**
18.9	10.0	0.757	14.4	4.4	14,241						20.0	47.2	802	38.3	18.3	**17,734**

Compressor: ZPS40K4E-PFV

* @ 37.3Pa (0.15inH2o) Ext. Static

Cooling Mode

RH-55-HACW-P-1T — **R410a 60 Hz**

Source Data (Indoor Loop)								Power Consumption					Sink Data (Outdoor Loop)					
EAT	Evap. Temp	Airflow	LAT	Delta T	Latent	Sensible	**HAB**	Compressor		Fan*	Effective	**Effi-ciency**	ELT	Cond. Temp.	Flow	LLT	Delta T	Rejection
°F	°F	CFM	°F	°F	BTU/Hr	BTU/Hr	**BTU/Hr**	Watts	Amps	Watts	Watts	**EER**	°F	°F	USGPM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts	Watts	**Watts**					**COPc**	°C	°C	L/s	°C	°C	Watts
80.6	45	1,700	56.4	24.2	14,834	44,502	**59,336**	2,100	9.1	310	2,392	**24.8**	51	75	12.0	62.3	11.3	67,562
27.0	7.2	802	13.6	13.4	4,346	13,039	**17,385**					**7.27**	10.6	23.9	0.757	16.8	6.3	19,795
80.6	45	1,700	57.0	23.6	14,494	43,481	**57,975**	2,244	9.7	310	2,536	**22.9**	56	80	12.0	67.1	11.1	66,693
27.0	7.2	802	13.9	13.1	4,247	12,740	**16,987**					**6.70**	13.3	26.7	0.757	19.5	6.2	19,541
80.6	46	1,700	57.1	23.5	14,425	43,276	**57,701**	2,392	10.4	310	2,684	**21.5**	61	85	12.0	72.2	11.2	66,924
27.0	7.8	802	13.9	13.1	4,227	12,680	**16,906**					**6.30**	16.1	29.4	0.757	22.3	6.2	19,608
80.6	46	1,700	57.7	22.9	14,060	42,180	**56,240**	2,542	11.0	310	2,834	**19.8**	66	90	12.0	77.0	11.0	65,976
27.0	7.8	802	14.3	12.7	4,120	12,359	**16,478**					**5.81**	18.9	32.2	0.757	25.0	6.1	19,331
80.6	47	1,700	59.1	21.5	13,182	39,547	**52,730**	2,589	11.6	310	2,891	**18.2**	74	95	12.0	84.4	10.4	62,623
27.0	8.3	802	15.1	11.9	3,862	11,587	**15,450**					**5.34**	23.3	35.0	0.757	29.1	5.8	18,348
80.6	47	1,700	59.7	20.9	12,812	38,437	**51,249**	2,743	12.3	310	3,045	**16.8**	79	100	12.0	89.3	10.3	61,670
27.0	8.3	802	15.4	11.6	3,754	11,262	**15,016**					**4.93**	26.1	37.8	0.757	31.8	5.7	18,069
80.6	48	1,700	59.9	20.7	12,681	38,044	**50,725**	2,906	13.0	310	3,208	**15.8**	84	105	12.0	94.3	10.3	61,700
27.0	8.9	802	15.5	11.5	3,716	11,147	**14,862**					**4.63**	28.9	40.6	0.757	34.6	5.7	18,078
80.6	48	1,700	60.6	20.0	12,284	36,852	**49,136**	3,076	13.8	310	3,378	**14.5**	89	110	12.0	99.1	10.1	60,691
27.0	8.9	802	15.9	11.1	3,599	10,798	**14,397**					**4.26**	31.7	43.3	0.757	37.3	5.6	17,782

Compressor: ZPS40K4E-PFV

* @ 37.3Pa (0.15inH2o) Ext. Static

Heating Mode

RH-65-HACW-P-1T — **Nominal 5 ton** — **R410a 60 Hz**

Source Data (Outdoor Loop)						Power Consumption					Sink Data (Indoor Loop)					
ELT	Evap. Temp	Flow	LLT	Delta T	HAB	Compressor		Fan*	Effective	COPh	EAT	Cond. Temp.	Flow	LAT	Delta T	Net Output
°F	°F	USGPM	°F	°F	BTU/Hr	Watts	Amps	Watts	Watts	W/W	°F	°F	CFM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts						°C	°C	L/min	°C	°C	Watts
26.0	15	14.4	21.2	4.8	32,607	3,170	14.9	465	3,593	**3.62**	68	97	2,100	87.5	19.5	**44,433**
-3.3	-9.4	0.909	-6.0	2.6	9,554						20.0	36.1	991	30.9	10.9	**13,019**
32.0	20	14.4	26.8	5.2	35,857	3,261	15.3	465	3,684	**3.82**	68	99	2,100	89.1	21.1	**47,993**
0.0	-6.7	0.909	-2.9	2.9	10,506						20.0	37.2	991	31.7	11.7	**14,062**
38.0	25	14.4	32.3	5.7	39,351	3,351	15.7	465	3,774	**4.02**	68	101	2,100	90.8	22.8	**51,796**
3.3	-3.9	0.909	0.1	3.2	11,530						20.0	38.3	991	32.7	12.7	**15,176**
44.0	30	14.4	37.7	6.3	43,096	3,443	16.1	465	3,866	**4.23**	68	103	2,100	92.6	24.6	**55,852**
6.7	-1.1	0.909	3.2	3.5	12,627						20.0	39.4	991	33.6	13.6	**16,365**
51.0	35	14.4	44.2	6.8	48,376	3,722	16.7	465	4,110	**4.43**	68	106	2,100	95.3	27.3	**62,080**
10.6	1.7	0.909	6.8	3.8	14,174						20.0	41.1	991	35.2	15.2	**18,189**
57.0	40	14.4	49.5	7.5	52,760	3,821	17.2	465	4,209	**4.65**	68	108	2,100	97.4	29.4	**66,802**
13.9	4.4	0.909	9.7	4.1	15,458						20.0	42.2	991	36.3	16.3	**19,573**
63.0	45	14.4	54.9	8.1	57,424	3,923	17.6	465	4,311	**4.88**	68	110	2,100	99.6	31.6	**71,813**
17.2	7.2	0.909	12.7	4.5	16,825						20.0	43.3	991	37.5	17.5	**21,041**
69.0	50	14.4	60.2	8.8	62,376	4,028	18.1	465	4,416	**5.12**	68	112	2,100	101.9	33.9	**77,123**
20.6	10.0	0.909	15.7	4.9	18,276						20.0	44.4	991	38.8	18.8	**22,597**

Compressor: ZPS51K4E-PFV

* @ 49.7Pa (0.20inH2o) Ext. Static

Cooling Mode

RH-65-HACW-P-1T — **R410a 60 Hz**

Source Data (Indoor Loop)								Power Consumption					Sink Data (Outdoor Loop)					
EAT	Evap. Temp	Airflow	LAT	Delta T	Latent	Sensible	HAB	Compressor		Fan*	Effective	Effi-ciency	ELT	Cond. Temp.	Flow	LLT	Delta T	Rejection
°F	°F	CFM	°F	°F	BTU/Hr	BTU/Hr	BTU/Hr	Watts	Amps	Watts	Watts	EER	°F	°F	USGPM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts	Watts	Watts					COPc	°C	°C	L/s	°C	°C	Watts
80.6	44	2,100	58.1	22.5	17,088	51,263	**68,351**	2,696	11.6	510	3,126	**21.9**	51	75	14.4	62.0	11.0	79,294
27.0	6.7	991	14.5	12.5	5,007	15,020	**20,027**					**6.41**	10.6	23.9	0.909	16.7	6.1	23,233
80.6	45	2,100	58.1	22.5	17,029	51,087	**68,115**	2,911	12.4	510	3,341	**20.4**	56	80	14.4	67.1	11.1	79,790
27.0	7.2	991	14.5	12.5	4,989	14,968	**19,958**					**5.97**	13.3	26.7	0.909	19.5	6.2	23,378
80.6	45	2,100	58.7	21.9	16,637	49,911	**66,548**	3,127	13.1	510	3,557	**18.7**	61	85	14.4	72.0	11.0	78,961
27.0	7.2	991	14.8	12.2	4,875	14,624	**19,498**					**5.48**	16.1	29.4	0.909	22.2	6.1	23,135
80.6	46	2,100	58.8	21.8	16,542	49,625	**66,166**	3,351	14.0	510	3,781	**17.5**	66	90	14.4	77.0	11.0	79,343
27.0	7.8	991	14.9	12.1	4,847	14,540	**19,386**					**5.13**	18.9	32.2	0.909	25.0	6.1	23,247
80.6	46	2,100	60.8	19.8	15,019	45,057	**60,076**	3,352	14.8	510	3,790	**15.9**	73	95	14.4	83.2	10.2	73,256
27.0	7.8	991	16.0	11.0	4,401	13,202	**17,602**					**4.64**	22.8	35.0	0.909	28.4	5.7	21,464
80.6	47	2,100	61.0	19.6	14,894	44,681	**59,575**	3,577	15.7	510	4,015	**14.8**	78	100	14.4	88.2	10.2	73,523
27.0	8.3	991	16.1	10.9	4,364	13,092	**17,455**					**4.35**	25.6	37.8	0.909	31.2	5.7	21,542
80.6	47	2,100	61.5	19.1	14,474	43,421	**57,895**	3,810	16.6	510	4,248	**13.6**	83	105	14.4	93.1	10.1	72,639
27.0	8.3	991	16.4	10.6	4,241	12,722	**16,963**					**3.99**	28.3	40.6	0.909	33.9	5.6	21,283
80.6	48	2,100	61.7	18.9	14,310	42,929	**57,239**	4,057	17.6	510	4,495	**12.7**	88	110	14.4	98.1	10.1	72,825
27.0	8.9	991	16.5	10.5	4,193	12,578	**16,771**					**3.73**	31.1	43.3	0.909	36.7	5.6	21,338

Compressor: ZPS51K4E-PFV

* @ 49.7Pa (0.20inH2o) Ext. Static

Heating Mode

RH-75-HACW-P-1T — **Nominal 6 ton** — **R410a 60 Hz**

Source Data (Outdoor Loop)						Power Consumption					Sink Data (Indoor Loop)					
ELT	Evap. Temp	Flow	LLT	Delta T	HAB	Compressor		Fan*	Effective	COPh	EAT	Cond. Temp.	Air Flow	LAT	Delta T	Net Output
°F	°F	USGPM	°F	°F	BTU/Hr	Watts	Amps	Watts	Watts	W/W	°F	°F	CFM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts						°C	°C	L/s	°C	°C	Watts
27.0	15	16.8	22.3	4.7	36,059	3,649	16.9	775	4,419	**3.34**	68	94	2,400	87.4	19.4	**50,553**
-2.8	-9.4	1.061	-5.4	2.6	10,565						20.0	34.4	1,133	30.8	10.8	**14,812**
33.0	20	16.8	27.8	5.2	39,711	3,739	17.3	775	4,509	**3.53**	68	96	2,400	89.0	21.0	**54,514**
0.6	-6.7	1.061	-2.3	2.9	11,635						20.0	35.6	1,133	31.7	11.7	**15,973**
39.0	25	16.8	33.3	5.7	43,637	3,830	17.8	775	4,600	**3.73**	68	98	2,400	90.6	22.6	**58,751**
3.9	-3.9	1.061	0.7	3.2	12,786						20.0	36.7	1,133	32.6	12.6	**17,214**
45.0	30	16.8	38.7	6.3	47,847	3,921	18.2	775	4,691	**3.94**	68	100	2,400	92.3	24.3	**63,272**
7.2	-1.1	1.061	3.7	3.5	14,019						20.0	37.8	1,133	33.5	13.5	**18,539**
51.0	35	16.8	44.2	6.8	53,985	4,145	18.8	775	4,865	**4.24**	68	103	2,400	95.0	27.0	**70,124**
10.6	1.7	1.061	6.8	3.8	15,817						20.0	39.4	1,133	35.0	15.0	**20,546**
57.0	40	16.8	49.6	7.4	58,933	4,242	19.3	775	4,962	**4.47**	68	105	2,400	97.0	29.0	**75,404**
13.9	4.4	1.061	9.8	4.1	17,267						20.0	40.6	1,133	36.1	16.1	**22,093**
63.0	45	16.8	54.9	8.1	64,198	4,342	19.8	775	5,062	**4.71**	68	107	2,400	99.2	31.2	**81,010**
17.2	7.2	1.061	12.7	4.5	18,810						20.0	41.7	1,133	37.3	17.3	**23,736**
69.0	50	16.8	60.2	8.8	69,788	4,445	20.2	775	5,165	**4.96**	68	109	2,400	101.5	33.5	**86,953**
20.6	10.0	1.061	15.7	4.9	20,448						20.0	42.8	1,133	38.6	18.6	**25,477**

Compressor: ZPS60K4E-PFV

* @ 49.7Pa (0.20inH2o) Ext. Static

Cooling Mode

RH-75-HACW-P-1T — **R410a 60 Hz**

Source Data (Indoor Loop)								Power Consumption					Sink Data (Outdoor Loop)					
EAT	Evap. Temp	Airflow	LAT	Delta T	Latent	Sensible	HAB	Compressor		Fan*	Effective	Effi-ciency	ELT	Cond. Temp.	Flow	LLT	Delta T	Rejection
°F	°F	CFM	°F	°F	BTU/Hr	BTU/Hr	BTU/Hr	Watts	Amps	Watts	Watts	EER	°F	°F	USGPM	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts	Watts	Watts					COPc	°C	°C	L/s	°C	°C	Watts
80.6	45	2,400	58.6	22.0	19,099	57,298	**76,397**	3,223	13.9	880	4,046	**18.9**	50	75	16.8	60.8	10.8	90,402
27.0	7.2	1,133	14.8	12.2	5,596	16,788	**22,384**					**5.53**	10.0	23.9	1.061	16.0	6.0	26,487
80.6	46	2,400	58.6	22.0	19,032	57,095	**76,127**	3,436	14.8	880	4,259	**17.9**	55	80	16.8	65.8	10.8	90,856
27.0	7.8	1,133	14.8	12.2	5,576	16,729	**22,305**					**5.24**	12.8	26.7	1.061	18.8	6.0	26,621
80.6	46	2,400	59.1	21.5	18,591	55,773	**74,364**	3,650	15.6	880	4,473	**16.6**	60	85	16.8	70.7	10.7	89,824
27.0	7.8	1,133	15.1	11.9	5,447	16,341	**21,788**					**4.87**	15.6	29.4	1.061	21.5	5.9	26,318
80.6	46	2,400	59.7	20.9	18,139	54,416	**72,554**	3,870	16.5	880	4,693	**15.5**	65	90	16.8	75.6	10.6	88,765
27.0	7.8	1,133	15.4	11.6	5,315	15,944	**21,258**					**4.53**	18.3	32.2	1.061	24.2	5.9	26,008
80.6	47	2,400	59.7	20.9	18,079	54,238	**72,317**	3,868	17.4	880	4,718	**15.3**	71	95	16.8	81.5	10.5	88,523
27.0	8.3	1,133	15.4	11.6	5,297	15,892	**21,189**					**4.49**	21.7	35.0	1.061	27.5	5.9	25,937
80.6	47	2,400	60.3	20.3	17,592	52,776	**70,368**	4,091	18.4	880	4,941	**14.2**	76	100	16.8	86.4	10.4	87,336
27.0	8.3	1,133	15.7	11.3	5,154	15,463	**20,618**					**4.17**	24.4	37.8	1.061	30.2	5.8	25,589
80.6	47	2,400	60.9	19.7	17,092	51,275	**68,366**	4,325	19.4	880	5,175	**13.2**	81	105	16.8	91.3	10.3	86,130
27.0	8.3	1,133	16.0	11.0	5,008	15,023	**20,031**					**3.87**	27.2	40.6	1.061	32.9	5.7	25,236
80.6	48	2,400	61.1	19.5	16,896	50,688	**67,584**	4,571	20.4	880	5,421	**12.5**	86	110	16.8	96.3	10.3	86,189
27.0	8.9	1,133	16.2	10.8	4,951	14,852	**19,802**					**3.65**	30.0	43.3	1.061	35.7	5.7	25,253

Compressor: ZPS60K4E-PFV

* @ 49.7Pa (0.20inH2o) Ext. Static

CAPACITY RATINGS (continued)

Heating Mode

RH-80-HACW-P-1S — **Nominal 6 ton Single Stage** — **R410a 60 Hz**

Source Data (Outdoor Loop)						Power Consumption					Sink Data (Indoor Loop)					
ELT	Evap. Temp	Flow	LLT	Delta T	HAB	Compressor		Fan*	Effective	COPh	EAT	Cond. Temp.	Air Flow	LAT	Delta T	Net Output
°F	°F	Igpm	°F	°F	BTU/Hr	Watts	Amps	Watts	Watts	W/W	°F	°F	CFM	°F	°F	BTU/Hr
°C	°C	L/min	°C	°C	Watts						°C	°C	L/s	°C	°C	Watts
27.0	15	16.8	22.0	5.0	42,083	4,560	19.8	775	5,330	**3.28**	68	94	2,400	91.0	23.0	**59,689**
-2.8	-9.4	1.1	-5.6	2.8	12,330						20.0	34.4	1,133	32.8	12.8	**17,489**
33.0	20	16.8	27.4	5.6	46,683	4,643	20.1	775	5,413	**3.50**	68	96	2,400	92.8	24.8	**64,569**
0.6	-6.7	1.1	-2.5	3.1	13,678						20.0	35.6	1,133	33.8	13.8	**18,918**
39.0	25	16.8	32.9	6.1	51,567	4,723	20.4	775	5,493	**3.72**	68	98	2,400	94.8	26.8	**69,728**
3.9	-3.9	1.1	0.5	3.4	15,109						20.0	36.7	1,133	34.9	14.9	**20,430**
45.0	30	16.8	38.2	6.8	56,762	4,802	20.6	775	5,572	**3.95**	68	100	2,400	96.9	28.9	**75,192**
7.2	-1.1	1.1	3.5	3.8	16,631						20.0	37.8	1,133	36.1	16.1	**22,031**
51.0	35	16.8	43.4	7.6	63,610	5,041	21.1	775	5,761	**4.21**	68	103	2,400	99.9	31.9	**82,807**
10.6	1.7	1.1	6.3	4.2	18,638						20.0	39.4	1,133	37.7	17.7	**24,262**
57.0	40	16.8	48.7	8.3	69,630	5,118	21.4	775	5,838	**4.47**	68	105	2,400	102.3	34.3	**89,090**
13.9	4.4	1.1	9.3	4.6	20,401						20.0	40.6	1,133	39.0	19.0	**26,103**
63.0	45	16.8	53.9	9.1	76,041	5,192	21.6	775	5,912	**4.75**	68	107	2,400	104.8	36.8	**95,754**
17.2	7.2	1.1	12.2	5.0	22,280						20.0	41.7	1,133	40.5	20.5	**28,056**
69.0	50	16.8	59.1	9.9	82,869	5,263	21.8	775	5,983	**5.04**	68	109	2,400	107.6	39.6	**102,826**
20.6	10.0	1.1	15.1	5.5	24,280						20.0	42.8	1,133	42.0	22.0	**30,128**

Compressor: ZP70KWE-PFV

* @ 49.7Pa (0.20inH2o) Ext. Static

Cooling Mode

RH-80-HACW-P-1S — **R410a 60 Hz**

Source Data (Indoor Loop)								Power Consumption					Sink Data (Outdoor Loop)					
EAT	Evap. Temp	Airflow	LAT	Delta T	Latent	Sensible	HAB	Compressor		Fan*	Effective	Effi-ciency	ELT	Cond. Temp.	Flow	LLT	Delta T	Rejection
°F	°F	CFM	°F	°F	BTU/Hr	BTU/Hr	BTU/Hr	Watts	Amps	Watts	Watts	EER	°F	°F	Igpm	°F	°F	BTU/Hr
°C	°C	L/s	°C	°C	Watts	Watts	Watts					COPc	°C	°C	L/min	°C	°C	Watts
80.6	44	2,400	55.5	25.1	21,747	65,241	**86,988**	3,832	15.8	880	4,655	**18.7**	50	75	16.8	62.3	12.3	103,071
27.0	6.7	1,133	13.1	13.9	6,372	19,116	**25,487**					**5.47**	10.0	23.9	1.060	16.8	6.8	30,200
80.6	45	2,400	55.5	25.1	21,738	65,215	**86,954**	4,073	16.6	880	4,896	**17.8**	55	80	16.8	67.4	12.4	103,857
27.0	7.2	1,133	13.1	13.9	6,369	19,108	**25,477**					**5.20**	12.8	26.7	1.060	19.7	6.9	30,430
80.6	45	2,400	56.0	24.6	21,285	63,856	**85,141**	4,328	17.4	880	5,151	**16.5**	60	85	16.8	72.3	12.3	102,917
27.0	7.2	1,133	13.4	13.6	6,237	18,710	**24,946**					**4.84**	15.6	29.4	1.060	22.4	6.8	30,155
80.6	45	2,400	56.6	24.0	20,803	62,410	**83,213**	4,598	18.2	880	5,421	**15.4**	65	90	16.8	77.1	12.1	101,907
27.0	7.2	1,133	13.7	13.3	6,095	18,286	**24,381**					**4.50**	18.3	32.2	1.060	25.1	6.7	29,859
80.6	46	2,400	56.5	24.1	20,907	62,722	**83,630**	4,650	19.1	880	5,500	**15.2**	71	95	16.8	83.2	12.2	102,503
27.0	7.8	1,133	13.6	13.4	6,126	18,377	**24,503**					**4.46**	21.7	35.0	1.060	28.5	6.8	30,033
80.6	46	2,400	57.1	23.5	20,354	61,062	**81,415**	4,941	20.1	880	5,791	**14.1**	76	100	16.8	88.1	12.1	101,283
27.0	7.8	1,133	13.9	13.1	5,964	17,891	**23,855**					**4.12**	24.4	37.8	1.060	31.1	6.7	29,676
80.6	46	2,400	57.8	22.8	19,770	59,311	**79,082**	5,255	21.1	880	6,105	**13.0**	81	105	16.8	92.9	11.9	100,020
27.0	7.8	1,133	14.3	12.7	5,793	17,378	**23,171**					**3.80**	27.2	40.6	1.060	33.8	6.6	29,306
80.6	47	2,400	58.0	22.6	19,540	58,619	**78,159**	5,582	22.2	880	6,432	**12.2**	86	110	16.8	97.9	11.9	100,215
27.0	8.3	1,133	14.5	12.5	5,725	17,175	**22,900**					**3.56**	30.0	43.3	1.060	36.6	6.6	29,363

Compressor: ZP70KWE-PFV

* @ 49.7Pa (0.20inH2o) Ext. Static

Table 18 - Heat Pump Electrical Information (230-1-60)								
Model	Compressor		Fan	Outdoor Circulators	FLA	MCA	Max Fuse/ Breaker	Wire Size**
	RLA	LRA	RLA	Max A	Amps	Amps	Amps	ga
25	11.4	52	2.5	4.0	18.7	21.6	30	#10-3
45	18.6	82	3.5	4.0	26.9	31.6	40	#8-3
55	23.6	96	4.0	5.0	33.4	39.3	50	#6-3
65	28.6	118	5.5	5.0	39.9	47.1	60	#6-3
75	30.4	150	6.5	5.0	42.7	50.3	60	#6-3
80	35.7	148	7.0	5.0	48.0	56.9	60	#6-3

* Models are single stage
** HAC models may be connected with 2 conductor cable if using 230VAC Outdoor Circulators

Table 19 - Heat Pump Electrical Information (208-3-60)								
Model	Compressor		Fan	Outdoor Circulators	FLA	MCA	Max Fuse/ Breaker	Wire Size**
	RLA	LRA	RLA	Max A	Amps	Amps	Amps	ga
25*	8.6	55	2.5	4.0	15.9	18.1	25	#10-4
45	12.4	58	3.5	4.0	20.7	23.8	30	#10-4
55	15.0	88	4.0	5.0	24.8	28.6	40	#8-4
65	19.6	123	5.5	5.0	30.9	35.8	50	#8-4
75*	21.2	123	6.5	5.0	33.5	38.8	60	#8-4

* Models are single stage
** HAC models may be connected with 3 conductor cable if using 230VAC Outdoor Circulators

Table 20 - Heat Pump Electrical Information (220-1-50)								
Model	Compressor		Fan	Outdoor Circulators	FLA	MCA	Max Fuse/ Breaker	Wire Size
	RLA	LRA	RLA	Max A	Amps	Amps	Amps	ga
25*	10.0	52	2.5	4.0	17.3	19.8	30	#10-2
45*	15.0	67	3.5	4.0	23.3	27.1	40	#8-2
55*	17.7	98	4.0	5.0	27.5	31.9	50	#6-2
65*	27.3	153	5.5	5.0	38.6	45.4	60	#6-2
75*	32.9	176	6.5	5.0	45.2	53.4	60	#6-2

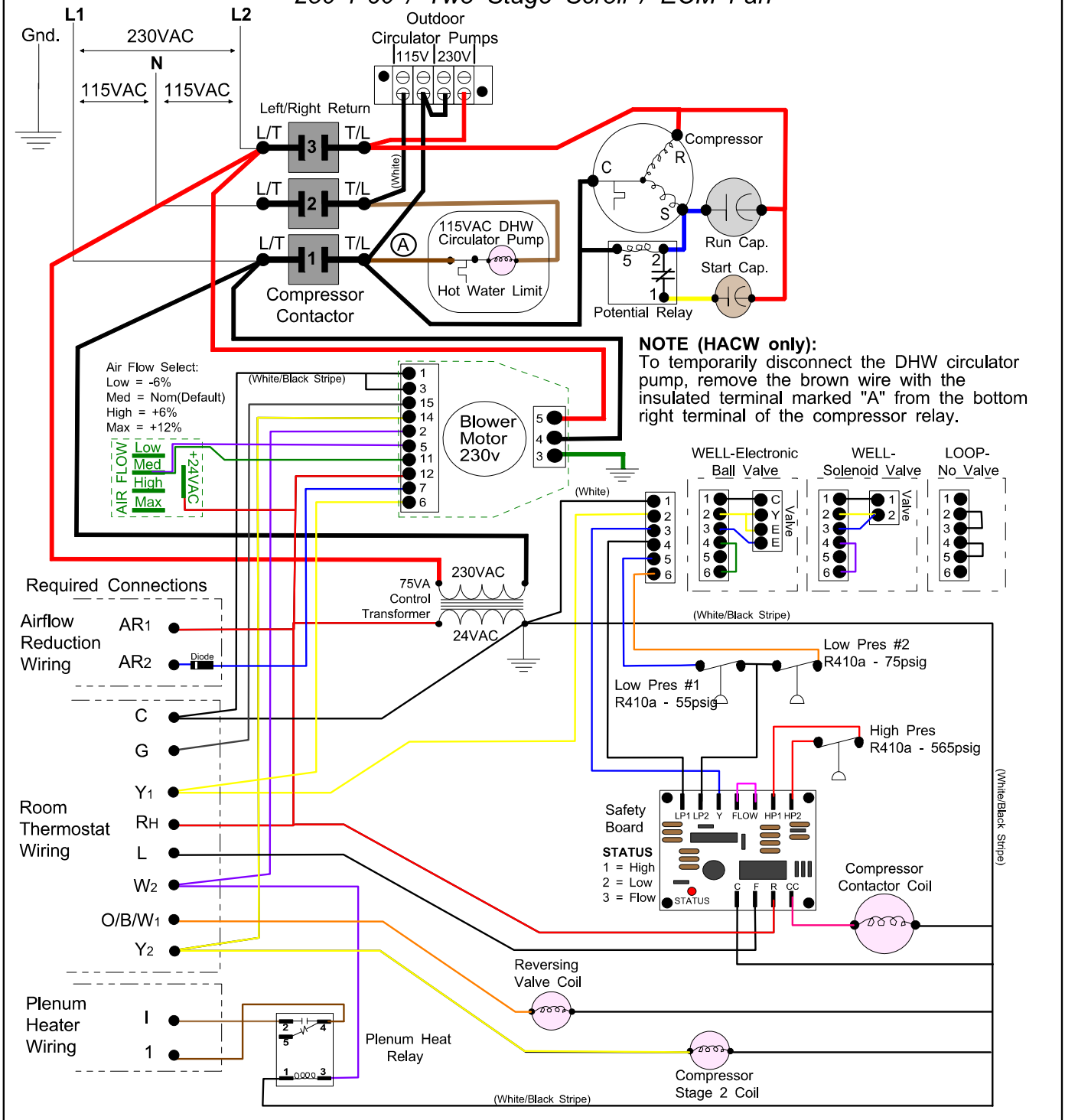
* Models are single stage

Table 21 - Heat Pump Electrical Information (380-3-50)								
Model	Compressor		Fan	Outdoor Circulators	FLA	MCA	Max Fuse/ Breaker	Wire Size
	RLA	LRA	RLA	Max A	Amps	Amps	Amps	ga
25*	4.4	23	2.5	4.0	11.7	12.8	15	#14-4
45	5.0	29	3.5	4.0	13.3	14.6	20	#12-4
55	7.1	41	4.0	5.0	16.9	18.7	25	#10-4
65	10.0	62	5.5	5.0	21.3	23.8	30	#10-4
75*	10.9	62	6.5	5.0	23.2	25.9	40	#8-4

* Models are single stage

RH-Series Schematic Diagram

230-1-60 / Two Stage Scroll / ECM Fan



PLENUM HEATER OPERATION

- I & 1 provides a set of dry contacts for operating plenum heater.
- Fan will run automatically with Thermostat W_2 signal.

AIRFLOW REDUCTION

Connect AR_1 & AR_2 together with dry contacts to reduce the airflow for zone applications.

REV	ECO #	IMPL BY	APVD BY	DATE
02	000143	C. GEDDES	C. GEDDES	25 MAY 09
01	Initial Release	C. GEDDES	C. GEDDES	15 APR 07

Drawn By: Chris Geddes	Date: 15 APR 07	
Checked By: Chris Geddes	Date: 15 APR 07	
Approved By (ENG): Chris Geddes	Date: 15 APR 07	
Approved By (MFG):	Date:	
Approved By:	Date:	

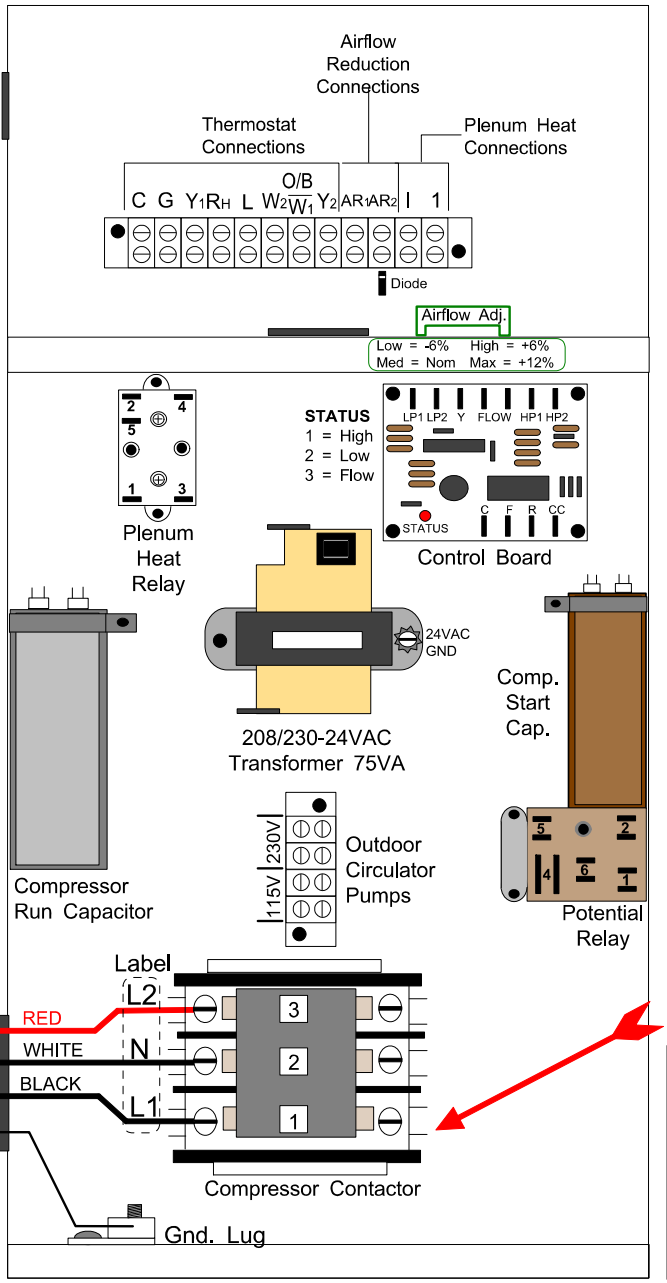
MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

Drawing Name: RH-**-HAC*-P-1T-*-*DE** Schematic Diagram

Size	Drawing Number	REV	SHEET
A	000683SCH	02	1 of 1

RH-Series Electrical Box Diagram

230-1-60 / Two Stage Scroll / ECM Fan / Left Return



Low Voltage Wiring (24VAC)

Thermostat Wiring

Use an 18-8 conductor cable to connect this unit to the thermostat.

C	- 24VAC Common
G	- Fan
Y_1	- Stage 1 Heat/Cool (Compressor)
R_H	- 24VAC Hot
L	- Trouble (if available on thermostat)
W_2	- Stage 2 Heat (Plenum Heater)
$O/B/W_1$	- Reversing Valve (Active in Cooling)
Y2	- Stage 2 Heat/Cool (Compressor S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed can be reduced by 15% for zone applications.

Plenum Heater Wiring

Use an 18-2 conductor cable to connect Electrical Box I 1 to Plenum Heater C 1 (or I 1)

Outdoor Circulator Pumps (Ground Loop)

REFER TO LABEL IN UNIT FOR MAX AMPS
Connect 115VAC circulators to 115V
Connect 230VAC circulators to 230V
Connect "Gnd" to Gnd. Lug

Domestic Hot water Circulator Pump Instructions (HACW):

Note: If heat pump is to be operated without the hot water circulator connected to the water tank and flooded with water, remove the brown wire with the insulated terminal located here. **This pump is water lubricated and must not be run dry.**

Heat Pump Electrical Service Requirements
230VAC Single Phase 60Hz (230/1/60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
25	22	10-3	30
45	33	8-3	40
55	39	6-3	50
65	47	6-3	60
75	50	6-3	60

230/115VAC CONNECTIONS

Wire	Colour	Label	Contactor
L2	Red	L2	3
N	White	N	2
L1	Black	L1	1
Connect "Gnd" to Gnd. Lug			

REV	ECO #	IMPL BY	APVD BY	DATE
02	000143	C. GEDDES	C. GEDDES	25 MAY 09
01	Initial Release	C. GEDDES	C. GEDDES	15 APR 08

Drawn By: Chris Geddes — Date: 15 APR 08
Checked By: Chris Geddes — Date: 15 APR 08
Approved By (ENG): Chris Geddes — Date: 15 APR 08
Approved By (MFG): — Date:
Approved By: — Date:

MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

Drawing Name: RH-**-HAC*-P-1T-*-*DEL* Electrical Box Diagram

Size	Drawing Number	REV	SHEET
A	000684ELB	02	1 of 1

RH-Series Electrical Box Diagram

230-1-60 / Two Stage Scroll / ECM Fan / Right Return

Low Voltage Wiring (24VAC)

Thermostat Wiring

Use an 18-8 conductor cable to connect this unit to the thermostat.

C	- 24VAC Common
G	- Fan
Y_1	- Stage 1 Heat/Cool (Compressor)
R_H	- 24VAC Hot
L	- Trouble (if available on thermostat)
W_2	- Stage 2 Heat (Plenum Heater)
O/B/W_1	- Reversing Valve (Active in Cooling)
Y2	- Stage 2 Heat/Cool (Compressor S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed can be reduced by 15% for zone applications.

Plenum Heater Wiring

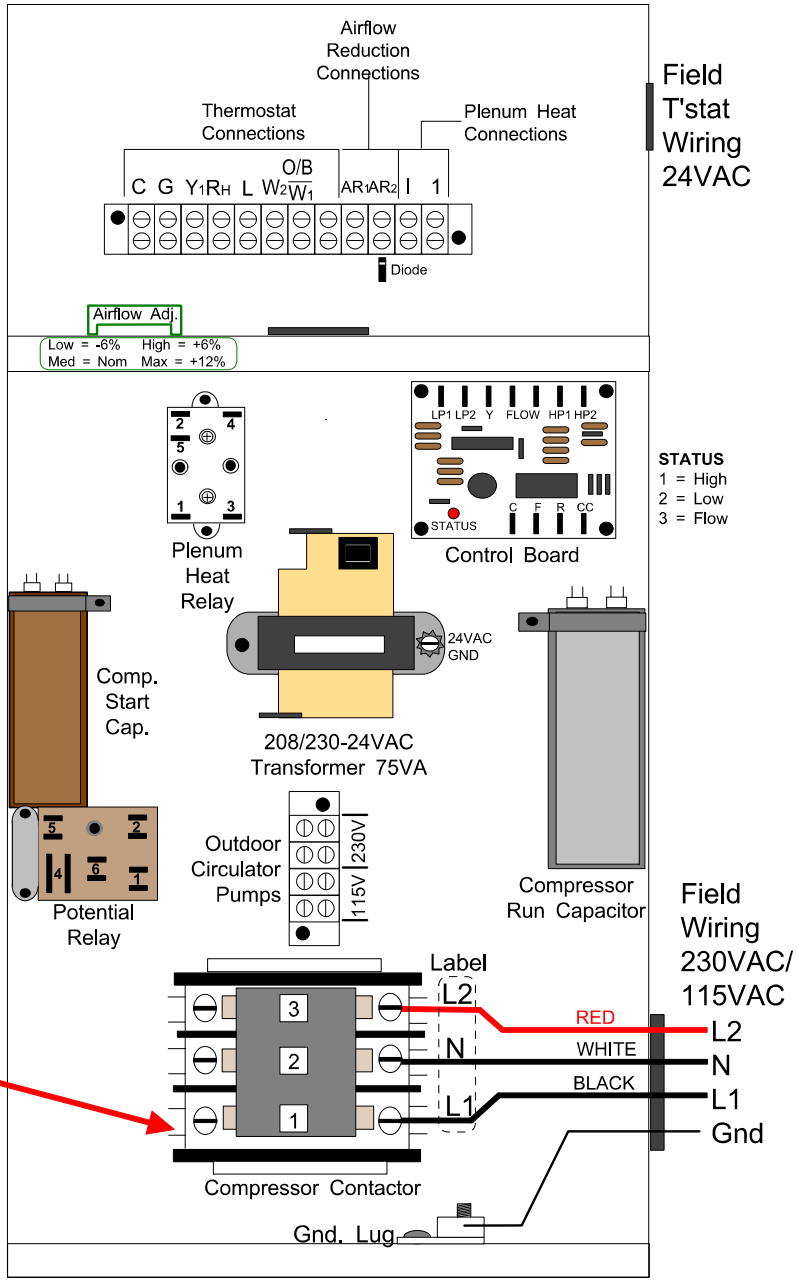
Use an 18-2 conductor cable to connect Electrical Box I 1 to Plenum Heater C 1 (or I 1)

Outdoor Circulator Pumps (Ground Loop)

REFER TO LABEL IN UNIT FOR MAX AMPS
Connect 115VAC circulators to 115V
Connect 230VAC circulators to 230V
Connect "Gnd" to Gnd. Lug

Domestic Hot water Circulator Pump Instructions (HACW):

Note: If heat pump is to be operated without the hot water circulator connected to the water tank and flooded with water, remove the brown wire with the insulated terminal located here. **This pump is water lubricated and must not be run dry.**



230/115VAC CONNECTIONS			
Wire	**Colour**	**Label**	**Contactor**
L2	Red	L2	3
N	White	N	2
L1	Black	L1	1
Connect "Gnd" to Gnd. Lug			

Heat Pump Electrical Service Requirements
230VAC Single Phase 60Hz (230/1/60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
25	22	10-3	30
45	33	8-3	40
55	39	6-3	50
65	47	6-3	60
75	50	6-3	60

REV	ECO #	IMPL BY	APVD BY	DATE
02	000143	C. GEDDES	C. GEDDES	25 MAY 09
01	Initial Release	C. GEDDES	C. GEDDES	15 APR 08

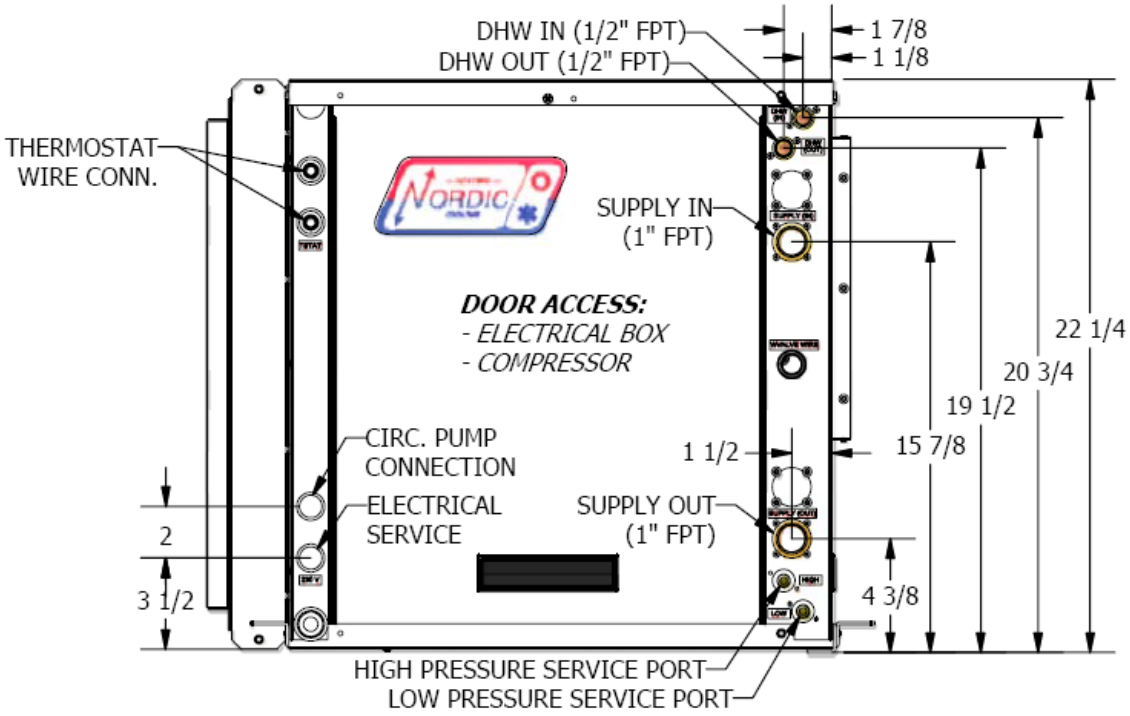
Drawn By Chris Geddes — Date 15 APR 08
Checked By Chris Geddes — Date 15 APR 08
Approved By (ENG) Chris Geddes — Date 15 APR 08
Approved By (MFG) — Date
Approved By — Date

MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

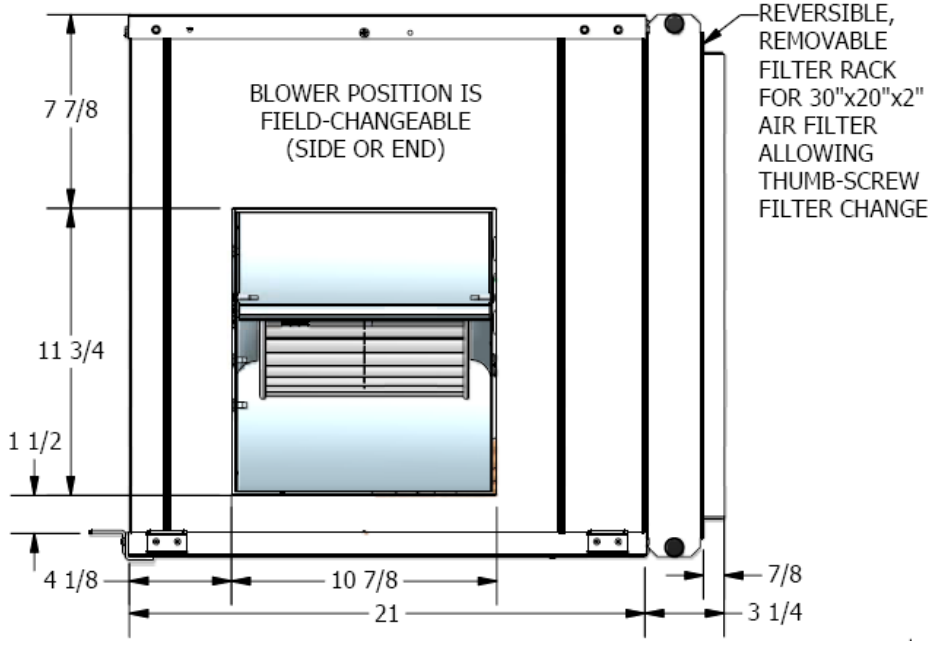
Drawing Name: RH-**-HAC*-P-1T-*-*DER* Electrical Box Diagram

Size	Drawing Number	REV	SHEET
A	000685ELB	02	1 of 1

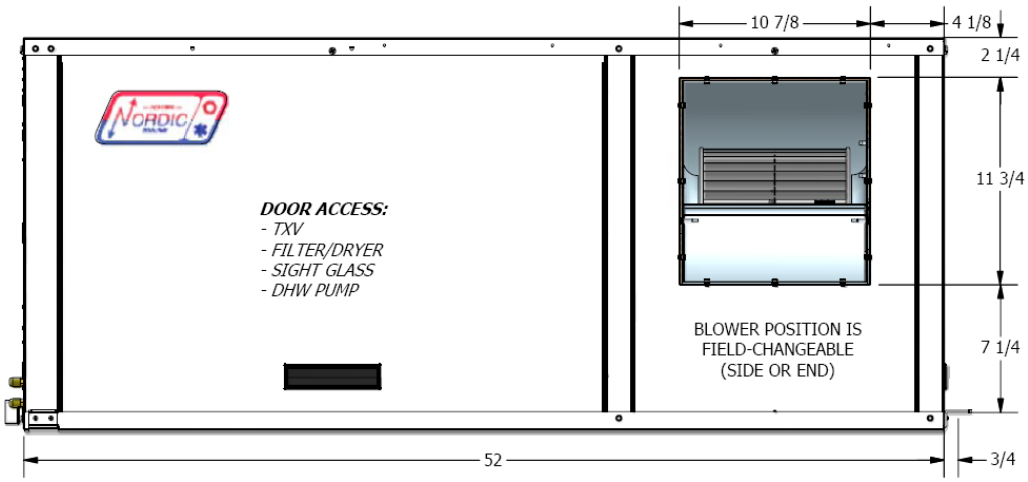
CASE DETAILS—Left Hand Return (Size 25 to 45)



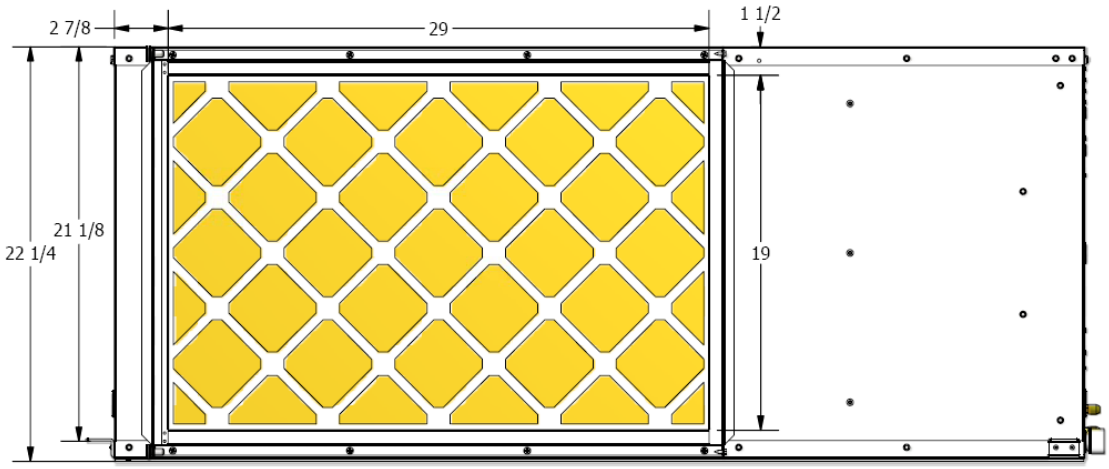
Front View



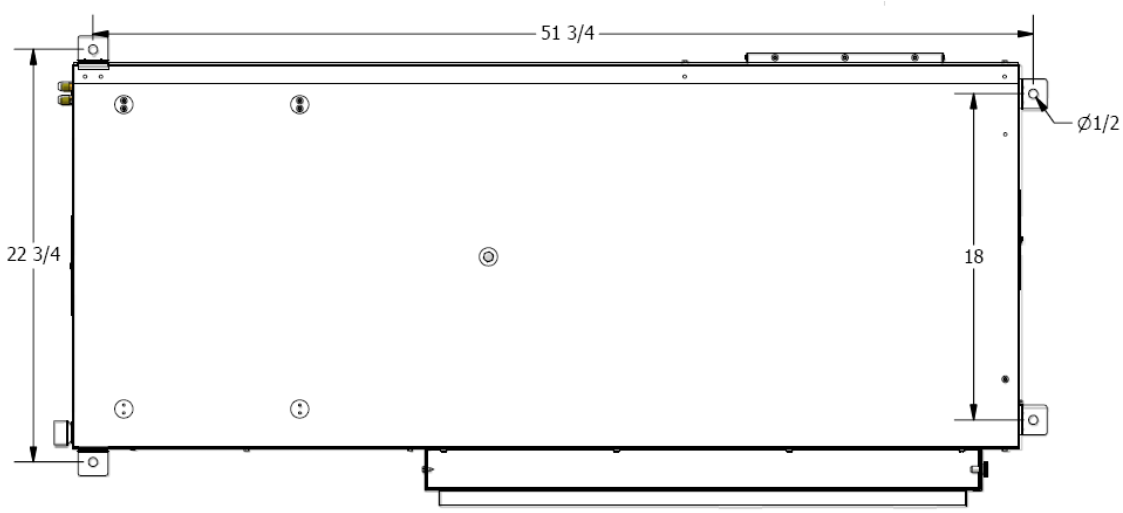
Back View



Left Side View

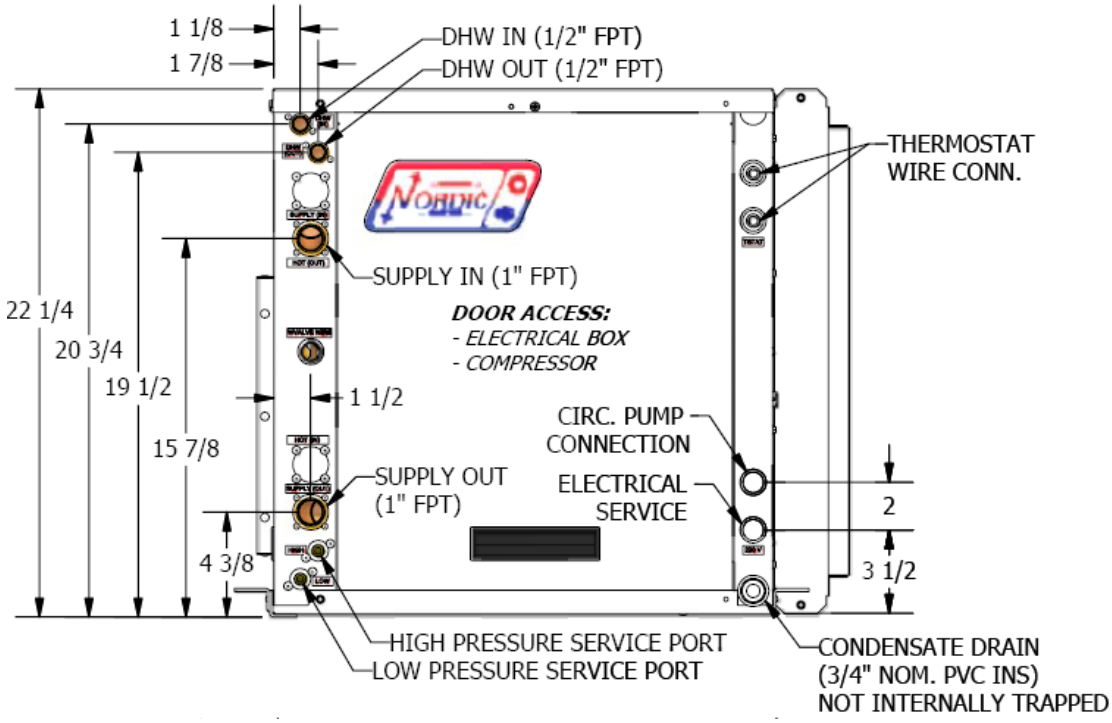


Right Side View

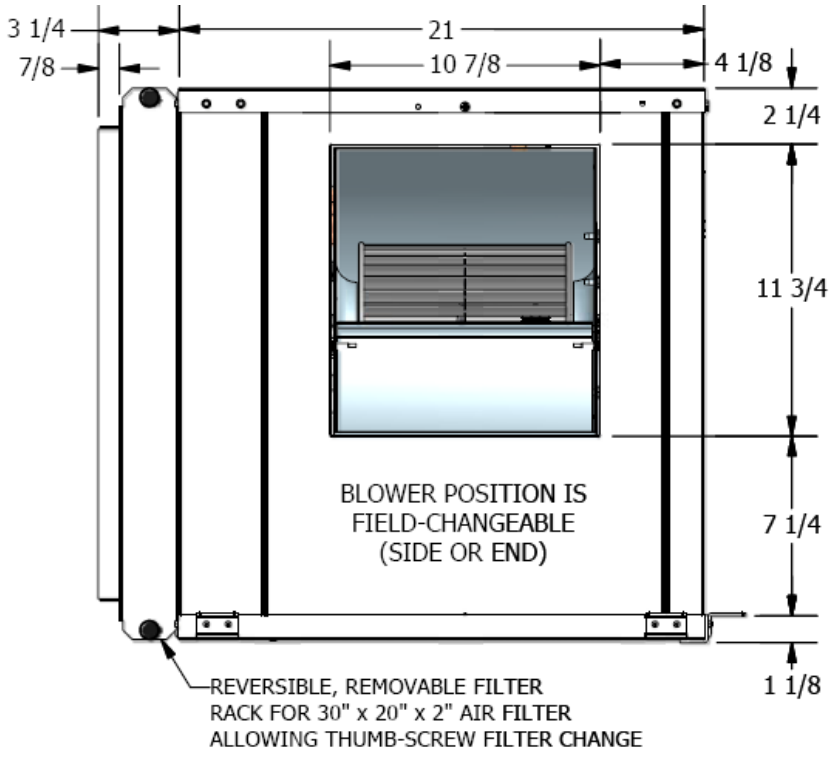


Bottom View

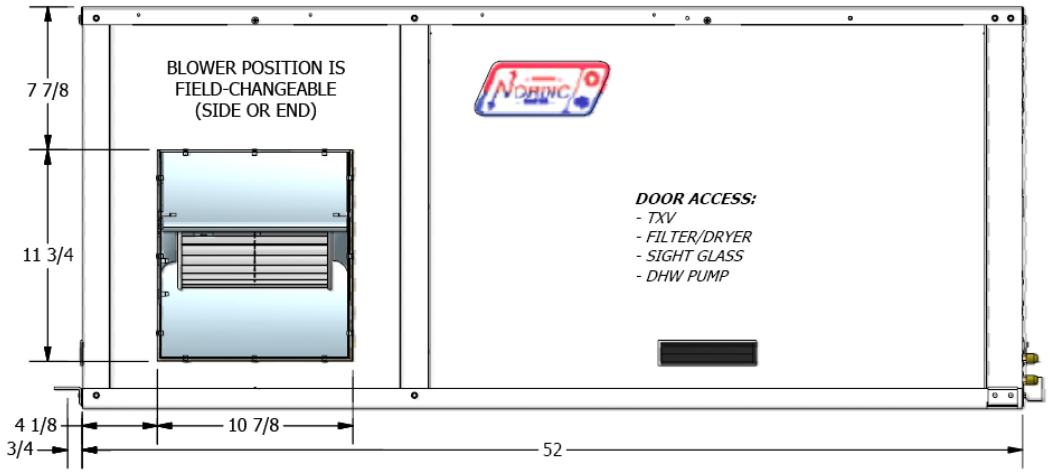
CASE DETAILS—Right Hand Return (Size 25 to 45)



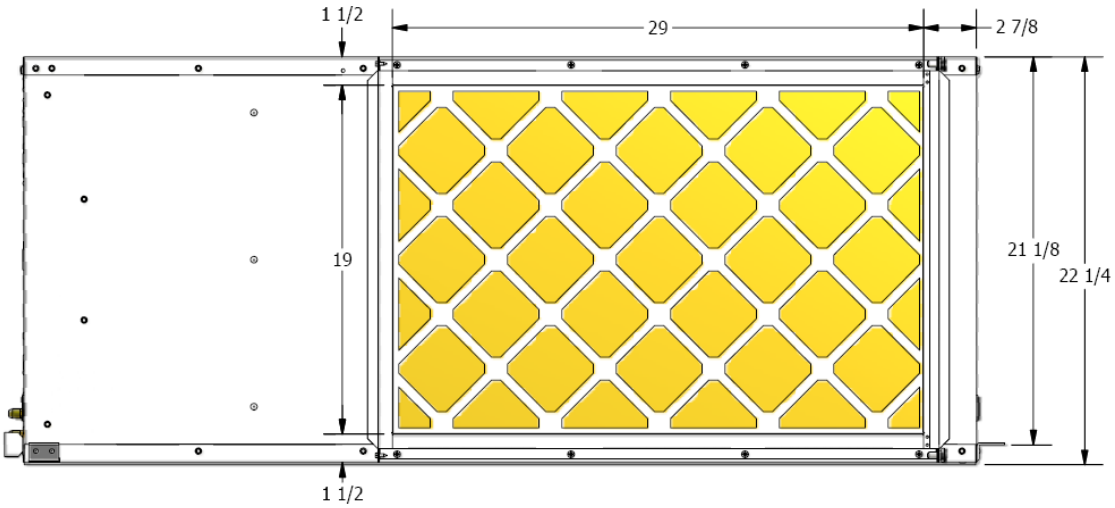
Front View



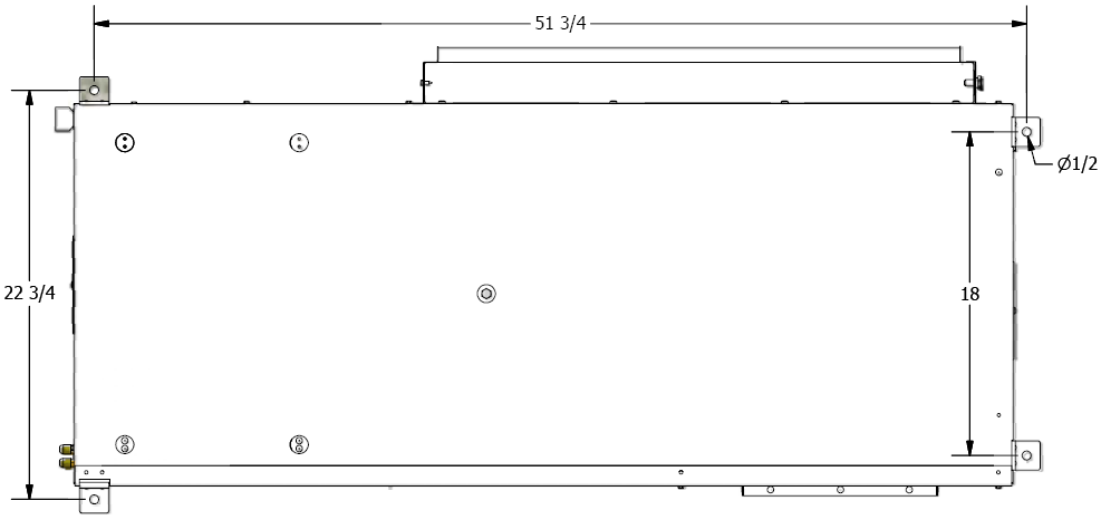
Back View



Left Side View

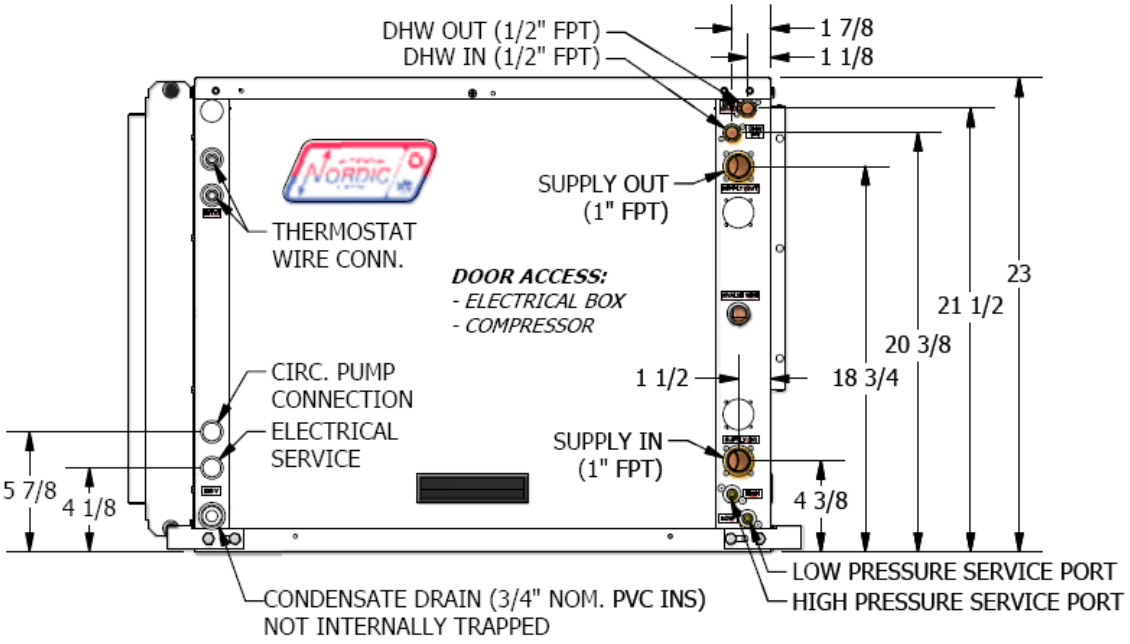


Right Side View

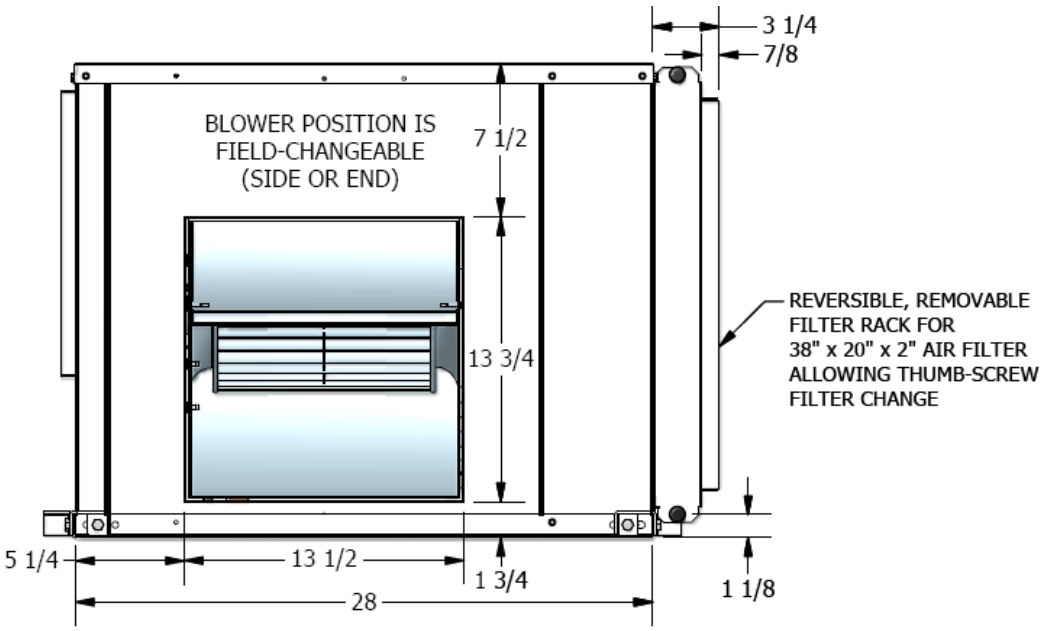


Bottom View

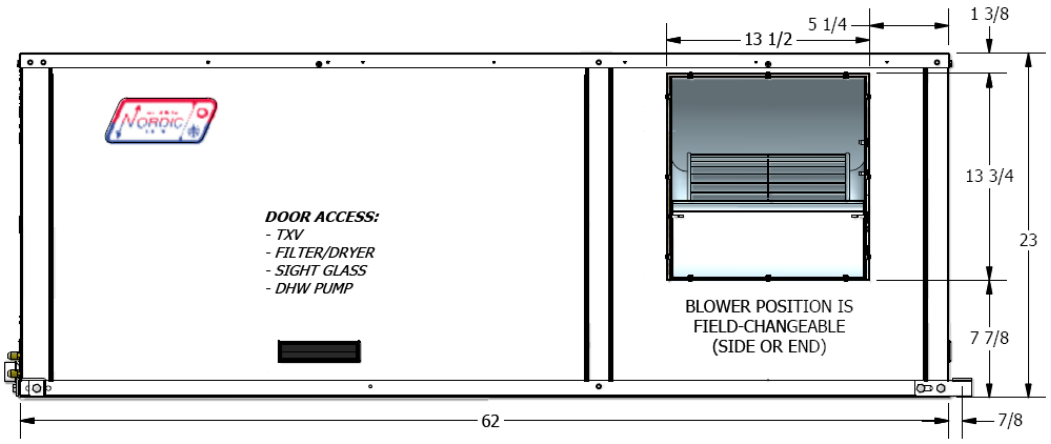
CASE DETAILS—Left Hand Return (Size 55 to 75)



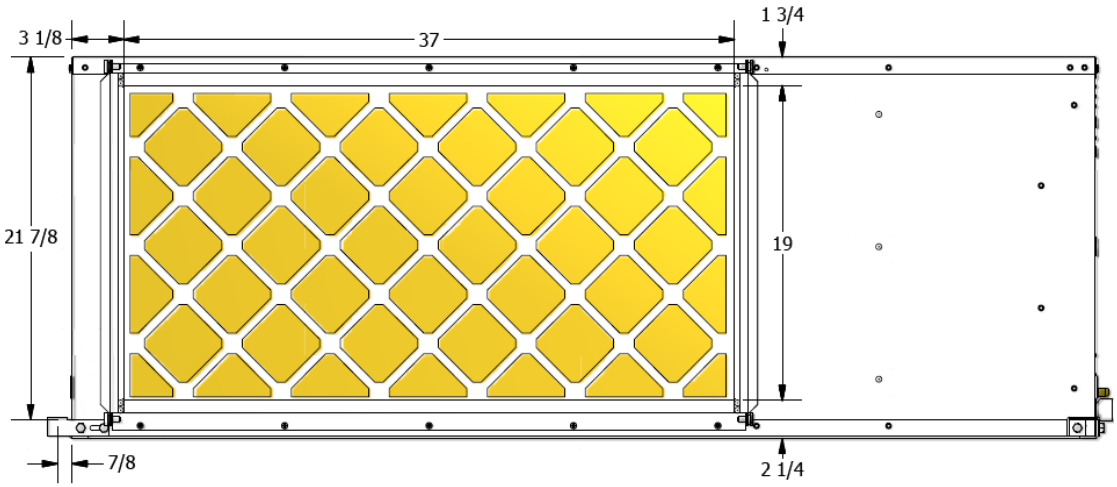
Front View



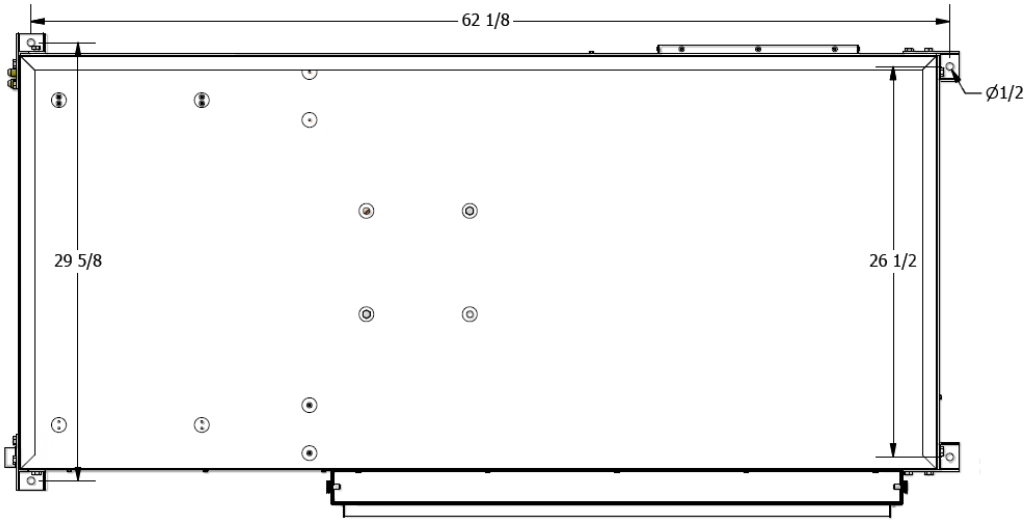
Back View



Left Side View

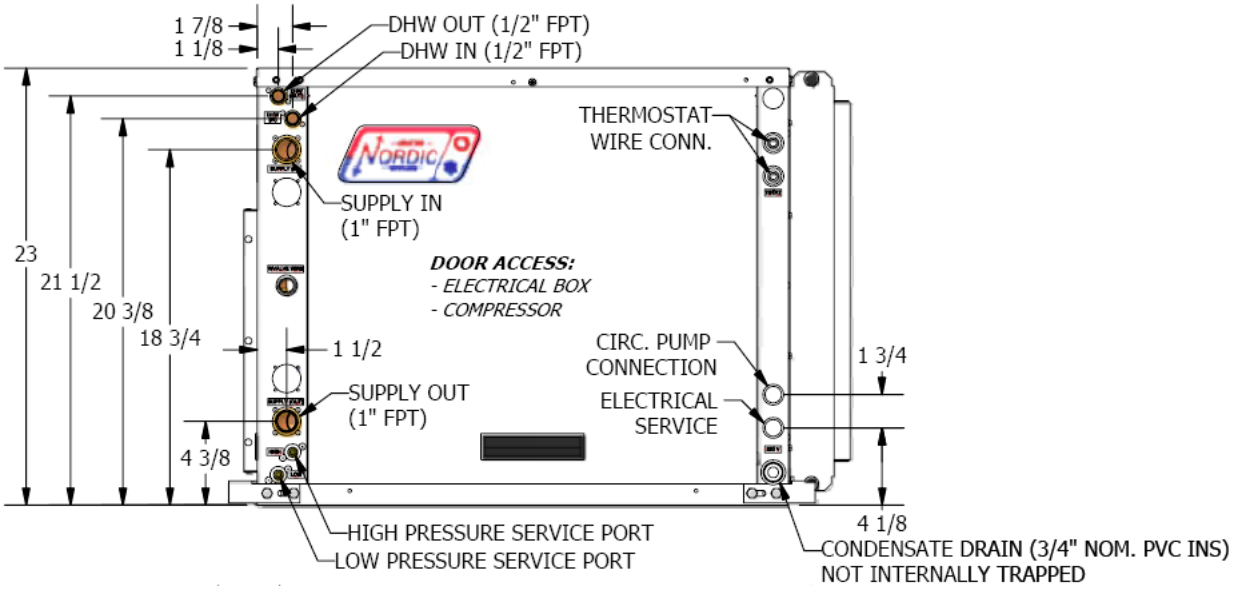


Right Side View

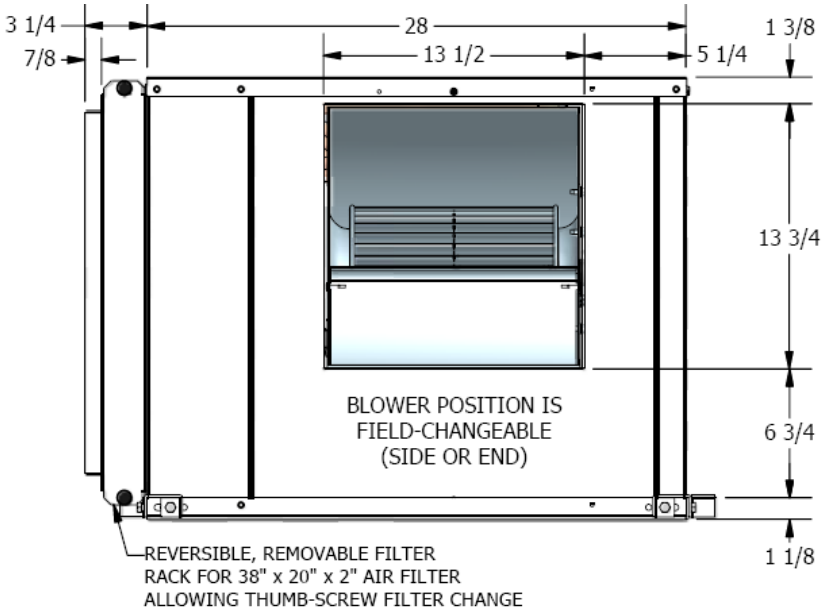


Bottom View

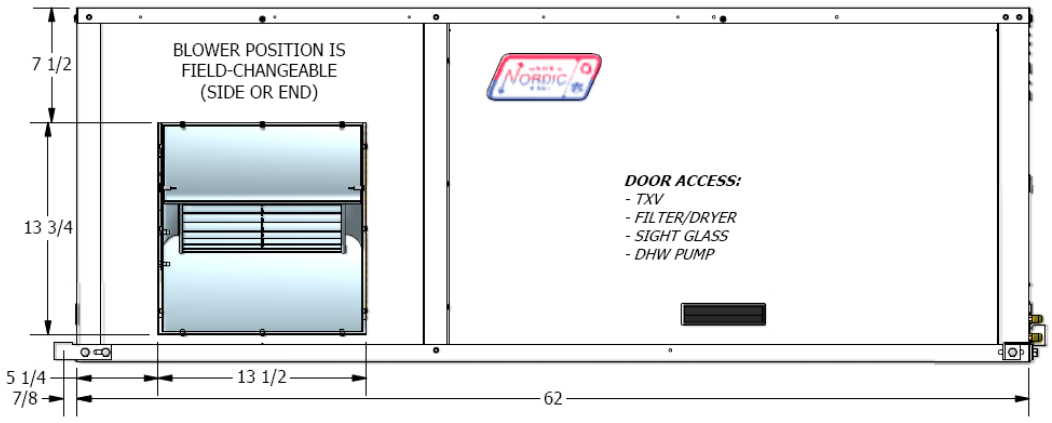
CASE DETAILS—Right Hand Return (Size 55 to 75)



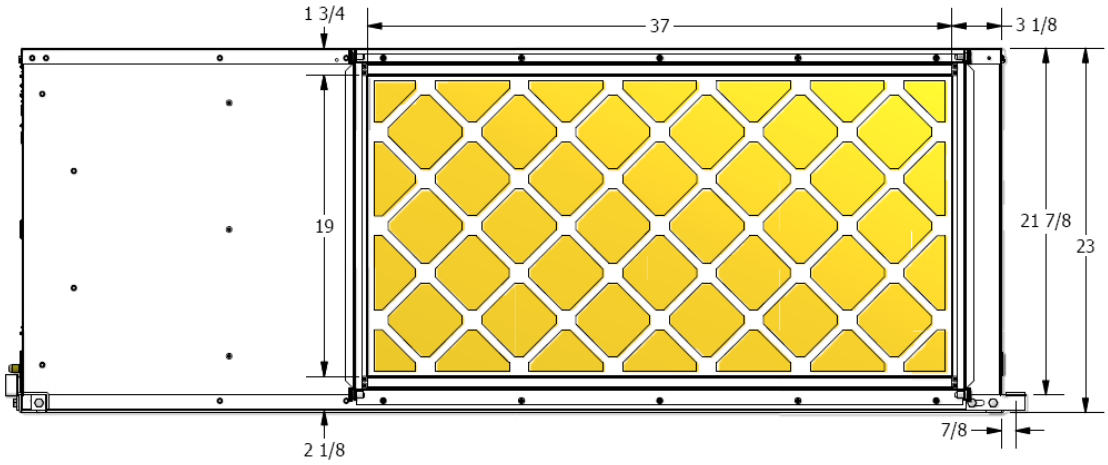
Front View



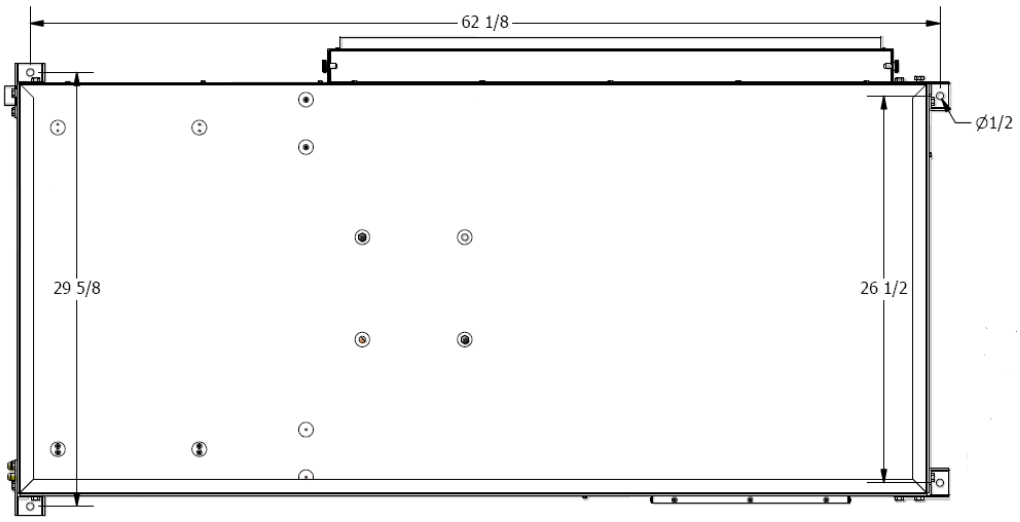
Back View



Left Side View



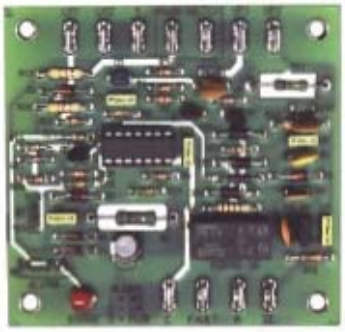
Right Side View



Bottom View

Lockout Protection Module

- **Anti-short cycle/lockout control**
- **Pressure/flow switch monitoring**
- **Alarm output during lockout**
- **5-minute anti-short cycle delay (5-second test mode)**
- **LED fault codes for lockout status**
- **Test mode for reduced test time**
- **Conformally coated for moisture protection**



Mode of Operation

The control will begin the 5-minute time delay upon a Y call from the thermosat. After the time delay expires, the compressor contactor will be energized as long as the high and low pressure switches are closed. If either switch is open after the delay expires, the compressor will not energize. If either switch opens while the compressor is energized, it will de-energize immediately and begin the anti-short cycle delay. The compressor will not be allowed to turn on again until the anti-short cycle delay expires and both pressure switches are closed. The flow switch will have a 30-second bypass timer in which the control will ignore an open flow switch for the first 30 seconds. If the flow switch remains open after the 30-second bypass timer expires, the unit will de-energize the compressor and begin the anti-short cycle delay. If the control experiences three high pressure, low pressure, or flow switch faults in a 60-minute period, it will lockout the compressor and energize the fault output. A manual reset of power will be required to reset the lockout condition.

The control has a status LED to indicate which type of fault or lockout has occurred. If a high pressure fault or lockout occurs, the status LED will blink once. If a low pressure fault or lockout occurs, the status LED will blink twice. If a flow switch fault occurs, the status LED will blink three times.

Specifications

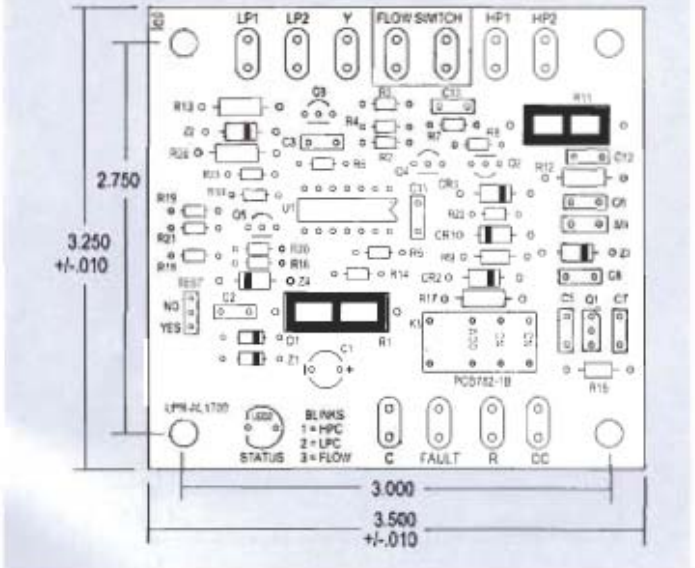
Input
- **Voltage:** 18 to 30 VAC
- **Frequency:** 50 to 60 Hz

Output
- **CC**
  - **Type:** Solid state (Triac)
  - **Rating:** 1 amp @ 30 VAC
- **Fault**
  - **Type:** Relay (SPDT) N.O.
  - **Rating:** 1 amp @ 30 VAC

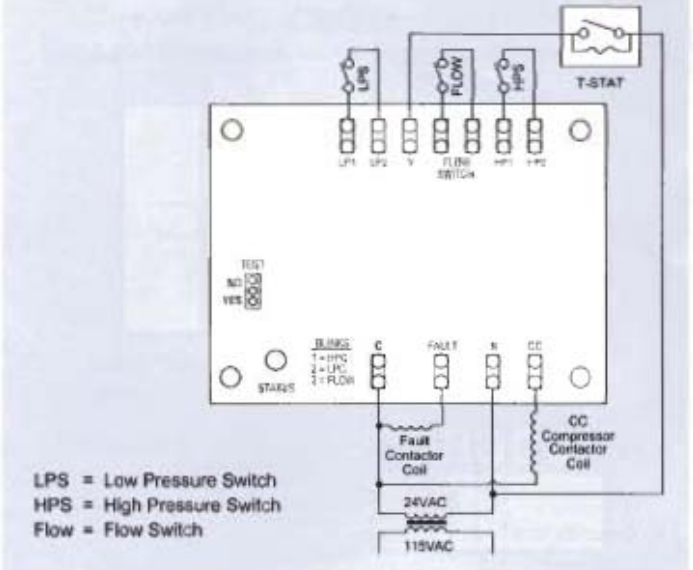
Time Delay
- **Anti-short cycle time:** 5-minutes fixed ±20% (5-second test mode)

Mechanical
- **Board dimensions:** 3.5" x 3.25" x 1"
- **Mounting:** Surface mount using (4) #6 or #8 screws

Dimensions



Wiring Diagram



APPENDIX B - ECM Fan Airflow Tables

NOMINAL AIRFLOW SETTING (MED)

	STAGE 2				STAGE 1				FAN ONLY (Recirculation)			
Model	Full		Reduced*		Full		Reduced*		Full		Reduced*	
	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s
25	800	378	680	321	680	321	578	273	448	211	381	180
45	1200	566	1020	481	1030	486	876	413	672	317	571	270
55	1500	708	1275	602	1240	585	1054	497	840	396	714	337
65	1900	897	1615	762	1540	727	1309	618	1064	502	904	427
75	2100	991	1785	842	1660	783	1411	666	1176	555	1000	472
80	2400	1133	2040	963	N/A	N/A	N/A	N/A	1344	634	1142	539

-6% AIRFLOW SETTING (LOW)

	STAGE 2				STAGE 1				FAN ONLY (Recirculation)			
Model	Full		Reduced*		Full		Reduced*		Full		Reduced*	
	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s
25	752	355	639	302	639	302	543	256	421	199	358	169
45	1128	532	959	453	968	457	823	388	632	298	537	253
55	1410	665	1199	566	1166	550	991	468	790	373	671	317
65	1786	843	1518	716	1448	683	1230	581	1000	472	850	401
75	1974	932	1678	792	1560	736	1326	626	1105	522	940	443
80	2256	1065	1918	905	N/A	N/A	N/A	N/A	1263	596	1074	507

+6% AIRFLOW SETTING (HIGH)

	STAGE 2				STAGE 1				FAN ONLY (Recirculation)			
Model	Full		Reduced*		Full		Reduced*		Full		Reduced*	
	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s
25	848	400	721	340	721	340	613	289	475	224	404	191
45	1272	600	1081	510	1092	515	928	438	712	336	605	286
55	1590	750	1352	638	1314	620	1117	527	890	420	757	357
65	2014	951	1712	808	1632	770	1388	655	1128	532	959	452
75	2226	1051	1892	893	1760	830	1496	706	1400	661	1190	562
80	2544	1201	2162	1021	N/A	N/A	N/A	N/A	1425	672	1211	572

+12% AIRFLOW SETTING (MAX)

	STAGE 2				STAGE 1				FAN ONLY (Recirculation)			
Model	Full		Reduced*		Full		Reduced*		Full		Reduced*	
	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s	CFM	L/s
25	896	423	762	359	762	359	647	306	502	237	426	201
45	1344	634	1142	539	1154	544	981	463	753	355	640	302
55	1680	793	1428	674	1389	655	1180	557	941	444	800	377
65	2128	1004	1809	854	1725	814	1466	692	1192	562	1013	478
75	2352	1110	1999	944	1859	877	1580	746	1317	622	1120	528
80	2688	1269	2285	1078	N/A	N/A	N/A	N/A	1505	710	1279	604

NOTES: Unit sizes 25, 45 and 55 nominal value up to 0.50 inH2o, sizes 65, 75 and 80 up to 0.70inH2o
*To obtain the REDUCED airflow values use a dry contact to connect AR1 to AR2 on the terminal strip

INFORMATION TAKEN FROM DOCUMENT 000527INF-04

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LIMITED EXPRESS WARRANTY

It is expressly understood that unless a statement is specifically identified as a warranty, statements made by Maritime Geothermal Ltd., a corporation registered in New Brunswick, Canada, ("MG") or its representatives, relating to MG's products, whether oral, written or contained in any sales literature, catalogue or agreement, are not express warranties and do not form a part of the basis of the bargain, but are merely MG's opinion or commendation of MG's products.
EXCEPT AS SPECIFICALLY SET FORTH HEREIN, THERE IS NO EXPRESS WARRANTY AS TO ANY OF MG'S PRODUCTS. MG MAKES NO WARRANTY AGAINST LATENT DEFECTS. MG MAKES NO WARRANTY OF MERCHANTABILITY OF THE GOODS OR OF THE FITNESS OF THE GOODS FOR ANY PARTICULAR PURPOSE.

LIMITED EXPRESS RESIDENTIAL WARRANTY - PARTS
MG warrants its Residential Class products, purchased and retained in the United States of America and Canada, to be free from defects in material and workmanship under normal use and maintenance as follows:
(1) Air conditioning, heating and/or heat pump units built or sold by MG ("MG Units") for five (5) years from the Warranty Inception Date (as defined below).
(2) Thermostats, auxiliary electric heaters and geothermal pumping modules built or sold by MG, when installed with MG Units, for five (5) years from the Warranty Inception Date (as defined below).
(3) Sealed refrigerant circuit components of MG Units (which components only include the compressor, refrigerant to air/water heat exchangers, reversing valve body and refrigerant metering device) for ten (10) years from the Warranty Inception Date (as defined below).
(4) Other accessories and parts built or sold by MG, when installed and purchased with MG Units, for five (5) years from the date of shipment from MG.
(5) Other accessories, when purchased separately, for (1) year from the date of shipment from MG.

The "Warranty Inception Date" shall be the date of original unit installation, as per the date on the installation Startup Record or six (6) months from date of unit shipment from MG, whichever comes first.

To make a claim under this warranty, parts must be returned to MG in Petitcodiac, New Brunswick, freight prepaid, no later than ninety (90) days after the date of the failure of the part. If MG determines the part to be defective and within MG's Limited Express Residential Warranty, MG shall, when such part has been either replaced or repaired, return such to a factory recognized distributor, dealer or service organization, freight prepaid. The warranty on any part repaired or replaced under warranty expires at the end of the original warranty period.

LIMITED EXPRESS RESIDENTIAL WARRANTY - LABOUR
This Limited Express Residential Labour Warranty shall cover the **labour** incurred by MG authorized service personnel in connection with the installation of a new or repaired warranty part that is covered by this Limited Express Residential Warranty only to the extent specifically set forth in the current **labour** allowance schedule "A" provided by MG's Warranty Department and only as follows:
(1) MG Units for two (2) years from the Warranty Inception Date.
(2) Thermostats, auxiliary electric heaters and geothermal pump modules built or sold by MG, when installed with MG Units, for two (2) years from the Warranty Inception Date.
(3) Sealed refrigerant circuit components of MG Units (which components only include the compressor, refrigerant to air/water heat exchangers, reversing valve body and refrigerant metering device) for five (5) years from the Warranty Inception Date.

Labour costs are not covered by this Limited Express Residential Warranty to the extent they **exceed** the amount allowed under said allowance schedule, they are not specifically provided for in said allowance schedule, they are not the result of work performed by MG authorized service personnel, they are incurred in connection with a part not covered by this Limited Express Residential Warranty, or they are incurred more than the time periods set forth in this paragraph after the Warranty Inception Date.
This warranty does not cover and does not apply to:
(1) Air filters, fuses, refrigerant, fluids, oil.
(2) Products relocated after initial installation.
(3) Any portion or component of any system that is not supplied by MG, regardless of the cause of the failure of such portion or component.
(4) Products on which the unit identification tags or labels have been removed or defaced.
(5) Products on which payment to MG, or to the owner's seller or installing contractor, is in default.
(6) Products subjected to improper or inadequate installation, maintenance, repair, wiring or voltage conditions.
(7) Products subjected to accident, misuse, negligence, abuse, fire, flood, lightning, unauthorized alteration, misapplication, contaminated or corrosive liquid or air supply, operation at abnormal air or liquid temperatures or flow rates, or opening of the refrigerant circuit by unqualified personnel.
(8) Mold, fungus or bacteria damage
(9) Corrosion or abrasion of the product.
(10) Products supplied by others.
(11) Products which have been operated in a manner contrary to MG's printed instructions.
(12) Products which have insufficient performance as a result of improper system design or improper application, installation, or use of MG's products.
(13) Electricity or fuel, or any increases or unrealized savings in same, for any reason whatsoever.

Except for the limited **labour** allowance coverage set forth above, MG is not responsible for:
(1) The costs of fluids, refrigerant or system components **supplied by others**, or associated **labour** to repair or replace the same, which is incurred as a result of a defective part covered by MG's Limited Residential Warranty.
(2) The costs of **labour**, refrigerant, materials or service incurred in diagnosis and removal of the defective part, or in obtaining and replacing the new or repaired part.
(3) Transportation costs of the defective part from the installation site to MG, or of the return of that part if not covered by MG's Limited Express Residential Warranty.
(4) The costs of normal maintenance.

This Limited Express Residential Warranty applies to MG Residential Class products manufactured on or after February 15, 2010. MG'S LIABILITY UNDER THE TERMS OF THIS LIMITED WARRANTY SHALL APPLY ONLY TO THE MG UNITS REGISTERED WITH MG THAT BEARS THE MODEL AND SERIAL NUMBERS STATED ON THE INSTALLATION START UP RECORD, AND MG SHALL NOT, IN ANY EVENT, BE LIABLE UNDER THE TERMS OF THIS LIMITED WARRANTY UNLESS THIS INSTALLATION START UP RECORD HAS BEEN ENDORSED BY OWNER & DEALER/INSTALLER AND RECIEVED BY MG LIMITED WITHIN 90 DAYS OF START UP.

Limitation: This Limited Express Residential Warranty is given in lieu of all other warranties. If, not withstanding the disclaimers contained herein, it is determined that other warranties exist, any such express warranty, including without imitation any express warranties or any implied warranties of fitness for particular purpose and merchantability, shall be limited to the duration of the Limited Express Residential Warranty.

LIMITATION OF REMEDIES In the event of a breach of the Limited Express Residential Warranty, MG will only be obligated at MG's option to repair the failed part or unit, or to furnish a new or rebuilt part or unit in exchange for the part or unit which has failed. If after written notice to MG's factory in Petitcodiac, New Brunswick of each defect, mal-function or other failure, and a reasonable number of attempts by MG to correct the defect, malfunction or other failure, and the remedy fails of its essential purpose, MG shall refund the purchase price paid to MG in exchange for the return of the sold good(s). Said refund shall be the maximum liability of MG. **THIS REMEDY IS THE SOLE AND EXCLUSIVE REMEDY OF THE BUYER OR PURCHASER AGAINST MG FOR BREACH OF CONTRACT, FOR THE BREACH OF ANY WARRANTY OR FOR MG'S NEGLIGENCE OR IN STRICT LIABILITY.**

LIMITATION OF LIABILITY MG shall have no liability for any damages if MG's performance is delayed for any reason or is prevented to any extent by any event such as, but not limited to: any war, civil unrest, government restrictions or restraints, strikes, or work stoppages, fire, flood, accident, shortages of transportation, fuel, material, or labour, acts of God or any other reason beyond the sole control of MG. **MG EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGE IN CONTRACT, FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY, OR IN TORT, WHETHER FOR MG's NEGLIGENCE OR AS STRICT LIABILITY.**

OBTAINING WARRANTY PERFORMANCE Normally, the dealer or service organization who installed the products will provide warranty performance for the owner. Should the installer be unavailable, contact any MG recognized distributor, dealer or service organization. If assistance is required in obtaining warranty performance, write or call: Maritime Geothermal Ltd • Customer Service • PO Box 2555 • Petitcodiac, New Brunswick E4Z 6H4 • (506) 756-8135 • or e-mail to info@nordicghp.com NOTE: Some states or Canadian provinces do not allow limitations on how long an implied warranty lasts, or the limitation or exclusions of consequential or incidental damages, so the foregoing exclusions and limitations may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state and from Canadian province to Canadian province. Please refer to the MG Installation, Installation and Service Manual for operating and maintenance instructions.

An extended warranty option is also available. Please contact Maritime Geothermal Ltd. via the contact information in the previous paragraph for more information.