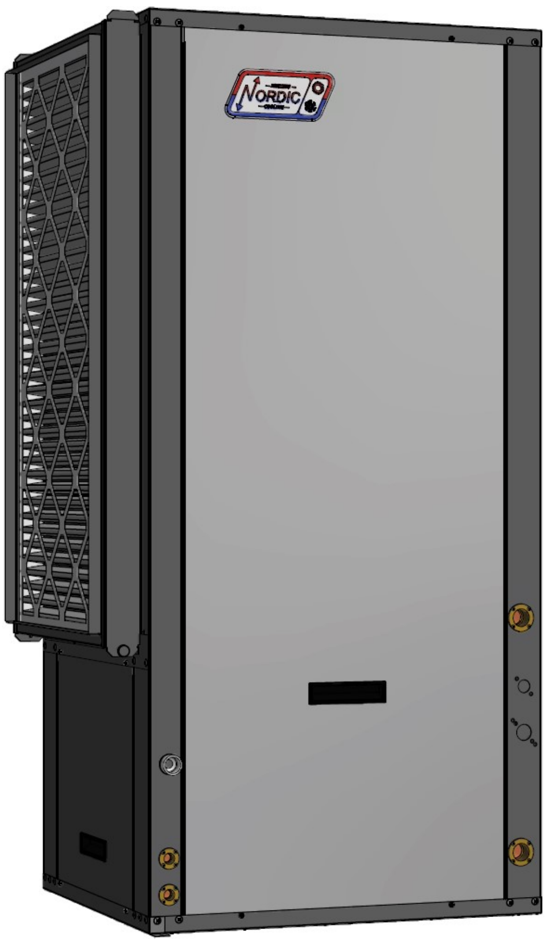
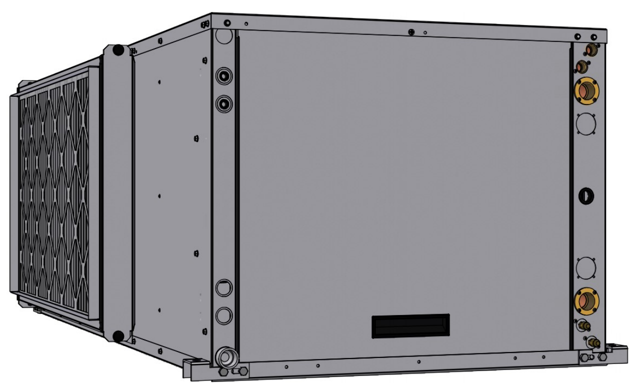
Application, Installation, & Service Manual

R/RH-Series
Liquid to Air Geothermal Heat Pumps

Two-Stage R410a
Model Sizes 45-80



R-Series



RH-Series

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ANSI/AHRI/ASHRAE/ISO13256-1

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ISSUE 02: 26-Sep-2023

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 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

R—65—HACW—P—1T—C—SDERF—xx

Series:
R = Reversing Liquid to Air (vertical)
RH = Reversing Liquid to Air (horiz.)

Nominal Size:
45 = 3 Ton
55 = 4 Ton
65 = 5 Ton
75 = 6 Ton
80 = 6.5 Ton

Functions:
H = heating
AC = active cooling
W = domestic hot water

Refrigerant:
P = R410a

Voltage Code:
1 = 208/230-1-60
2 = 208-3-60
3 = 265/277-1-60
4 = 460-3-60
6 = 220-1-50
7 = 380-3-50

Compressor:
S = 1 stage scroll
T = 2 stage scroll

Outdoor Loop Exchanger:
C = copper
Y = CuNi coil & piping
Z = CuNi coil only

Air Coil:
S = standard (non-coated)
K = e-coated

Blower Type:
D = direct drive

Blower Motor:
E = ECM (constant airflow)

Air Return Orientation:
L = left return
R = right return

Air Outlet Orientation:
F = field configurable
(R: top or side)
(RH: end or side)

Revision:
01, 02 etc.

APPLICATION TABLE										
SIZE	FUNCTION	REFRIGERANT	VOLTAGE	COMPRESSOR	OUTDOOR COIL	FAN/CASE	REVISIONS			
R-45	HACW	P	1 2 3 4 6 7	T	C Y Z	SDELF SDERF	16			
R-55	HACW	P	1 2 3 4 6 7	T	C Y Z	SDELF SDERF	16			
R-65	HACW	P	1 2 3 4 6 7	T	C Y Z	SDELF SDERF	16			
R-75	HACW	P	1 2 4 6 7	T T T S T	C Y Z	SDELF SDERF	16			
R-80	HACW	P	1 2 4 7	S	C Y Z	SDELF SDERF	11			
RH-45	HACW	P	1 2 3 4 6 7	T	C Y Z	SDELF SDERF	09			
RH-55	HACW	P	1 2 3 4 6 7	T	C Y Z	SDELF SDERF	09			
RH-65	HACW	P	1 2 3 4 6 7	T	C Y Z	SDELF SDERF	09			
RH-75	HACW	P	1 2 4 6 7	T T T S T	C Y Z	SDELF SDERF	09			
This manual applies only to the models and revisions listed in this table.										

Maritime Geothermal Ltd. has a continuous improvement policy and reserves the right to modify specification data at any time without prior notice .

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R/RH-Series System Description

General Overview

The Nordic R/RH-series is a package water source heat pump that can heat or chill air in a forced air duct system. The duct system can be zoned, but only to limited extent (see **Wiring** and **Ductwork** chapters).

Being a 'ground source', 'water source', 'geoexchange', or 'geothermal' heat pump, the R/RH-series does require either a **closed ground loop** or **open loop water well** for a heat source/sink. There is no outdoor fan unit for ground source heat pumps.

The air heating and cooling functions are controlled by a standard 3H/2C 24V room thermostat.

In additional to space heating/cooling, there is a double-wall desuperheater for pre-heating domestic hot water with ~5% of the heat pump's capacity. This function is only active when the heat pump is running for space heating or cooling purposes. An energy-efficient bronze head ECM circ pump for the desuperheater circuit is built in, along with a temperature control.

A two-stage scroll compressor with suction accumulator is standard. The blower motor is a premium constant-airflow ECM. The outdoor loop refrigerant to water heat exchanger is a heavy duty coaxial copper / steel model, with optional CuNi inner tube available for open loop applications. A single thermostatic expansion valve (TXV) regulates superheat. The cabinet is constructed from powder coated galvanized sheet metal.

1. Heating Mode

In heating mode, the heat pump heats warm air in a duct system. As the unit operates, heat is extracted from the ground loop or well water. The heat pump is activated by by a standard 3H/2C 24V room thermostat, which will call for stage 1 or stage 2 heat according to its own algorithm. The thermostat can also call for stage 3 (due to air temperature falling further below the setpoint, or after a certain run time), which will activate the optional electric plenum heater. The plenum heater accessory is available in different sizes to provide either full backup or partial auxiliary heat.

If a closed ground loop is used, the circulation pumps are powered and controlled by the heat pump; if open loop, a water valve is opened by the heat pump during heating operation and closed when the heat pump is idle.

2. Cooling Mode

In cooling mode, the heat pump cools air in the duct system. As the unit operates, heat is extracted from the ducted air stream and rejected to the ground loop or well water.

Factory Options

Looking at the main service panel and piping connections, the heat pump can be ordered as a left or right hand air return from the factory. This must be specified at time of order as the physical construction of the two configurations is different.

Sizing

Heat Pump Sizing

The following table is a rough guideline as to the size of space each heat pump size can handle for **ground loop (closed loop)** installations.

TABLE 1 - Heat Pump Size vs. Heated Area for a Ground Loop System		
Model	ft^2	*m^2*
R/RH-45	1400	*130*
R/RH-55	2000	*185*
R/RH-65	2600	*240*
R/RH-75	3100	*290*
R-80	3500	*325*

The following table is a rough guideline as to the size of home each heat pump size can handle for **ground water (open loop)** installations.

TABLE 2 - Heat Pump Size vs. Heated Area for an Open Loop System		
Model	ft^2	*m^2*
R/RH-45	1800	*165*
R/RH-55	2500	*230*
R/RH-65	3200	*295*
R/RH-75	3800	*355*
R-80	4200	*390*

THE TABLES ABOVE ARE FOR ESTIMATION ONLY. THEY SHOULD NOT BE USED TO SELECT A FINAL UNIT SIZE. They simply show what size unit is required for a northern home with typical construction: R20 walls, R40 ceiling, and average size and number of windows. The heated area is the area of the above grade 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 PERFORMED BY A PROFESSIONAL WITH APPROVED CSA F-280 SOFTWARE BEFORE SELECTING THE HEAT PUMP SIZE. For heating dominant climates, 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 standard 448.2-02. For ground loop applications, the ground loop should be designed using suitable software with a multi-year analysis.

The analysis will result in a heat load for the coldest day, which is influenced by, for example, the number of levels, the size of the windows, the orientation of the home, attached garage, bonus rooms, walk-in basement, and coldest outdoor temperature for the region.

A heat pump model size can then be selected by comparing the calculated heat load to the heat pump capacity at the standard indoor air temperature, which can be found in the performance tables in the **Model Specific Information** section. For R-series, the *Standard Capacity Ratings* rather than detailed performance tables can be used for simplicity. For 100% heat pump sizing, choose a heat pump with a standard capacity rating that matches or just slightly exceeds the calculated heat load.

Some background on *Standard Capacity Ratings*: closed ground loops are normally designed to reach a minimum temperature of just below freezing at the end of the heating season, in order to take advantage of the latent heat of groundwater (at least in northern climates). Hence, the Standard Capacity Ratings for Ground Loop Heating should apply in all northern climates. Conversely, the Standard Capacity Ratings for Ground Water (open loop) heat pumps assume a well water temperature of 50°F (10° C). In more southerly climates, the groundwater or ground loop will probably be at a warmer minimum temperature, and it will be necessary to consult the more detailed performance tables for heat pump output at a different ELT.

In cooling dominant climates, the heat pump should be similarly sized using the Ground Loop Cooling or Ground Water Cooling Standard Capacity Ratings. **Even in northern heating dominant climates, it should be ensured that 100% of the cooling load will be covered when sizing the heat pump, since there is normally no auxiliary or backup cooling available.**

Plenum Heater Sizing

The plenum heater is available as an accessory in 5, 7, 10, 15 and 20kW sizes. If full backup is desired, choose a size that covers **100% of the coldest day heat load**, according to the heat loss analysis mentioned in the last section. If that is not available, use the following recommendation:

TABLE 3 - Plenum Heater Sizing			
Model	Plenum Heater Size (kW)		
	Full Backup	Possible	Not Possible
R/RH-45	10	5, 7, 10	15, 20*
R/RH-55	10	5, 7, 10, 15, 20	
R/RH-65	15	5, 7, 10, 15, 20	
R/RH-75	20	5, 7, 10, 15, 20	
R-80	20	5, 7, 10, 15, 20	

* Although these plenum heaters will not fit inside heat pump, there are versions available for external mounting.

Two styles of plenum heater are available; the first is for R-series internal installation (inside the indoor unit). Note limit for size 45 in above table.

The second has a wider element profile for installation outside the unit, in the ductwork. For RH series or for R series when field-installing the fan in the convertible side discharge position, this type of plenum heater should be used.

Installation Basics

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.

Unit Placement

Ducted or forced air heat pumps should be centrally located in the home with respect to the conditioned space. This provides the best 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 temperature throughout the building when it is located at one end of the structure and the heated or cooled air is transmitted with uninsulated metal ductwork.

If possible the front (piping side) access panel and side access panel opposite the air return should remain clear of obstruction for a distance of **2 ft (0.7 m)** to facilitate servicing

Sample Bill of Materials - Ground Loop Installations

FROM MARITIME GEOTHERMAL
- R/RH SERIES HEAT PUMP (L OR R RETURN)
- PLENUM HEATER __kW
- THERMOSTAT (WIFI OR STD)
- P/T PORTS AND HOSE ADAPTERS (2)
- 1 OR 2 PUMP PACK
- PIPE ADAPTERS FOR PUMP PACK

OPTIONAL FROM MARITIME GEOTHERMAL
- ANTI-VIBRATION PAD
- SOUND JACKET
- SECURE START
- ELECTROSTATIC FILTER

DUCTWORK
- OUTLET PLENUM ADAPTER W/ FLEXIBLE COLLAR
- RETURN AIR ADAPTER W/ FLEXIBLE COLLAR
- FIBREGLASS INSULATION (FOR NOISE, IF REQ'D)
- TRUNK DUCT W/ JOINERS (IF NOT EXISTING)
- 6" ROUND DUCT W/ADAPTERS (IF NOT EXISTING)
- ALUMINUM TAPE
- SHEET METAL SCREWS

DHW
- PREHEAT TANK, 40 OR 60 GAL
- ½" COPPER PIPE
- ½" FITTINGS, BALL VALVES, BOILER DRAINS, CV

GROUND LOOP
- ¾" PE PIPE
- 1-1/4" PE PIPE
- PE PIPE FITTINGS
- 1" CLEAR HOSE (HEAT PUMP TO PUMP PACK)
- HOSE CLAMPS
- ANTIFREEZE: METHANOL OR PROP. GLYCOL

ELECTRICAL
- HEAT PUMP SERVICE WIRE: 6-3 OR 8-3
- PLENUM HEATER SERVICE WIRE
- HEAT PUMP BREAKER
- PLENUM HEATER BREAKER
- THERMOSTAT WIRE 18-8
- THERMOSTAT WIRE 18-2 (PLENUM HEATER)
- FORK TERMINALS FOR TSTAT WIRE (10)
- CONDENSATE PUMP & HOSE (IF REQUIRED)

- 2" STYROFOAM INSUL. (IF PAD NOT PURCHASED)

Sample Bill of Materials - Open Loop Installations

FROM MARITIME GEOTHERMAL
- R/RH SERIES HEAT PUMP (L OR R RETURN)
- PLENUM HEATER __kW
- THERMOSTAT (WIFI OR STD)
- P/T PORTS AND HOSE ADAPTERS (2)
- DOLE VALVE
- MOTORIZED WATER VALVE

OPTIONAL FROM MARITIME GEOTHERMAL
- ANTI-VIBRATION PAD
- SOUND JACKET
- SECURE START
- ELECTROSTATIC FILTER

DUCTWORK
- OUTLET PLENUM ADAPTER W/ FLEXIBLE COLLAR
- RETURN AIR ADAPTER W/ FLEXIBLE COLLAR
- FIBREGLASS INSULATION (FOR NOISE, IF REQ'D)
- TRUNK DUCT W/ JOINERS (IF NOT EXISTING)
- 6" ROUND DUCT W/ ADAPTERS (IF NOT EXISTING)
- ALUMINUM TAPE
- SHEET METAL SCREWS

DHW
- PREHEAT TANK, 40 OR 60 GAL
- ½" COPPER PIPE
- ½" FITTINGS, BALL VALVES, BOILER DRAINS, CV

WATER SYSTEM
- 1" BLACK PLASTIC WATER PIPE
- 1" BARBED FITTINGS & HOSE CLAMPS
- VSP SUBMERSIBLE PUMP (IF NOT EXISTING)
- PRESSURE TANK (IF NOT EXISTING)
- CYCLE STOP VALVE (IF FIXED SPEED PUMP)

ELECTRICAL
- HEAT PUMP SERVICE WIRE: 6-3 OR 8-3
- PLENUM HEATER SERVICE WIRE
- HEAT PUMP BREAKER
- PLENUM HEATER BREAKER
- THERMOSTAT WIRE 18-8
- THERMOSTAT WIRE 18-2 (PLENUM HEATER)
- FORK TERMINALS FOR TSTAT WIRE (10)
- CONDENSATE PUMP & HOSE (IF REQUIRED)

- 2" STYROFOAM INSUL. (IF PAD NOT PURCHASED) and general maintenance. For **vertical R-series**, no access is required on the back side. Ensure the unit is level to eliminate any possible condensate draining issues.

The heat pump comes equipped with 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. Be careful not to run piping in front of the filter rack access cover, since access is required in order to change the air filter.

Floor mounted units should be placed on an anti-vibration pad, available as an accessory, or a piece of 2” styrofoam.

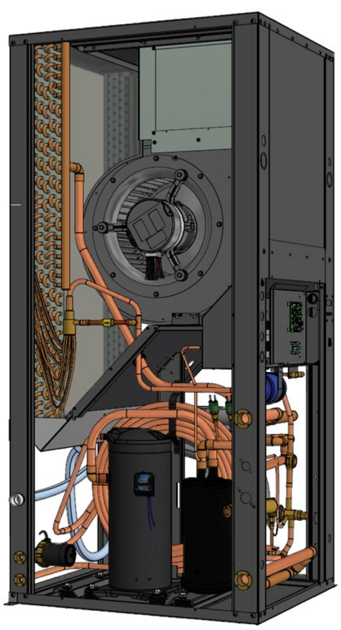
Horizontal RH-series units may be hung using threaded rod and the four built-in hangers. Be sure the hanging system is suitable for **2X** the weight of the unit.

R-Series Air Outlet Orientation

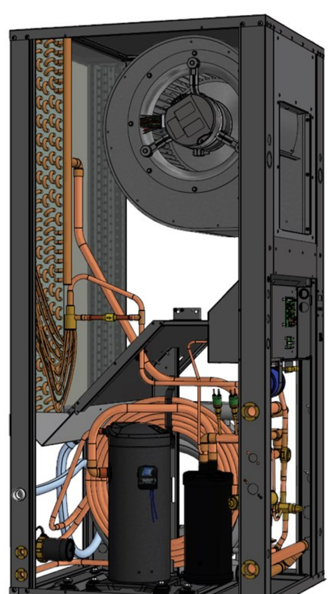
The **vertical R-series** has a field configurable blower position, resulting in **top** or **side** air discharge. Its default location from the factory is in the top of the unit, providing a “ninety” in the airflow. It can easily be placed in the side of the unit for straight through airflow. Note that if this is done, plenum heater will need to be placed in the ductwork outside unit.

To switch the location of the fan outlet:

1. Be sure power supply to unit is turned off.
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. Disconnect the two wiring harnesses and ground wire from the blower motor.
4. Repeat step 2 for the access panel with the blower mounted in it. Set the assembly on the floor.
5. Disconnect the plenum heater extension from the blower housing and from the access panel.
6. Mount the blower housing directly to the access panel.
7. Install the blower in its panel in the new location and secure with the screw.
8. Reconnect both harnesses and ground wire.
9. Install the remaining access panel and secure with the remaining screw.



BLOWER IN TOP DISCHARGE POSITION (DEFAULT)



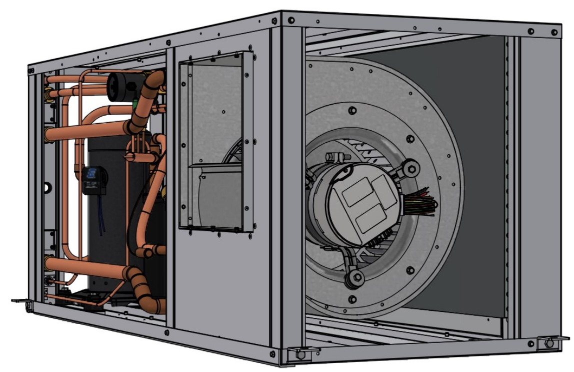
BLOWER IN SIDE DISCHARGE POSITION

RH-Series Air Outlet Orientation

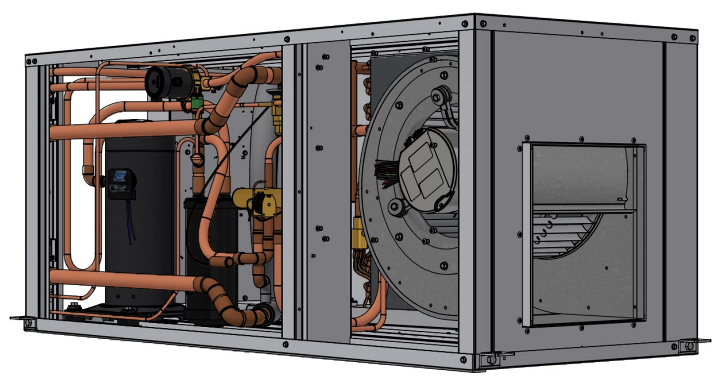
The **horizontal RH-series** has a field configurable blower position, resulting in **straight through (side)** or **end** air discharge. Its default location from the factory is in the straight through (side) position. It can easily be placed in the end of the unit to provide a 90° turn in the air flow.

To switch the location of the fan outlet:

1. Be sure power supply to unit is turned off.
2. Remove the screw that holds the access panel adjacent to the blower in place and remove the it by pulling up on the handle and then outward from the bottom.
3. Disconnect the two wiring harnesses and ground wire from the fan motor.
4. Repeat step 2 for the access panel with the blower mounted in it.
5. Install the blower in its panel in the new location and secure with the screw. Be sure to **flip the blower over** so that the motor faces out the adjacent access panel, so that wiring harness may be reconnected and that service access to the motor is maintained even with ductwork connected.
6. Reconnect both harnesses and ground wire.
7. Install the remaining access panel and secure with the remaining screw.



BLOWER IN SIDE DISCHARGE POSITION (DEFAULT)



BLOWER IN END DISCHARGE POSITION

Plenum Heater Installation (Optional)

Be sure to specify the type of installation anticipated, since the plenum heater models are different for internal or external (duct) installation.

1. **Vertical R-series, blower in top discharge position:** Plenum heater is mounted inside heat pump cabinet. See diagram on following page. Remove the screws from the cover plate, remove the cover plate, and place the plenum heater in the cutout. Slide it up and secure the bottom flange with three cover plate screws. Use the indicated knockouts on the heat pump cabinet for electrical connections.

   When installation is complete, check the appropriate box of the label on the unit door to indicate which size heater was installed.

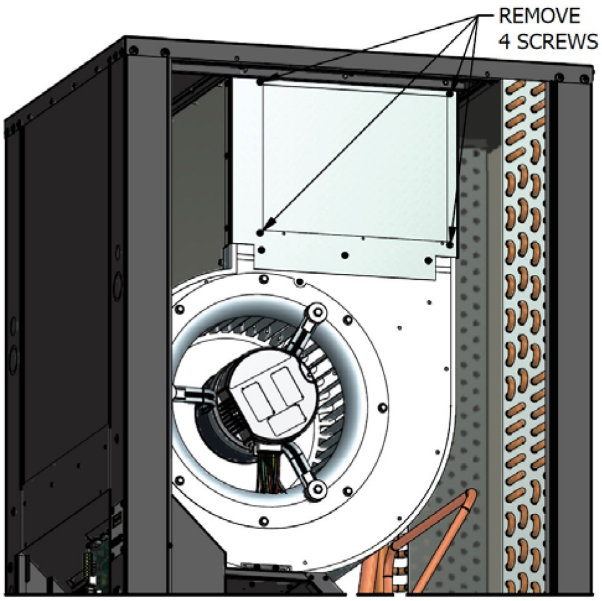
2. **Vertical R-series, blower in side discharge position OR RH-series:** Plenum heater should be installed in the air discharge duct outside the heat pump cabinet in a manner that allows all of the airflow to pass through it, to prevent any hot spots in the heater elements. Ensure that the plenum heater is mounted in an approved position as per its instructions.

Air Return Orientation

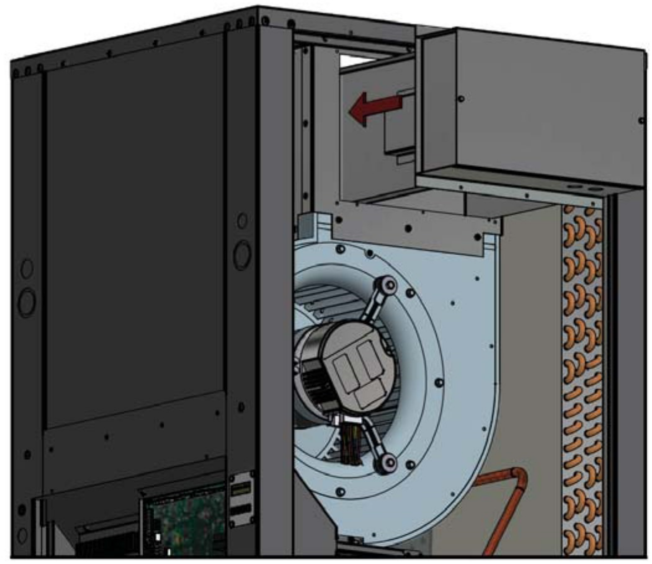
The heat pump can be ordered as left or right air return from the factory. This must be specified at time of order as the physical construction of the two configurations is different. Refer to the **Dimensions** section toward the end of this manual for physical dimensions of the units.

Internal Plenum Heater Installation
R, TF, ATA, ATF, DX, DXTF Series

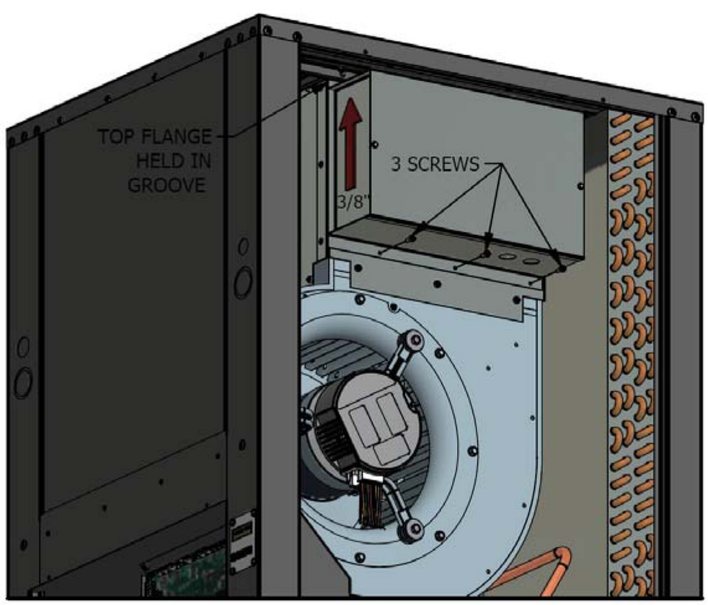
1. Remove four screws as shown, and remove blank panel.



2. Slide plenum heater into cutout until heater flange is flush with blower.



3. Slide plenum heater *UP* approximately 3/8". Top flange of heater is held in top groove of blower assembly and requires no fasteners. Install 3 screws through bottom flange of heater through pre-punched holes in heater and blower assembly.



01	Initial Release	Dan Rheault	Dan Rheault	9-Jan-2015
REV	ECO#	IMPL BY	APVD BY	DATE

Drawn By: Dan Rheault	Date: 9-Jan-2015
Checked By: Dan Rheault	Date: 9-Jan-2015
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Drawing Name: **Internal Plenum Heater Installation**

Size	Drawing Number	Revision	Sheet
LET	001915INF	01	1 / 1

Wiring

Power Supply Connections

The heat pump has a concentric 1.093" / 0.875" knockout for main power supply connection from the breaker panel to the electrical box. There are also 0.875" knockouts and plastic grommet(s) for connections to plenum heater power supply, thermostat, and water valve or ground loop pump pack.

NOTE: Two separate power supplies are required, one for the heat pump and a second one for the plenum heater. Each must have its own supply wires and breaker.

A schematic diagram (SCH) and electrical box layout diagram (ELB) can be found on the electrical box cover of the unit as well as in the **Model Specific Information** section of this manual. The Electrical Tables in the **Model Specific Information** section contain information about the wire and breaker size.

NOTE: A properly qualified electrician should be retained for all connections to the heat pump and associated controls. The connections to the unit MUST CONFORM TO LOCAL CODES.

IMPORTANT NOTE FOR 3-PHASE UNITS: If on startup compressor is noisy and not pumping, reverse L1 and L2 supply wires.

TABLE 4 - Power Supply Connections (Heat Pump)

Line	Description	Voltages
L1	Line 1	All
L2	Line 2	All
L3	Line 3	3-phase only
GND	Ground	All (connect to ground lug)
N	Neutral	208/230-1-60**, 208-3-60**, 380-3-50, 460-3-60

** Only required if connecting 115VAC circulators to the heat pump for 208/230-1-60 and 208-3-60 models (the heat pump itself does not require a neutral). Required for 380-3-50 and 460-3-60 models.

TABLE 5 - Power Supply Connections (Plenum Heater)

Line	Description	Voltages
L1	Line 1	All
L2	Line 2	All
L3	Line 3	3-phase only
GND	Ground	All (connect to ground lug)

Outdoor Loop 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 (115V or 230V) of the terminal strip marked **OUTDOOR CIRCULATORS** in the heat pump, as per the voltage of the circulator pump module. Ground wire should be connected to the ground lug in the electrical box. Ensure that the total current draw does not exceed the value indicated on the label in the heat pump electrical box.

TABLE 6 - Ground Loop Circulator Connections

Terminal	Description
115V	Connection for 115V circulator
115V	
230V	Connection for 230V circulator
230V	

Use a 2-conductor 14ga cable.

Control Transformer

The low voltage controls for most voltage models are powered by a class II transformer with 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.

Other voltage models have a transformer with primary and secondary fuses for circuit protection.

IMPORTANT NOTE: For 208/230VAC-1-60 units, if connecting to 208VAC power supply move the red wire connected to the 240 terminal of the transformer to the 208 terminal of the transformer.

Domestic Hot Water (Desuperheater)

The desuperheater function is pre-wired and no field connections are necessary. There is a built-in temperature switch to turn off the built-in DHW circulator when the output temperature reaches 140°F (60°C), and on again when the temperature falls to 120°F (49°C).

After the desuperheater is filled with water and purged of air, activate the built-in DHW circulator by connecting the brown wire with the blue insulated terminal to L1 of the compressor contactor as shown on the wiring diagram in the **Model Specific Information** section. **Ensure the power is off when connecting the wire.** Also, turn on the DHW ON/OFF switch.

Thermostat Requirements

A three-stage heating and two stage cooling heat pump configurable thermostat is required for two-stage models. 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 heat pump 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 does the below table. Refer to diagram on a following page for connections between the thermostat and the heat pump.

NOTE: Some models are not available in two-stage. Model numbers with a T in the Compressor Stages designator are two-stage; models with an S are single stage (verify the model number against pages 2 and 3 of this manual, or refer to the **Electrical Specifications** near the end of this manual to determine if the model is two stage or one stage). The Y2 signal is not used for these units, and they only require a 2 stage heat 1 stage cool thermostat. The stages are S1 = Compressor and S2 = electric auxiliary (heating only). If the selected thermostat has more stages than this, configure it for 2 and 1.

TABLE 7 - Control Signal Description

Signal	Description
C	**24VAC Common (Ground)**
G	**Fan low speed (for air recirculation)**
Y_1	**Heat Pump Stage 1**
R_H	**24VAC Hot**
L	**Fault (24VAC when fault condition)**
W_2	**Heat Pump Stage 3 (auxiliary heat) / Emergency Heat**
O	**Cooling Mode (reversing valve)**
Y_2	**Heat Pump Stage 2 (not used for single stage units)**
AR_1	**Airflow Reduction***
AR_2	**Airflow Reduction***
CP(I)	**Plenum Heater dry contact (Connect to C or I in plenum heater)**
1	**Plenum Heater dry contact. (Connect to 1 and 2 in plenum heater)**

* 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.

Airflow Adjustment

The unit is equipped with a direct drive ECM fan motor for maximum efficiency. The motor features a soft start which provides a smooth, quiet ramp up to operating speed . The motor will maintain the programmed air flow up to a maximum external static value.

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 the table. Refer also to the airflow tables in the **Model Specific Information** section. Units are shipped with the **MED** position selected for nominal air flow.

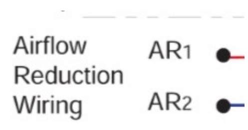
TABLE 8 - Airflow Selections

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

It is recommended that airflow reduction (below) 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.

Airflow Reduction for Zoning

For zoning purposes, airflow may be reduced by 15% using a switch or dry contact connected to **AR1-AR2** on the terminal strip. The dry contact may be from a relay and interconnected thermostats, or more commonly a zone controller.



For more zoning advice, see **Ductwork** chapter.

Safety Controls

The heat pump has two important 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.

1. 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 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 air temperature (unlikely).
3. Plugged air filter, or dirty air coil.
4. High refrigerant charge after service, or mechanical malfunction (see **Troubleshooting** section).

2. 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 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.
4. Low refrigerant charge due to leak, or mechanical malfunction (see **Troubleshooting** section).

The unit contains a control board that monitors the safety controls and operates the compressor accordingly. The low pressure control and high pressure controls are connected to the control board as shown on the wiring diagram later in this manual.

The compressor will not be allowed to start if a ‘fault’ condition exists. A ‘fault’ occurs if either one of the pressure controls exhibits an open circuit. In addition, the board monitors a condensate overflow sensor, located in the drip tray, and the voltage of the 24vac transformer. A fault will occur if a condensate overflow is detected, or a low voltage condition (electricity grid brownout) is detected.

The control board has an on-board LED and an ALR pin with a 24VAC output, which is routed to the L terminal of the thermostat terminal strip. An external indicator or relay can be connected across L and C on the terminal strip if external signaling is desired. Should a fault condition occur, the LED will flash the code of the fault condition. The codes are shown in the following table. The control board will lock out the compressor for five minutes when a fault occurs. The control board will then restart the compressor if the fault is no longer present. Should a second fault condition occur within a 60 minute period the control board will go into permanent lockout mode and energize the ALR pin. The LED will flash the fault code until the control board is reset by powering down the unit.

The board has a **TEST** jumper, which defeats the 5 minute anti-short cycle timer for test purposes. If left in the TEST position, it will time out and return to normal operation after a set time period. This is to prevent compressor short cycling and possible damage or shortened lifespan if the jumper is accidentally left in the TEST position.

There are also **FREEZE TEMP** and **WATER TEMP** jumpers on the control board. **These are not used and have no effect on heat pump operation.**

TABLE 9 - Control Board Fault Codes

Fault	LED Flashes
High Pressure	**1**
Low Pressure	**2**
Condensate Overflow	**4**
Brownout	**5**

Open/Closed Loop LPC Selection

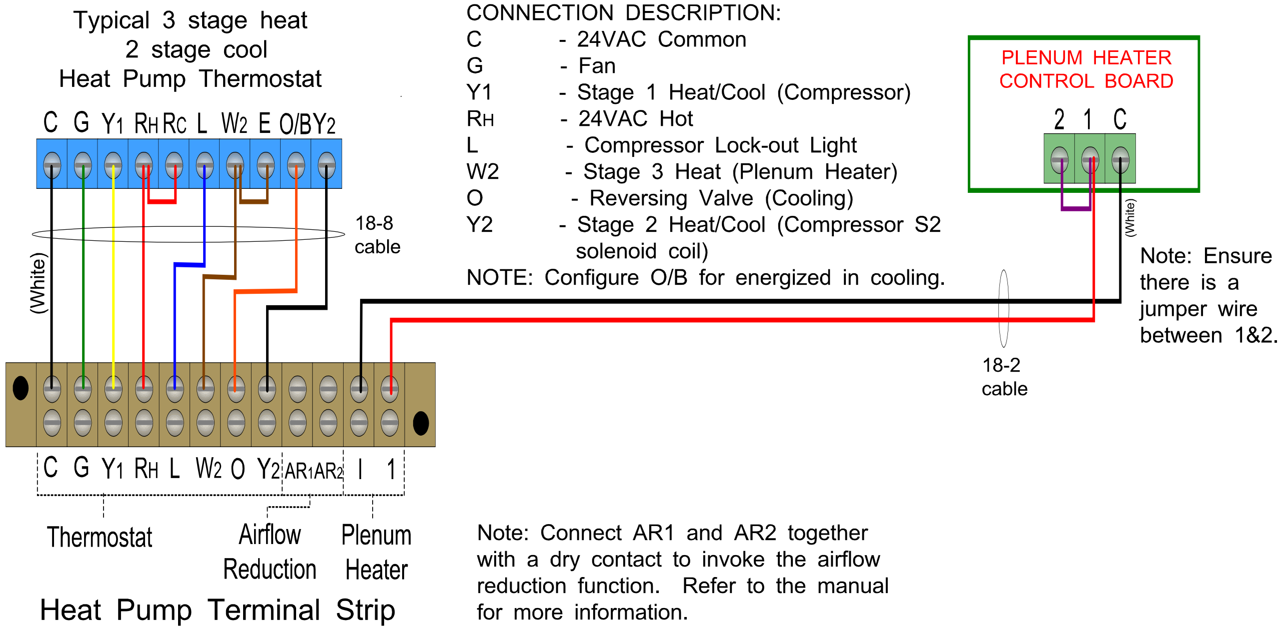
There are two low pressure safety controls in the heat pump: 75 psi for open loop (water), and 55 psi for closed loop (antifreeze). As shipped, the closed loop LPC will be active.

If an open loop is used, it is very important to remove the jumper plug located in the wiring harness behind the piping post, and replace it with the water valve connection harness that comes with the water valve from Maritime Geothermal. This will automatically select the higher LPC, and ensure that the heat pump is properly protected from freezing. It will also ensure the water valve is open before starting the compressor. See wiring diagram for water valve wiring.

WARNING: Connecting an open loop water valve without a harness provided by Maritime Geothermal could lead to frozen and ruptured heat exchanger, voiding the warranty.

Typical Thermostat Connections

Two-Stage Models (Compressor Stages = T)



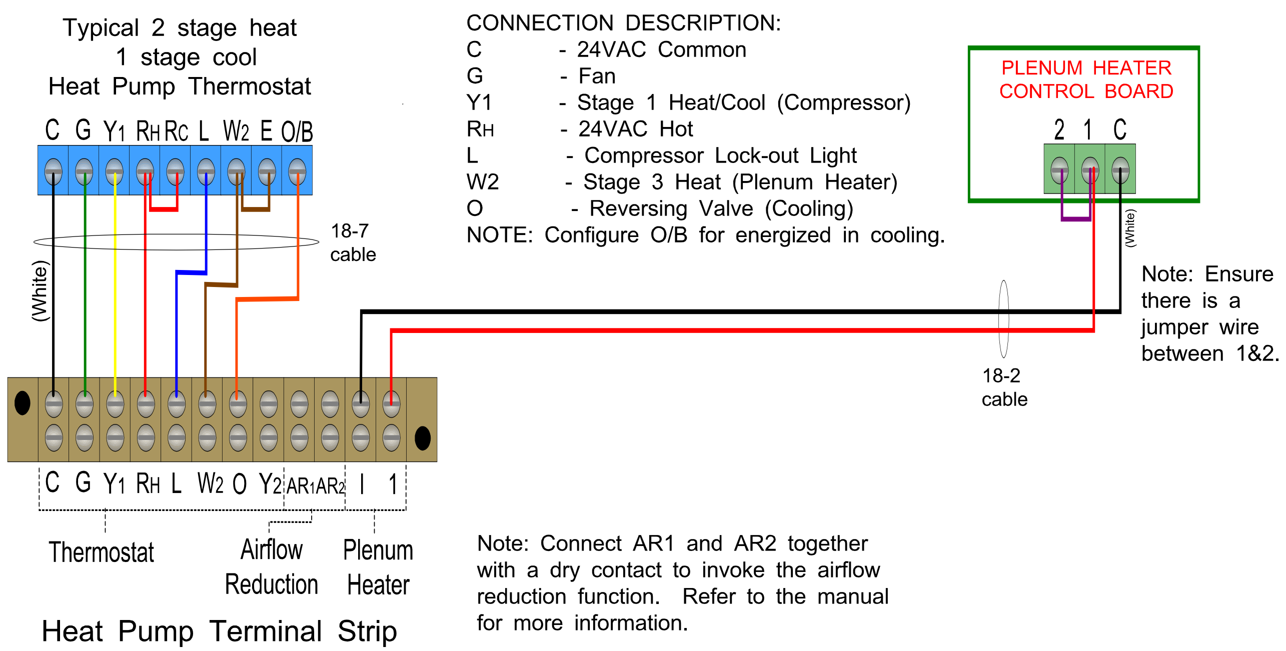
CONNECTION DESCRIPTION:

C	- 24VAC Common
G	- Fan
Y1	- Stage 1 Heat/Cool (Compressor)
RH	- 24VAC Hot
L	- Compressor Lock-out Light
W2	- Stage 3 Heat (Plenum Heater)
O	- Reversing Valve (Cooling)
Y2	- Stage 2 Heat/Cool (Compressor S2 solenoid coil)

NOTE: Configure O/B for energized in cooling.

Note: Connect AR1 and AR2 together with a dry contact to invoke the airflow reduction function. Refer to the manual for more information.

Single-Stage Models (Compressor Stages = S)



CONNECTION DESCRIPTION:

C	- 24VAC Common
G	- Fan
Y1	- Stage 1 Heat/Cool (Compressor)
RH	- 24VAC Hot
L	- Compressor Lock-out Light
W2	- Stage 3 Heat (Plenum Heater)
O	- Reversing Valve (Cooling)

NOTE: Configure O/B for energized in cooling.

Note: Connect AR1 and AR2 together with a dry contact to invoke the airflow reduction function. Refer to the manual for more information.

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	C. GEDDES	C. GEDDES	18 MAR 2014

Drawn By: Chris Geddes	Date: 18 MAR 2014
Checked By: Chris Geddes	Date: 18 MAR 2014
Approved By (ENG): Chris Geddes	Date: 18 MAR 2014
Approved By (MFG)	Date
Approved By	Date

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Drawing Name: Typical Thermostat Connections

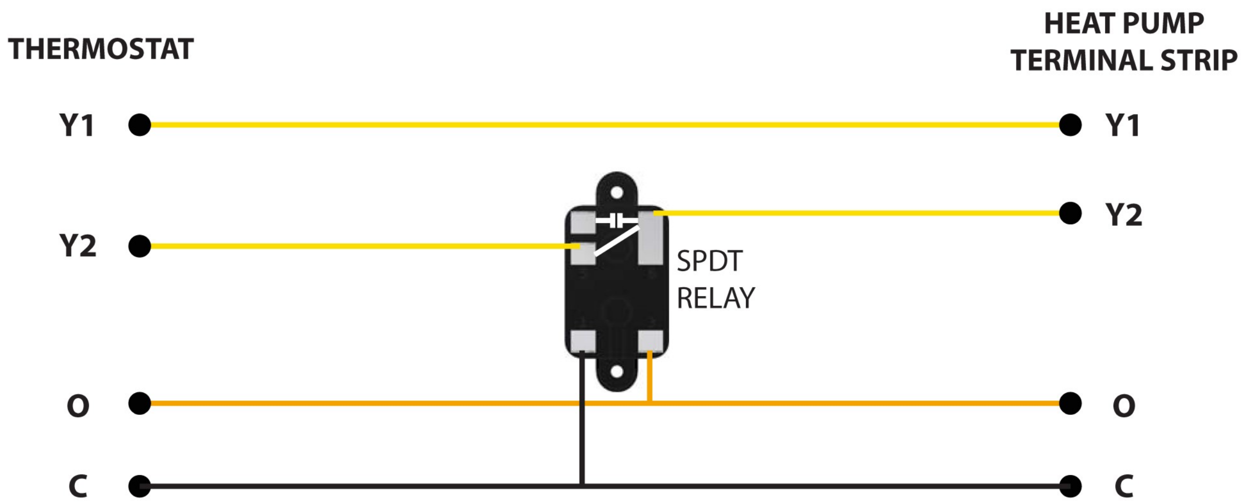
Size	Drawing Number	Drawing Rev	SHEET
A	001827SCH	01	1 of 1

Water-to-Air Heat Pumps: Wiring for Best Cooling Mode Dehumidification in Heating-Dominant Climates

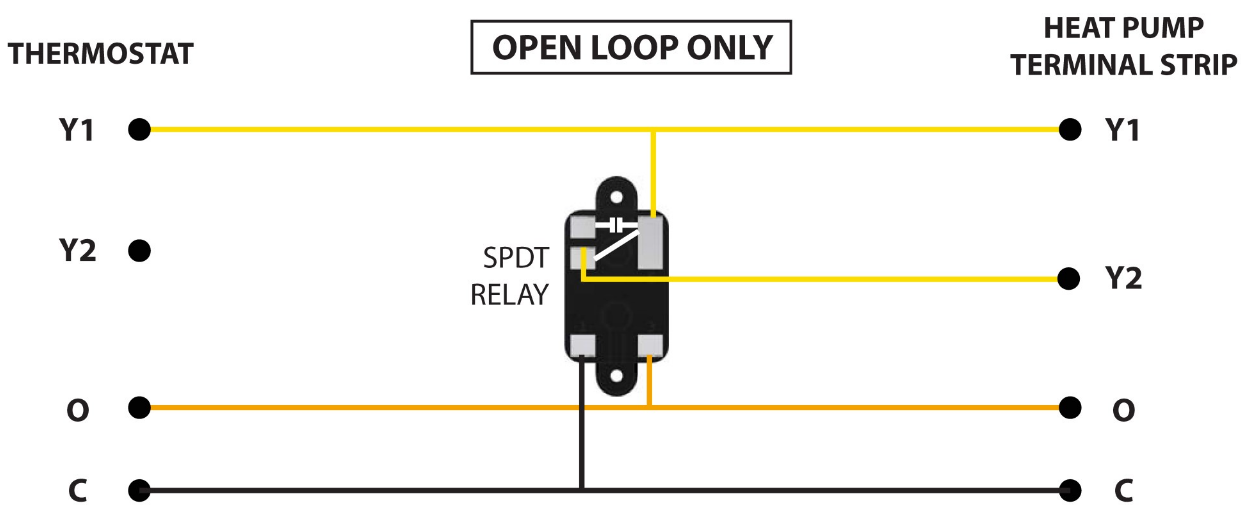
Dehumidification is maximized by maximizing run time.

In heating-dominant climates, where heat pump is generally sized for the heating load, maximizing run time in cooling mode can be achieved by disabling the Y2 signal when the O signal is on.

This should be done only if the cooling load is less than 2/3 of the heating load. This can be checked on the heating/cooling load analysis that is often done as part of the installation design.



On many open loop systems, where the sizable submersible pump power negates the COP benefit of running on stage 1, Y1 and Y2 are jumpered together. In this case, the wiring should be modified as follows. With this wiring, the heat pump will always run on stage 1 in cooling mode and stage 2 in heating mode.



01	Initial Release	Dan Rheault	Dan Rheault	9-Dec-2014	Drawn By: Dan Rheault	Date: 9-Dec-2014
REV	ECO#	IMPL BY	APVD BY	DATE	Checked By: Dan Rheault	Date: 9-Dec-2014
					Eng. Approved By	Date
					Mfg. Approved By	Date
					Approved By	Date

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Drawing Name: **Wiring for Cooling Mode in Heating-Dominant Climates**

Size	Drawing Number	Revision	Sheet
LET	001901PDG	01	1 / 1

Piping

Domestic Hot Water (Desuperheater) Connections

The connections for the DHW circuit are 1/2" brass FPT fittings. They are marked DHW IN and DHW OUT.

A typical piping diagram for a pre-heat tank configuration can be found in document **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 CAN BE >200°F NEAR THE UNIT WITH DESUPERHEATER TURNED OFF, POTENTIALLY MELTING & RUPTURING PLASTIC PIPING.

Ensure the tank is filled with water and under pressure before activating the built-in DHW circulator as described below. First, slightly loosen the boiler drain on the DHW Out pipe to allow air to escape from the system. 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.

Activate the built-in DHW circulator by connecting the brown wire with the blue insulated terminal to L1 of the compressor contactor. **Ensure the power is off when connecting the wire.** Once connected the DHW switch on the front of the unit may be used to enable/disable the domestic hot water circulator.

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),** which is required by most codes. 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, and eliminates the possibility of reverse heating of the refrigerant gas under low condensing temperature operating conditions.

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.

Note that connection and use of the desuperheater is optional, and there is no problem for the heat pump if desuperheater is left unconnected.

Condensate Drain

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

R-series: The condensate drain is internally trapped and does not require an external trap.

RH-series: The condensate drain is **not** internally trapped, and an external trap and vent must be installed.

An external condensate pump may be installed if there is not sufficient slope to drain condensate under gravity to its destination.

To avoid overflow of the condensate pan, the drain line and trap should be inspected periodically to ensure they are not plugged with accumulated debris. There is an alarm for condensate overflow, which will disable unit operation.

See following page and also **Ductwork** chapter for diagrams showing the condensate drain connection.

Outdoor Loop

The connections for the Outdoor Loop circuit are 1" brass female NPT. They are labelled OUTDOOR IN and OUTDOOR OUT.

See the following chapters for details on ground loop and open loop installations.

Typical Loop Connections - R Series

See other diagrams and instructions in the manual for design, selection, and installation details of ground loop and hydronic heating accessories.

Many of the items illustrated in this diagram are available as accessories from Maritime Geothermal Ltd.. Other items are commonly available from plumbing or HVAC wholesalers.

There are some valid connection methods or details which differ from those shown, including:

- Open loop installation, which uses a well water system in place of a ground loop.
- Piping routed differently from that shown, or different piping & component types.

01	Initial Rel.	Dan Rheault	Dan Rheault	6-Apr-2021
REV	ECO#	IMPL BY	APVD BY	DATE

Drawn By: Dan Rheault	Date: 6-Apr-2021
Checked By: Dan Rheault	Date: 6-Apr-2021
Eng. Approved By	Date
Mfg. Approved By	Date
Approved By	Date

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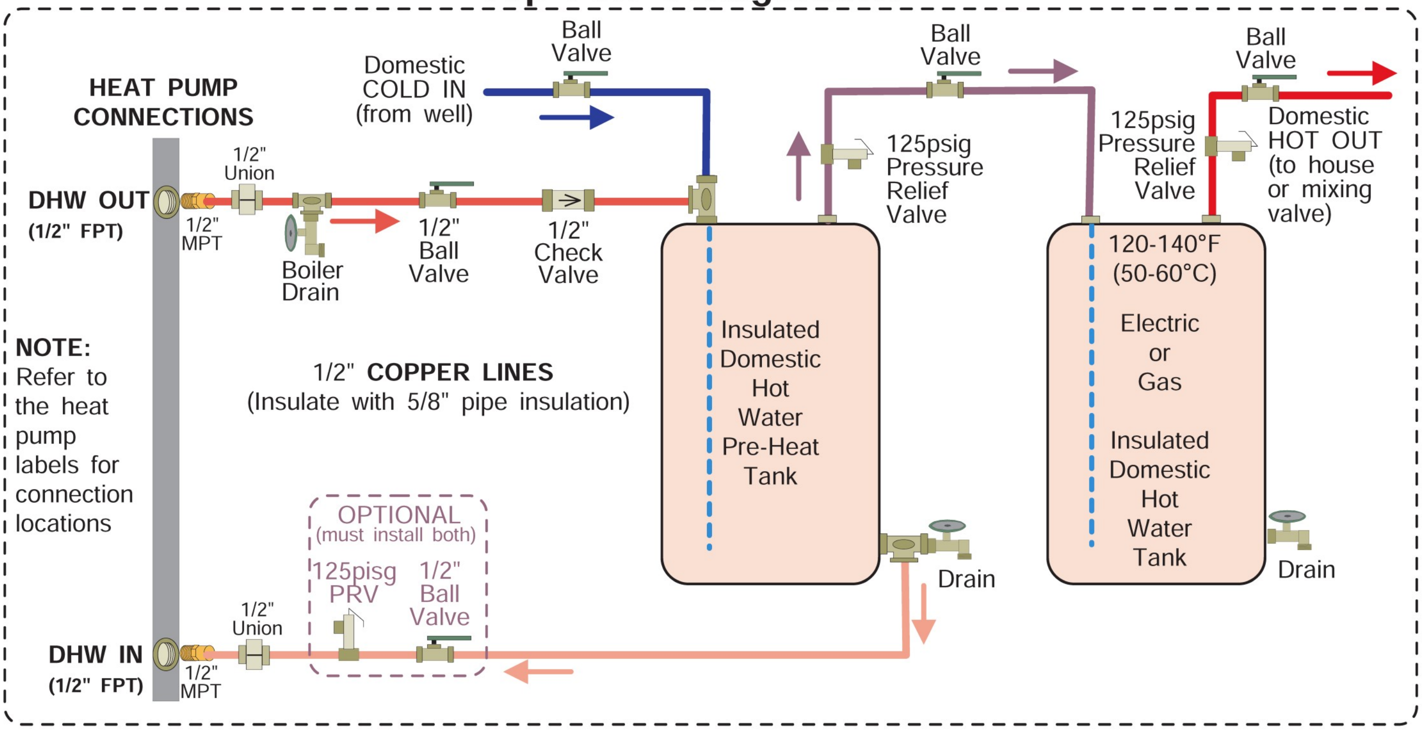
Drawing Name: **Typical Loop Connections - R Series**

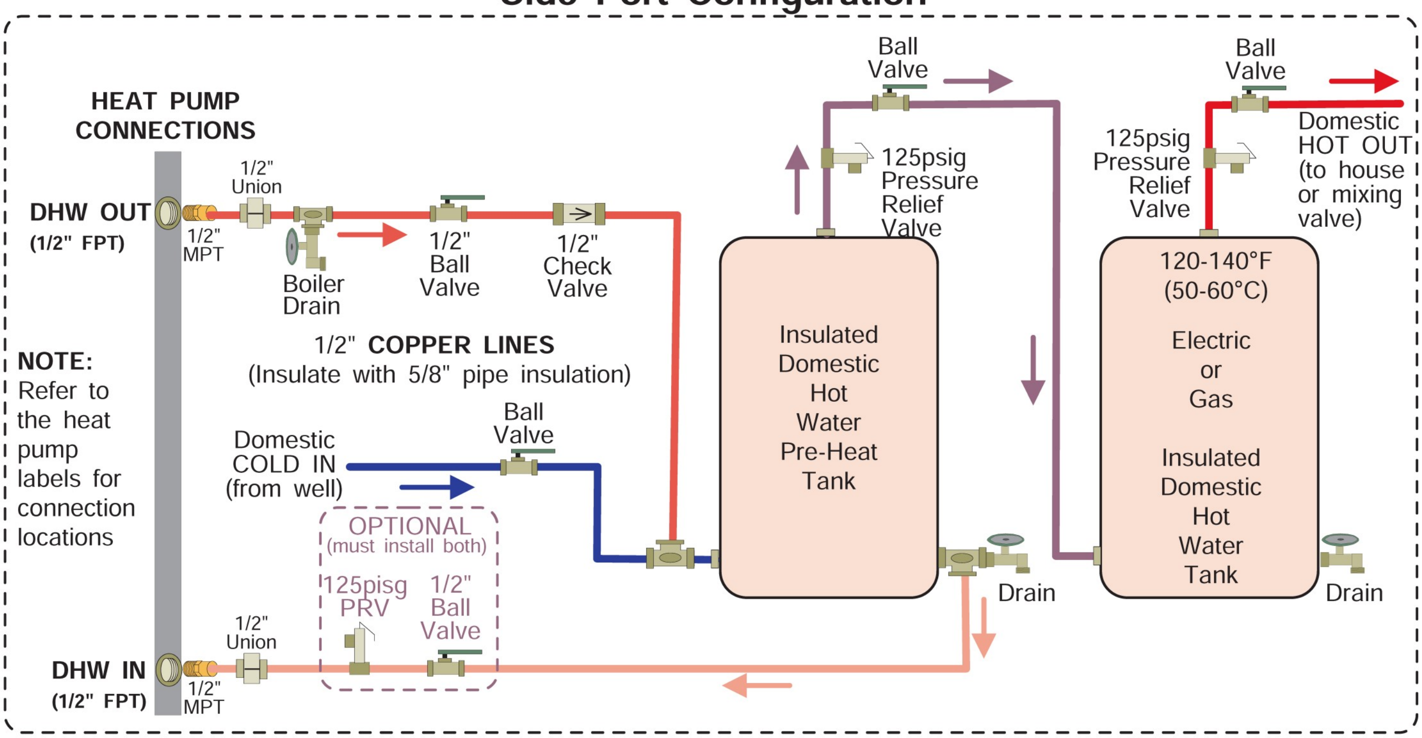
Size	Drawing Number	Revision	Sheet
LET	002511PDG	01	1 / 1

Desuperheater Connection to DHW Pre-Heat Tank

Top Port Configuration



Side Port Configuration



REV	ECO #	IMPL BY	APVD BY	DATE
01a	Re-titled	D. RHEAULT	D. RHEAULT	15 JAN 19
01	Initial Release	C. GEDDES	C. GEDDES	10 MAR 09

Drawn By Chris Geddes	Date 10 MAR 09	MARITIME GEOTHERMAL LTD.	170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By Chris Geddes	Date 10 MAR 09	Drawing Name	Single Unit Connection to DHW Pre-Heat Tank (Brass FPT)
Approved By (ENG) Chris Geddes	Date 10 MAR 09	Size A	Drawing Number 000970PDG
Approved By (MFG)	Date	REV 01a	SHEET 1 of 1
Approved By	Date		

Ductwork

Zoning

Zoning can be done with heat pumps that have 2-stage compressors, but only to a limited extent. It is recommended that no zone be less than 1/3 the total area, to avoid problems of high airflow and noise through one zone or safety control trips due to capacity mismatch between heat pump and zones.

The airflow can be reduced by 15% by making a dry contact across **AR1** and **AR2** on the thermostat terminal strip in the heat pump's electrical box, as show in **Wiring** chapter.

When only one zone of 50% or less is calling for heating or cooling, the compressor should be limited to **stage 1** operation by the zone controller by sending only a **Y1** (without Y2) control signal. Stage 1 corresponds to ~67% compressor capacity and ~80% airflow.

Refer to airflow tables in the **Model Specific Information** chapter for airflows with the various reductions.

Duct Systems - General

Ductwork layout for a 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 fossil fuel 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 airflow without creating a high static pressure or high velocity at the floor diffusers.

A duct system capable of supplying the required airflow is of utmost importance. Maritime Geothermal Ltd. recommends that the external static pressure from the duct system 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 following tables.

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 cross sectional area of leads being fed at any given point.
4. Return air grills should have a minimum of the same total cross sectional area as the total of the supply grills.
5. The cross sectional area of the return trunks should equal the cross sectional 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 act like a fluid and, just like water, 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.

If desired, the first 5-10 feet of the main supply trunks can be insulated internally 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.

Duct Systems - Grill Layout

Most forced air heating systems in homes have the floor grills placed around the perimeter of the room. 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 square inches each) to allow **100 cfm** of airflow.

In a typical new construction, there should be one supply grill for every 100 square feet 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. The table shows the number of grills recommended per heat pump size.

TABLE 10 - Heat Pump Size vs. Hot Air Grills

Model	Size (tons)	# of Grills (@100 cfm)
45	3	12
55	4	15
65	5	19
75	6	21
80	6.5	23

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 optimize heat distribution across the room.

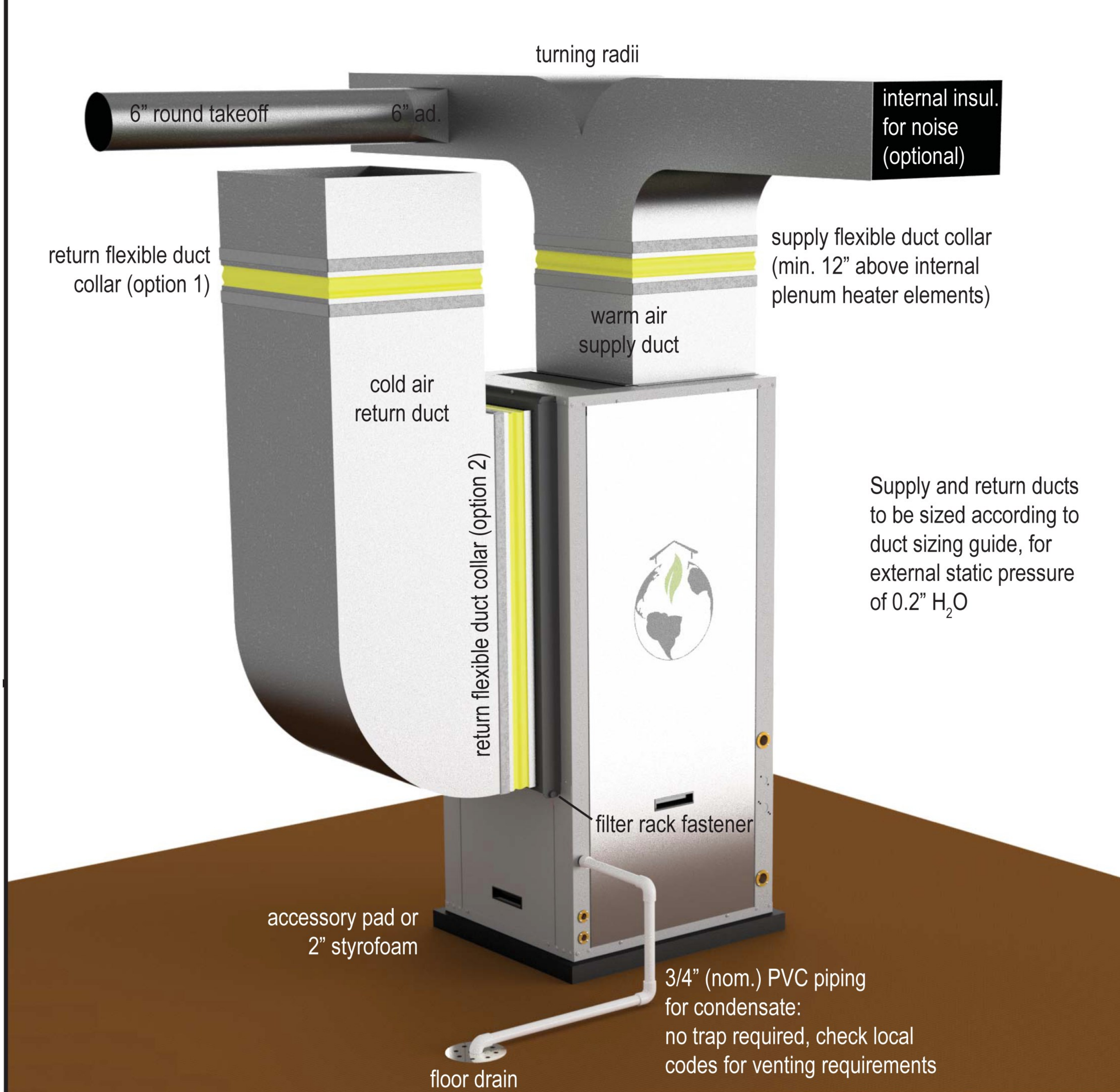
Thermostat Location

Most homes are a single ducted air 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 on 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

The plenum heater will be usually installed inside the heat pump, as described in the **Installation Basics** section. If the blower is installed in the side discharge position, the plenum heater will be installed in the discharge ductwork outside the unit, at least 12" away from any flexible duct collars. There is an accessory plenum heater with a wider cage profile available that is more suitable for duct installation.

Typical Duct & Condensate Connections - R Series



Note that proper duct system design is VERY IMPORTANT, since this is how the heat pump delivers heat into the living space.

02	-	Dan Rheault	Dan Rheault	15-May-2017
01	Initial Rel.	Chris Geddes	Chris Geddes	22-Jan-2008
REV	ECO#	IMPL BY	APVD BY	DATE

Drawn By: Dan Rheault	Date: 15-May-2017
Checked By: Dan Rheault	Date: 15-May-2017
Eng. Approved By	Date
Mfg. Approved By	Date
Approved By	Date

MARITIME GEOTHERMAL LTD. P.O. Box 2555, 170 Plantation Rd., Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: **Typical Duct & Condensate Connections - R Series**

Size	Drawing Number	Revision	Sheet
LET	001201PDG	02	1 / 1

TABLE 11 - Duct Sizing Guide (external static of 0.20" H_2O)

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				

Ground Loop Installations

Refer to diagrams **000608INF** & **000609INF** at the end of this section for typical ground loop configurations. They are for reference only, and should not be used to replace formal training and computerized loop design.

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. **The port connections for the Outdoor Loop are 1" brass FPT fittings. They are marked as OUTDOOR IN and OUT.**

Circulator Pump Module

Maritime Geothermal Ltd. offers 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, 35, and 45); the two pump module will typically handle 4 to 6 ton systems (model sizes 55, 65, 75, 80). 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/ports (pressure / temperature, pronounced "*Pete's plugs*") is recommended on both the entering and leaving lines at the heat pump. This 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. P/T ports, adapters, and gauge adapters and are available as accessories from Maritime Geothermal Ltd..

Flushing & Purging

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 **Figure 1**) 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.

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.

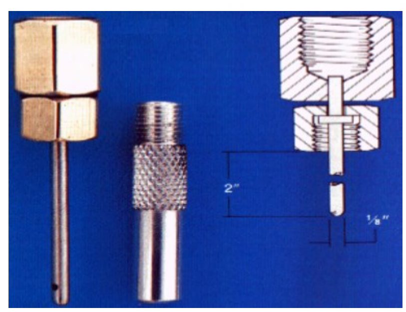
Figure 1: Ground Loop Accessories & Tools

2-pump module

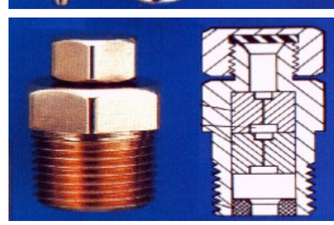
Barbed Adapters

PE Adapters

Purge Cart



Gauge adapter for P/T port



P/T port

P/T adapters for heat pump (1" NPT to barb)

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 following table for details of freeze protection provided by different concentrations.

TABLE 12 - 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%

WARNING: Add enough antifreeze to allow for a temperature 20°F (11°C) lower than the expected lowest loop fluid temperature entering the heat pump. Insufficient anti-freeze concentration could cause the heat exchanger to freeze and rupture, voiding the warranty.

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 the following table 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 the table, drain the equivalent amount of water from the flush cart or mixing barrel and replace it with the antifreeze.

TABLE 13 - Volume of fluid per 100 ft. of pipe				
		Volume /100ft.		
Type of Pipe	**Diameter**	**I.gal**	**gal**	**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**		

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.

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.

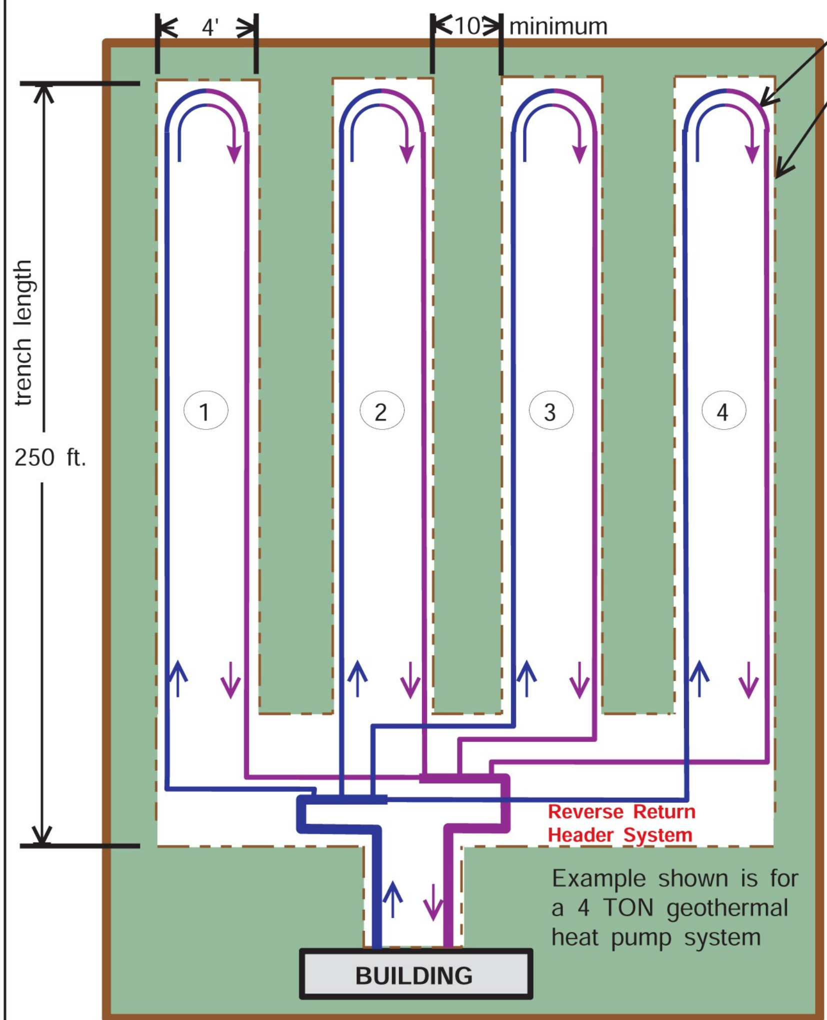
- Pressurize the loop to a static pressure of **45 psig**. when installing a system in the fall going into the heating season.
- Pressurize the loop to a static pressure of **25 psig**. when installing a system in the spring or summer going into the cooling season.

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.

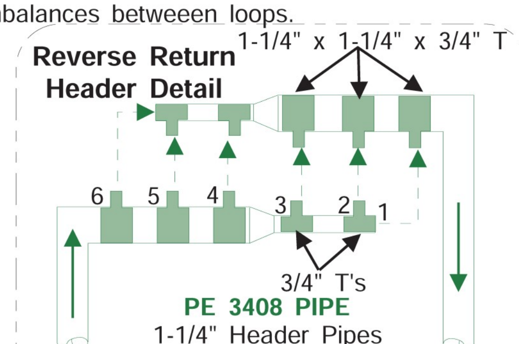
Pipe Insulation

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.

TYPICAL HORIZONTAL GROUND LOOP CONFIGURATION

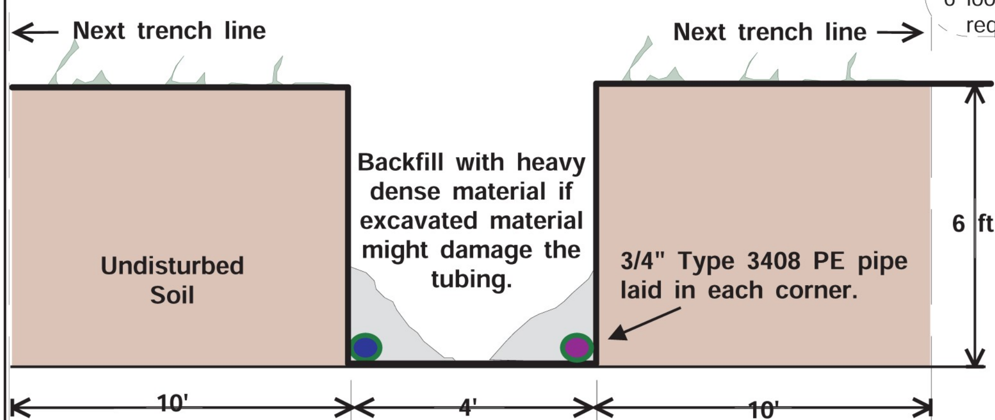


- Type PE 3408 Pipe
- Excavated trenches minimum 4' wide x 6' deep
- Trenches will be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Each loop consists of 500ft. of 3/4" type 3408 PE 160 psig (SDR 11) geothermal heat pump polyethelene tubing.
- Each trench is 250ft. begining from the header. This allows one 500ft. rool of pipe to be used with only two fusion connections (one at each header).
- Allow a minimum of 10 ft. between each trench and preferably 15 - 20 ft. if space is available.
- Insulate all tubing within 12ft. of the structure with 1/2" thick closed cell armaflex insulation.
- Piping that is laid in a header trench should be insulated to a point where each loop branches to it's individual trench.
- The loop with the most pipe in the header trench could be left uninsulated to pick up heat from the header trench as long as the header trench is more than 12' out from the building.
- Reverse return headers minimize flow imbalances betweeen loops.



Three loop system uses only 1, 2, 3, etc. Minimum 2ft/sec to purge air. Each 3/4" loop requires 4USPGM to purge. 24USGPM to purge 6 loops, 20 for 5, 16 for 4, 12 for 3, 2 loops requires 10USGPM due to 1-1/4" header.

Elevation View of Trench



- Hand backfilling in the area just over the plastic pipe is recommended to prevent crushing or pinching of the pipe during backfilling operations.
- Horizontal style pipe runs should be placed 6' deep x minimum of 48" wide trench as shown above, with a minimum of 10ft. between trenches

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	C. GEDDES	C. GEDDES	17 JAN 08

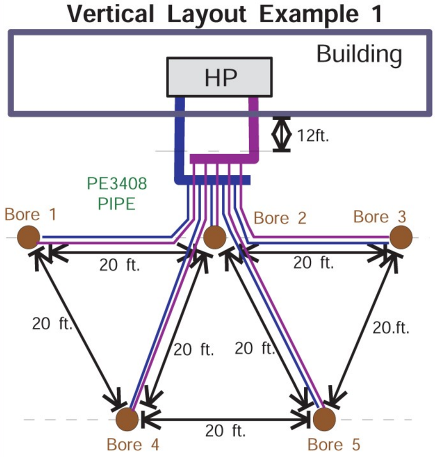
	Name	Date
Drawn By	Chris Geddes	17 JAN 08
Checked By	Chris Geddes	17 JAN 08
Approved By (ENG)	Chris Geddes	17 JAN 08
Approved By (MFG)		
Approved By		

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

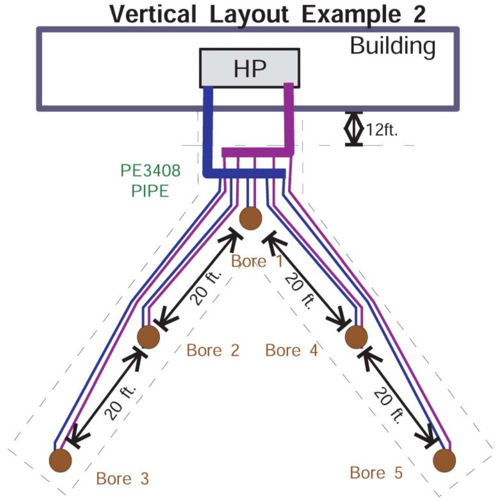
Drawing Name			
Typical Horizontal Ground Loop Configuration			
Size	**Drawing Number**	**REV**	**SHEET**
A	000608INF	01	1 of 1

TYPICAL VERTICAL GROUND LOOP CONFIGURATION

Vertical Layout Example 1

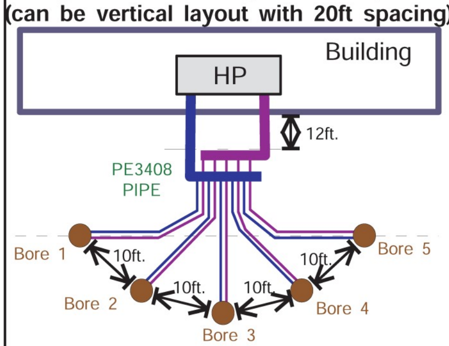


Vertical Layout Example 2

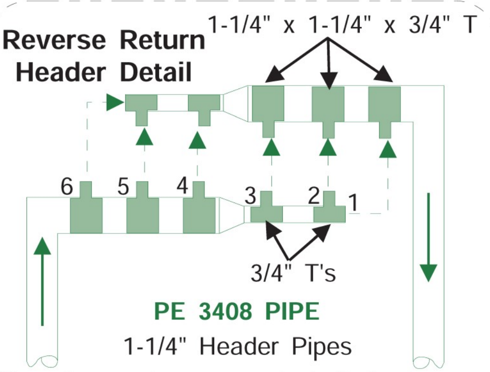


- Examples shown are for a 5 TON geothermal heat pump system
- Type PE 3408 Pipe
- Excavated trenches to boreholes minimum 4' wide x 6' deep
- Trenches should be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Hand backfilling in the area just over the plastic pipe is recommended to prevent crushing or pinching of the pipe during backfilling operations.
- Allow a minimum of 20 ft. between each borehole for vertical boreholes and 10ft for vertical angled boreholes.
- Piping that is laid in a header trench should be insulated up to the individual trench to the borehole.
- Insulate all tubing within 12ft. of the structure with 1/2" thick closed cell armaflex insulation.
- Reverse return headers minimize flow imbalances betweeen loops.
- The number of boreholes can be reduced by increasing the depth of the boreholes. Do not exceed 300ft depth and care must be taken to size the circulator pump module accordingly.
- Be sure to obtain permission prior to drilling if angled boreholes enter neighbouring properties.

Angled Vertical Layout Example 1
(can be vertical layout with 20ft spacing)

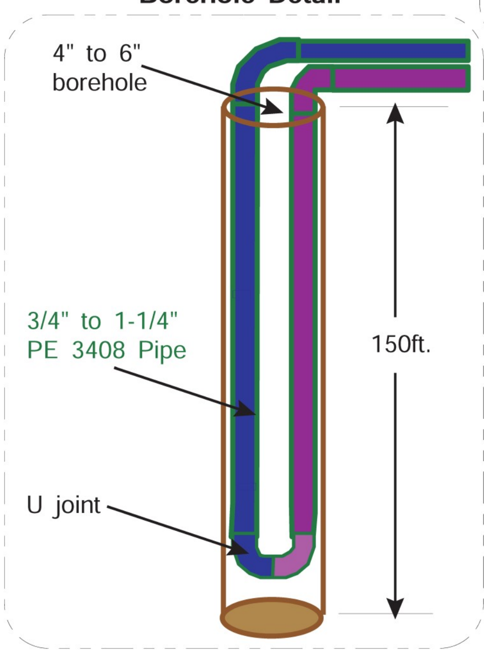


Reverse Return Header Detail



Three loop system uses only 1, 2, 3, etc. Minimum 2ft/sec to purge air. Each 3/4" loop requires 4USPGM to purge. 24USGPM to purge 6 loops, 20 for 5, 16 for 4, 12 for 3, 2 loops requires 10USGPM due to 1-1/4" header.

Borehole Detail

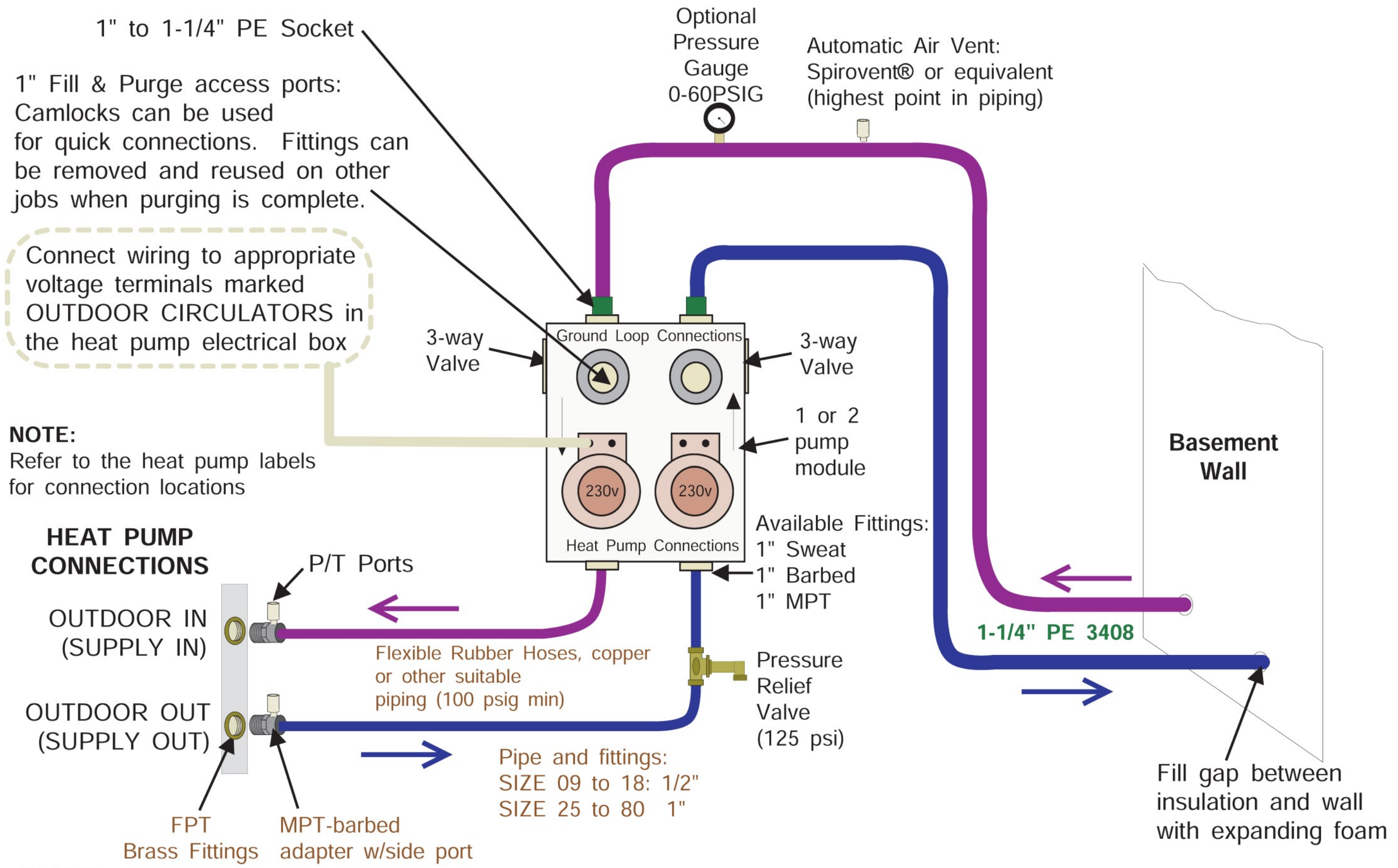


- Each loop consists of minimum 300ft. of 3/4" type 3408 PE 160 psig (SDR 11) geothermal heat pump polyethelene tubing.
- Each borehole is 4-6" diameter and 150ft deep for 1 loop per ton applications.
- Allow enough exra pipe to be able to reach the headers to minimize the number of fusion joints.
- "U" tubes should be taped together every 10ft. A heavy piece of rebar or galvanized pipe can be taped to the last 10ft. to help keep the end straight and also for added weight.
- Fill each "U" tube with water and pressurize to 100PSIG before insertion. The added weight of the water will help with the insertion process
- Tremie grout from the bottom to within 10ft of the top of the borehole. Use neat cement or a mixture of neat cement and bentonite. Check local codes, there may be regulations that must be adhered to.

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	C. GEDDES	C. GEDDES	22 JAN 08

Drawn By Chris Geddes	Date 22 JAN 08	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By Chris Geddes	Date 22 JAN 08	
Approved By (ENG) Chris Geddes	Date 22 JAN 08	Drawing Name: Typical Vertical Ground Loop Configuration
Approved By (MFG)	Date	
Approved By	Date	Size A — Drawing Number 000609INF — REV 01 — SHEET 1 of 1

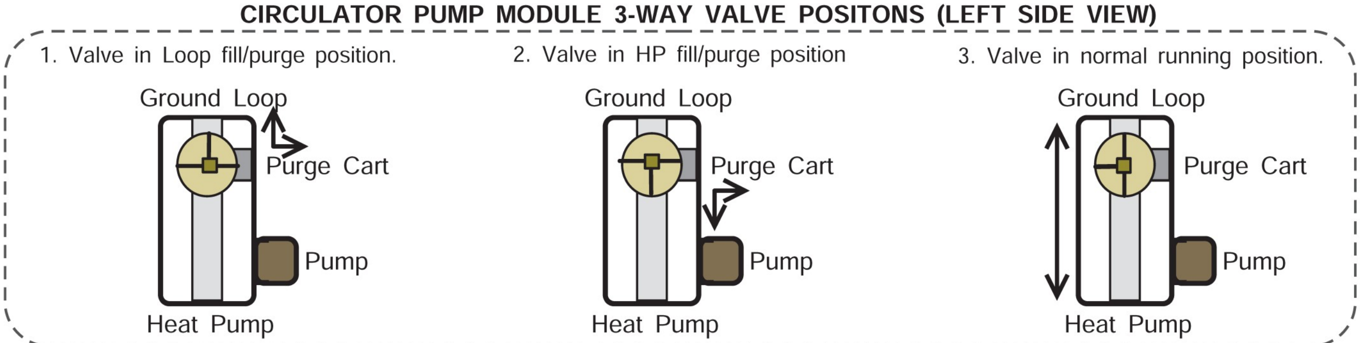
Geo-Flo Circulator Pump Module Installation
(Units with Brass FPT Fittings)



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.
- A pressure gauge is recommended if P/T plugs are not installed.
- For most applications, a 1 pump module will accomodate model sizes 09 to 45, and a 2 pump module will accomodate sizes 55 to 80. 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)

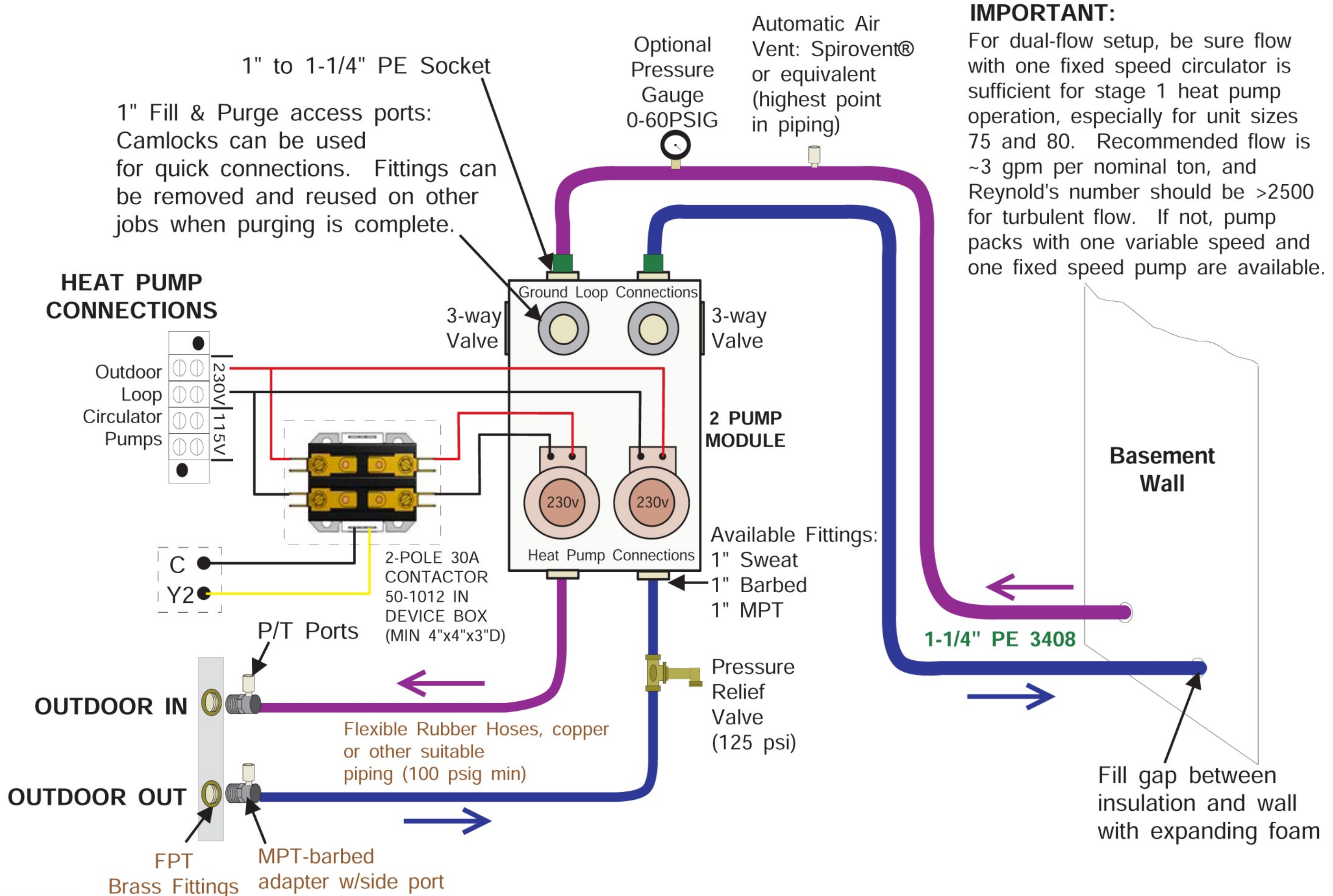


REV	ECO #	IMPL BY	APVD BY	DATE
03	000264	D. RHEAULT	D. RHEAULT	21-Aug-2018
02	000213	C. GEDDES	C. GEDDES	21-May-2013
01	Initial Release	C. GEDDES	C. GEDDES	9-Dec-2008

Drawn By Chris Geddes	Date 09 DEC 08	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By Chris Geddes	Date 09 DEC 08	Drawing Name: Geo-Flo Circulator Pump Module Installation (Brass FPT)
Approved By (ENG) Chris Geddes	Date 09 DEC 08	Size: A; Drawing Number: 000906PDG; Drawing Rev: 03; SHEET: 1 of 1
Approved By (MFG)	Date	
Approved By	Date	

Dual Flow Circulator Pump Module Installation for 2-Stage Heat Pumps

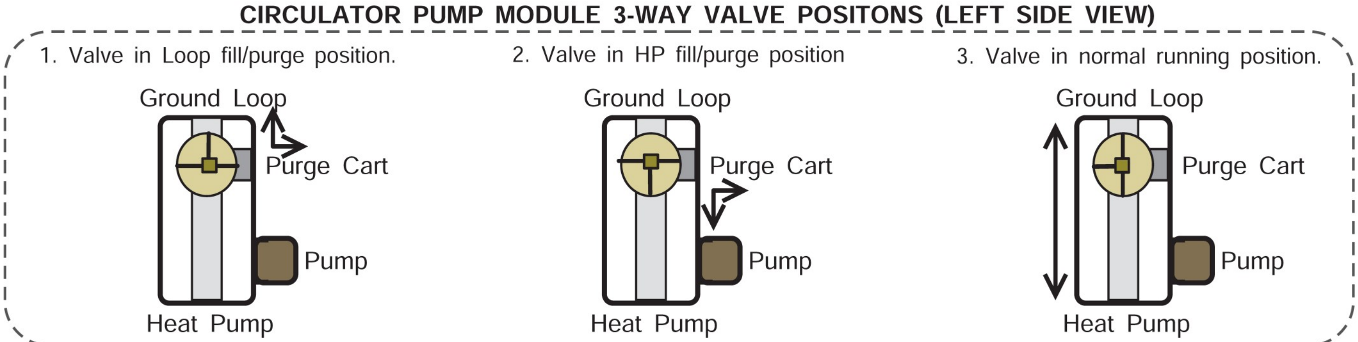
IMPORTANT:
For dual-flow setup, be sure flow with one fixed speed circulator is sufficient for stage 1 heat pump operation, especially for unit sizes 75 and 80. Recommended flow is ~3 gpm per nominal ton, and Reynold's number should be >2500 for turbulent flow. If not, pump packs with one variable speed and one fixed speed pump are available.



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.
- A pressure gauge is recommended if P/T plugs are not installed.
- For most applications, a 1 pump module will accomodate model sizes 09 to 45, and a 2 pump module will accomodate sizes 55 to 80. 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)



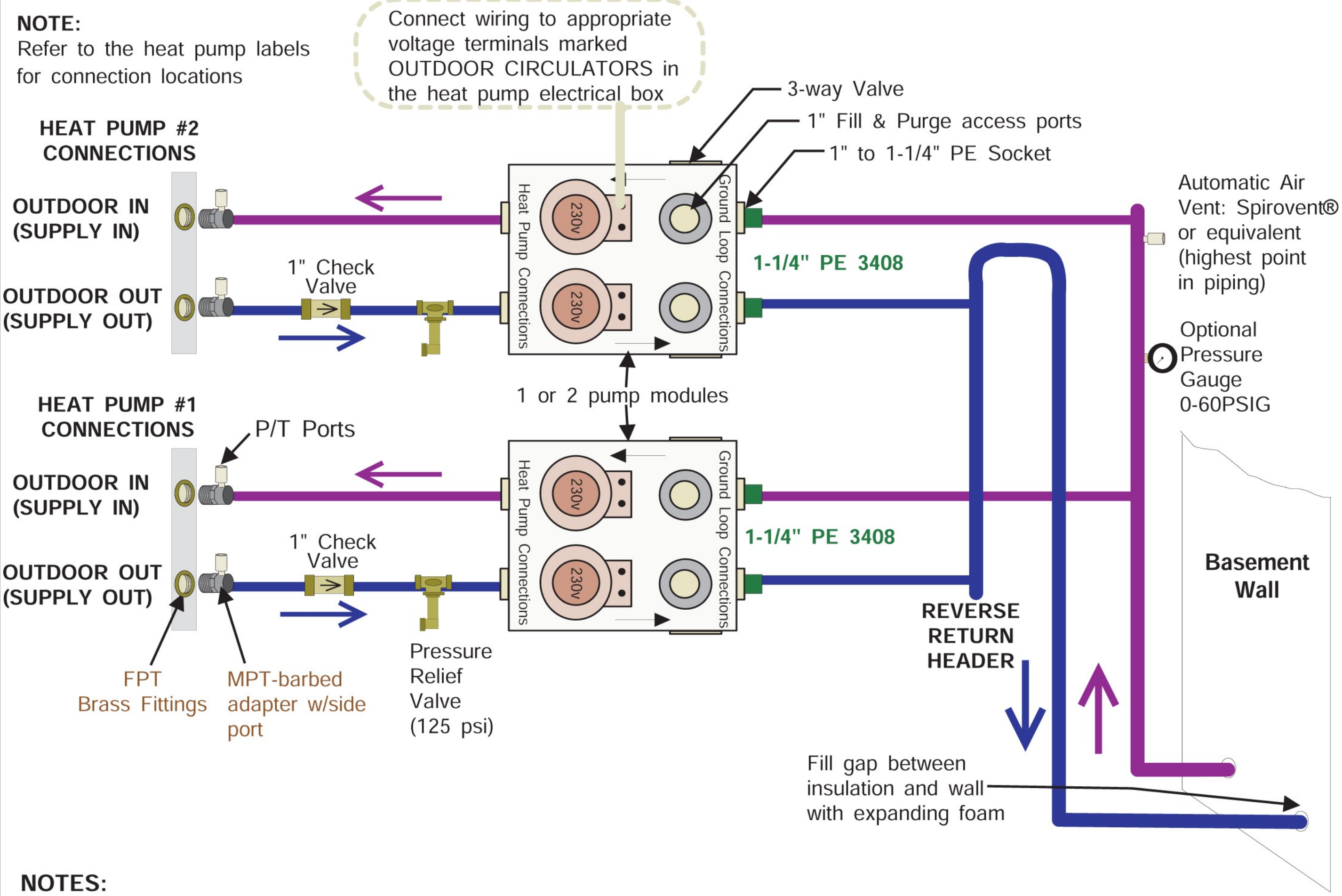
REV	ECO #	IMPL BY	APVD BY	DATE
03	000264	D. RHEAULT	D. RHEAULT	21-Aug-2018
02	-	D. RHEAULT	D. RHEAULT	20-May-2014
01	Initial Release	D. RHEAULT	D. RHEAULT	22-Nov-2013

Drawn By: Dan Rheault	Date: 22-Nov-2013
Checked By: Dan Rheault	Date: 22-Nov-2013
Approved By (ENG)	Date
Approved By (MFG)	Date
Approved By	Date

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

Drawing Name	Dual Flow Circulator Pump Module Installation for 2-Stage Heat Pumps		
Size	**Drawing Number**	**REV**	**SHEET**
A	001823CDG	03	1 of 1

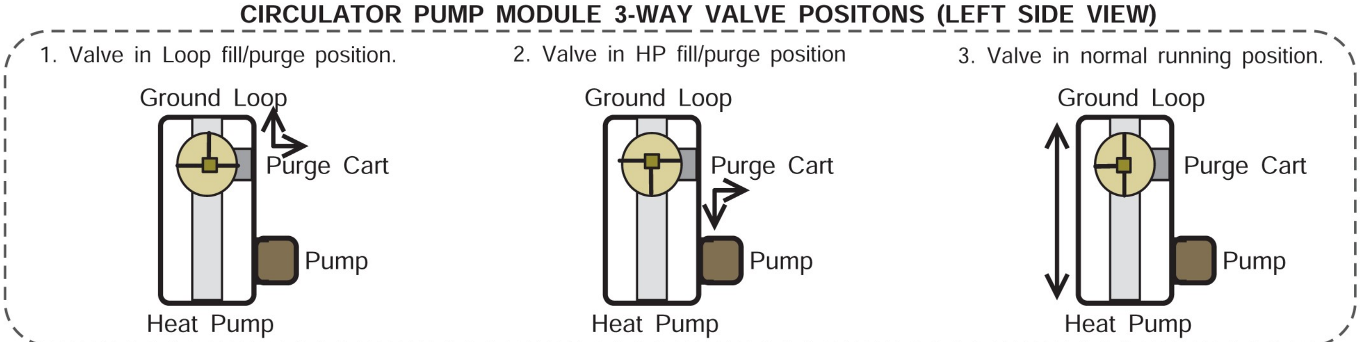
Geo-Flo Circulator Pump Module Installation - Two Units On One Ground Loop



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.
- A pressure gauge is recommended if P/T plugs are not installed.
- For most applications, a 1 pump module will accomodate model sizes 09 to 45, and a 2 pump module will accomodate sizes 55 to 80. 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	D. RHEAULT	D. RHEAULT	21-Aug-2018

Drawn By	Dan Rheault	Date	21-Aug-2018
Checked By	Dan Rheault	Date	21-Aug-2018
Approved By (ENG)	Dan Rheault	Date	21-Aug-2018
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-Two Units on One Ground Loop

Size	Drawing Number	REV	SHEET
A	002336PDG	01	1 of 1

Open Loop Installations

Well Water Temperature

The temperature of the well water should be a minimum of **41°F (5°C),** and should normally be **45°F+ (7°C+).** In general, groundwater temperatures across the Canadian prairie provinces and Northern Ontario may be close to the 41°F minimum, while in other parts of southern Canada it will probably be 46-50°F, although local exceptions will exist. In more southern locations, it will be warmer.

The well water temperature should be verified as the first step in a proposed open loop installation.

Well Water Flow

The water source is normally a drilled water well with submersible pump that is the same well which supplies domestic water needs. It must be able to supply the required water flow as listed under the Total Flow column in the table.

TABLE 14 - Required Open Loop Flow

Heat Pump Model Size	Heat Pump Flow* gpm (L/s)	Domestic Water Usage gpm (L/s)	Total Flow gpm (L/s)
25	**8.0 (0.50)**	**4 (0.25)**	**12 (0.76)**
45	**10.0 (0.63)**	**4 (0.25)**	**14 (0.88)**
55	**12.0 (0.76)**	**4 (0.25)**	**16 (1.01)**
65	**14.0 (0.88)**	**4 (0.25)**	**18 (1.14)**
75	**16.0 (1.01)**	**4 (0.25)**	**20 (1.26)**
80	**17.0 (1.07)**	**4 (0.25)**	**21 (1.32)**

* These are minimum water requirements based on an entering water temperature of 45° F.

For groundwater temperatures of 50°F or greater, these flows can be reduced by 25% if required.

Rather than being estimated by a well driller, the flow from a proposed source well should be measured by performing an extended flow test to be sure it is capable of supplying the required flow over an extended period of time. This is done by flowing the well at the highest possible rate, noting the static water level in the well, and monitoring the pumping fluid level until stable. Unless the fluid level is very high, fluid level monitoring will require a device called a water level sounder. The flow rate can then be measured either by a cumulative gallon meter, a flowmeter, or by timing the filling of a bucket of known size. The test data can be recorded as follows:

TIME	METER READING (USGAL)	TOTAL FLOW (USGAL)	FLOW RATE (USGPM)	WATER LEVEL (FT)	(IN)	WATER LEVEL (FT)
20:25	131735.5	0		20	6	20.5
20:27	131756	20.5	10.3	24	0	24.0
20:30	131779	23	6.0	26	0	26.0
20:42	131847	68	6.1	29	0	29.0
20:51	131906	59	6.6	29	0	29.0
21:03	131982	76	6.3	29	0	29.0
21:32	132156	174	6.0	29	0	29.0

It is best to flow the well for as long as possible (e.g. 12 hours) at the flow rate required by the proposed heat pump size. However, if the test is performed before a larger submersible pump is installed, it may be assumed that any unused water level drop during the test (that is, any distance remaining between the pumping fluid level and the pump intake) would contribute linearly to the flow rate should a larger pump be installed.

In the above example, it was recorded that the flow rate stabilized at 6 gpm, while the water level dropped from 20 to 29 feet (9 feet). If the intake of a larger pump could be placed so that a further pumping fluid level drop of 9 feet could be achieved (total 18 feet), it can be assumed that the flow would double to 12 gpm. Of course, this should be verified with a second test once the larger pump is actually installed.

Well Water Quality

The well water should be tested to be sure it meets minimum standards. Although the threat of poor water quality to open loop installations is often exaggerated, poor water quality can lead to rapid heat exchanger failure or frequent servicing.

First, the well should not produce any sand. Sand will physically erode heat exchanger surfaces, and quickly clog return (injection) wells. **Solids** or **TDS** should be less than **1 ppm (1 mg/L)** if a return well is used.

To avoid scale formation on the inside of the heat pump's outdoor loop coil, total **hardness** should be less than **350 ppm / 350 mg/L**. In practice, scaling is very rarely a problem at northern groundwater temperatures of 50°F or less because scale does not generally form at low well water temperatures (unlike, for example, in a domestic hot water tank). In more southern climates, the hardness guideline will be a more important consideration. Should scale form, heat pump performance will gradually deteriorate, and will require periodic flushing with a calcium/lime removing solution (see General Maintenance section). If the need for periodic flushing is anticipated, the optional Cupro-Nickel (CuNi) coil and piping should be ordered.

Corrosive (salty) water can cause failure of the inner tube of the heat exchanger, leading to loss of refrigerant and water entering the refrigeration circuit, which ruins the heat pump. If **chlorides** exceed **20 ppm (20 mg/L)**, the optional CuNi coil and piping should be ordered. If chlorides exceed **150 ppm (150 mg/L)**, or significant **Ammonia (>0.5 ppm)** or **H_2S (>0.2 ppm)** is present, the use of an open loop system should be reconsidered.

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.

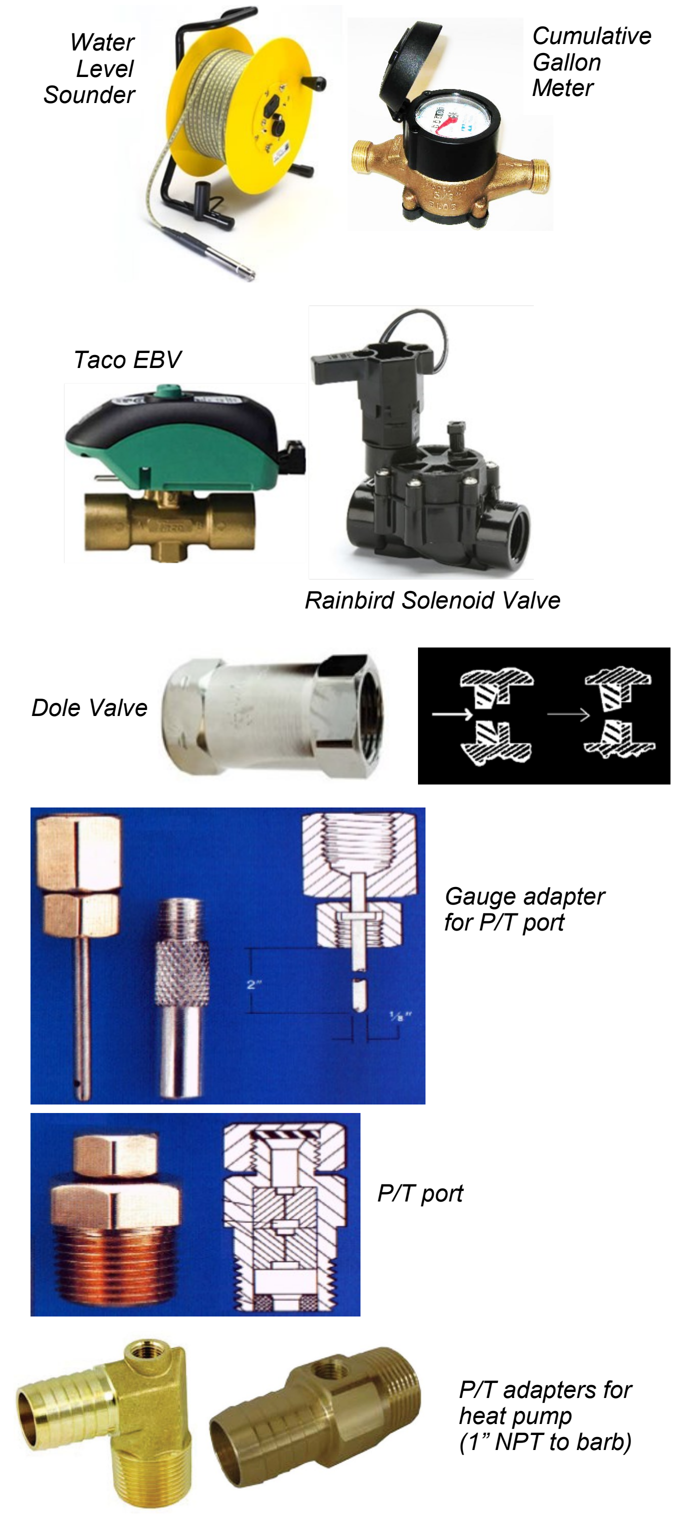
Acceptable methods for disposing of the waste water are listed below. The waste water is clean; the heat pump has no effect other than reducing the temperature of the water. Refer to diagram on following page for typical disposal method diagrams.

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

ENSURE SELECTED METHOD CONFORMS TO LOCAL REGULATIONS.

A return well should be a minimum of **80 ft.** from the supply

Figure 2: Open Loop Accessories & Tools



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 inject into it, preferably much more, since injection capacity will tend to decrease over time due to clogging. It may be necessary to place a pressure-tight 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 may be needed to force the return water back down the well in cases of limited injectivity.

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, 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. A screen should be installed on the end of large discharge pipes, to prevent animals from building nests inside during extended 'off' periods and causing a backflooding risk for open water drains.

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 or lake, 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. This reduces the back pressure generated by the weight of the water in the pond.

Water Valve

Water flow through the heat pump is turned on and off by a water valve, which is controlled by a 24VAC signal from the heat pump. It should be installed on the OUT pipe of the heat pump, so that the heat exchanger remains full of water at all times. There are 3 types of water valves that may be available from Maritime Geothermal.

- **Hailin** or equivalent slow acting **motorized ball valve**, which is always powered with 24VAC from **R** and opened with a **Y** or **Y1** signal.
- **Taco** slow acting **motorized ball valve**, which is powered open and stores the energy required to close using a capacitor.
- **Rainbird** or equivalent fast acting **solenoid valve**.

Most installations use a slow closing motorized ball valve. These take 5-15 seconds to close, so avoid the water hammer which can occur with fast acting valves. A fast acting solenoid valve can be used for applications where water hammer is not expected.

All valves come from Maritime Geothermal Ltd. with a **wiring harness**, which plugs into a connector behind the pipe post of the heat pump. (If buying a water valve elsewhere, be sure to get the wiring harness from Maritime Geothermal.) This both allows the heat pump to properly control the valve, turning the water flow on and off with the compressor, and also tells the heat pump to select the higher low pressure safety control for open loop operation (since there is no antifreeze present).

Water Flow Control

A flow restricting ('Dole') valve is highly recommended, installed downstream of the water valve. This is a passive (non-electrical) device which automatically varies the size of its rubber orifice in order to restrict flow to its stamped gpm value, regardless of water pressure. This is important in order to provide some backpressure to the water system, which could otherwise be too low for the comfort of people taking showers or otherwise using the domestic water system. It also prevents excessively low refrigerant discharge pressure when in cooling mode. Dole valves are available as an accessory.

Dole valves can emit a 'whistling' sound if the pressure drop through them is high. Therefore, they should be placed where the noise will not cause a nuisance, e.g. outside the basement wall or perhaps in a well insulated box.

Submersible Pump Selection

Of course, the submersible pump must be large enough to supply the flow required by the heat pump. This is usually not a problem, pumps often being oversized by default.

However, if a conventional fixed speed pump is too large, its fixed capacity will exceed that of the Dole valve at reasonable pressure switch settings (<80 psi). This will cause the submersible pump to cycle on and off continuously while the heat pump is running, causing excessive wear to the submersible pump. The installation of a large air bladder tank will cause the cycles to have a longer duration, but will not solve the problem.

To avoid this problem, the fixed speed pump should be sized according to its head vs. flow curve. The required head should be calculated using height between the pumping fluid level in the well and the elevation of the heat pump, pipe pressure drop at nominal flow rate, desired system water pressure, and any back pressure from return well. Then a pump can be selected that delivers the nominal flow for the chosen heat pump size at that head. In case this calculation is not exact, a variety of Dole valves can be carried by the installer, and a larger Dole valve installed if submersible pump cycling is observed.

An alternate approach would be to install a variable speed submersible pump, which varies its speed to maintain a constant water system pressure. Or use a mechanical 'cycle stop' valve, which is installed upstream of the air bladder / pressure tank and varies its orifice to put backpressure on the pump during periods of low flow in order to keep it from cycling off.

Stage 1 vs. 2 on Open Loop

In an open loop installation, the submersible water pump draws significant power compared to the heat pump, especially for smaller heat pump sizes. This is particularly true when using a conventional fixed speed submersible pump. Under normal usage, the efficiency of such a pump is not particularly important, due to short run times in a domestic water system. When used with a geothermal heat pump, which can run all day on the coldest days of the year, it is highly recommended that effort be made to select an energy efficient submersible pump. However, these may be hard to find.

The significant power draw of submersible pump will probably negate the COP benefit of running the heat pump on stage 1. In this case, it is recommended to jumper Y1 and Y2 together at the heat pump terminal strip, in order to satisfy the heating demand as quickly as possible and minimize run time. For the same reason, slightly oversizing the heat pump is acceptable on open loop applications, although this will require higher water flow.

If Y1 and Y2 are jumpered together, it is recommended to consult diagram 001901PDG found earlier in this manual, so that stage 1 may be used for cooling in order to achieve better dehumidification. This should be done only if stage 1 alone (67% compressor capacity) can satisfy the cooling demand in the local climate.

Plumbing the Heat Pump

The port connections for the Outdoor Loop are 1" brass FPT fittings. They are marked as OUTDOOR IN and OUT.

Plumbing lines, both IN (supply) and OUT (discharge), must be of adequate size to handle the water flow necessary for the heat pump. A 1" or 1-1/4" copper or plastic line should be run to the Outdoor IN (Supply IN) pipe of the heat pump. Similarly, a 1"' or 1-1/4" 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 in the Ground Loop chapter for a description of P/T plugs. The water valve should be installed in the OUT (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 cabinet. After the water valve is installed, run the valve harness into the cabinet through the hole provided. Remove the jumper plug from the Valve Connector and connect the harness in its place.

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.

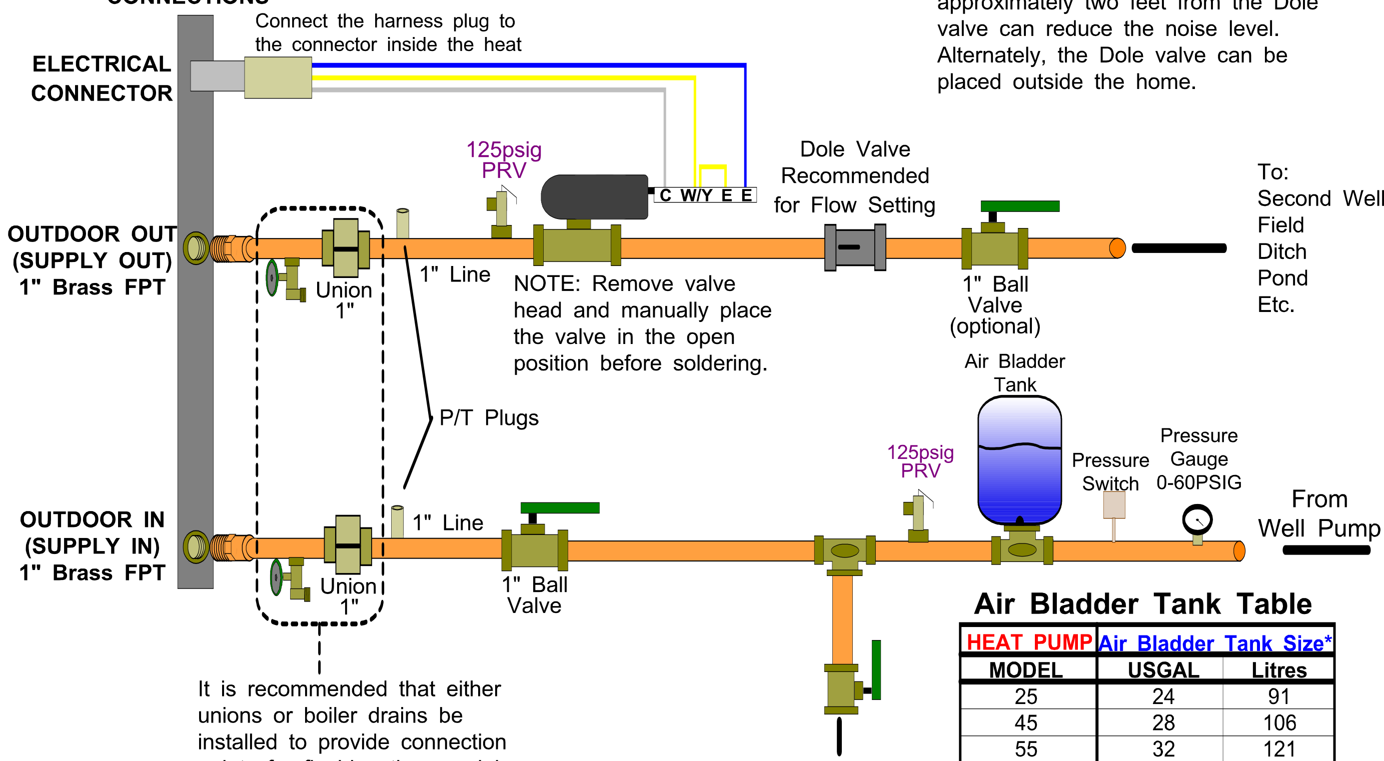
All water line valves on both the supply and discharge lines should be either BALL or GATE valves. GLOBE valves have a higher pressure drop, meaning more pumping power to maintain the required flow to the heat pump.

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.

Typical Ground Water Installation for Size 25-80 Heat Pumps for Units With Brass FPT Fittings

TACO 24VAC EBV (Electronic Ball Valve)



NOTE: Dole valves can be quite noisy. Placing a the optional ball valve approximately two feet from the Dole valve can reduce the noise level. Alternately, the Dole valve can be placed outside the home.

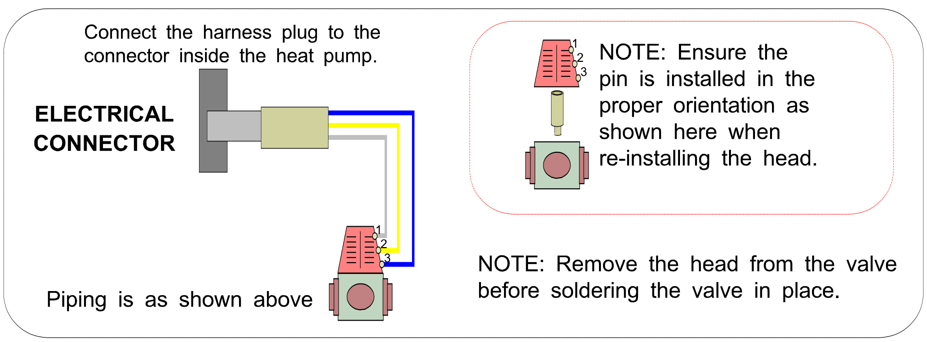
It is recommended that either unions or boiler drains be installed to provide connection points for flushing the coaxial exchanger should it need to be cleaned due to scaling.

Air Bladder Tank Table

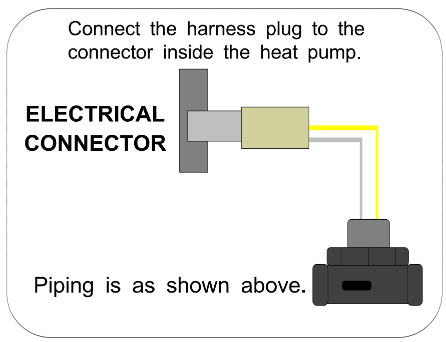
HEAT PUMP	Air Bladder Tank Size*	
MODEL	USGAL	Litres
25	24	91
45	28	106
55	32	121
65	36	136
75	40	151
80	42	159

*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



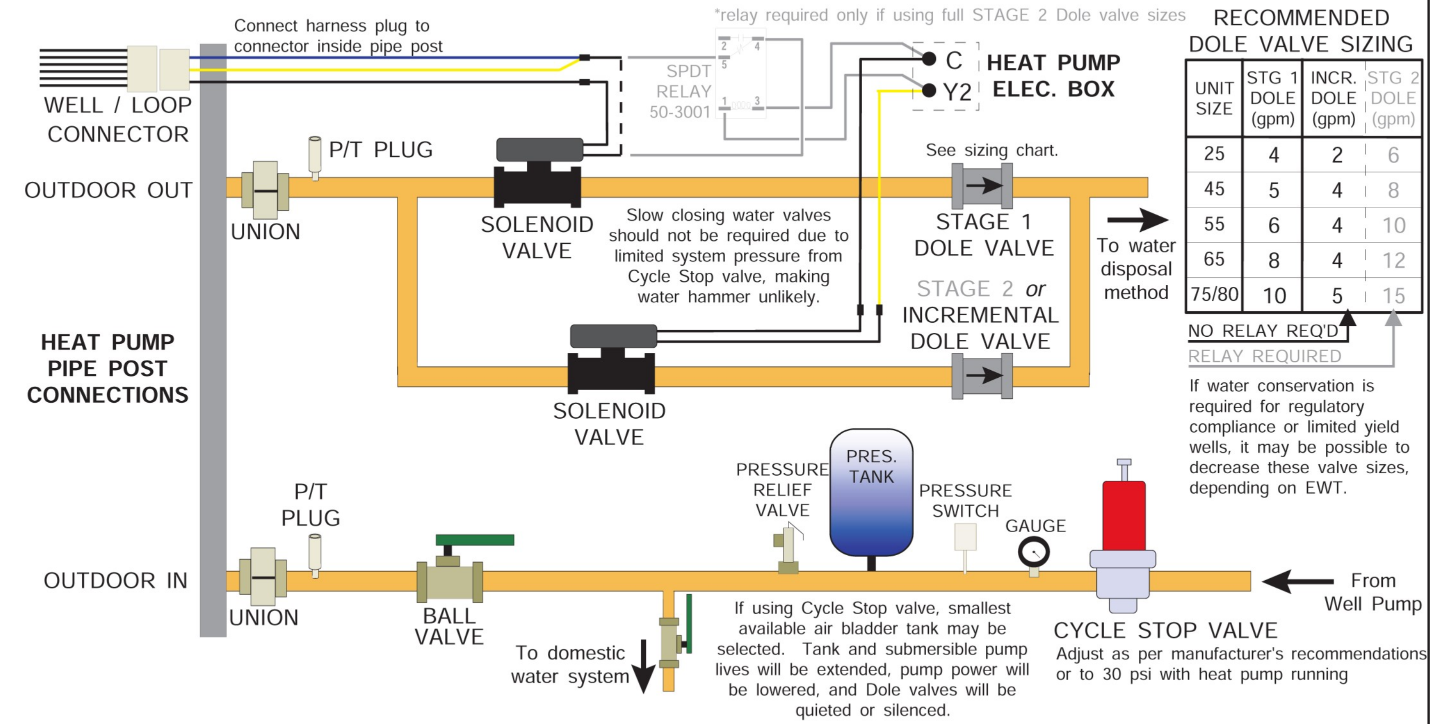
Generic 24VAC Solenoid Water Valve



REV	ECO #	IMPL BY	APVD BY	DATE
02	000228	C. GEDDES	C. GEDDES	21 MAY 2014
01	Initial Release	C. GEDDES	C. GEDDES	10 DEC 08

Drawn By: Chris Geddes	Date: 10 DEC 08	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By: Chris Geddes	Date: 10 DEC 08	Drawing Name: Typical Ground Water Installation for Size 25-80 Heat Pumps (Brass FPT)
Approved By (ENG): Chris Geddes	Date: 10 DEC 08	
Approved By (MFG)	Date	
Approved By	Date	Size: A; Drawing Number: 000907CDG; Drawing Rev: 02; SHEET: 1 of 1

1. Dual-Flow Groundwater (Well) Installation

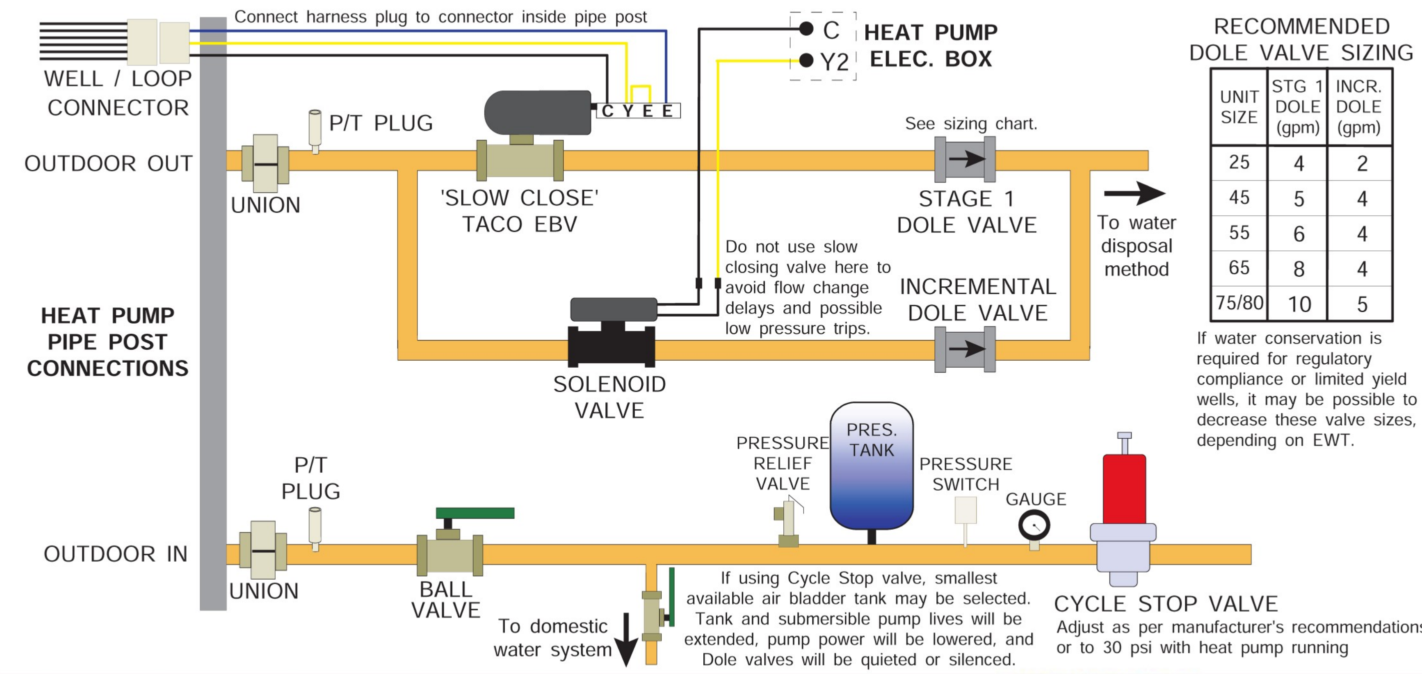


RECOMMENDED DOLE VALVE SIZING

UNIT SIZE	STG 1 DOLE (gpm)	INCR. DOLE (gpm)	STG 2 DOLE (gpm)
25	4	2	6
45	5	4	8
55	6	4	10
65	8	4	12
75/80	10	5	15

2. Dual-Flow Groundwater (Well) Installation with Slow Closing Water Valve

For Installations Subject to Water Hammer Even at Low System Pressures, or Without Cycle Stop Valve



RECOMMENDED DOLE VALVE SIZING

UNIT SIZE	STG 1 DOLE (gpm)	INCR. DOLE (gpm)
25	4	2
45	5	4
55	6	4
65	8	4
75/80	10	5

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	22-Nov-2013

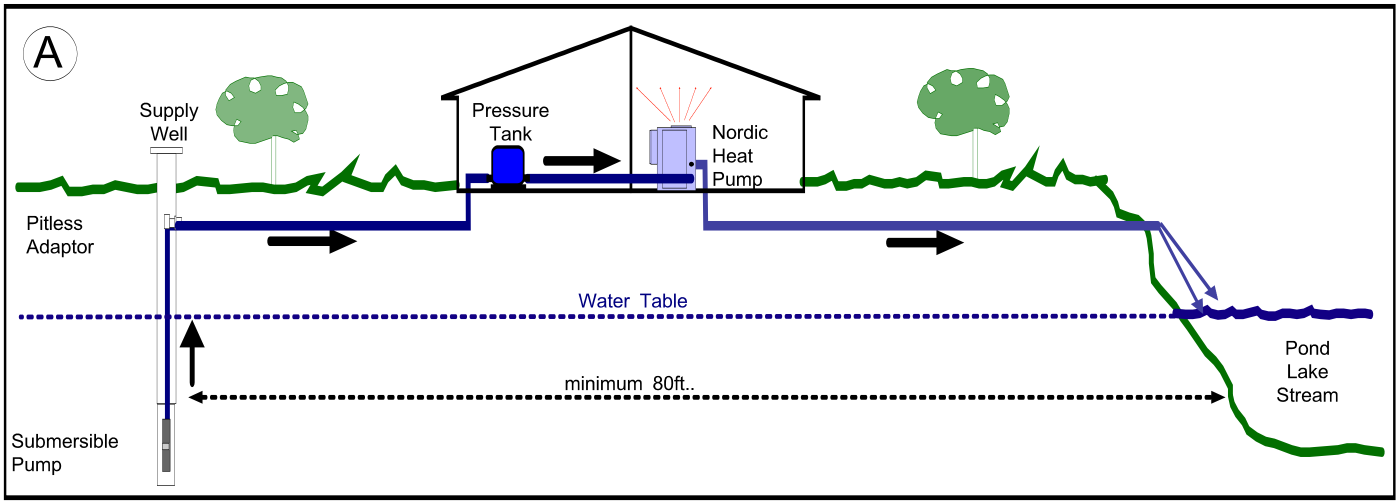
Drawn By Dan Rheault	Date 22-Nov-2013
Checked By Dan Rheault	Date 22-Nov-2013
Approved By (ENG)	Date
Approved By (MFG)	Date
Approved By	Date

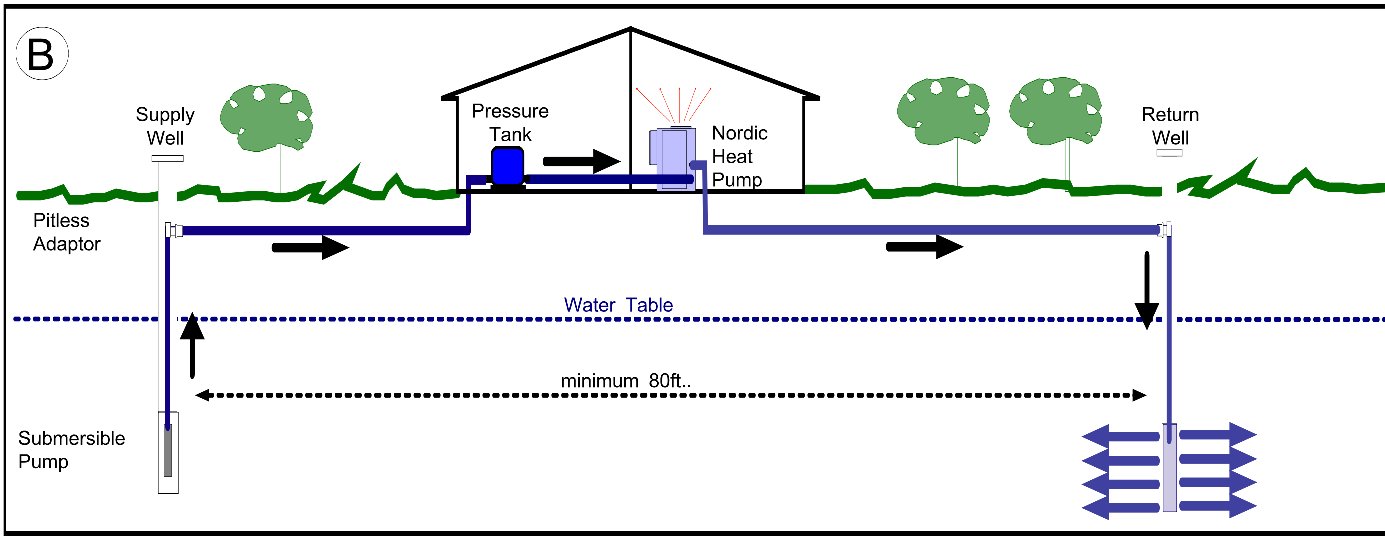
MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

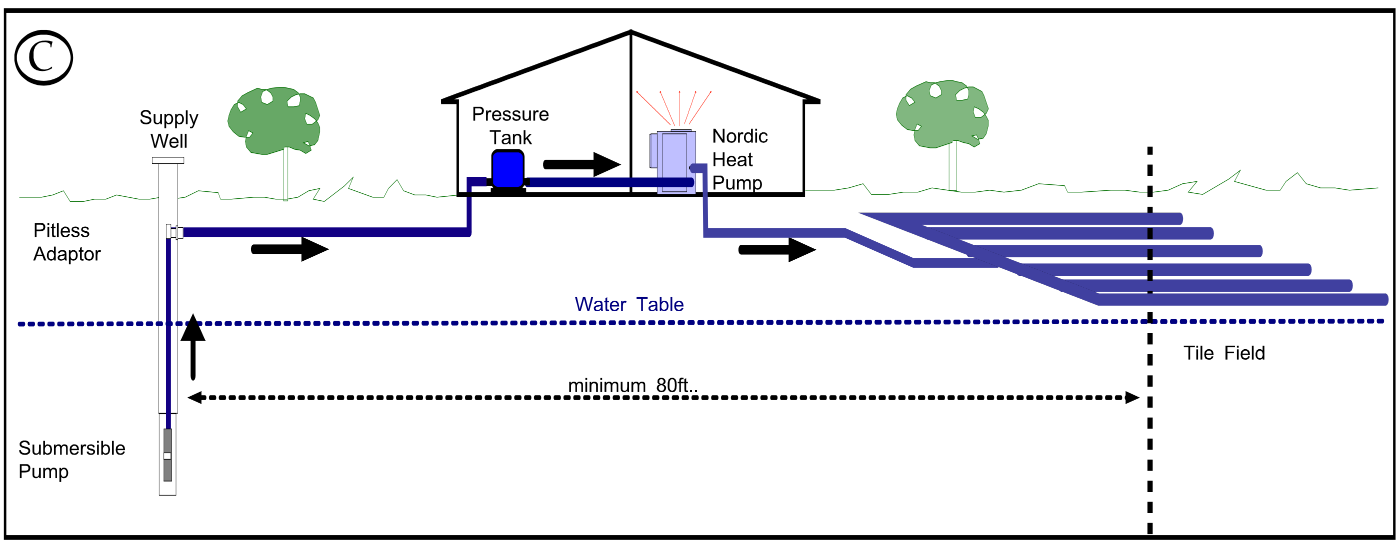
Drawing Name: Dual-Flow Groundwater (Well) Installation for Size 25-75 Heat Pumps

Size	Drawing Number	REV	SHEET
A	001822CDG	01	1 of 1

GROUND WATER DISPOSAL METHODS







					Drawn By Chris Geddes	Date 04 FEB 08	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Chris Geddes	Date 04 JAN 08	
					Approved By (ENG) Chris Geddes	Date 04 FEB 08	Drawing Name: Ground Water Disposal Methods
01	Initial Release	C. GEDDES	C. GEDDES	04 FEB 08	Approved By (MFG)	Date	Size: A — Drawing Number: 000619INF — REV: 01 — SHEET: 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date	

Startup Procedure

The R/RH-Series 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.

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 (Open Loop):

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

Domestic Hot Water (Desuperheater):

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 system type: heat pump). 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 **22-32°F, 12-18°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, suction pressure, and 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 DHW Switch in the unit post on. 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 (i.e. 1°F (0.5°C) less than room temperature) and let the unit run through a cycle. Record the thermostat setpoint, suction pressure and discharge 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 installer shall sign and date the Startup Record and have the homeowner sign as well. The installer 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: R/RH-Series

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

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							

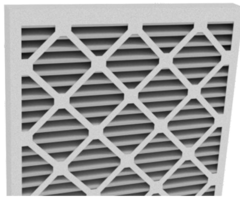
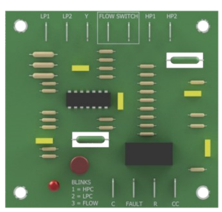
STARTUP DATA

Preparation	Voltage across L1 and L2, L1 and L3, L2 and L3							VAC
Heating Mode (10 minutes)	Suction Pressure / Discharge Pressure					psi	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	gpm		L/s		
	Compressor L1 (black wire) current		A					
	Domestic Hot Water functioning							
	Thermostat setpoint, suction and discharge pressures at cycle end		°F	°C			psi	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, suction and discharge pressures at cycle end		°F	°C			psi	kPa

Date:		**Installer Signature:**		**Homeowner Signature:**	

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

Routine Maintenance

MAINTENANCE SCHEDULE			
Item		**Interval**	**Procedure**
Air Filter		6 months	Inspect for dirt. Replace if necessary.
Compressor Contactor		1 year	Inspect for pitted or burned points. Replace if necessary.
Condensate Drain		1 year	Inspect for clogs. Clean if necessary.
Control Board		When heat pump problem is suspected	Check status light for faults. Rectify problem if alarms found. See **Troubleshooting** chapter.
Coaxial Heat Exchanger		When experiencing performance degradation that is not explained by a refrigeration circuit problem or low ground loop flow rate	Disconnect the outdoor loop and flush heat exchanger with a calcium removing solution. Generally not required for closed loop or cold water open loop systems; whenever system performance is reduced for warm water open loop systems (unusual).

Coaxial Heat Exchanger Flushing Procedure - Open Loop

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

Coaxial Heat Exchanger Flushing Procedure - Closed Ground Loop

1. Isolate the heat exchanger by placing the pump module valves in the exchanger flushing position.
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.
3. Connect a purge cart to the pump module purge ports.
4. Place 2 gallons of RYDLYME or similar in the purge cart. Circulate the fluid through the heat exchanger for at least 2 hours (3 hours recommended).
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.
6. Connect fresh water and a drain to the pump module purge ports and flush the exchanger for several minutes.
7. Blow the heat exchanger out with compressed air as per STEP 2 and dump the water down a drain.
8. Connect the purge cart to the pump module purge ports. Re-fill and purge the heat exchanger with as per standard procedures (the antifreeze from STEP 2 can be re-used).
9. Disconnect the purge cart and set the pump module valves back to the original positions. Operate the system and check for improved performance.

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 TROUBLESHOOTING, 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**. Be aware that if left in the TEST position, functionality may automatically revert back to standard operation after a short period of time; remove jumper, install in standard position, run unit, and replace jumper in TEST position to re-activate.

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.
	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 Y1 & C of the thermostat	Correct the setup.
	Faulty thermostat to heat pump wiring	24VAC signal present across Y1 & C of the thermostat but not present across Y1 & C of the terminal strip.	Correct or replace wiring
	Faulty thermostat	No 24VAC between Y1 & C of the thermostat when a call is indicated.	Replace thermostat.

FAULT CODE TROUBLESHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Fault Code 1 (High Pressure Control)	High operating refrigerant pressure	Using a refrigeration gauge set, verify that high pressure approaches or exceeds 565psi with compressor on.	See “High Discharge Pressure” in Heating Mode / Cooling Mode Troubleshooting section.
	Faulty High Pressure Control, failed open (**very unlikely**) * For this test there must be a signal present on Y, but compressor should not be running (disconnect compressor power plug)	Verify that there is 24VAC across HPS (right terminal) on the control board and C of the terminal strip, as well as HPS (left terminal) and C.	Replace high pressure control if voltage is present on one terminal but not the other.
	Faulty control board (**very unlikely**)	24VAC is present across HPS (right terminal) and C of the terminal strip, as well as HPS (left terminal) and C, but is not present across CC on the control board and C after 10 minutes.	Replace control board.
Fault Code 2 (Low Pressure Control)	Low operating refrigerant pressure	Using a refrigeration gauge set, verify that low pressure approaches or dips below 55psi (ground loop) or 75 psi (open loop) with compressor on.	See “Low Discharge Pressure” in Heating Mode / Cooling Mode Troubleshooting section.
	Faulty low pressure control, failed open (**very unlikely**) * For this test there must be a signal present on Y1, but compressor should not be running (disconnect compressor power plug)	Verify if there is 24VAC across LPS on the control board and C of the terminal strip, as well as HPS (left terminal) and C.	Replace high pressure control if voltage is present on one terminal but not the other.
	Faulty control board (**very unlikely**)	24VAC is present across LPS and C of the terminal strip, as well as HPS (left terminal) and C, but is not present across CC on the control board and C after 10 minutes.	Replace control board.
	Little or no refrigerant in unit	With compressor off, use a refrigeration gauge set to check refrigeration pressure of the unit for a very low value (less than 100 psi).	Locate the leak and repair it. Spray 9, a sniffer, and dye are common methods of locating a leak.
Fault Code 4 (Condensate overflow)	Condensate overflow	Drip tray under air coil is full of water up to the terminals of the condensate sensor.	Locate blockage or other cause of drain problem and rectify.
Fault Code 5 (Brownout)	Low voltage from the electrical grid	Verify that the electrical supply has dropped below ~165VAC, causing transformer voltage to drop below 18VAC.	Contact electrical utility or wait for regular service to be restored.

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 (particularly *high suction pressure* and *high discharge pressure*) 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	Low airflow	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-dryer plugged	Feel each end of the filter- dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes low suction pressure.	Replace filter-dryer.
	Unit is overcharged (Only possible if unit has been field serviced and incorrectly charged)	High subcooling, low delta T across air coil.	Remove 1/2lb of refrigerant at a time and verify that the discharge pressure reduces. Or remove charge and weigh back in the amount listed on nameplate.
Low Suction Pressure	Low or no Outdoor liquid flow	Delta T across the Outdoor Loop ports should be 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 to see if it is less than ~25F.	Increase the size of the ground loop.
	Dirty or fouled coaxial heat exchanger (more likely for open loop, unlikely for ground loop)	Disconnect the water lines and check the inside of the pipes for scale deposits.	Backflush the coaxial exchanger with a calcium-removing cleaning solution.
	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. Weigh refrigerant out and compare to charge listed on nameplate.	Locate the leak and repair it. Spray 9, a sniffer, and dye are common methods of locating a leak.
High Suction Pressure (may appear to not be pumping)	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 (can cause compressor to overheat and trip internal overload)	Reversing valve is the same temperature on both ends of body, common suction line is warm, compressor is running hot, low compressor discharge pressure.	Tap reversing valve, and switch it back and forth between heating and cooling positions. If this does not work for a long term fix, 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 (more likely for open loop, unlikely for ground loop)	Disconnect the water lines and check the inside of the pipes for scale deposits.	Backflush the coaxial exchanger with a calcium-removing cleaning solution.

OPERATION TROUBLESHOOTING - COOLING MODE			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
High Discharge pressure	Unit is overcharged (Only possible if unit has been field serviced and incorrectly charged)	High subcooling, low delta T across water coil.	Remove 1/2lb of refrigerant at a time and verify that the discharge pressure reduces. Or remove charge and weigh back in the amount listed on nameplate.
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 (can cause compressor to overheat and trip internal overload)	Reversing valve is the same temperature on both ends of body, common suction line is warm, compressor is running hot, low compressor discharge pressure.	Switch back and forth into cooling mode to try to free up valve. If it can't be freed, replace reversing valve.
	Faulty compressor, not pumping	Pressures change only slightly from static values when compressor is started.	Replace compressor.
Low Suction Pressure	Low airflow	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 the unit for a very low value. Weigh refrigerant out and compare to charge listed on nameplate.	Locate the leak and repair it. Spray 9, a sniffer, and dye are common methods of locating a leak.
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/BLOWER 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.
	Airflow selected on tap board is too low	Check selection on tap board.	Select a higher setting.
	Air flow reduction is enabled	AR1 and AR2 are connected with a dry contact or jumper.	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 (may be hard to detect)	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 **Ensure signal is present on terminal strip**	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): Recirculation = 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 **Ensure signal is present on terminal strip**	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): Recirculation = 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.
	Faulty Fan Power Harness 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 that some thermostats require a jumper between auxiliary and emergency. Check the tstat manual.)
	Faulty thermostat	Thermostat doesn’t indicate a call for auxiliary or emergency when it should. Or 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 board	Plenum heater transformer is burned out	Voltmeter does not show 24VAC across transformer secondary .	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 board (when a plenum heater demand is present)	Faulty wiring	24VAC present across C and ground at the plenum heater, but not across ground of the plenum heater and C_P of the heat pump terminal strip	Correct the wire which should run from heat pump C_P to plenum heater C.
		If above tested OK, 24VAC is present across ground of plenum heater and 1 of the heat pump terminal strip, but not across ground of plenum heater and 1 of the plenum heater.	Correct the wire which should run from heat pump terminal “1” to plenum heater terminal “1”.
	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.

PLENUM HEATER TROUBLE SHOOTING			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Plenum heater thermal overload is tripped	Fan not operating	See Fan/Blower Troubleshooting section	Correct problem. Reset thermal overload.
	Plenum heater is not positioned so that majority of airflow passes over elements (if installed in ductwork outside heat pump)	Plenum heater meant for internal heat pump installation is installed in a larger duct outside heat pump, or is positioned after duct elbow	Reposition plenum heater, or obtain a plenum heater model with a wider element cage (contact Maritime Geothermal).
	Faulty overload	Reset thermal overload	Replace if faulty.

DOMESTIC HOT WATER (DESUPERHEATER) 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 to 140°F	Visually inspect the setting.	Adjust the setting.
	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 (possible shorted element).	Correct problem, and 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)	DHW switch is turned off	Inspect switch, located on heat pump cabinet post.	Turn switch on.
	Circulator pump seized or motor failed	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 obstructions.	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 to 140°F	Visually inspect the setting.	Adjust the setting.

Repair Procedures

Pumpdown Procedure

1. Connect the refrigerant recovery unit to the heat pump's internal service ports via a refrigeration charging manifold and to a recovery tank as per the instructions in the recovery unit manual. Plan to dispose of refrigerant if there was a compressor burnout.
2. All refrigerant to water heat exchangers (brazed plates) **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.
3. Ensure all hose connections are properly purged of air. Start the refrigerant recovery as per the instructions in the recovery unit manual.
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.
5. Connect a nitrogen tank to the charging manifold and add nitrogen to the heat pump until a positive gauge pressure of 5-10 psig is reached. This prevents air from being sucked into the unit by the vacuum when the hoses are disconnected.

The heat pump is now ready for repairs.

General Repair Procedure

1. Perform repairs to system.

    - Always ensure nitrogen is flowing through the system at the lowest flow rate that can be felt at the discharge during any brazing procedures to prevent soot buildup inside the pipes.
    - It is recommended to replace the liquid line filter-dryer any time the refrigeration system has been exposed to the atmosphere.
    - Place a wet rag around any valves being installed, as almost all valve types have non-metallic seats or seals that will be damaged by excessive heat, and aim the torch flame away from the valve body. Solder only one joint at a time and cool joints down in between.

2. Pressure test the system with nitrogen. It is recommended to check for leaks using leak detection spray, Spray Nine, or soapy water. Check at 10, 25, 50 and 100 psig. Allow the system to sit at 100 psig for at least an hour, then re-check.

Vacuuming & Charging Procedure

After completion of repairs and nitrogen pressure testing, the refrigeration circuit is ready for vacuuming.

1. Release the nitrogen 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.
2. 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.
3. Weigh in the appropriate amount **and type** of refrigerant through the low pressure (suction) service port. Refer to the nameplate label on the unit for the proper refrigerant type and charge amount.
4. 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.

Compressor Replacement Procedure

1. Pump down the unit as per the Pumpdown Procedure above. **If there was a compressor burn out (motor failure), the refrigerant cannot be reused and must be disposed of according to local codes**.
2. Disconnect piping.
3. Replace the compressor. Replace the liquid line filter-dryer. Always ensure nitrogen is flowing through the system at the lowest flow rate that can be felt at the discharge during any brazing procedures to prevent soot buildup inside the pipes.
4. Vacuum the unit as per above procedure.
5. If there was a compressor burnout:
   a) Charge the unit with **new** refrigerant and operate it for continuously for 2 hours. Pump down the unit and replace the filter-dryer. Vacuum the unit as per above procedure.
   b) Charge the unit (refrigerant can be re-used) and operate it for 2-3 days. Perform an acid test. If it fails, pump down the unit and replace the filter-dryer.
   c) Charge the unit (refrigerant can be re-used) and operate it for 2 weeks. Perform and acid test. If it fails, pump down the unit and replace the filter-dryer.
5. Charge the unit a final time. Unit should now be clean and repeated future burn-outs can be avoided.

Model Specific Information

Table 15 - Refrigerant Charge				
MODEL	**lb**	***kg***	**Refrigerant**	**Oil Type**
R/RH-45	7.5	*3.4*	R410a	POE
R/RH-55	8.0	*3.6*	R410a	POE
R/RH-65	10.0	*4.5*	R410a	POE
R/RH-75	12.5	*5.7*	R410a	POE
R-80	11.5	*5.2*	R410a	POE

- Oil capacity is marked on the compressor label.
- **Refrigerant charge is subject to revision;** actual charge is indicated on the unit nameplate.

Table 16 - Weights and Shipping Dimensions					
MODEL	**SHIPPING WEIGHT lb. (kg)**	**HANGING WEIGHT lb. (kg)**	**SHIPPING DIMENSIONS inches (cm)**		
			L	**W**	**H**
R-45	390 (177)		44 (112)	36 (91)	66 (167)
R-55	460 (209)		44 (112)	36 (91)	66 (167)
R-65	490 (222)		44 (112)	36 (91)	66 (167)
R-75	530 (240)		44 (112)	36 (91)	66 (167)
R-80	598 (271)		44 (112)	36 (91)	68 (173)
RH-45	420 (191)	361 (164)	60 (152)	30 (76)	28 (71)
RH-55	463 (210)	404 (183)	70 (178)	36 (91)	29 (74)
RH-65	511 (232)	452 (205)	70 (178)	36 (91)	29 (74)
RH-75	550 (249)	491 (222)	70 (178)	36 (91)	29 (74)

Table 17 - Operating Temperature Limits					
Loop	**Mode**	**Parameter**	**°F**	**°C**	**Note**
OUTDOOR (ground loop)	Heating (water/open loop)	Minimum ELT	41	*5*	
	Heating (antifreeze/ground loop)	Minimum ELT	23	*-5*	Adequate antifreeze concentration required.
	Heating	Maximum ELT	80	*27*	Reduce flow above this temperature.
	Cooling	Minimum ELT	41	*5*	Flow reduction may be required.
	Cooling	Maximum ELT	110	*43*	
INDOOR (air duct)	Heating	Minimum EAT	60	*16*	Reduce air flow if necessary during heating startup.
	Heating	Maximum EAT	100	*38*	
	Cooling	Minimum EAT	50	*10*	
	Cooling	Maximum EAT	100	*38*	Reduce air flow if necessary during cooling startup.

* Values in this table are for rated liquid and airflow values.

Standard Capacity Ratings

Standards C13256-1 / ISO13256-1 / ARI 13256-1

Table 18 - Standard Capacity Ratings - Ground Loop Heating* 60Hz

EAT 68°F (20°C) * 15% Methanol by Weight Ground Loop Fluid STAGE 1 - ELT 41°F (5°C) STAGE 2 - ELT 32°F (0°C)

Model	Nominal Size	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP_H
	tons	gpm	L/s		cfm	L/s	Watts	Btu/hr	kW	W/W
R/RH-45	3	10	0.63	Stage 1	1030	486	1,535	22,000	6.4	4.3
				Stage 2	1200	566	2,155	27,200	8.0	3.6
R/RH-55	4	12	0.76	Stage 1	1240	585	2,045	29,100	8.5	4.2
				Stage 2	1500	708	2,700	35,600	10.4	3.8
R/RH-65	5	14	0.88	Stage 1	1540	727	2,565	35,900	10.5	4.0
				Stage 2	1900	897	3,390	44,000	12.9	3.7
R/RH-75	6	16	1.01	Stage 1	1660	783	3,435	45,100	13.2	3.9
				Stage 2	2100	991	4,355	53,200	15.6	3.6
R-80	6	17	1.07	Stage 1	2400	1133	4,940	63,000	18.5	3.5

Table 19 - Standard Capacity Ratings - Ground Water Heating 60Hz

EAT 68°F (20°C) ELT 50°F (10°C)

Model	Nominal Size	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP_H
	tons	gpm	L/s		cfm	L/s	Watts	Btu/hr	kW	W/W
R/RH-45	3	10	0.63	Stage 1	1030	486	1,625	25,500	7.5	4.5
				Stage 2	1200	566	2,375	35,700	10.5	4.3
R/RH-55	4	12	0.76	Stage 1	1240	585	2,075	34,500	10.1	4.8
				Stage 2	1500	708	2,960	47,200	13.8	4.6
R/RH-65	5	14	0.88	Stage 1	1540	727	2,670	42,800	12.5	4.6
				Stage 2	1900	897	3,740	58,700	17.2	4.5
R/RH-75	6	16	1.01	Stage 1	1660	783	3,540	52,000	15.2	4.3
				Stage 2	2100	991	4,780	68,500	20.1	4.2
R-80	6	17	1.07	Stage 1	2400	1133	5,315	77,500	22.7	4.1

Table 20 - Standard Capacity Ratings - Ground Loop Cooling* 60Hz

EAT 80.6°F (27°C), RH=46% * 15% Methanol by Weight Ground Loop Fluid STAGE 1 - ELT 68°F (20°C) STAGE 2 - ELT 77°F (25°C)

Model	Size	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP_c	EER
	tons	gpm	L/s		cfm	L/s	Watts	Btu/hr	kW	W/W	Btu/W
R/RH-45	3	10	0.63	Stage 1	1030	486	1,130	26,800	7.9	7.0	23.7
				Stage 2	1200	566	2,155	35,100	10.3	4.8	16.3
R/RH-55	4	12	0.76	Stage 1	1240	585	1,470	35,800	10.5	7.2	24.5
				Stage 2	1500	708	2,640	45,400	13.3	5.1	17.3
R/RH-65	5	14	0.88	Stage 1	1540	727	1,910	45,500	13.3	6.6	22.6
				Stage 2	1900	897	3,445	57,600	16.9	4.9	16.8
R/RH-75	6	16	1.01	Stage 1	1660	783	2,620	52,700	15.4	6.2	21.0
				Stage 2	2100	991	4,300	66,400	19.5	4.6	15.7
R-80	6	17	1.07	Stage 1	2400	1133	4,950	81,500	23.9	4.5	15.4

Table 21 - Standard Capacity Ratings - Ground Water Cooling 60Hz

EAT 80.6°F (27°C), RH=46% ELT 59°F (15°C)

Model	Size	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP_c	EER
	tons	gpm	L/s		cfm	L/s	Watts	Btu/hr	kW	W/W	Btu/W
R/RH-45	3	10	0.63	Stage 1	1030	486	1,080	29,500	8.6	8.0	27.3
				Stage 2	1200	566	1,805	38,500	11.3	6.3	21.3
R/RH-55	4	12	0.76	Stage 1	1240	585	1,315	37,300	10.9	8.4	28.5
				Stage 2	1500	708	2,245	50,200	14.7	6.6	22.5
R/RH-65	5	14	0.88	Stage 1	1540	727	1,705	47,200	13.8	8.0	27.1
				Stage 2	1900	897	2,865	62,600	18.3	6.3	21.5
R/RH-75	6	16	1.01	Stage 1	1660	783	2,305	54,300	15.9	7.2	24.4
				Stage 2	2100	991	3,710	69,800	20.5	5.7	19.4
R-80	6	17	1.07	Stage 1	2400	1133	4,130	86,500	25.4	5.8	19.6

Pressure Drop Data

Table 22: Loop Pressure Drop Data

Model	gpm	*L/s*	Water 104°F psi	Water 104°F *kPa*	Water 50°F psi	Water 50°F *kPa*	15% Methanol 32°F psi	15% Methanol 32°F *kPa*	35% prop. glycol 32°F psi	35% prop. glycol 32°F *kPa*
R/RH-45	4	*0.25*	0.8	*5.5*	0.9	*6.2*	1.0	*6.9*	1.3	*9.0*
	5	*0.32*	1.1	*7.6*	1.2	*8.3*	1.4	*9.6*	1.8	*13*
	6	*0.38*	1.6	*11*	1.7	*12*	2.0	*14*	2.6	*18*
	7	*0.44*	1.9	*13*	2.1	*14*	2.5	*17*	3.3	*23*
	8	*0.50*	2.6	*18*	2.8	*19*	3.0	*21*	4.0	*27*
	9	*0.57*	3.2	*22*	3.5	*24*	3.8	*26*	5.0	*34*
	10	***0.63***	**3.8**	***26***	**4.0**	***28***	**4.7**	***32***	**6.2**	***43***
	11	*0.69*	4.3	*30*	4.6	*32*	5.5	*38*	7.2	*50*
	12	*0.76*	5.2	*36*	5.5	*38*	6.6	*45*	8.7	*60*
	13	*0.82*	5.9	*41*	6.2	*43*	7.4	*51*	9.7	*67*
	14	*0.88*	6.7	*46*	7.0	*48*	8.6	*59*	11.3	*78*
	15	*0.95*	8.0	*55*	8.2	*57*	9.5	*65*	12.5	*86*
R/RH-55	6	*0.38*	1.1	*7.6*	1.2	*8.3*	1.3	*9.0*	1.7	*12*
	7	*0.44*	1.5	*10*	1.6	*11*	1.6	*11*	2.1	*14*
	8	*0.50*	1.8	*12*	1.9	*13*	2.1	*14*	2.8	*19*
	9	*0.57*	2.2	*15*	2.4	*17*	2.4	*17*	3.2	*22*
	10	*0.63*	2.7	*19*	2.9	*20*	3.1	*21*	4.1	*28*
	11	*0.69*	2.8	*19*	3.1	*21*	3.6	*25*	4.7	*33*
	12	***0.76***	**3.4**	***23***	**3.7**	***26***	**4.4**	***30***	**5.8**	***40***
	13	*0.82*	4	*28*	4.3	*30*	5	*34*	6.6	*45*
	14	*0.88*	4.7	*32*	5	*34*	5.7	*39*	7.5	*52*
	15	*0.95*	5.6	*39*	5.8	*40*	6.4	*44*	8.4	*58*
	16	*1.01*	6.1	*42*	6.3	*43*	7.1	*49*	9.3	*64*

Table 22: (cont'd) Loop Pressure Drop Data			Water 104°F		Water 50°F		15% Methanol 32°F		35% prop. glycol 32°F	
	gpm	*L/s*	psi	*kPa*	psi	*kPa*	psi	*kPa*	psi	*kPa*
R/RH-65	6	*0.38*	1.1	*7.6*	1.2	*8.3*	1.3	*9.0*	1.7	*12*
	7	*0.44*	1.4	*10*	1.5	*10*	1.8	*12*	2.4	*16*
	8	*0.50*	1.8	*12*	1.9	*13*	2.2	*15*	2.9	*20*
	9	*0.57*	2.1	*14*	2.3	*16*	2.7	*19*	3.6	*24*
	10	*0.63*	2.4	*17*	2.6	*18*	3.3	*23*	4.3	*30*
	11	*0.69*	2.9	*20*	3.2	*22*	4	*28*	5.3	*36*
	12	*0.76*	3.6	*25*	3.9	*27*	4.6	*32*	6.0	*42*
	13	*0.82*	4.1	*28*	4.4	*30*	5.2	*36*	6.8	*47*
	14	***0.88***	**4.7**	***32***	**5**	***34***	**5.8**	***40***	**7.6**	***53***
	15	*0.95*	5.5	*38*	5.7	*39*	6.5	*45*	8.5	*59*
	16	*1.01*	6.3	*43*	6.5	*45*	7.3	*50*	9.6	*66*
R/RH-75	6	*0.38*	0.6	*4.1*	0.7	*4.8*	0.9	*6.2*	1.2	*8.2*
	7	*0.44*	0.8	*5.5*	0.9	*6.2*	1.0	*6.9*	1.3	*9.0*
	8	*0.50*	1.2	*8.3*	1.3	*9.0*	1.3	*9.0*	1.7	*12*
	9	*0.57*	1.5	*10*	1.6	*11*	1.6	*11*	2.1	*14*
	10	*0.63*	1.8	*12*	1.9	*13*	2.1	*14*	2.8	*19*
	11	*0.69*	2.1	*14*	2.3	*16*	2.4	*17*	3.2	*22*
	12	*0.76*	2.4	*17*	2.6	*18*	2.9	*20*	3.8	*26*
	13	*0.82*	2.8	*19*	3.0	*21*	3.3	*23*	4.3	*30*
	14	*0.88*	2.9	*20*	3.2	*22*	3.7	*26*	4.9	*33*
	15	*0.95*	3.2	*22*	3.5	*24*	4.1	*28*	5.4	*37*
	16	***1.01***	**3.8**	***26***	**4.0**	***28***	**4.7**	***32***	**6.2**	***43***
	17	*1.07*	4.2	*29*	4.4	*30*	5.2	*36*	6.8	*47*
R-80	9	*0.57*	1.2	*8.3*	1.3	*9.0*	1.4	*10*	1.8	*13*
	10	*0.63*	1.5	*10*	1.6	*11*	1.7	*12*	2.2	*15*
	11	*0.69*	1.8	*12*	1.9	*13*	2.2	*15*	2.9	*20*
	12	*0.76*	2.2	*15*	2.4	*17*	2.6	*18*	3.4	*24*
	13	*0.82*	2.5	*17*	2.7	*19*	3.1	*21*	4.1	*28*
	14	*0.88*	2.9	*20*	3.1	*21*	3.5	*24*	4.6	*32*
	15	*0.95*	3.1	*21*	3.3	*23*	3.8	*26*	5.0	*34*
	16	*1.01*	3.3	*23*	3.6	*25*	4.1	*28*	5.4	*37*
	17	***1.07***	**3.7**	***26***	**4.1**	***28***	**4.6**	***32***	**6.0**	***42***
	18	*1.14*	4.2	*29*	4.5	*31*	4.9	*34*	6.4	*44*

Performance Tables

R/RH-45-HACW-P-1T *R410a, 60 Hz, ZPS30K5E-PFV*

HEATING

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	**Heating (Btu/hr)**	**COP_H**
HEATING	26	15	10	22	4.1	19,393	8.4	179	2,128		96	1,200	84	22.7	**26,396**	**3.63**
	32	20	10	28	4.4	21,005	8.8	179	2,211		99	1,200	86	24.3	**28,290**	**3.75**
	38	25	10	33	4.8	22,718	9.1	179	2,295		102	1,200	89	26.0	**30,291**	**3.87**
	44	30	10	39	5.3	25,249	9.5	179	2,404	68	105	1,200	92	28.5	**33,196**	**4.05**
	49	35	10	43	5.6	28,175	9.8	179	2,479		107	1,200	94	31.3	**36,401**	**4.30**
	55	40	10	49	6.1	30,329	10.2	179	2,572		110	1,200	96	33.4	**38,873**	**4.43**
	61	45	10	55	6.5	32,592	10.6	179	2,669		113	1,200	100	35.6	**41,467**	**4.55**
	67	50	10	60	7.0	34,965	11.1	179	2,770		116	1,200	103	38.0	**44,185**	**4.67**

COOLING

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	**Cooling (Btu/hr)**	**EER**
COOLING	51	70	10	61	9.5	47,375	6.0	171	1,642		44	1,200	57	23.2	13,299	28,417	**41,716**	**25.4**
	56	75	10	66	9.5	47,222	6.4	171	1,766		44	1,200	58	22.9	13,115	28,024	**41,140**	**23.3**
	61	80	10	70	9.4	47,190	6.9	171	1,892		45	1,200	58	22.6	12,968	27,709	**40,677**	**21.5**
	66	85	10	75	9.4	46,908	7.4	171	2,036	80.6	46	1,200	58	22.2	12,721	27,182	**39,904**	**19.6**
	72	90	10	82	9.8	46,530	7.9	171	2,192		46	1,200	59	21.9	12,344	26,670	**39,014**	**17.8**
	77	95	10	87	9.8	46,441	8.4	171	2,332		47	1,200	59	21.6	12,165	26,283	**38,447**	**16.5**
	82	100	10	92	9.7	46,200	9.0	171	2,478		48	1,200	59	21.2	11,931	25,777	**37,707**	**15.2**
	87	105	10	97	9.7	45,950	9.6	171	2,632		48	1,200	60	20.7	11,685	25,246	**36,931**	**14.0**

METRIC

HEATING

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating (W)**	**COP_H**
HEATING	-3.3	-9.4	0.63	-5.6	2.3	5,682	8.4	179	2,128		35.6	566	28.7	12.6	**7,734**	**3.63**
	0.0	-6.7	0.63	-2.5	2.5	6,154	8.8	179	2,211		37.2	566	30.2	13.5	**8,289**	**3.75**
	3.3	-3.9	0.63	0.7	2.7	6,656	9.1	179	2,295		38.9	566	31.7	14.5	**8,875**	**3.87**
	6.7	-1.1	0.63	3.7	3.0	7,398	9.5	179	2,404	20	40.6	566	33.1	15.8	**9,726**	**4.05**
	9.4	1.7	0.63	6.3	3.1	8,255	9.8	179	2,479		41.7	566	34.6	17.4	**10,665**	**4.30**
	12.8	4.4	0.63	9.4	3.4	8,886	10.2	179	2,572		43.3	566	35.8	18.6	**11,390**	**4.43**
	16.1	7.2	0.63	12.5	3.6	9,549	10.6	179	2,669		45.0	566	37.6	19.8	**12,150**	**4.55**
	19.4	10.0	0.63	15.6	3.9	10,245	11.1	179	2,770		46.7	566	39.4	21.1	**12,946**	**4.67**

COOLING

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (W)	**Cooling (W)**	**COP_C**
COOLING	10.6	21.1	0.63	15.8	5.3	13,881	6.0	171	1,642		6.6	566	14.1	12.9	3,897	8,326	**12,223**	**7.44**
	13.3	23.9	0.63	18.6	5.3	13,836	6.4	171	1,766		6.8	566	14.3	12.7	3,843	8,211	**12,054**	**6.82**
	16.1	26.7	0.63	21.4	5.2	13,826	6.9	171	1,892		7.2	566	14.4	12.6	3,800	8,119	**11,918**	**6.30**
	18.9	29.4	0.63	24.1	5.2	13,744	7.4	171	2,036	27	7.6	566	14.7	12.3	3,727	7,964	**11,692**	**5.74**
	22.2	32.2	0.63	27.7	5.4	13,633	7.9	171	2,192		7.9	566	14.8	12.2	3,617	7,814	**11,431**	**5.22**
	25.0	35.0	0.63	30.4	5.4	13,607	8.4	171	2,332		8.3	566	15.0	12.0	3,564	7,701	**11,265**	**4.83**
	27.8	37.8	0.63	33.2	5.4	13,537	9.0	171	2,478		8.6	566	15.2	11.8	3,496	7,552	**11,048**	**4.46**
	30.6	40.6	0.63	35.9	5.4	13,463	9.6	171	2,632		8.9	566	15.5	11.5	3,424	7,397	**10,821**	**4.11**

Performance Tables

R/RH-55-HACW-P-1T *R410a, 60 Hz, ZPS40K5E-PFV*

HEATING

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	**Heating (Btu/hr)**	**COP_H**
HEATING	27	15	12	22	4.7	26,809	11.8	185	2,718	68	98	1,500	92	23.6	**35,782**	**3.86**
	33	20	12	28	5.2	29,763	12.1	185	2,784		100	1,500	94	25.7	**38,963**	**4.10**
	39	25	12	33	5.8	32,940	12.5	185	2,850		102	1,500	96	28.0	**42,364**	**4.36**
	45	30	12	39	6.3	36,095	12.8	185	2,942		104	1,500	98	30.3	**45,834**	**4.56**
	50	35	12	43	6.6	39,435	13.1	185	3,033		106	1,500	100	32.0	**49,511**	**4.78**
	56	40	12	49	7.2	43,264	13.4	185	3,102		108	1,500	103	34.7	**53,577**	**5.06**
	62	45	12	54	7.9	47,338	13.8	185	3,174		110	1,500	106	37.5	**57,895**	**5.34**
	68	50	12	59	8.6	51,663	14.1	185	3,247		112	1,500	108	40.4	**62,471**	**5.64**

COOLING

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	**Cooling (Btu/hr)**	**EER**
COOLING	51	70	12	61	10.1	60,504	8.5	192	2,151	80.6	44	1,500	58	22.3	16,911	36,135	**53,046**	**24.7**
	56	75	12	66	10.0	60,047	9.1	192	2,297		44	1,500	59	21.9	16,606	35,484	**52,090**	**22.7**
	61	80	12	71	9.9	59,555	9.7	192	2,444		44	1,500	59	21.5	16,289	34,806	**51,095**	**20.9**
	66	85	12	76	9.8	58,920	10.3	192	2,530		44	1,500	60	21.1	15,993	34,173	**50,166**	**19.8**
	71	90	12	81	10.2	58,230	11.0	192	2,614		45	1,500	60	20.4	16,727	32,470	**49,197**	**18.8**
	76	95	12	86	10.1	57,809	11.6	192	2,764		45	1,500	61	20.0	16,409	31,853	**48,262**	**17.5**
	81	100	12	91	10.0	57,166	12.3	192	2,920		45	1,500	61	19.5	16,009	31,077	**47,087**	**16.1**
	86	105	12	96	9.9	56,499	13.0	192	3,083		45	1,500	62	19.0	15,594	30,270	**45,864**	**14.9**

METRIC

HEATING

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating (W)**	**COP_H**
HEATING	-2.8	-9.4	0.76	-5.4	2.6	7,855	11.8	185	2,718	20	36.7	708	33.1	13.1	**10,484**	**3.86**
	0.6	-6.7	0.76	-2.3	2.9	8,721	12.1	185	2,784		37.8	708	34.3	14.3	**11,416**	**4.10**
	3.9	-3.9	0.76	0.7	3.2	9,651	12.5	185	2,850		38.9	708	35.5	15.5	**12,413**	**4.36**
	7.2	-1.1	0.76	3.7	3.5	10,576	12.8	185	2,942		40.0	708	36.8	16.8	**13,429**	**4.56**
	10.0	1.7	0.76	6.3	3.7	11,554	13.1	185	3,033		41.1	708	37.8	17.8	**14,507**	**4.78**
	13.3	4.4	0.76	9.3	4.0	12,676	13.4	185	3,102		42.2	708	39.3	19.3	**15,698**	**5.06**
	16.7	7.2	0.76	12.3	4.4	13,870	13.8	185	3,174		43.3	708	40.8	20.8	**16,963**	**5.34**
	20.0	10.0	0.76	15.2	4.8	15,137	14.1	185	3,247		44.4	708	42.5	22.5	**18,304**	**5.64**

COOLING

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (W)	**Cooling (W)**	**COP_C**
COOLING	10.6	21.1	0.76	16.2	5.6	17,727	8.5	192	2,151	27	6.4	708	14.6	12.4	4,955	10,587	**15,542**	**7.23**
	13.3	23.9	0.76	18.9	5.6	17,593	9.1	192	2,297		6.6	708	14.8	12.2	4,866	10,397	**15,262**	**6.64**
	16.1	26.7	0.76	21.6	5.5	17,449	9.7	192	2,444		6.7	708	15.1	11.9	4,773	10,198	**14,971**	**6.12**
	18.9	29.4	0.76	24.3	5.5	17,263	10.3	192	2,530		6.8	708	15.3	11.7	4,686	10,013	**14,699**	**5.81**
	21.7	32.2	0.76	27.3	5.7	17,061	11.0	192	2,614		7.0	708	15.7	11.3	4,901	9,514	**14,415**	**5.51**
	24.4	35.0	0.76	30.1	5.6	16,938	11.6	192	2,764		7.2	708	15.9	11.1	4,808	9,333	**14,141**	**5.12**
	27.2	37.8	0.76	32.8	5.6	16,749	12.3	192	2,920		7.3	708	16.1	10.9	4,691	9,106	**13,796**	**4.72**
	30.0	40.6	0.76	35.5	5.5	16,554	13.0	192	3,083		7.4	708	16.4	10.6	4,569	8,869	**13,438**	**4.36**

Performance Tables

R/RH-65-HACW-P-1T *R410a, 60 Hz, ZPS51K5E-PFV*

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	**Heating (Btu/hr)**	**COP$_H$**
HEATING	26	15	14	21	4.8	31,644	14.9	300	3,573	68	97	1,900	91	22.6	**43,391**	**3.56**
	32	20	14	27	5.2	34,798	15.3	300	3,667		99	1,900	92	24.4	**46,866**	**3.74**
	38	25	14	32	5.7	37,954	15.9	300	3,806		102	1,900	94	26.3	**50,495**	**3.89**
	44	30	14	38	6.4	42,566	16.3	300	3,903		104	1,900	97	28.9	**55,440**	**4.16**
	49	35	14	42	6.8	47,314	16.9	300	4,045		107	1,900	99	31.0	**60,717**	**4.40**
	55	40	14	48	7.4	51,599	17.4	300	4,144		109	1,900	101	33.4	**65,344**	**4.62**
	61	45	14	53	8.0	56,159	17.8	300	4,247		111	1,900	104	35.9	**70,253**	**4.85**
	67	50	14	58	8.7	61,001	18.3	300	4,353		113	1,900	107	38.6	**75,456**	**5.08**

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	**Cooling (Btu/hr)**	**EER**
COOLING	49	70	14	60	11.1	77,969	10.8	325	2,663	80.6	45	1,900	56	24.6	19,665	49,095	**68,760**	**25.8**
	54	75	14	65	11.1	77,594	11.6	325	2,864		45	1,900	56	24.2	19,362	48,337	**67,698**	**23.6**
	59	80	14	70	11.0	77,174	12.4	325	3,067		45	1,900	57	23.8	19,043	47,542	**66,585**	**21.7**
	64	85	14	75	10.8	75,547	13.2	325	3,186		46	1,900	58	23.1	18,462	46,091	**64,553**	**20.3**
	70	90	14	81	11.1	73,856	14.0	325	3,307		46	1,900	58	22.6	18,682	43,799	**62,481**	**18.9**
	75	95	14	86	11.0	73,315	14.8	325	3,513		46	1,900	59	22.1	18,309	42,926	**61,235**	**17.4**
	80	100	14	91	10.9	72,743	15.7	325	3,728		47	1,900	59	21.7	17,919	42,012	**59,931**	**16.1**
	85	105	14	96	10.8	72,145	16.6	325	3,952		47	1,900	59	21.2	17,512	41,056	**58,567**	**14.8**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating (W)**	**COP$_H$**
HEATING	-3.3	-9.4	0.88	-6.0	2.6	9,272	14.9	300	3,573	20	36.1	900	32.6	12.6	**12,713**	**3.56**
	0.0	-6.7	0.88	-2.9	2.9	10,196	15.3	300	3,667		37.2	900	33.6	13.6	**13,732**	**3.74**
	3.3	-3.9	0.88	0.2	3.2	11,120	15.9	300	3,806		38.9	900	34.6	14.6	**14,795**	**3.89**
	6.7	-1.1	0.88	3.1	3.6	12,472	16.3	300	3,903		40.0	900	36.1	16.1	**16,244**	**4.16**
	9.4	1.7	0.88	5.7	3.8	13,863	16.9	300	4,045		41.7	900	37.2	17.2	**17,790**	**4.40**
	12.8	4.4	0.88	8.7	4.1	15,118	17.4	300	4,144		42.8	900	38.5	18.5	**19,146**	**4.62**
	16.1	7.2	0.88	11.7	4.5	16,455	17.8	300	4,247		43.9	900	39.9	19.9	**20,584**	**4.85**
	19.4	10.0	0.88	14.6	4.8	17,873	18.3	300	4,353		45.0	900	41.4	21.4	**22,108**	**5.08**

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (W)	**Cooling (W)**	**COP$_C$**
COOLING	9.4	21.1	0.88	15.6	6.2	22,845	10.8	325	2,663	27	7.1	900	13.3	13.7	5,762	14,385	**20,147**	**7.56**
	12.2	23.9	0.88	18.4	6.2	22,735	11.6	325	2,864		7.3	900	13.5	13.5	5,673	14,163	**19,835**	**6.93**
	15.0	26.7	0.88	21.1	6.1	22,612	12.4	325	3,067		7.4	900	13.8	13.2	5,580	13,930	**19,509**	**6.36**
	17.8	29.4	0.88	23.8	6.0	22,135	13.2	325	3,186		7.6	900	14.2	12.8	5,409	13,504	**18,914**	**5.94**
	21.1	32.2	0.88	27.3	6.2	21,640	14.0	325	3,307		7.8	900	14.4	12.6	5,474	12,833	**18,307**	**5.54**
	23.9	35.0	0.88	30.0	6.1	21,481	14.8	325	3,513		7.9	900	14.7	12.3	5,365	12,577	**17,942**	**5.11**
	26.7	37.8	0.88	32.7	6.1	21,314	15.7	325	3,728		8.1	900	15.0	12.0	5,250	12,309	**17,560**	**4.71**
	29.4	40.6	0.88	35.5	6.0	21,138	16.6	325	3,952		8.3	900	15.2	11.8	5,131	12,029	**17,160**	**4.34**

Performance Tables

R/RH-75-HACW-P-1T *R410a, 60 Hz, ZPS60K5E-PFV*

HEATING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	**Heating (Btu/hr)**	**COP_H**
28	15	16	23	5.1	38,593	17.5	410	4,094	68	97	2,100	93	24.6	**52,075**	**3.73**
34	20	16	28	5.6	42,497	17.9	410	4,186		99	2,100	95	26.5	**56,292**	**3.94**
40	25	16	34	6.1	46,404	18.5	410	4,320		102	2,100	97	28.6	**60,659**	**4.11**
46	30	16	39	6.7	50,856	19.0	410	4,466		104	2,100	99	30.9	**65,609**	**4.30**
51	35	16	44	6.9	55,258	19.7	410	4,643		107	2,100	101	32.7	**70,689**	**4.46**
57	40	16	50	7.5	60,316	20.1	410	4,743		109	2,100	103	35.2	**76,088**	**4.70**
63	45	16	55	8.2	65,697	20.6	410	4,845		111	2,100	106	37.8	**81,818**	**4.95**
69	50	16	60	8.9	71,411	21.1	410	4,951		113	2,100	109	40.6	**87,893**	**5.20**

COOLING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	**Cooling (Btu/hr)**	**EER**
52	70	16	63	10.9	86,865	13.1	450	3,412	80.6	44	2,100	59	21.2	24,039	51,083	**75,123**	**22.0**
57	75	16	68	10.8	86,123	13.9	450	3,619		44	2,100	60	20.7	23,576	50,099	**73,675**	**20.4**
62	80	16	73	10.7	85,342	14.7	450	3,828		44	2,100	60	20.3	23,097	49,082	**72,179**	**18.9**
67	85	16	78	10.6	84,654	15.6	450	3,941		44	2,100	61	20.0	22,755	48,353	**71,108**	**18.0**
73	90	16	84	11.0	83,917	16.5	450	4,050		44	2,100	60	20.3	21,843	48,167	**70,010**	**17.3**
78	95	16	89	10.9	82,973	17.4	450	4,263		45	2,100	61	19.8	21,321	47,017	**68,338**	**16.0**
83	100	16	94	10.8	82,003	18.3	450	4,485		45	2,100	61	19.3	20,782	45,828	**66,610**	**14.9**
88	105	16	99	10.7	81,008	19.3	450	4,717		45	2,100	62	18.8	20,225	44,599	**64,824**	**13.7**

METRIC

HEATING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating (W)**	**COP_H**
-2.2	-9.4	1.0	-5.0	2.8	11,308	17.5	410	4,094	20	36.1	990	33.6	13.6	**15,258**	**3.73**
1.1	-6.7	1.0	-2.0	3.1	12,452	17.9	410	4,186		37.2	990	34.7	14.7	**16,493**	**3.94**
4.4	-3.9	1.0	1.1	3.4	13,596	18.5	410	4,320		38.9	990	35.9	15.9	**17,773**	**4.11**
7.8	-1.1	1.0	4.1	3.7	14,901	19.0	410	4,466		40.0	990	37.2	17.2	**19,223**	**4.30**
10.6	1.7	1.0	6.7	3.8	16,191	19.7	410	4,643		41.7	990	38.2	18.2	**20,712**	**4.46**
13.9	4.4	1.0	9.7	4.2	17,672	20.1	410	4,743		42.8	990	39.5	19.5	**22,294**	**4.70**
17.2	7.2	1.0	12.7	4.6	19,249	20.6	410	4,845		43.9	990	41.0	21.0	**23,973**	**4.95**
20.6	10.0	1.0	15.6	5.0	20,923	21.1	410	4,951		45.0	990	42.6	22.6	**25,752**	**5.20**

COOLING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (W)	**Cooling (W)**	**COP_C**
11.1	21.1	1.0	17.1	6.0	25,451	13.1	450	3,412	27	6.7	990	15.2	11.8	7,043	14,967	**22,011**	**6.45**
13.9	23.9	1.0	19.9	6.0	25,234	13.9	450	3,619		6.7	990	15.5	11.5	6,908	14,679	**21,586**	**5.96**
16.7	26.7	1.0	22.6	5.9	25,005	14.7	450	3,828		6.8	990	15.7	11.3	6,767	14,381	**21,148**	**5.52**
19.4	29.4	1.0	25.3	5.9	24,803	15.6	450	3,941		6.8	990	15.9	11.1	6,667	14,167	**20,834**	**5.29**
22.8	32.2	1.0	28.9	6.1	24,587	16.5	450	4,050		6.9	990	15.7	11.3	6,400	14,113	**20,513**	**5.06**
25.6	35.0	1.0	31.6	6.1	24,311	17.4	450	4,263		6.9	990	16.0	11.0	6,247	13,776	**20,023**	**4.70**
28.3	37.8	1.0	34.3	6.0	24,027	18.3	450	4,485		7.0	990	16.3	10.7	6,089	13,427	**19,517**	**4.35**
31.1	40.6	1.0	37.0	5.9	23,735	19.3	450	4,717		7.1	990	16.6	10.4	5,926	13,067	**18,993**	**4.03**

Performance Tables

R-80-HACW-P-1S *R410a, 60 Hz, ZP72KCE-PFV*

	OUTDOOR LOOP *(15% Methanol)*						**ELECTRICAL**			**INDOOR LOOP** *(Air)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	**Heating (Btu/hr)**	**COP_H**
HEATING	**25**	15	17	20	4.9	40,600	22.2	410	5,173	68	99	2,300	93	25.2	**57,900**	**3.28**
	30	19	17	25	5.3	44,000	22.5	410	5,246		100	2,300	95	26.8	**61,600**	**3.44**
	35	24	17	29	5.7	47,500	22.8	410	5,316		102	2,300	96	28.4	**65,300**	**3.60**
	40	28	17	34	6.1	51,200	23.1	410	5,393		104	2,300	98	30.1	**69,200**	**3.76**
	45	33	17	38	6.6	54,900	23.4	410	5,465		106	2,300	100	31.8	**73,200**	**3.93**
	50	37	17	43	7.1	59,000	23.7	410	5,540		107	2,300	102	33.7	**77,500**	**4.10**
	55	42	17	47	7.6	63,200	24.0	410	5,618		109	2,300	104	35.6	**81,900**	**4.27**
	60	46	17	52	8.1	67,500	24.4	410	5,702		111	2,300	106	37.6	**86,500**	**4.45**

	OUTDOOR LOOP *(15% Methanol)*						**ELECTRICAL**			**INDOOR LOOP** *(Air @ 46% RH)*								
	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	**Cooling (Btu/hr)**	**EER**
COOLING	**55**	79	17	67	12.2	101,200	17.5	308	4,209	80.6	46	2,300	54	26.7	26,300	61,300	**87,600**	**20.8**
	60	84	17	72	12.1	100,600	18.7	308	4,452		46	2,300	54	26.2	25,900	60,300	**86,200**	**19.4**
	65	90	17	77	12.0	100,000	20.0	308	4,695		46	2,300	55	25.8	25,400	59,400	**84,800**	**18.1**
	70	95	17	82	11.9	99,500	21.2	308	4,942		47	2,300	55	25.4	25,000	58,400	**83,400**	**16.9**
	75	100	17	87	11.9	98,900	22.4	308	5,199		47	2,300	56	25.0	24,600	57,400	**82,000**	**15.8**
	80	106	17	92	11.8	98,600	23.7	308	5,470		48	2,300	56	24.6	24,200	56,500	**80,700**	**14.8**
	85	111	17	97	11.8	98,000	25.0	308	5,757		48	2,300	57	24.1	23,700	55,500	**79,200**	**13.8**
	90	116	17	102	11.7	97,500	26.5	308	6,068		48	2,300	57	23.6	23,300	54,300	**77,600**	**12.8**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						**ELECTRICAL**			**INDOOR LOOP** *(Air)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating (kW)**	**COP_H**
HEATING	**-3.9**	-9.6	1.1	-6.6	2.7	11.90	22.2	410	5,173	20	37.0	1,085	34.0	14.0	**17.00**	**3.28**
	-1.1	-7.1	1.1	-4.0	2.9	12.90	22.5	410	5,246		37.9	1,085	34.9	14.9	**18.10**	**3.44**
	1.7	-4.6	1.1	-1.5	3.2	13.90	22.8	410	5,316		38.9	1,085	35.8	15.8	**19.10**	**3.60**
	4.4	-2.1	1.1	1.0	3.4	15.00	23.1	410	5,393		39.9	1,085	36.7	16.7	**20.30**	**3.76**
	7.2	0.3	1.1	3.5	3.7	16.10	23.4	410	5,465		40.8	1,085	37.7	17.7	**21.50**	**3.93**
	10.0	2.8	1.1	6.1	3.9	17.30	23.7	410	5,540		41.8	1,085	38.7	18.7	**22.70**	**4.10**
	12.8	5.3	1.1	8.6	4.2	18.50	24.0	410	5,618		42.7	1,085	39.8	19.8	**24.00**	**4.27**
	15.6	7.8	1.1	11.1	4.5	19.80	24.4	410	5,702		43.7	1,085	40.9	20.9	**25.40**	**4.45**

	OUTDOOR LOOP *(15% Methanol)*						**ELECTRICAL**			**INDOOR LOOP** *(Air @ 46% RH)*								
	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (kW)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (kW)	**Cooling (kW)**	**COP_C**
COOLING	**12.8**	26.1	1.1	19.6	6.8	29.66	17.5	308	4,209	27	7.5	1,085	12.2	14.8	7.71	18.00	**25.70**	**6.10**
	15.6	29.1	1.1	22.3	6.7	29.48	18.7	308	4,452		7.7	1,085	12.4	14.6	7.59	17.70	**25.30**	**5.69**
	18.3	32.0	1.1	25.0	6.7	29.31	20.0	308	4,695		7.9	1,085	12.7	14.3	7.44	17.40	**24.90**	**5.30**
	21.1	34.9	1.1	27.7	6.6	29.20	21.2	308	4,942		8.2	1,085	12.9	14.1	7.33	17.10	**24.40**	**4.95**
	23.9	37.9	1.1	30.5	6.6	29.00	22.4	308	5,199		8.4	1,085	13.1	13.9	7.21	16.80	**24.00**	**4.63**
	26.7	40.8	1.1	33.3	6.6	28.90	23.7	308	5,470		8.7	1,085	13.3	13.7	7.09	16.60	**23.70**	**4.34**
	29.4	43.8	1.1	36.0	6.6	28.70	25.0	308	5,757		8.9	1,085	13.6	13.4	6.95	16.30	**23.20**	**4.04**
	32.2	46.7	1.1	38.7	6.5	28.60	26.5	308	6,068		9.1	1,085	13.9	13.1	6.83	15.90	**22.70**	**3.75**

Airflow Data

Table 23: MED Airflow (nominal)												
	STAGE 2				STAGE 1				FAN ONLY (Recirculation)			
Model	Full		AR1-AR2 reduction		Full		AR1-AR2 reduction		Full		AR1-AR2 reduction	
	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	2300	1085	1955	922	N/A	N/A	N/A	N/A	1288	608	1095	517

Table 24: LOW Airflow (-6%)												
	STAGE 2				STAGE 1				FAN ONLY (Recirculation)			
Model	Full		AR1-AR2 reduction		Full		AR1-AR2 reduction		Full		AR1-AR2 reduction	
	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	2162	1020	1838	867	N/A	N/A	N/A	N/A	1211	572	1029	486

Table 25: HIGH Airflow (+6%)												
	STAGE 2				STAGE 1				FAN ONLY (Recirculation)			
Model	Full		AR1-AR2 reduction		Full		AR1-AR2 reduction		Full		AR1-AR2 reduction	
	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	2438	1150	2072	977	N/A	N/A	N/A	N/A	1365	644	1161	548

Table 26: MAX Airflow (+12%)												
	STAGE 2				STAGE 1				FAN ONLY (Recirculation)			
Model	Full		AR1-AR2 reduction		Full		AR1-AR2 reduction		Full		AR1-AR2 reduction	
	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	2500	1180	2190	1033	N/A	N/A	N/A	N/A	1443	681	1226	579

Maximum external static pressure (all model sizes): **0.50 inH_2O**

Electrical Specifications

** equipped with K6E compressors where available*

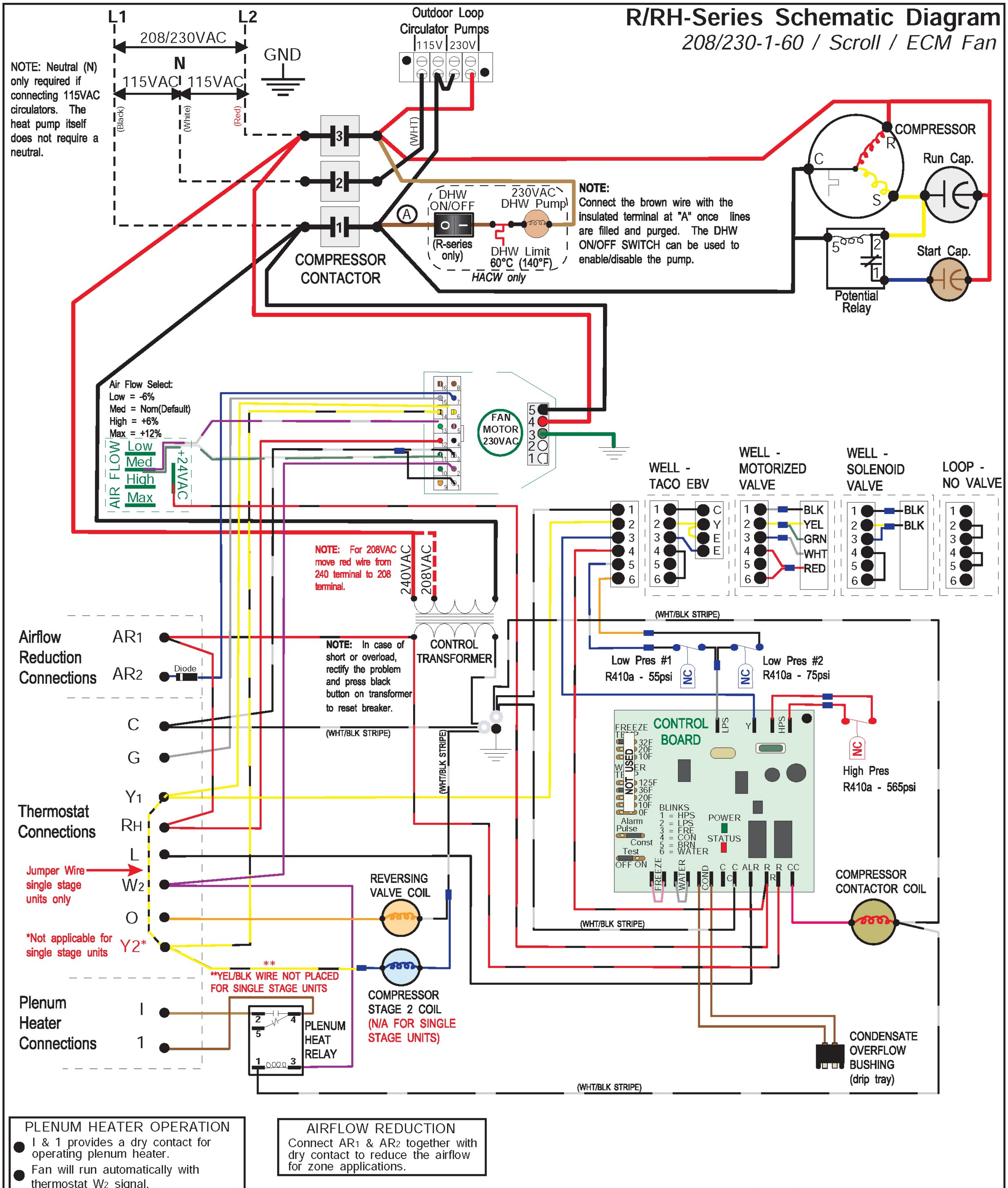
TABLE 27	Elec. Code	Power Supply			Compressor		Fan	Out-door Circ.	FLA	MCA	Max. Fuse/ Breaker	Min. Wire Size
		V-ø-Hz	MIN	MAX	RLA	LRA	RLA	Max A	Amps	Amps	Amps	ga
R/RH-45	1	208/230-1-60	187	253	**14.1**	**84**	**3.5**	**4.0**	**22.4**	**25.9**	**40**	**#8-2***
	2	208-3-60	187	229	**9.6**	**74**	**3.5**	**4.0**	**17.9**	**20.3**	**30**	**#10-3***
	3	265/277-1-60	226	304	**13.0**	**72**	**3.5**	**-**	**16.7**	**20.0**	**30**	**#10-2**
	4	460-3-60	414	506	**5.1**	**37**	**3.5**	**-**	**9.4**	**10.7**	**15**	**#14-4**
	6	220-1-50	187	253	**12.4**	**67**	**3.5**	**4.0**	**20.7**	**23.8**	**40**	**#8-2**
	7	380-3-50	342	418	**4.9**	**37**	**3.5**	**4.0**	**13.2**	**14.4**	**20**	**#12-4**
R/RH-55	1	208/230-1-60	187	253	**20.4**	**122**	**4.0**	**5.0**	**30.2**	**35.3**	**50**	**#8-2***
	2	208-3-60	187	229	**14.0**	**83**	**4.0**	**5.0**	**23.8**	**27.3**	**40**	**#8-3***
	3	265/277-1-60	226	304	**16.0**	**110**	**4.0**	**-**	**20.2**	**24.2**	**40**	**#8-2**
	4	460-3-60	414	506	**6.4**	**41**	**4.0**	**-**	**11.2**	**12.8**	**20**	**#12-4**
	6	220-1-50	187	253	**15.5**	**100**	**4.0**	**5.0**	**25.3**	**29.2**	**40**	**#8-2**
	7	380-3-50	342	418	**6.1**	**43**	**4.0**	**5.0**	**15.9**	**17.4**	**20**	**#12-4**
R/RH-65	1	208/230-1-60	187	253	**22.8**	**147**	**5.5**	**5.0**	**34.1**	**39.8**	**60**	**#6-2***
	2	208-3-60	187	229	**16.5**	**110**	**5.5**	**5.0**	**27.8**	**31.9**	**40**	**#8-3***
	3	265/277-1-60	226	304	**22.4**	**130**	**5.5**	**-**	**28.1**	**33.7**	**50**	**#8-2**
	4	460-3-60	414	506	**7.2**	**52**	**5.5**	**-**	**13.5**	**15.3**	**20**	**#12-4**
	6	220-1-50	187	253	**21.5**	**126**	**5.5**	**5.0**	**32.8**	**38.2**	**60**	**#6-2**
	7	380-3-50	342	418	**6.9**	**52**	**5.5**	**5.0**	**18.2**	**19.9**	**30**	**#10-4**
R/RH-75	1	208/230-1-60	187	253	**27.6**	**190**	**6.5**	**5.0**	**39.9**	**46.8**	**60**	**#6-2***
	2	208-3-60	187	229	**18.6**	**149**	**6.5**	**5.0**	**30.9**	**35.6**	**50**	**#8-3***
	3	-	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	4	460-3-60	414	506	**9.0**	**61**	**6.5**	**-**	**16.3**	**18.6**	**30**	**#10-4**
	6	220-1-50	187	253	**28.2**	**155**	**6.5**	**5.0**	**40.5**	**47.6**	**60**	**#6-2**
	7	380-3-50	342	418	**7.7**	**59**	**6.5**	**5.0**	**20.0**	**21.9**	**30**	**#10-4**
R/RH-80	1	208/230-1-60	187	253	**36.9**	**185**	**7.0**	**5.0**	**49.7**	**58.9**	**80**	**#4-2***
	2	208-3-60	187	229	**23.2**	**164**	**7.0**	**5.0**	**36.0**	**41.8**	**60**	**#6-3***
	3	-	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	4	460-3-60	414	506	**11.2**	**75**	**7.0**	**-**	**19.0**	**21.8**	**30**	**#10-4**
	6	-	-	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	7	380-3-50	342	418	**11.2**	**75**	**7.0**	**5.0**	**24.0**	**26.8**	**40**	**#8-4**

* additional conductor required if connecting 115VAC circulators to the unit

TABLE 28 - Plenum Heater Electrical Specifications

Size (kW)	(230-1-60)					(208-1-60)					(220-1-50)				
	Actual (kW)	FLA (A)	MCA (A)	Breaker (A)	Wire Size	Actual (kW)	FLA (A)	MCA (A)	Breaker (A)	Wire Size	Actual (kW)	FLA (A)	MCA (A)	Breaker (A)	Wire Size
5	**5**	**20.8**	**26.0**	**30**	**#10**	**3.8**	**18.1**	**22.6**	**30**	**#10**	**4.2**	**19.1**	**19.1**	**30**	**#10**
7	**7**	**29.2**	**36.5**	**40**	**#8**	**5.3**	**25.3**	**31.6**	**40**	**#8**	**5.9**	**26.7**	**26.7**	**40**	**#6**
10	**10**	**41.7**	**52.1**	**60**	**#6**	**7.5**	**36.1**	**45.1**	**50**	**#6**	**8.4**	**38.1**	**38.1**	**50**	**#6**
15	**15**	**62.5**	**78.1**	**80**	**#4**	**11.3**	**54.2**	**67.7**	**80**	**#4**	**12.6**	**57.2**	**57.2**	**80**	**#3**
20	**20**	**83.3**	**104.2**	**100**	**#3**	**15.0**	**72.2**	**90.3**	**100**	**#3**	**16.8**	**76.3**	**76.3**	**100**	**#3**

Wiring Diagram (208/230-1-60)



REV	ECO #	IMPL BY	APVD BY	DATE
05	000305	D. RHEAULT	D. RHEAULT	6 SEP 2022
04	000294	D. RHEAULT	D. RHEAULT	1 NOV 2021
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017
02	000229	C. GEDDES	C. GEDDES	01 APR 2015
01	000212 (IR)	C. GEDDES	C. GEDDES	01 MAY 2013

Drawn By	Chris Geddes	Date 01 MAY 2013
Checked By	Chris Geddes	Date 01 MAY 2013
Approved By (ENG)	Chris Geddes	Date 01 MAY 2013
Approved By (MFG)		Date
Approved By		Date

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

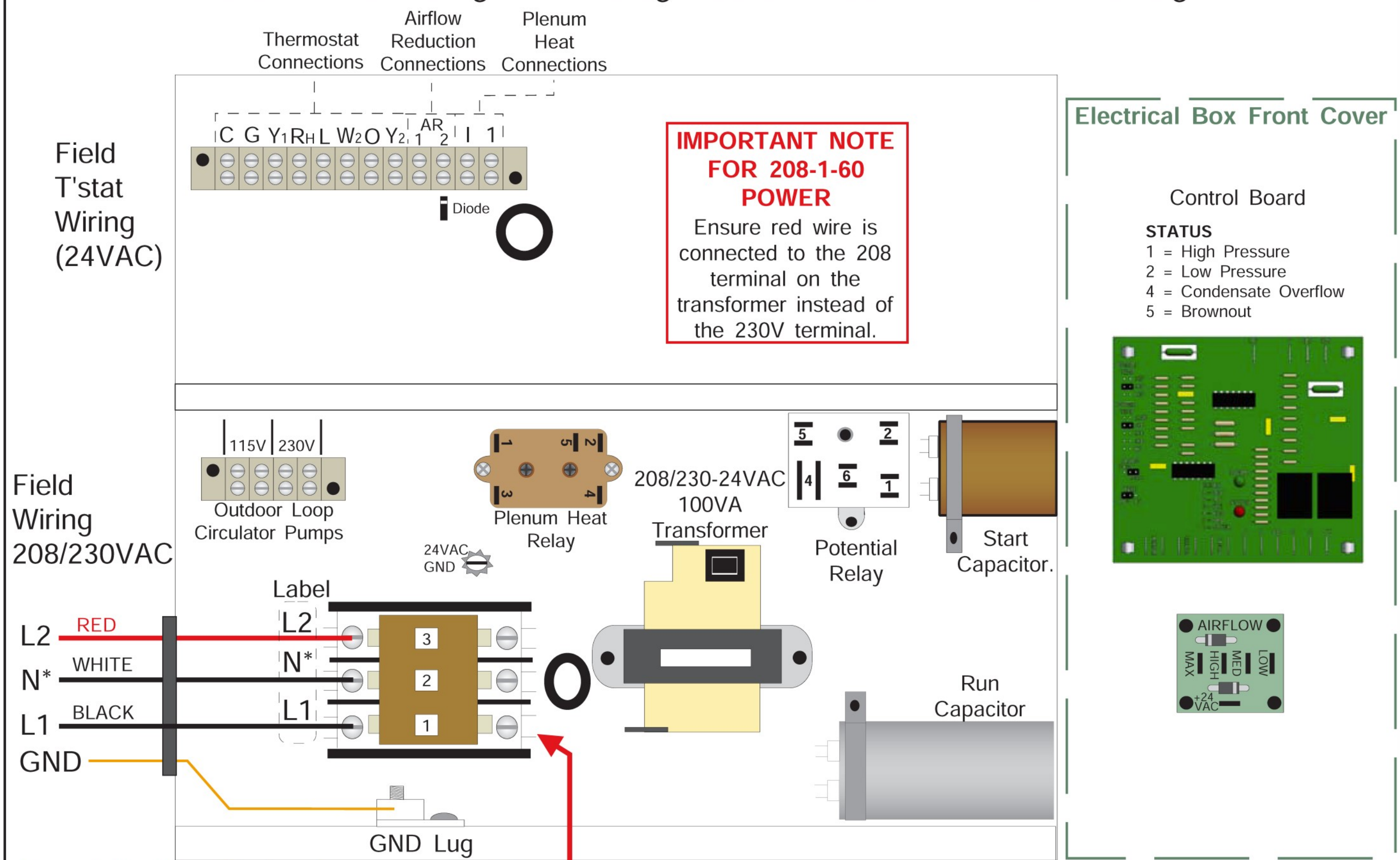
Drawing Name: R/RH-**-HAC*-P-1*-*-*DE** Schematic Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	001754SCH	05	1 of 1

Electrical Box Layout - R 45-75 (208/230-1-60)

R-Series Electrical Box Diagram

208/230-1-60 / Single/Two Stage Scroll / ECM Fan / Slim Design



Domestic Hot Water Circulator Pump Instructions:

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.** Once connected the external ON/OFF switch may be used to temporarily turn the pump off.

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

208/230/115VAC CONNECTIONS		
Wire	**Colour**	**Contactor**
Line 2	Red	L2
Neutral*	White	N*
Line 1	Black	L1
Connect "Gnd" to Gnd. Lug		

NOTE: Neutral (N) only required if connecting 115VAC circulators. The heat pump itself does not require a neutral.

Heat Pump Electrical Service Requirements

208/230VAC Single Phase 60Hz (208/230-1-60)

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

Low Voltage Wiring (24VAC)

Thermoststat Wiring

Use an 18-8 (7 for 1 stage) conductor cable. Connect the eight Thermostat Connections in the electrical box to the corresponding letters on the thermostat.

C - 24VAC Common
G - Fan
Y1 - Stage1 Heat/Cool (Compressor On/Off)
RH - 24VAC Hot
L - Trouble Indicator
W2 - Stage3 (2 for 1 stage) Heat (Plenum Heater)
O - Cooling (Reversing Valve)
Y2 - Stage2 (N/A for 1 stage) Heat/Cool (S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed will 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)

					Drawn By Chris Geddes	Date 01 MAY 2013
					Checked By Chris Geddes	Date 01 MAY 2013
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017	Approved By (ENG) Chris Geddes	Date 01 MAY 2013
02	000229	C. GEDDES	C. GEDDES	01 APR 2015	Approved By (MFG)	Date
01	000212 (IR)	C. GEDDES	C. GEDDES	02 JAN 2014	Approved By	Date
REV	ECO #	IMPL BY	APVD BY	DATE		

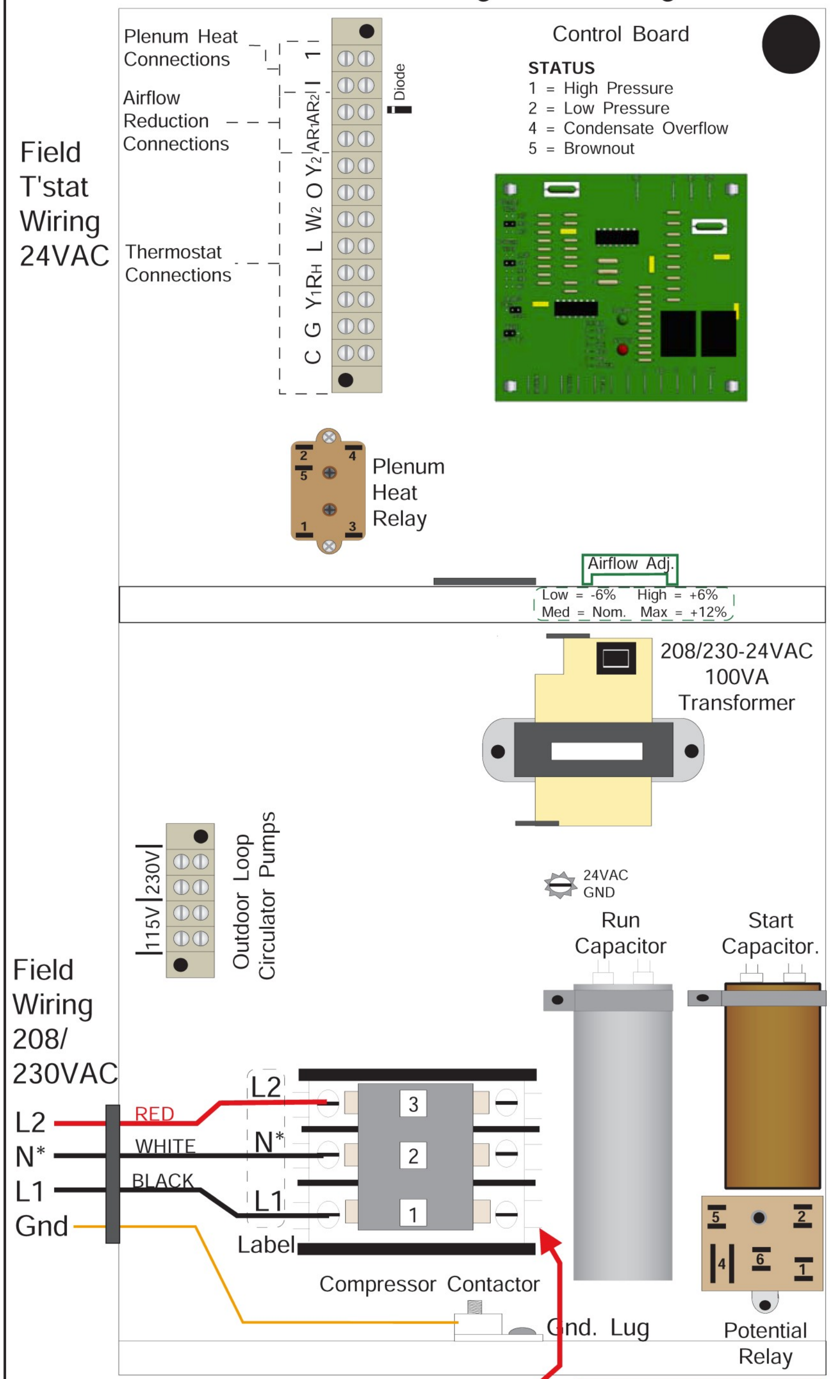
Drawing Name: R-25-75-HAC*-P-1*-*-*DE** Electrical Box Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	001755ELB	03	1 of 1

Electrical Box Layout - R-80 (208/230-1-60)

R-Series Electrical Box Diagram

208/230-1-60 / Single/Two Stage Scroll / ECM Fan / Modular Design



Low Voltage Wiring (24VAC)

Thermoststat Wiring

Use an 18-8 (7 for 1 stage) conductor cable. Connect the eight Thermostat Connections in the electrical box to the corresponding letters on the thermostat.

- C - 24VAC Common
- G - Fan
- Y1 - Stage1 Heat/Cool (Compressor On/Off)
- RH - 24VAC Hot
- L - Trouble Indicator
- W2 - Stage3 (2 for 1 stage) Heat (Plenum Heater)
- O - Cooling (Reversing Valve)
- Y2 - Stage2 (N/A for 1 stage) Heat/Cool (S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed will 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

208/230/115VAC CONNECTIONS		
Wire	**Colour**	**Contactor**
Line 2	Red	L2
Neutral*	White	N*
Line 1	Black	L1
Connect "Gnd" to Gnd. Lug		

NOTE: Neutral (N) only required if connecting 115VAC circulators. The heat pump itself does not require a neutral.

Domestic Hot Water Circulator Pump Instructions:

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.** Once connected the external ON/OFF switch may be used to temporarily turn the pump off.

IMPORTANT NOTE FOR 208-1-60 POWER

Ensure red wire is connected to the 208 terminal on the transformer instead of the 230V terminal.

Heat Pump Electrical Service Requirements

208/230VAC Single Phase 60Hz (208/230-1-60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
25	22	10-3	30
45	33	8-3	40
55	39	8-3	50
65	47	6-3	60
75	50	6-3	60
80	57	6-3	60

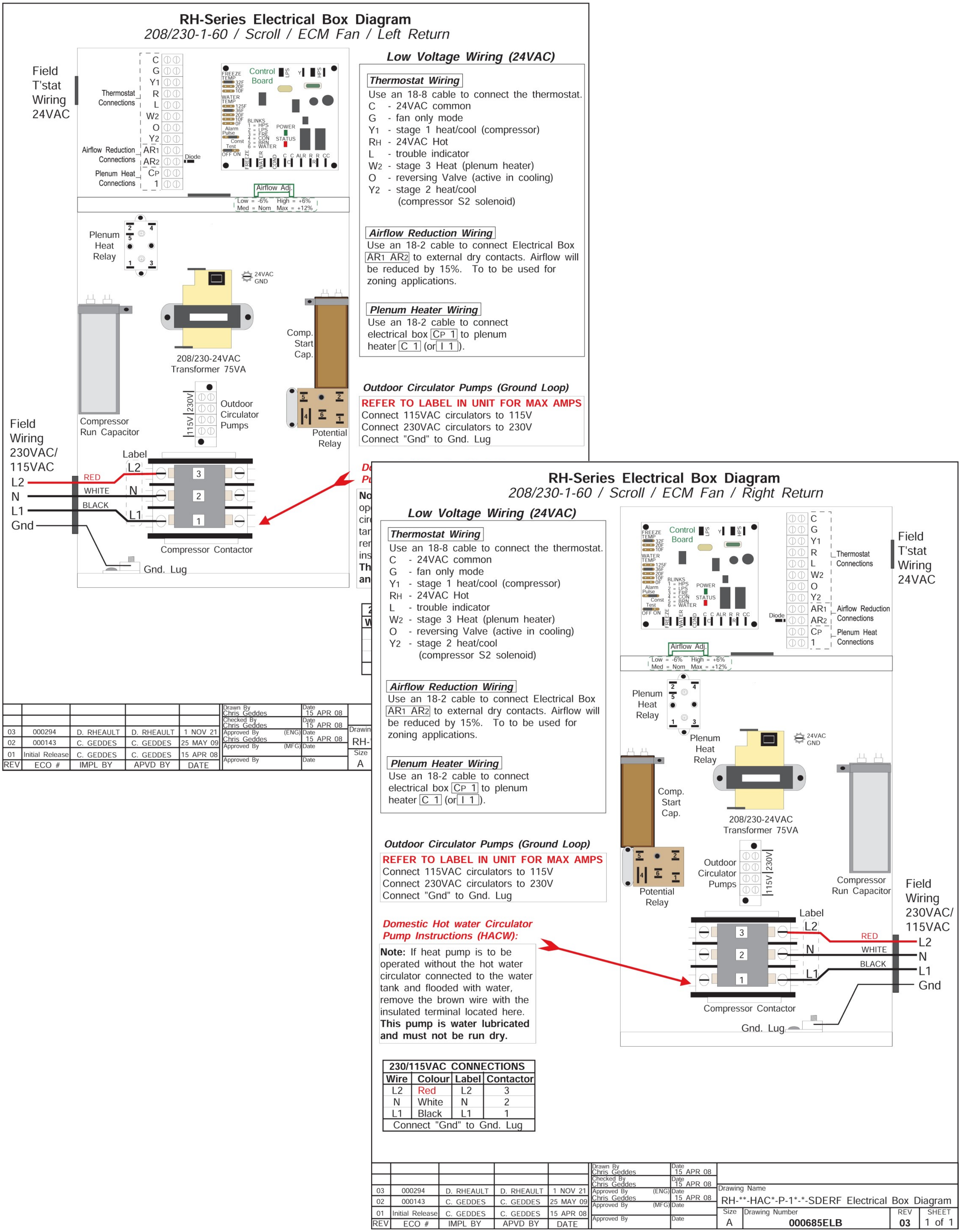
REV	ECO #	IMPL BY	APVD BY	DATE
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 17
02	000178	C. GEDDES	C. GEDDES	01 FEB 11
01	Initial Release	C. GEDDES	C. GEDDES	29 SEP 09

Drawn By Chris Geddes	Date 29 SEP 09
Checked By Chris Geddes	Date 29 SEP 09
Approved By (ENG) Chris Geddes	Date 29 SEP 09
Approved By (MFG)	Date
Approved By	Date

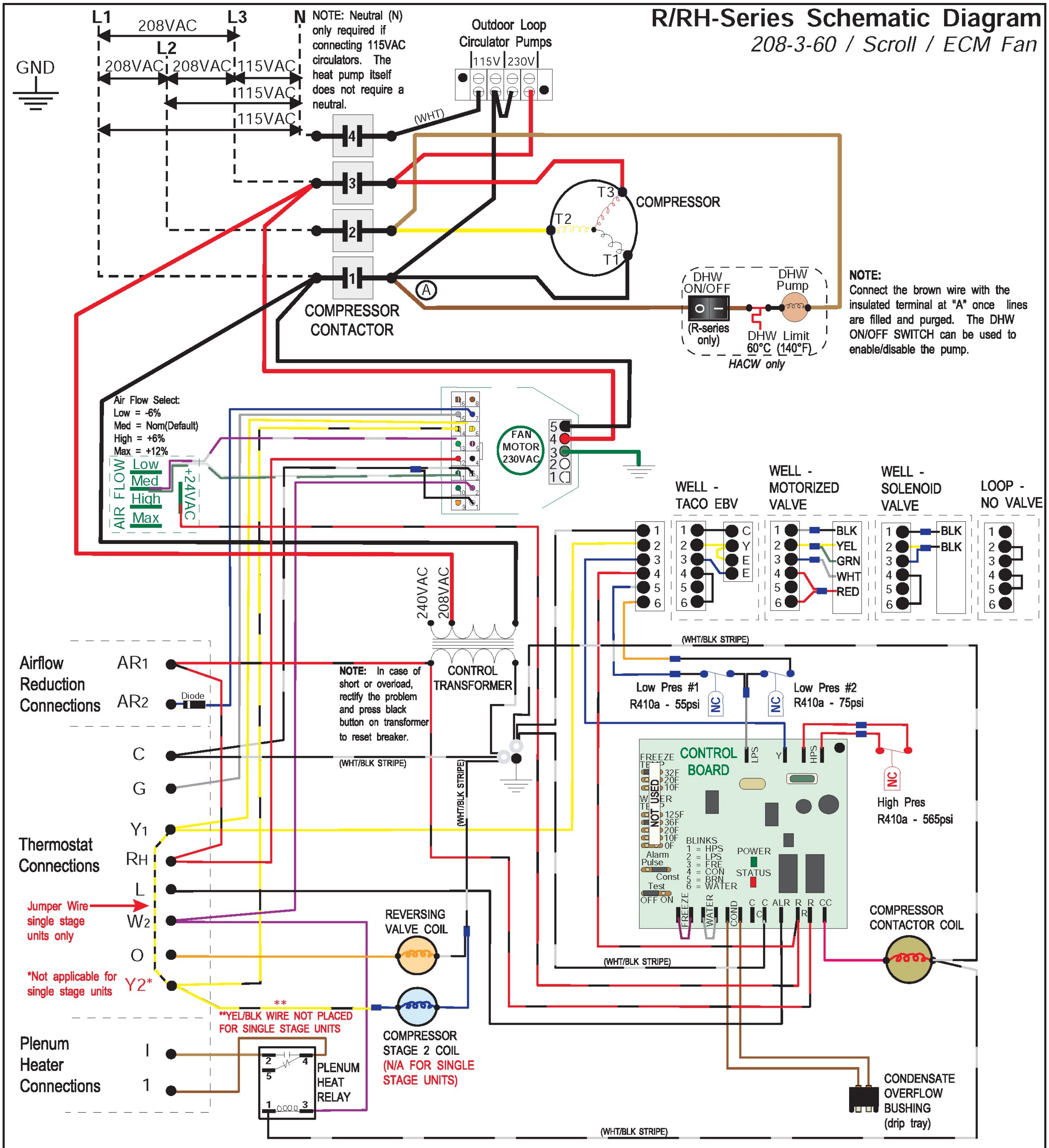
Drawing Name: R-**-HAC*-P-1*-*-*DE** Electrical Box Diagram

Size	Drawing Number	REV	SHEET
A	**001136ELB**	**03**	1 of 1

Electrical Box Layout - RH 45-75 (208/230-1-60)



Wiring Diagram (208-3-60)



PLENUM HEATER OPERATION

- I & 1 provides a dry contact for operating plenum heater.
- Fan will run automatically with thermostat W2 signal.

AIRFLOW REDUCTION

Connect AR1 & AR2 together with dry contact to reduce the airflow for zone applications.

REV	ECO #	IMPL BY	APVD BY	DATE
05	000305	D. RHEAULT	D. RHEAULT	6 SEP 2022
04	000294	D. RHEAULT	D. RHEAULT	1 NOV 2021
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017
02	000229	C. GEDDES	C. GEDDES	01 APR 2015
01	000212 (IR)	C. GEDDES	C. GEDDES	01 MAY 2013

Drawn By: Chris Geddes	Date: 01 MAY 2013
Checked By: Chris Geddes	Date: 01 MAY 2013
Approved By (ENG): Chris Geddes	Date: 01 MAY 2013
Approved By (MFG)	Date
Approved By	Date

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

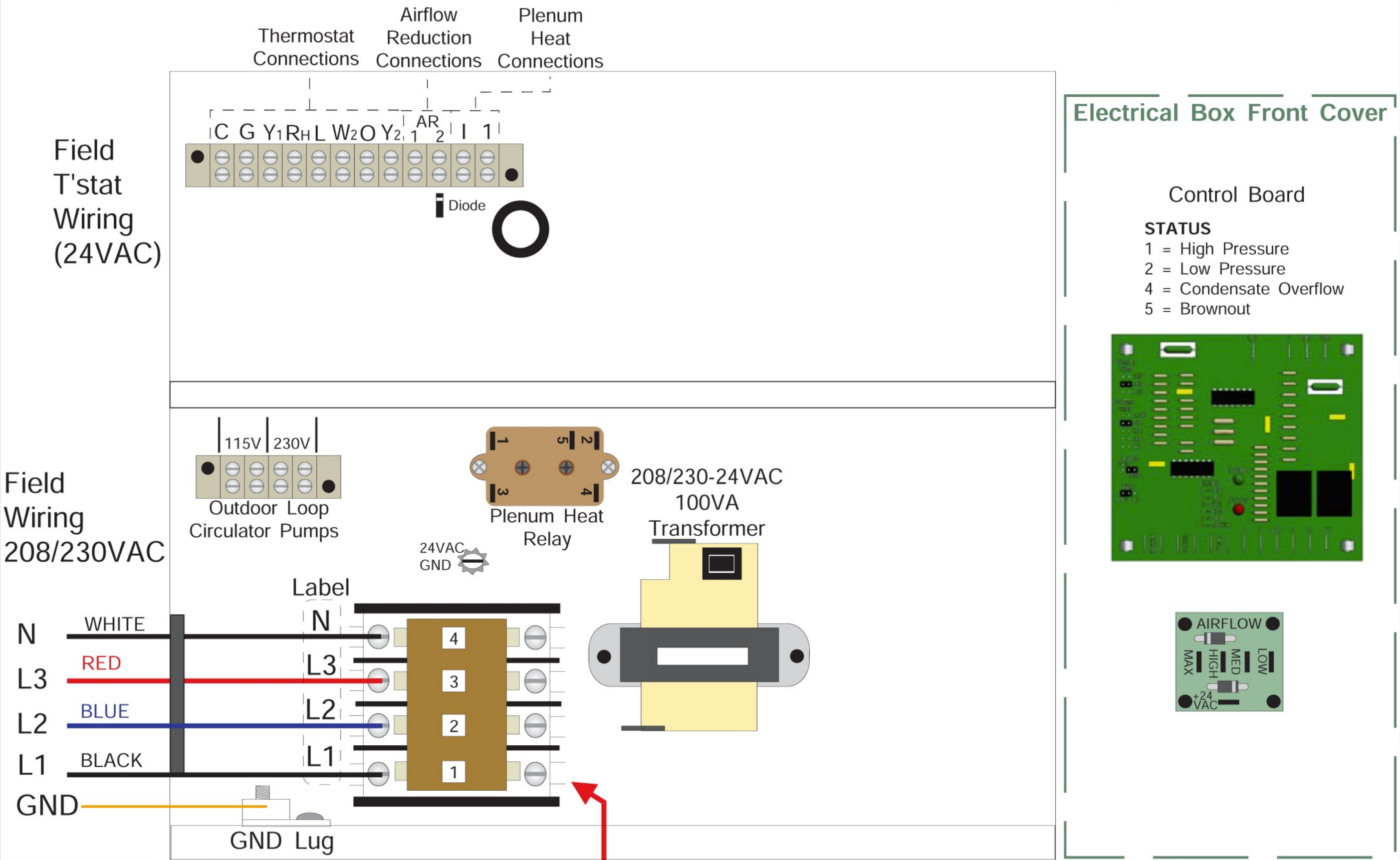
Drawing Name: R/RH-**-HAC*-P-2*-*-*DE** Schematic Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	001756SCH	05	1 of 1

Electrical Box Layout - R 45-75 (208-3-60)

R-Series Electrical Box Diagram

208-3-60 / Single/Two Stage Scroll / ECM Fan / Slim Design



Domestic Hot Water Circulator Pump Instructions:

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.** Once connected the external ON/OFF switch may be used to temporarily turn the pump off.

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

208/115VAC CONNECTIONS			
Wire	**Colour**	**Label**	**Contactor**
N	White	N	4
L3	Red	L3	3
L2	Blue	L2	2
L1	Black	L1	1
Connect "Gnd" to Gnd. Lug			

Heat Pump Electrical Service Requirements

208VAC Three Phase 60Hz (208-3-60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
45	24	10-4	30
55	29	8-4	40
65	36	8-4	50
75	39	8-4	60

IMPORTANT NOTE FOR THREE PHASE SCROLL COMPRESSORS

This unit is quipped a scroll compressor, if on initial startup the compressor is noisy and not pumping, reverse the L1 and L2 supply wires.

Low Voltage Wiring (24VAC)

Thermoststat Wiring

Use an 18-8 (7 for 1 stage) conductor cable. Connect the eight Thermostat Connections in the electrical box to the corresponding letters on the thermostat.

C - 24VAC Common
G - Fan
Y1 - Stage1 Heat/Cool (Compressor On/Off)
RH - 24VAC Hot
L - Trouble Indicator
W2 - Stage3 (2 for 1 stage) Heat (Plenum Heater)
O - Cooling (Reversing Valve)
Y2 - Stage2 (N/A for 1 stage) Heat/Cool (S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed will 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)

REV	ECO #	IMPL BY	APVD BY	DATE
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017
02	000229	C. GEDDES	C. GEDDES	01 APR 2015
01	000212 (IR)	C. GEDDES	C. GEDDES	01 MAY 2013

Drawn By: Chris Geddes		Date: 01 MAY 2013
Checked By: Chris Geddes		Date: 01 MAY 2013
Approved By: Chris Geddes	(ENG)	Date: 01 MAY 2013
Approved By	(MFG)	Date
Approved By		Date

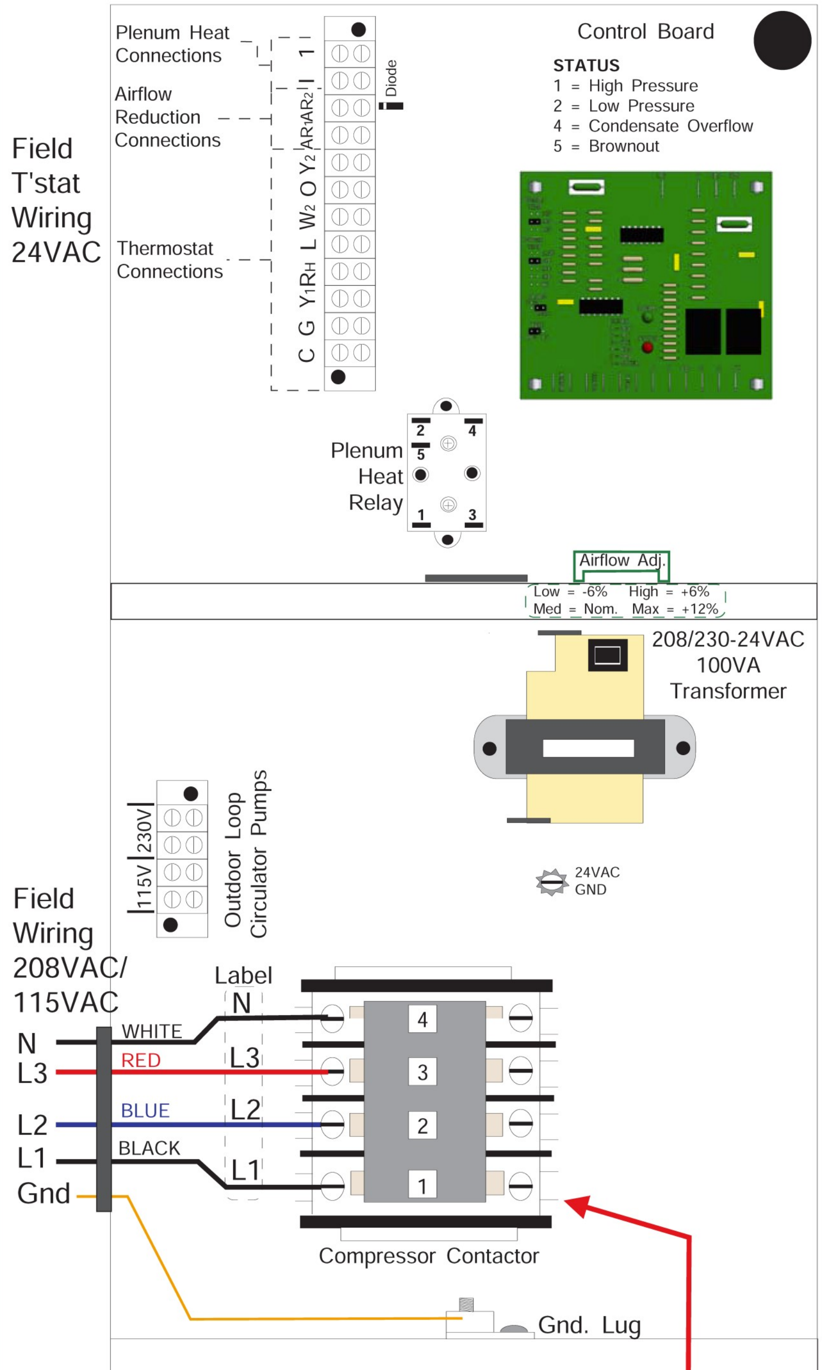
Drawing Name: R-25-75-HAC*-P-2*-*-*DE** Electrical Box Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	001757ELB	03	1 of 1

Electrical Box Layout - R-80 (208-3-60)

R-Series Electrical Box Diagram

208-3-60 / Single/Two Stage Scroll / ECM Fan / Modular Design



Domestic Hot Water Circulator Pump Instructions:

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.** Once connected the external ON/OFF switch may be used to temporarily turn the pump off.

Low Voltage Wiring (24VAC)

Thermoststat Wiring

Use an 18-8 (7 for 1 stage) conductor cable. Connect the eight Thermostat Connections in the electrical box to the corresponding letters on the thermostat.

C - 24VAC Common
G - Fan
Y1 - Stage1 Heat/Cool (Compressor On/Off)
RH - 24VAC Hot
L - Trouble Indicator
W2 - Stage3 (2 for 1 stage) Heat (Plenum Heater)
O - Cooling (Reversing Valve)
Y2 - Stage2 (N/A for 1 stage) Heat/Cool (S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed will 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

IMPORTANT NOTE FOR THREE PHASE SCROLL COMPRESSORS

This unit is quipped with scroll compressors which must rotate in the proper direction. After the initial connection, start the compressors while observing the suction and discharge pressures with a refrigeration gauge set. If the compressors are not pumping, reverse the L1 and L2 supply leads and recheck. (Reversing any two of the three input wires to a three phase motor will reverse the rotation direction of the motor.

208/115VAC CONNECTIONS

Wire	Colour	Label	Contactor
N	White	N	4
L3	Red	L3	3
L2	Blue	L2	2
L1	Black	L1	1

Connect "Gnd" to Gnd. Lug

Heat Pump Electrical Service Requirements

208VAC Three Phase 60Hz (208-3-60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
25	17	10-4	25
45	24	10-4	30
55	29	8-4	40
65	36	8-4	50
75	39	6-4	60
80	44	6-4	60

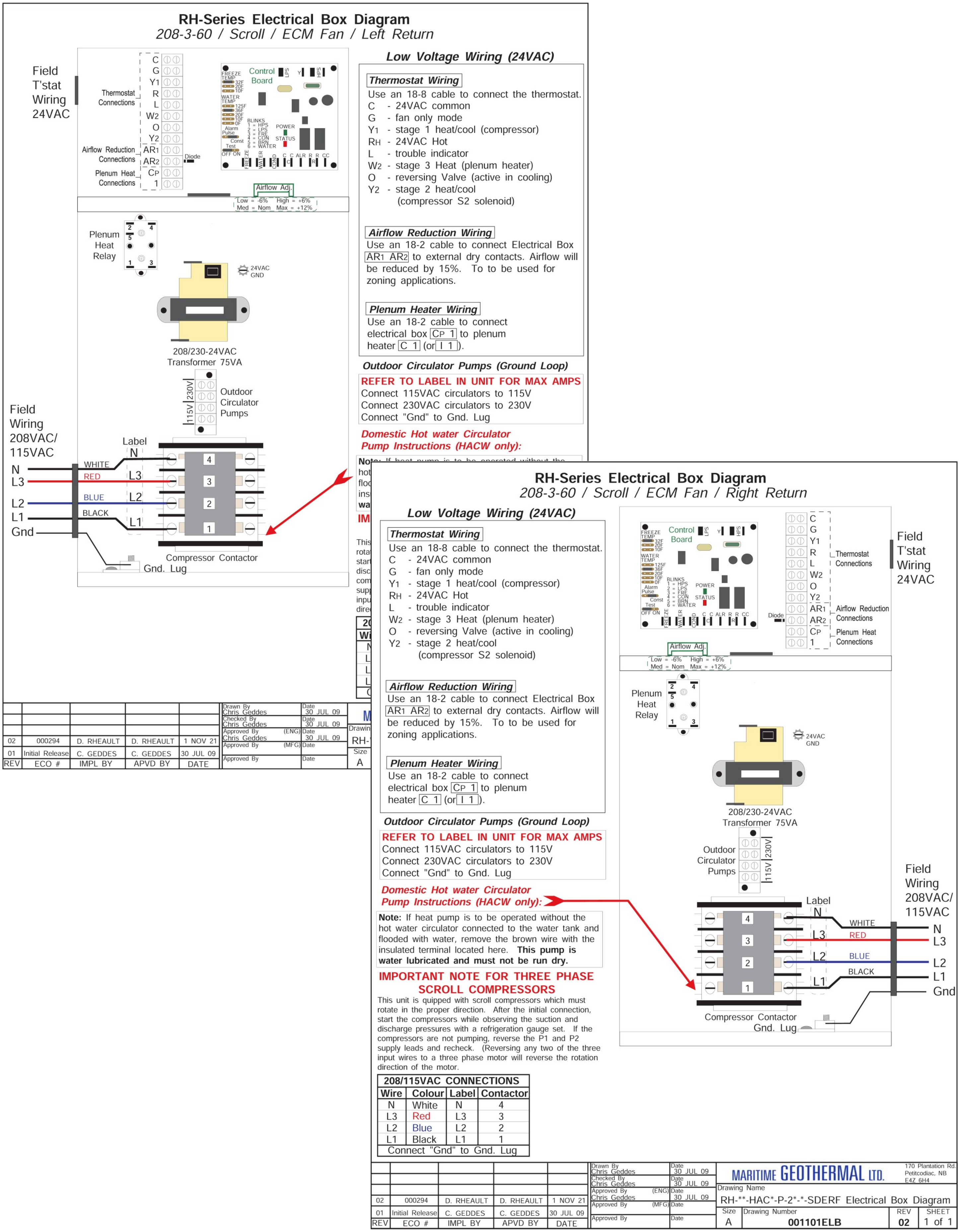
REV	ECO #	IMPL BY	APVD BY	DATE
02	000251	D. RHEAULT	D. RHEAULT	15 MAY 17
01	Initial Release	C. GEDDES	C. GEDDES	23 DEC 11

Drawn By: Chris Geddes	Date: 23 DEC 11
Checked By: Chris Geddes	Date: 23 DEC 11
Approved By (ENG): Chris Geddes	Date: 23 DEC 11
Approved By (MFG)	Date
Approved By	Date

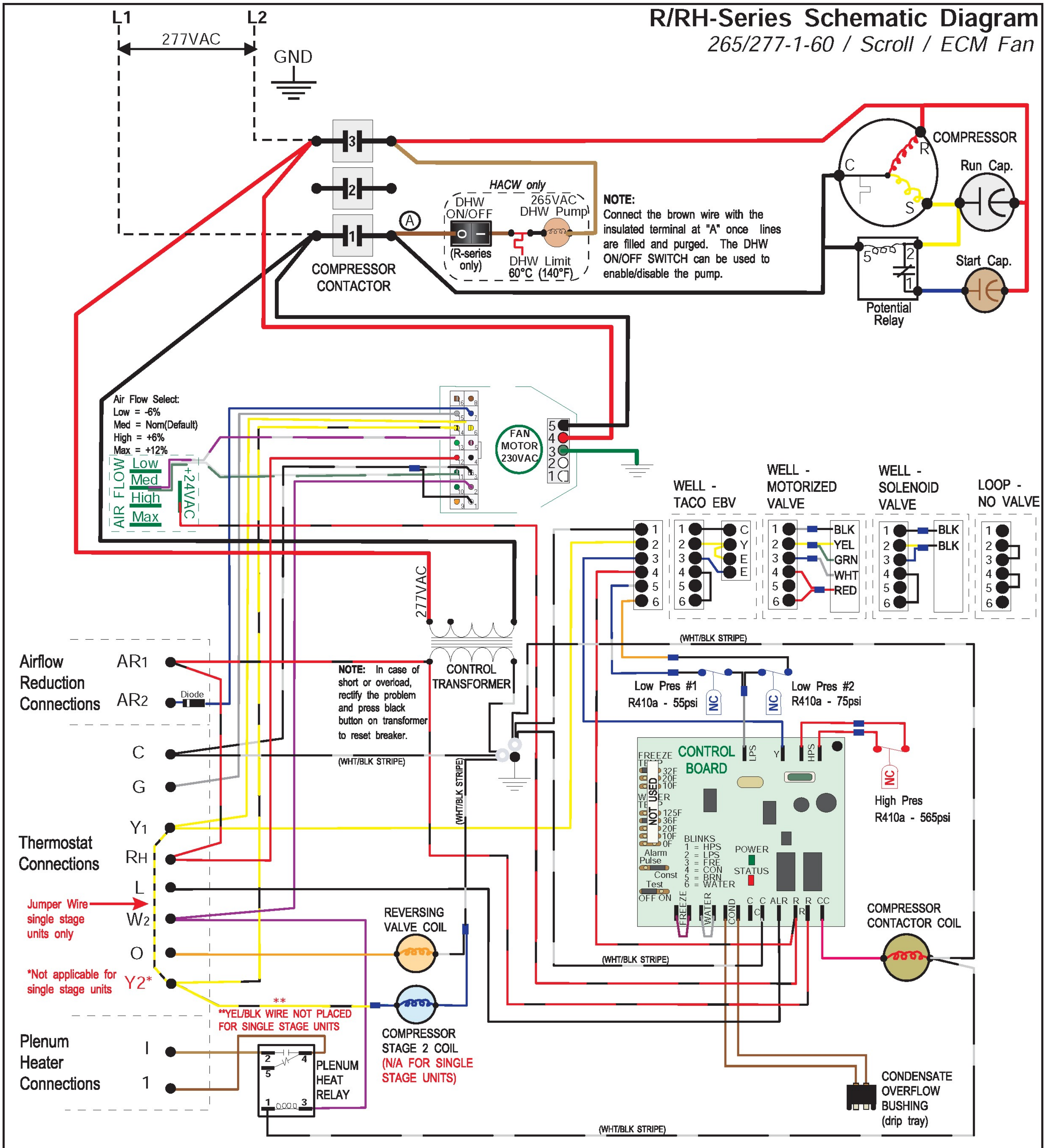
Drawing Name: R-**-HAC*-P-2*-*-*DE** Electrical Box Diagram

Size	Drawing Number	REV	SHEET
A	001585ELB	02	1 of 1

Electrical Box Layout - RH 45-75 (208-3-60)



Wiring Diagram (265/277-1-60)



PLENUM HEATER OPERATION

- I & 1 provides a dry contact for operating plenum heater.
- Fan will run automatically with thermostat W_2 signal.

AIRFLOW REDUCTION

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

REV	ECO #	IMPL BY	APVD BY	DATE
05	000305	D. RHEAULT	D. RHEAULT	6 SEP 2022
04	000294	D. RHEAULT	D. RHEAULT	1 NOV 2021
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017
01	IR	C. GEDDES	C. GEDDES	14 JUN 2016

	Date
Drawn By Chris Geddes	14 JUN 2016
Checked By Chris Geddes	14 JUN 2016
Approved By (ENG) Chris Geddes	14 JUN 2016
Approved By (MFG)	
Approved By	

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

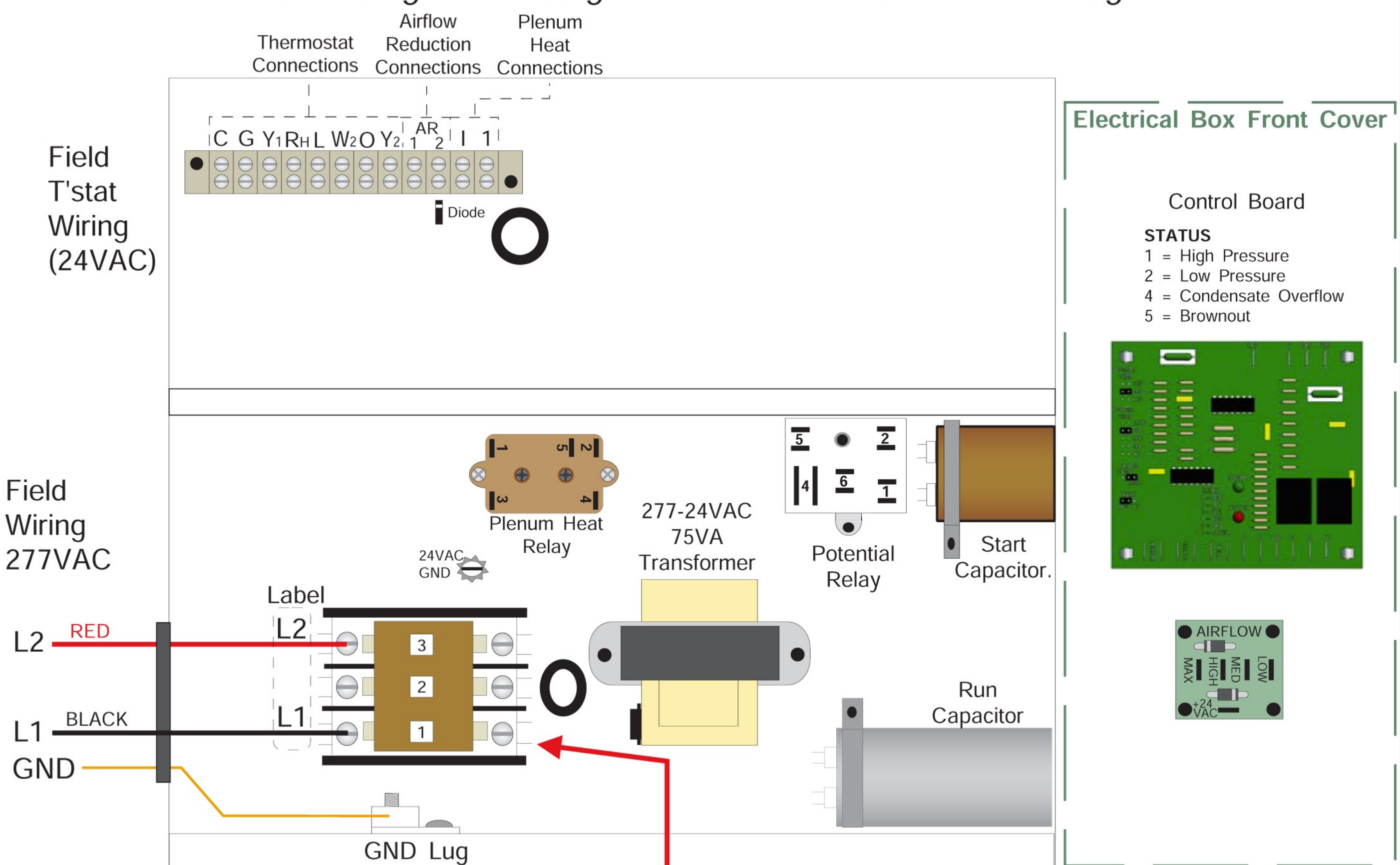
Drawing Name: R/RH-**-HAC*-P-3*-*-*DE** Schematic Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	002113SCH	05	1 of 1

Electrical Box Layout - R 45-75 (265/277-1-60)

R-Series Electrical Box Diagram

277-1-60 / Single/Two Stage Scroll / ECM Fan / Slim Design



Domestic Hot Water Circulator Pump Instructions (HACW only):

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.** Once connected the external ON/OFF switch may be used to temporarily turn the pump off.

277VAC CONNECTIONS		
Wire	**Colour**	**Contactor**
Line 2	Red	L2
Line 1	Black	L1
Connect "Gnd" to Gnd. Lug		

Heat Pump Electrical Service Requirements

277VAC Single Phase 60Hz (277-1-60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
25	14	12-2	20
45	20	10-2	30
55	24	8-2	40
65	34	8-2	50
75	N/A	N/A	N/A

Low Voltage Wiring (24VAC)

Thermoststat Wiring

Use an 18-8 (7 for 1 stage) conductor cable. Connect the eight Thermostat Connections in the electrical box to the corresponding letters on the thermostat.

C - 24VAC Common
G - Fan
Y1 - Stage1 Heat/Cool (Compressor On/Off)
RH - 24VAC Hot
L - Trouble Indicator
W2 - Stage3 (2 for 1 stage) Heat (Plenum Heater)
O - Cooling (Reversing Valve)
Y2 - Stage2 (N/A for 1 stage) Heat/Cool (S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed will 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)

REV	ECO #	IMPL BY	APVD BY	DATE
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017
02	IR	C. GEDDES	C. GEDDES	14 JUN 2016

Drawn By Chris Geddes	Date 14 JUN 2016
Checked By Chris Geddes	Date 14 JUN 2016
Approved By (ENG) Chris Geddes	Date 14 JUN 2016
Approved By (MFG)	Date
Approved By	Date

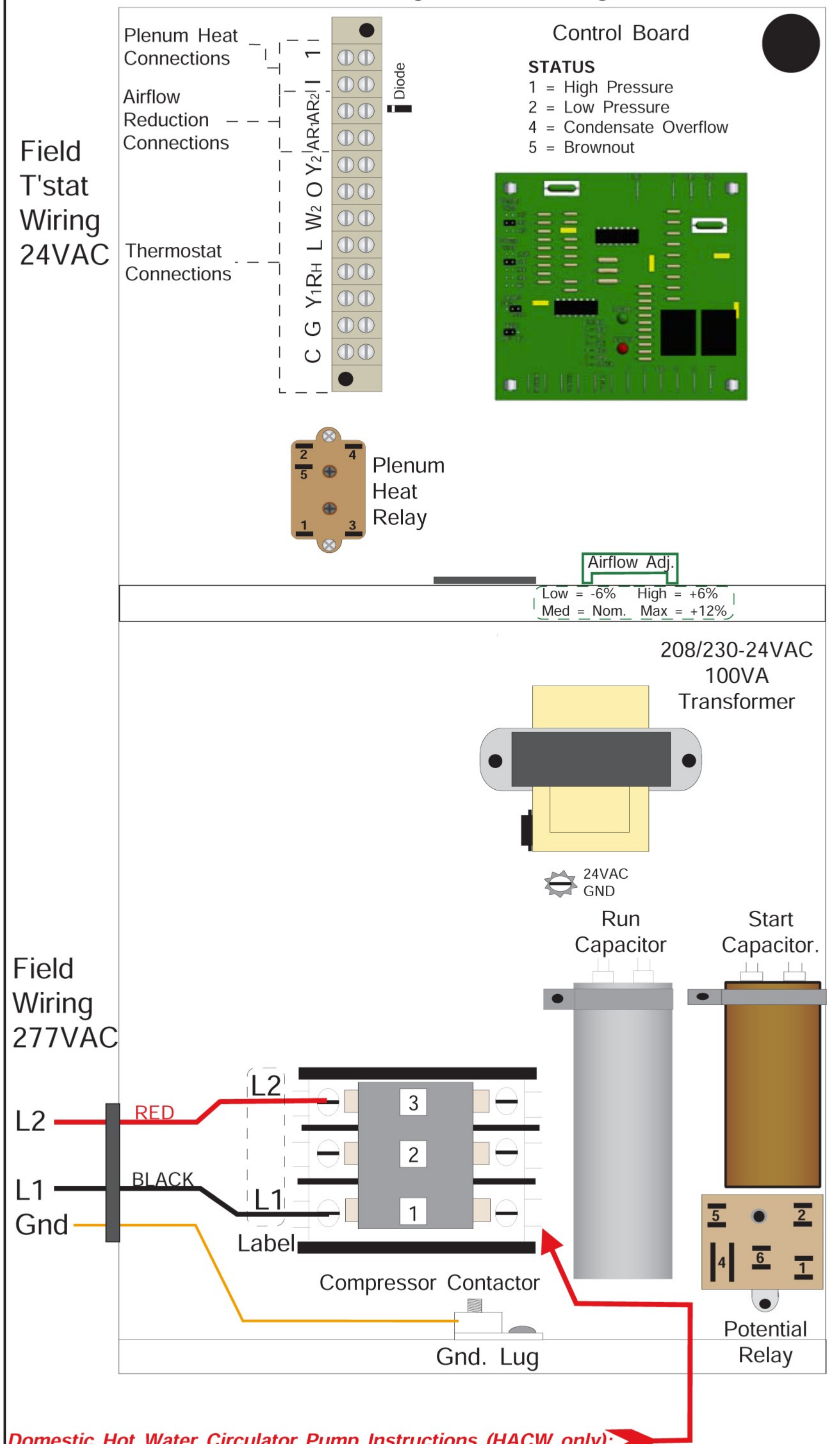
Drawing Name: R-25-75-HAC*-P-3*-*-*DE** Electrical Box Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	002114ELB	03	1 of 1

Electrical Box Layout - R-80 (265/277-1-60)

R-Series Electrical Box Diagram

277-1-60 / Single/Two Stage Scroll / ECM Fan / Modular Design



Low Voltage Wiring (24VAC)

Thermoststat Wiring

Use an 18-8 (7 for 1 stage) conductor cable. Connect the eight Thermostat Connections in the electrical box to the corresponding letters on the thermostat.

C - 24VAC Common
G - Fan
Y1 - Stage1 Heat/Cool (Compressor On/Off)
RH - 24VAC Hot
L - Trouble Indicator
W2 - Stage3 (2 for 1 stage) Heat (Plenum Heater)
O - Cooling (Reversing Valve)
Y2 - Stage2 (N/A for 1 stage) Heat/Cool (S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed will 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)

277VAC CONNECTIONS		
Wire	**Colour**	**Contactor**
Line 2	Red	L2
Line 1	Black	L1
Connect "Gnd" to Gnd. Lug		

Heat Pump Electrical Service Requirements
277VAC Single Phase 60Hz (277-1-60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
80	46	6-2	60

Domestic Hot Water Circulator Pump Instructions (HACW only):

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.** Once connected the external ON/OFF switch may be used to temporarily turn the pump off.

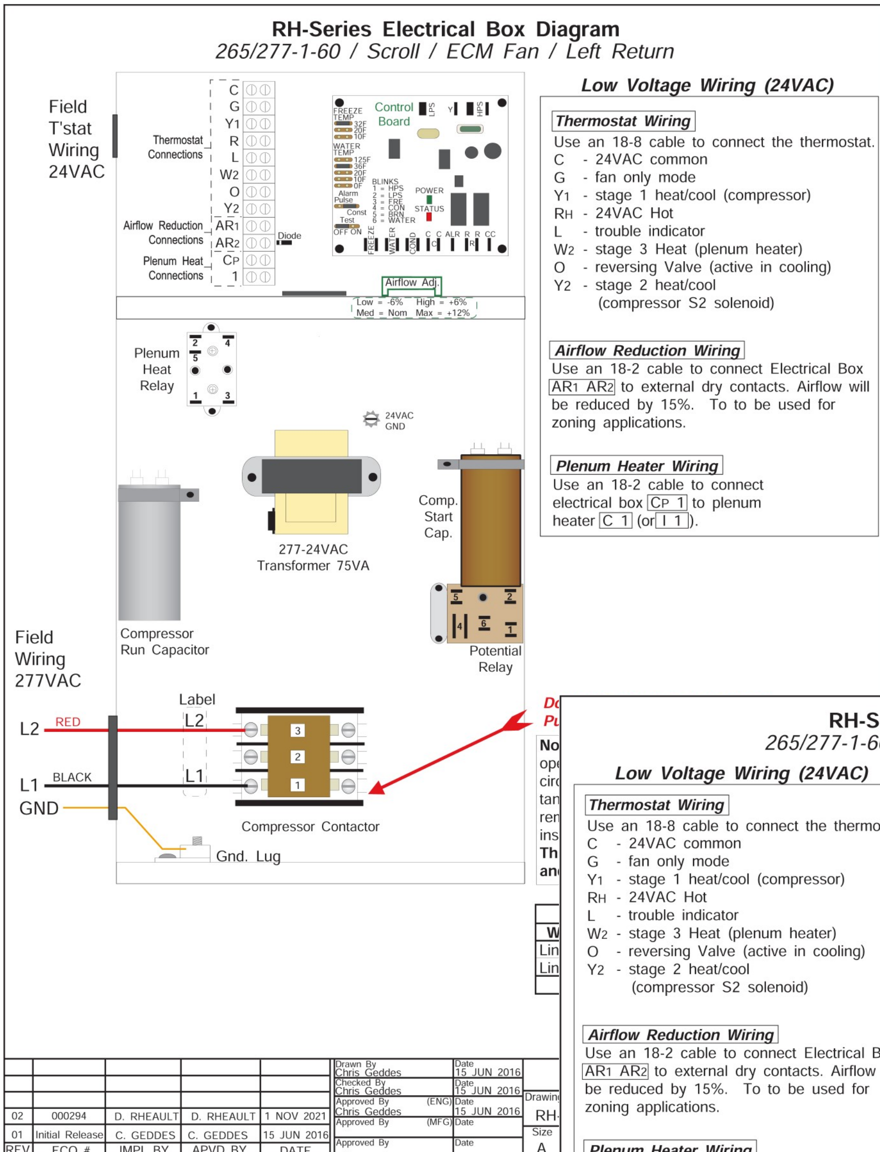
REV	ECO #	IMPL BY	APVD BY	DATE
02	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017
01	Initial Release	C. GEDDES	C. GEDDES	14 JUN 2016

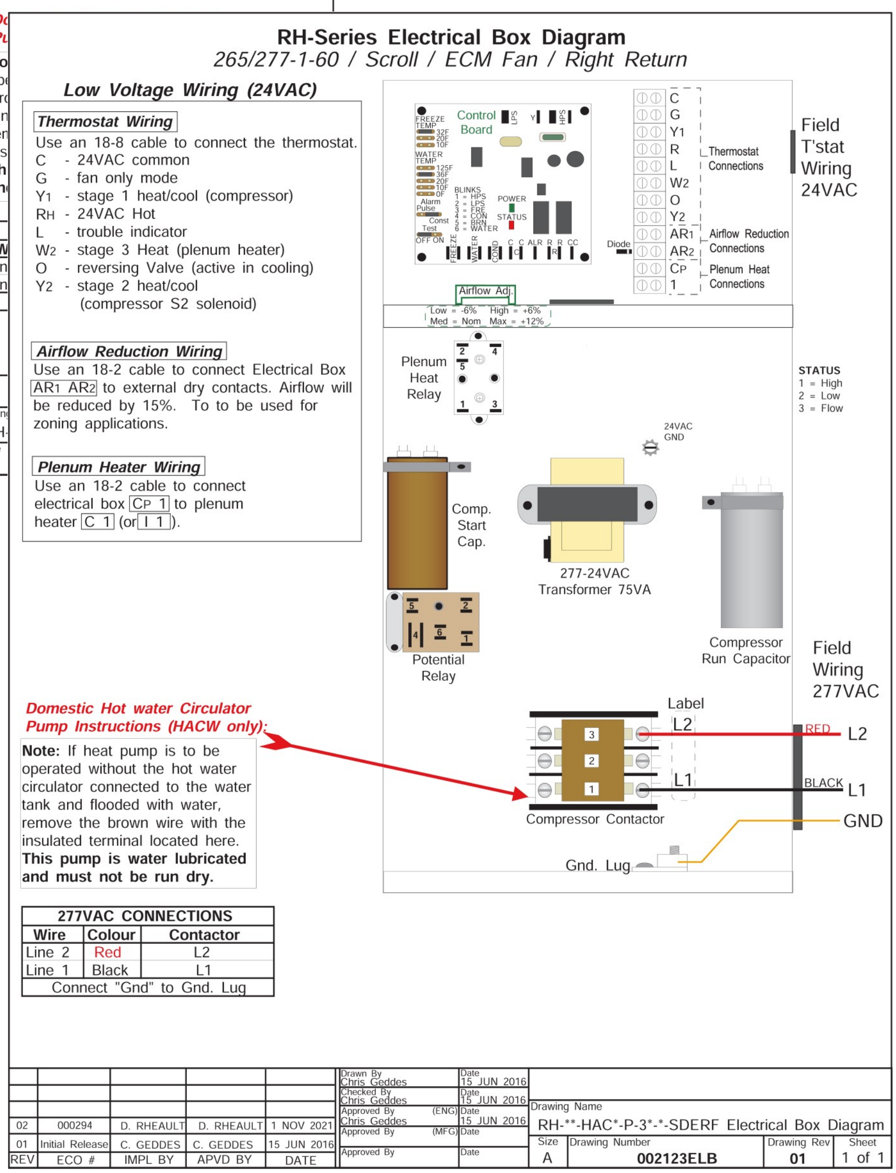
Drawn By	Chris Geddes	Date 14 JUN 2016
Checked By	Chris Geddes	Date 14 JUN 2016
Approved By (ENG)	Chris Geddes	Date 14 JUN 2016
Approved By (MFG)		Date
Approved By		Date

Drawing Name: R-80-HAC*-P-3*-*-*DE** Electrical Box Diagram

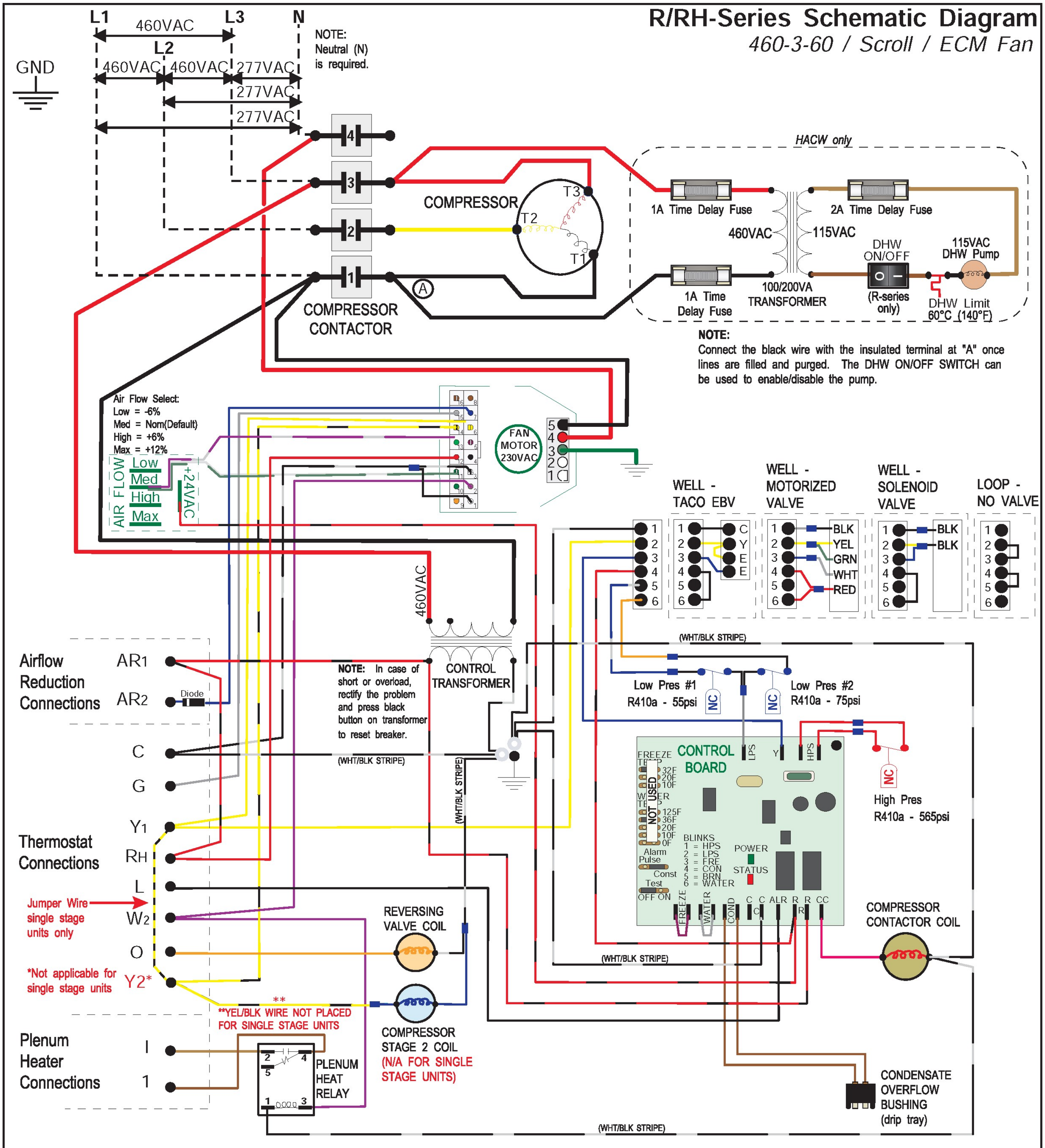
Size	Drawing Number	Drawing Rev	Sheet
A	002118ELB	02	1 of 1

Electrical Box Layout - RH 45-75 (265/277-1-60)





Wiring Diagram (460-3-60)



PLENUM HEATER OPERATION

- I & 1 provides a dry contact for operating plenum heater.
- Fan will run automatically with thermostat W2 signal.

AIRFLOW REDUCTION

Connect AR1 & AR2 together with dry contact to reduce the airflow for zone applications.

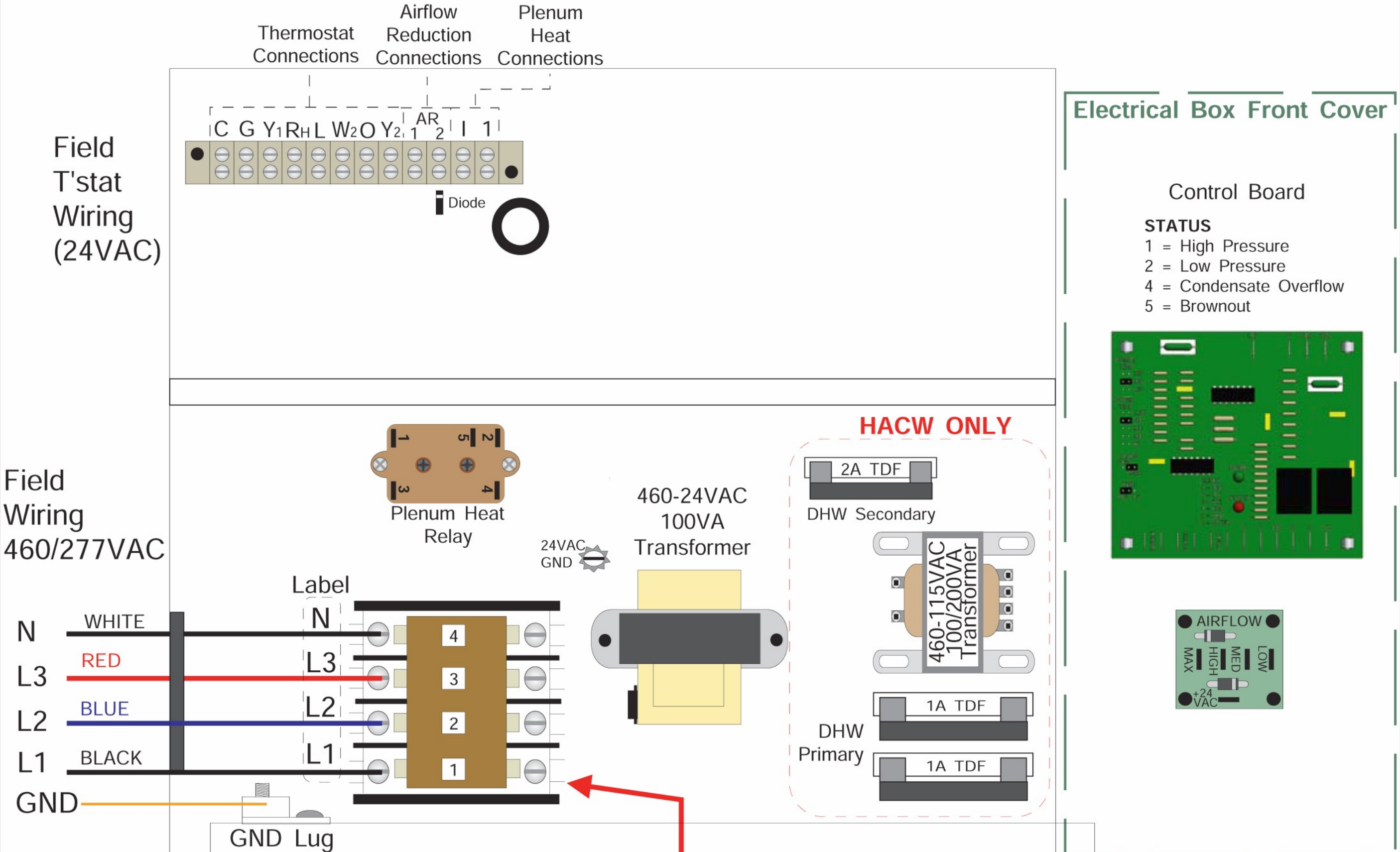
REV	ECO #	IMPL BY	APVD BY	DATE
05	000305	D. RHEAULT	D. RHEAULT	6 SEP 2022
04	000294	D. RHEAULT	D. RHEAULT	1 NOV 2021
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017
01	IR	C. GEDDES	C. GEDDES	14 JUN 2016

Drawn By: Chris Geddes	Date: 14 JUN 2016	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By: Chris Geddes	Date: 14 JUN 2016	Drawing Name: R/RH-**-HAC*-P-4*-*-*DE** Schematic Diagram
Approved By (ENG): Chris Geddes	Date: 14 JUN 2016	
Approved By (MFG)	Date	Size: A / Drawing Number: 002115SCH / Drawing Rev: 05 / SHEET: 1 of 1
Approved By	Date	

Electrical Box Layout - R 25-75 (460-3-60)

R-Series Electrical Box Diagram

460-3-60 / Single/Two Stage Scroll / ECM Fan / Slim Design



Domestic Hot Water Circulator Pump Instructions (HACW only):
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.** Once connected the external ON/OFF switch may be used to temporarily turn the pump off.

IMPORTANT NOTE FOR THREE PHASE SCROLL COMPRESSORS

This unit is quipped with scroll compressors which must rotate in the proper direction. After the initial connection, start the compressors while observing the suction and discharge pressures with a refrigeration gauge set. If the compressors are not pumping, reverse the L1 and L2 supply leads and recheck. (Reversing any two of the three input wires to a three phase motor will reverse the rotation direction of the motor.

460/277VAC CONNECTIONS			
Wire	**Colour**	**Label**	**Contactor**
N	White	N	4
L3	Red	L3	3
L2	Blue	L2	2
L1	Black	L1	1
Connect "Gnd" to Gnd. Lug			

Heat Pump Electrical Service Requirements
460VAC Three Phase 60Hz (460-3-60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
25	8	14-4	15
45	11	14-4	15
55	13	12-4	20
65	15	12-4	20
75	18	10-4	30

Low Voltage Wiring (24VAC)

Thermoststat Wiring

Use an 18-8 (7 for 1 stage) conductor cable. Connect the eight Thermostat Connections in the electrical box to the corresponding letters on the thermostat.

C - 24VAC Common
G - Fan
Y1 - Stage1 Heat/Cool (Compressor On/Off)
RH - 24VAC Hot
L - Trouble Indicator
W2 - Stage3 (2 for 1 stage) Heat (Plenum Heater)
O - Cooling (Reversing Valve)
Y2 - Stage2 (N/A for 1 stage) Heat/Cool (S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed will 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)

					Drawn By Chris Geddes	Date 14 JUN 2016
					Checked By Chris Geddes	Date 14 JUN 2016
03	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017	Approved By (ENG) Chris Geddes	Date 14 JUN 2016
01	IR	C. GEDDES	C. GEDDES	14 JUN 2016	Approved By (MFG)	Date
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date

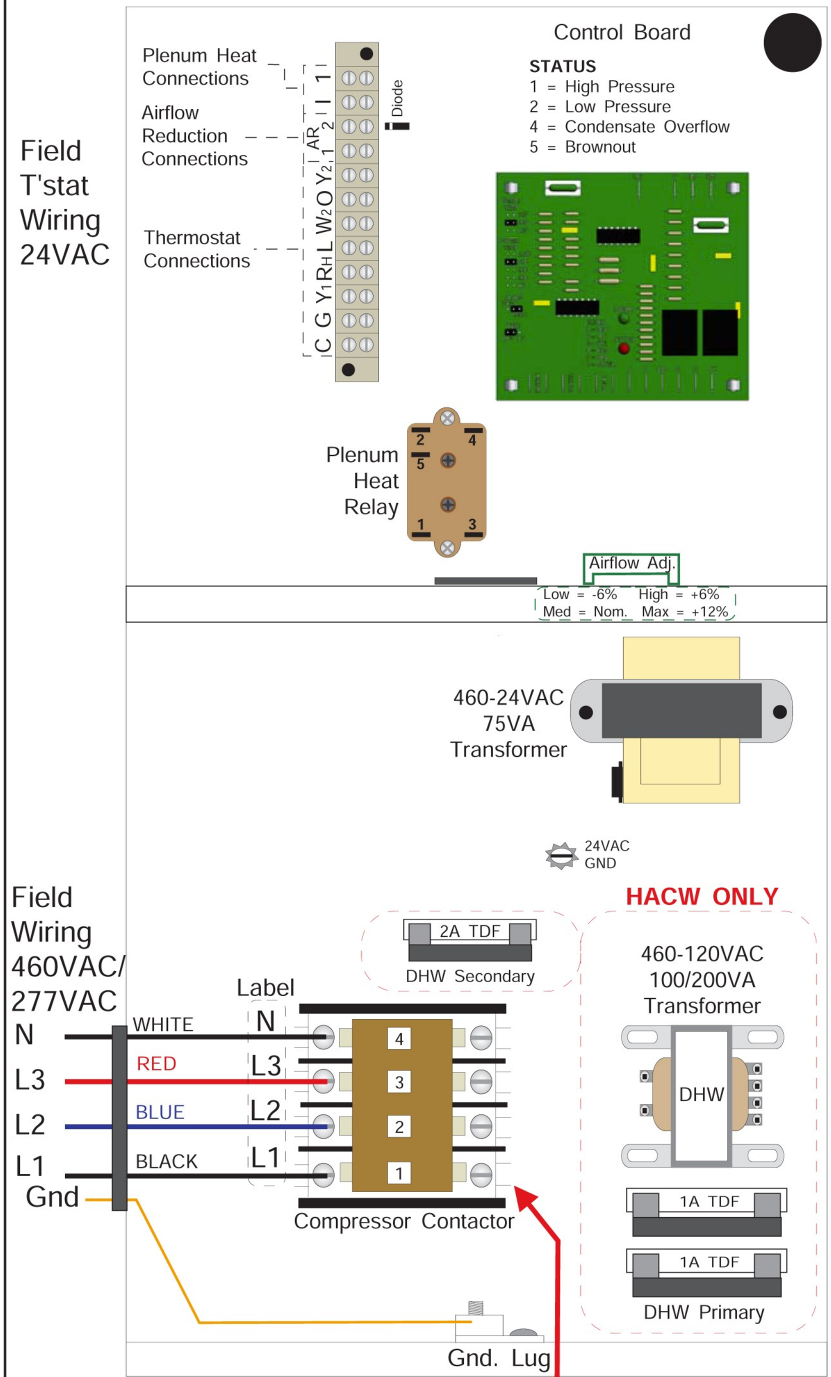
Drawing Name
R-25-75-HAC*-P-4*-*-*DE** Electrical Box Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	002116ELB	03	1 of 1

Electrical Box Layout - R-80 (460-3-60)

R-Series Electrical Box Diagram

460-3-60 / Modular Design



Low Voltage Wiring (24VAC)

Thermostat Wiring

Use an 18-8 (7 for 1 stage) conductor cable. Connect the eight Thermostat Connections in the electrical box to the corresponding letters on the thermostat.

C - 24VAC Common
G - Fan
Y1 - Stage1 Heat/Cool (Compressor On/Off)
RH - 24VAC Hot
L - Trouble Indicator
W2 - Stage3 (2 for 1 stage) Heat (Plenum Heater)
O - Cooling (Reversing Valve)
Y2 - Stage2 (N/A for 1 stage) Heat/Cool (S2 Solenoid)

Airflow Reduction Wiring

Use an 18-2 conductor cable to connect Electrical Box AR1 AR2 to dry contacts. Fan speed will 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)

IMPORTANT NOTE FOR THREE PHASE SCROLL COMPRESSORS

This unit is quipped with scroll compressors which must rotate in the proper direction. After the initial connection, start the compressors while observing the suction and discharge pressures with a refrigeration gauge set. If the compressors are not pumping, reverse the L1 and L2 supply leads and recheck. (Reversing any two of the three input wires to a three phase motor will reverse the rotation direction of the motor.

460/277VAC CONNECTIONS			
Wire	**Colour**	**Label**	**Contactor**
N	White	N	4
L3	Red	L3	3
L2	Blue	L2	2
L1	Black	L1	1
Connect "Gnd" to Gnd. Lug			

Heat Pump Electrical Service Requirements
460VAC Single Phase 60Hz (460-1-60)

Model Size	Min. Circuit Ampacity	Min. Wire Gauge	TD Fuse or Breaker
80	21	10-4	30

Domestic Hot Water Circulator Pump Instructions (HACW only):

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.** Once connected the external ON/OFF switch may be used to temporarily turn the pump off.

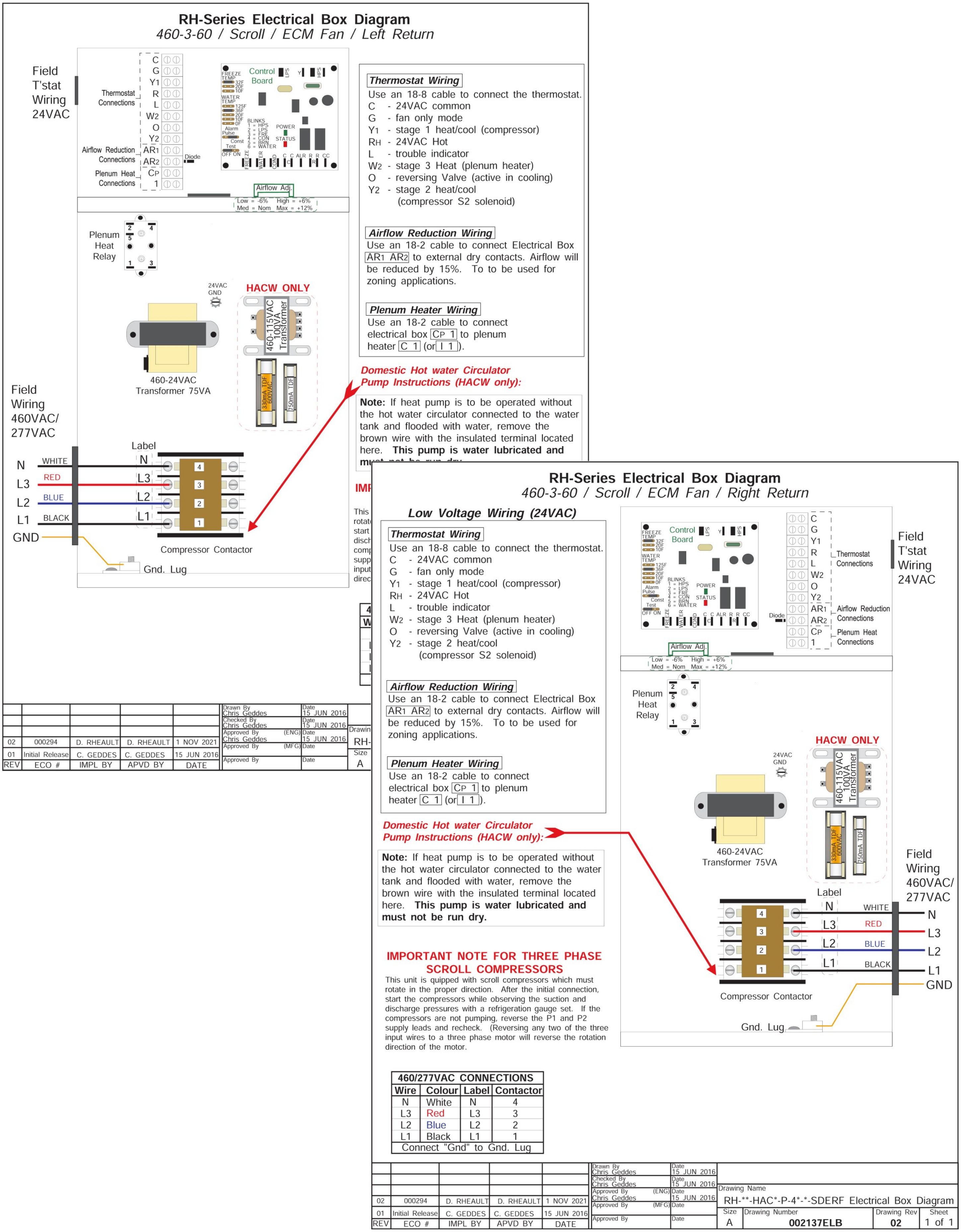
REV	ECO #	IMPL BY	APVD BY	DATE
02	000251	D. RHEAULT	D. RHEAULT	15 MAY 2017
01	Initial Release	C. GEDDES	C. GEDDES	14 JUN 2016

Drawn By: Chris Geddes	Date: 14 JUN 2016
Checked By: Chris Geddes	Date: 14 JUN 2016
Approved By (ENG): Chris Geddes	Date: 14 JUN 2016
Approved By (MFG)	Date
Approved By	Date

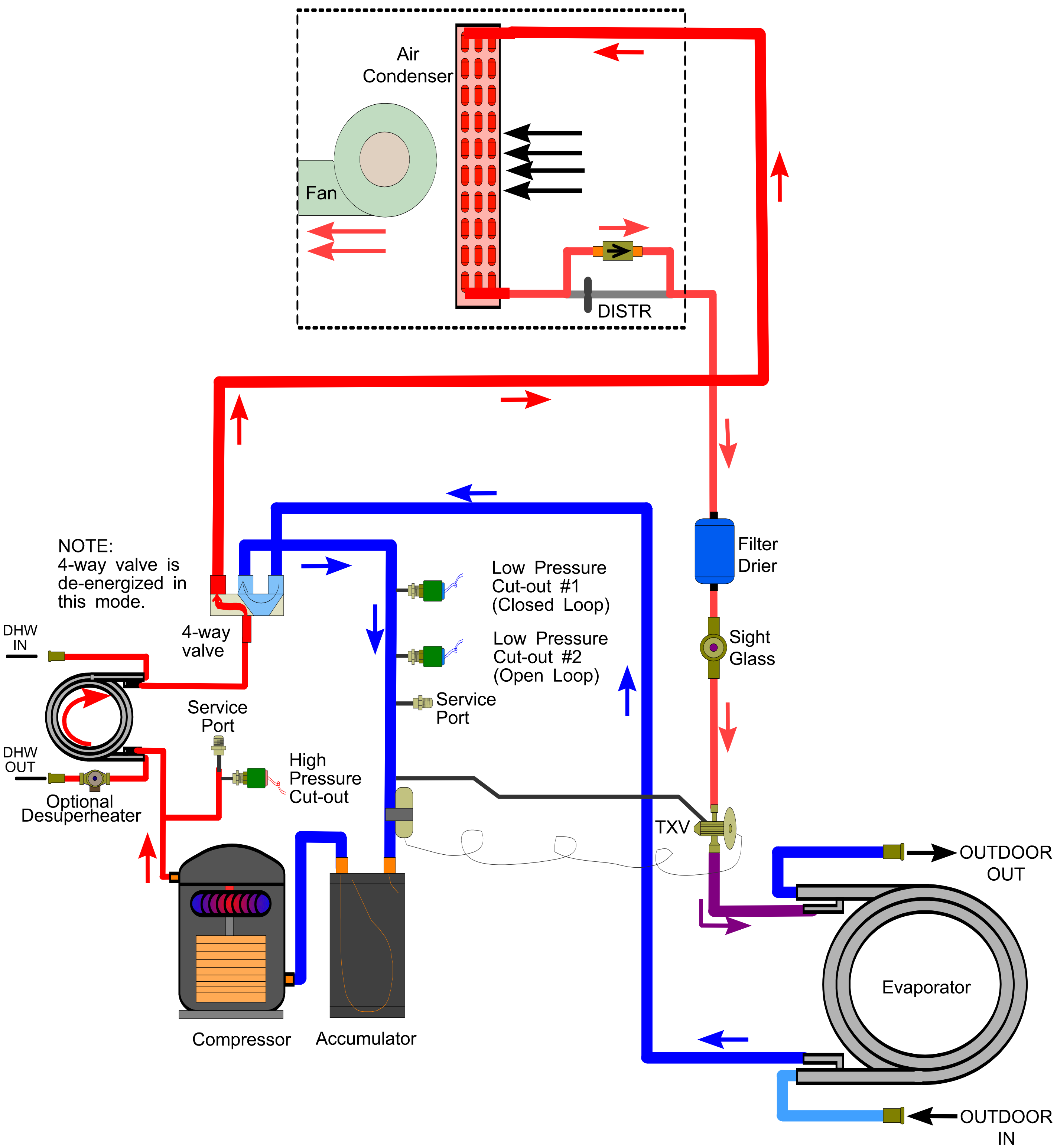
Drawing Name: R-80-HAC*-P-4*-*-*DE** Electrical Box Diagram

Size	Drawing Number	Drawing Rev	Sheet
A	002120ELB	02	1 of 1

Electrical Box Layout - RH 25-75 (460-3-60)



R(H)-Series Refrigeration Circuit - Heating Mode



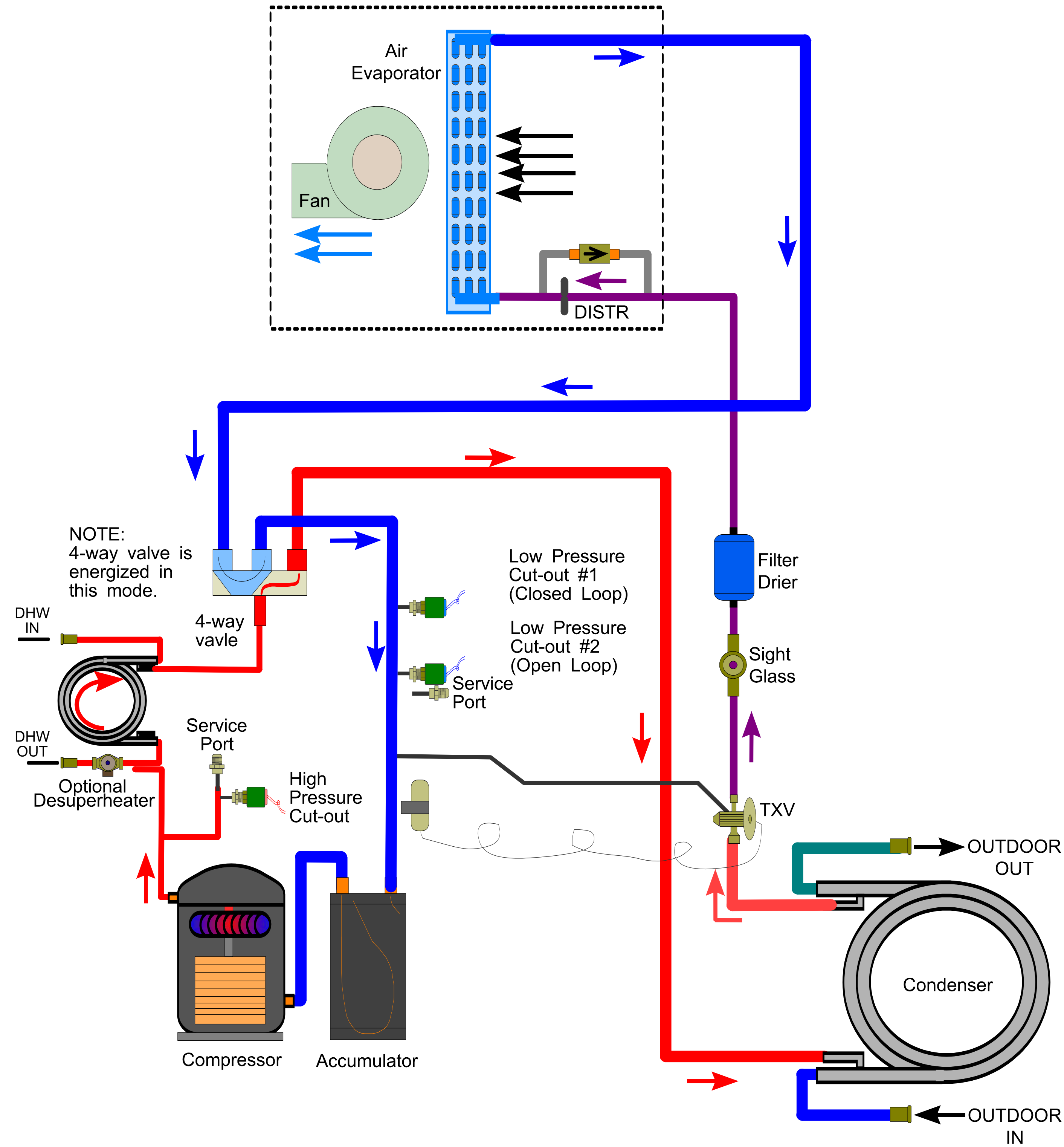
03	000212	D. RHEAULT	C. GEDDES	01 JAN 2014
02	000203	D. RHEAULT	D. RHEAULT	26 SEP 12
01	Initial Release	C. GEDDES	C. GEDDES	25 JAN 10
REV	ECO #	IMPL BY	APVD BY	DATE

Drawn By Chris Geddes	Date 25 JAN 10
Checked By Chris Geddes	Date 25 JAN 10
Approved By (ENG) Chris Geddes	Date 25 JAN 10
Approved By (MFG)	Date
Approved By	Date

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

Drawing Name			
R(H)-Series Refrigeration Circuit Diagram - Heating Mode			
Size	Drawing Number	Drawing Rev	SHEET
A	001207RCD	03	1 of 1

R(H)-Series Refrigeration Circuit - Cooling Mode

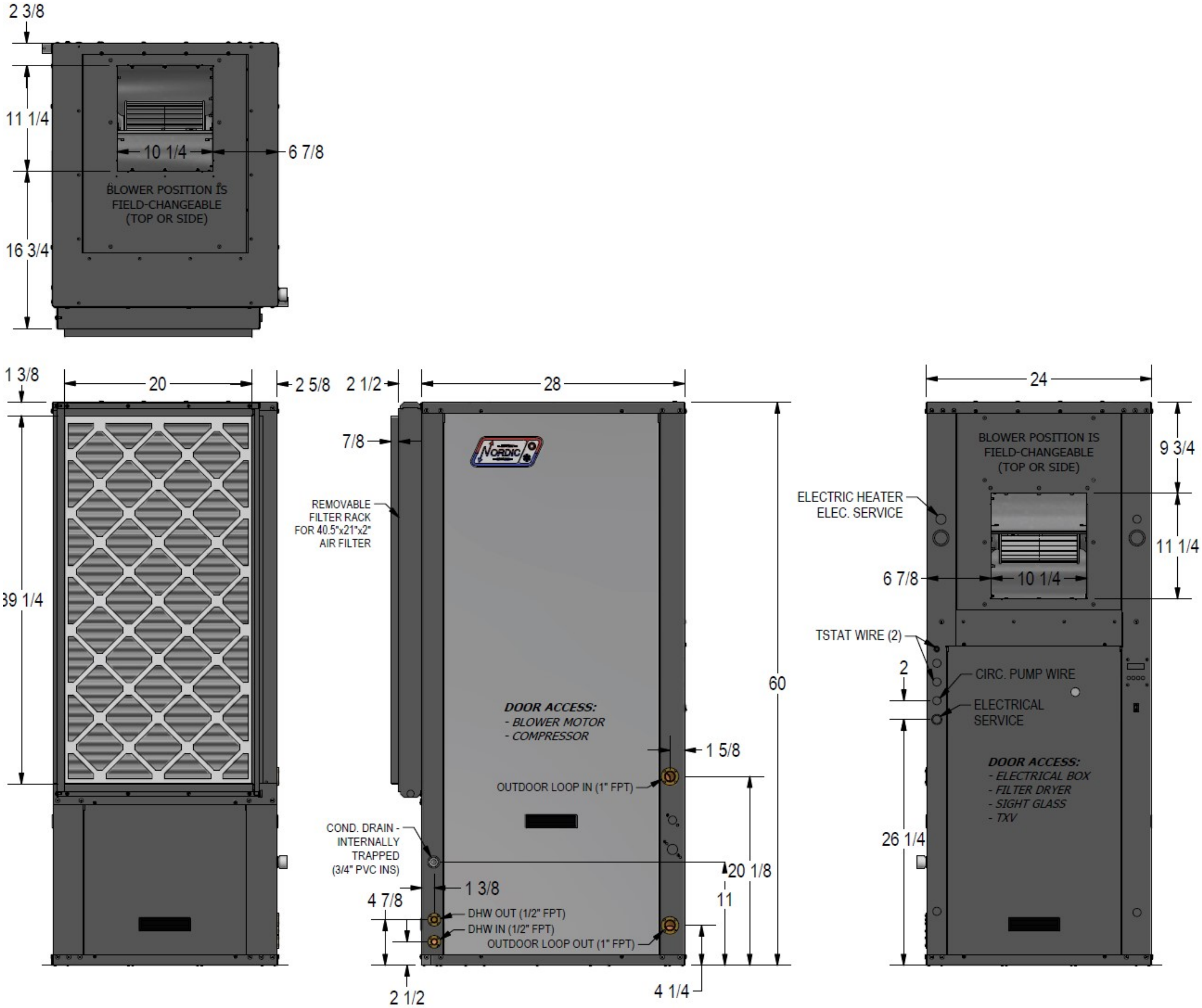


					Drawn By Chris Geddes	Date 25 JAN 10
					Checked By Chris Geddes	Date 25 JAN 10
03	000212	C. GEDDES	C. GEDDES	01 JAN 2014	Approved By (ENG) Chris Geddes	Date 25 JAN 10
02	000203	D. RHEAULT	D. RHEAULT	26 SEP 12	Approved By (MFG)	Date
01	Initial Release	C. GEDDES	C. GEDDES	25 JAN 10	Approved By	Date
REV	ECO #	IMPL BY	APVD BY	DATE		

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

Drawing Name			
R(H)-Series Refrigeration Circuit Diagram - Cooling Mode			
Size	Drawing Number	Drawing Rev	SHEET
A	001208RCD	03	1 of 1

Dimensions: R-45 Left Return

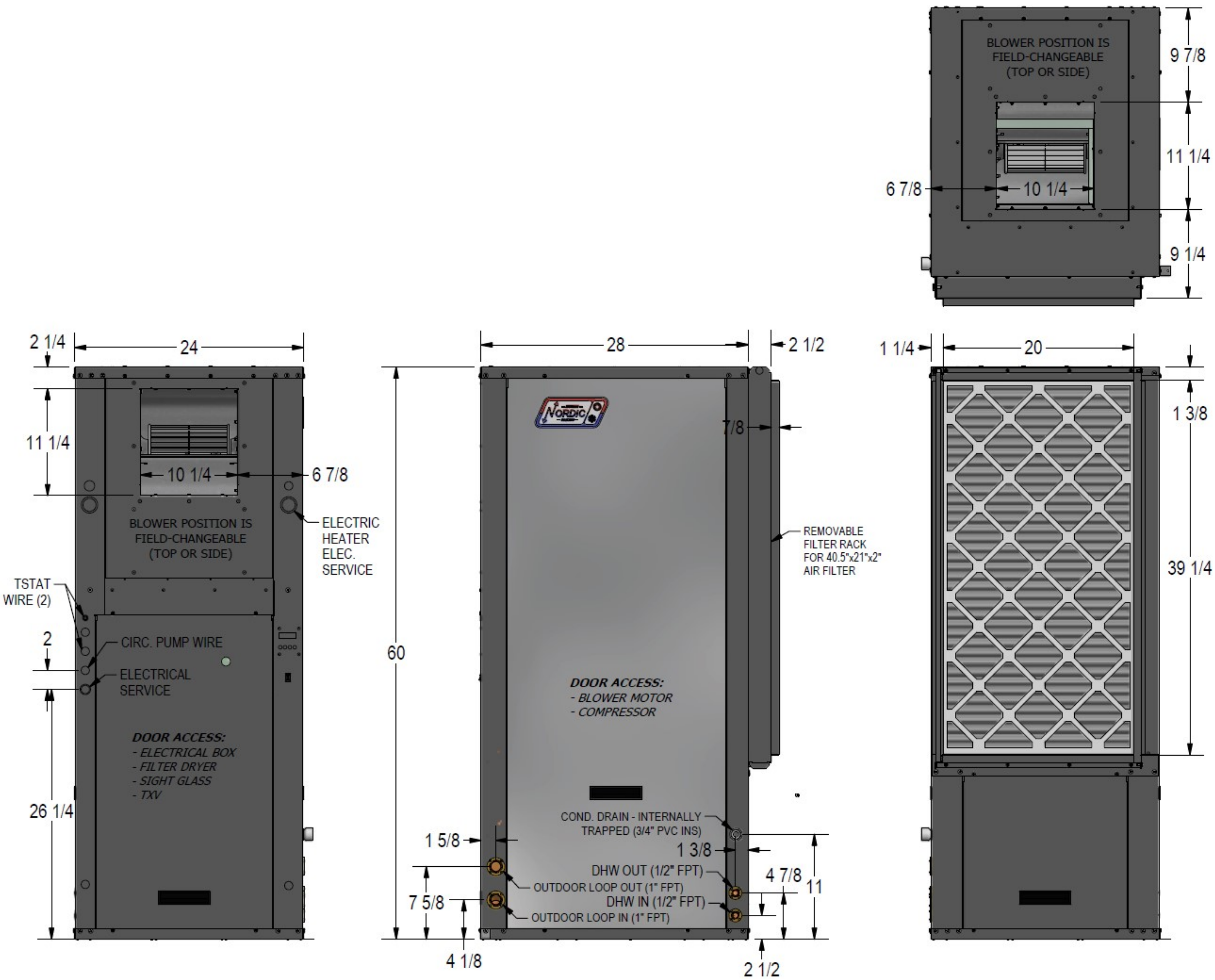


RECOMMENDED
FRONT CLEARANCE:
2 FT

RECOMMENDED
RIGHT SIDE
CLEARANCE:
2 FT

NO BACK CLEARANCE REQUIRED

Dimensions: R-45 Right Return

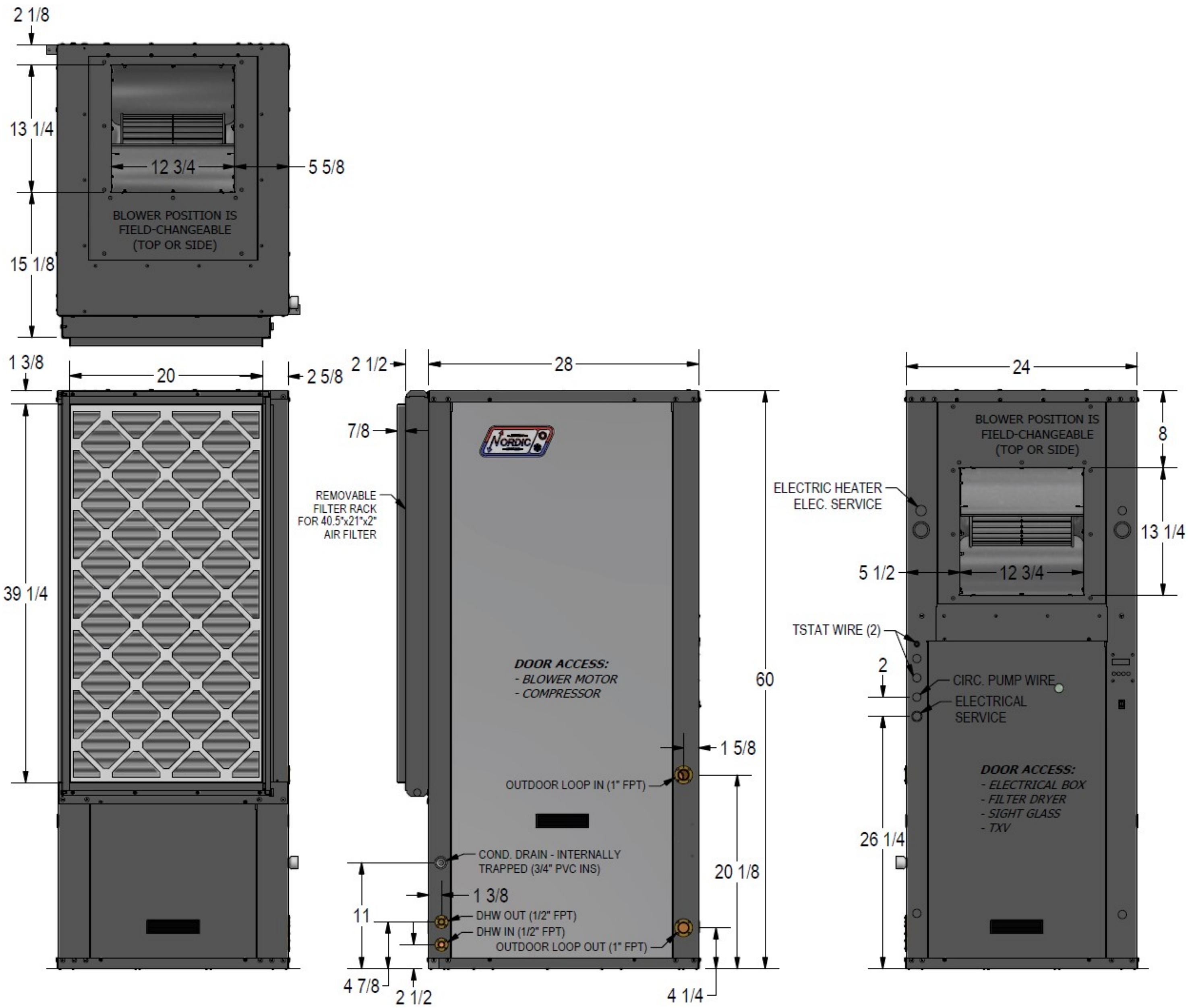


RECOMMENDED
LEFT SIDE
CLEARANCE:
2 FT

RECOMMENDED
FRONT CLEARANCE:
2 FT

NO BACK CLEARANCE REQUIRED

Dimensions: R-55/65/75 Left Return

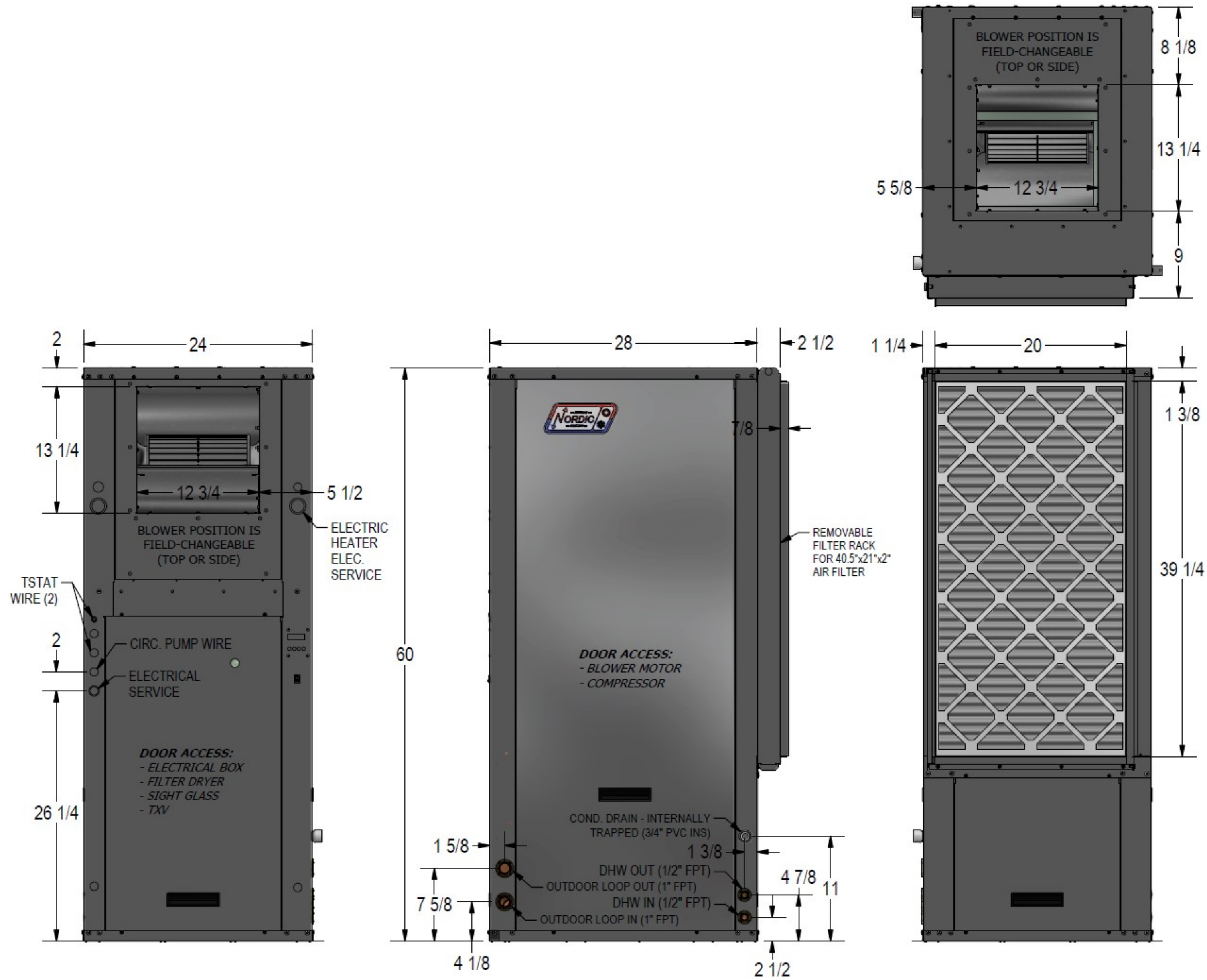


RECOMMENDED FRONT CLEARANCE:
2 FT

RECOMMENDED RIGHT SIDE CLEARANCE:
2 FT

NO BACK CLEARANCE REQUIRED

Dimensions: R-55/65/75 Right Return

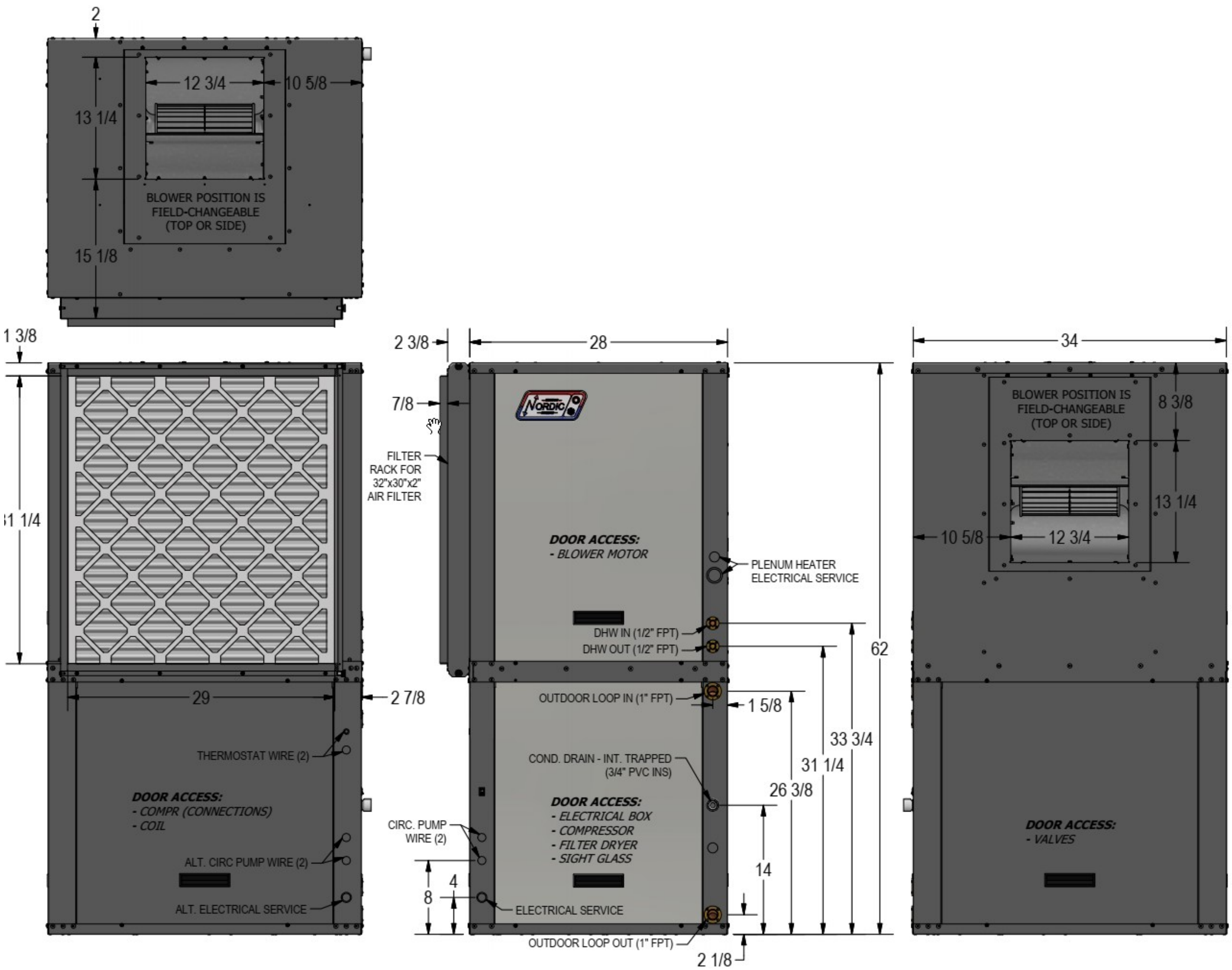


RECOMMENDED
LEFT SIDE
CLEARANCE:
2 FT

RECOMMENDED
FRONT CLEARANCE:
2 FT

NO BACK CLEARANCE REQUIRED

Dimensions: R-80 Left Return

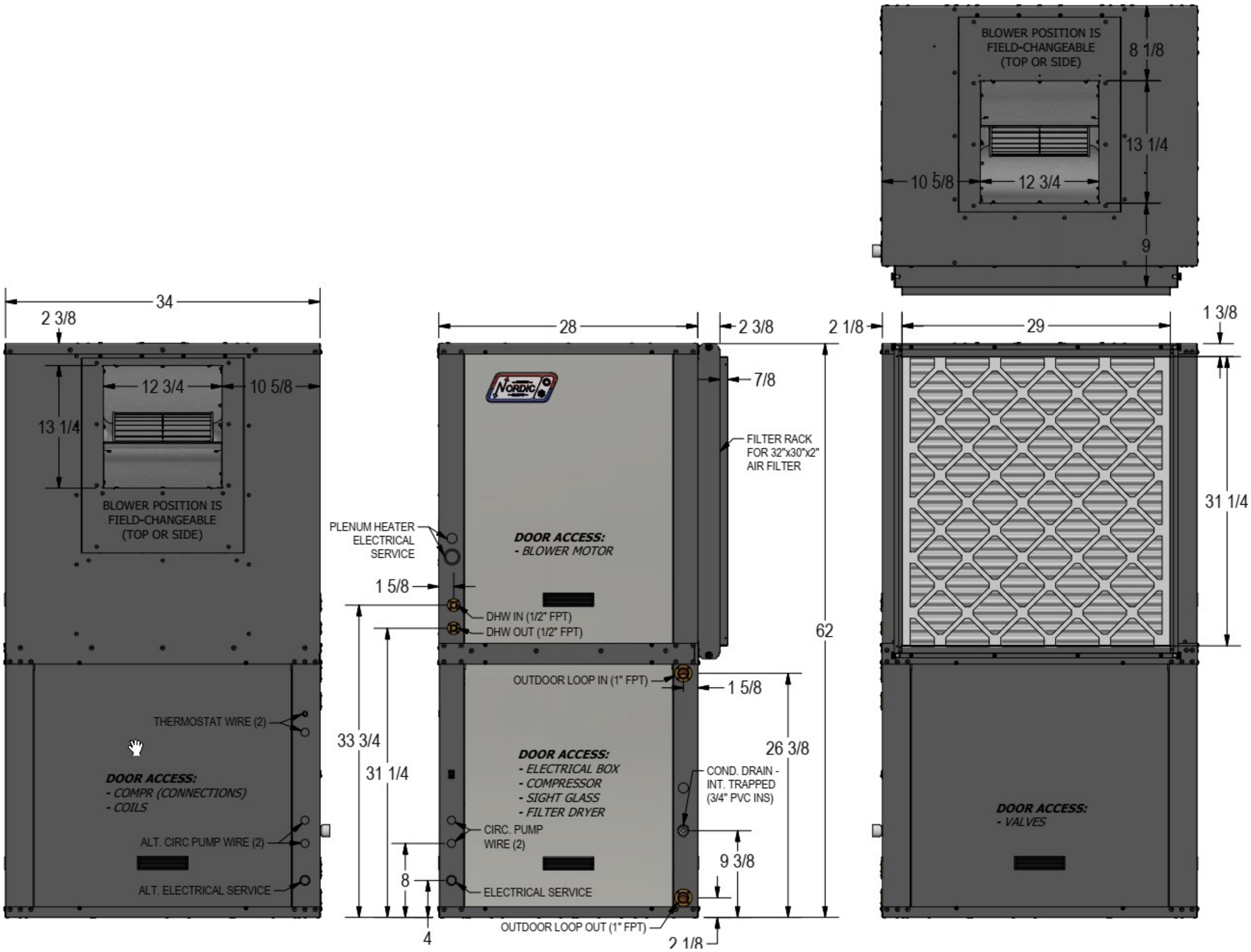


RECOMMENDED
FRONT CLEARANCE:
2 FT

RECOMMENDED
RIGHT SIDE
CLEARANCE:
2 FT

NO BACK CLEARANCE REQUIRED

Dimensions: R-80 Right Return



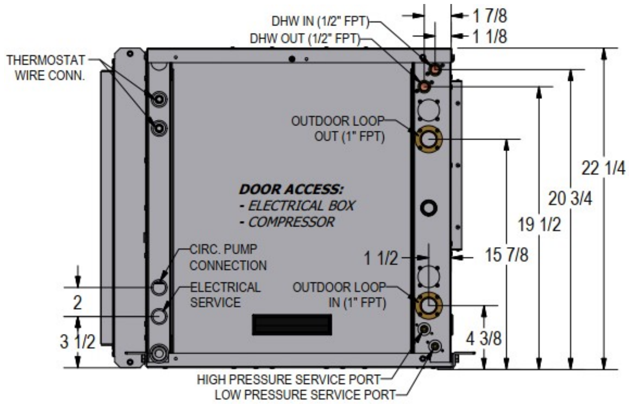
RECOMMENDED
LEFT SIDE
CLEARANCE:
2 FT

RECOMMENDED
FRONT CLEARANCE:
2 FT

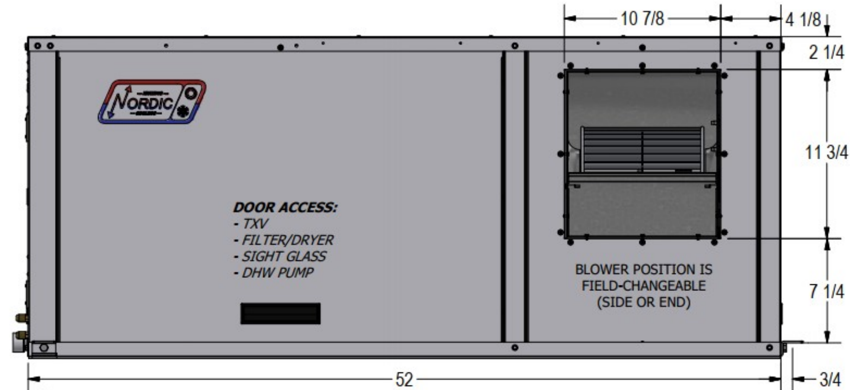
NO BACK CLEARANCE REQUIRED

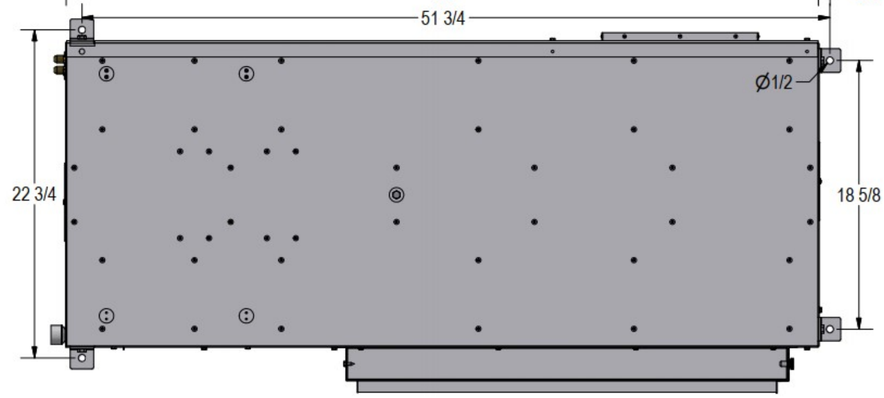
Dimensions: RH-45 Left Return

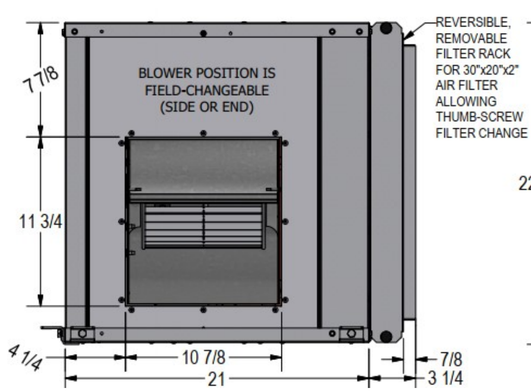
RECOMMENDED
FRONT CLEARANCE:
2 FT

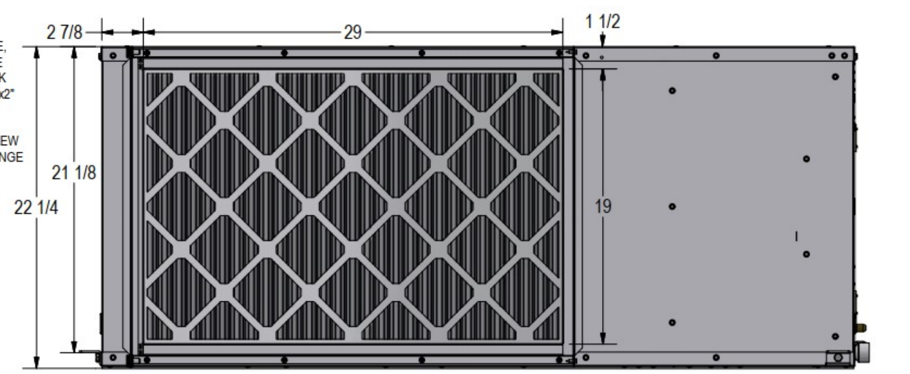


RECOMMENDED RIGHT SIDE CLEARANCE:
2 FT





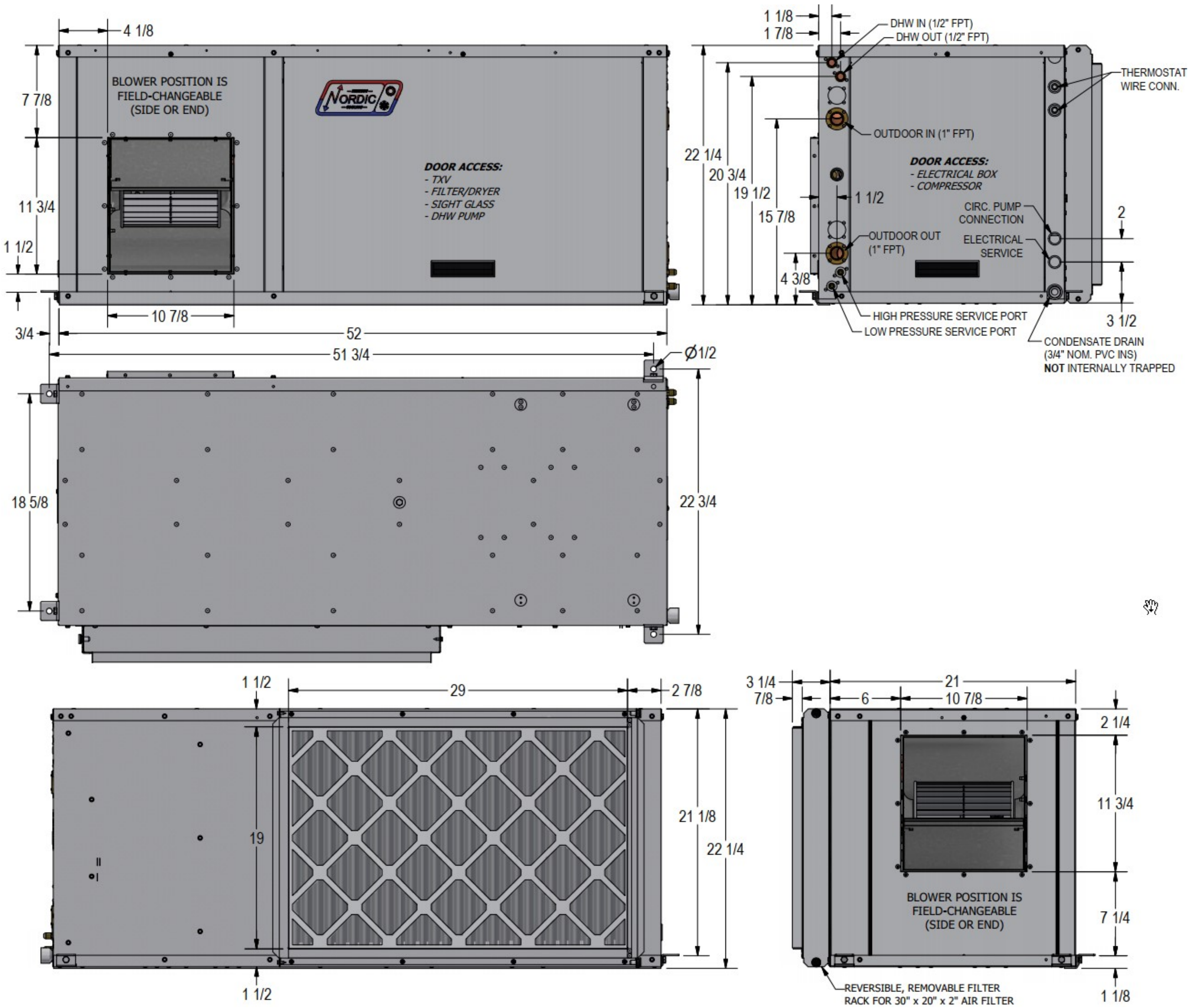




Dimensions: RH-45 Right Return

RECOMMENDED LEFT SIDE CLEARANCE:
2 FT

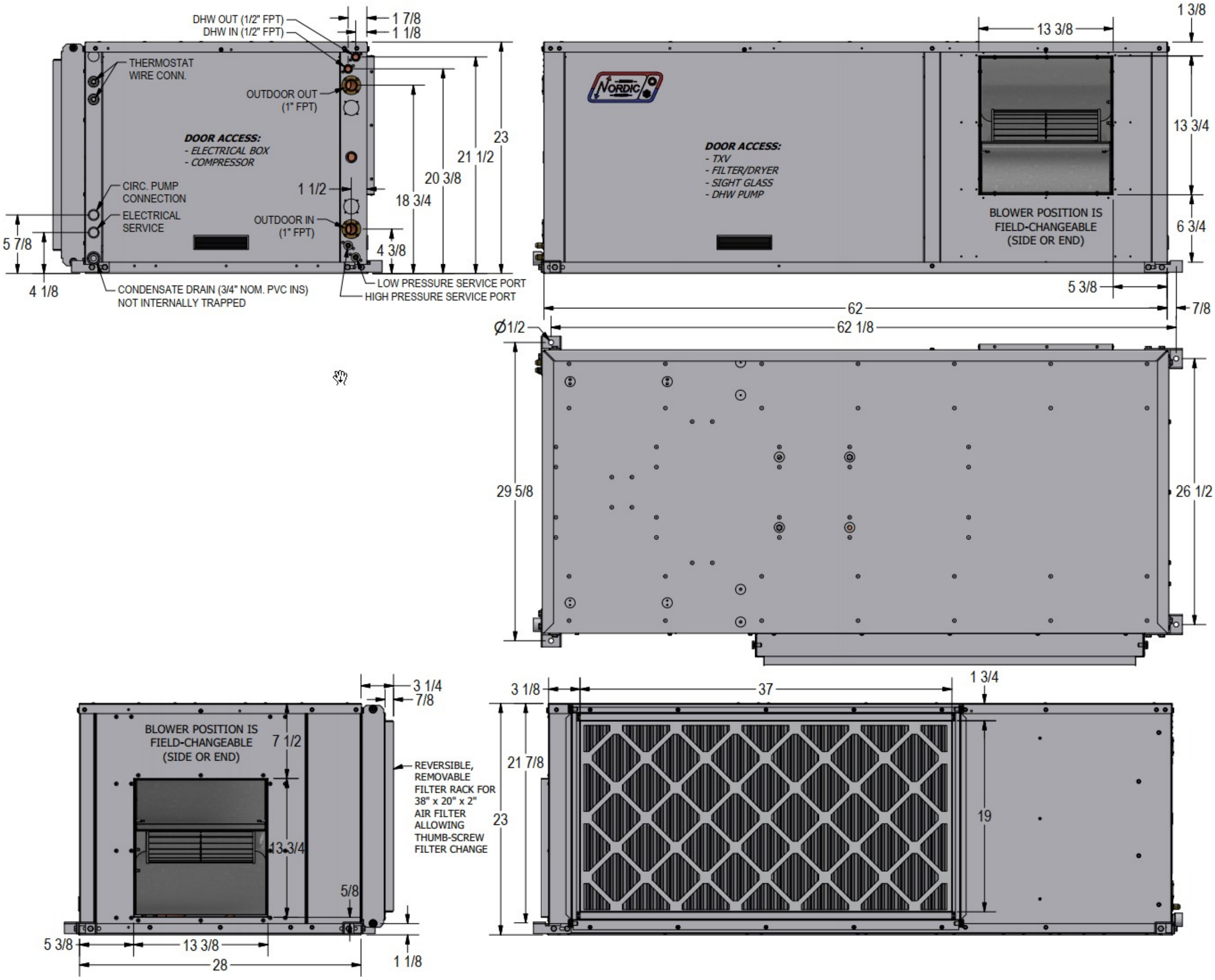
RECOMMENDED
FRONT CLEARANCE:
2 FT



Dimensions: RH-55/65/75 Left Return

RECOMMENDED
FRONT CLEARANCE:
2 FT

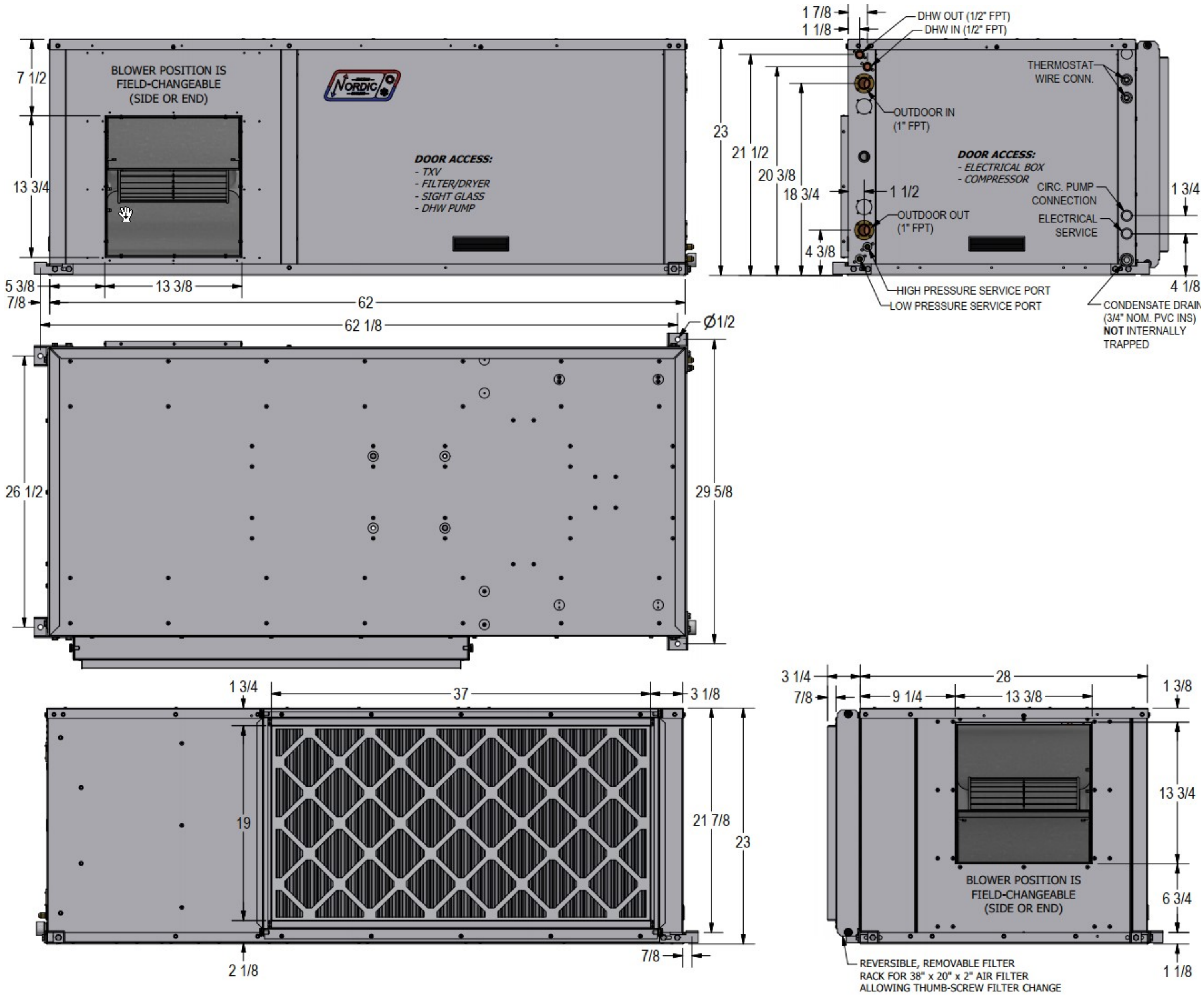
RECOMMENDED RIGHT SIDE CLEARANCE:
2 FT



Dimensions: RH-55/65/75 Right Return

RECOMMENDED LEFT SIDE CLEARANCE:
2 FT

RECOMMENDED
FRONT CLEARANCE:
2 FT



Warranty: R/RH-Series

RESIDENTIAL LIMITED EXPRESS WARRANTY

Unless a statement is specifically identified as a warranty, statements made by Maritime Geothermal Ltd. ("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.
SET FORTH HERE IS THE ONLY EXPRESS WARRANTY THAT APPLIES TO 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 BEAR 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, notwithstanding 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, malfunction 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.

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.