Application, Installation, & Service Manual

R/RH-Series Liquid to Air Heat Pumps

Single-Stage R454b
Model Sizes 09-24

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LOOK FOR GREY TEXT BOXES LIKE THIS ONE THROUGHOUT MANUAL FOR
A2L-SPECIFIC WARNINGS / INSTRUCTIONS

A2L refrigerant: mildly flammable.

Installation and service work should only be performed by properly certified technicians with A2L-specific training. See also Service Procedures chapter.

Refrigerant does NOT have an odour so is only detectable with suitable field instruments.

Do NOT pierce or burn. Do NOT use flame to defrost or clean. Check for presence of refrigerant using a detector before initiating any service work, especially work involving torches.

For units covered in this manual, refrigerant charge is less than "m_1" as defined in the UL/CSA 60335-2-40 standard (m_1=3.9lb / 1.8kg for R454b). Therefore, an A2L leak detection system is not required.

Installation of a unit with A2L refrigerant may require calculations involving the size of the mechanical room and/or rooms served by the unit. However, the equipment covered by this manual is likely to be exempt since refrigerant charge is less than "m_1" as defined in the UL/CSA 60335-2-40 standard.

GENERAL SAFETY PRECAUTIONS

To avoid electric shock, which can cause serious injury or death, ensure all access panels are in place and properly secured before applying power to the unit. Before performing service or maintenance on the heat pump system, ensure all power sources are DISCONNECTED.

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.

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

This appliance is not intended for intervention by persons with reduced physical, sensory, or mental capabilities or lack of experience and knowledge, unless suitably supervised. Children should be prevented from playing with appliance.

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Model Nomenclature

R—18—HAC—X—1L—C—SDELT—01

Series:
R = Reversing liquid to air, **vertical**
RH = Reversing liquid to air, **horizontal**

Nominal Size:
09 = 0.75 ton
12 = 1 ton
18 = 1.5 ton
24 = 2 ton

Functions:
H = Heating
AC = Active Cooling

Refrigerant:
X = R454b **[A2L]**

Voltage Code:
1 = 208/230-1-60 VAC (factory set to 230-1-60)
3 = 265/277-1-60
9 = 208/230-1-60 VAC (factory set to 208-1-60)

Compressor:
L = fixed speed rotary

Outdoor Loop Exchanger:
C = copper coaxial coil
Z = CuNi coaxial coil

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

Blower Type:
D = direct drive

Blower Motor:
E = ECM (5spd)

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

Air Supply Orientation:
T = top
F = field configurable
(end or side)

Revision:
01, 02 etc.

APPLICATION/AVAILABILITY TABLE											
MODEL SERIES	**MODEL SIZE**	**FUNCTION**	**REFRIGERANT**	**VOLTAGE**	**COMPRESSOR**	**OUTDOOR COIL**	**FAN/CASE**	**REVISIONS**			
R	09 12 24	HAC	X	1 3 9	L	C Z	SDELT SDERT	01			
R	24	HAC	X	1 9	L	C Z	SDELT SDERT	01			
RH	09 12 24	HAC	X	1 3 9	L	C Z	SDELF SDERF	01			
RH	24	HAC	X	1 9	L	C Z	SDELF SDERF	01			
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 vertical **R-series** and horizontal **RH-series**, geothermal standards for more than 40 years, are package water source heat pumps that can heat or chill air in a forced air duct system. Being 'ground source', 'water source', 'geo-exchange', or 'geothermal' heat pumps, the R and RH-series do require a **building loop**, **ground loop** or **open loop water well** for a heat source/sink. There is no outdoor fan unit for ground source heat pumps.

The residential **NORDIC R/RH** product line, with premium features expected in a central heating/cooling system, runs from size **45** to **75**. The smaller **R/RH-09** to **24** described in this document aim to economize on price while still maintaining high reliability and many premium features. They are normally considered a 'commercial' product for multiple-unit installations, although they can be employed residentially.

On R/RH-09 to 24, there is no desuperheater for DHW heating. A single stage rotary compressor with built in accumulator is used. The blower motor is an ECM, which has 5 fixed constant torque airflow settings which are selected during installation. The outdoor loop refrigerant to water heat exchanger is a heavy duty coaxial copper / steel model, and an optional CuNi inner tube may be available for challenging water applications (check with factory). A single thermostatic expansion valve (TXV) regulates superheat. The cabinet is constructed from galvanized sheet metal, partly powder coated.

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, well water, or building loop. The heat pump is activated by by a standard 2H/1C 24V room thermostat, which will call for heat from the compressor first. The thermostat can also call for stage 2 (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.

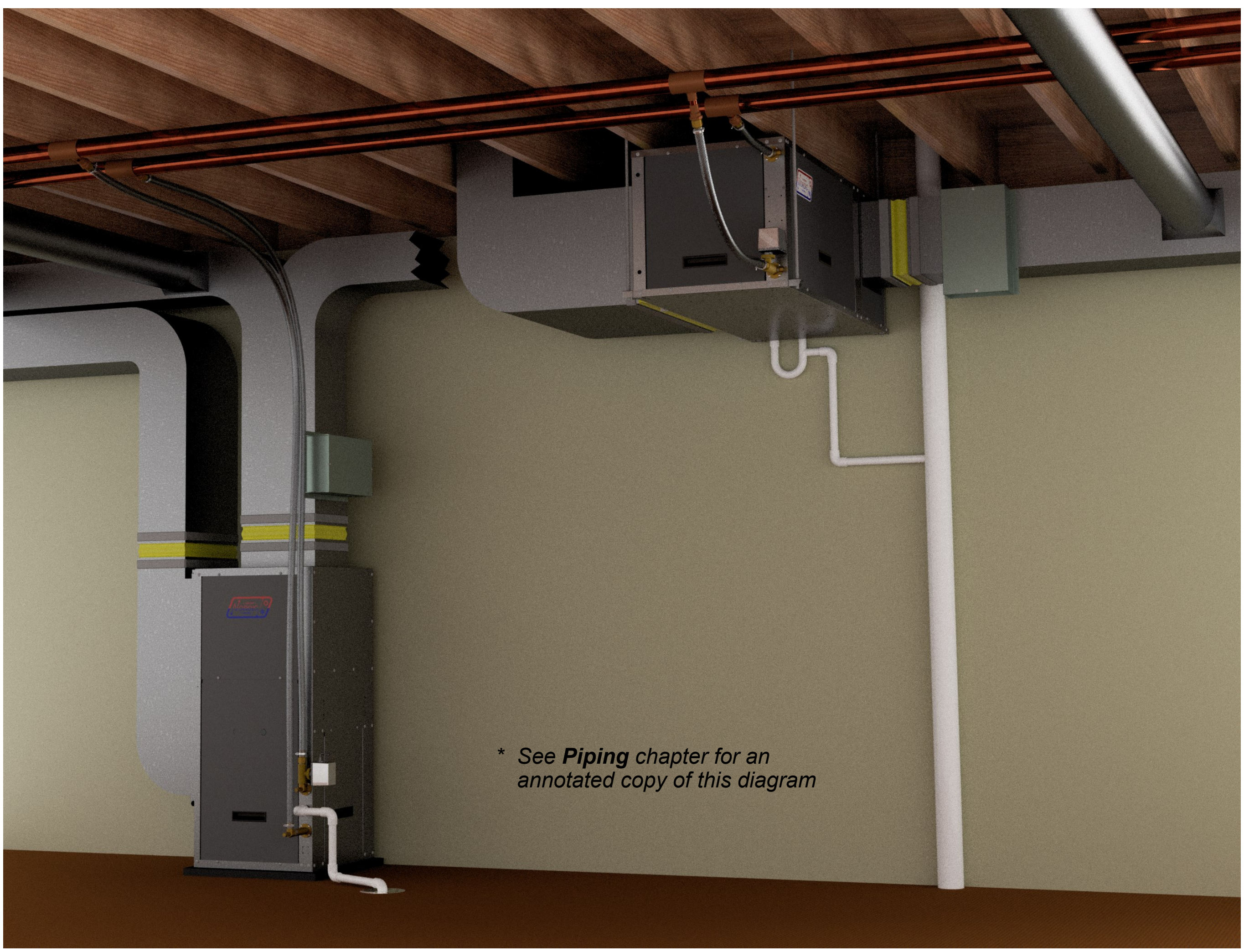
If a closed ground loop is used, 230v circulation pumps can be powered and controlled by the heat pump; if building loop or open loop, a water valve is opened by the heat pump during heating operation and closed when the heat pump is idle.

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.



* *See **Piping** chapter for an annotated copy of this diagram*

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R/RH-Series 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	**ft²**	**m²**
R/RH-09	**300**	**28**
R/RH-12	**400**	**37**
R/RH-18	**600**	**56**
R/RH-24	**800**	**74**

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

TABLE 2 - Heat Pump Size vs. Heated Area for an Open / Building Loop System		
Model	**ft²**	**m²**
R/RH-09	**375**	**35**
R/RH-12	**500**	**46**
R/RH-18	**750**	**70**
R/RH-24	**1000**	**93**

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 residential installation 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 design indoor loop temperature, which can be found in the performance tables in the **Model Specific Information** section. For these heat pump 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 20 kW 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 for full backup**
R/RH-09	**5 kW (or smaller)**
R/RH-12	**5 kW (or smaller)**
R/RH-18	**5 kW**
R/RH-24	**7 kW**

Be sure to order the 'internally mounted' type of plenum heater, even though on these units it is mounted externally. This is because the "internally mounted" model has a narrower cage that is more suitable for the smaller discharge ductwork used with smaller heat pump sizes.

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Installation Basics

A2L-SPECIFIC WARNING / INSTRUCTION

The heat pump uses **R454b,** an **A2L** refrigerant which is a classification meaning "slightly flammable".

Safety measures to mitigate **A2L** refrigerant leaks are outlined in standard **UL/CSA 60335-2-40** and also **CSA B52:23.**

These units are classified as "enhanced tightness refrigerating systems" with refrigerant charge $\mathbf{m_c} < \mathbf{m_1}$ for the purposes of UL/CSA 60335-2-40, clause GG.10. This has two significant consequences:

- A unit-mounted refrigerant leak detector is not required.
- For single unit installation, most or all requirements related to A2L refrigerants for mechanical room size and mechanical room ventilation do not apply.

If there are multiple units containing A2L refrigerants in one mechanical room or at one site, it is highly recommended that a ***mechanical consulting engineer*** *be involved, whether for new installation or replacement of non-A2L units.* This is because the mechanical room requirements can be onerous and also difficult to decipher for the layperson.

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.

Unit Placement

Ducted or forced air heat pumps should be centrally located in the building 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 space. A heating system cannot be expected to produce an even temperature throughout the space when it is located at one end of the structure and the heated or cooled air is transmitted with uninsulated metal ductwork.

For vertical **R**-series units, the front access panel (on the side where pipes are connected) should remain clear of obstruction for a distance of **2 ft (0.7 m)** to facilitate servicing and general maintenance. No access is required on the left, right, or back sides. Raising the indoor unit off the floor a few inches is generally a good practice since this will prevent rusting of the bottom panel of the unit from concrete floors, and deaden vibrations. An anti-vibration pad, available as an accessory, or a piece of 2" styrofoam should be placed under the unit.

Horizontal **RH**-series units are normally mounted in a concealed ceiling, and securely hung using the built-in hangers (or floor mounted in a crawl space). The front access panel, the access panel opposite the air return, and the access panel on the end or side which is the same size as the fan discharge panel should remain clear of obstruction for a distance of **2 ft (0.7 m)** to facilitate servicing and general maintenance.

For both **R** and **RH** units, ensure the unit is level to eliminate 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.

Plenum Heater Installation (Accessory)

Be sure to order the 'internally mounted' type of plenum heater, since the plenum heater intended for external installation in larger heat pumps has a cage which is too wide for the smaller ductwork used with these smaller heat pumps.

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. (If there is an airflow direction arrow on the plenum heater, it can be disregarded.)

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Air Outlet Orientation

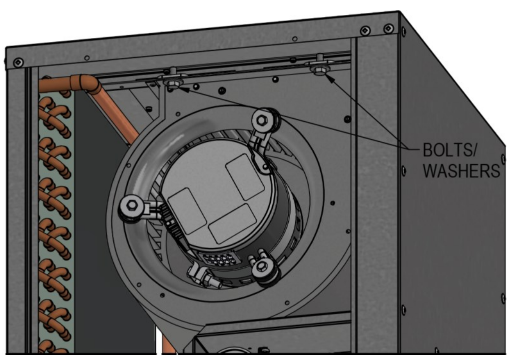
For vertical **R**-series units, the air discharge location is in a fixed position, blowing upwards.

For horizontal **RH**-series units, as is typical for heat pumps of this type, the air discharge can be field installed in either the side (default position, opposite the air return) or the end (90° to the air return). To switch it to the end position, before ductwork is installed:

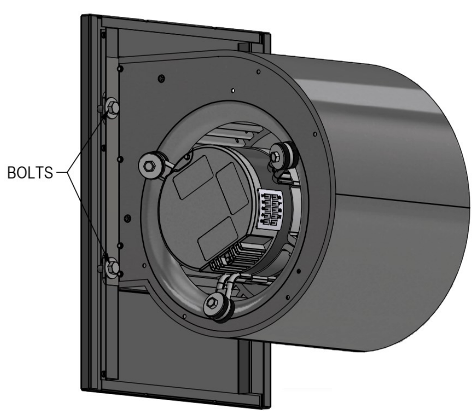
1. Ensure power to the unit is off.
2. Remove the screws that hold the access panel adjacent to the blower panel in place and remove the access panel by pulling up on the handle and then outward from the bottom.
3. Repeat for the access panel with the blower mounted in it. Ensure the wiring harnesses move freely while removing the blower.
4. Disconnect the wiring harness plugs from the motor, and the ground wire from the fan housing.
5. Place the blower in front of its new 'end' location, making sure the motor is facing toward the adjacent access panel. Flip the blower and panel over if required. Reconnect both motor plugs and the housing ground wire.
6. Install the blower and secure panel with the screws.
7. Install the adjacent access panel and secure with the remaining screws.

Note for both **R** and **RH** units, for blower motor servicing the entire blower can be removed out the adjacent access panel by removing two bolts:

R



RH



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.

LEFT RETURN *RIGHT RETURN*

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Sample Bill of Materials - Ground Loop Installations

FROM MARITIME GEOTHERMAL
- R/RH SERIES HEAT PUMP (L OR R RETURN)
- PLENUM HEATER 5/7kW
- 2H/1C THERMOSTAT (OR SOURCED ELSEWHERE)
- P/T PORTS AND HOSE ADAPTERS (2)
- 1 PUMP PACK
- PIPE ADAPTERS FOR PUMP PACK

OPTIONAL FROM MARITIME GEOTHERMAL
- ANTI-VIBRATION PAD
- SOUND JACKET

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

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: 14-2 OR 12-2
- 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/Building Loop Installations

FROM MARITIME GEOTHERMAL
- R/RH SERIES HEAT PUMP (L OR R RETURN)
- PLENUM HEATER 5/7kW
- 2H/1C THERMOSTAT (OR SOURCED ELSEWHERE)
- P/T PORTS AND HOSE ADAPTERS (2)
- DOLE/HAYS FLOW RESTRICTOR VALVE
- SOLENOID OR MOTORIZED WATER VALVE

OPTIONAL FROM MARITIME GEOTHERMAL
- ANTI-VIBRATION PAD
- SOUND JACKET

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

WATER SYSTEM (OPEN LOOP ONLY)
- 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: 14-2 OR 12-2
- 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)

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Wiring

Power Supply Connections

The heat pump has a 0.875" knockout for main power supply connection from the breaker panel to the electrical box. There are also 0.875" knockouts and a plastic grommet 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.

Electrical diagram can be found on the electrical box cover 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

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.

TABLE 4 - Power Supply Connections (Heat Pump)		
Line	**Description**	**Voltages**
L1	**Line 1**	**208/230-1-60, 277-1-60**
L2	**Line 2**	**208/230-1-60, 277-1-60**
GND	**Ground**	**208/230-1-60, 277-1-60**
N	**Neutral**	**No Connection**

TABLE 5 - Power Supply Connections (Plenum Heater)		
Line	**Description**	**Voltages**
L1	**Line 1**	**All**
L2	**Line 2**	**All**
GND	**Ground**	**All (connect to ground lug)**
N	**Neutral**	**No Connection**

Outdoor Loop Pump Module Wiring

(Ground Loop, or Single Pipe Building Loop)

The circulator pump or pump module should be wired so that they will be turned on whenever the compressor operates.

Unlike other NORDIC model series, there is no dedicated terminal strip for circulator pump connection in the heat pump, and there is no neutral wire connection to the heat pump to allow 115v circulators to be powered from the heat pump. Circulators may be externally powered and controlled, using a relay or contactor activated by the **Y** signal from the thermostat.

However, 230v circulators may be connected to the load side of the heat pump's compressor contactor using ring terminals or female disconnects, as long as they do not exceed **1.5A** maximum current draw. Ground wire should be connected to the ground lug in the electrical box.

Control Transformer

The low voltage controls for 208/230-1-60 models are powered by a class II transformer with impedance protection. If the 24v side is accidentally shorted out and impedance protection is tripped, it will be necessary to replace the transformer.

NOMENCLATURE CODE "**1**L" - red wire is factory set to **230**V

NOMENCLATURE CODE "**9**L" - red wire is factory set to **208**V

IMPORTANT NOTE: Red wire may be switched between 208VAC and 230VAC terminals on transformer at customer location to suit local electrical service type. If not set correctly, controls and accessories may not work properly.

Thermostat Requirements

A 2-stage heating and 1-stage cooling heat pump configurable thermostat is required. The first thermostat heating stage activates the compressor by sending a **Y** signal, and the second activates the electric auxiliary (accessory plenum heater) by sending a $\mathbf{W_2}$ signal. The electrical 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.

Cooling mode is activated by the thermostat by sending an **O** signal, along with a **Y** signal to activate the compressor.

TABLE 6 - Control Signal Description	
Signal	**Description**
C	**24VAC common (ground)**
G	**Fan lowest speed (for air recirculation)**
R	**24VAC hot**
L	**Fault (24VAC when fault condition)**
O	**Cooling mode (reversing valve)**
Y	**Compressor ON**
$\mathbf{W_2}$	**Auxiliary / Emergency Heat**
C(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)**

Blower Motor

The blower is equipped with a 5-speed (actually 5 constant torque) direct drive ECM. The motor features a soft start which provides a smooth, quiet ramp up to operating speed .

The lowest speed is activated by a **G** signal from the thermostat, used for air recirculation or fan only mode. There are 4 speeds associated with compressor operation, one of which should be selected during heat pump commissioning.

Move the fork terminal with the yellow and purple wire to one of the terminals $\mathbf{SP_1}$ / $\mathbf{SP_2}$ / $\mathbf{SP_3}$ / $\mathbf{SP_4}$. Measure the airflow in the discharge ductwork and select a speed that most closely matches the required airflow for the model size according to the following table. Proper airflow can be verified by observing the air delta T, which should be **25-32°F**. Assuming a room temperature of 68°F, compressor discharge pressure at proper airflow should be **320-400 psi**.

If too low an airflow is selected, heat pump efficiency will be lower and nuisance high or low safety control trips may occur. Too high an airflow will result in excessive noise and a cooler discharge air temperature. If the target airflow cannot be achieved even on $\mathbf{SP_4}$, the ductwork is likely undersized and ductwork design should be reviewed as per following chapter.

TABLE 7 - Airflow	
Model	**Required Airflow**
R/RH-09	**325**
R/RH-12	**400**
R/RH-18	**650**
R/RH-24	**800**

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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 indoor loop flow.
2. High indoor loop entering liquid temperature.
3. Dirty or fouled indoor loop heat exchanger.
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 has been cleared. 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. Under standard heat pump configurations, **these are not used and have no effect on heat pump operation.**

TABLE 8 - 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 controls (LPC's) in the heat pump: 75 psi for building loop or open loop (fresh water), and 55 psi for closed loop (antifreeze). As shipped, the open loop LPC will be active, since there will be no jumper between $\mathbf{LP_1}$ and $\mathbf{LP_2}$ on the heat pump's terminal strip.

If a closed ground loop with antifreeze is used, a wire jumper should be installed between $\mathbf{LP_1}$ and $\mathbf{LP_2}$ on the heat pump's terminal strip. This will cause the lower 55 psi low pressure control to be selected, to allow a lower loop temperature than would be appropriate for fresh water before tripping.

WARNING: WHEN LP1 AND LP2 ARE JUMPERED, A PROPER LOOP ANTIFREEEZE CONCENTRATION IS REQUIRED TO PREVENT FREEZING AND RUPTURING OF THE HEAT EXCHANGER, VOIDING THE WARRANTY.

Refrigerant Vent Fan Connections

Since these units are classified as "enhanced tightness refrigerating systems" with refrigerant charge $\mathbf{m_c < m_1}$ for the purposes of UL/CSA 60335-2-40, a unit-mounted refrigerant leak detector is not required.

Therefore, a vent fan connection is not necessary.

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Piping

Condensate Drain

The unit comes equipped with one 3/4” female PVC socket or 3/4” PVC female NPT 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.

For vertical **R** units, the condensate drain is internally trapped and does not require an external trap. For horizontal **RH** units, 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 drain piping slope possible 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 pages for diagrams showing the condensate drain connection.

Outdoor Loop

The connections for the Outdoor Loop are 1/2” or 3/4” brass female NPT. They are labelled OUTDOOR IN and OUTDOOR OUT.

See the following page for an illustration of a building loop installation, and also the following chapters for details on ground loop and open loop installations.

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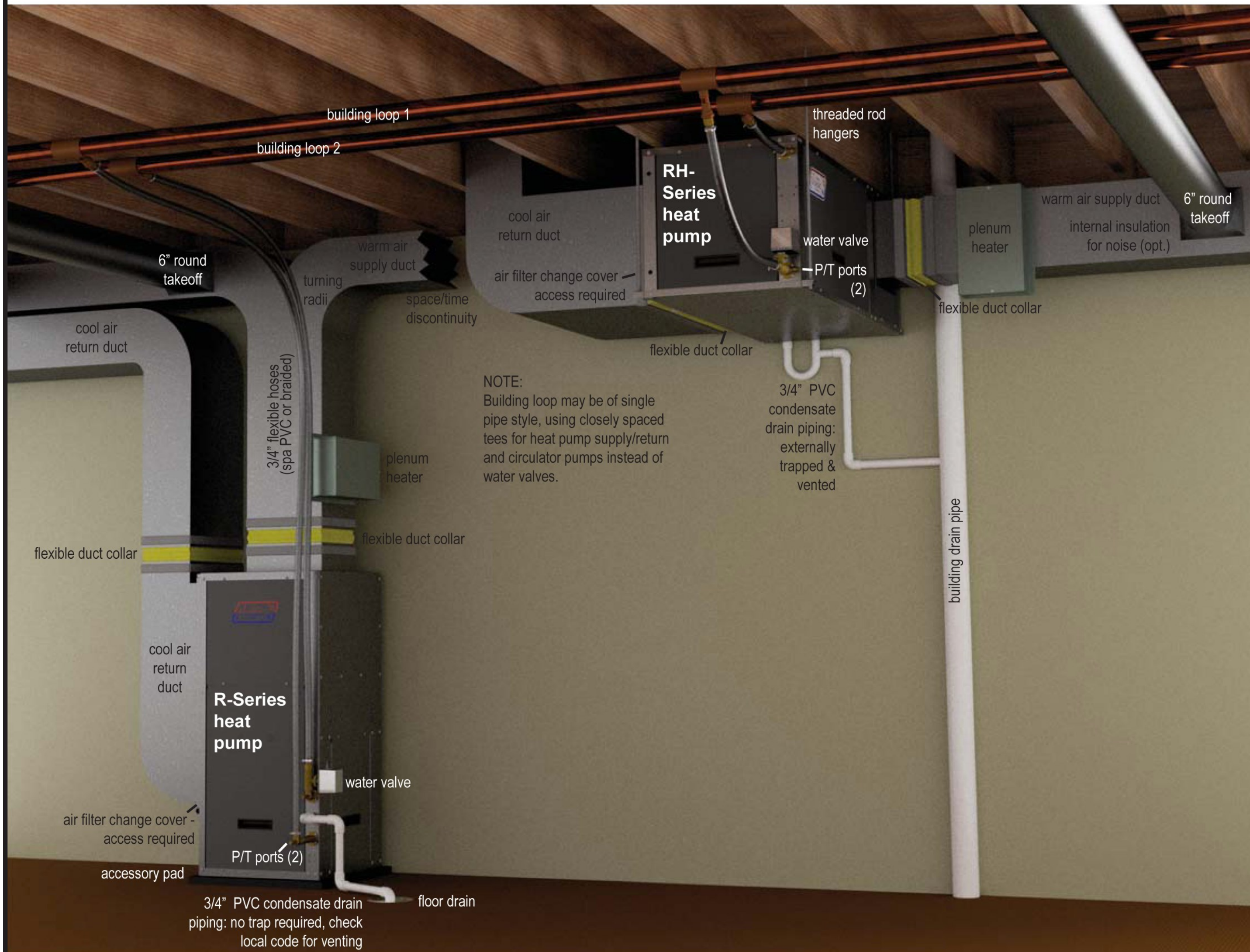
Typical Loop Connections - R/RH Commercial



See other diagrams and instructions in the manual for design, selection, and installation details. 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.

This diagram illustrates the use of an externally conditioned building loop as a heat source (heating mode) or heat sink (cooling mode). Piping will differ for:

- Open loop installation, which uses a well water system in place of a closed buidling loop.
- Ground loop installation, which uses a horizontal or vertical antifreeze loop in the ground as a heat source/sink.

See manual for details.

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01	Initial Rel.	Dan Rheault	Dan Rheault	5-May-2021

Drawn By: Dan Rheault	Date: 5-May-2021
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Eng. Approved By	Date
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Approved By	Date

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

Drawing Name: **Typical Loop Connections - Commercial R/RH Series**

Size	Drawing Number	Revision	Sheet
LET	002513PDG	01	1 / 1

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Ductwork

Blower Motor

The indoor unit is equipped with a direct drive 5-speed ECM blower. See Wiring chapter for description and airflow adjustment.

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 square surface 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 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 9 - Heat Pump Size vs. Hot Air Grills

Model	Size (tons)	# of Grills (@100 cfm)
09	0.75	3
12	1	4
18	1.5	6
24	2	8

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 small installations are a single ducted air zone with one thermostat. The thermostat should be centrally located within the space, typically on the main floor. It should be placed away from any supply grills, and should not be positioned directly above a return grill. The thermostat can be located in a hallway, or on the inner wall of a room. It should be noted that most buildings 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 space to be warmer than indicated by the thermostat.

Plenum Heater

As described in the **Installation Basics** section, 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 than the model with the narrower cage which is meant for internal installation in larger heat pumps.

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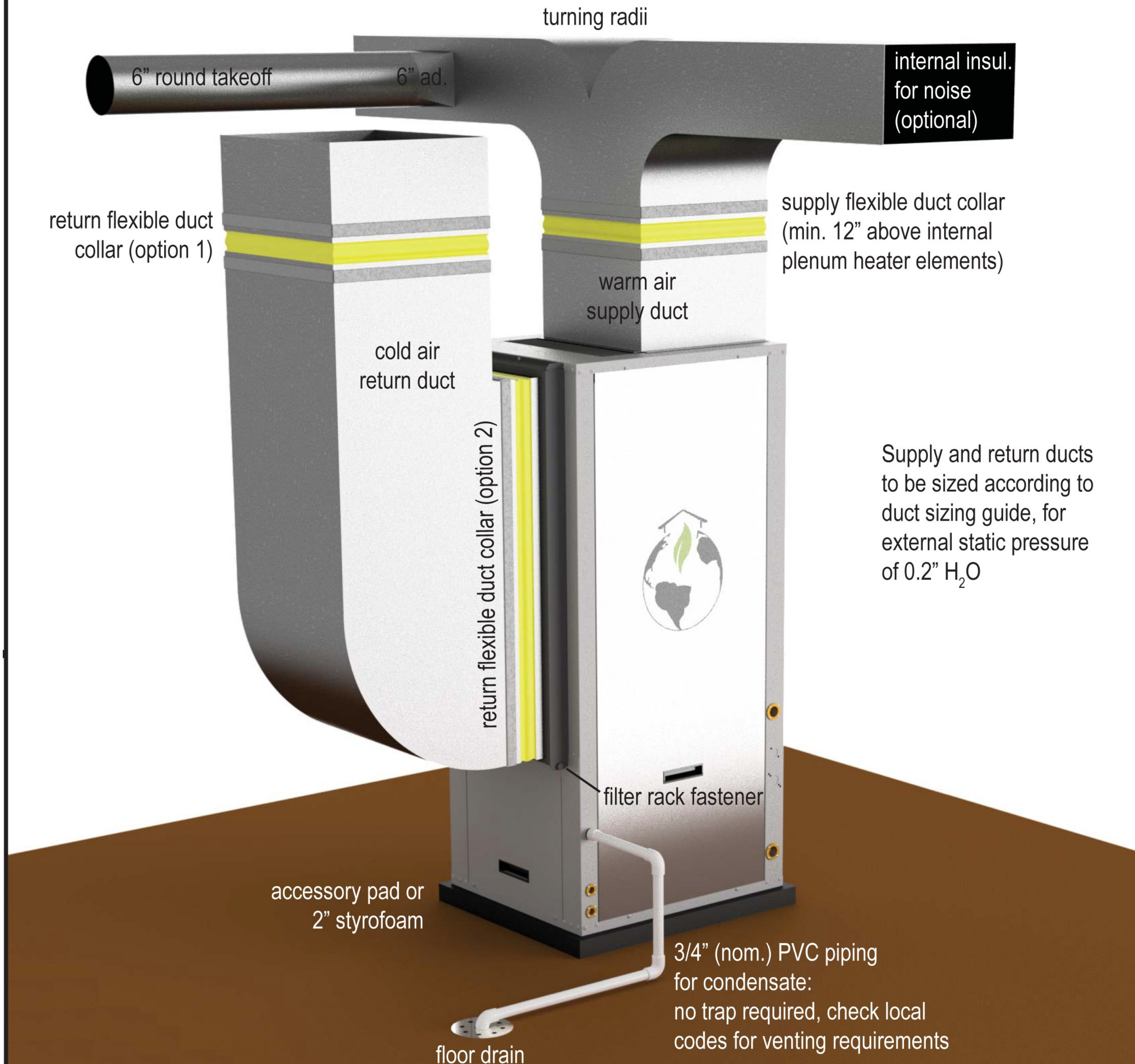
Typical Duct & Condensate Connections - R Series



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
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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

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TABLE 10 - 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				

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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.

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. This is based on a typical parallel system with one circuit per ton.

Calculate 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.

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.

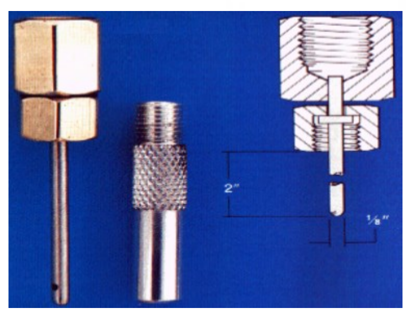
Figure 1: Ground Loop Accessories & Tools

2-pump module

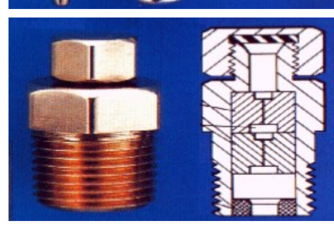
Barbed Adapters

PE Adapters

Purge Cart



Gauge adapter for P/T port



P/T port

P/T adapters for heat pump (3/4" NPT to barb)

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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 11 - 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.

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

TABLE 12 - 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**		

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.

Low Pressure Control Selection

The purpose of the low pressure control is prevent heat exchanger freezing in the case of a flow problem.

Unlike other NORDIC model series, low pressure control selection for open loop for the R/RH 09-24 is done manually, with a wire jumper. For closed loops with antifreeze, make sure a jumper is connected between **LP1** and **LP2** on the heat pump's terminal strip. This will cause the lower 55 psi low pressure control to be selected, to allow a lower loop temperature than would be appropriate for fresh water before tripping.

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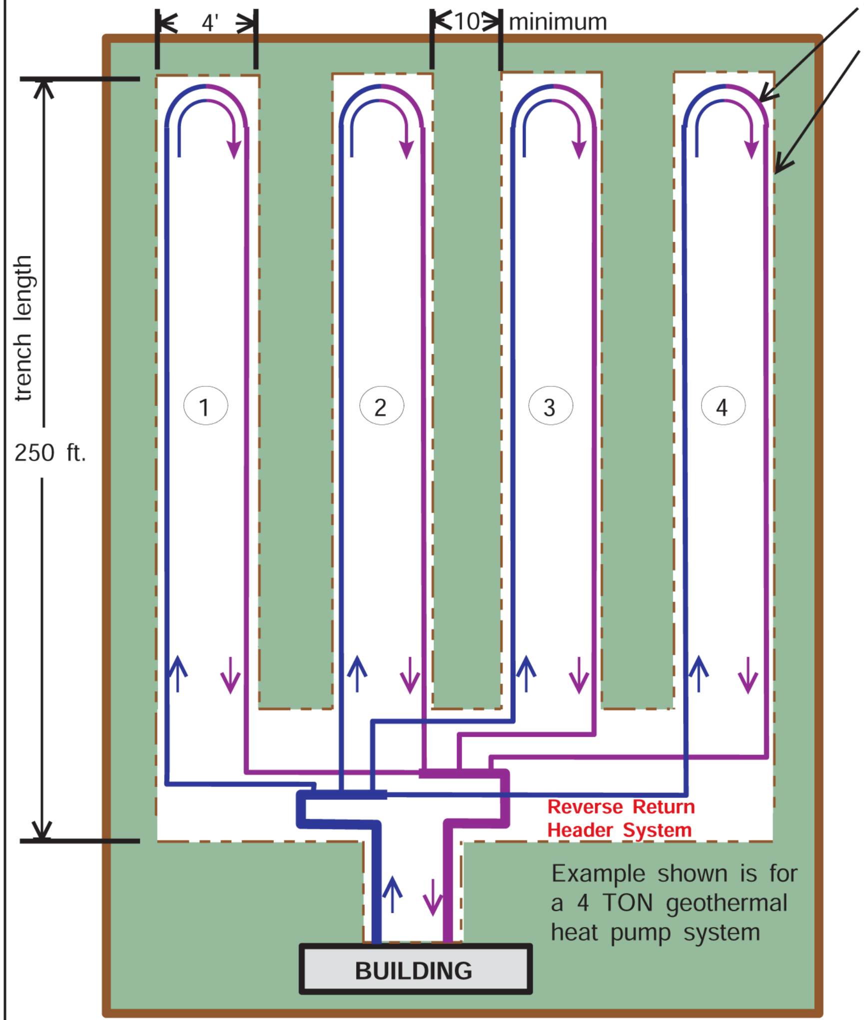
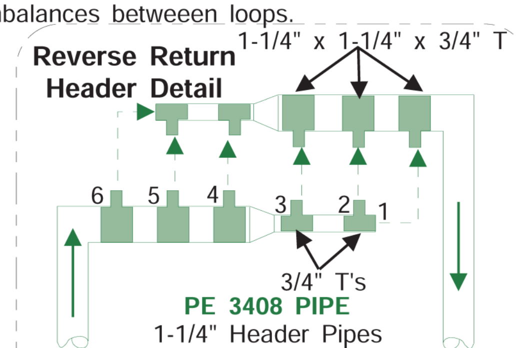
TYPICAL HORIZONTAL GROUND LOOP CONFIGURATION

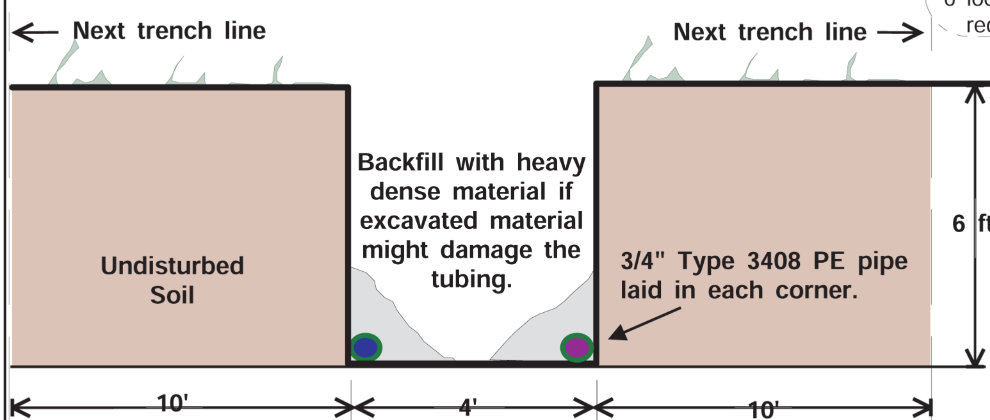


- Type PE 3408 Pipe
- Excavated trenches minimum 4' wide x 6' deep
- Trenches will be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Each loop consists of 500ft. of 3/4" type 3408 PE 160 psig (SDR 11) geothermal heat pump polyethelene tubing.
- Each trench 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

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01	Initial Release	C. GEDDES	C. GEDDES	17 JAN 08

Drawn By Chris Geddes	Date 17 JAN 08	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By Chris Geddes	Date 17 JAN 08	Drawing Name: Typical Horizontal Ground Loop Configuration
Approved By (ENG) Chris Geddes	Date 17 JAN 08	
Approved By (MFG)	Date	Size: A; Drawing Number: 000608INF; REV: 01; SHEET: 1 of 1
Approved By	Date	

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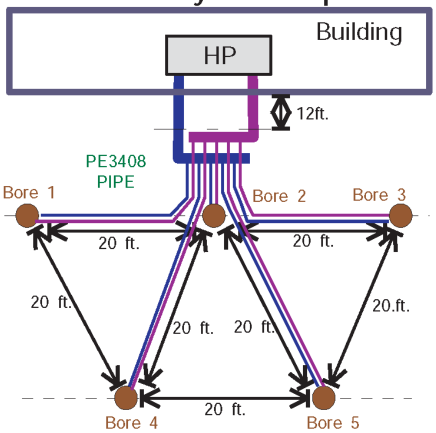
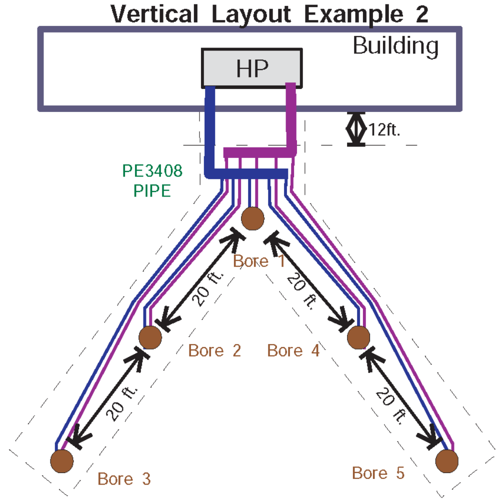
TYPICAL VERTICAL GROUND LOOP CONFIGURATION

Vertical Layout Example 1

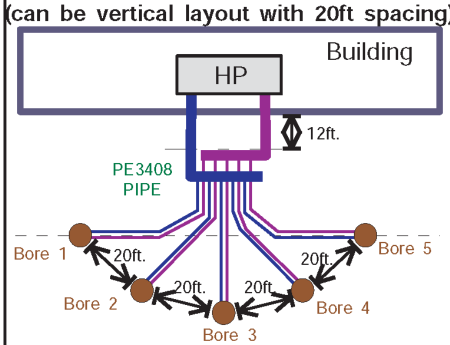


Vertical Layout Example 2

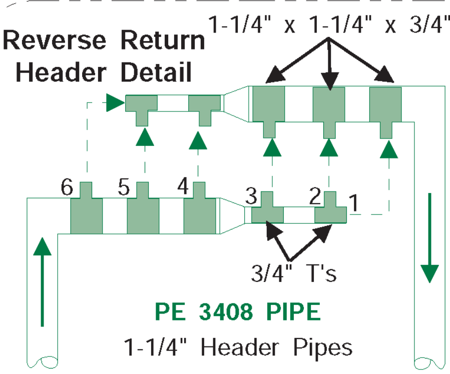


- Examples shown are for a 5 TON geothermal heat pump system
- Type PE 3408 Pipe
- Excavated trenches to boreholes minimum 4' wide x 6' deep
- Trenches should be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Hand backfilling in the area just over the plastic 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. 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)

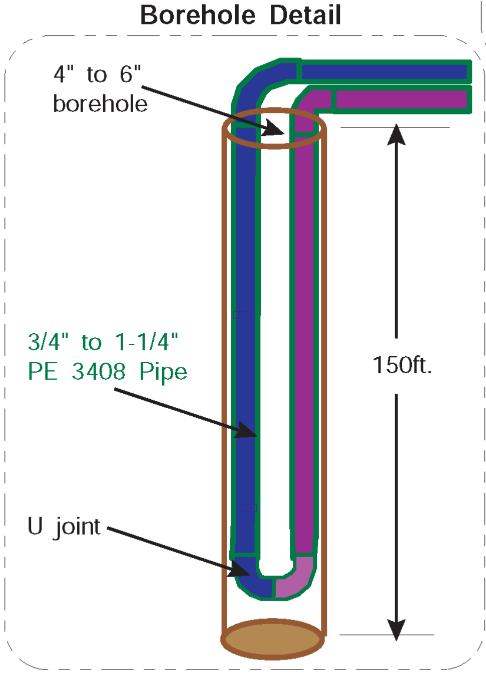


Reverse Return Header Detail



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	ISSUE 02	D. RHEAULT	D. RHEAULT	11 SEP 24
01	Initial Release	C. GEDDES	C. GEDDES	22 JAN 08

	Date
Drawn By Chris Geddes	22 JAN 08
Checked By Chris Geddes	22 JAN 08
Approved By (ENG) Chris Geddes	22 JAN 08
Approved By (MFG)	
Approved By	

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

Drawing Name			
Typical Vertical Ground Loop Configuration			
Size	Drawing Number	REV	SHEET
A	000609INF	01	1 of 1

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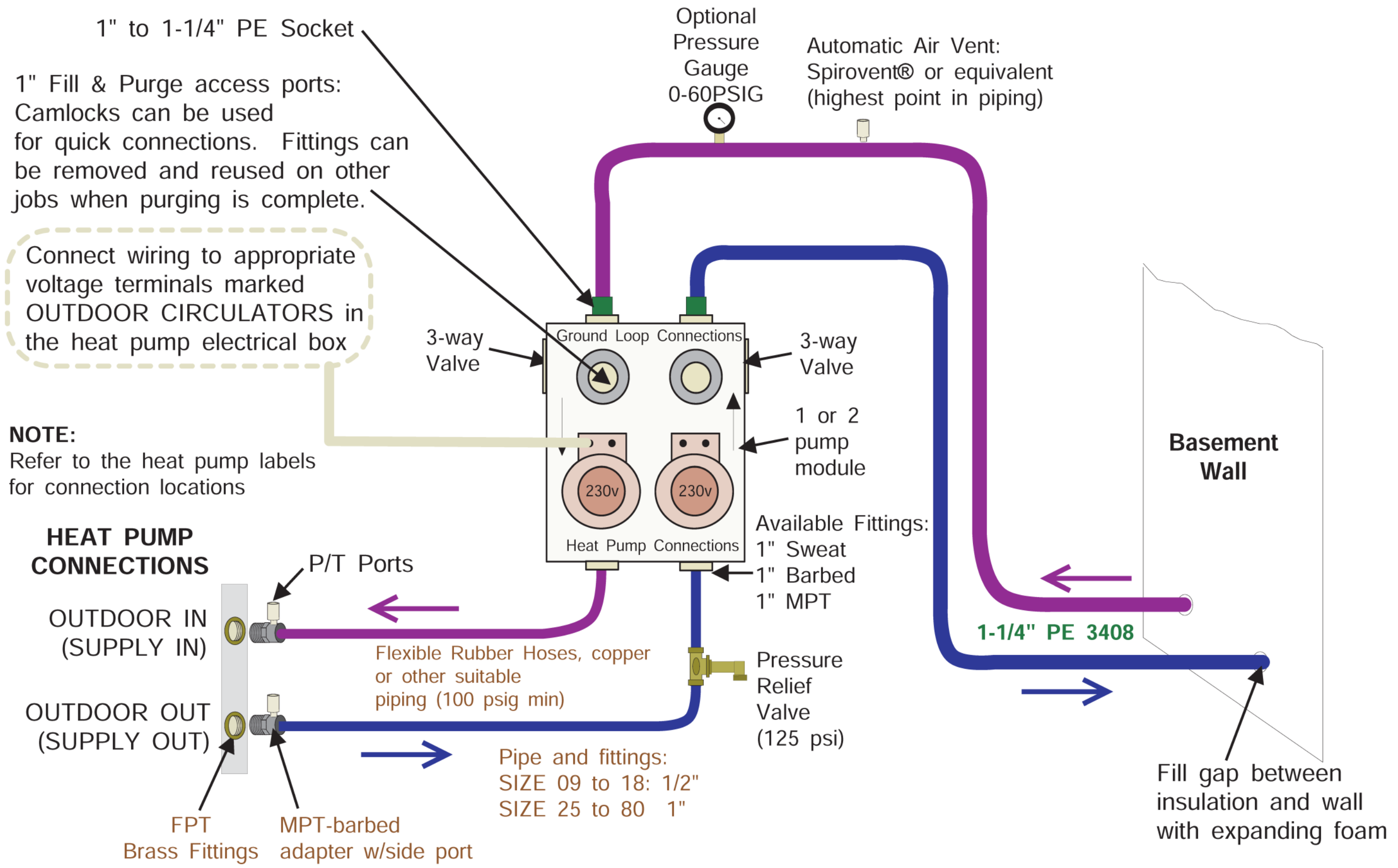
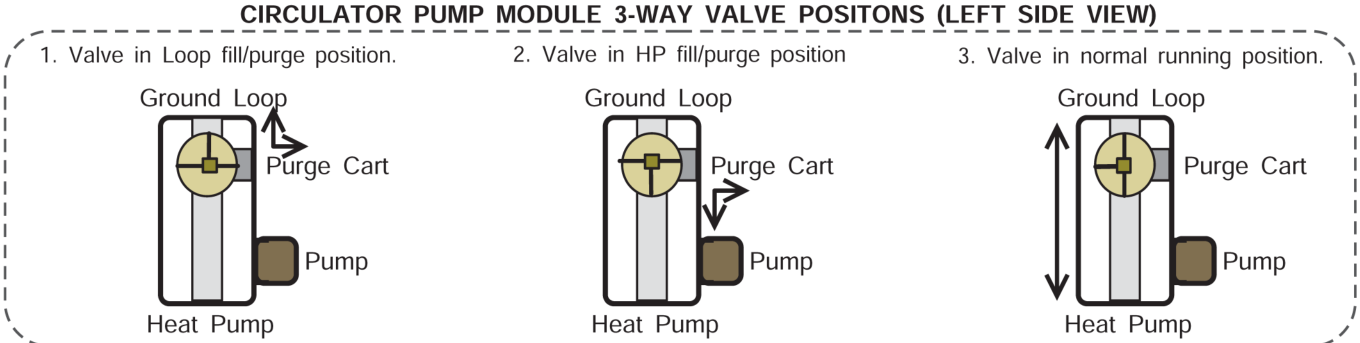
Geo-Flo Circulator Pump Module Installation (Units with Brass FPT Fittings)



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

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

Drawing Name			
Geo-Flo Circulator Pump Module Installation (Brass FPT)			
Size	**Drawing Number**	**Drawing Rev**	**SHEET**
A	000906PDG	03	1 of 1

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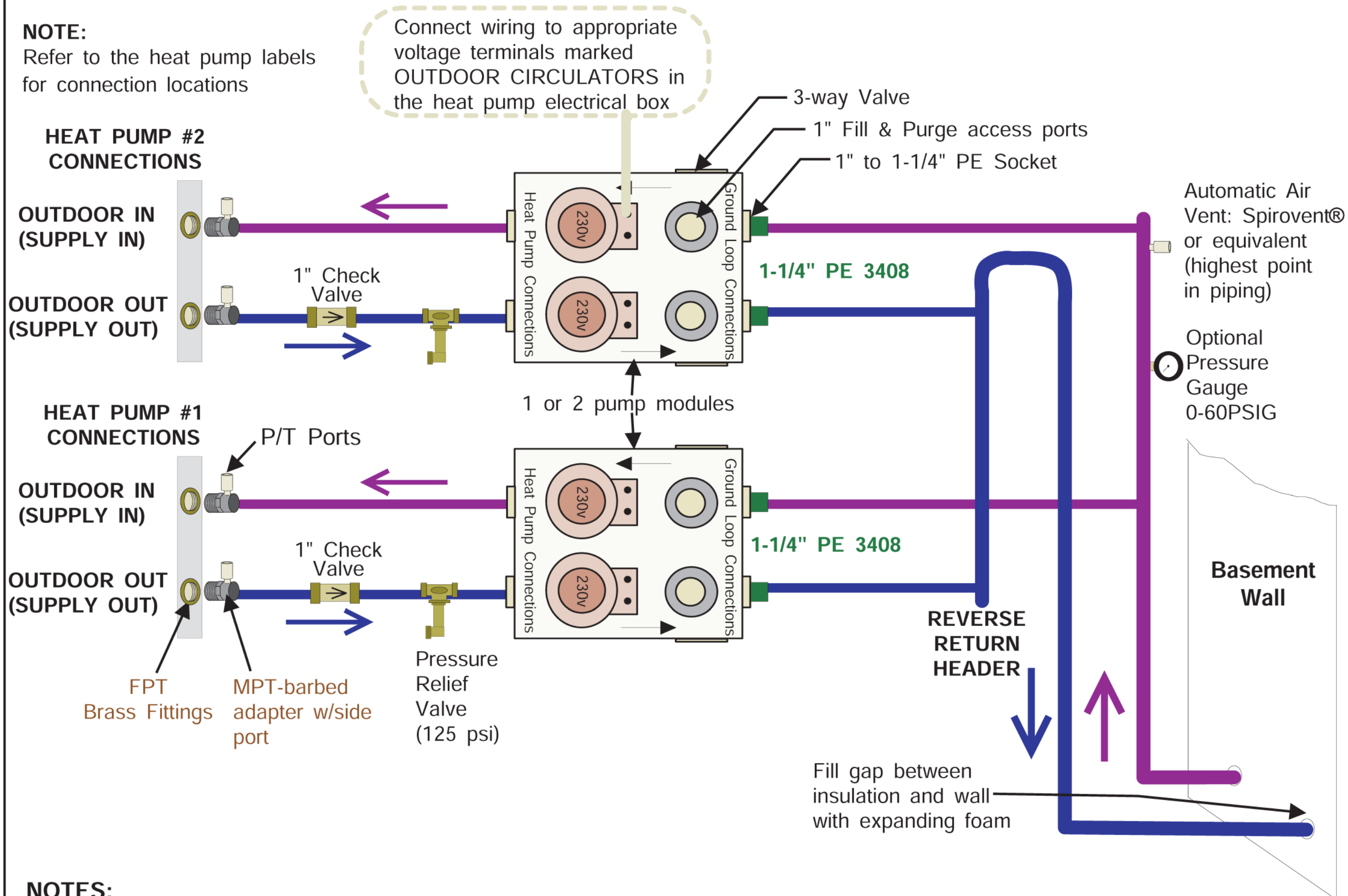
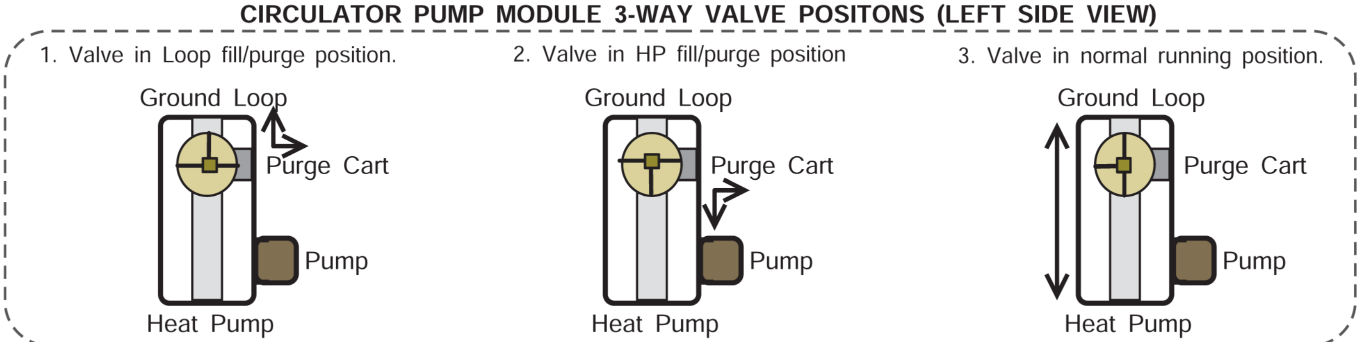
Geo-Flo Circulator Pump Module Installation - Two Units On One Ground Loop



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

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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 13 - Required Flow			
Model Size	**Flow* gpm (L/s)**	**Domestic Water Usage - gpm (L/s)**	**Total Flow gpm (L/s)**
09	**2.5 (0.16)**	**4 (0.25)**	**6.5 (0.43)**
12	**3.0 (0.20)**	**4 (0.25)**	**7.0 (0.46)**
18	**4.5 (0.28)**	**4 (0.25)**	**8.5 (0.54)**
24	**8.0 (0.50)**	**4 (0.25)**	**12 (0.76)**

* 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 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

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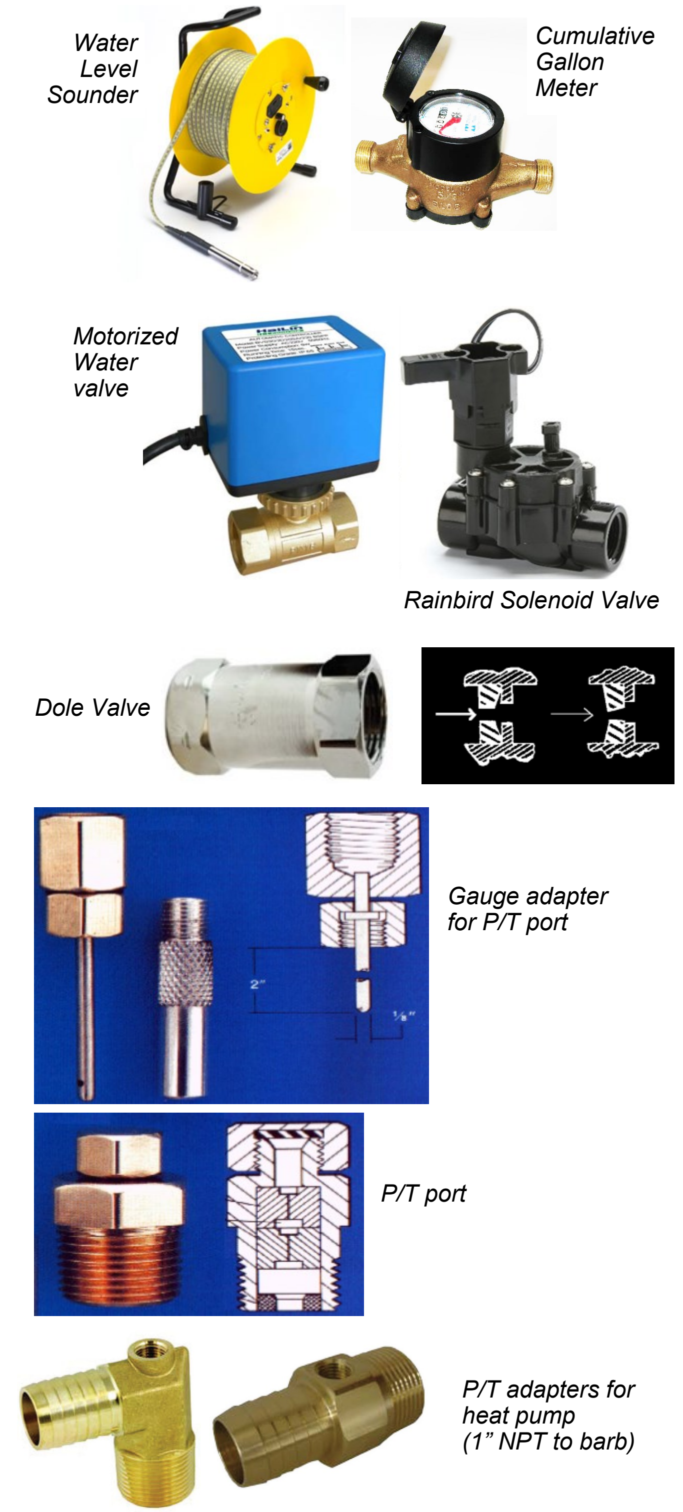
Figure 2: Open Loop Accessories & Tools



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.

Most installations of small heat pumps like these use a fast acting solenoid valve. The valve will have 2 wires or two connections, to **Y** and **C** on the thermostat terminal strip in the heat pump’s electrical box. A ‘Rainbird’ solenoid valve is available from Maritime Geothermal Ltd. as an accessory.

If water hammer associated with a fast acting valve is shown to be a problem, there are a couple of alternatives:

- **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.

These take ~5 seconds to close, and avoid the water hammer which can occur with faster acting valves. If used, **Y** from the thermostat should be wired first to the valve, and then through the valve’s end switch to **Y** on the heat pump’s terminal strip.

Low Pressure Control Selection

The purpose of the low pressure control is prevent heat exchanger freezing in the case of a flow problem.

Unlike other NORDIC model series, low pressure control selection for open loop for the R/RH 09-24 is done manually, with a wire jumper. For open loop (fresh water) operation, make sure a jumper is **not** connected between **LP1** and **LP2** on the heat pump’s terminal strip. This will ensure the higher 75psi low pressure control is selected to prevent heat exchanger freezing in the case of a flow problem.

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Water Flow Control

A flow restricting ('Dole' or 'Hays') 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. Hays flow restrictors do not have this drawback.

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.

Plumbing the Heat Pump

The port connections for the Outdoor Loop are 1/2" or 3/4" 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 copper or plastic line should be run to the Outdoor IN pipe of the heat pump. Similarly, a line should be run from the Outdoor 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 case. After the water valve is installed, run the valve harness into the case through the hole provided. Remove the jumper plug from the Valve Connector and connect the harness in its place.

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.

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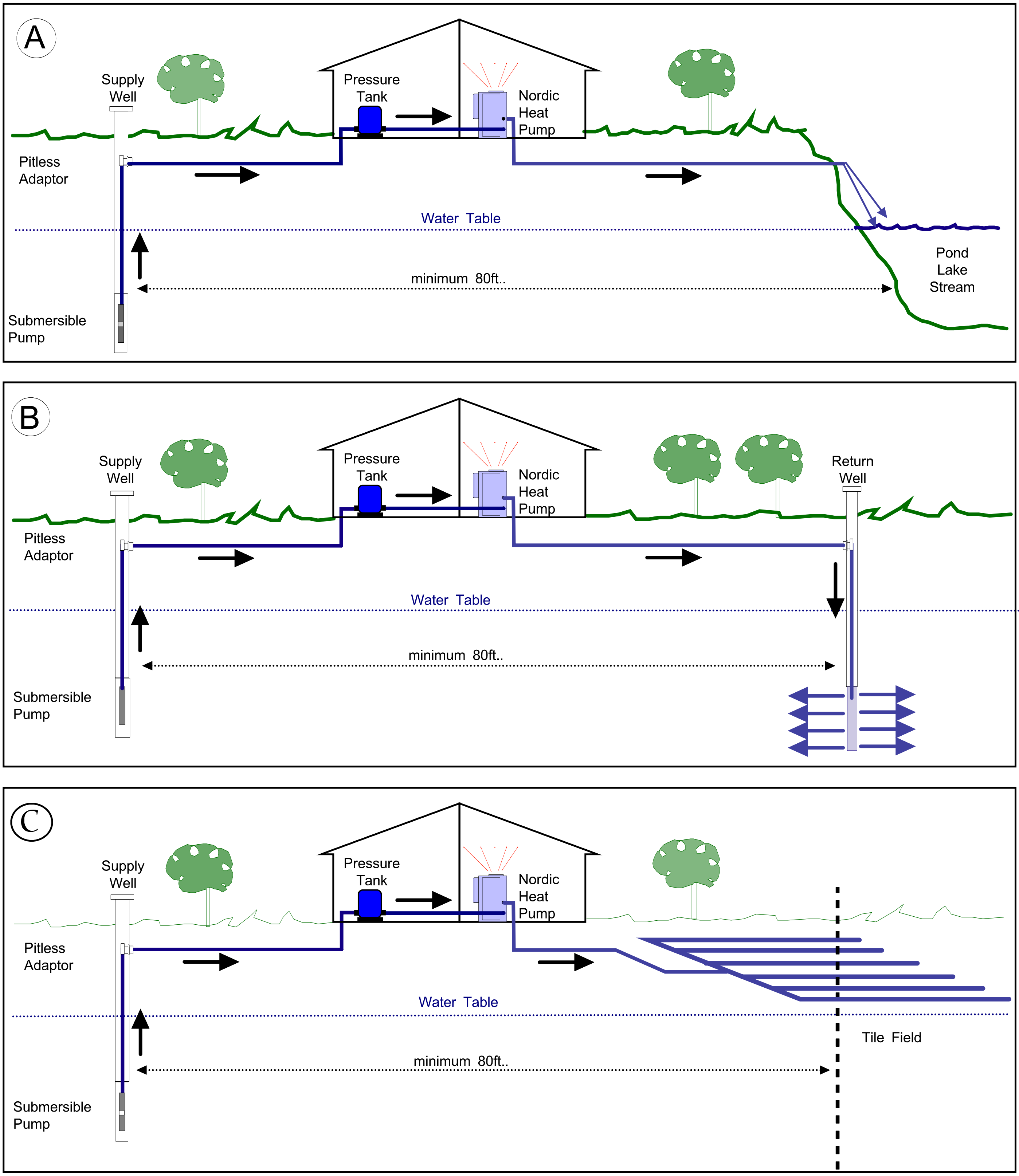
GROUND WATER DISPOSAL METHODS



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

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

MARITIME GEOTHERMAL LTD.

170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

Drawing Name	Ground Water Disposal Methods		
Size	Drawing Number	REV	SHEET
A	**000619INF**	**01**	1 of 1

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Startup Procedure

The 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.

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.

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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 heat pump. 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.

Cooling Mode:

1. Set the thermostat to cooling mode and adjust the setpoint to activate heat pump.
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.

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Startup Record: R-Series Size 09-24

Installation Site		**Startup Date**	**Installer**	
City			**Company**	
Province			**Model**	
Country			**Serial #**	
Customer Name		**Customer 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							
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					
	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:**		**Customer 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.

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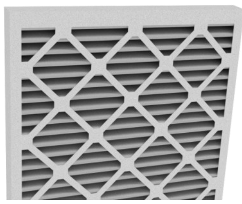
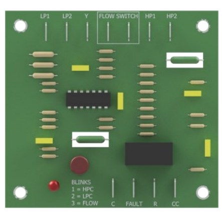
Routine Maintenance

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).

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Troubleshooting Guide

The following steps are for troubleshooting the 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 later in this manual.

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 Y 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 Y 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 impedance protection tripped or faulty transformer	230VAC is present across L1 and L3 of the compressor contactor but 24VAC is not present across R 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 Y signal to heat pump (after 6 minutes)	Incorrect thermostat setup	Thermostat does not indicate a call for heat. No 24VAC signal present across Y & C of the thermostat	Correct the setup.
	Faulty thermostat to heat pump wiring	24VAC signal present across Y & C of the thermostat but not present across Y & C of the terminal strip.	Correct or replace wiring
	Faulty thermostat	No 24VAC between Y & C of the thermostat when a call is indicated.	Replace thermostat.

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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 wires)	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 Y, but compressor should not be running (disconnect compressor wires)	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.

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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, HPS left & right terminals, and LPS; 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.

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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.

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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 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.

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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.	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.
	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.

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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 can provide only a certain amount of torque, according to the speed SP1/SP2/SP3/SP4 selected. The ductwork is poorly designed or greatly undersized if the fan motor cannot provide the required airflow.
	Airflow selected on 4-speed terminal strip (SP1/SP2/SP3/SP4) is too low	Check selection.	Select a higher setting.
Fan operating on wrong speed, or does not respond to speed selection change	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/ Black (pin C) and the following at the fan control signal harness (insert probes in connector where wire is inserted, do not unplug the connector): Recirculation = red (pin 1) SP1 = orange (pin 2) SP2 = blue (pin 3) SP3 = brown (pin 4) SP4 = grey (pin 5)	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/ Black (pin C) and the following at the fan control signal harness (insert probes in connector where wire is inserted, do not unplug the connector): Recirculation = red (pin 1) SP1 = orange (pin 2) SP2 = blue (pin 3) SP3 = brown (pin 4) SP4 = grey (pin 5)	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

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Service Procedures

A2L-SPECIFIC WARNING / INSTRUCTION

Servicing a Unit with an A2L Refrigerant

1. Work procedure

Work should be undertaken under a controlled procedure, for example according to an ordered checklist. This may be in contrast to how refrigeration service work has normally been performed in the past, and is to minimize the risk of flammable gas being present while the work is being performed .

2. General work area

All maintenance staff and others working in the local area should be instructed on the nature of work being carried out. Work in confined spaces should be avoided.

3. Checking for presence of refrigerant

The area should be checked with a refrigerant detector prior to and during work, to ensure the technician is aware of potentially oxygen-deprived or flammable atmospheres.

Ensure that the leak detection equipment being used is suitable for use with A2L refrigerants, i.e. non-sparking, and adequately sealed or intrinsically safe. Under no circumstances should a torch or flame be used in the searching for refrigerant leaks.

Electronic leak detectors may be used but for A2L's they may need re-calibration in a refrigerant-free area. Leak detection equipment should be set at a percentage of the LFL (lower flammability limit) of the refrigerant (25% maximum). The worst-case LFL for R454b is **0.296 kg/m³** or **11.3%** by volume.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine should be avoided as the chlorine can react with the refrigerant and corrode the copper pipe-work.

If a leak is suspected at any time, all naked flames should be removed/extinguished.
If a leakage of refrigerant is found which requires brazing, all of the refrigerant should be first recovered from the system, or isolated (by means of shut-off valves) in a part of the system remote from the leak.

5. Presence of fire extinguisher

If any torch work (brazing) or refrigerant charging or removal is to be conducted, a dry powder or CO2 fire extinguisher should be ready at hand.

6. No ignition sources

Sources of ignition should be eliminated in the vicinity of work being carried out on a system containing an A2L refrigerant. Prior to work taking place, the area around the equipment should be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs should be displayed .

6. Ventilation of area

Ensure that the area is open to the outdoors or that it is adequately ventilated before breaking into the system or conducting any hot work. Ventilation should continue during the work, and can function to disperse any released refrigerant into a large space or preferably expel it into the outdoors.

7. Checks of the refrigeration equipment

- The refrigerant charge is in accordance with the size of the room within which the system is installed.
- The ventilation equipment (if any) is operating adequately and is not obstructed.
- The water/glycol/pool water loop should be checked for the presence of refrigerant, which might show up with a refrigerant detector or by over-pressure in that loop.
- Equipment markings continue to be visible and legible. Illegible signs or markings should be corrected.
- Refrigeration piping is installed in a position where it is unlikely to be exposed to corrosive substances, unless the piping is constructed of materials which are inherently resistant to corrosion from that substance.

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A2L-SPECIFIC WARNING / INSTRUCTION

Servicing a Unit with an A2L Refrigerant (continued)

8. Checks to electrical devices & wiring

Where electrical components are being changed, they should be as specified by Maritime Geothermal Ltd.. If in doubt, consult technical support for assistance.

Electrical components should be inspected. If a fault is found, electrical supply should not be connected to the circuit until the fault is rectified. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution should be used. This should be reported to the owner of the equipment so all parties are advised.

Initial safety checks should include:

- Capacitors are discharged - this should be done in a safe manner to avoid possibility of sparking.
- No live electrical components and wiring are exposed while charging, recovering or purging the system.
- There is continuity of earth grounding/bonding.
- Check cabling for wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check should take into account the effects of aging or continual vibration from sources such as compressors or fans.

9. Refrigerant removal and circuit evacuation

When breaking into the refrigerant circuit to make repairs - or for any other purpose - conventional procedures should be used. However, with flammable refrigerants it is important that best practice is followed:

a) Safely remove refrigerant following local and national regulations, recovering into the correct recovery cylinders.
b) Evacuate (vacuum). Ensure that the outlet of the vacuum pump is not close to any potential ignition sources and that ventilation is available.
c) Purge the circuit by breaking the vacuum in the system with dry nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere.
d) Evacuate (vacuum) again, then vent to atmospheric pressure to enable work to take place.
e) Open the circuit with torch, continuously flushing with dry nitrogen.

10. Charging

In addition to conventional charging procedures, the following should be observed.

- Ensure that contamination between different refrigerants does not occur when using charging equipment. Hoses should be as short as possible to minimize the amount of refrigerant contained in them.
- Cylinders should be kept in an appropriate position according to the instructions.
- Ensure that the refrigerating system is grounded prior to charging the system with refrigerant.
- Label the system when charging is complete (if final refrigerant charge is different from factory label).
- Extreme care should be taken not to over-charge the refrigerating system.

Prior to recharging the system, it should be pressure-tested with dry nitrogen. In addition, the system should be A2L leak-tested on completion of charging but prior to commissioning. A final A2L leak test should be carried out prior to leaving the site.

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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.

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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.

Blower Motor Replacement Procedure

See **Air Outlet Orientation** in the **Installation Basics** chapter for an illustration of the blower being removed through the adjacent service access panel. In this way, the nut securing the blower wheel to the motor shaft can be loosened to change the motor, without having access to the back of the unit.

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Decommissioning

When the heat pump has reached the end of its useful lifetime after many years of service, it must be decommissioned.

Before carrying out this procedure, it is essential that the technician is completely familiar with the system and all its connected equipment. It is good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample should be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

1. Examine all parts of the system to become familiar with the equipment and its operation.
2. Isolate system electrically.
3. Before starting the procedure, ensure that:
   a) equipment is available for handling refrigerant and refrigerant cylinders.
   b) recovery equipment and cylinders conform to the appropriate standards.
   c) all personal protective equipment is available and being used correctly.
   d) personnel are appropriately qualified.
4. Pump down refrigerant system.
5. If solenoid valves are closed and can't be powered open or there are other obstructions in the refrigeration system, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that the cylinder is situated on a scale before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80 % volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When all the refrigerant has been removed and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant should not be charged into another refrigerating system unless it has been checked and/or cleaned.

Equipment should be labelled stating that it has been de-commissioned and emptied of refrigerant. The label should be dated and signed.

Every effort should be made to check and **RE-USE** refrigerant and **RECYCLE** mechanical equipment.

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Model Specific Information

A2L

Table 14 - Refrigerant Charge				
MODEL	lb	kg	Refrigerant	Oil Type
R-09	1.9	0.86	R454b	POE
R-12	2.0	0.91	R454b	POE
R-18	2.3	1.0	R454b	POE
R-24	2.8	1.3	R454b	POE
RH-09	1.9	0.86	R454b	POE
RH-12	2.0	0.91	R454b	POE
RH-18	2.3	1.0	R454b	POE
RH-24	2.8	1.3	R454b	POE

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

Table 15 - Shipping Information					
MODEL	SHIPPING WEIGHT lb (kg)	HANGING WEIGHT lb (kg)	DIMENSIONS inches (cm)		
			L	W	H
R-09	161 (73)		25 (64)	28 (71)	48 (122)
R-12	166 (75)		25 (64)	28 (71)	48 (122)
R-18	187 (85)		25 (64)	28 (71)	48 (122)
R-24	250 (114)		25 (64)	28 (71)	48 (122)
RH-09	161 (73)	125 (57)	41 (104)	21 (53)	16 (41)
RH-12	172 (78)	136 (62)	41 (104)	21 (53)	16 (41)
RH-18	190 (86)	148 (67)	48 (122)	21 (53)	18 (46)
RH-24	250 (114)	208 (95)	48 (122)	21 (53)	18 (46)

See ***Dimensions*** later in this manual for RH-series hanger weight distribution.

Table 16 - 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.

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Pressure Drop Data

Table 17: 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-09 RH-09	1.5	*0.09*	1.4	*9.7*	1.5	*10*	1.7	*12*	2.3	*16*
	2	*0.13*	2.4	*17*	2.6	*18*	2.9	*20*	3.6	*25*
	2.5	***0.16***	**3.6**	***25***	**3.9**	***27***	**4.1**	***28***	**5.5**	***38***
	3	*0.19*	5.1	*35*	5.3	*37*	5.9	*41*	7.4	*51*
	3.5	*0.22*	6.7	*46*	6.9	*48*	7.7	*53*	9.7	*67*
	4	*0.25*	8.4	*58*	8.6	*59*	9.5	*66*	12	*83*
R-12 RH-12	1.5	*0.09*	1.4	*9.7*	1.5	*10*	1.7	*12*	2.3	*16*
	2	*0.13*	2.4	*17*	2.6	*18*	2.9	*20*	3.6	*25*
	2.5	*0.16*	3.6	*25*	3.9	*27*	4.1	*28*	5.5	*38*
	3	***0.19***	**5.1**	***35***	**5.3**	***37***	**5.9**	***41***	**7.4**	***51***
	3.5	*0.22*	6.7	*46*	6.9	*48*	7.7	*53*	9.7	*67*
	4	*0.25*	8.4	*58*	8.6	*59*	9.5	*66*	12	*83*
R-18 RH-18	2.5	*0.16*	0.8	*5.5*	0.8	*5.5*	0.9	*6.2*	1.4	*9.7*
	3	*0.19*	1.0	*6.9*	1.1	*7.6*	1.2	*8.3*	1.9	*13*
	3.5	*0.22*	1.4	*9.7*	1.5	*10*	1.7	*12*	2.3	*16*
	4	*0.25*	1.7	*12*	1.8	*12*	2.0	*14*	2.6	*18*
	4.5	***0.28***	**2.1**	***15***	**2.3**	***16***	**2.6**	***18***	**3.2**	***22***
	5	*0.32*	2.5	*17*	2.7	*19*	3.0	*21*	3.8	*26*
	5.5	*0.35*	3.1	*21*	3.4	*23*	3.8	*26*	4.8	*33*
	6	*0.38*	3.6	*25*	3.9	*27*	4.3	*30*	5.5	*38*
R-24	4	*0.25*	0.9	*6.2*	1.0	*6.9*	1.1	*7.6*	1.7	*12*
	5	*0.32*	1.4	*9.7*	1.5	*10*	1.7	*12*	2.3	*16*
	6	*0.38*	1.9	*13*	2.1	*15*	2.3	*16*	2.9	*20*
	7	*0.44*	2.5	*17*	2.7	*19*	3.0	*21*	3.8	*26*
	8	***0.50***	**3.1**	***21***	**3.4**	***23***	**3.8**	***26***	**4.8**	***33***
	9	*0.57*	4.0	*28*	4.3	*30*	4.8	*33*	6.0	*41*
	10	*0.63*	4.9	*34*	5.1	*35*	5.7	*39*	7.1	*49*
RH-24	4	*0.25*	1.0	*6.9*	1.1	*7.6*	1.2	*8.3*	1.9	*13*
	5	*0.32*	1.4	*9.7*	1.5	*10*	1.7	*12*	2.3	*16*
	6	*0.38*	1.9	*13*	2.1	*15*	2.3	*16*	2.9	*20*
	7	*0.44*	2.5	*17*	2.7	*19*	3.0	*21*	3.8	*26*
	8	***0.50***	**3.2**	***22***	**3.5**	***24***	**3.9**	***27***	**4.9**	***34***
	9	*0.57*	4.1	*28*	4.3	*30*	4.8	*33*	6.0	*41*
	10	*0.63*	5.1	*35*	5.3	*37*	5.9	*41*	7.4	*51*

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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 ELT 32°F (0°C)

Model Size	Nominal Size	Liquid Flow		Airflow		Input Energy	Capacity		COP_H
	tons	gpm	L/s	cfm	L/s	Watts	Btu/hr	kW	W/W
09	0.75	2.5	0.16	325	153	628	8,000	2.3	3.73
12	1	3.0	0.19	400	189	771	9,700	2.8	3.69
18	1.5	4.5	0.28	650	307	1,128	13,900	4.1	3.61
24	2	8.0	0.50	800	380	1,561	18,800	5.5	3.53

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

EAT 68°F (20°C) ELT 50°F (10°C)

Model Size	Nominal Size	Liquid Flow		Airflow		Input Energy	Capacity		COP_H
	tons	gpm	L/s	cfm	L/s	Watts	Btu/hr	kW	W/W
09	0.75	2.5	0.16	325	153	673	9,900	2.9	4.31
12	1	3.0	0.19	400	189	817	12,000	3.5	4.30
18	1.5	4.5	0.28	650	307	1,242	18,200	5.3	4.29
24	2	8.0	0.50	800	380	1,704	25,200	7.4	4.33

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

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

Model Size	Size	Liquid Flow		Airflow		Input Energy	Capacity		EER	COP_C
	tons	gpm	L/s	cfm	L/s	Watts	Btu/hr	kW	Btu/hr/W	W/W
09	0.75	2.5	0.16	325	153	558	9,600	2.8	5.04	17.2
12	1	3.0	0.19	400	189	686	11,800	3.5	5.04	17.2
18	1.5	4.5	0.28	650	307	1,023	17,500	5.1	5.01	17.1
24	2	8.0	0.50	800	380	1,423	24,200	7.1	4.99	17.0

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		Airflow		Input Energy	Capacity		EER	COP_C
	tons	gpm	L/s	cfm	L/s	Watts	Btu/hr	kW	Btu/hr/W	W/W
09	0.75	2.5	0.16	325	153	457	10,100	3.0	6.48	22.1
12	1	3.0	0.19	400	189	559	12,300	3.6	6.45	22.0
18	1.5	4.5	0.28	650	307	871	18,900	5.5	6.36	21.7
24	2	8.0	0.50	800	380	1,199	25,900	7.6	6.33	21.6

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Performance Tables

R/RH-09-HAC-X-1L *R454b, 60 Hz, KKN086*

	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	2.5	21	-4.3	5,250	2.0	82	610	68	100	325	89	21	**7,250**	**3.48**
	30	20	2.5	25	-4.7	5,700	2.1	82	622		102	325	90	22	**7,750**	**3.65**
	35	25	2.5	30	-5.0	6,150	2.2	82	636		104	325	92	24	**8,250**	**3.80**
	40	29	2.5	35	-5.4	6,650	2.3	82	649		106	325	93	25	**8,800**	**3.97**
	45	34	2.5	39	-5.9	7,150	2.4	82	661		108	325	95	27	**9,350**	**4.15**
	50	39	2.5	44	-6.3	7,650	2.5	82	673		110	325	96	28	**9,900**	**4.31**
	55	44	2.5	48	-6.7	8,100	2.5	82	685		111	325	98	30	**10,400**	**4.45**
	60	48	2.5	53	-7.1	8,600	2.6	82	696		113	325	99	31	**10,900**	**4.59**
	65	53	2.5	58	-7.5	9,050	2.6	82	709		115	325	101	33	**11,400**	**4.71**
	70	58	2.5	62	-7.8	9,500	2.6	82	720		117	325	102	34	**11,900**	**4.84**

	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	50	72	2.5	60	9.6	**11,700**	1.1	93	389	80.6	43	325	60	-20	3,250	7,200	10,450	**26.9**
	55	77	2.5	65	9.5	**11,600**	1.3	93	428		44	325	61	-20	3,100	7,100	10,200	**23.8**
	60	83	2.5	70	9.5	**11,600**	1.5	93	463		44	325	61	-20	3,000	7,050	10,050	**21.7**
	65	88	2.5	75	9.6	**11,600**	1.6	93	494		45	325	61	-20	2,900	7,050	9,950	**20.1**
	70	93	2.5	80	9.5	**11,550**	1.8	93	522		45	325	61	-20	2,800	7,000	9,800	**18.8**
	75	99	2.5	85	9.5	**11,450**	1.9	93	548		46	325	61	-20	2,700	6,950	9,650	**17.6**
	80	104	2.5	89	9.4	**11,400**	2.0	93	573		46	325	61	-20	2,650	6,850	9,500	**16.6**
	85	109	2.5	94	9.4	**11,350**	2.1	93	596		47	325	61	-19	2,550	6,800	9,350	**15.7**
	90	114	2.5	99	9.3	**11,200**	2.2	93	620		47	325	62	-19	2,450	6,700	9,150	**14.8**
	95	120	2.5	104	9.2	**11,050**	2.3	93	644		48	325	62	-19	2,300	6,600	8,900	**13.8**

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	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	-9.3	0.16	-6.3	-2.4	1.5	2.0	82	610	20.0	37.7	153	31.6	11.6	**2.1**	**3.48**
	-1.1	-6.7	0.16	-3.7	-2.6	1.7	2.1	82	622		38.8	153	32.3	12.3	**2.3**	**3.65**
	1.7	-4.1	0.16	-1.1	-2.8	1.8	2.2	82	636		39.9	153	33.1	13.1	**2.4**	**3.80**
	4.4	-1.4	0.16	1.4	-3.0	2.0	2.3	82	649		40.9	153	34.0	14.0	**2.6**	**3.97**
	7.2	1.2	0.16	3.9	-3.3	2.1	2.4	82	661		42.0	153	34.9	14.9	**2.7**	**4.15**
	10.0	3.8	0.16	6.5	-3.5	2.2	2.5	82	673		43.1	153	35.7	15.7	**2.9**	**4.31**
	12.8	6.4	0.16	9.1	-3.7	2.4	2.5	82	685		44.1	153	36.6	16.6	**3.1**	**4.45**
	15.6	9.0	0.16	11.7	-3.9	2.5	2.6	82	696		45.2	153	37.3	17.3	**3.2**	**4.59**
	18.3	11.7	0.16	14.1	-4.2	2.7	2.6	82	709		46.3	153	38.1	18.1	**3.3**	**4.71**
	21.1	14.3	0.16	16.8	-4.3	2.8	2.6	82	720		47.3	153	38.9	18.9	**3.5**	**4.84**

	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 (kW)	Sensible (kW)	**Cooling (kW)**	**COP_C**
COOLING	10.0	22.2	0.16	15.3	5.3	**3.4**	1.1	93	389	27.0	6.3	20.5	15.7	-11.3	1.0	2.1	3.1	**7.88**
	12.8	25.2	0.16	18.1	5.3	**3.4**	1.3	93	428		6.6	20.5	15.8	-11.2	0.9	2.1	3.0	**6.98**
	15.6	28.1	0.16	20.9	5.3	**3.4**	1.5	93	463		6.8	20.5	15.9	-11.1	0.9	2.1	3.0	**6.36**
	18.3	31.1	0.16	23.6	5.3	**3.4**	1.6	93	494		7.1	20.5	15.9	-11.1	0.9	2.1	2.9	**5.89**
	21.1	34.0	0.16	26.4	5.3	**3.4**	1.8	93	522		7.3	20.5	16.0	-11.0	0.8	2.1	2.9	**5.51**
	23.9	36.9	0.16	29.2	5.3	**3.4**	1.9	93	548		7.6	20.5	16.1	-10.9	0.8	2.0	2.8	**5.16**
	26.7	39.9	0.16	31.9	5.2	**3.3**	2.0	93	573		7.9	20.5	16.2	-10.8	0.8	2.0	2.8	**4.86**
	29.4	42.8	0.16	34.6	5.2	**3.3**	2.1	93	596		8.2	20.5	16.3	-10.7	0.7	2.0	2.7	**4.60**
	32.2	45.8	0.16	37.4	5.2	**3.3**	2.2	93	620		8.4	20.5	16.4	-10.6	0.7	2.0	2.7	**4.34**
	35.0	48.7	0.16	40.1	5.1	**3.2**	2.3	93	644		8.7	20.5	16.6	-10.4	0.7	1.9	2.6	**4.04**

** *Fan power at 24.9Pa (0.10inH_2O) external static.*

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Performance Tables

R/RH-12-HAC-X-1L *R454b, 60 Hz, KKN106*

	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	3.0	21	-4.3	6,350	2.8	104	752	68	100	400	89	21	**8,850**	**3.45**
	30	20	3.0	25	-4.7	6,950	2.9	104	765		102	400	90	22	**9,500**	**3.64**
	35	25	3.0	30	-5.1	7,500	3.0	104	779		104	400	91	23	**10,050**	**3.78**
	40	29	3.0	35	-5.5	8,100	3.1	104	792		105	400	93	25	**10,700**	**3.96**
	45	34	3.0	39	-5.9	8,700	3.1	104	804		107	400	94	26	**11,350**	**4.14**
	50	39	3.0	44	-6.4	9,300	3.2	104	817		109	400	96	28	**12,000**	**4.30**
	55	43	3.0	48	-6.8	9,900	3.3	104	829		111	400	97	29	**12,650**	**4.47**
	60	48	3.0	53	-7.2	10,500	3.3	104	841		113	400	99	31	**13,300**	**4.63**
	65	53	3.0	57	-7.6	11,050	3.3	104	852		115	400	100	32	**13,900**	**4.78**
	70	57	3.0	62	-8.0	11,600	3.3	104	865		117	400	102	34	**14,500**	**4.91**

	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	50	72	3.0	60	9.7	**14,200**	1.7	116	476	80.6	44	400	61	-20	3,900	8,750	12,650	**26.6**
	55	77	3.0	65	9.7	**14,150**	1.8	116	524		44	400	61	-20	3,800	8,650	12,450	**23.8**
	60	83	3.0	70	9.7	**14,100**	2.0	116	568		44	400	61	-20	3,650	8,600	12,250	**21.6**
	65	88	3.0	75	9.7	**14,100**	2.1	116	606		45	400	61	-20	3,550	8,550	12,100	**20.0**
	70	93	3.0	80	9.7	**14,100**	2.3	116	640		45	400	61	-20	3,450	8,550	12,000	**18.8**
	75	99	3.0	85	9.7	**14,050**	2.4	116	674		46	400	61	-20	3,350	8,500	11,850	**17.6**
	80	104	3.0	90	9.7	**14,000**	2.5	116	704		46	400	61	-20	3,250	8,450	11,700	**16.6**
	85	109	3.0	95	9.6	**13,950**	2.7	116	734		47	400	61	-19	3,150	8,400	11,550	**15.7**
	90	115	3.0	100	9.6	**13,900**	2.8	116	765		47	400	61	-19	3,000	8,350	11,350	**14.8**
	95	120	3.0	105	9.5	**13,700**	2.9	116	796		47	400	62	-19	2,850	8,200	11,050	**13.9**

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	-9.4	0.19	-6.3	-2.4	1.9	2.8	104	752	20.0	37.7	189	31.4	11.4	**2.6**	**3.45**
	-1.1	-6.8	0.19	-3.7	-2.6	2.0	2.9	104	765		38.7	189	32.3	12.3	**2.8**	**3.64**
	1.7	-4.2	0.19	-1.1	-2.8	2.2	3.0	104	779		39.7	189	33.0	13.0	**3.0**	**3.78**
	4.4	-1.6	0.19	1.3	-3.1	2.4	3.1	104	792		40.8	189	33.8	13.8	**3.1**	**3.96**
	7.2	1.1	0.19	3.9	-3.3	2.6	3.1	104	804		41.8	189	34.7	14.7	**3.3**	**4.14**
	10.0	3.7	0.19	6.4	-3.6	2.7	3.2	104	817		42.9	189	35.5	15.5	**3.5**	**4.30**
	12.8	6.3	0.19	9.0	-3.8	2.9	3.3	104	829		43.9	189	36.3	16.3	**3.7**	**4.47**
	15.6	8.9	0.19	11.6	-4.0	3.1	3.3	104	841		45.0	189	37.2	17.2	**3.9**	**4.63**
	18.3	11.5	0.19	14.1	-4.2	3.2	3.3	104	852		46.1	189	37.9	17.9	**4.1**	**4.78**
	21.1	14.1	0.19	16.7	-4.4	3.4	3.3	104	865		47.1	189	38.7	18.7	**4.3**	**4.91**

	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 (kW)	Sensible (kW)	**Cooling (kW)**	COP_C
COOLING	10.0	22.2	0.19	15.4	5.4	**4.2**	1.7	116	476	27.0	6.4	25.2	15.8	-11.2	1.1	2.6	3.7	**7.80**
	12.8	25.2	0.19	18.2	5.4	**4.2**	1.8	116	524		6.7	25.2	15.9	-11.1	1.1	2.5	3.7	**6.98**
	15.6	28.2	0.19	21.0	5.4	**4.1**	2.0	116	568		6.9	25.2	16.0	-11.0	1.1	2.5	3.6	**6.33**
	18.3	31.1	0.19	23.7	5.4	**4.1**	2.1	116	606		7.1	25.2	16.1	-10.9	1.0	2.5	3.6	**5.86**
	21.1	34.1	0.19	26.5	5.4	**4.1**	2.3	116	640		7.3	25.2	16.1	-10.9	1.0	2.5	3.5	**5.51**
	23.9	37.1	0.19	29.3	5.4	**4.1**	2.4	116	674		7.6	25.2	16.1	-10.9	1.0	2.5	3.5	**5.16**
	26.7	40.0	0.19	32.1	5.4	**4.1**	2.5	116	704		7.8	25.2	16.2	-10.8	1.0	2.5	3.4	**4.86**
	29.4	42.9	0.19	34.7	5.3	**4.1**	2.7	116	734		8.1	25.2	16.2	-10.8	0.9	2.5	3.4	**4.60**
	32.2	45.9	0.19	37.5	5.3	**4.1**	2.8	116	765		8.3	25.2	16.3	-10.7	0.9	2.5	3.3	**4.34**
	35.0	48.9	0.19	40.3	5.3	**4.0**	2.9	116	796		8.5	25.2	16.6	-10.4	0.8	2.4	3.2	**4.07**

** *Fan power at 24.9Pa (0.10inH_2O) external static.*

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Performance Tables

R/RH-18-HAC-X-1L *R454b, 60 Hz, KKN156*

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**
25	15	4.5	21	-4.0	8,750	4.0	135	1,082	68	100	650	86	18	**12,350**	**3.35**
30	20	4.5	26	-4.4	9,700	4.2	135	1,115		102	650	87	19	**13,450**	**3.54**
35	25	4.5	30	-4.9	10,700	4.4	135	1,148		104	650	89	21	**14,550**	**3.71**
40	30	4.5	35	-5.3	11,750	4.6	135	1,180		106	650	91	23	**15,700**	**3.90**
45	34	4.5	39	-5.9	12,900	4.8	135	1,211		108	650	92	24	**16,950**	**4.10**
50	39	4.5	44	-6.4	14,050	5.0	135	1,243		110	650	94	26	**18,250**	**4.30**
55	44	4.5	48	-6.9	15,200	5.1	135	1,273		112	650	96	28	**19,500**	**4.49**
60	48	4.5	53	-7.5	16,450	5.2	135	1,304		114	650	98	30	**20,850**	**4.69**
65	53	4.5	57	-8.1	17,700	5.3	135	1,335		116	650	100	32	**22,200**	**4.87**
70	58	4.5	61	-8.7	19,000	5.4	135	1,364		117	650	102	34	**23,600**	**5.07**

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**
50	71	4.5	60	10.2	**22,300**	2.6	143	739	80.6	44	650	61	-19	6,100	13,700	19,800	**26.8**
55	77	4.5	65	10.0	**22,000**	2.9	143	819		44	650	62	-19	5,900	13,400	19,300	**23.6**
60	82	4.5	70	9.9	**21,700**	3.2	143	883		44	650	62	-19	5,600	13,200	18,800	**21.3**
65	88	4.5	75	9.8	**21,500**	3.4	143	936		45	650	62	-18	5,400	13,000	18,400	**19.7**
70	93	4.5	80	9.8	**21,300**	3.6	143	978		45	650	62	-18	5,200	12,800	18,000	**18.4**
75	99	4.5	85	9.7	**21,100**	3.8	143	1,012		46	650	63	-18	5,000	12,700	17,700	**17.5**
80	104	4.5	90	9.6	**20,800**	3.9	143	1,040		46	650	63	-18	4,800	12,500	17,300	**16.6**
85	110	4.5	94	9.4	**20,500**	4.0	143	1,063		46	650	63	-17	4,600	12,300	16,900	**15.9**
90	115	4.5	99	9.2	**20,000**	4.1	143	1,083		47	650	64	-17	4,400	12,000	16,400	**15.1**
95	121	4.5	104	9.0	**19,500**	4.2	143	1,101		47	650	64	-17	4,100	11,700	15,800	**14.4**

METRIC

HEATING

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**
-3.9	-9.3	0.28	-6.1	-2.2	2.6	4.0	135	1,082	20.0	37.8	307	29.8	9.8	**3.6**	**3.35**
-1.1	-6.7	0.28	-3.5	-2.4	2.8	4.2	135	1,115		38.9	307	30.7	10.7	**3.9**	**3.54**
1.7	-4.1	0.28	-1.0	-2.7	3.1	4.4	135	1,148		40.0	307	31.6	11.6	**4.3**	**3.71**
4.4	-1.4	0.28	1.5	-2.9	3.4	4.6	135	1,180		41.1	307	32.5	12.5	**4.6**	**3.90**
7.2	1.2	0.28	3.9	-3.3	3.8	4.8	135	1,211		42.1	307	33.5	13.5	**5.0**	**4.10**
10.0	3.8	0.28	6.4	-3.6	4.1	5.0	135	1,243		43.2	307	34.5	14.5	**5.4**	**4.30**
12.8	6.4	0.28	9.0	-3.8	4.5	5.1	135	1,273		44.2	307	35.5	15.5	**5.7**	**4.49**
15.6	9.1	0.28	11.4	-4.2	4.8	5.2	135	1,304		45.3	307	36.6	16.6	**6.1**	**4.69**
18.3	11.7	0.28	13.8	-4.5	5.2	5.3	135	1,335		46.4	307	37.7	17.7	**6.5**	**4.87**
21.1	14.3	0.28	16.3	-4.8	5.6	5.4	135	1,364		47.4	307	38.8	18.8	**6.9**	**5.07**

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. (kW)	Compressor Current (A)	Fan** (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (kW)	Sensible (kW)	**Cooling (kW)**	**COP_C**
10.0	21.8	0.28	15.7	5.7	**6.5**	2.6	143	739	27.0	6.5	41.0	16.2	-10.8	1.8	4.0	5.8	**7.85**
12.8	24.9	0.28	18.4	5.6	**6.5**	2.9	143	819		6.7	41.0	16.4	-10.6	1.7	3.9	5.7	**6.92**
15.6	27.9	0.28	21.1	5.5	**6.4**	3.2	143	883		6.9	41.0	16.6	-10.4	1.6	3.9	5.5	**6.24**
18.3	31.0	0.28	23.7	5.4	**6.3**	3.4	143	936		7.1	41.0	16.8	-10.2	1.6	3.8	5.4	**5.77**
21.1	34.1	0.28	26.5	5.4	**6.2**	3.6	143	978		7.3	41.0	16.9	-10.1	1.5	3.8	5.3	**5.39**
23.9	37.1	0.28	29.3	5.4	**6.2**	3.8	143	1,012		7.5	41.0	17.0	-10.0	1.5	3.7	5.2	**5.13**
26.7	40.2	0.28	32.0	5.3	**6.1**	3.9	143	1,040		7.7	41.0	17.2	-9.8	1.4	3.7	5.1	**4.86**
29.4	43.2	0.28	34.6	5.2	**6.0**	4.0	143	1,063		7.9	41.0	17.3	-9.7	1.4	3.6	5.0	**4.66**
32.2	46.3	0.28	37.3	5.1	**5.9**	4.1	143	1,083		8.1	41.0	17.6	-9.4	1.3	3.5	4.8	**4.43**
35.0	49.3	0.28	40.0	5.0	**5.7**	4.2	143	1,101		8.3	41.0	17.8	-9.2	1.2	3.4	4.6	**4.22**

** *Fan power at 24.9Pa (0.10inH_2O) external static.*

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Performance Tables

R/RH-24-HAC-X-1L *R454b, 60 Hz, KJS215*

	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	8.0	22	-3.0	11,700	5.6	185	1,507		101	800	87	19	**16,600**	**3.23**
	30	20	8.0	27	-3.3	13,100	5.8	185	1,547		103	800	89	21	**18,200**	**3.45**
	35	25	8.0	31	-3.7	14,600	6.1	185	1,584		105	800	91	23	**19,800**	**3.66**
	40	29	8.0	36	-4.1	16,200	6.3	185	1,622		107	800	93	25	**21,600**	**3.90**
	45	34	8.0	40	-4.6	17,900	6.5	185	1,663	68	109	800	95	27	**23,400**	**4.12**
	50	39	8.0	45	-5.0	19,600	6.7	185	1,705		110	800	97	29	**25,200**	**4.33**
	55	43	8.0	50	-5.5	21,400	6.9	185	1,749		112	800	100	32	**27,200**	**4.56**
	60	48	8.0	54	-6.0	23,300	7.0	185	1,800		114	800	102	34	**29,300**	**4.77**
	65	52	8.0	59	-6.5	25,200	7.2	185	1,854		116	800	105	37	**31,400**	**4.96**
	70	57	8.0	63	-7.0	27,200	7.3	185	1,914		118	800	107	39	**33,600**	**5.14**

	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	50	71	8.0	56	6.2	**30,300**	4.0	192	1,013		44	1200	67	-14	8,600	18,400	27,000	**26.7**
	55	77	8.0	61	6.2	**30,000**	4.3	192	1,124		44	1200	67	-14	8,300	18,000	26,300	**23.4**
	60	82	8.0	66	6.1	**29,800**	4.6	192	1,217		45	1200	67	-14	8,000	17,800	25,800	**21.2**
	65	88	8.0	71	6.1	**29,500**	4.8	192	1,292		45	1200	67	-14	7,700	17,600	25,300	**19.6**
	70	93	8.0	76	6.0	**29,200**	5.0	192	1,354		46	1200	67	-13	7,400	17,400	24,800	**18.3**
	75	98	8.0	81	6.0	**29,000**	5.2	192	1,405	80.6	46	1200	67	-13	7,100	17,300	24,400	**17.4**
	80	104	8.0	86	5.9	**28,700**	5.4	192	1,448		47	1200	68	-13	6,900	17,000	23,900	**16.5**
	85	109	8.0	91	5.9	**28,300**	5.5	192	1,483		47	1200	68	-13	6,600	16,800	23,400	**15.8**
	90	115	8.0	96	5.8	**27,800**	5.7	192	1,513		48	1200	68	-13	6,300	16,500	22,800	**15.1**
	95	120	8.0	101	5.7	**27,200**	5.8	192	1,538		48	1200	68	-12	6,000	16,100	22,100	**14.4**

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	-9.3	0.51	-5.6	-1.7	3.4	5.6	185	1,507		38.4	378	30.8	10.8	**4.9**	**3.23**
	-1.1	-6.7	0.51	-2.9	-1.8	3.8	5.8	185	1,547		39.5	378	31.8	11.8	**5.3**	**3.45**
	1.7	-4.1	0.51	-0.4	-2.1	4.3	6.1	185	1,584		40.5	378	32.8	12.8	**5.8**	**3.66**
	4.4	-1.6	0.51	2.1	-2.3	4.8	6.3	185	1,622		41.5	378	34.0	14.0	**6.3**	**3.90**
	7.2	1.1	0.51	4.6	-2.6	5.3	6.5	185	1,663	20.0	42.6	378	35.2	15.2	**6.9**	**4.12**
	10.0	3.6	0.51	7.2	-2.8	5.7	6.7	185	1,705		43.6	378	36.3	16.3	**7.4**	**4.33**
	12.8	6.2	0.51	9.7	-3.1	6.3	6.9	185	1,749		44.6	378	37.6	17.6	**8.0**	**4.56**
	15.6	8.8	0.51	12.3	-3.3	6.8	7.0	185	1,800		45.6	378	38.9	18.9	**8.6**	**4.77**
	18.3	11.3	0.51	14.7	-3.6	7.4	7.2	185	1,854		46.6	378	40.3	20.3	**9.2**	**4.96**
	21.1	13.9	0.51	17.2	-3.9	8.0	7.3	185	1,914		47.6	378	41.7	21.7	**9.9**	**5.14**

	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 (kW)	Sensible (kW)	**Cooling (kW)**	**COP$_C$**
COOLING	10.0	21.8	0.51	13.4	3.4	**8.9**	4.0	192	1,013		6.6	75.7	19.2	-7.8	2.5	5.4	7.9	**7.83**
	12.8	24.8	0.51	16.2	3.4	**8.8**	4.3	192	1,124		6.8	75.7	19.3	-7.7	2.4	5.3	7.7	**6.86**
	15.6	27.8	0.51	19.0	3.4	**8.7**	4.6	192	1,217		7.1	75.7	19.4	-7.6	2.3	5.2	7.6	**6.21**
	18.3	30.8	0.51	21.7	3.4	**8.7**	4.8	192	1,292		7.4	75.7	19.5	-7.5	2.3	5.2	7.4	**5.74**
	21.1	33.8	0.51	24.4	3.3	**8.6**	5.0	192	1,354	27.0	7.6	75.7	19.6	-7.4	2.2	5.1	7.3	**5.36**
	23.9	36.8	0.51	27.2	3.3	**8.5**	5.2	192	1,405		7.9	75.7	19.7	-7.3	2.1	5.1	7.2	**5.10**
	26.7	39.9	0.51	30.0	3.3	**8.4**	5.4	192	1,448		8.2	75.7	19.8	-7.2	2.0	5.0	7.0	**4.84**
	29.4	42.9	0.51	32.7	3.3	**8.3**	5.5	192	1,483		8.4	75.7	19.8	-7.2	1.9	4.9	6.9	**4.63**
	32.2	45.9	0.51	35.4	3.2	**8.2**	5.7	192	1,513		8.7	75.7	20.0	-7.0	1.9	4.8	6.7	**4.43**
	35.0	48.9	0.51	38.2	3.2	**8.0**	5.8	192	1,538		8.9	75.7	20.2	-6.8	1.8	4.7	6.5	**4.22**

** *Fan power at 24.9Pa (0.10inH$_2$O) external static.*

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Electrical Specifications

TABLE 22 - R-Series (R454b) Electrical Specifications												
	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-09	1	208/**230**-1-60	187	253	3.9	22	2.8	1.5	8.4	9.4	15	#14-2
	3	265/277-1-60	226	304	3.5	23	2.6	-	6.3	7.2	15	#14-2
	9	**208**/230-1-60	187	253	3.9	22	2.8	1.5	8.4	9.4	15	#14-2
R/RH-12	1	208/**230**-1-60	187	253	5.0	25	2.8	1.5	9.5	10.8	15	#14-2
	3	265/277-1-60	226	304	4.0	21	2.6	-	6.8	7.8	15	#14-2
	9	**208**/230-1-60	187	253	5.0	25	2.8	1.5	9.5	10.8	15	#14-2
R/RH-18	1	208/**230**-1-60	187	253	7.6	36	2.8	1.5	12.1	14.0	20	#12-2
	3	265/277-1-60	226	304	5.8	27	2.6	-	8.6	10.1	15	#14-2
	9	**208**/230-1-60	187	253	7.6	36	2.8	1.5	12.1	14.0	20	#12-2
R/RH-24	1	208/**230**-1-60	187	253	9.6	43	2.8	1.5	14.1	16.5	20	#12-2
	9	**208**/230-1-60	187	253	9.6	43	2.8	1.5	14.1	16.5	20	#12-2

TABLE 23 - Plenum Heater Electrical Specifications										
Size (kW)	(230-1-60)					(208-1-60)				
	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
7	7	29.2	36.5	40	#8	5.3	25.3	31.6	40	#8
10	10	41.7	52.1	60	#6	7.5	36.1	45.1	50	#6

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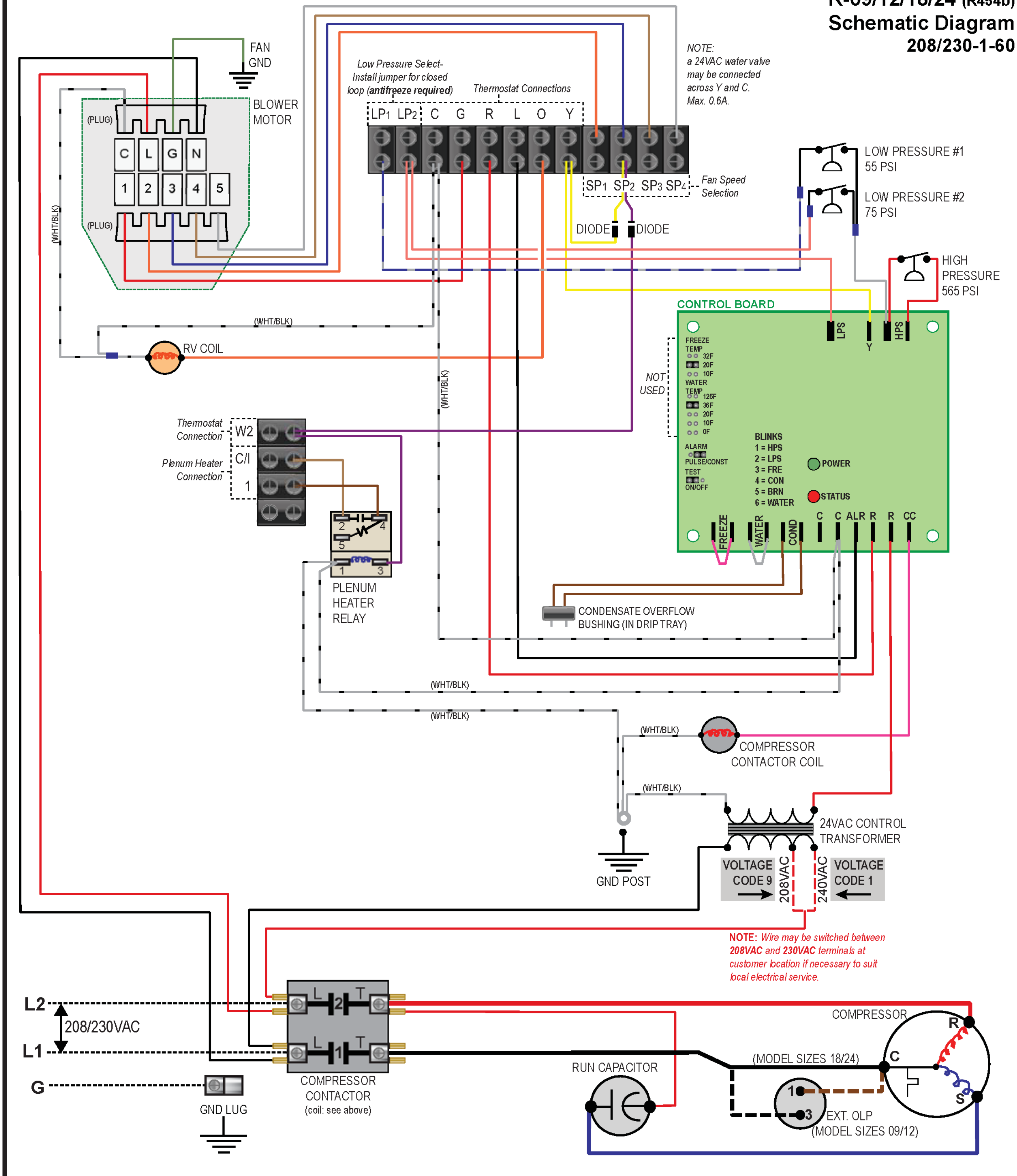
R-09/12/18/24 (R454b) Schematic Diagram 208/230-1-60



01	Initial Release	D. RHEAULT	D. RHEAULT	1-APR-2025
REV	ECO#	IMPL BY	APVD BY	DATE

Drawn By: D. RHEAULT	Date: 1-APR-2025
Checked By: D. RHEAULT	Date: 1-APR-2025
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: R-09/12/18/24-HAC-X-1L/9L-*-*DE*F Schematic Diagram

Size	Drawing Number	Drawing Rev	Sheet
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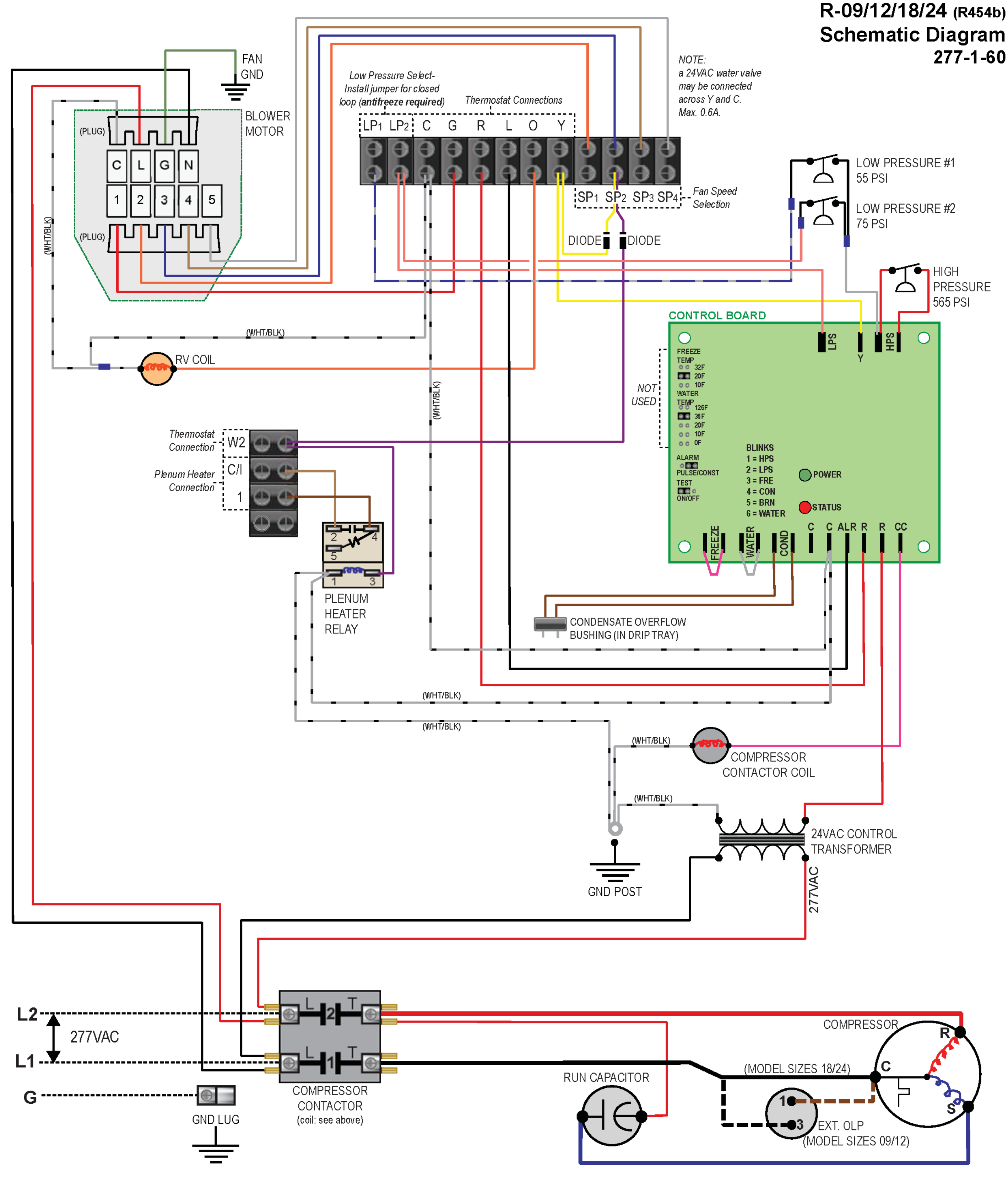
R-09/12/18/24 (R454b) Schematic Diagram 277-1-60



Drawn By	Date
D. RHEAULT	1-APR-2025
Checked By	Date
D. RHEAULT	1-APR-2025
Eng. Approved By	Date
Mfg. Approved By	Date
Approved By	Date

REV	ECO#	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	1-APR-2025

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

Drawing Name
R-09/12/18/24-HAC-X-3L-*-*DE*F
Schematic Diagram

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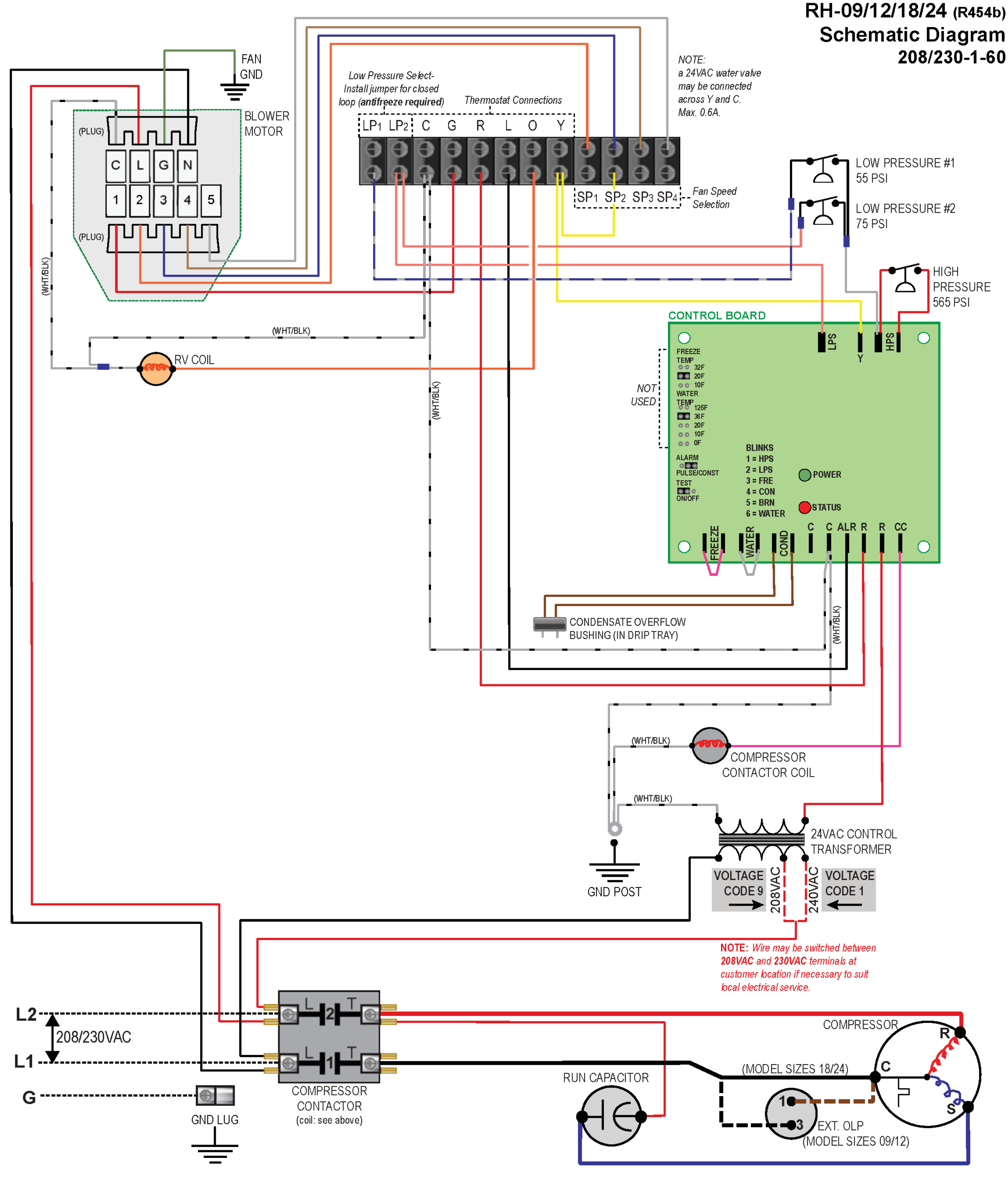
RH-09/12/18/24 (R454b) Schematic Diagram 208/230-1-60



Drawn By	Date
D. RHEAULT	1-APR-2025
Checked By D. RHEAULT	Date 1-APR-2025
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
RH-09/12/18/24-HAC-X-1L/9L-*-*DE*F
Schematic Diagram

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REV	ECO#	IMPL BY	APVD BY	DATE
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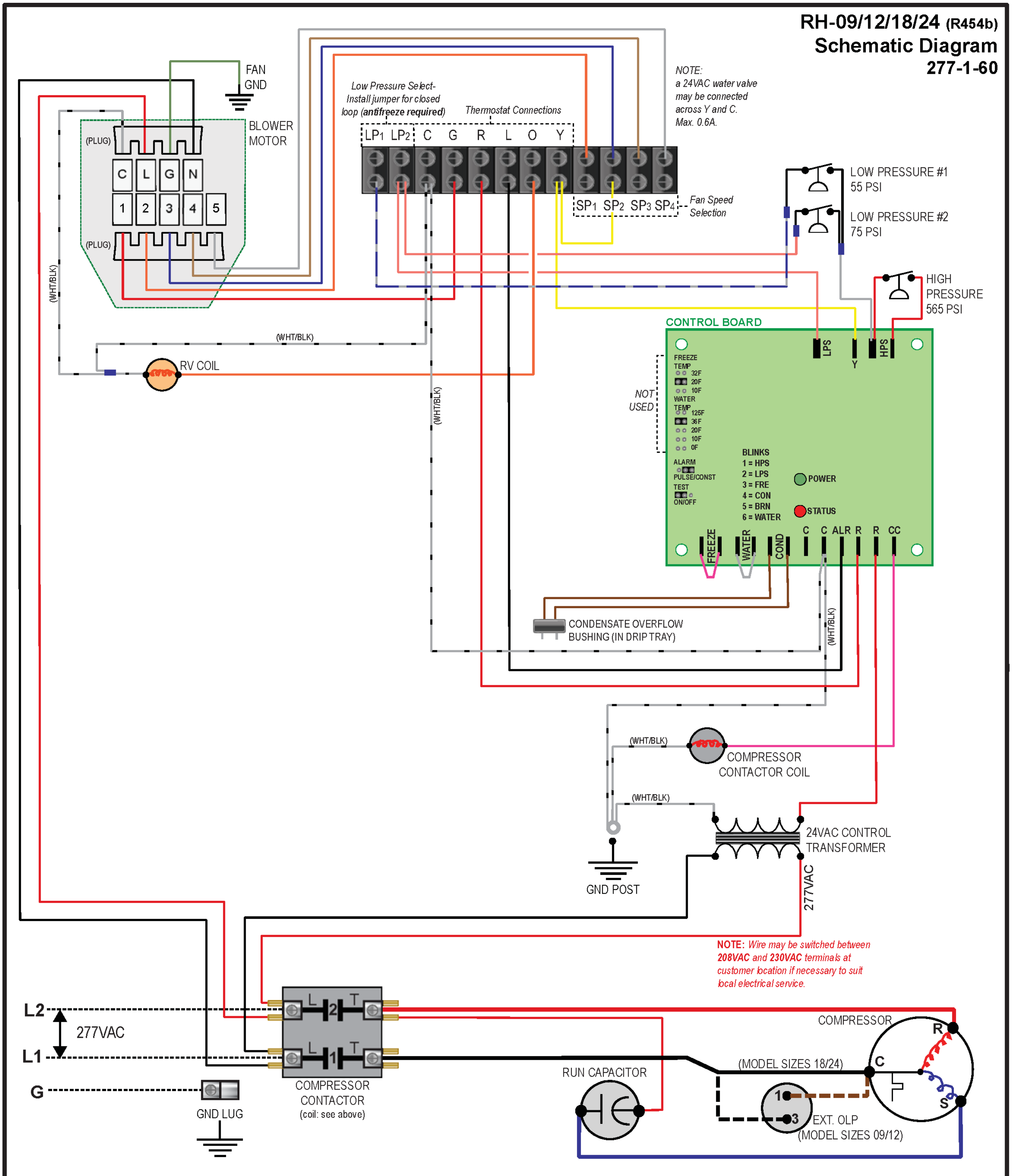
RH-09/12/18/24 (R454b) Schematic Diagram 277-1-60



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Checked By	Date
D. RHEAULT	1-APR-2025
Eng. Approved By	Date
Mfg. Approved By	Date
Approved By	Date

REV	ECO#	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	1-APR-2025

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

Drawing Name
RH-09/12/18/24-HAC-X-3L-*-*DE*F
Schematic Diagram

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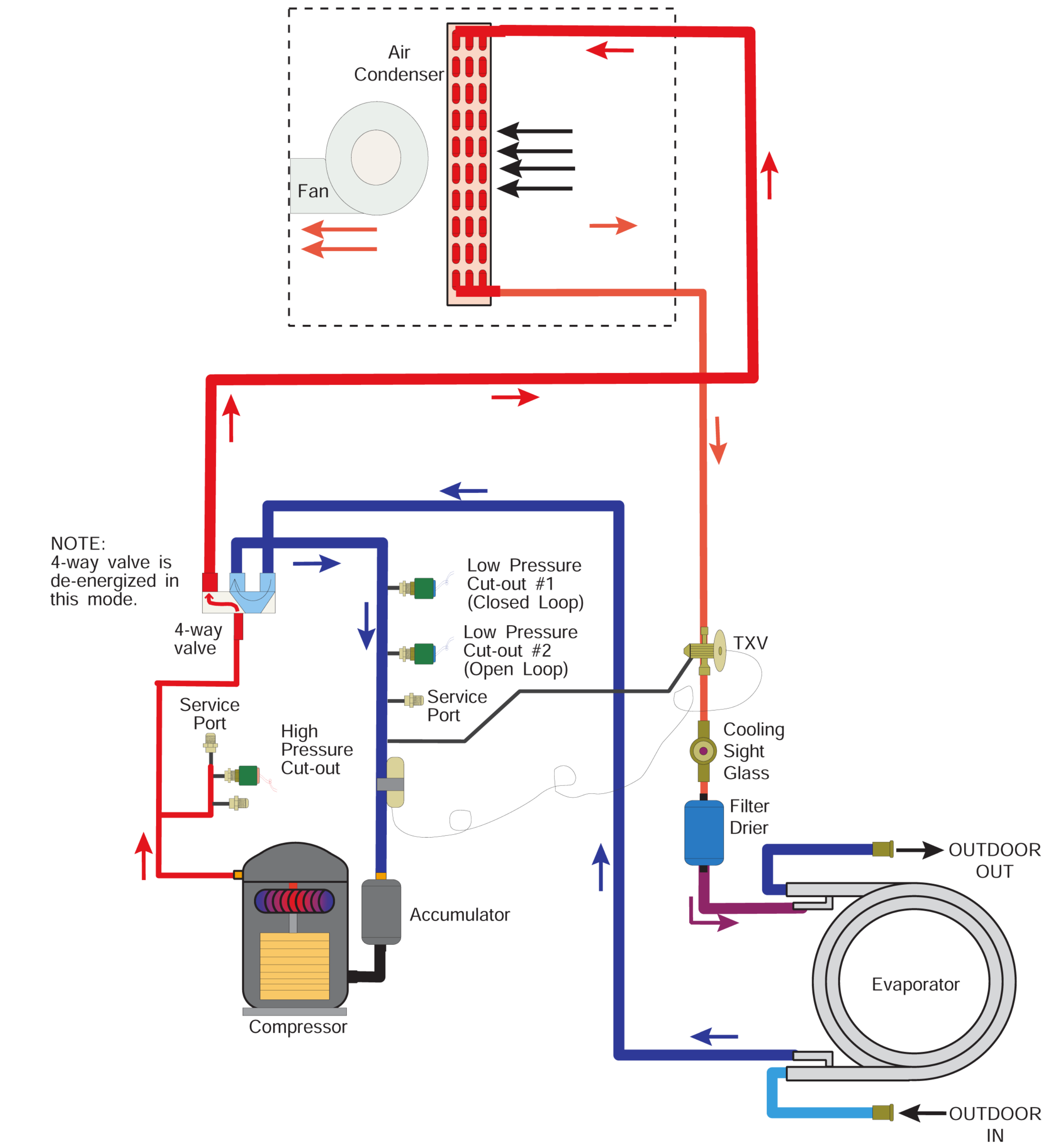
R(H) 09-24 Refrigeration Circuit - Heating Mode



					Drawn By Chris Geddes	Date 21 MAY 2103	MARITIME GEOTHERMAL LTD.		170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Chris Geddes	Date 21 MAY 2103			
					Approved By (ENG) Chris Geddes	Date 21 MAY 2103	Drawing Name	R(H) 09-24 Refrigeration Circuit Diagram - Heating Mode	
01	Initial Release	C. GEDDES	C. GEDDES	21 MAY 2013	Approved By (MFG)	Date	Size A	Drawing Number 001766RCD	Drawing Rev 01 / SHEET 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date			

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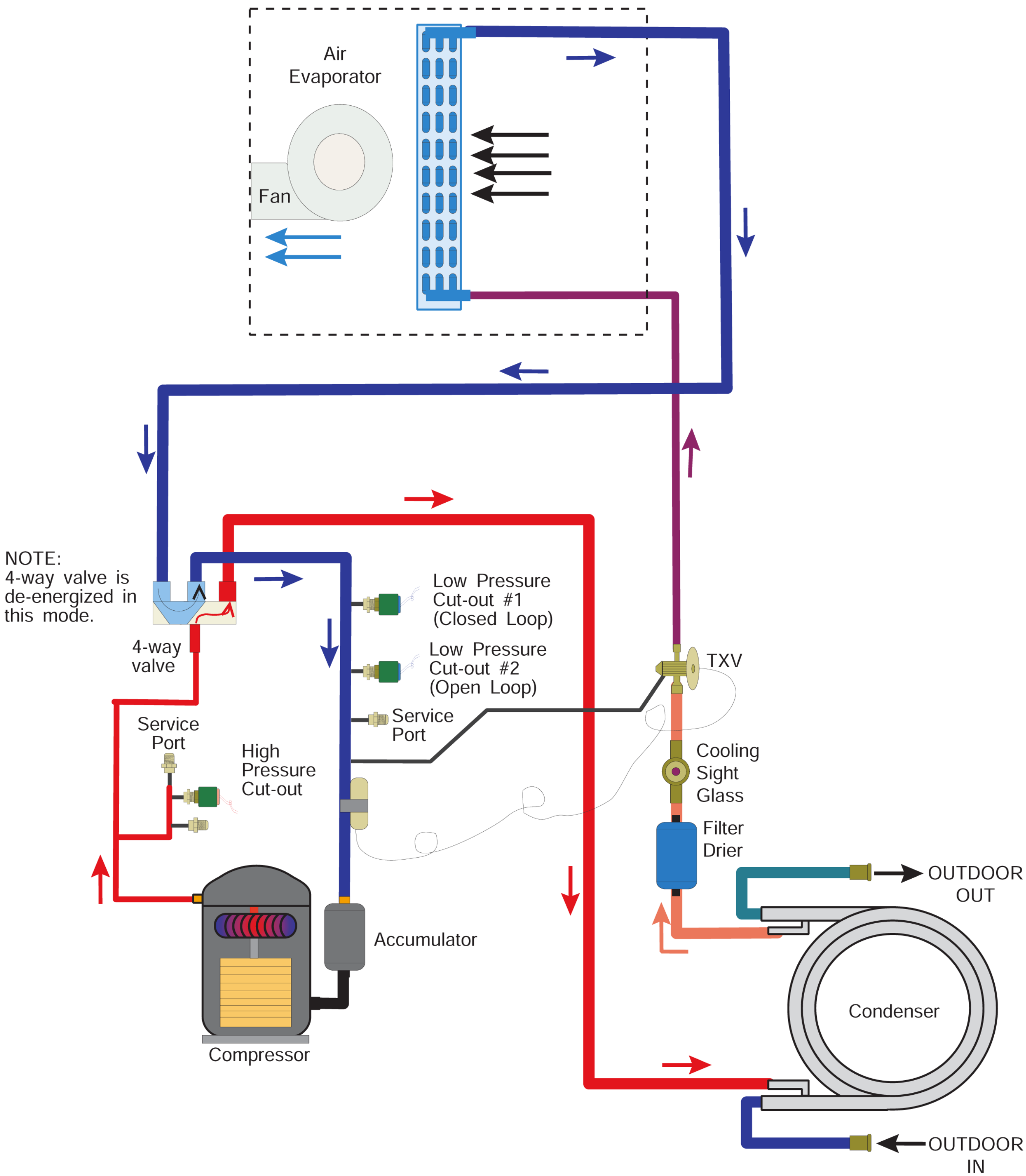
R(H) 09-24 Refrigeration Circuit - Cooling Mode



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					Approved By (ENG) Chris Geddes	Date 21 MAY 2103	Drawing Name R(H) 09-24 Refrigeration Circuit Diagram - Cooling Mode
01	Initial Release	C. GEDDES	C. GEDDES	21 MAY 2013	Approved By (MFG)	Date	
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date	Size A / Drawing Number 001767RCD / Drawing Rev 01 / SHEET 1 of 1

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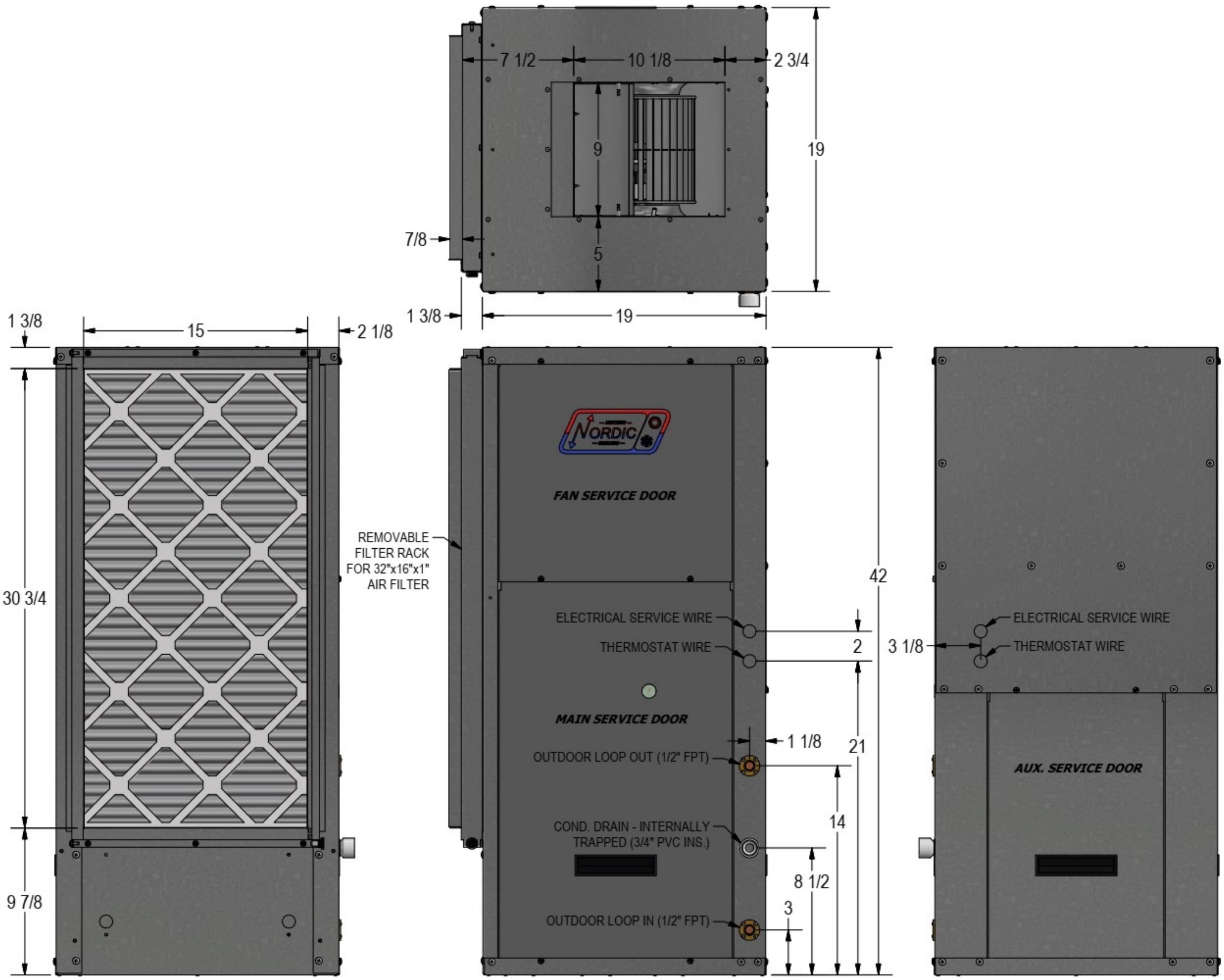
Dimensions: R-09/12 Left Return

All dimensions in inches.

NO BACK CLEARANCE REQUIRED



RECOMMENDED FRONT CLEARANCE:
2 FT

SIDE CLEARANCE OPTIONAL

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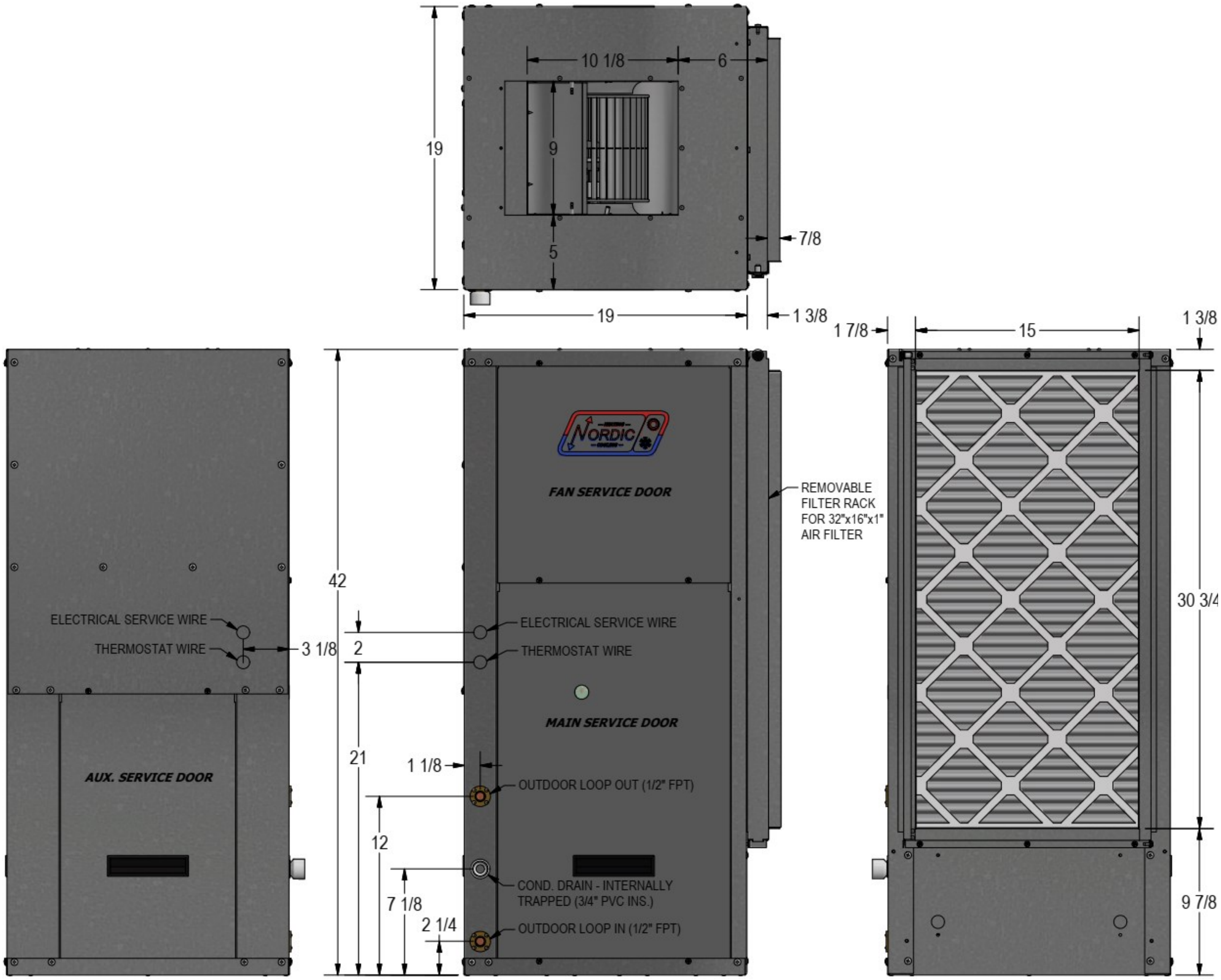
Dimensions: R-09/12 Right Return

All dimensions in inches.

NO BACK CLEARANCE REQUIRED



SIDE
CLEARANCE
OPTIONAL

RECOMMENDED
FRONT CLEARANCE:
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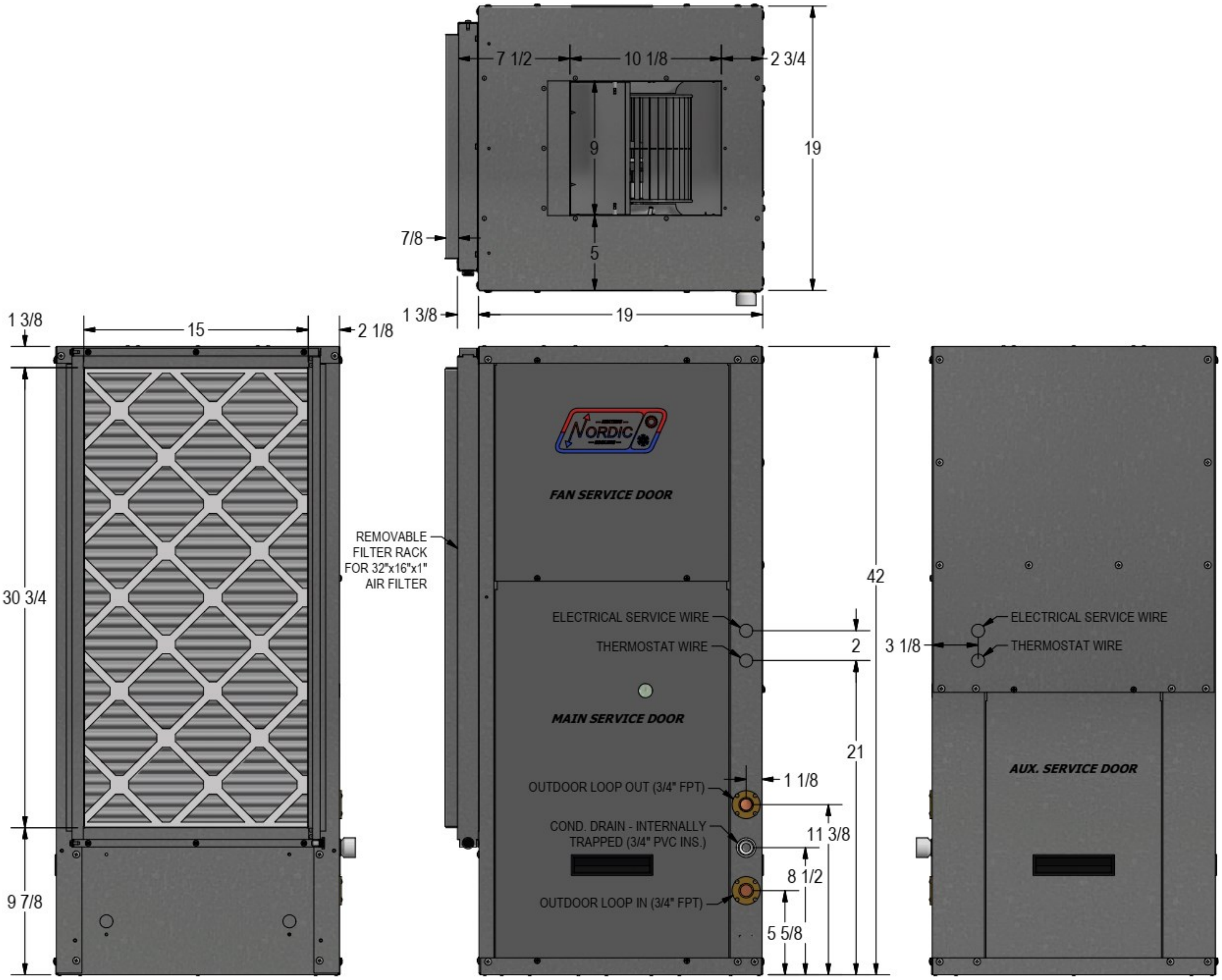
Dimensions: R-18/24 Left Return

All dimensions in inches.

NO BACK CLEARANCE REQUIRED



RECOMMENDED
FRONT CLEARANCE:
2 FT

SIDE
CLEARANCE
OPTIONAL

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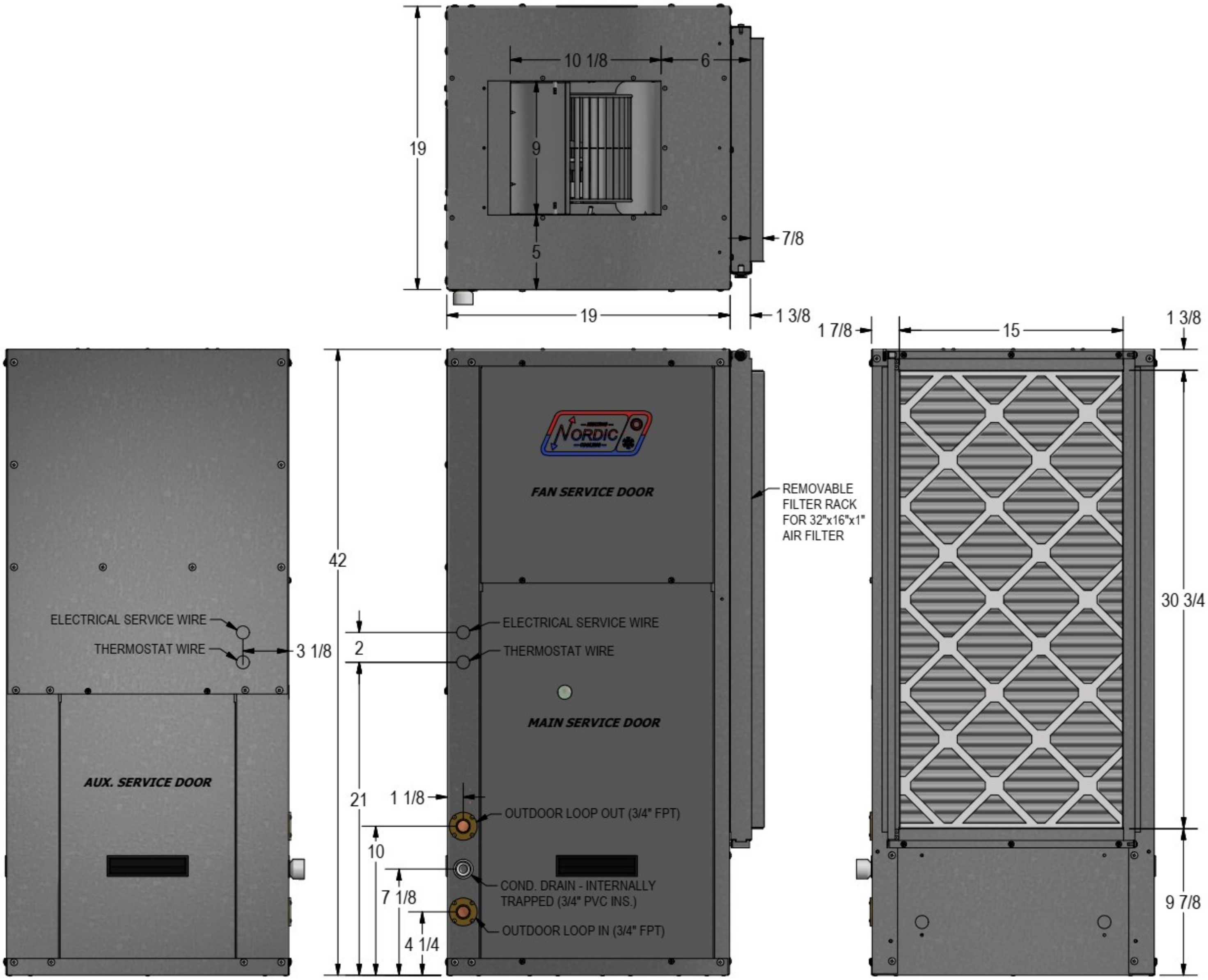
Dimensions: R-18/24 Right Return

All dimensions in inches.

NO BACK CLEARANCE REQUIRED



SIDE
CLEARANCE
OPTIONAL

RECOMMENDED
FRONT CLEARANCE:
2 FT

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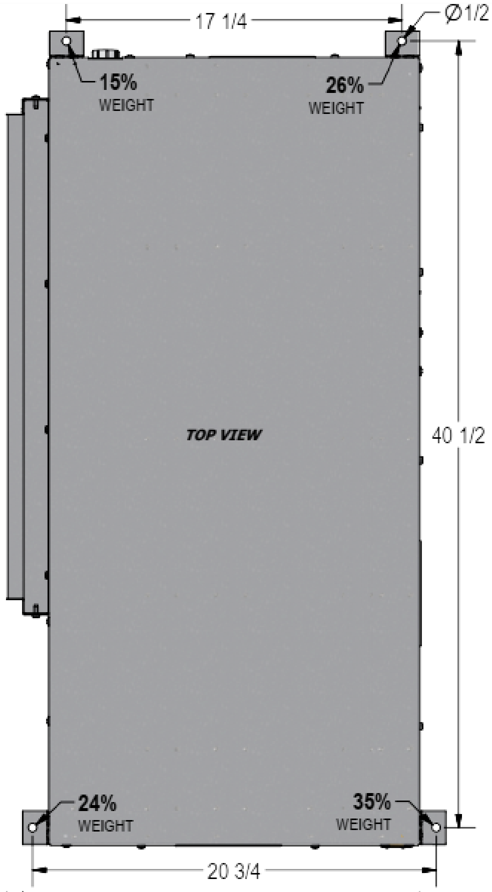
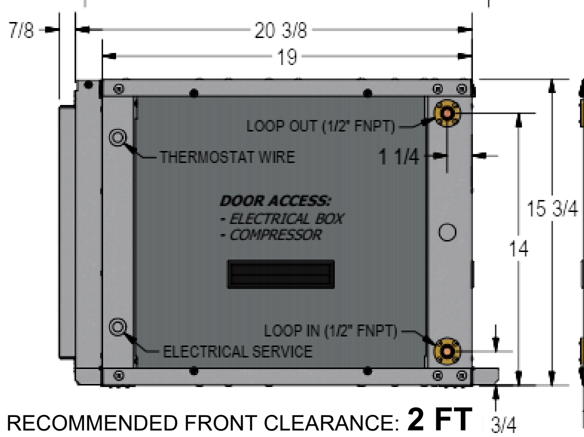
Dimensions: RH-09/12 Left Return

All dimensions in inches.





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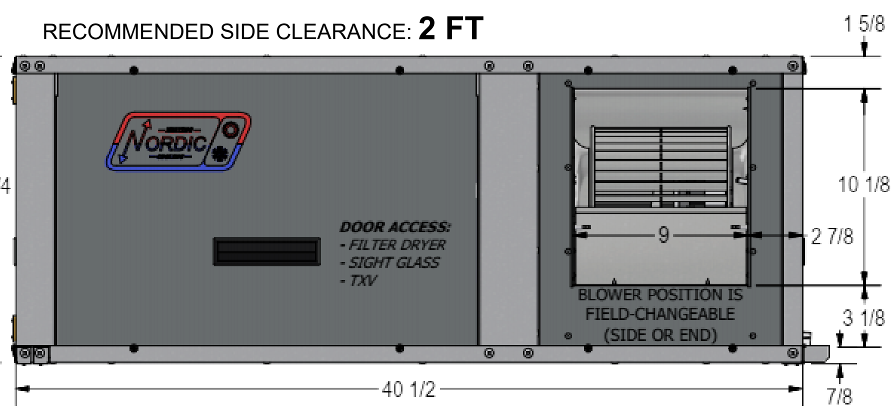

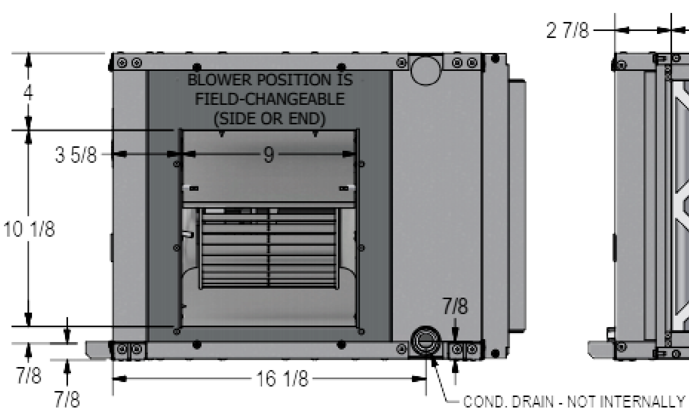

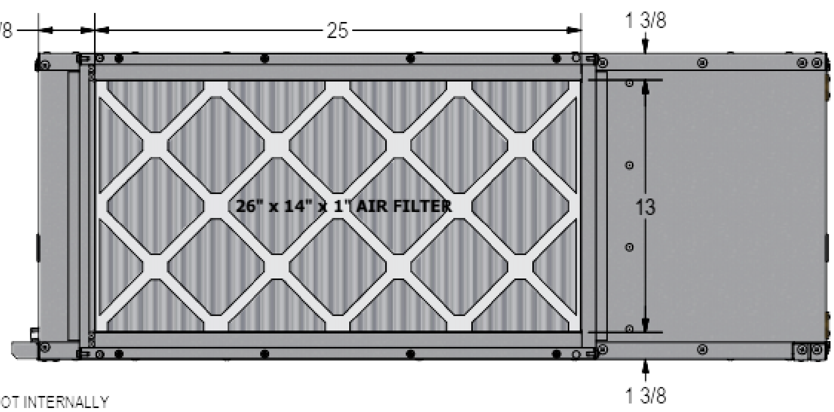

RECOMMENDED CLEARANCE FOR PANEL ADJACENT TO BLOWER:

2 FT

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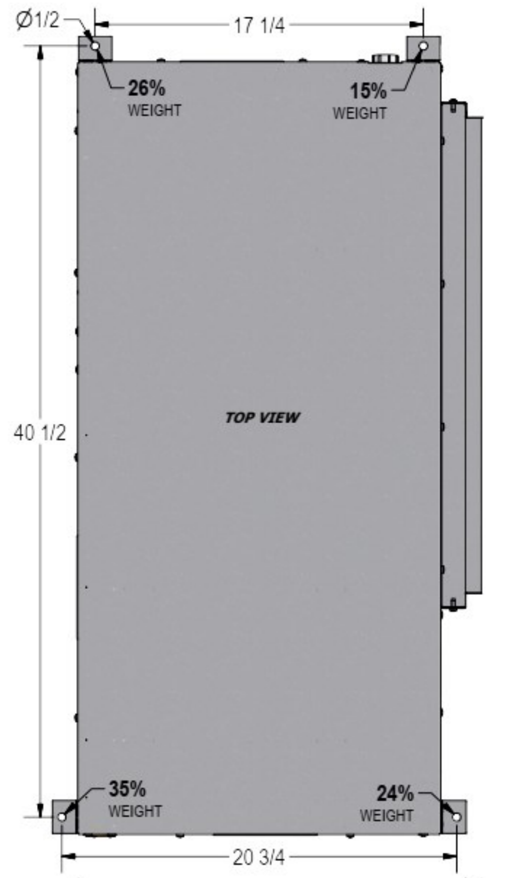
Dimensions: RH-09/12 Right Return

All dimensions in inches.



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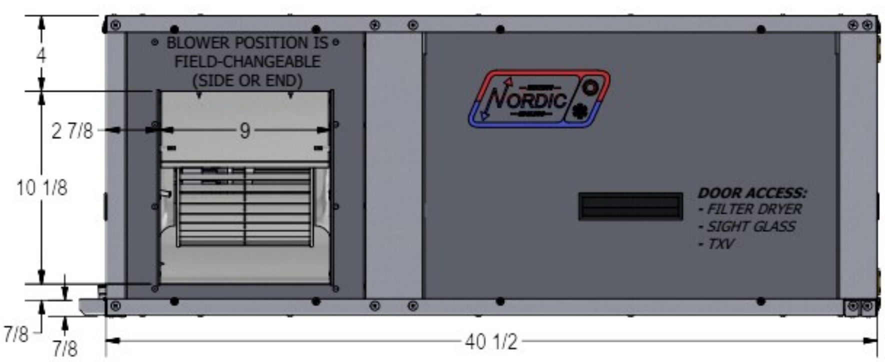

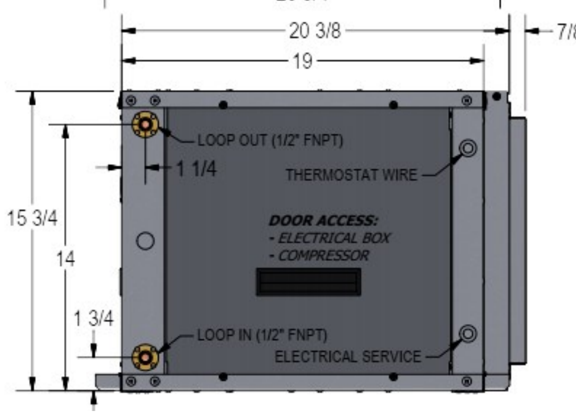

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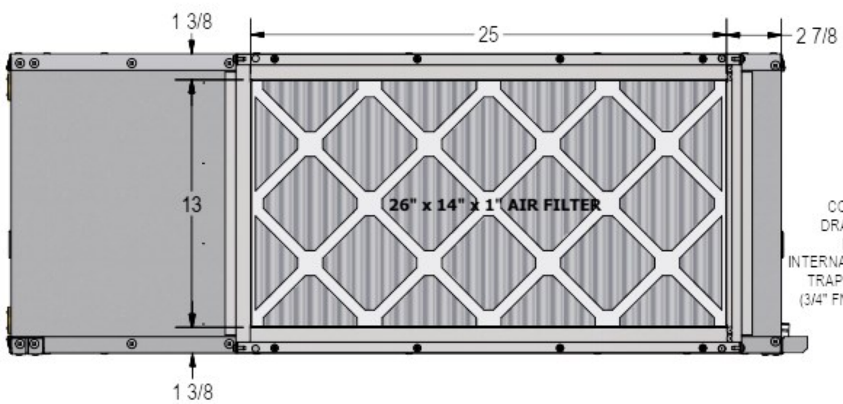

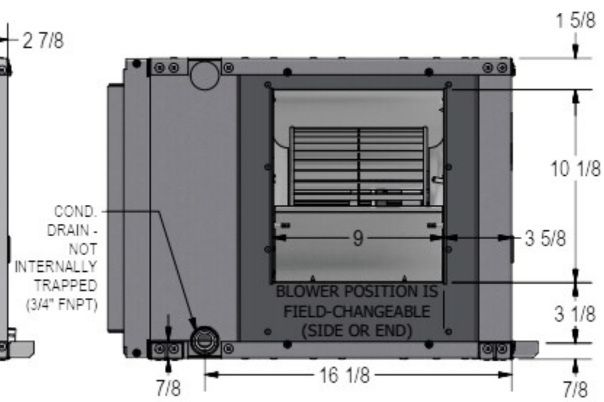

RECOMMENDED CLEARANCE FOR PANEL ADJACENT TO BLOWER:

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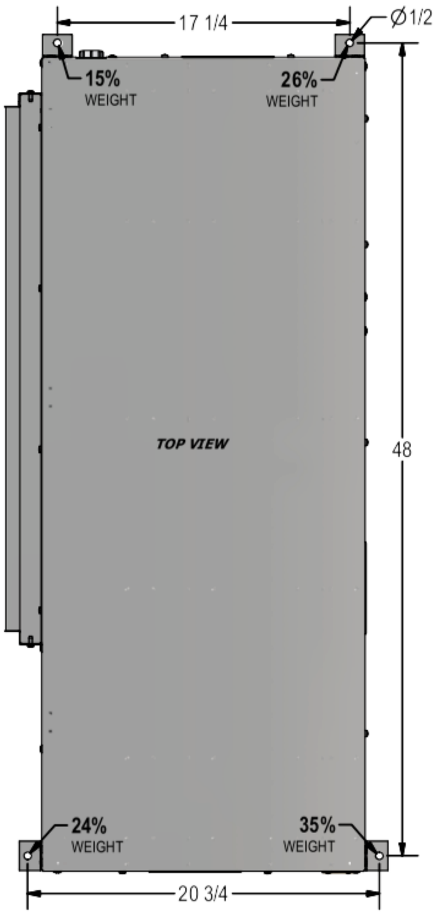
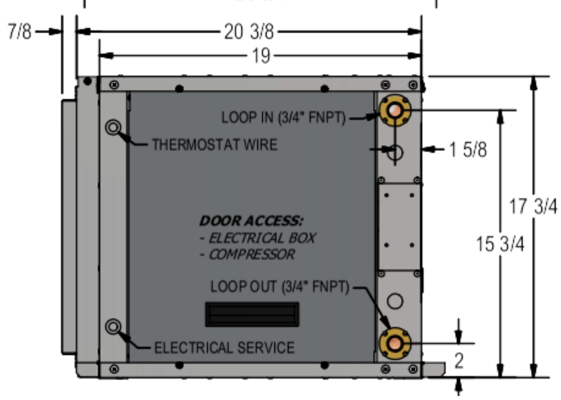
Dimensions: RH-18/24 Left Return

All dimensions in inches.





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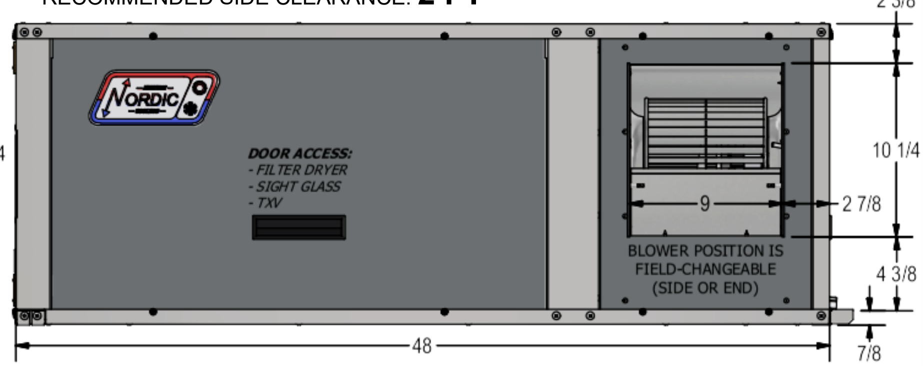

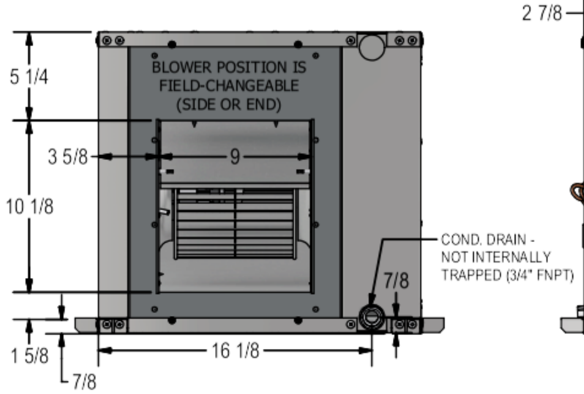

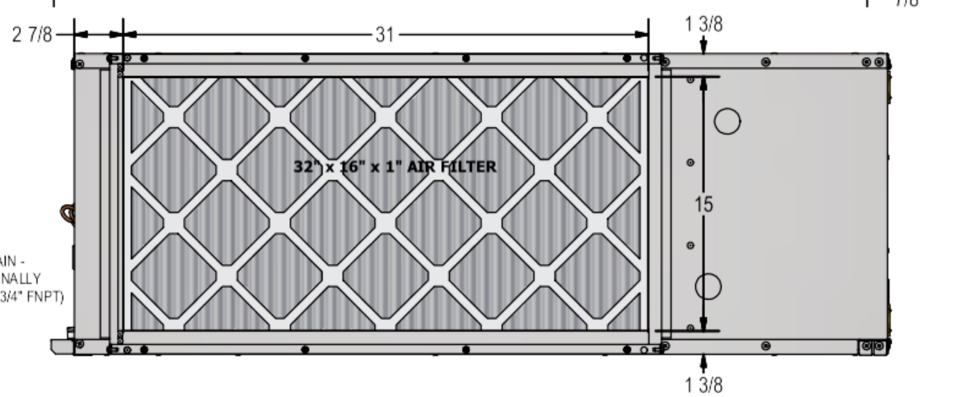

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2 FT

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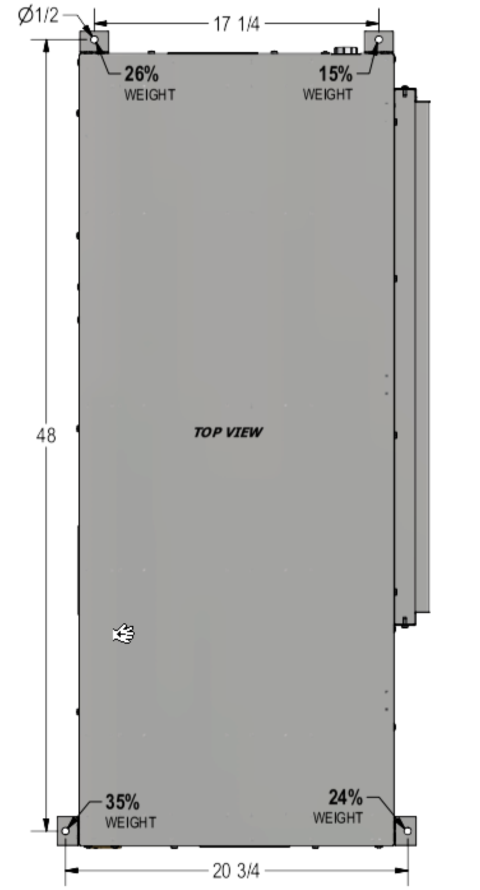
Dimensions: RH-18/24 Right Return

All dimensions in inches.



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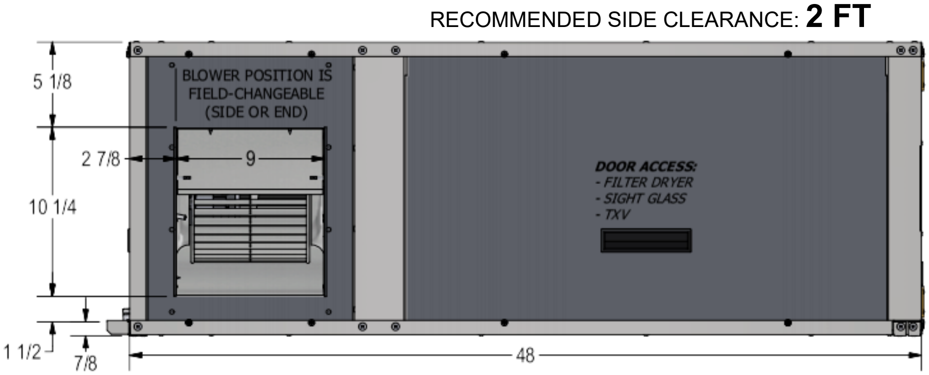

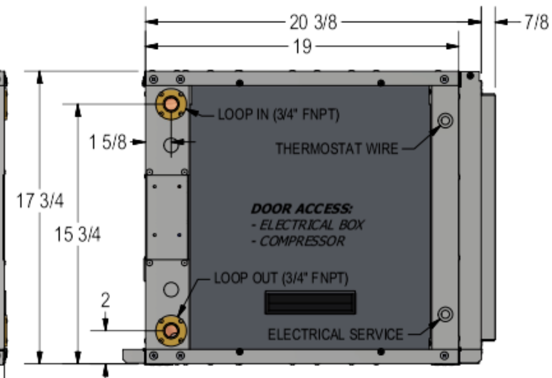

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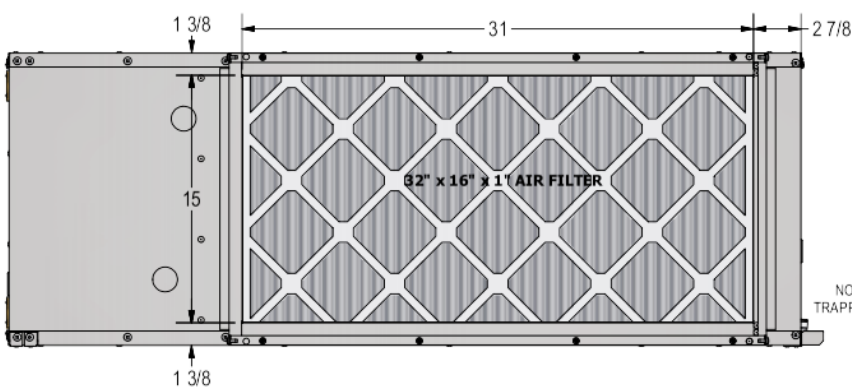

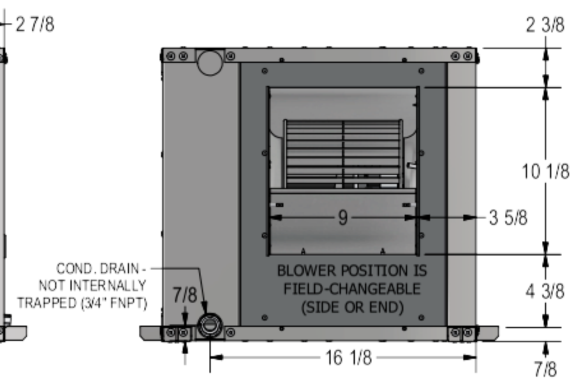

RECOMMENDED CLEARANCE FOR PANEL ADJACENT TO BLOWER:

2 FT

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LIMITED WARRANTY

MARITIME GEOTHERMAL LTD. warrants that its commercial geothermal heat pumps shall be free from defects in materials and workmanship for a period of ONE (1) YEAR after the date of installation or for a period of ONE (1) YEAR AND SIXTY (60) DAYS after the date of shipment, whichever occurs first. This warranty covers all internal components of the heat pump.

MARITIME GEOTHERMAL LTD. shall, at its option, repair or replace any part covered by this warranty. Defective parts shall be returned to MARITIME GEOTHERMAL LTD., transportation charges prepaid. Replacement or repaired parts and components are warranted only for the remaining portion of the original warranty period.

This warranty is subject to the following conditions:

1. The geothermal heat pump must be properly installed and maintained in accordance with MARITIME GEOTHERMAL LTD. guidelines.

2. The installer must complete the **Startup Record** and return it to MARITIME GEOTHERMAL LTD. within 21 days of unit installation.

3. For new construction, it is the responsibility of the building or general contractor to supply temporary heat to the structure prior to occupancy. Geothermal heat pumps are designed to provide heat only to the completely finished and insulated structure. Startup of the unit shall not be scheduled prior to completion of construction and final duct installation for validation of this warranty.

4. It is the customer's responsibility to supply the proper quantity and quality of water or properly sized ground loop with adequate freeze protection.

If a geothermal heat pump manufactured by MARITIME GEOTHERMAL LTD. fails to conform to this warranty, MARITIME GEOTHERMAL LTD.'s sole and exclusive liability shall be, at its option, to repair or replace any part or component which is returned by the customer during the applicable warranty period set forth above, provided that (1) MARITIME GEOTHERMAL LTD. is promptly notified in writing upon discovery by the customer that such part or component fails to conform to this warranty; (2) the customer returns such part or component to MARITIME GEOTHERMAL LTD., transportation charges prepaid, within (30) thirty days of failure, and (3) MARITIME GEOTHERMAL LTD.'s examination of such component discloses to its satisfaction that such part or component fails to conform to this warranty and the alleged defects were not caused by accident, misuse, neglect, alteration, improper installation, repair or improper testing. MARITIME GEOTHERMAL LTD. will not be responsible for any consequential damages or labour costs incurred. In additional, MARITIME GEOTHERMAL LTD. will not be responsible for the cost of replacement parts purchased from a third party.

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