

Maritime Geothermal Ltd.

Installation Manual

Models RH 13-19-24-30-36-42-48-60

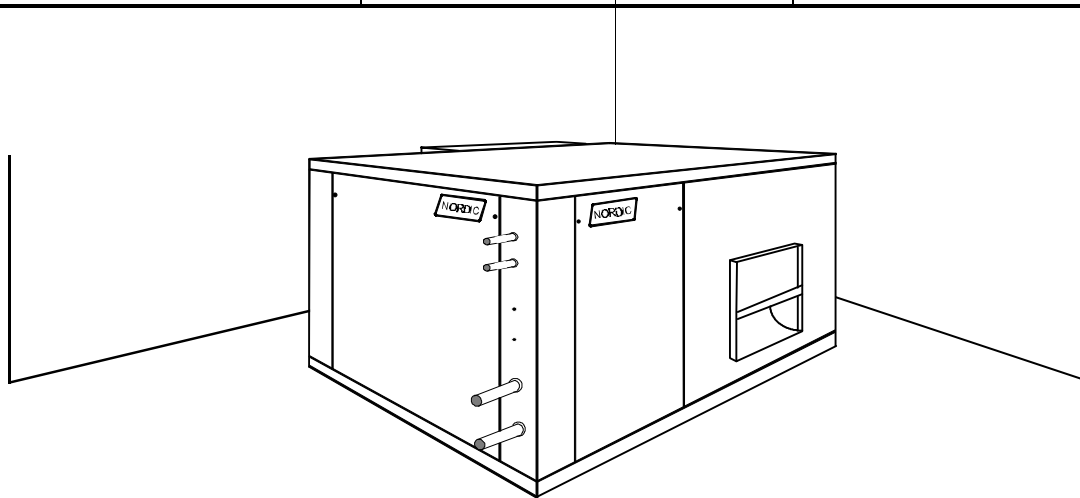
Revision 1/2000

Feb. 6, 00

Horizontal Slim Line Liquid Source Heat Pumps

Table of Contents

Physical Data, Dimensions,	2	Horiz. & Vertical Groundloops	9	Troubleshooting Guide	25
Summary of Requirements	3	Socket Fusion	9	Schematic Diagram	28
Unpacking, Placement, Well Plumbing	4	Pump Modules & Piping	11	Field Wiring Diagram	29
Water Disposal Methods	5	Flushing & Purging the Loop	11	Plenum Heater Connections	30
Condensate Drain, Hot Water Piping	5	Antifreeze selection & quantity	13	Duct sizing Guide	31
Safety Controls, Electrical, Ductwork	6	Pressurizing the Loop	13	Warranty	32
Starting the heat pump	6	Electrical Specifications	16		
General Maintenance	7	CFM Available	16		
Introduction to Groundloops	9	Performance Specifications	17		



For Water Well or Groundloop Operation

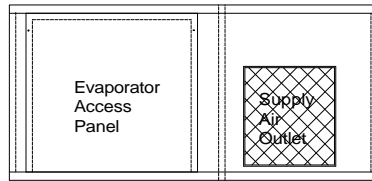
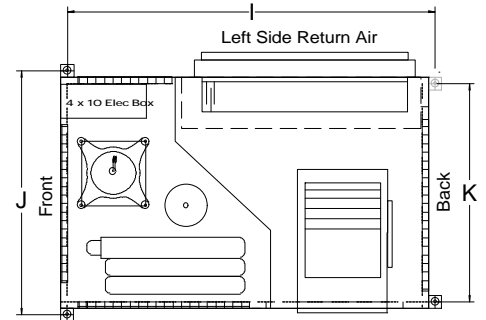
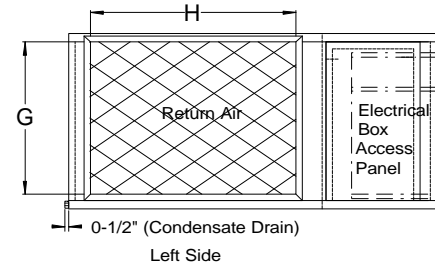
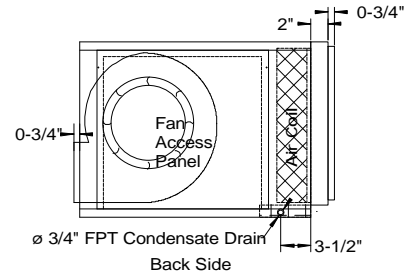
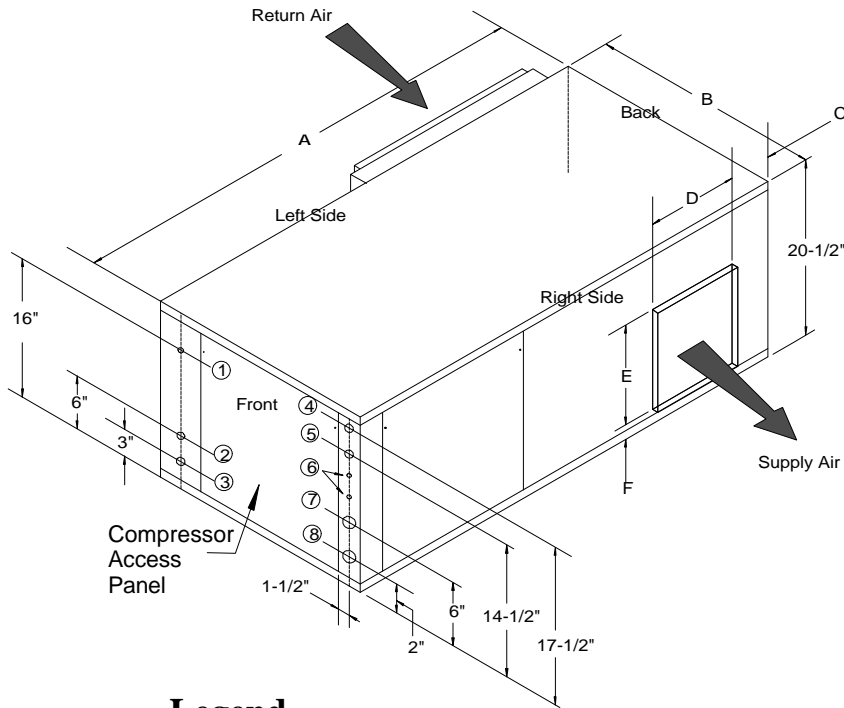


LR 56328

Maritime Geothermal Ltd.
P.O. Box 413
Petitcodiac, N.B. E0A 2H0

Email: nordic@atcon.com
<http://www.discribe.ca/nordic/mgmain.htm>

Physical Data & Dimensions - RH Commercial Series



Right Side

Right Side Supply Air
Hanger Bracket Dimensions

Legend

1. Thermostat Access
2. Aux. Electrical Access
3. Main Electrical Access
4. Domestic Hot Water (IN)
5. Domestic Hot Water (Out)
6. Refrigerant Access Ports
7. Supply Liquid (IN)
8. Supply Liquid (Out)

Model	Size	A	B	C	D	E	F	G	H	I	J	K
RH-13/19/24	in	35	22	3-3/4	9-7/16	10-1/2	1-11/16	18	16	35	23-1/2	20-1/2
RH-30/36/42	in	43	27	4-7/8	10-3/4	11-5/8	1-11/16	18	24	43	28-1/2	25-1/2
RH-48/60	in	55	27	6-3/8	13-3/8	11-5/8	1-11/16	18	39	55	28-1/2	25-1/2

Physical Data									
Model	RH-13	RH-19	RH-24	RH-30	RH-36	RH-42	RH-48	RH-60	
Blower wheel	G7-5	G9-5	G7	GT9	G9-7	G9-8	G9	G10-8	
Fan Motor HP - Speeds	1/6 - 3	1/6 - 3	1/3 - 3	1/3 - 3	1/2 - 3	1/2 - 3	3/4 - 3	3/4 - 3	
CFM (High @ .1"H2O)	500	730	840	1300	1550	1700	1975	2400	
Comp. Nominal HP.	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	
R-22 Charge (lbs.)	2.0	2.5	3.5	4.5	5.0	5.5	6.5	7.5	
Coil Face Area (Sq. ft.)	1.08	1.58	2.00	2.50	3.00	3.50	4.08	4.83	
No. of Circuits	6	6	8	8	8	8	8	8	
Filter size (1")	20"x20"	20"x 20"	20"x20"	20x14" (2)	20x14" (2)	20x14" (2)	20"x20" (2)	20"x20" (2)	

RH-Commercial Series Water Well Installation

There are five specific parts or sub-systems to a groundwater heat pump installation:

- | | |
|--|---------------------|
| 1. The Source of energy. | ⇒ Water Well |
| 2. The method of supplying energy to the heat pump. | ⇒ Water Pump System |
| 3. Converting energy to a useable form. | ⇒ Heat Pump |
| 4. Distributing the heat. | ⇒ Ductwork |
| 5. Returning exhaust water to the earth for reheating. | ⇒ Water Disposal |

Water Well Requirements

1. A DRILLED well of 5" diameter or larger.
2. Well casing properly sealed or grouted into rock.
3. Water flow preferably entering well at a depth of 75 ft. or more.
4. Temperature of well at least 40° F. (Normally 45+° F.)
5. Well must be able to supply requirements of all heat pumps in use at the same time with maximum drawdown from static level of 30 ft.
6. A return well or approved open discharge method approved by the local governing authority.

Sizing The Heat Pump

A heat pump with Btu output capable of heating the space in all winter weather conditions should be selected using a computerized heat load software package and the performance charts in the engineering section of this manual. Heating/cooling analysis software is available from several sources on the Internet or from your local HVAC dealer. Contact us for an Microsoft Excel spreadsheet version of the above.

Water Requirements For Nordic® Heat Pumps

Note: These are minimum water requirements based on

Model	Flow (usgpm)	CFM
RH-13	3	500
RH-19	4.5	730
RH-24	6	840
RH-30	7.5	1300
RH-36	9	1550
RH-42	11	1700
RH-48	12	1975
RH-60	15	2400

an entering water temperature of 46° F.

Water Pump System

1. A submersible pump is generally required.
2. Must be able to pump the required water flow listed above at a minimum of 30 psig. at the dynamic pumping depth of your well.
3. Make sure you select the pump using the pump manufacturers pump chart.
4. Use a minimum of 30 gal. equivalent air bladder tank.

Duct Systems (Basic)

A duct system capable of supplying the required air flow is of utmost importance.

- Generally allow 100 cfm for each floor grill.
- All leads to the grills should be 6" in diameter (28 sq.in. each).
- Your main hot air trunks should be at least 75% of the square surface area of leads being fed at any given point.
- Return air grills should have the same total square surface area supply trunks and the return trunks be made with TURNING RADII. Remember that air is a fluid and, just like water, resistance to flow increases when air is forced around a SHARP corner.

Discharge Water Methods

1. You do NOT necessarily have to have a return well.
2. 80% of our customers do one of the following with their return or waste water:
 - A. Run it into a drain or ditch.
 - B. Pond, river or stream.
 - C. Leaching field.

In most instances if you run the water right out on top of the ground it will soak back into the ground in less than 50 ft. of travel. If suitable care is taken to insure that the drain pipe runs downhill and the end of the pipe is protected by a bale of hay or spruce bows etc. the end of the pipe will not freeze. When snow comes it will usually cover the entire process much like a small spring.

The above information is intended to give the prospective user/purchaser some insight as to the general requirements for a successful application of the NORDIC® heat

pump.

Unpacking

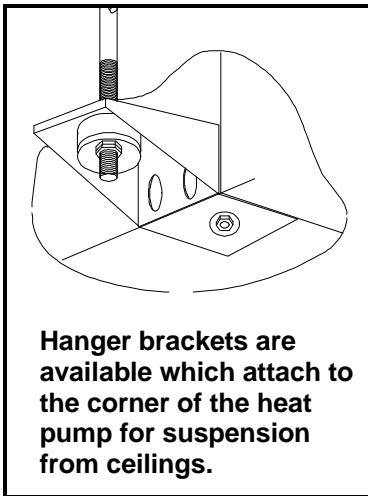
When the heat pump reaches its destination it should be unpacked to determine if any damage has occurred during shipment. Any visible damage should be noted on the carrier's freight bill and a suitable claim filed at once.

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

If the heat pump is to be stored on site for an extended period of time leave the shipping carton in place and store in a safe dry location.

Optimum Placement

RH-Series heat pumps have been designed for applications where it is desired to place the units above a false ceiling enclosure such as is commonly found in commercial buildings and schools. Hanger brackets are available so that a standard threaded rod type suspension system can easily be employed. Adequate care should be taken to ensure that there is ample room around the unit so that servicing can easily be carried out on the unit if required. If the heat pumps are to be installed in a mechanical room they can be stacked up to (3) units high without requiring a rack system. Fire retardant acoustic insulation should be installed between each unit to limit the transmission of vibration and operational noise between units.



The RH-Series NORDIC® heat pump has an air-filter rack which can be removed for easy entry through a doorway or to facilitate moving the unit with a furniture cart. Simply remove the two screws which hold the end cap in place, slide the cap off and push the rack back off its rails. When the heat pump is in place the filter rack can be reinstalled with the removable end (where the filter is accessed) facing the direction that allows easiest access for changing the filter.

To achieve the greatest efficiency, the heat pump should be centrally located with respect to the conditioned space. This design provides the utmost in economy and comfort and usually can be accomplished in harmony with the design of the building. All ductwork must be thermally and acoustically insulated. A heating / cooling system cannot be expected to produce an even temperature throughout a conditioned space when it is located at one end of the structure and the conditioned air is transmitted with uninsulated metal ductwork.

If possible the four main service doors should remain clear of obstruction for a distance of (2) two ft. so that servicing and general maintenance can be carried out with a mini-

mum of difficulty. In mechanical room installations, raising the heat pump off the floor a few inches is generally a good practice since this will prevent unnecessary rusting of the bottom panel of the unit.

For mechanical room installations we recommend that the heat pump be placed on a piece of 2" Styrofoam covered with 1/4" plywood. The Styrofoam will smooth out any irregularities in the cement floor while the plywood will distribute the weight of the NORDIC® unit evenly over the Styrofoam. This process will also deaden the compressor noise emitted from the bottom of the cabinet.

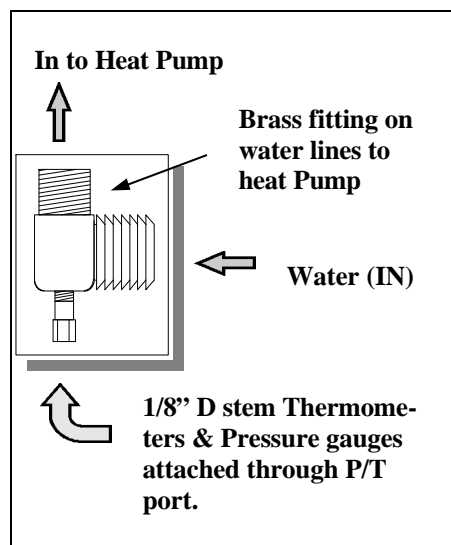
Units installed in an overhead area should be placed in a secondary drain pan on a suitably insulated base to prevent the possibility of condensate overflowing and causing damage to a ceiling etc. The drain pan and associated drains should be inspected once per year to be sure they are clear of obstructions and operating properly.

Water Well Plumbing

If operating the NORDIC heat pump from a water well, provision must be made for an adequate water supply, since in essence, water is the fuel for the unit. It is imperative that the flow requirements listed in the engineering section be closely adhered to.

Plumbing lines, both supply and discharge, must be of adequate size to handle the water flow necessary for the heat pump. For distances less than 40 ft. from the pressure tank, 3/4" copper or plastic lines should be run while for longer distances we recommend that 1" plastic or copper lines should be run to the heat exchanger. Similarly, a 1" line should be run from the discharge pipe to the method of disposal.

Ideally there will be water flow available in excess of the requirement of the heat pump. In such a situation the proper pump can be selected from the manufacturer's pump chart to maintain a pressure of 30 to 40 psig. on the lines when the heat pump is operating. However in some cases a



well can supply a heat pump only if the minimum requirement for water is used. Water flow to the heat pump can be controlled very accurately by the installation of a reverse action pressure valve in the discharge line of the unit. Another method of regulating the flow is by the use of a "DOLE" valve. This valve will automatically control

the amount of water flowing through it by varying the diameter of a flexible rubber orifice through which the water passes. If either of such valves is needed they can be supplied

and installed by your dealer.

All water line valves on both the supply and discharge lines should be BALL valves since a GLOBE valve will create too much restriction across the line possibly causing the heat pump to trip out on it's low pressure safety cutout control as a result of insufficient water flow.

Install a P/T (*Pete's Plug*) plug on the Water (IN) and Water (OUT) lines just outside the heat pump so that it is easy to record the water in and out temperatures and pressures accurately.

Exposed water lines will have a tendency to sweat when the heat pump is in operation, therefore it is recommended that both the water supply and discharge lines be insulated with suitable insulation.

Hot Water Connections

If you have ordered the "RH" unit with the "W" suffix on the nameplate, the unit will be equipped with a separate heat exchanger and circulator pump specifically engineered to produce domestic hot water for use throughout the building.

Connection to the hot water generator feature of the heat pump is accomplished by teeing into an electric or oil fired hot water tank with a capacity of 40 gal. minimum. A typical piping diagram is shown elsewhere in this manual. Be sure to note the position of the check valve and the direction of water flow.

One should be sure the tank is filled with water and is under pressure before activating the heat pump. Slightly loosen the copper union on the hot water discharge pipe to allow air to escape from the system before the unit is started. This step will make certain that the water circulator is flooded with water when it is started.

Since the pump is water lubricated, damage will occur to the pump if it is run dry for even a short period.

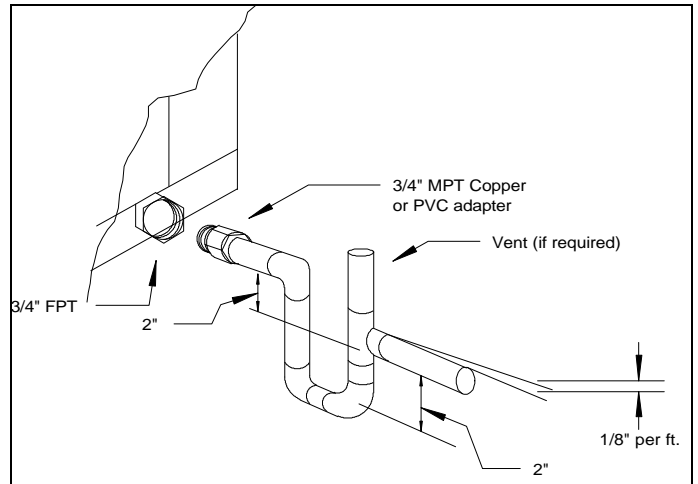
Maritime Geothermal recommends the installation of a "hose bib" on the hot water output line to facilitate the easy removal of air from the desuperheater lines once the plumbing has been installed. The hose bib on the discharge water line may have to be purged of air several times before good circulation is obtained. A hand placed several feet down the line will sense when the water is flowing.

The thermostats on the hot water tank should be set to 120°F. since the heat pump has an internal thermostat set at a low of 130°F. By setting the tank thermostats as described, the heat pump will try to keep the tank above the cut-in point of the electric element settings thus generating hot water from the heat pump only. During summer, or periods of high demand, the electric elements will energize to help make hot water.

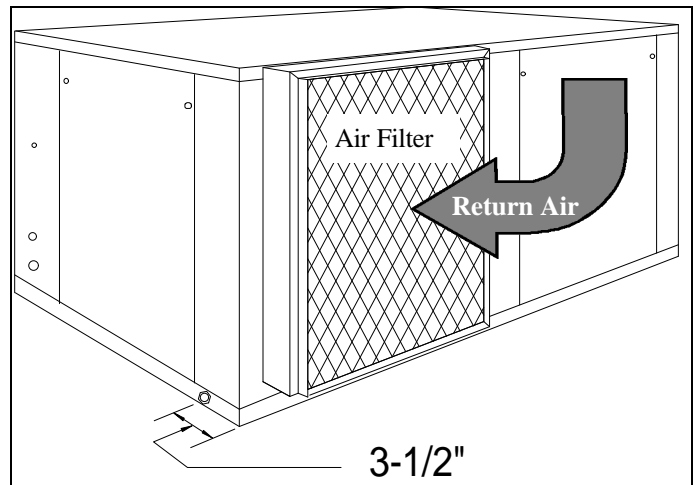
NOTE: If (2) shut-off valves are located on the hot water lines as shown in the diagram, be sure that the valves are open when the heat pump is operating. If both valves are closed when the heat pump is operating, water will expand in the hot water heat exchanger and could cause damage to the hot water circulator pump.

Condensate Drain

You will notice in the piping diagram that there is a small drain pipe to the right of the blower service door (back side of heat pump). This drain allows the condensed water



Typical Condensate Drain connection



RH - Condensate Drain location

vapor which forms during the air-conditioning cycle to escape to a suitable area of your selection. On a very humid day there could be as much as 25 gallons of water formed. An inspection should be carried out each year prior to the cooling season to insure that this pipe is not plugged with dust that has collected during the winter since the water formed will overflow into the bottom of the heat pump. This line is not internally trapped, therefore the installer must construct a suitable trap as shown in the diagram at left. Check all drain pans and associated piping to be sure all condensate outlets are operational.

Water Disposal 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. Generally speaking, returning water to a second well, pond lake or stream is acceptable while returning

water to the same well will usually cool the water so much that the heat pump will shut off on its low pressure / temperature safety control.

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 be necessarily be pumped into the same aquifer, depending on underground conditions, but the return well does have to be able to supply the same quantity of water as the amount you wish to recharge into it.

If the static level (level when not being pumped) of a well is high (10 to 20 ft. from the surface) it may be necessary to place a well cap on the well to keep the return water from flowing out the top of the well. This cap is commonly required since a certain amount of pressure is needed to force the return water back down the well if the static level is high.

Return wells are not always the answer and to some it may be more satisfactory to pump the water to a pond or away to another location.

Water recharged naturally through percolation into the soil is an alternative to a recharge well. The water discharged will generally soak into the ground within a distance of 50 to 100 ft. If care is taken to make sure the end of the pipe does not freeze then this method of disposal works well.

Safety Controls

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

A. LOW PRESSURE / TEMPERATURE CONTROL

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

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

1. Low water flow. (See requirements for each model)
2. Low water temperature. (Below 40 °F.)
3. Dirty or fouled heat exchanger.
4. Low refrigerant charge.

B. HIGH PRESSURE CONTROL

The second safety control is a high pressure safety limit which monitors compressor discharge pressure. This device will not normally trip unless there is an interruption in air flow.

Such a situation could occur if the blower motor or fan belt failed or if the heat pump had an extremely dirty air filter.

If either of these controls trips it will activate a **LOCK-OUT RELAY** which prevents the unit from restarting until power to the control circuit is broken (by turning the thermostat to the **OFF** position and then back on again) or the electrical supply to the unit is broken by opening the heat pump breaker and then closing it again. If one of these controls trips there is a serious problem with the system and it must be rectified if the unit is to maintain good service.

NOTE: Under no circumstances should the heat pump lock-out relay be reset more than twice in an hour. If the heat pump is shutting off because of **LOW** or **NO** water flow then repeated resetting of the unit could cause the heat exchanger to freeze and rupture destroying the heat pump.

Electrical Nordic™ (R) Models

The NORDIC unit is supplied with an opening for 3/4" conduit nipple on the front side of the unit. An additional knockout (1/2") is provided to facilitate connection of a plenum heater blower control wire if required. Above this is another 3/8" hole for the thermostat wire. A wiring diagram is located inside the electrical box cover for quick reference and although the connections to be made are quite simple, Maritime Geothermal Ltd. recommends that a properly qualified electrician be retained to make the connections and wire the thermostat.

Unless specifically deleted (e.g. for a building management system) the NORDIC unit comes supplied with a thermostat and connections are clearly marked on the control box. Using a 8-conductor (18 gauge) wire suitable for the job, connect the terminals in the heat pump electrical box to the corresponding terminals on the thermostat. An additional 4-conductor wire will be required for low voltage control of a NORDIC plenum heater if required.

Ductwork

Ductwork layout for a NORDIC™ heat pump will differ from normal design in the number of leads and size of main trunks required. Air temperature leaving the heat pump is normally 95° to 105° F., much cooler than that of a conventional warm air furnace. To compensate for this, larger volumes of lower temperature air must be moved and consequently duct sizing must be able to accommodate the greater air flow without creating a higher static pressure or high velocity at the floor diffusers. Maritime Geothermal Ltd. recommends that the external static pressure (ESP) be kept below .20 inches of water total. Return ducts should ideally be placed in every room and be sized 50% larger than corresponding supplies. In some instances the number of floor diffusers will actually double when compared to the number that would normally be used for a warm air oil-fired furnace.

NOTE: See the duct sizing chart in the engineering section of this manual.

Starting the Heat Pump

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

1. Check all high voltage field wiring and electrical connections inside the control box for good connection.
2. Check all low voltage thermostat to make sure they are connected properly. Place thermostat HEAT-OFF-COOL switch in the OFF position.
3. Turn on the main power switch. Allow the power to remain ON without starting the unit for a period of 4 hours.

Refrigerant migrates to the compressor oil when the compressor is unheated. A crankcase heater is standard equipment on your heat pump and it will warm the compressor, dispelling the liquid refrigerant. Compressor damage can occur if the heat pump has been brought in from a cold location and immediately started up.

4. Turn on the water supply and check all plumbing for leaks.

5. Check the hot water tank to be sure it is filled with water before energizing the circuit.

NOTE: In a low ambient air start-up the hot water tank should be energized for at least 4 hours before the heat pump is started. A combination of low air temperature and 45° F. water in the hot water tank can sometimes cause the unit to shut down on it's low pressure control. If this happens close ONE valve in the hot water circuit to temporarily shut off the flow to the hot water generator. Do not shut off both valves since water expanding in the hot water generator loop may cause damage to the circulator pump housing. When the home has come up to temperature open the valve for normal hot water operation. Slightly open the union or hose bib on the hot water discharge pipe to make sure that all air is out of the system and the circulator pump is flooded with water.

6. Make sure the air filter is clean and in place.

7. Vacuum out any dust and debris that may have collected in the unit during installation. Check the condensate drain to be sure that it is free of obstruction.

8. Make sure the unit is sitting level so that condensate water will not overflow the catch pan.

9. Make sure the proper time-delay fuse has been installed in the fuse box.

10. Have the following tools on hand and know how to use them.

- ⇒ A refrigeration gauge set.
- ⇒ An electronic or other accurate thermometer
- ⇒ An amprobe.
- ⇒ A water flow meter.

11. Connect your refrigeration gauge set.

12. After the 4 hour warm-up period place the thermostat function switch in the HEAT position, turn up the thermostat. The compressor, blower and hot water circulator will start.

NOTE: If the unit is equipped with an electric TACO® water valve the blower will start first followed by the compressor in 30 to 60 seconds. When the TACO® water valve is fully open, an internal switch activates the compressor circuit.

13. Observe the readings on the high and low pressure gauge set. When the home reaches a temperature of 65 to 70 °.F. the suction pressure (blue gauge) should be approximately 53 to 58 psig. while the head or discharge pressure (red gauge) should be in the area of 225 to 275 psig. Record this information on the warranty test card.

14. Using an electronic thermometer or other accurate thermometer, record the supply water temp. "IN" and the water temperature "OUT".

The outlet water temperature should be from 4° to 7° F. cooler than the inlet water temperature.

15. Record the supply water flow in gpm.

16. Record the return air temperature by drilling a small

hole the turn ple-ap-



in re-air num

proximately 2 ft. from the filter rack and inserting the thermometer's sensing device.

17. Similarly record the discharge air temp. There should be a rise across the air exchanger of from 25° to 35 °. F.

18. At the electrical disconnect switch place the amprobe jaws around the supply wires and record the current in each.

19. Place the thermostat function selector in the COOL position and turn down the stat to a temperature that will cause the air-conditioning to begin. When the thermostat selector switch is set in the COOL mode the reversing valve will be energized. The blower should start followed by the compressor. The outlet temperature will be approx. 10° to 20°.F. cooler than the return air temp.

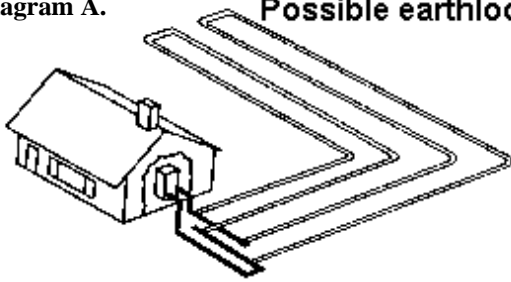
General Maintenance

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

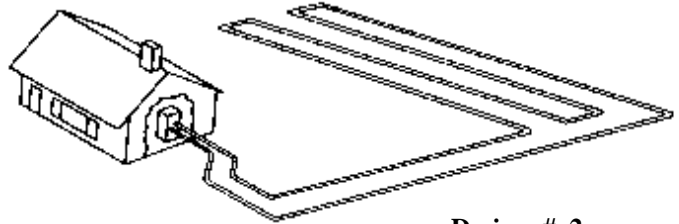
1. Change the air filter when required.
2. On an open well system, clean the groundwater heat exchanger (if required).
3. Insure the condensate drain is clean.

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

Diagram A. Possible earthloop configurations - Type 3408 High Density PE tubing



Design # 1



Design # 2

Parallel piping - Reverse Return Header System

Series piping - 1 or 2 pipes per trench.

Diagram A.

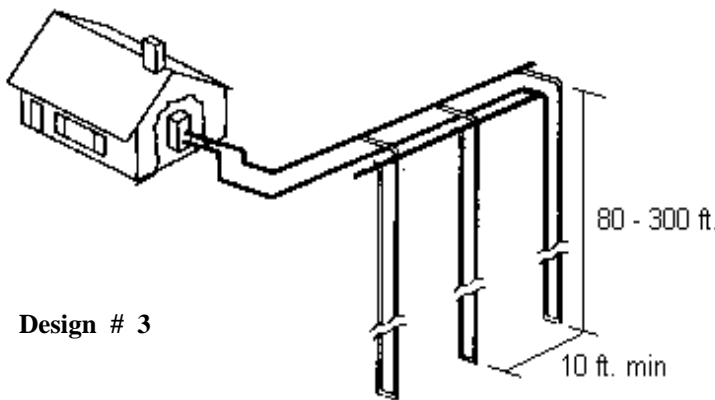
Shown above are several of the many possible horizontal loop layouts which have been successfully employed in various types of ground conditions.

Design # 1

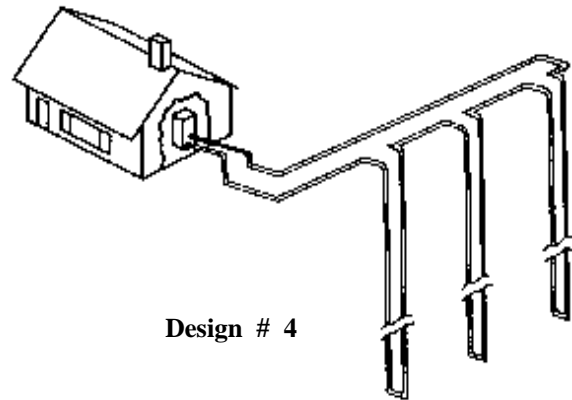
Shown is a typical reverse return header system and 2 parallel loops. On a 2 ton system each of these loops would be 500 ft. long with 4 ft. spacing between the “U” sections, 10 ft spacing between the loops and buried 6 ft. underground.

Design # 2 is a single loop of 1-1/4” to 1-1/2” diameter pipe with a length of 500 ft. x the tonnage of the system and buried to a depth of 6 ft. underground. Individual runs of pipe should be kept a minimum of 10 ft. apart.

Diagram B.



Design # 3



Design # 4

Vertical - Parallel

Vertical - Series

Design # 3.

Shown is a vertical borehole reverse-return header system. Vertical systems generally require 125 to 175 ft of borehole per ton of heat pump for successful heat transfer to take place with the earth. Boreholes should be spaced a minimum of 10 ft apart while if land is available, 15 ft. spacing will produce better results.

Boreholes should be tremie grouted from bottom to top with bentonite or a mixture of bentonite and neat cement for proper conduction with the earth.

Design # 4.

Shown here is a typical series loop design using 1-1/4 to 1-1/2” pipe for the loops. Some designs incorporate a double “U” tube assembly down the well which allows for better heat transfer between the earth and the loop.

NOTE

Many other loop designs are in common use throughout North America. For a more comprehensive manual on earthloop design refer to our Earthloop Design Manual or contact IGSHPA (International Ground Source Heat Pump Association) and request their earth systems dealer training manual.

RH- Series Closed Loop Installation Information

Introduction

Many commercial buildings select a vertical or horizontal closed loop as the earth heat exchanger either because of a lack of available groundwater or for the reduced maintenance costs which can be obtained when compared to open loop systems. Often the problems which occur in a geothermal system are associated with the wells, pumps, or the direct result of utilizing poor quality water or water which is contaminated with sand or other foreign materials. Such contamination can cause premature failure with pumps, water valves, heat exchangers and return wells.

To reduce these problems to a minimum a closed secondary heat exchange system is constructed with **Type 3408 Polyethylene Plastic Pipe** specifically engineered for the job. Materials such as PVC and polybutylene are not recommended since their underground joining process is not as reliable as the fusion process used with type 3408 polyethylene. The earthloop heat exchanger can consist of a single long length of plastic commonly called a series style heat exchanger or more commonly is found as a number of parallel loops connected to a **reverse return header system**. The series system for homes or light commercial applications up to 10 tons normally is constructed with 1-1/4" to 2" diameter pipe while the parallel system uses multiple branch loops from 3/4" to 1" connected to a larger header pipe system of 1-1/4" to 2" diameter. The parallel system offers several advantages such as:

- Less expensive pipe.
- Easier to handle the smaller pipe.
- Lower pressure drop
- Smaller circulator pump(s)

Of course on larger commercial systems it would not be unusual to find header systems with up to 6" diameter pipe for fluid flow into and out of the building.

Socket Fusion

Mechanical joints or metal fittings of any kind are not acceptable underground in an earth loop system due to large temperature fluctuations which may loosen and break clamps and the possibility of eventual corrosion perforation in couplings and "T"s.

Fittings and joints are socket or butt fused together into one contiguous unit using a technique developed by the gas industry. A heater tool with the appropriate faces heats both the pipe and fitting for a prescribed period of time and then the two pieces are quickly removed from the heater, inserted together and held in place until the joint cools. When properly done the resulting joint is stronger than the original pipe with no chance of leaks or breaks. For more information on butt and socket fusion techniques see our website at (<http://www.discrim.ca/nordic/fusion.htm>) or request a copy of the Cen-

tral Tools Butt and Socket fusion manual.

Horizontal Groundloops

Horizontal groundloop systems are most commonly used where land is readily available since they are cheaper to construct than their vertical counterparts. Although many configurations are available, we have found that a parallel system with one (1) 500 ft. "U" pipe per ton placed in a 250 ft. x 4 ft. wide x 6 ft. deep trench is easy to construct and provides ample ground impact area to adequately supply a 32°F or better Entering Fluid Temperature to the heat pump even in the most severe winter months. (See opposite Diagram A.)

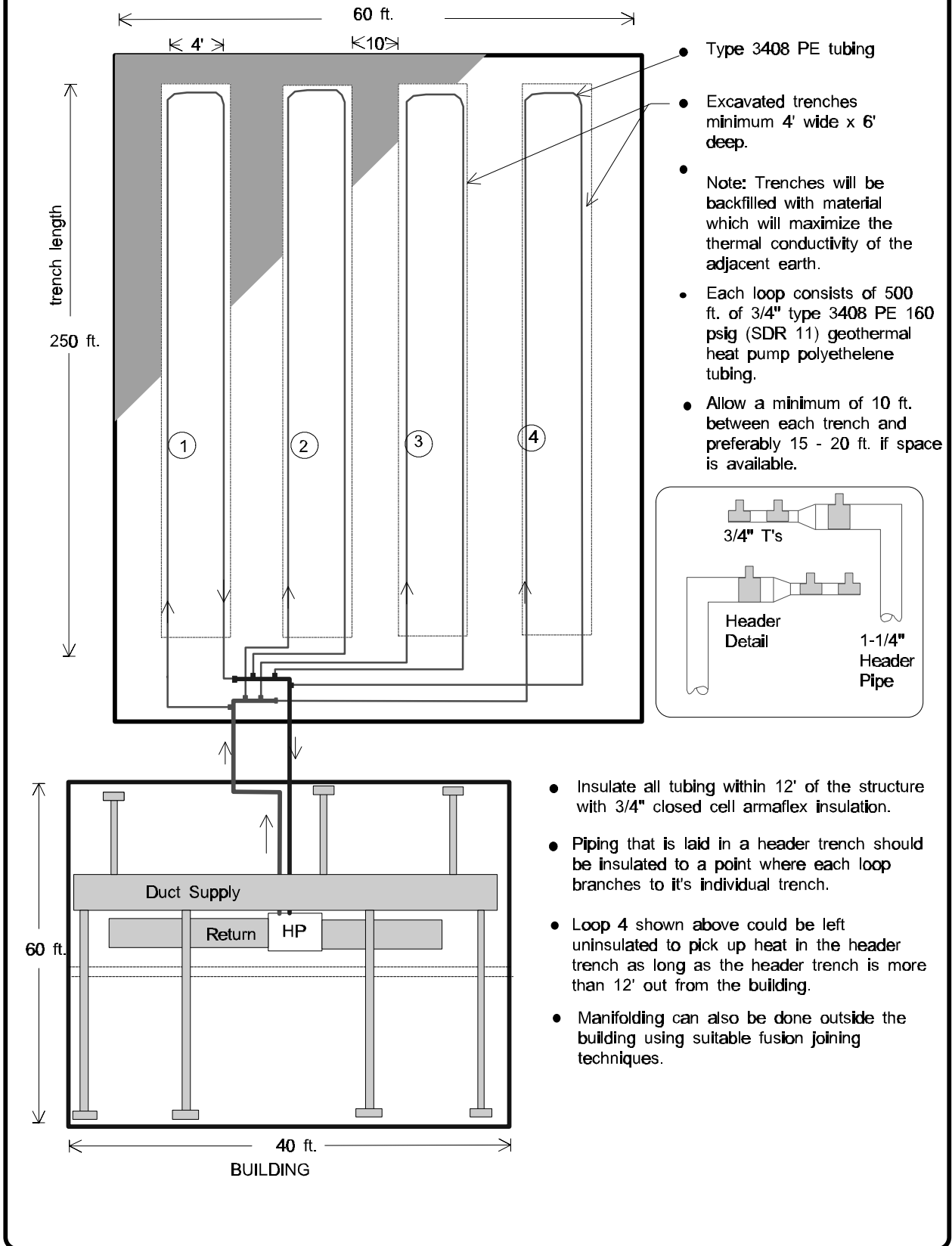
Several companies including "**Thermalworks**" and the International Ground Source Heat Pump Association (igshpa) provide modeling software to size the heat pump to the home and then size the loop to the demand of the home and heat pump. Consideration is given to many factors such as type of ground, moisture content and configuration of loops desired. It is often possible to shorten loop lengths and resulting costs when using some of the newer "**Slinky**" designs of earth-loops. A comprehensive manual dedicated entirely to the installation of Groundloops is available from Maritime Geothermal Ltd. which describes in detail the techniques involved in installing a closed loop system.

Vertical Groundloops

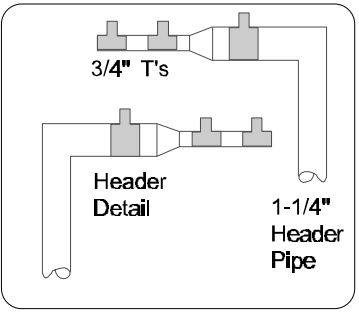
Vertical groundloop systems are generally the system of choice for commercial and institutional buildings since the land area available is often limited to parking lots with some adjacent landscaped areas.

Boreholes of 4 to 6 in. diameter are drilled with conventional drilling equipment usually to a depth of less than 300 ft. Each "ton" of heat pump installed requires approximately 150 ft. of borehole. The 3/4" to 1" plastic pipe "U" tubes are fused together using socket fusion techniques and then pressure tested for leaks at 100 psig. using either water or air. Provision should be made to allow enough extra pipe to extend from the boreholes to the proposed location of the header system. Prior to inserting down the hole the assembly must be filled with water so that buoyancy will be at a minimum when inserting the "U" tube. Cap the ends so that mud and debris cannot enter the loops during insertion and grouting. A piece of heavy rebar or galvanized pipe is attached to the bottom 10 to 15 ft of the "U" tube with tape to add weight to the assembly and also prevent it from curling up and gouging into the side of the borehole during insertion. The entire length of the assembly should be taped every 10 ft. to create greater rigidity in the "U" tube assembly as it is installed in the borehole. The "U" tube is inserted into the borehole and the borehole is tremie grouted from bottom to within 10 ft. of the top with a mixture of neat cement and bentonite or 100% ben-

One Example of Piping Layout for Horizontal Closed Loop Heat Pump System (4 ton system shown)



- Type 3408 PE tubing
- Excavated trenches minimum 4' wide x 6' deep.
- Note: Trenches will be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Each loop consists of 500 ft. of 3/4" type 3408 PE 160 psig (SDR 11) geothermal heat pump polyethylene tubing.
- Allow a minimum of 10 ft. between each trench and preferably 15 - 20 ft. if space is available.



- Insulate all tubing within 12' of the structure with 3/4" closed cell armaflox insulation.
- Piping that is laid in a header trench should be insulated to a point where each loop branches to its individual trench.
- Loop 4 shown above could be left uninsulated to pick up heat in the header trench as long as the header trench is more than 12' out from the building.
- Manifolding can also be done outside the building using suitable fusion joining techniques.

tonite. When using bentonite refer to the manufacturers instructions for mixing and select a product that provides a total solids content of from 25 to 30% when mixed.

Horizontal trenches from 4 to 6 ft. deep are dug alongside the boreholes to the building so that a reverse return (first pipe out on the supply line is the last pipe back on the return line) header pipe arrangement can be constructed to tie all the loops together. Lay out the header system so that air cannot be easily trapped in the header using a technique approved by

Protection down to:	10°F	15°F	20°F	25°F
Methanol	25%	21%	16%	10%
Propylene Glycol	38%	30%	22%	15%

igshpa or the local governing authority. Use a shovel to break away any ground between the trench and the boreholes and dig a relief no less than 30 times the diameter of the pipe to allow the pipe to bend to the header pipe without kinking. Be very careful not to disturb the original ground under the relief so that you do not have to worry about the pipe being kinked through compaction of the earth under the pipe after the trench is backfilled. Fuse the individual smaller loops to the main header loops and extend these into the home by drilling through the concrete wall or by rising up the outside of the basement wall or slab and entering the structural part of the home or building above grade. Any piping that comes within 10 ft. of the structure should be insulated with 3/8" to 1/2" closed cell armaflex insulation to prevent freezing from occurring near any structural part of the building. Likewise, all piping inside the building must be insulated to prevent condensation and subsequent dripping onto floors or walls.

Circulator Pump Module

When the groundloop has been brought inside the home or building to the location of the heat pump it must be connected to the pump module which generally consists of (1) Grundfoss® Model UPS 26-99 or Taco® Model 0011 pump for systems up to 3 ton and (2) pumps for systems up to 5 ton. These units must be able to pump at least 2.5 to 3 USgpm. per ton of heat pump for proper operation of the system. To calculate the size of pumps required use the pressure drop tables for the diameter and type of tubing used along with all elbows, T's etc and the pressure drop through the unit's heat exchanger to arrive at:

$$(\text{total ft of head}) \times (3 \text{ gpm/ton}) \times (\text{No. of tons})$$

Heat Pump to Circulator Piping

The heat pump must be connected to the circulator pump module with a lineset suitable for the flow required with minimum pressure drop. Common line sizes would be 3/4" rubber or plastic for heat pumps from 1 to 2.5 ton while for unit sizes 3 through 5 ton, 1" lines should be used. The installation of P/

T plugs (pressure / temperature) pronounced "Pete's plugs" should be installed on both the entering and leaving lines at the heat pump. The P/T plug will allow the installer or homeowner to check water flow through the loop by measuring the pressure difference through the heat exchanger and comparing this pressure drop to that of the appropriate model in the engineering section. (see **Pressure Drop vs. Water Flow Table**)

Flushing & Purging the Earthloop

Once the earthloop has been installed and all connections are completed to the heat pump and pumping station the entire plumbing system should be pressure tested with air to 60 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.

NOTE: If you use pressure gauges permanently installed on the system as in the case of a demonstration situation etc. be careful not to exceed the maximum pressure rating of the gauges to avoid damage to their mechanism.

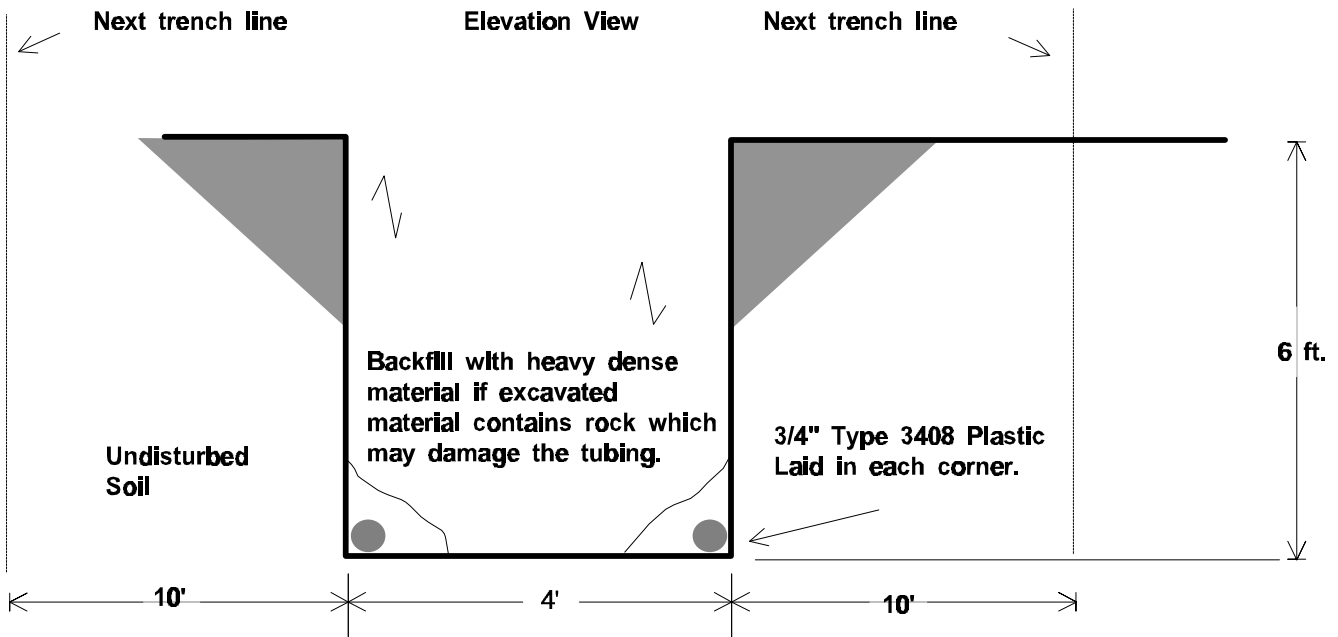
When satisfied all connections are leak free, release the air pressure and connect a flush cart (see diagram) to the flushing access ports at the pump station. A temporary flushing system can alternately be constructed using a 45 gal. barrel and a pump with sufficient volume and head capability to circulate fluid at a velocity of at least 2 ft./min. through all parts of the loop. Begin pumping water through the earthloop making sure that the intake of the pump stays submerged at all times by continuously adding water from a hose etc. Water flowing back on 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

Type of Pipe	Diameter	Volume (US gal.)
Copper	1"	4.1
	1-1/4"	6.4
	1-1/2"	9.2
Rubber Hose	1"	3.9
	3/4" IPS SDR11	2.8
Polyethylene	1" IPS SDR11	4.5
	1-1/4" IPS SDR11	8.0
	1-1/2" IPS SDR11	10.9
Heat Exchanger	2" IPS SDR11	18.0
	Average	1.5
Flush Cart Tank	15"D x 3 ft. high	28

the flow valves to circulate water through the heat pump using the same technique as described above. When all air is

NORDIC® Horizontal Trench Design

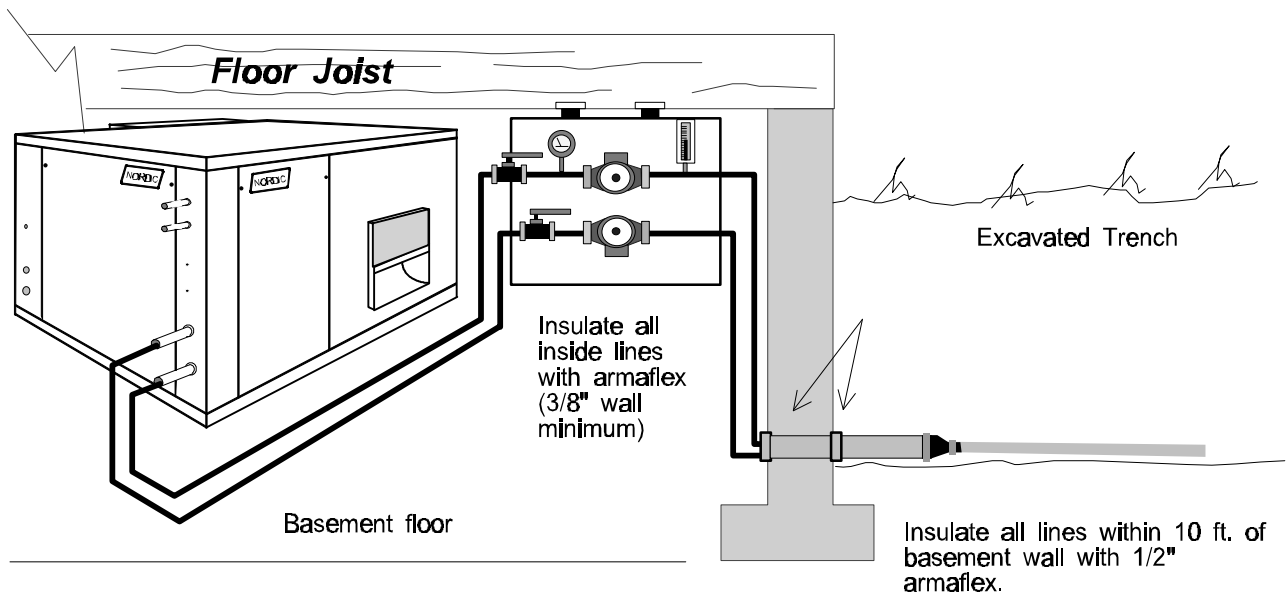
Closed loop Plastic Earthloop



IMPORTANT NOTES:

Horizontal style pipe runs should be placed 6' deep x minimum of 48" wide trench as shown above. Hand backfilling in the area just over the plastic i.e. is recommended to prevent crushing or pinching of the pipe during backfilling operations. Individual trenches (1 per ton) should be spaced a minimum of 10 ft. apart to allow the best performance of the groundfield.

See additional diagrams for pump and piping information.



Water Flow Rate vs. Pressure Drop Through Heat Exchanger							
Model	4 usgpm	6 usgpm	8 usgpm	10 usgpm	12 usgpm	14 usgpm	16 usgpm
RH-13	2.4psig.	4.6	8.0				
RH-19	1.8	3.0	4.9	7.1			
RH-24		2.2	3.5	5.2	7.1		
RH-30		2.3	3.3	4.8	6.7		
RH-36		2.3	3.3	4.8	6.7	8.2	
RH-42		1.5	1.5	3.7	5.0	6.5	
RH-48			1.6	2.4	3.4	4.5	5.7
RH-60			1.1	1.8	2.4	3.1	3.9
Nordic® RH-Series							

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.

Installing 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, and refrigerant temperatures inside the heat pump's heat exchanger may be as low as 20°F cooler. See the antifreeze concentration chart at left for details of freeze protection afforded under different concentrations.

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

NOTE: Although many different antifreeze solutions have been employed in geothermal systems, the alcohols such as methanol or ethanol have the most desirable characteristics for earthloop application. 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 which increases pumping watts. The volume of fluid that your loop system holds can be closely estimated by totaling the number of ft. of each size pipe in the system and referencing **Table 2.** the for approximate volume per 100 ft.

When the volume of the loop has been calculated and the appropriate amount of antifreeze is ready for addition by referencing **Table 1.**, 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 it below the water line to reduce initial volatility of the pure antifreeze. If the loop is large and the tank is small 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 insure the remaining fluid has been well mixed.

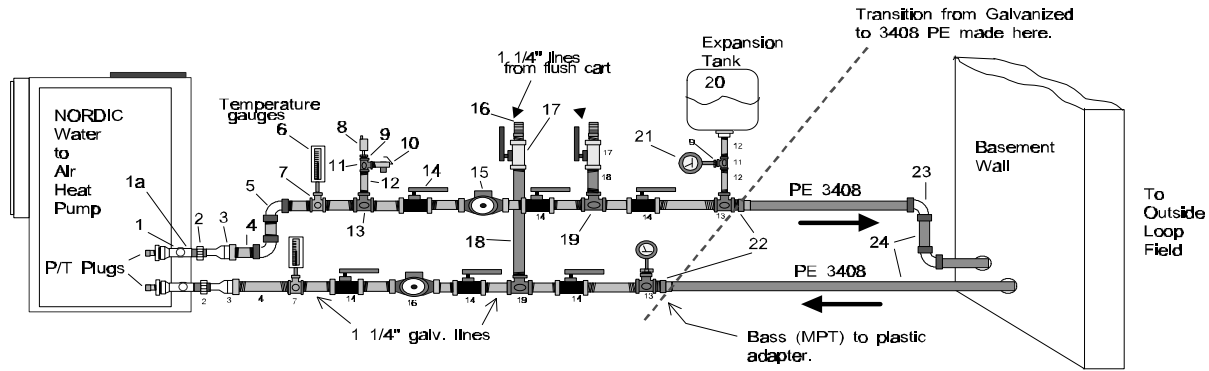
Initial Pressurization

At this point open all valves in the flow circuit and slowly close off the supply and return flush cart valves in a manner that leaves about 20-30 psig. on the system. If an air bladder expansion tank is used it should be charged to the above pressure before actual water pressure is put on the system. Systems employing a commercially available loop pump kit that do not have an expansion tank, thermometers and pressure gauges will experience a greater fluctuation of pressure in the loop between winter and summer. 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 pressure of 45 psig. when installing a system in the fall going into the heating season. If installing in spring or summer charge to 25 psig.

After operating the machine for a period of time, any residual air in the system can be bled off through valved vertical standpipes in the pump module. If pressure drops below 25 psig. add additional water / antifreeze mix with the purge pump to bring the pressure back to the original setting.



Inside Plumbing - Heat Pump to Groundloop (Galvanized or PVC Fittings)



Shown above is one possible method of connecting a geothermal heat pump to a typical polyethylene groundloop. The configuration above allows for two pumps, however, one pump may be omitted if pressure drop calculations dictate. Provisions are shown for incoming and outgoing pressure gauges and thermometers as well as an expansion tank and a pressure relief valve. Flush cart connections are permanently installed. The ball valves on the flush cart lines can be used for manually purging small quantities of air from the system.

Legend

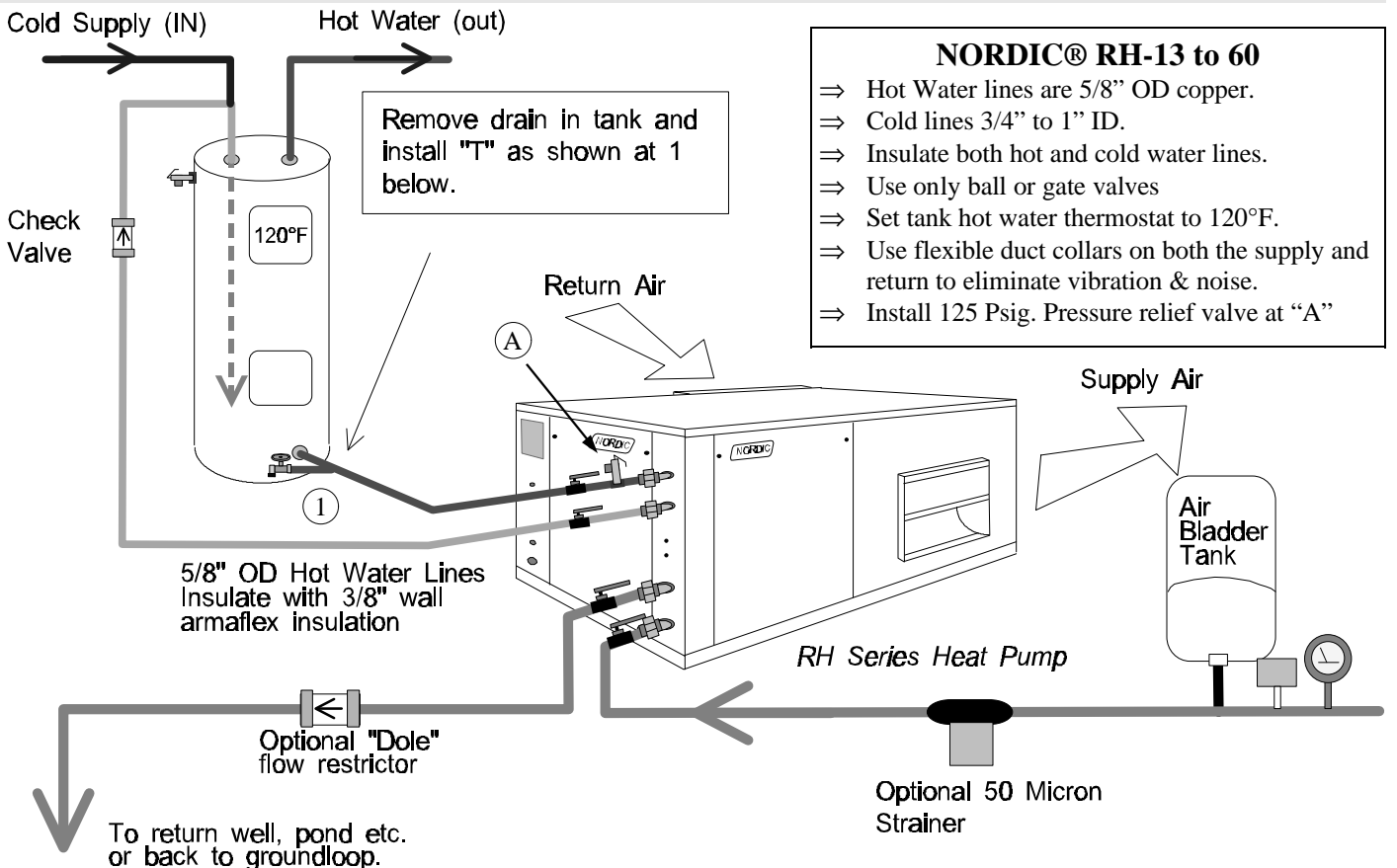
1. 3/4" copper "T"
- 1a. 3/4" Type "L" copper pipe
2. 3/4" copper union
3. 3/4" to 1-1/4" Copper-to-Female adapter
4. 1 1/4" galvanized nipple or threaded pipe.
5. 1 1/4" Galvanized 90° elbow
6. -20°C to 60°C thermometer (3/4" MPT)
7. 1-1/4" x 1-1/4" x 1/2" Galv. "T"
8. Automatic air vent (1/4" MPT)
9. 3/4" x 1/4" reducing bushing
10. 75 Psig. pressure relief valve (3/4" MPT)
11. 3/4" Galv. "T"

12. 3/4" Galv. nipple
13. 1-1/4" x 1-1/4" x 3/4" Galv. "T"
14. 1-1/4" FPT Full port ball valve
15. Taco® 011 or Grundfos® UP-26-99 pump
16. 1" Barbed adaptor to 1" MPT
17. 1" FPT Full port ball valve
18. 1" Galv. nipple or threaded pipe
19. 1-1/4" x 1-1/4" x 1" Galv. "T"
20. 2 Gal. expansion tank.
21. 0 to 30 Psig. gauge (1/4" MPT)
22. 1-1/4" PE 3408 to Brass MPT transition adapter.
23. 1-1/4" PE 3408 90° elbow
24. 1-1/4" PE 3408 Plastic earthloop pipe.

NOTE: Several other small plumbing fittings may also be required to adapt the thermometers, pressure gauges, etc. to the 1 1/4" lines.

The above technique could also be employed using PVC elbows, fittings etc.

Open Well & Hot Water Tank Plumbing Diagram



NORDIC® Series RH - Horizontal

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

Engineering and Performance Data

[Redacted]

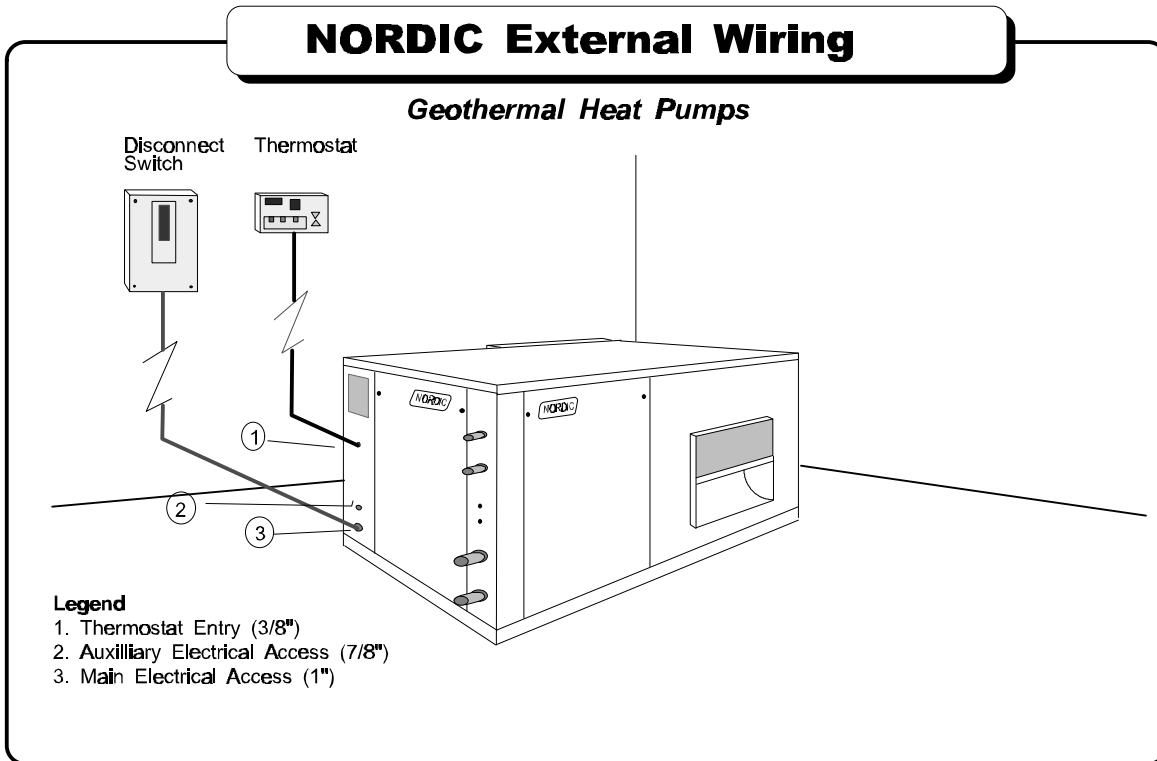
[Redacted]

[Redacted]

[Redacted]

[Redacted]

December 1997



Model	RH13	RH19	RH24	RH30	RH36	RH42	RH48	RH60
Nominal BTU output	13,500	20,000	25,000	32,500	37,000	43,000	50,000	62,500
Blower - Horse Power	1/6	1/6	1/3	1/3	1/2	1/2	3/4	3/4
Blower - Full Load Amps	1.3	1.3	1.8	1.8	2.6	2.6	4	4
Comp. Rated Load Amps (RLA)	6.3	9.2	10.4	13.5	15.4	17.1	21.5	24.8
Comp. Locked Rotor Amps (LRA)	43.0	52.0	60.0	79	98	107	116	141
Minimum circuit ampacity	10	13	15	20	22	25	31	35
Maximum Fuse Size	15	20	20	30	30	40	50	60
Maximum Circuit Breaker	15	20	20	30	30	40	50	60
Electrical characteristics above for 208/230/1/60					Call for 3-phase specifications			

CFM Available VS External Static Pressure (Motor tap set at High Speed)					
Model	.1 ("H ₂ O ESP)	.15	.2	.25	.3
RH-13 (G7/5)	500	475	460	440	430
RH-19 (G9/5)	730	690	630	500	300
RH-24 (G7)	840	810	760	720	650
RH-30 (GT9)	1300	1120	925	500	300
RH-36 (G9/7)	1550	1475	1400	1350	1250
RH-42 (G9/8)	1700	1650	1575	1490	1350
RH-48 (G9)	1975	1850	1730	1575	1300
RH-60 (G10/8)	2400	2350	2300	2240	2150

Capacity Data				Heating Mode				Model RH-13-HAC				Nominal 1 ton					
EWT	gpm	Lpm	LWT	Diff	HAB	Pres. Drop	EAT	LAT	Diff	Btu's Out	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	COP	CSA COP
70	6	27.12	65.4	4.4	15818	3.24	70	107	37.6	20255	6.0	1060	0.95	160	1220	4.87	4.35
70	4	18.08	63.3	6.5	15502	1.35	70	107	36.9	19850	5.9	1038	0.95	160	1199	4.86	4.52
70	2	9.04	57.1	12.5	15037	0.9	70	106	36.1	19453	5.9	1055	0.96	162	1217	4.69	4.53
65	6	27.12	61.1	4.0	14426	3.27	70	105	35.4	19064	5.8	1107	0.94	159	1266	4.42	3.90
65	4	18.08	59.1	5.8	13993	1.94	69	104	34.7	18682	5.7	1120	0.95	160	1280	4.28	3.94
65	2	9.04	53.8	11.3	13573	0.8	70	104	34.0	18309	5.7	1131	0.94	159	1289	4.17	4.01
60	6	27.12	56.2	3.7	13157	2.97	70	103	33.3	17943	5.6	1143	0.95	160	1303	4.04	3.52
60	4	18.08	54.6	5.3	12762	1.32	70	102	32.7	17584	5.6	1151	0.94	159	1310	3.94	3.60
60	2	9.04	49.6	10.3	12379	0.85	70	102	32.0	17232	5.5	1159	0.94	159	1318	3.84	3.68
55	6	27.12	51.9	3.3	11999	3.24	71	102	31.4	16887	5.4	1167	0.93	157	1324	3.74	3.22
55	4	18.08	50.6	4.8	11639	1.59	70	101	30.7	16550	5.4	1173	0.95	160	1333	3.64	3.30
55	2	9.04	45.8	9.4	11290	0.82	71	101	30.1	16219	5.3	1177	0.93	157	1334	3.57	3.41
50	6	27.12	47.0	3.0	10943	3.24	70	100	29.5	15894	5.3	1182	0.93	157	1339	3.48	2.96
50	4	18.08	45.6	4.4	10615	1.94	70	99	28.9	15576	5.2	1185	0.92	155	1340	3.41	3.07
50	2	9.04	41.4	8.6	10296	0.86	70	98	28.3	15265	5.1	1187	0.93	157	1343	3.33	3.17
45	6	27.12	42.3	2.8	9980	3.41	70	98	27.8	14960	5.1	1189	0.94	159	1348	3.26	2.74
45	4	18.08	41.1	4.0	9680	1.94	71	98	27.2	14660	5.0	1189	0.93	157	1346	3.20	2.86
45	2	9.04	37.3	7.8	9390	0.89	70	96	26.7	14367	5.0	1189	0.93	157	1345	3.13	2.97
40	6	27.12	37.6	2.5	9108	5.24	70	96	26.1	14080	4.9	1187	0.92	155	1342	3.08	2.56

Closed loop penalty

Operational figures below obtained with a 15% solution of methanol & water

40	6	27.1	37.5	2.53	9111	5.31	71	95.9	25.4	13700	5.1	1189	0.92	155	1344	2.99	2.85
40	4	18.1	36.3	3.7	8884	3.12	69.8	94.8	25.0	13462	5.1	1184	0.93	157	1341	2.94	2.82
40	2	9.04	32.8	7.22	8662	1.58	69.8	94.4	24.6	13229	5.0	1180	0.94	159	1338	2.90	2.82
38	6	27.1	35.5	2.49	8975	5.3	69.6	94.7	25.1	13509	5.1	1175	0.91	154	1329	2.98	2.84
38	4	18.1	34.4	3.65	8750	3	69.6	94.3	24.7	13274	5.0	1170	0.92	155	1326	2.93	2.81
38	2	9.04	30.9	7.11	8532	1.48	69.8	94.0	24.2	13040	4.9	1166	0.92	155	1321	2.89	2.81
36	6	27.1	33.5	2.46	8840	5.3	69.6	94.3	24.7	13326	4.9	1161	0.91	154	1314	2.97	2.83
36	4	18.1	32.4	3.59	8619	2.91	69.8	94.1	24.3	13090	4.8	1156	0.91	154	1310	2.93	2.81
36	2	9.04	29.0	7	8404	1.5	70.5	94.4	23.9	12858	4.8	1152	0.91	154	1305	2.89	2.81
34	6	27.1	31.6	2.42	8707	5.27	69.8	94.2	24.4	13146	4.7	1147	0.91	154	1301	2.96	2.82
34	4	18.1	30.5	3.54	8490	2.91	70.2	94.2	24.0	12907	4.7	1142	0.90	152	1294	2.92	2.80
34	2	9.04	27.1	6.9	8278	1.38	69.6	93.2	23.6	12685	4.6	1138	0.91	154	1291	2.88	2.80
32	6	27.1	29.6	2.38	8577	5.21	69.6	93.7	24.1	12963	4.6	1133	0.90	152	1285	2.96	2.82
32	4	18.1	28.5	3.48	8362	2.88	70.5	94.2	23.7	12739	4.5	1129	0.91	154	1282	2.91	2.79
32	2	9.04	25.2	6.79	8153	1.45	70	93.2	23.2	12515	4.5	1124	0.91	154	1278	2.87	2.79
30	6	27.1	27.7	2.35	8448	5.21	70	93.7	23.7	12788	4.4	1120	0.90	152	1272	2.95	2.81
30	4	18.1	26.6	3.43	8237	2.85	70.2	93.5	23.3	12562	4.4	1115	0.90	152	1267	2.90	2.78
30	2	9.04	23.3	6.69	8031	1.41	69.4	92.3	22.9	12341	4.3	1111	0.90	152	1263	2.86	2.78

Rating conditions: Voltage 230/1/60 Entering air: 70DB / 60 WB CFM = 500 @ External static: .1 in.wc

RH-13-HAC Cooling Mode																			
					Water	Pres.				Sens	Latent	Total	Comp	Comp.	Fan	Fan	Total		CSA
50	2	9.49	68.1	18.3	18430	0.82	79.9	53.9	26.0	12352	7054	19606	5.3	1189	.92	155	1343	14.6	14.5
50	4	18.1	59.8	9.98	19557	0.91	80.6	53.3	27.3	12970	7407	20586	5.1	1153	.91	154	1306	15.8	15.6
50	6	26.8	57.4	7.15	21067	1.91	80.1	51.3	28.8	13683	7814	21719	5.1	1141	.91	154	1294	16.8	16.5
60	2	8.59	80.3	19.9	17877	0.81	79.9	54.7	25.2	11981	6842	19018	5.6	1254	.92	155	1409	13.5	13.4
60	4	17.6	70.0	10.1	18970	0.91	79.7	53.2	26.5	12581	7184	19969	5.4	1216	.92	155	1371	14.6	14.4
60	6	27.6	67.2	6.85	20435	1.79	80.4	52.5	27.9	13272	7580	21067	5.4	1204	0.91	154	1357	15.5	15.3
70	2	9.04	88.9	18.7	17340	0.83	79.5	55.0	24.5	11622	6637	18447	5.9	1323	0.93	157	1479	12.5	12.4
70	4	18	79.9	9.74	18401	0.94	79.7	54.0	25.7	12203	6969	19370	5.7	1283	0.93	157	1440	13.5	13.3
70	6	27.1	76.9	6.87	19822	1.88	79.7	52.6	27.1	12874	7352	20435	5.7	1270	0.92	155	1425	14.3	14.1
77	2	9.49	94.8	17.6	16820	0.85	80.1	56.4	23.7	11273	6438	17894	6.2	1396	0.92	155	1550	11.5	11.5
78	4	18.5	86.8	9.35	17849	1.35	80.2	55.3	24.9	11837	6760	18789	6.0	1354	0.91	154	1507	12.5	12.3
77	6	27.6	83.4	6.65	19227	2.09	79.5	53.2	26.3	12488	7132	19822	6.0	1340	0.93	157	1497	13.2	13.0

Rating conditions: Voltage 230/1/60 Entering air: 80DB / 67 WB External static: .1 in.wc 500 CFM

In accordance with ARI 325 and 330 standards & CAN/CSA C446-M94

Capacity Data			Heating Mode			Model RH-19-HAC						Nominal 1.5 ton					
EWT	lgpm	Lpm	LWT	Diff	HAB	Pres. Drop	EAT	LAT	Diff	Btu's Out	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	COP	CSA COP
70	6	27.1	63.3	6.5	23453	5.47	70	108	38.1	30381	8.5	1654	1.12	189	1843	4.83	4.31
70	4	18.1	60.2	9.6	22984	3.24	70	108	37.4	29774	8.4	1621	1.12	189	1810	4.82	4.48
70	2	9.0	51.0	18.6	22294	1.35	70	107	36.6	29178	8.3	1644	1.13	191	1835	4.67	4.51
65	6	27.1	59.2	5.9	21389	4.88	70	106	35.9	28595	8.2	1721	1.11	187	1908	4.40	3.88
65	4	18.1	56.3	8.6	20747	3.27	69	105	35.2	28023	8.1	1737	1.12	189	1926	4.27	3.93
65	2	9.0	48.3	16.8	20125	1.94	70	105	34.5	27462	8.0	1752	1.11	187	1939	4.15	3.99
60	6	27.1	54.5	5.4	19507	5.41	70	104	33.8	26913	8.0	1769	1.12	189	1958	4.03	3.51
60	4	18.1	52.0	7.9	18922	2.97	70	103	33.1	26375	7.9	1780	1.11	187	1967	3.93	3.59
60	2	9.0	44.6	15.3	18354	1.32	70	102	32.4	25847	7.8	1789	1.11	187	1977	3.84	3.68
55	6	27.1	50.3	4.9	17790	5.71	71	102	31.8	25330	7.7	1801	1.10	186	1986	3.74	3.22
55	4	18.1	48.2	7.2	17257	3.24	70	101	31.2	24824	7.6	1807	1.12	189	1996	3.65	3.31
55	2	9.0	41.3	13.9	16739	1.59	71	101	30.5	24327	7.5	1812	1.10	186	1998	3.57	3.41
50	6	27.1	45.5	4.5	16225	5.85	70	100	29.9	23841	7.4	1819	1.10	186	2004	3.49	2.97
50	4	18.1	43.4	6.6	15738	3.24	70	99	29.3	23364	7.4	1821	1.09	184	2005	3.42	3.08
50	2	9.0	37.3	12.7	15266	1.94	70	98	28.7	22897	7.3	1822	1.10	186	2008	3.35	3.19
45	6	27.1	41.0	4.1	14797	5.88	70	98	28.2	22439	7.2	1825	1.11	187	2012	3.27	2.75
45	4	18.1	39.1	6.0	14353	3.41	71	98	27.6	21990	7.1	1824	1.10	186	2009	3.21	2.87
45	2	9.0	33.5	11.6	13922	1.94	70	97	27.0	21550	7.0	1821	1.10	186	2007	3.15	2.99
40	6	27.1	36.3	3.8	13505	5.34	70	96	26.5	21119	7.0	1818	1.09	184	2002	3.10	2.58

Closed loop penalty

Operational figures below obtained with a 15% solution of methanol & water

40	6	27.1	36.2	3.8	13508	5.31	71	96.0	25.5	20348	7.2	1820	1.09	184	2004	2.97	2.83
40	4	18.1	34.5	5.5	13170	3.12	69.8	94.9	25.1	19991	7.1	1813	1.10	186	1999	2.93	2.81
40	2	9.0	29.3	10.7	12841	1.58	69.8	94.5	24.7	19643	7.0	1806	1.11	187	1993	2.89	2.81
38	6	27.1	34.3	3.7	13305	5.3	69.6	94.8	25.2	20065	7.1	1799	1.08	182	1981	2.97	2.83
38	4	18.1	32.6	5.4	12973	3	69.6	94.3	24.7	19714	7.0	1791	1.09	184	1975	2.92	2.80
38	2	9.0	27.5	10.5	12648	1.48	69.8	94.1	24.3	19365	6.9	1784	1.09	184	1968	2.88	2.80
36	6	27.1	32.4	3.6	13106	5.3	69.6	94.4	24.8	19793	6.9	1777	1.08	182	1959	2.96	2.82
36	4	18.1	30.7	5.3	12778	2.91	69.8	94.2	24.4	19441	6.8	1770	1.08	182	1952	2.92	2.80
36	2	9.0	25.6	10.4	12459	1.5	70.5	94.5	24.0	19097	6.7	1763	1.08	182	1945	2.88	2.80
34	6	27.1	30.4	3.6	12909	5.27	69.8	94.3	24.5	19523	6.6	1756	1.08	182	1938	2.95	2.81
34	4	18.1	28.8	5.2	12586	2.91	70.2	94.3	24.1	19171	6.6	1749	1.07	181	1929	2.91	2.79
34	2	9.0	23.8	10.2	12272	1.38	69.6	93.2	23.6	18838	6.5	1742	1.08	182	1924	2.87	2.79
32	6	27.1	28.5	3.5	12715	5.21	69.6	93.8	24.2	19252	6.4	1735	1.07	181	1915	2.95	2.81
32	4	18.1	26.8	5.2	12397	2.88	70.5	94.2	23.7	18917	6.3	1728	1.08	182	1910	2.90	2.78
32	2	9.0	21.9	10.1	12088	1.45	70	93.3	23.3	18583	6.3	1721	1.08	182	1903	2.86	2.78
30	6	27.1	26.5	3.5	12525	5.21	70	93.8	23.8	18991	6.2	1714	1.07	181	1895	2.94	2.80
30	4	18.1	24.9	5.1	12212	2.85	70.2	93.6	23.4	18654	6.1	1707	1.07	181	1888	2.90	2.78
30	2	9.0	20.1	9.9	11906	1.41	69.4	92.4	23.0	18326	6.1	1700	1.07	181	1881	2.85	2.77

Rating conditions: Voltage 230/1/60 Entering air: 70DB / 60 WB CFM = 675 @ External static: .1 in.wc.

RH-19-HAC Cooling Mode																			
EWT	lgpm	Lpm	LWT	Diff	Water Loop	Pres. Drop	EAT	LAT	Diff	Sens Cool	Latent Cool	Total Cool	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	EER	CSA EER
50	2	9.5	75.4	25.6	25871	0.91	79.9	55.2	24.7	17456	9631	27522	7.5	1682	1.09	184	1866	14.8	14.7
50	4	18.1	63.8	14.0	27453	1.91	80.6	54.7	25.9	18329	10113	28898	7.3	1631	1.08	182	1814	15.9	15.8
50	6	26.8	60.2	10.0	29573	3.21	80.1	52.8	27.3	19337	10669	30487	7.2	1615	1.08	182	1797	17.0	16.7
60	2	8.6	88.3	27.9	25095	0.91	79.9	56.0	23.9	16932	9342	26696	7.9	1774	1.09	184	1958	13.6	13.6
60	4	17.6	74.1	14.2	26630	1.79	79.7	54.6	25.1	17779	9809	28031	7.7	1721	1.09	184	1905	14.7	14.6
60	6	27.6	70.0	9.6	28686	3.09	80.4	53.9	26.5	18757	10349	29573	7.6	1704	1.08	182	1886	15.7	15.4
70	2	9.0	96.3	26.1	24342	0.94	79.5	56.3	23.2	16424	9062	25895	8.3	1872	1.10	186	2058	12.6	12.5
70	4	18.0	83.8	13.6	25831	1.88	79.7	55.3	24.4	17246	9515	27190	8.1	1816	1.10	186	2001	13.6	13.5
70	6	27.1	79.6	9.6	27825	3.18	79.7	54.0	25.7	18194	10038	28686	8.0	1798	1.09	184	1982	14.5	14.2
77	2	9.5	101.8	24.6	23611	1.35	80.1	57.6	22.5	15932	8790	25119	8.8	1975	1.09	184	2159	11.6	11.6
77	4	18.5	90.6	13.1	25056	2.09	80.2	56.6	23.6	16728	9229	26375	8.5	1916	1.08	182	2098	12.6	12.5
77	6	27.6	86.1	9.3	26990	3.38	79.5	54.6	24.9	17648	9737	27825	8.5	1897	1.10	186	2082	13.4	13.1

Rating conditions: Voltage 230/1/60 Entering air: 80DB / 67 WB External static: .1 in.wc. 675 CFM

In accordance with ARI 325 and 330 standards & CAN/CSA C446-M94

Capacity Data			Heating Mode				Model RH-24-HAC				Nominal 2 ton						
EWT	gpm	Lpm	LWT	Diff	HAB	Pres. Drop	EAT	LAT	Diff	Btu's Out	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	COP	CSA COP
70	8	36.2	63.8	6.0	28671	5.47	70	107	36.9	36538	9.8	1879	1.38	233	2111	5.08	4.35
70	6	27.1	62.0	7.8	28098	3.24	70	106	36.2	35807	9.7	1841	1.38	233	2074	5.06	4.54
70	4	18.1	58.2	11.4	27255	1.35	70	106	35.5	35091	9.6	1871	1.39	235	2106	4.89	4.55
65	8	36.2	59.7	5.4	26148	4.88	70	105	34.8	34389	9.5	1968	1.37	231	2199	4.59	3.86
65	6	27.1	57.9	7.0	25364	3.27	69	103	34.1	33701	9.4	1991	1.38	233	2224	4.45	3.93
65	4	18.1	54.8	10.3	24603	1.94	70	104	33.4	33027	9.3	2012	1.37	231	2243	4.32	3.98
60	8	36.2	54.9	5.0	23847	5.41	70	103	32.7	32367	9.2	2035	1.38	233	2267	4.19	3.85
60	6	27.1	53.5	6.4	23132	2.97	70	102	32.1	31720	9.1	2051	1.37	231	2282	4.08	3.74
60	4	18.1	50.6	9.3	22438	1.32	70	101	31.4	31085	9.0	2065	1.37	231	2296	3.97	3.63
55	8	36.2	50.7	4.5	21748	5.71	71	101	30.8	30463	8.9	2081	1.36	230	2311	3.87	3.53
55	6	27.1	49.5	5.9	21096	3.24	70	100	30.2	29854	8.8	2091	1.38	233	2324	3.77	3.43
55	4	18.1	46.7	8.5	20463	1.59	71	100	29.6	29257	8.7	2100	1.36	230	2329	3.68	3.34
50	8	36.2	45.9	4.1	19835	5.85	70	99	29.0	28672	8.6	2110	1.36	230	2340	3.60	3.26
50	6	27.1	44.7	5.3	19240	3.24	70	98	28.4	28099	8.5	2115	1.35	228	2343	3.52	3.18
50	4	18.1	42.2	7.8	18662	1.94	70	97	27.8	27537	8.4	2119	1.36	230	2349	3.44	3.10
45	8	36.2	41.3	3.8	18089	5.88	70	97	27.3	26986	8.3	2124	1.37	231	2356	3.36	3.02
45	6	27.1	40.2	4.9	17546	3.41	71	97	26.7	26446	8.2	2125	1.36	230	2355	3.30	2.96
45	4	18.1	38.0	7.1	17020	1.94	70	96	26.2	25917	8.1	2125	1.36	230	2354	3.23	2.89
40	8	36.2	36.7	3.4	16509	5.34	70	95	25.7	25399	8.0	2123	1.35	228	2351	3.17	2.83

Closed loop penalty

Operational figures below obtained with a 15% solution of methanol & water

40	8	36.2	36.6	3.4	16512	5.31	71	95.3	24.8	24542	8.2	2125	1.35	228	2353	3.06	2.85
40	6	27.1	35.5	4.5	16100	3.12	69.8	94.2	24.4	24113	8.1	2118	1.36	230	2348	3.01	2.87
40	4	18.1	33.5	6.5	15697	1.58	69.8	93.8	24.0	23694	8.1	2112	1.37	231	2343	2.96	2.84
38	8	36.2	34.6	3.4	16265	5.3	69.6	94.1	24.5	24223	8.1	2106	1.34	226	2332	3.04	2.83
38	6	27.1	33.6	4.4	15858	3	69.6	93.7	24.1	23801	8.1	2099	1.35	228	2327	3.00	2.86
38	4	18.1	31.6	6.4	15462	1.48	69.8	93.4	23.6	23383	8.0	2093	1.35	228	2321	2.95	2.83
36	8	36.2	32.7	3.3	16021	5.3	69.6	93.8	24.2	23915	7.9	2087	1.34	226	2313	3.03	2.82
36	6	27.1	31.7	4.3	15620	2.91	69.8	93.6	23.8	23493	7.8	2081	1.34	226	2307	2.98	2.84
36	4	18.1	29.7	6.3	15230	1.5	70.5	93.8	23.3	23081	7.7	2074	1.34	226	2300	2.94	2.82
34	8	36.2	30.7	3.3	15780	5.27	69.8	93.7	23.9	23610	7.6	2068	1.34	226	2294	3.02	2.81
34	6	27.1	29.7	4.3	15386	2.91	70.2	93.6	23.4	23189	7.5	2062	1.33	224	2286	2.97	2.83
34	4	18.1	27.7	6.3	15001	1.38	69.6	92.6	23.0	22789	7.5	2056	1.34	226	2282	2.93	2.81
32	8	36.2	28.8	3.2	15544	5.21	69.6	93.2	23.6	23305	7.4	2049	1.33	224	2274	3.00	2.79
32	6	27.1	27.8	4.2	15155	2.88	70.5	93.7	23.2	22901	7.3	2043	1.34	226	2269	2.96	2.82
32	4	18.1	25.8	6.2	14776	1.45	70	92.8	22.8	22501	7.2	2037	1.34	226	2263	2.91	2.79
30	8	36.2	26.8	3.2	15311	5.21	70	93.3	23.3	23009	7.1	2031	1.33	224	2256	2.99	2.78
30	6	27.1	25.9	4.1	14928	2.85	70.2	93.1	22.9	22605	7.1	2025	1.33	224	2249	2.94	2.80
30	4	18.1	23.9	6.1	14555	1.41	69.4	91.9	22.5	22211	7.0	2019	1.33	224	2243	2.90	2.78

Rating conditions: Voltage 230/1/60 Entering air: 70DB / 60 WB CFM = 810 @ External static: .15 in.wc.

RH-24-HAC Cooling Mode																			
					Water	Pres.				Sens	Latent	Total	Comp	Comp.	Fan	Fan	Total	CSA	
50	4	17.7	65.7	15.9	29762	0.9	79.9	53.5	26.4	20677	9701	31662	8.4	1884	1.91	322	2206.0	14.4	14.2
50	6	27.0	60.7	10.9	31583	1.9	80.6	52.9	27.7	21711	10186	33245	8.1	1827	1.90	321	2147.8	15.5	15.2
50	8	36.3	58.8	8.6	34021	3.2	80.1	50.9	29.2	22905	10747	35074	8.1	1809	1.90	321	2129.5	16.5	16.1
60	4	17.9	75.8	15.4	28869	0.9	79.9	54.3	25.6	20057	9410	30712	8.9	1987	1.91	322	2309.6	13.3	13.2
60	6	27.0	70.6	10.7	30635	1.8	79.7	52.8	26.9	21060	9881	32248	8.6	1928	1.91	322	2250.0	14.3	14.1
60	8	36.2	68.9	8.5	33001	3.1	80.4	52.0	28.4	22218	10424	34021	8.5	1908	1.90	321	2229.0	15.3	14.8
70	4	17.7	85.7	15.5	28003	0.9	79.5	54.7	24.8	19455	9128	29791	9.3	2097	1.92	324	2420.6	12.3	12.2
70	6	26.7	80.9	10.7	29716	1.9	79.7	53.6	26.1	20428	9584	31280	9.1	2034	1.92	324	2357.7	13.3	13.0
70	8	36.3	78.3	8.3	32011	3.2	79.7	52.2	27.5	21551	10111	33001	9.0	2013	1.91	322	2335.7	14.1	13.7
77	4	18.6	91.7	14.5	27163	1.4	80.1	56.0	24.1	18871	8854	28897	9.9	2212	1.91	322	2534.2	11.4	11.3
78	6	27.3	87.8	10.3	28825	2.1	80.2	54.9	25.3	19815	9297	30342	9.6	2146	1.90	321	2466.2	12.3	12.0
77	8	35.6	85.1	8.3	31050	3.4	79.5	52.8	26.7	20905	9808	32011	9.5	2124	1.92	324	2448.1	13.1	12.7

Rating conditions: Voltage 230/1/60 Entering air: 80DB / 67 WB External static: .15 in.wc. 810 CFM

In accordance with ARI 325 and 330 standards & CAN/CSA C446-M94

Capacity Data				Heating Mode				Model RH-30-HAC				Nominal 2.5 ton					
EWT	lgpm	Lpm	LWT	Diff	HAB	Pres. Drop	EAT	LAT	Diff	Btu's Out	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	COP	CSA COP
70	10	45.2	63.7	6.1	36528	8.65	70	108	38.4	47467	13.0	2612	2.21	373	2985	4.66	3.81
70	8	36.2	62.3	7.5	35797	5.47	70	108	37.6	46517	12.9	2560	2.22	375	2934	4.65	3.92
70	6	27.1	60.0	9.6	34724	3.24	70	107	36.9	45587	12.7	2594	2.21	373	2967	4.51	3.94
65	10	45.2	59.5	5.6	33314	6.94	70	105	35.4	43782	12.4	2500	2.21	373	2873	4.47	3.62
65	8	36.2	58.2	6.7	32314	4.88	69	104	34.7	42906	12.3	2529	2.21	373	2902	4.34	3.61
65	6	27.1	56.4	8.7	31345	3.27	70	104	34.0	42048	12.2	2556	2.22	375	2930	4.21	3.64
60	10	45.2	54.8	5.1	30382	8.62	70	102	32.7	40383	11.9	2388	2.21	373	2761	4.29	3.44
60	8	36.2	53.8	6.1	29470	5.41	70	102	32.0	39575	11.8	2413	2.20	371	2784	4.17	3.44
60	6	27.1	52.0	7.9	28586	2.97	70	101	31.4	38784	11.6	2435	2.21	373	2808	4.05	3.48
55	10	45.2	50.6	4.6	27708	8.83	71	101	30.1	37248	11.4	2278	2.20	371	2649	4.12	3.27
55	8	36.2	49.8	5.6	26877	5.71	70	100	29.5	36503	11.3	2299	2.19	370	2668	4.01	3.28
55	6	27.1	48.0	7.2	26071	3.24	71	99	28.9	35773	11.1	2317	2.21	373	2690	3.90	3.33
50	10	45.2	45.8	4.2	25270	8.68	70	98	27.8	34356	10.9	2170	2.19	370	2539	3.97	3.12
50	8	36.2	44.9	5.1	24512	5.85	70	97	27.2	33669	10.8	2187	2.18	368	2555	3.87	3.14
50	6	27.1	43.4	6.6	23777	3.24	70	96	26.7	32996	10.7	2201	2.19	370	2571	3.77	3.20
45	10	45.2	41.3	3.8	23046	8.91	70	95	25.6	31689	10.4	2064	2.19	370	2433	3.82	2.97
45	8	36.2	40.4	4.7	22355	5.88	71	96	25.1	31055	10.3	2078	2.19	370	2447	3.72	2.99
45	6	27.1	39.1	6.0	21684	3.41	70	94	24.6	30434	10.2	2089	2.18	368	2457	3.63	3.06
40	10	45.2	36.6	3.5	21034	9	70	94	24.1	29826	10.1	2099	2.18	368	2467	3.55	3.07
40	8	36.2	35.7	4.3	20403	7.12	71	94	23.6	29229	10.0	2108	2.18	368	2476	3.46	2.61

Closed loop penalty

Operational figures below obtained with a 15% solution of methanol & water

40	10	45.2	36.5	3.5	21037	8.5	71	94.3	23.8	29459	10.2	2101	2.17	366	2468	3.50	3.18
40	8	36.2	35.7	4.3	20511	5.3	69.8	93.2	23.4	28917	10.1	2095	2.18	368	2463	3.44	3.23
40	6	27.1	34.4	5.6	19998	3.1	69.8	92.8	23.0	28389	9.9	2089	2.19	370	2458	3.38	3.24
38	10	45.2	34.5	3.5	20721	8.5	69.6	93.1	23.5	29073	10.1	2083	2.16	365	2447	3.48	3.16
38	8	36.2	33.8	4.2	20203	5.3	69.6	92.7	23.1	28539	9.9	2076	2.17	366	2443	3.42	3.21
38	6	27.1	32.5	5.5	19698	3.0	69.8	92.5	22.7	28013	9.8	2070	2.17	366	2436	3.37	3.23
36	10	45.2	32.6	3.4	20410	7.4	69.6	92.8	23.2	28698	9.7	2064	2.16	365	2428	3.46	3.14
36	8	36.2	31.9	4.1	19900	5.3	69.8	92.6	22.8	28167	9.6	2058	2.16	365	2422	3.41	3.20
36	6	27.1	30.6	5.4	19403	2.9	70.5	92.9	22.4	27648	9.5	2052	2.16	365	2416	3.35	3.21
34	10	45.2	30.6	3.4	20104	8.6	69.8	92.7	22.9	28329	9.4	2045	2.16	365	2410	3.44	3.12
34	8	36.2	29.9	4.1	19602	5.3	70.2	92.7	22.5	27800	9.3	2039	2.15	363	2402	3.39	3.18
34	6	27.1	28.7	5.3	19112	2.9	69.6	91.7	22.1	27295	9.2	2033	2.16	365	2398	3.34	3.20
32	10	45.2	28.7	3.3	19803	8.3	69.6	92.2	22.6	27959	9.1	2027	2.15	363	2390	3.43	3.11
32	8	36.2	28.0	4.0	19308	5.2	70.5	92.7	22.2	27449	9.0	2021	2.16	365	2385	3.37	3.16
32	6	27.1	26.8	5.2	18825	2.9	70	91.8	21.8	26946	8.9	2015	2.16	365	2379	3.32	3.18
30	10	45.2	26.7	3.3	19506	8.4	70	92.3	22.3	27600	8.8	2009	2.15	363	2372	3.41	3.09
30	8	36.2	26.0	4.0	19018	5.2	70.2	92.1	21.9	27092	8.7	2003	2.15	363	2366	3.36	3.15
30	6	27.1	24.8	5.2	18542	2.9	69.4	90.9	21.5	26596	8.6	1997	2.15	363	2360	3.30	3.16

Rating conditions: Voltage 230/1/60 Entering air: 70DB / 60 WB CFM = 1120 @ External static: .15 in.wc

RH-30-HAC Cooling Mode																			
					Water	Pres.				Sens	Latent	Total	Comp	Comp.	Fan	Fan	Total	CSA	
50	4	17.7	71.3	21.5	41065	0.91	79.9	50.8	29.1	30115	11653	43686	10.5	2355	2.12	358	2712.4	16.1	16.0
50	6	27.0	64.5	14.7	43577	1.91	80.6	50.0	30.6	31621	12236	45870	10.2	2284	2.11	356	2640.0	17.4	17.1
50	8	36.3	61.8	11.6	46941	3.21	80.1	47.8	32.3	33360	12909	48393	10.1	2261	2.11	356	2617.2	18.5	18.1
60	4	17.9	81.2	20.8	39833	0.91	79.9	51.6	28.3	29212	11303	42375	11.1	2484	2.12	358	2841.9	14.9	14.8
60	6	27.0	74.3	14.4	42269	1.79	79.7	50.0	29.7	30672	11869	44494	10.7	2410	2.12	358	2767.4	16.1	15.8
60	8	36.2	71.8	11.4	45533	3.09	80.4	49.1	31.3	32359	12521	46941	10.6	2386	2.11	356	2741.6	17.1	16.7
70	4	17.7	91.0	20.8	38638	0.94	79.5	52.1	27.4	28335	10964	41104	11.7	2621	2.13	359	2980.2	13.8	13.7
70	6	26.7	84.6	14.4	41001	1.88	79.7	50.9	28.8	29752	11513	43159	11.3	2542	2.13	359	2901.6	14.9	14.6
70	8	36.3	81.2	11.2	44167	3.18	79.7	49.3	30.4	31388	12146	45533	11.2	2517	2.12	358	2874.5	15.8	15.4
77	4	18.6	96.7	19.5	37479	1.35	80.1	53.5	26.6	27485	10635	39871	12.3	2765	2.12	358	3122.6	12.8	12.6
77	6	27.3	91.3	13.8	39771	2.09	80.2	52.3	27.9	28859	11167	41865	12.0	2682	2.11	356	3038.0	13.8	13.5
77	8	35.6	88.1	11.3	42842	3.38	79.5	50.1	29.4	30447	11781	44167	11.8	2655	2.13	359	3014.6	14.7	14.2

Rating conditions: Voltage 230/1/60 Entering air: 80DB / 67 WB External static: .15 in.wc 1120 CFM

In accordance with ARI 325 and 330 standards & CAN/CSA C446-M94

Capacity Data					Heating Mode					Model RH-36-HAC				Nominal 3 ton			
EWT	gpm	Lpm	LWT	Diff	HAB	Pres. Drop	EAT	LAT	Diff	Btu's Out	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	COP	CSA COP
70	10	45.2	63.0	6.8	40859	8.7	70	106	36.2	53746	15.1	3077	2.31	390	3467	4.55	3.70
70	8	36.2	61.5	8.3	40042	5.5	70	106	35.5	52672	14.9	3016	2.32	392	3407	4.53	3.80
70	6	27.1	58.8	10.8	38841	3.2	70	105	34.8	51618	14.8	3051	2.31	390	3441	4.40	3.83
65	10	45.2	58.9	6.2	37263	6.9	70	103	33.4	49574	14.4	2940	2.31	390	3330	4.37	3.52
65	8	36.2	57.4	7.5	36146	4.9	69	102	32.7	48583	14.3	2970	2.31	390	3360	4.24	3.51
65	6	27.1	55.4	9.7	35061	3.3	70	102	32.1	47611	14.1	2997	2.32	392	3388	4.12	3.55
60	10	45.2	54.2	5.7	33984	8.6	70	101	30.8	45726	13.8	2804	2.31	390	3194	4.20	3.35
60	8	36.2	53.0	6.9	32965	5.4	70	100	30.2	44811	13.7	2829	2.30	388	3217	4.09	3.36
60	6	27.1	51.0	8.9	31976	3.0	70	99	29.6	43915	13.5	2851	2.31	390	3241	3.98	3.41
55	10	45.2	50.0	5.2	30994	8.8	71	99	28.4	42176	13.2	2670	2.30	388	3058	4.05	3.20
55	8	36.2	49.1	6.3	30064	5.7	70	98	27.9	41332	13.1	2691	2.29	386	3077	3.94	3.21
55	6	27.1	47.1	8.1	29162	3.2	71	98	27.3	40506	12.9	2709	2.31	390	3099	3.84	3.27
50	10	45.2	45.3	4.7	28266	8.7	70	96	26.2	38902	12.7	2540	2.29	386	2926	3.90	3.05
50	8	36.2	44.3	5.7	27418	5.9	70	95	25.7	38124	12.5	2556	2.28	385	2941	3.80	3.07
50	6	27.1	42.6	7.4	26596	3.2	70	95	25.2	37361	12.4	2571	2.29	386	2957	3.71	3.14
45	10	45.2	40.8	4.3	25779	8.9	70	94	24.2	35882	12.1	2412	2.29	386	2799	3.76	2.91
45	8	36.2	39.9	5.2	25005	5.9	71	94	23.7	35164	12.0	2426	2.29	386	2812	3.67	2.94
45	6	27.1	38.4	6.7	24255	3.4	70	93	23.2	34461	11.8	2437	2.28	385	2822	3.58	3.01
40	10	45.2	36.2	3.9	23528	9.0	70	92	22.8	33771	11.7	2446	2.28	385	2831	3.50	3.02
40	8	36.2	35.2	4.8	22822	7.1	71	93	22.3	33096	11.6	2453	2.28	385	2838	3.42	2.57

Closed loop penalty

Operational figures below obtained with a 15% solution of methanol & water

40	10	45.2	36.1	3.9	23531	8.5	71	92.9	22.4	33194	11.8	2448	2.27	383	2831	3.44	3.12
40	8	36.2	35.2	4.8	22942	5.31	69.8	91.8	22.0	32586	11.6	2441	2.28	385	2826	3.38	3.17
40	6	27.1	33.8	6.2	22369	3.12	69.8	91.4	21.6	31993	11.5	2433	2.29	386	2820	3.32	3.18
38	10	45.2	34.1	3.9	23178	8.5	69.6	91.7	22.1	32760	11.6	2426	2.26	381	2808	3.42	3.10
38	8	36.2	33.3	4.7	22598	5.3	69.6	91.3	21.7	32161	11.5	2419	2.27	383	2802	3.36	3.15
38	6	27.1	31.9	6.1	22033	3	69.8	91.1	21.3	31572	11.4	2412	2.27	383	2795	3.31	3.17
36	10	45.2	32.2	3.8	22830	7.36	69.6	91.4	21.8	32338	11.3	2404	2.26	381	2786	3.40	3.08
36	8	36.2	31.4	4.6	22259	5.3	69.8	91.2	21.4	31743	11.1	2397	2.26	381	2779	3.35	3.14
36	6	27.1	30.0	6.0	21703	2.91	70.5	91.5	21.0	31162	11.0	2390	2.26	381	2771	3.29	3.15
34	10	45.2	30.3	3.7	22488	8.56	69.8	91.3	21.5	31922	10.9	2383	2.26	381	2764	3.38	3.06
34	8	36.2	29.4	4.6	21925	5.27	70.2	91.3	21.1	31329	10.8	2376	2.25	380	2755	3.33	3.12
34	6	27.1	28.1	5.9	21377	2.91	69.6	90.3	20.7	30763	10.7	2369	2.26	381	2750	3.28	3.14
32	10	45.2	28.3	3.7	22150	8.27	69.6	90.8	21.2	31506	10.5	2361	2.25	380	2741	3.37	3.05
32	8	36.2	27.5	4.5	21596	5.21	70.5	91.4	20.9	30934	10.4	2354	2.26	381	2736	3.31	3.10
32	6	27.1	26.2	5.8	21057	2.88	70	90.5	20.5	30370	10.3	2347	2.26	381	2729	3.26	3.12
30	10	45.2	26.4	3.6	21818	8.36	70	91.0	21.0	31101	10.2	2340	2.25	380	2720	3.35	3.03
30	8	36.2	25.6	4.4	21272	5.21	70.2	90.8	20.6	30532	10.1	2333	2.25	380	2713	3.30	3.09
30	6	27.1	24.2	5.8	20741	2.85	69.4	89.6	20.2	29976	10.0	2326	2.25	380	2706	3.25	3.11

Rating conditions: Voltage 230/1/60 Entering air: 70DB / 60 WB CFM = 1475 @ External static: .15 in.wc.

<i>RH-36-HAC Cooling Mode</i>																			
					Water	Pres.				Sens	Latent	Total	Comp	Comp.	Fan	Fan	Total	CSA	
50	4	17.7	73.2	23.4	43756	0.91	79.9	54.0	25.9	34133	12453	46549	12.2	2736	3.1	515	3250.5	14.3	14.2
50	6	27.0	65.8	16.0	46433	1.91	80.6	53.4	27.2	35840	13076	48876	11.8	2654	3.0	513	3166.8	15.4	15.2
50	8	36.3	62.7	12.5	49544	3.21	80.1	51.7	28.4	37452	13664	51076	11.7	2627	3.0	513	3140.2	16.3	15.8
60	4	17.9	83.1	22.7	42443	0.91	79.9	54.8	25.1	33109	12079	45153	12.7	2859	3.1	515	3373.7	13.4	13.3
60	6	27.0	75.6	15.7	45040	1.79	79.7	53.4	26.3	34764	12683	47410	12.4	2773	3.1	515	3287.9	14.4	14.2
60	8	36.2	72.7	12.3	48057	3.09	80.4	52.9	27.5	36329	13254	49544	12.2	2745	3.0	513	3258.5	15.2	14.8
70	4	17.7	92.8	22.6	41170	0.94	79.5	55.2	24.3	32116	11717	43798	13.3	2988	3.1	516	3504.0	12.5	12.4
70	6	26.7	85.8	15.6	43688	1.88	79.7	54.2	25.5	33722	12303	45988	12.9	2898	3.1	516	3414.4	13.5	13.2
70	8	36.3	82.1	12.1	46616	3.18	79.7	53.0	26.7	35239	12857	48057	12.8	2869	3.1	515	3383.7	14.2	13.8
77	4	18.6	98.4	21.2	39935	1.35	80.1	56.5	23.6	31152	11366	42484	13.9	3122	3.1	515	3636.7	11.7	11.6
77	6	27.3	92.5	15.0	42378	2.09	80.2	55.4	24.8	32710	11934	44608	13.5	3028	3.0	513	3541.4	12.6	12.3
77	8	35.6	88.9	12.1	45217	3.38	79.5	53.6	25.9	34182	12471	46616	13.4	2998	3.1	516	3514.5	13.3	12.8

Rating conditions: Voltage 230/1/60 Entering air: 80DB / 67 WB External static: .15 in.wc. 1475 CFM

In accordance with ARI 325 and 330 standards & CAN/CSA C446-M94

Capacity Data				Heating Mode				Model RH-42-HAC				Nominal 3.5 ton					
EWT	lgpm	Lpm	LWT	Diff	HAB	Pres. Drop	EAT	LAT	Diff	Btu's Out	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	COP	CSA COP
70	10	45.2	62.4	7.4	44221	8.7	70	103	33.1	57269	16.9	3097	3.1	523	3620	4.64	3.79
70	8	36.2	59.7	9.0	43337	5.5	70	103	32.4	56124	16.7	3035	3.1	525	3560	4.62	3.89
70	6	27.1	57.0	11.7	42036	3.2	70	102	31.8	55001	16.6	3077	3.1	523	3600	4.48	3.91
65	10	45.2	57.0	6.7	40330	6.9	70	101	30.5	52823	16.2	2965	3.1	523	3488	4.44	3.59
65	8	36.2	55.4	8.1	39120	4.9	69	99	29.9	51767	16.1	3001	3.1	523	3525	4.31	3.58
65	6	27.1	53.6	10.5	37946	3.3	70	100	29.3	50731	15.9	3034	3.1	525	3559	4.18	3.61
60	10	45.2	52.3	6.1	36781	8.6	70	98	28.2	48722	15.6	2834	3.1	523	3357	4.26	3.41
60	8	36.2	51.1	7.4	35677	5.4	70	97	27.6	47748	15.4	2865	3.1	521	3386	4.14	3.41
60	6	27.1	49.3	9.6	34607	3.0	70	97	27.0	46793	15.3	2892	3.1	523	3415	4.02	3.45
55	10	45.2	48.4	5.6	33544	8.8	71	96	26.0	44940	15.0	2705	3.1	521	3226	4.09	3.24
55	8	36.2	47.3	6.8	32538	5.7	70	96	25.4	44041	14.8	2730	3.1	520	3250	3.98	3.25
55	6	27.1	45.5	8.8	31561	3.2	71	95	24.9	43160	14.7	2753	3.1	523	3276	3.87	3.30
50	10	45.2	43.7	5.1	30592	8.7	70	94	23.9	41451	14.4	2577	3.1	520	3097	3.93	3.08
50	8	36.2	42.6	6.2	29674	5.9	70	93	23.5	40622	14.2	2598	3.1	518	3116	3.82	3.09
50	6	27.1	40.8	8.0	28784	3.2	70	93	23.0	39810	14.1	2617	3.1	520	3136	3.72	3.15
45	10	45.2	39.4	4.6	27900	8.9	70	92	22.1	38233	13.8	2452	3.1	520	2972	3.77	2.92
45	8	36.2	38.3	5.6	27063	5.9	71	92	21.6	37469	13.7	2470	3.1	520	2989	3.68	2.95
45	6	27.1	36.7	7.3	26251	3.4	70	91	21.2	36719	13.5	2484	3.1	518	3002	3.59	3.02
40	10	45.2	34.9	4.2	25463	9.0	70	90	20.8	35985	13.4	2497	3.1	518	3015	3.50	3.02
40	8	36.2	34.0	5.1	24700	7.1	71	91	20.4	35265	13.3	2507	3.1	518	3026	3.42	2.57

Closed loop penalty

Operational figures below obtained with a 15% solution of methanol & water

40	10	45	35.8	4.2	25466	7.7	71	98.2	27.7	35966	13.5	2560	3.1	516	3076	3.4	3.05
40	8	36	34.8	5.2	24830	5.4	69.8	96.4	26.6	35309	13.4	2552	3.1	518	3070	3.4	3.08
40	6	27	33.3	6.7	24209	3.7	69.8	96.4	26.6	34668	13.2	2545	3.1	520	3064	3.3	3.16
38	10	45	33.8	4.2	25084	7.8	69.6	95.4	25.8	35500	13.4	2537	3.1	515	3052	3.4	3.03
38	8	36	32.9	5.1	24457	5.6	69.6	95.4	25.8	34853	13.2	2529	3.1	516	3046	3.4	3.06
38	6	27	31.4	6.6	23846	3.9	69.8	95	25.2	34215	13.1	2522	3.1	516	3038	3.3	3.15
36	10	45	31.9	4.1	24708	7.8	69.6	96.1	26.5	35046	13.0	2514	3.1	515	3029	3.4	3.01
36	8	36	31.0	5.0	24091	5.5	69.8	95.7	25.9	34403	12.8	2507	3.1	515	3021	3.3	3.05
36	6	27	29.5	6.5	23488	3.7	70.5	96.1	25.6	33775	12.7	2499	3.1	515	3014	3.3	3.13
34	10	45	29.9	4.1	24338	7.8	69.8	95.4	25.6	34598	12.6	2492	3.1	515	3006	3.4	2.99
34	8	36	29.1	4.9	23729	5.6	70.2	95.4	25.2	33959	12.5	2484	3.0	513	2997	3.3	3.03
34	6	27	27.6	6.4	23136	3.9	69.6	93.9	24.3	33346	12.3	2477	3.1	515	2991	3.3	3.12
32	10	45	28.0	4.0	23973	7.8	69.6	94.6	25	34151	12.2	2469	3.0	513	2982	3.4	2.98
32	8	36	27.1	4.9	23373	5.7	70.5	94.8	24.3	33532	12.1	2462	3.1	515	2977	3.3	3.01
32	6	27	25.7	6.3	22789	3.7	70	93.6	23.6	32923	12.0	2455	3.1	515	2969	3.2	3.10
30	10	45	26.1	3.9	23613	7.7	70	93.9	23.9	33716	11.8	2447	3.0	513	2960	3.3	2.96
30	8	36	25.2	4.8	23023	5.7	70.2	93.7	23.5	33101	11.7	2440	3.0	513	2953	3.3	2.99
30	6	27	23.8	6.2	22447	3.7	69.4	92.1	22.7	32500	11.6	2433	3.0	513	2946	3.2	3.08

Rating conditions: Voltage 230/1/60 Entering air: 70DB / 60 WB CFM = 1650 @ External static: .15 in.wc.

RH-42-HAC Cooling Mode																			
					Water	Pres.				Sens	Latent	Total	Comp	Comp.	Fan	Fan	Total	CSA	
50	4	17.7	74.3	24.5	46397	0.91	79.9	56.4	23.5	35006	13945	49359	12.20	2736	3.1	515	3250.5	15.2	15.1
50	6	27.0	66.6	16.8	49236	1.91	80.6	55.9	24.7	36757	14642	51827	11.83	2654	3.0	513	3166.8	16.4	16.1
50	8	36.3	63.3	13.1	52534	3.21	80.1	54.3	25.8	38411	15301	54159	11.72	2627	3.0	513	3140.2	17.2	16.8
60	4	17.9	84.1	23.7	45006	0.91	79.9	57.1	22.8	33956	13527	47878	12.75	2859	3.1	515	3373.7	14.2	14.1
60	6	27.0	76.4	16.5	47759	1.79	79.7	55.8	23.9	35654	14203	50272	12.37	2773	3.1	515	3287.9	15.3	15.0
60	8	36.2	73.3	12.9	50958	3.09	80.4	55.4	25.0	37258	14842	52534	12.24	2745	3.0	513	3258.5	16.1	15.7
70	4	17.7	93.9	23.7	43655	0.94	79.5	57.4	22.1	32938	13121	46442	13.32	2988	3.1	516	3504.0	13.3	13.1
70	6	26.7	86.6	16.4	46326	1.88	79.7	56.5	23.2	34584	13777	48764	12.92	2898	3.1	516	3414.4	14.3	14.0
70	8	36.3	82.7	12.7	49430	3.18	79.7	55.4	24.3	36141	14397	50958	12.79	2869	3.1	515	3383.7	15.1	14.6
77	4	18.6	99.4	22.2	42346	1.35	80.1	58.6	21.5	31949	12727	45049	13.92	3122	3.1	515	3636.7	12.4	12.3
78	6	27.3	93.2	15.7	44936	2.09	80.2	57.7	22.5	33547	13364	47301	13.50	3028	3.0	513	3541.4	13.4	13.1
77	8	35.6	89.5	12.7	47947	3.38	79.5	56.0	23.5	35057	13965	49430	13.37	2998	3.1	516	3514.5	14.1	13.6

Rating conditions: Voltage 230/1/60 Entering air: 80DB / 67 WB External static: .15 in.wc. 1650 CFM

In accordance with ARI 325 and 330 standards & CAN/CSA C446-M94

Capacity Data			Heating Mode			Model RH-48-HAC					Nominal 4 ton						
EWT	gpm	Lpm	LWT	Diff	HAB	Pres. Drop	EAT	LAT	Diff	Btu's Out	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	COP	CSA COP
70	10	45.2	60.8	9.2	55223	8.7	70	114.6	44.6	69507	21.9	4686	3.3	559	5245	3.88	3.09
70	8	35.9	59	11.2	51454	5.7	70.2	113.5	43.3	67041	21.2	4593	3.3	560	5154	3.81	3.20
70	6	27.3	55.8	14	50644	3.6	70.2	112.5	42.3	66483	20.7	4485	3.3	559	5045	3.86	3.43
60	10	45.2	52.7	7.6	45619	8.7	70.2	108.7	38.5	60529	19.7	4271	3.3	559	4830	3.67	2.88
60	8	36.2	51.1	9.3	44478	6.2	70	107.8	37.8	59142	19.6	4188	3.3	559	4747	3.65	3.04
60	6	27.2	48.4	11.9	42974	3.6	70.2	106.7	36.5	57498	19.2	4095	3.3	560	4655	3.62	3.19
55	10	45.2	48.2	7	41975	8.7	69.8	106.3	36.5	57229	18.6	4051	3.3	559	4610	3.64	2.85
55	8	36.0	46.2	8.8	42086	6.1	70.2	105.1	34.9	54486	18.7	3982	3.3	557	4540	3.52	2.91
55	6	27.0	43.7	11.2	40173	3.6	70.3	103.8	33.5	52614	18.2	3894	3.3	559	4454	3.46	3.03
50	10	45.2	43.7	6.5	38977	9.2	69.8	103.1	33.3	52812	17.9	3865	3.3	557	4423	3.50	2.71
50	8	36.2	42.1	8.1	38837	5.9	69.6	102.4	32.8	51999	17.8	3811	3.3	555	4367	3.49	2.88
50	6	27.1	39.6	10	35930	3.5	70	101.7	31.7	50588	17.4	3748	3.3	559	4307	3.44	3.01
47	10	45.2	41	6.1	36690	9.1	70.3	101.7	31.4	50055	17.8	3738	3.3	555	4294	3.42	2.63
47	8	36.2	39.4	7.5	36006	6.2	70.3	100.8	30.5	48969	17.2	3689	3.3	554	4243	3.38	2.77
47	6	27.0	36.7	9.9	35510	3.8	70	99.3	29.3	48279	17.2	3601	3.3	555	4157	3.40	2.97
45	11	50.5	39.6	5.2	34734	11.0	70	100.6	30.6	48629	17.5	3689	3.3	554	4243	3.36	2.57
45	10	45.0	39.2	5.9	35271	8.8	69.6	99.7	30.1	48898	17.2	3680	3.3	555	4235	3.38	2.77
45	8	35.8	37.4	7.7	36591	5.8	69.8	99.1	29.3	47281	16.8	3636	3.3	555	4191	3.31	2.88
42	11	51.4	36.9	5	34130	11.6	69.6	99	29.4	47765	17.0	3582	3.3	554	4136	3.38	2.59
40	12	52.2	35.4	4.7	32541	11.7	69.7	98.2	28.5	45697	16.7	3523	3.3	550	4074	3.29	2.50

Closed loop penalty

Operational figures below obtained with a 15% solution of methanol & water

38	12	52.6	33.6	4.7	29904	12.0	70.3	98.4	28.1	44754	16.3	3499	3.2	547	3806	3.44	3.06
39	10	45.2	33.3	5.4	29991	8.9	70.9	97.9	27	43980	16.2	3407	3.3	548	3726	3.46	3.17
38	8	36.1	31.1	6.7	29754	5.8	69.8	96.3	26.5	42980	15.8	3338	3.2	547	3662	3.44	3.23
38	6	27.0	29.5	8.6	28268	3.5	70.2	95.5	25.3	41248	15.5	3284	3.2	545	3632	3.33	3.20
35	12	52.2	29.9	4.6	29038	11.9	70.2	95.7	25.5	41568	15.7	3343	3.2	547	3664	3.32	2.94
35	10	45.0	30.2	5.2	28343	9.1	69.8	95.5	25.7	41761	15.8	3338	3.2	547	3687	3.32	3.03
35	8	36.0	28.8	6.6	28779	5.8	70.2	95	24.8	40590	15.6	3294	3.3	548	3619	3.29	3.08
35	6	27.0	26.8	8.4	27424	3.4	70.2	95.2	25	40947	15.3	3211	3.2	545	3524	3.40	3.27
32	12	52.5	27.5	4.2	26676	12.2	69.6	93.9	24.3	39144	15.0	3201	3.2	547	3539	3.24	2.86
32	10	45.2	27.3	4.9	26789	9.0	69.8	94.3	24.5	39563	15.1	3211	3.2	545	3529	3.28	2.99
32	8	36.0	25.7	6.1	26564	5.7	69.8	93.6	23.8	38505	14.8	3153	3.2	547	3475	3.25	3.04
32	6	27.2	24.3	7.7	25310	3.4	70.2	92.8	22.6	37398	14.5	3089	3.2	545	3413	3.21	3.08
31	12	52.7	26.4	4.2	26770	12.1	69.8	93.9	24.1	39339	15.2	3192	3.2	545	3510	3.28	2.90
30	10	45.2	25.5	4.7	25696	9.1	70.3	94.3	24	38967	14.9	3167	3.2	543	3510	3.25	2.96
30	8	36.2	24.1	5.9	25825	5.9	69.6	92.3	22.7	37072	14.5	3094	3.2	547	3418	3.18	2.97
30	6	27.0	22.5	7.5	24527	3.4	69.8	91.9	22.1	36426	14.5	3055	3.2	543	3407	3.13	3.00

Rating conditions: Voltage 230/1/60 Entering air: 70DB / 60 WB CFM = 1850 @ External static: .15 in.wc.

RH-48-HAC Cooling Mode

					Water	Pres.				Sens	Latent	Total	Comp	Comp.	Fan	Fan	Total		CSA
50	4	18.2	78.4	28.6	56074	0.91	80.2	56.7	23.5	37793	19610	58080	16.0	3421.3	3.2	538	3960	14.7	14.5
50	6	27.2	69.1	19.1	57609	1.91	80.2	55.6	24.6	38828	20432	59965	15.2	3211.2	3.2	537	3748	16.0	15.7
50	8	36.0	64.9	14.9	59450	3.21	80.1	55.6	24.5	38410	21940	61107	14.8	3103.8	3.2	537	3640	16.8	16.4
60	4	18.2	87.6	27.9	54051	0.91	80.1	57.6	22.5	35125	18154	53905	17.3	3675.2	3.2	538	4214	12.8	12.7
60	6	27.6	79.0	19.1	57012	1.79	80.2	57	23.2	36424	19308	56399	16.4	3445.7	3.2	537	3982	14.2	13.9
60	8	36.3	74.1	14.4	56902	3.09	80.4	56.5	23.9	36618	20729	58064	15.8	3362.6	3.2	537	3899	14.9	14.5
70	4	18.3	96.6	27.0	50981	0.94	79.9	58.6	21.3	33808	17090	51485	18.1	3934.1	3.2	537	4471	11.5	11.4
70	6	27.2	88.2	18.4	52532	1.88	79.5	57.6	21.9	34761	18442	53834	17.4	3738.7	3.2	535	4274	12.6	12.3
70	8	35.8	84.0	14.0	53146	3.18	80.1	57.6	22.5	35149	18045	54121	17.0	3636.1	3.2	537	4173	13.0	12.6
77	4	18.4	104.0	26.6	49622	1.35	80.2	59.4	20.8	33356	17114	51061	19.4	4183.2	3.2	535	4718	10.8	10.7
77	6	27.3	94.8	17.8	50124	2.09	80.4	58.6	21.8	34098	18215	52944	17.9	3909.7	3.2	537	4446	11.9	11.6
77	8	36.2	91.0	13.8	52035	3.38	80.4	58.3	22.1	34326	18545	53513	17.8	3831.5	3.2	537	4368	12.3	11.8

Rating conditions: Voltage 230/1/60 Entering air: 80DB / 67 WB External static: .15 in.wc. 1850 CFM

In accordance with ARI 325 and 330 standards & CAN/CSA C446-M94

Capacity Data					Heating Mode					Model RH-60-HAC					Nominal 5 ton			
EWT	gpm	Lpm	LWT	Diff	HAB	Pres. Drop	EAT	LAT	Diff	Btu's Out	Comp Amps	Comp Watts	Fan Amps	Fan Watts	Total Watts	COP	CSA COP	
70	12	54.1	61.3	8.5	61240	6.9	70	104	34.4	82250	24.0	4986	3.5	591	5577	4.33	3.48	
70	10	45.3	59.7	10.0	60015	4.9	70	104	33.7	80605	23.8	4887	3.5	592	5479	4.32	3.59	
70	8	36.0	57.0	12.2	58215	3.2	70	103	33.0	78993	23.5	4931	3.5	591	5522	4.20	3.63	
65	12	54.4	57.0	7.7	55851	6.9	70	102	31.7	75865	23.1	4750	3.5	591	5340	4.17	3.32	
65	10	45.2	55.4	9.0	54175	4.9	69	101	31.1	74347	22.8	4787	3.5	591	5378	4.06	3.33	
65	8	36.2	53.6	10.9	52550	3.3	70	101	30.5	72861	22.6	4820	3.5	592	5413	3.95	3.38	
60	12	54.2	52.3	7.1	50936	6.9	70	99	29.3	69975	22.1	4519	3.5	591	5109	4.02	3.17	
60	10	45.3	51.1	8.2	49408	4.9	70	98	28.7	68576	21.9	4549	3.5	589	5138	3.92	3.19	
60	8	36.3	49.3	9.9	47926	3.3	70	98	28.1	67204	21.7	4575	3.5	591	5166	3.82	3.25	
55	12	54.3	48.4	6.4	46454	7.1	71	98	27.0	64543	21.3	4293	3.5	589	4882	3.88	3.03	
55	10	45.4	47.3	7.5	45060	5.1	70	97	26.5	63252	21.1	4317	3.5	587	4905	3.78	3.05	
55	8	36.2	45.5	9.1	43708	3.3	71	96	25.9	61987	20.8	4338	3.5	591	4929	3.69	3.12	
50	12	54.0	43.7	5.9	42366	7.1	70	95	24.9	59532	20.4	4074	3.5	587	4661	3.75	2.90	
50	10	45.0	42.6	6.9	41095	5.1	70	94	24.4	58342	20.2	4093	3.5	586	4679	3.66	2.93	
50	8	36.2	40.8	8.3	39862	3.8	70	94	23.9	57175	20.0	4109	3.5	587	4696	3.57	3.00	
45	12	54.1	39.4	5.4	38638	7.2	70	93	23.0	54911	19.6	3862	3.5	587	4449	3.62	2.77	
45	10	45.2	38.3	6.2	37478	5.2	71	93	22.5	53813	19.4	3877	3.5	587	4464	3.54	2.81	
45	8	36.0	36.7	7.6	36354	3.4	70	92	22.1	52736	19.2	3888	3.5	586	4474	3.46	2.89	
40	12	54.2	34.9	4.9	35263	7.3	70	91	21.6	51682	19.0	3896	3.5	586	4482	3.38	2.90	
40	10	45.2	34.0	5.7	34206	5.6	71	92	21.2	50648	18.9	3902	3.5	586	4488	3.31	2.46	

Closed loop penalty

Operational figures below obtained with a 15% solution of methanol & water

40	12	54.2	35.1	4.9	35266	7.7	71	98.2	27.7	50655	19.0	3925	3.5	584	4509	3.3	2.91
40	10	45.1	34.3	5.7	34385	5.4	69.8	96.4	26.6	49739	18.8	3913	3.5	586	4499	3.2	2.95
40	8	36.2	33.0	7.0	33525	3.7	69.8	96.4	26.6	48845	18.6	3901	3.5	587	4489	3.2	2.90
38	12	54.2	33.2	4.8	34737	7.8	69.6	95.4	25.8	50000	18.8	3890	3.5	582	4472	3.3	3.13
38	10	45.2	32.4	5.6	33869	5.6	69.6	95.4	25.8	49098	18.6	3878	3.5	584	4462	3.2	3.07
38	8	36.2	31.1	6.9	33022	3.9	69.8	95	25.2	48211	18.4	3866	3.5	584	4450	3.2	3.04
36	12	54.4	31.3	4.7	34216	7.8	69.6	96.1	26.5	49360	18.3	3855	3.5	582	4437	3.3	2.88
36	10	45.1	30.4	5.6	33361	5.5	69.8	95.7	25.9	48465	18.1	3843	3.5	582	4426	3.2	2.92
36	8	36.0	29.2	6.8	32527	3.7	70.5	96.1	25.6	47592	17.9	3832	3.5	582	4414	3.2	3.01
34	12	54.1	29.3	4.7	33703	7.8	69.8	95.4	25.6	48729	17.7	3820	3.5	582	4402	3.2	2.86
34	10	45.2	28.5	5.5	32861	5.6	70.2	95.4	25.2	47841	17.5	3809	3.4	581	4389	3.2	2.90
34	8	36.3	27.4	6.6	32039	3.9	69.6	93.9	24.3	46987	17.4	3797	3.5	582	4380	3.1	2.99
32	12	54.3	27.4	4.6	33198	7.8	69.6	94.6	25	48100	17.2	3786	3.4	581	4367	3.2	2.85
32	10	45.2	26.6	5.4	32368	5.7	70.5	94.8	24.3	47238	17.0	3775	3.5	582	4357	3.2	2.89
32	8	36.2	25.4	6.6	31558	3.7	70	93.6	23.6	46390	16.8	3763	3.5	582	4346	3.1	2.98
30	12	54.1	25.4	4.6	32700	7.7	70	93.9	23.9	47487	16.7	3752	3.4	581	4333	3.2	2.83
30	10	45.3	24.7	5.3	31882	5.7	70.2	93.7	23.5	46631	16.5	3741	3.4	581	4321	3.2	2.87
30	8	35.8	23.5	6.5	31085	3.7	69.4	92.1	22.7	45795	16.3	3730	3.4	581	4310	3.1	2.96

Rating conditions: Voltage 230/1/60 Entering air: 70DB / 60 WB CFM = 2300 @ External static: .20 in.wc.

RH-60-HAC Cooling Mode																			
					Water	Pres.				Sens	Latent	Total	Comp	Comp.	Fan	Fan	Total	CSA	
50	4	17.7	84.7	34.9	62091	0.9	79.9	58.5	21.4	40774	22067	63600	24.6	4205	3.5	591	4796	13.3	13.1
50	6	27.0	73.6	23.8	66071	1.9	80.6	58.3	22.3	42812	23171	66780	24.9	4092	3.5	589	4681	14.3	14.0
50	8	36.3	67.8	17.6	66472	3.2	80.1	57.6	22.5	44739	24213	69786	25.1	3962	3.5	589	4551	15.3	14.9
60	4	17.9	93.9	33.5	58528	0.9	79.9	59.9	20	39550	21405	61692	25.4	4332	3.5	591	4923	12.5	12.4
60	6	27.0	82.8	22.9	62020	1.8	79.7	58.6	21.1	41528	22476	64777	25.6	4218	3.5	589	4807	13.5	13.2
60	8	36.2	77.7	17.3	63497	3.1	80.4	57.9	22.5	43397	23487	67692	25.9	3952	3.5	589	4541	14.9	14.5
70	4	17.7	102	31.8	52711	0.9	79.5	60.1	19.4	38364	20763	59842	26.2	4400	3.5	589	4989	12.0	11.9
70	6	26.7	92.3	22.1	58009	1.9	79.7	58.8	20.9	40282	21801	62834	26.4	4204	3.5	587	4791	13.1	12.9
70	8	36.3	87.1	17.1	59391	3.2	79.7	58.3	21.4	42095	22782	65661	26.7	4111	3.5	587	4698	14.0	13.6
77	4	18.6	108.5	31.3	54689	1.4	80.1	60.8	19.3	37213	20140	58046	27.0	4484	3.5	586	5070	11.4	11.3
77	6	27.3	99.1	21.6	56610	2.1	80.2	60.4	19.8	39074	21147	60949	27.2	4393	3.5	587	4980	12.2	12.0
77	8	35.6	93.6	16.8	58296	3.4	79.5	59.2	20.3	40832	22099	63691	27.5	4233	3.5	586	4819	13.2	12.8

Rating conditions: Voltage 230/1/60 Entering air: 80DB / 67 WB External static: .20 in.wc. 2300 CFM

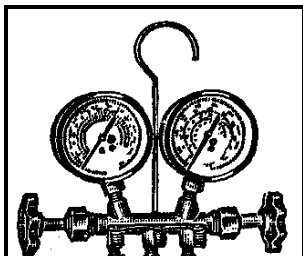
In accordance with ARI 325 and 330 standards & CAN/CSA C446-M94

NORDIC® RH-Series Trouble Shooting Guide

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

Fault	Possible Cause	Verification	Recommended Action
Compressor not operating	Open control circuit.	<ul style="list-style-type: none"> • Thermostat not calling for heat. • High or low pressure limit open. • Lock-out relay energized. 	Locate open control and determine cause. Replace faulty control if necessary.
	Compressor repeatedly locks out on it's LOW pressure safety control.	Open contacts on low pressure safety limit switch. Lock out relay energized. Water heat exchanger frozen.	Check for "low" or "no" water. Restore proper water flow. Thaw out heat exchanger.
Compressor "short cycles"	Intermittent contact in electrical control circuit.	Normal operation except too frequent starting and stopping.	Check anticipator in thermostat. Make sure setting is for "longest cycle" or max. amps.
Unit trips off on "LOW" suction pressure control.	Low water flow	Manually open water valve and measure water flow with a flowmeter.	Check well pump for proper operation. Check water valve for proper operation. Replace.
	Water supply too cold.	Measure temperature of water. Check flow rate with spec. sheet to determine if proper gpm is available.	Increase flow to proper gpm.
	Ambient air too cold.	Measure return air temp. Should be above 60°F.	Restrict air flow temporarily until room comes up to temperature.
	Faulty low pressure ctrl. Faulty low "temp" ctrl.	Refrigerant pressure control should open on drop at approx. 45 psig. Temp. ctrl. will open in about 1 minute if water flow is interrupted or if unit is run with suction pressure below 50 psig.	Both controls should reset automatically. Heat pump can then be restarted by resetting the lock-out relay. (Turn power off then back on) Replace faulty control if it will not reset.
	Low refrigerant charge.	Check water temp. and flow. Clean heat exchanger. If suction is still low check return air temp. Normal suction is 50-60 psig.	Add refrigerant slowly. Check for possible leaks.
Low or "no" air conditioning	No water flow. Unit trips out on it's high pressure limit.	Check flow with flowmeter or other method.	Check water pump operation.
	Reversing valve "stuck" in the heating mode.	Unit works well in the heating mode but there is no loud rushing sound when unit is quickly switched to cooling mode.	Check or replace valve solenoid and if necessary replace entire reversing valve assembly.

Fault	Possible Cause	Verification	Recommended Action
Low or "no" air conditioning	Open control circuit	Thermostat not set to signal operation	Turn room thermostat down.
	Reduced air flow or re-turn air temperature too cold. Unit trips out on low suction pressure control.	Check for: 1. Dirty air filter. 2. Fan belt slipping. 3. Broken blower belt. 4. Inoperative blower motor.	1. Replace filter 2. Tighten blower belt. 3. Replace belt. 4. Replace blower motor.
Insufficient hot water	Circulator pump not operating.	Visually inspect the pump to see if shaft is turning. Use an amprobe to measure current draw.	Replace if faulty.
	Blockage or restriction in the water line or hot water heat exchanger.	Check water flow and power to pump. Check water lines for obstruction	Remove obstruction in water lines. Acid treat the domestic hot water coil.
	Thermostat limit is open.	Check contact operation. Should close at 120°F and open at 140°F.	Replace thermostat if faulty.
	Disconnect switch open, or fuse blown in electrical supply to hot water tank.	Check both line and load sides of fuses. If switch is open determine why.	Replace blown fuse or breaker or close switch.
	Reset button tripped on hot water tank.	Check voltage at elements with multimeter.	Push reset button.
	Thermostat on hot water tank set too low. Should be set at 120°F.	Visually inspect the setting.	Readjust the setting to 120°F.
	Heat pump not running enough hours to make sufficient hot water.	Note the amount of time the heat pump runs in any given hour.	Temporarily turn up the tank thermostats until colder weather creates longer run cycles.

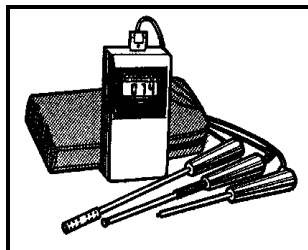


Refrigeration Gauges



In-line Flowmeter

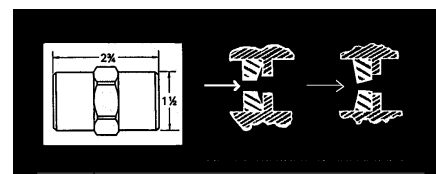
Trouble Shooting Tools



Digital Thermometer



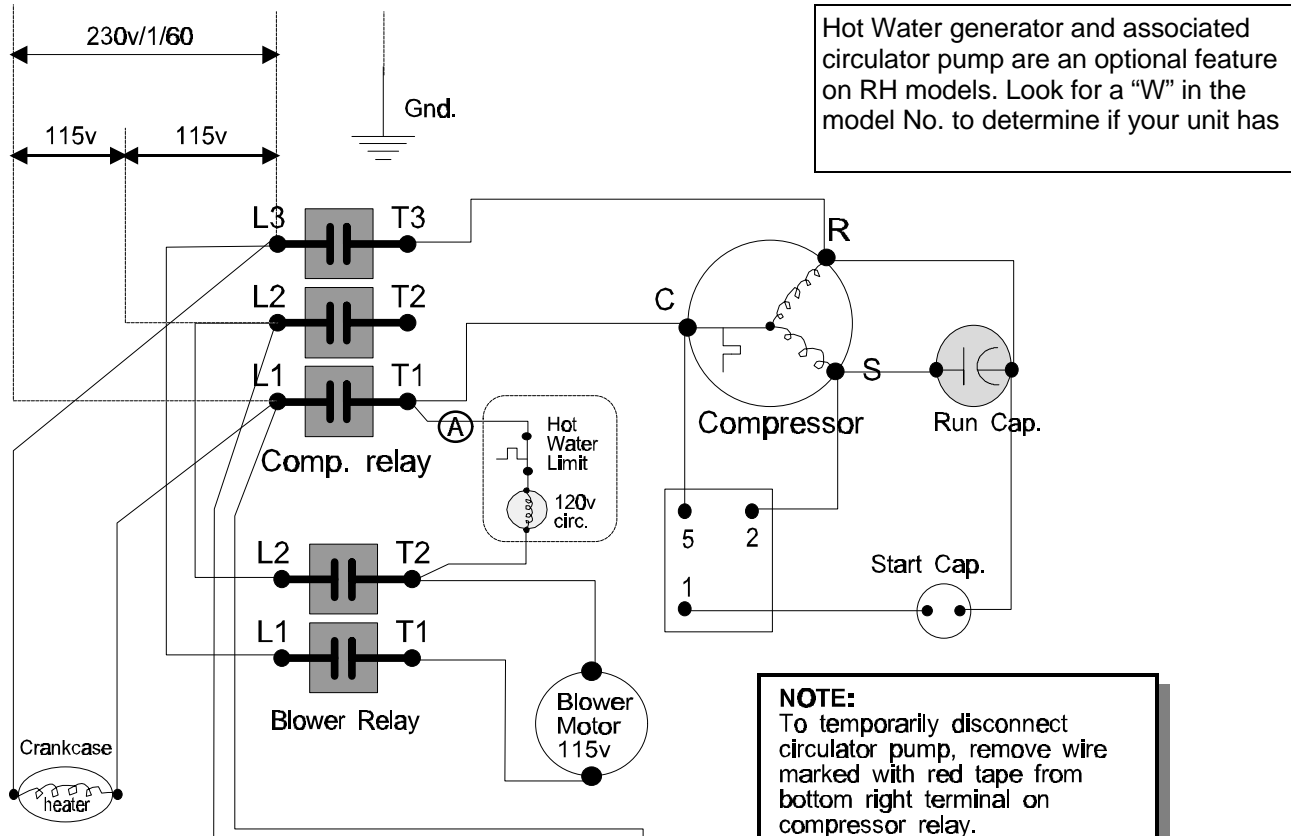
Amprobe



Dole flow control Valve

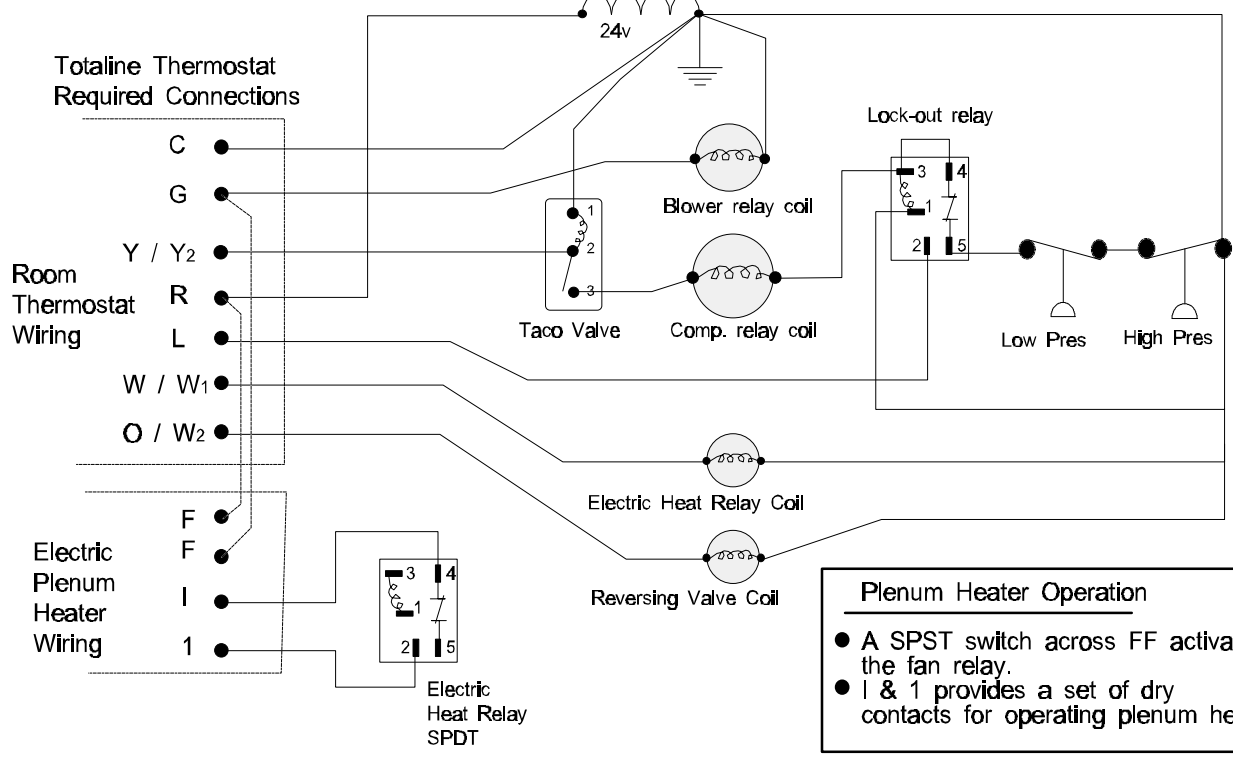
The Dole® flow control is a simple, self-cleaning device designed to deliver a constant volume of water from any outlet whether the pressure is 15 psig or as high as 125 psig. The controlling mechanism consists of a flexible orifice that varies its area inversely with pressure so that a constant flow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

NORDIC® "RH" Series - Schematic Wiring Diagram



Hot Water generator and associated circulator pump are an optional feature on RH models. Look for a "W" in the model No. to determine if your unit has

NOTE:
To temporarily disconnect circulator pump, remove wire marked with red tape from bottom right terminal on compressor relay. Marked "A" on diagram at left.

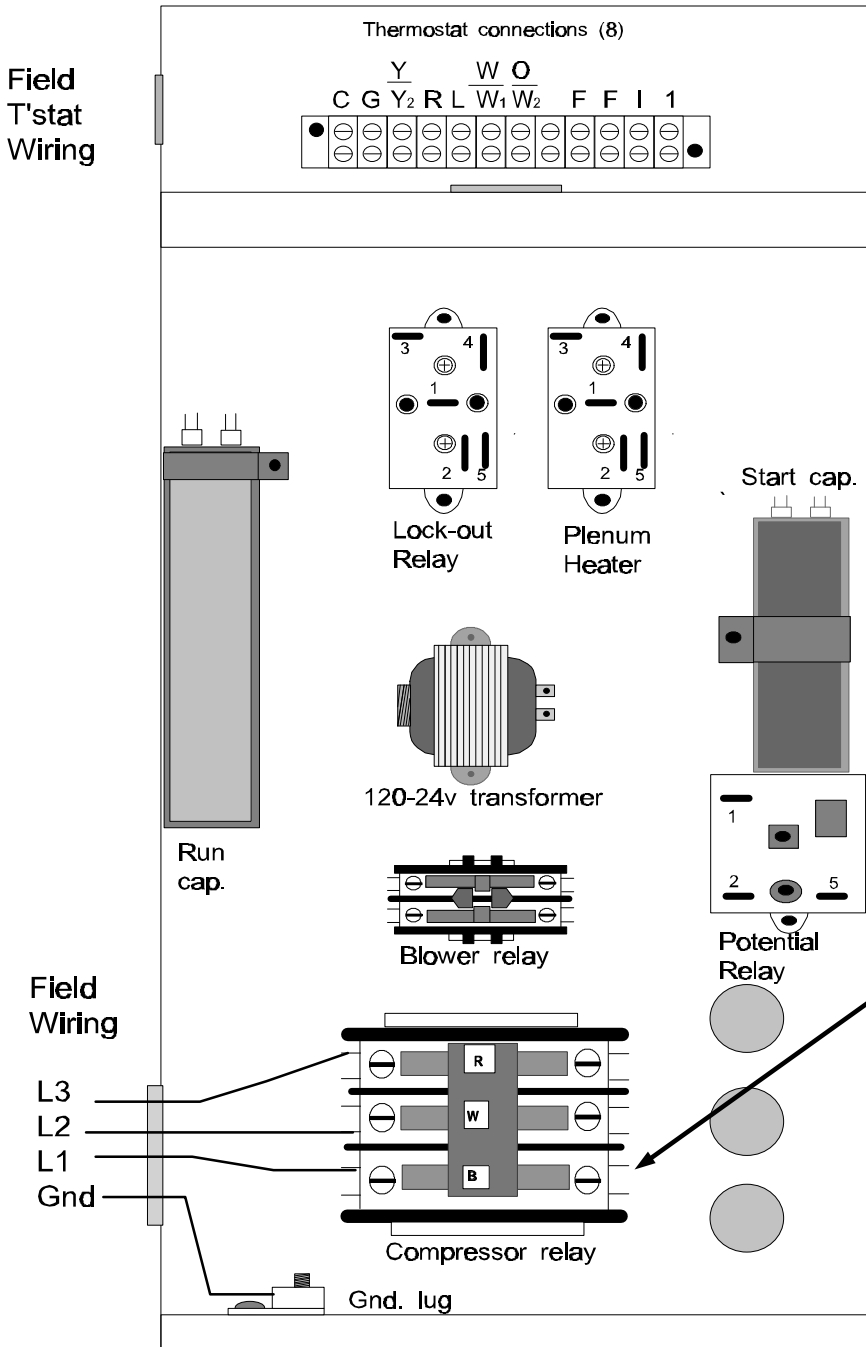


Plenum Heater Operation

- A SPST switch across FF activates the fan relay.
- I & 1 provides a set of dry contacts for operating plenum heater.

NORDIC® “RH” Series Electrical Box Connections

Electrical Box Block Wiring Diagram - Field Wiring



Low Voltage (24v) Wiring

Use an (18-8) conductor cable. Connect C,G, Y/Y₂, R, L, W/W₁, O/W₂, in terminal box to the corresponding letters on the thermostat supplied.

- C - common
- G - blower relay
- Y/Y₂ - compressor
- R - 24v hot supply
- L - compressor lock-out light
- O/W₂ - reversing valve
- F - Plenum Heater Fan Control (see next page for instructions)
- I - Plenum Heater Switch

(Optional) Hot Water Circulator Special Instructions

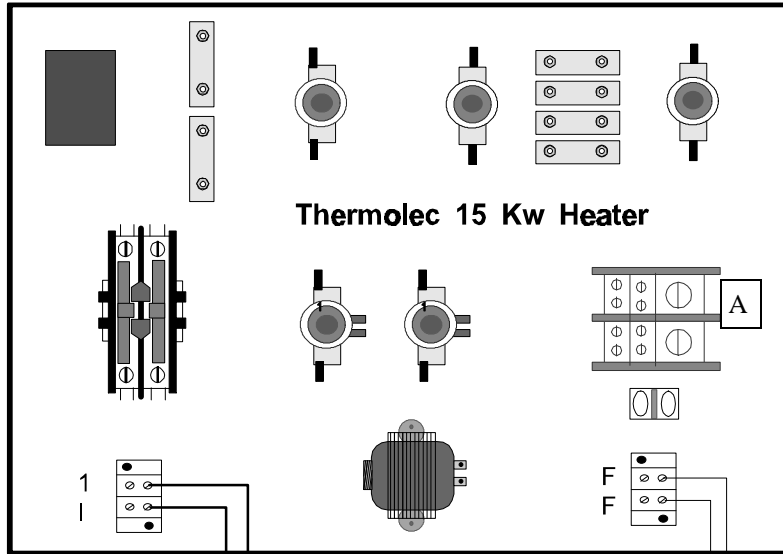
Note: If heat pump is to be operated without the hot water circulator connected to the water tank and flooded with water, remove the wire marked with **RED** tape located here. **This pump is water lubricated and must not be run dry.**

230/115v / 1 / 60 connections

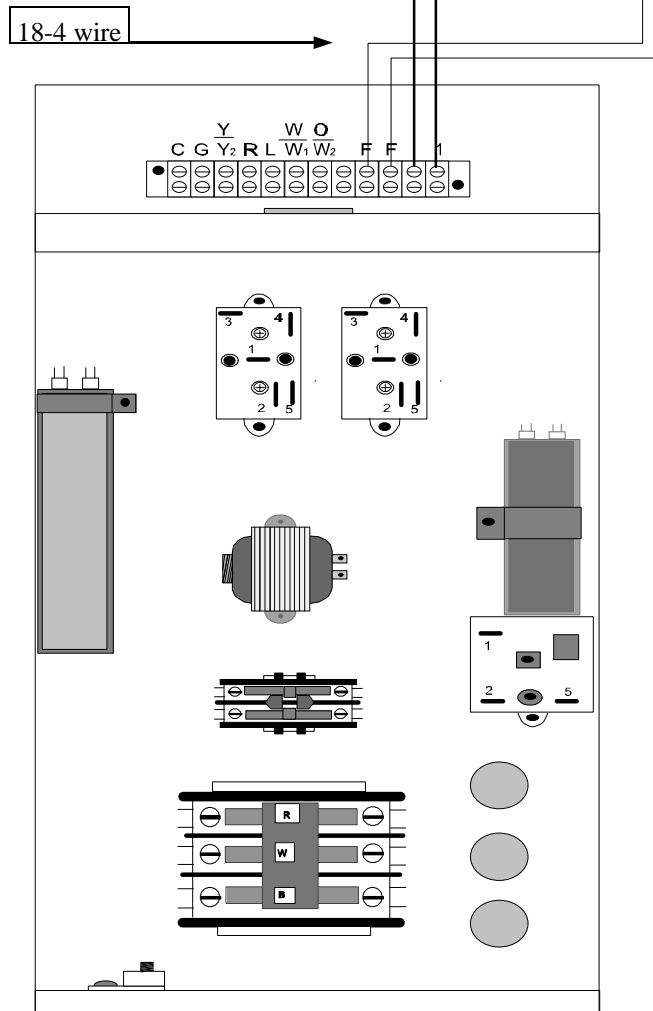
- Wire to lugs on compressor relay:
- Connect L3 to (Black)
 - Connect L2 to (White) neutral
 - Connect L1 to (Red)
 - Connect GND to GND lug.

Heat Pump Electrical Service Requirements - 230v / Ph / 60Hz.					15 KW
Model	Minimum Circuit Ampacity	Recommended Wire Size	TD Fuse or Breaker	Thermostat Wire	Plenum Heater 230 / 1 / 60
RH-42	25	8-3	40	18-8	61.5 Amps
RH-48	31	8-3	50	18-8	@ 230 v AC
RH-60	35	6-3	60	18-8	

NORDIC® Thermolec® Plenum Heater Connections



- ### Electrical Connection to a NORDIC® Heat Pump
1. Connect the proper electrical supply with a suitable breaker to the main terminal block shown. ("A" at left)
 2. Using 2 conductors in a length of 18-4 thermostat wire, Connect "T" and "1" in the control section of the heat pump's electrical box to "T" and "1" terminal strip in the plenum heater as shown.
 3. Using the remaining 2 conductors, connect "F" and "F" in the heat pump's electrical box to "F" and "F" in the plenum heater.



Thermostat Operation

The NORDIC® heat pump comes supplied with a 2-stage heating / 1-stage cooling, auto change-over, digital thermostat. The heat pump is already prewired for this stat and requires only the connections mentioned above for full operation.

The thermostat operates the heat pump as the first stage of heat bringing the electric backup on only if required. There is a 2° differential between the first and second stage of heat. The thermostat automatically changes between heating and cooling as required by the building.

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

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

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

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

This warranty is subject to the following conditions:

1. The NORDIC® heat pump must be properly installed and maintained in accordance with MARITIME Geothermal LTD.'s installation and maintenance instructions.
2. The installer must complete the “**Installation Data Sheet**”, have it endorsed by the owner and return it to Maritime Geothermal Ltd. within 21 days after the installation of the unit.
3. It is the responsibility of the building or general contractor to supply temporary heat to the structure prior to occupancy. These heat pumps are designed to provide heat only to the completely finished and insulated structure. Start-up of the unit shall not be scheduled prior to completion of construction and final duct installation for validation of this warranty.
4. It is the customer's responsibility to supply the proper quantity and quality of water.

If the heat pump, manufactured by MARITIME GEOTHERMAL LTD. fails to conform to this warranty, MARITIME GEOTHERMAL LTD. 's sole and exclusive liability shall be, at it's option, to repair or replace any part or component which is returned by the customer during the applicable warranty period set forth above, provided that (1) MARITIME Geothermal LTD. is promptly notified in writing upon discovery by the customer that such part or component fails to conform to this warranty. (2) The customer returns such part or component to MARITIME GEOTHERMAL LTD., transportation charges prepaid, within (30) thirty days of failure, and (3) MARITIME GEOTHERMAL LTD. 's examination of such component shall disclose to it's sat-