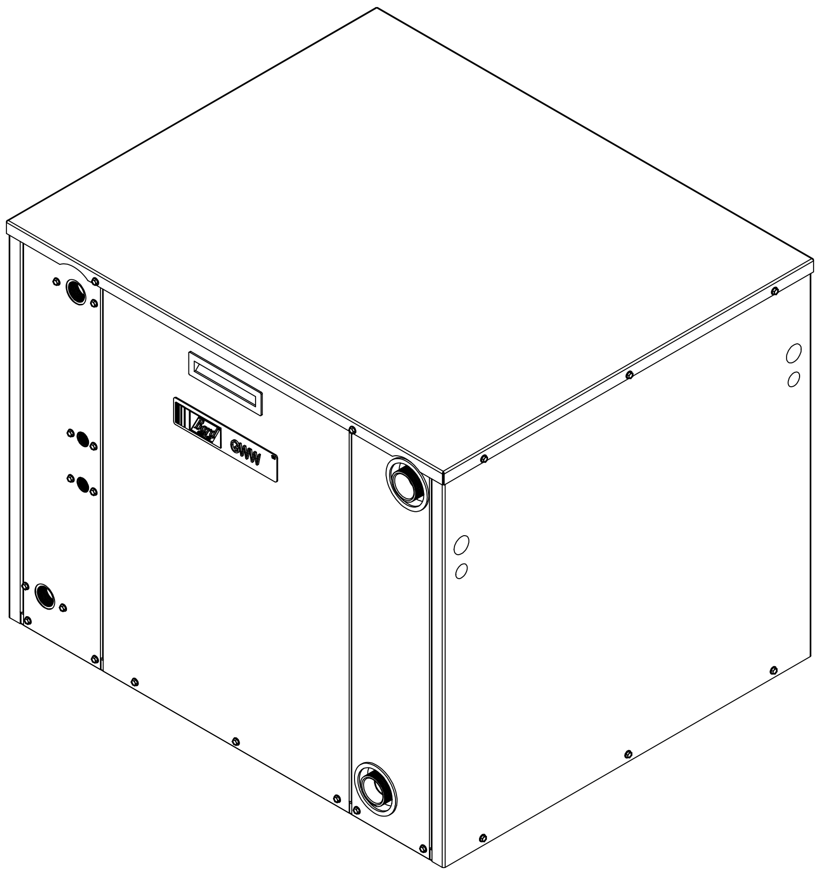
INSTALLATION INSTRUCTIONS

Water-to-Water Geothermal Heat Pump

Models:

GW024 GW036 GW048
GW060 GW070



MIS-3159

Earth Loop Fluid Temperatures 25° - 110°F
Ground Water Fluid Temperatures 45° - 75°

NOTE: MODELS COVERED BY THIS INSTALLATION MANUAL ARE <u>NOT</u> FOR USE AS A POOL HEATER OR IN MARINE APPLICATIONS

BMC, Inc.
Bryan, Ohio 43506

Manual:	2100-583A
Supersedes:	2100-583
File:	Volume 1, Tab 8
Date:	07-11-13

CONTENTS

GETTING OTHER INFORMATION AND PUBLICATIONS

These publications can help you install the air conditioner or heat pump. You can usually find these at your local library or purchase them directly from the publisher. Be sure to consult current edition of each standard.

National Electrical Code .... ANSI/NFPA 70

Standard for the Installation .... ANSI/NFPA 90A
of Air Conditioning and Ventilating Systems

Standard for Warm Air .... ANSI/NFPA 90B
Heating and Air Conditioning Systems

Load Calculation for Residential ...... ACCA Manual J
Winter and Summer Air Conditioning

Duct Design for Residential .... ACCA Manual D
Winter and Summer Air Conditioning and Equipment Selection

Closed-Loop/Ground Source Heat Pump .... IGSHPA
Systems Installation Guide

Grouting Procedures for Ground-Source .... IGSHPA
Heat Pump Systems

Soil and Rock Classification for .... IGSHPA
the Design of Ground-Coupled Heat Pump Systems

Ground Source Installation Standards .... IGSHPA

Closed-Loop Geothermal Systems .... IGSHPA
– Slinky Installation Guide

Radiant Systems Design .... RPA
.... IAMPO
.... ASSE

FOR MORE INFORMATION, CONTACT THESE PUBLISHERS:

ACCA — **Air Conditioning Contractors of America**
1712 New Hampshire Avenue
Washington, DC 20009
Telephone: (202) 483-9370
Fax: (202) 234-4721

ANSI — **American National Standards Institute**
11 West Street, 13th Floor
New York, NY 10036
Telephone: (212) 642-4900
Fax: (212) 302-1286

ASHRAE — **American Society of Heating Refrigerating, and Air Conditioning Engineers, Inc.**
1791 Tullie Circle, N.E.
Atlanta, GA 30329-2305
Telephone: (404) 636-8400
Fax: (404) 321-5478

NFPA — **National Fire Protection Association**
Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9901
Telephone: (800) 344-3555
Fax: (617) 984-7057

IGSHPA — **International Ground Source Heat Pump Association**
490 Cordell South
Stillwater, OK 74078-8018

Radiant Professionals Association
www.radiantprofessionalsalliance.org

IAPMO
www.iampo.org

American Society of Sanitary Engineering
www.asse-plumbing.org

World of Plumbing Council
www.worldplumbing.org

EPA WaterSense Partner
www.epa.gov/watersense

American Society of Mechanical Engineers
www.asme.org

NSF International
www.nsf.org

United Association (Union of Plumbers, Fitters, Welders & HVAC Service Techs.
www.ua.org

GEO WATER-TO-WATER HEAT PUMP MODEL NUMBER NOMENCLATURE

G W 048 1 S 1 — A X R C C X

- **G** — Geothermal
- **W** — Water-to-Water
- **048** — **Capacity MBTUH**
  - 024
  - 036
  - 048
  - 060
  - 070
- **1** — No. of Compressors
- **S** — **Compressor Type**
  - S = Step Capacity
- **1** — Revision Level
- **A** — **Voltage**
  - A = 230/208-60-1
- **X** — **Hot Water Generator Option**
  - X = No HWG
  - 1 = HWG & Pump
- **R** — **Reversible Option**
  - H = Heating Only (Phase 2 Release)
  - R = Reversible (Phase 1 Release)
- **C** — **Source Coax**
  - C = Copper (closed loop)
  - N = Cupronickel (open loop)
- **C** — **Load Coax**
  - C = Copper
- **X** — Options
  - X = None

Loop circulating pumps – Source & Load are field-installed external of the GSH unit for ease of installation, maintenance and service.

TABLE 1
RATED FLOW RATES FOR VARIOUS FLUIDS

APPLICATION	SOURCE	MODEL				
		GW024	GW036	GW048	GW060	GW070
Ground Loop (15% Methanol, Propylene, Glycol, etc.	Loop Load	7 7	9 9	11 11	13 13	15 16
Ground Water	Loop Load	7 7	9 9	11 11	13 13	15 16

TABLE 2
ELECTRICAL SPECIFICATIONS

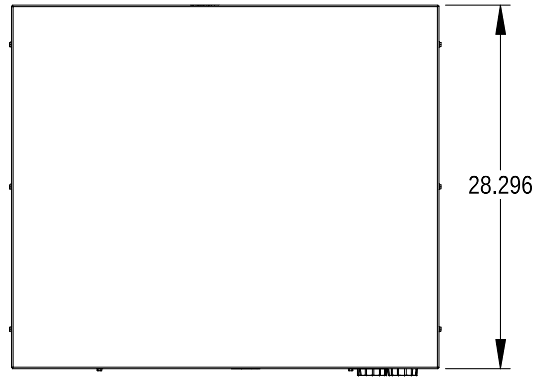
MODEL	GW024	GW036	GW048	GW060	GW070
Electrical Ratings (Volts/Hz/Phase)	208/230-60-1				
Operating Voltage Range	253-197 VAC				
Minimum Circuit Ampacity	16.9	21.4	28.8	36.1	39.4
+Field Wire Size	10	8	6	6	6
Ground Wire Size	12	12	10	10	10
++Delay Fuse of Circuit Breaker Max.	25	35	50	60	60
COMPRESSOR					
Volts	208/230-60-1				
Rated Load Amps (230/208)	8.2 / 9.2	12.2 / 14.0	17.6 / 20.3	21.8 / 24.1	29 / 32
Branch Circuit Selection Current	11.7	15.3	21.2	27.1	29.7
Locked Rotor Amps (230/208)	58.3	83.0	104.0	152.9	179.2
Flow Center (Based upon DORFC-2)					
Volts	208/230-60-1				
Amps	2.14				
Desuperheat Pump Motor					
Volts	208/230-60-1				
Amps	0.15				

+75°C copper wire ++ HACR type circuit breaker

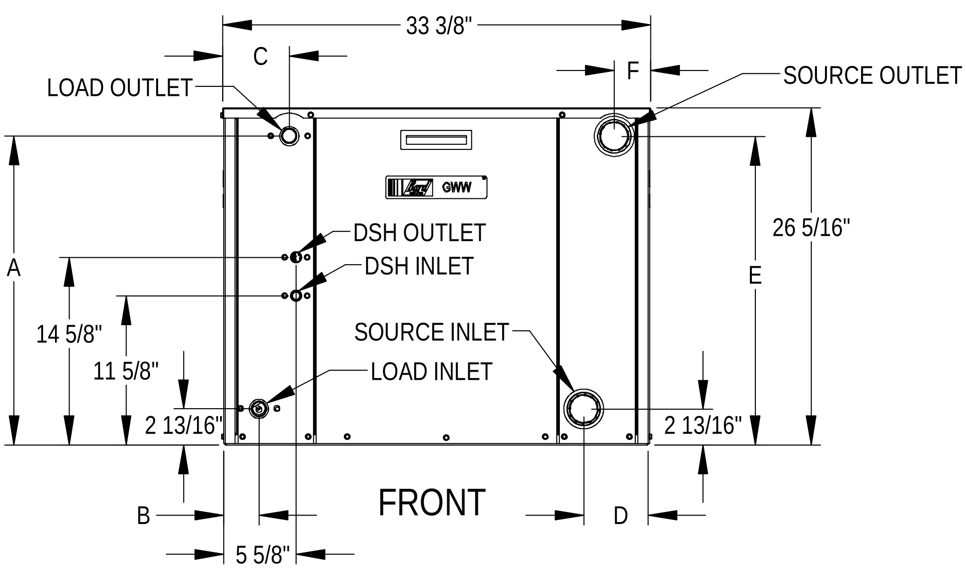
TABLE 3
SOURCE SIDE WATER COIL PRESSURE DROPS
(Based upon 15% Methanol in Heating Mode @ 50°F)

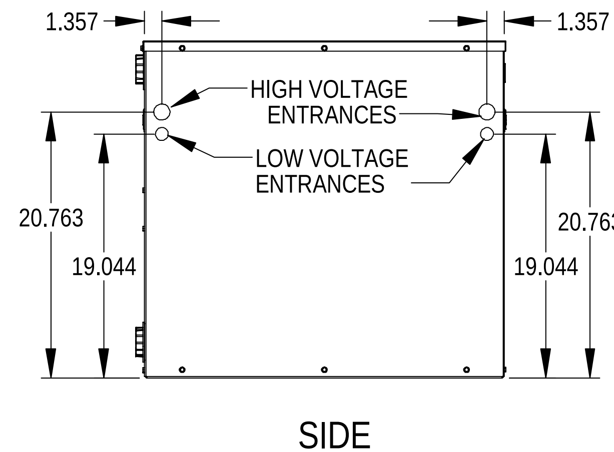
Model	GW024		GW036		GW048		GW060		GW070	
GPM	PSID	Ft. Hd.	PSID	Ft. Hd.	PSID	Ft. Hd.	PSID	Ft. Hd.	PSID	Ft. Hd.
4	.93	2.15								
5	1.55	3.58	1.57	3.62						
6	2.17	5.01	2.19	5.05	1.63	3.75				
7	2.79	6.44	2.81	6.48	2.21	5.10				
8	3.48	8.03	3.56	8.21	2.80	6.45	1.76	4.06		
9	4.17	9.62	4.31	9.94	3.38	7.80	2.20	5.08		
10		0	5.18	11.95	4.12	9.49	2.64	6.09	2.6	6.07
11			6.05	13.96	4.85	11.19	3.08	7.11	3.1	7.17
12					5.70	13.15	3.58	8.25	3.6	8.28
13					6.55	15.11	4.07	9.39	4.1	9.39
14							4.63	10.67	4.6	10.58
15							5.18	11.95	5.1	11.77
16							5.74	13.23	5.7	13.12
17									6.3	14.46
18									6.9	15.81

FIGURE 1 – UNIT DIMENSIONS



UNIT	A	B	C	D	E	F
GW024	19 1/2"	3 1/2"	5 3/8"	5 1/2"	19 7/16"	3 9/16"
GW036	19 1/2"	3 1/2"	5 3/8"	5 1/2"	19 7/16"	3 1/2"
GW048	20 5/16"	3 1/2"	5 5/16"	5 7/16"	20 5/16"	3 11/16"
GW060	21 3/8"	2 3/4"	5 1/4"	5 1/8"	21 3/8"	3"
GW070	24 1/8"	2 3/4"	5 1/8"	5"	24 1/16"	2 5/8"





MIS-3160

NOTE: MODELS COVERED BY THIS INSTALLATION MANUAL ARE NOT FOR USE AS A POOL HEATER OR IN MARINE APPLICATIONS

GENERAL

Each unit is shipped internally wired, requiring both ground-source and load-side water piping, aquastat wiring, 230/208 volt AC power wiring, and optional desuperheater piping. The equipment covered in this manual is to be installed by trained, experienced service and installation technicians.

These instructions and any instructions packaged with any separate equipment required to make up the entire heat pump system should be carefully read before beginning the installation. Note particularly any tags and/or labels attached to the equipment.

While these instructions are intended as a general recommended guide, they do not in any way supercede any national and/or local codes. Authorities having jurisdiction should be consulted before the installation is made.

SHIPPING DAMAGE

Upon receipt of the equipment, the carton should be checked for external signs of shipping damage. If damage is found, the receiving party must contact the last carrier immediately, preferably in writing, requesting inspection by the carrier's agent.

APPLICATION

Capacity of the unit for a proposed installation should be based on heat loss calculations made in accordance with methods of the Air Conditioning Contractors of America. The piping systems should be installed in accordance all local, state, and federal requirements, and to the references included on Page 3 of this document.

LOCATION

The unit may be installed in a basement, closet, or utility room provided adequate service access is ensured, and equipment will not freeze.

These units are not approved for outdoor installation and therefore must be installed inside structure being conditioned. ***Do not locate in areas subject to freezing in the winter, or subject to sweating in the summer.***

Prior to setting the unit, consider ease of piping and electrical connections for the unit. Also for units which will be used with a desuperheater, consider the proximity of the unit to the water heater or storage tank. Place the unit on a solid base, preferably concrete, to minimize undesirable noise and vibration. **DO NOT** elevate the base pan on rubber or cork vibration eliminator pads as this will permit the unit base to act like a drum, transmitting objectionable noise.

UNIT STACKING

The GW-Series products are designed to allow them to be stacked up to three units high to lower the amount of installed square footage requirements. Included with unit are tie plates to secure the units together once they are stacked. Remove, then replace the bottom three (3) screws from bottom sides of the upper unit, and the top of the lower unit to apply the tie plate.

ADDITIONAL CONSIDERATION

As an additional measure of safety in regard to the structure, consider installing a drain pan with an alarm switch underneath this water-bearing equipment.

ANSI Z535.5 Definitions:

• DANGER (color RED): Indicate[s] a hazardous situation which, if not avoided, will result in death or serious injury. The signal word “DANGER” is to be limited to the most extreme situations. DANGER [signs] should not be used for property damage hazards unless personal injury risk appropriate to these levels is also involved.

• WARNING (color ORANGE): Indicate[s] a hazardous situation which, if not avoided, could result in death or serious injury. WARNING [signs] should not be used for property damage hazards unless personal injury risk appropriate to this level is also involved.

• CAUTION (color YELLOW): Indicate[s] a hazardous situation which, if not avoided, could result in minor or moderate injury. CAUTION [signs] without a safety alert symbol may be used to alert against unsafe practices that can result in property damage only.

• NOTICE (color BLUE): [this header is] preferred to address practices not related to personal injury. The safety alert symbol shall not be used with this signal word. As an alternative to “NOTICE” the word “CAUTION” without the safety alert symbol may be used to indicate a message not related to personal injury.

DANGER

BEFORE DRILLING OR DRIVING ANY SCREWS INTO CABINET, CHECK TO ENSURE SCREW WILL NOT HIT ANY INTERNAL PARTS, REFRIGERANT LINES, WATER LINES, OR ELECTRICAL WIRES/COMPONENTS.

WARNING

FAILURE TO FOLLOW THIS CAUTION MAY RESULT IN PERSONAL INJURY. USE CARE AND WEAR APPROPRIATE PROTECTIVE CLOTHING, SAFETY GLASSES AND PROTECTIVE GLOVES WHEN SERVICING UNIT AND HANDLING PARTS.

CAUTION

ALL GEOTHERMAL EQUIPMENT IS DESIGNED FOR INDOOR INSTALLATION ONLY. DO NOT INSTALL OR STORE UNIT IN A CORROSIVE ENVIRONMENT OR IN A LOCATION WHERE TEMPERATURE AND HUMIDITY ARE SUBJECT TO EXTREMES. EQUIPMENT IS NOT CERTIFIED FOR OUTDOOR APPLICATIONS. SUCH INSTALLATION WILL VOID ALL WARRANTIES.

NOTICE

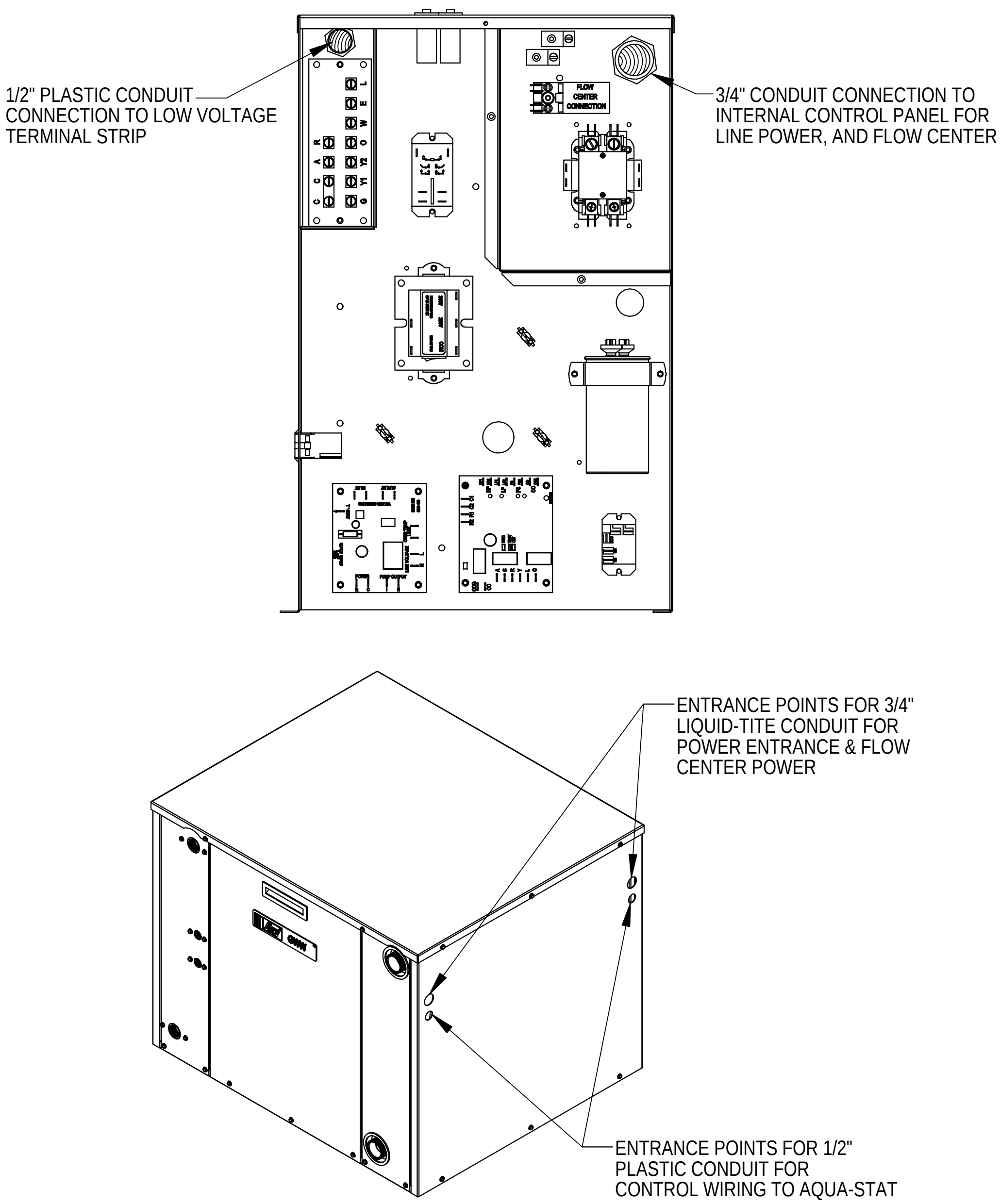
HIGH VOLTAGE LINE SUPPLY

Supplied with the unit is an adequate length of ¾" liquid-tite conduit and fittings to run internally within the sheet metal chassis from the control panel to one of four (4) 1⅛" holes in the chassis sides (front/rear corners) for line voltage wires to be ran through. See Figures 2 & 4.

LOW VOLTAGE CONTROL WIRES

Supplied with the unit is an adequate length of ½" plastic conduit and fittings to run internally within the sheet metal chassis from the low voltage box to one of four (4) ⅞" holes in the chassis sides (front/rear corners) for thermostat wires to be ran through. See Figures 2 & 4.

FIGURE 2
WIRE ROUTING TO CONTROL PANEL



RELOCATABLE CONTROL PANEL

The control panel of the GW-Series products can be relocated to best suit the installation. It is factory shipped where the control panel is located on the same side of the unit the water connections are located. *NOTE: the control panel can be moved to the rear of the unit opposite to where the water connections are located.* See Figure 3.

1. Remove both front and rear service panels.
2. Remove control panel cover.
3. Remove four (4) screws securing control panel to unit base.
4. Lift and turn control panel sideways guiding it along the right side of the compressor toward the rear of the unit.
5. Re-secure to unit base at new location.

FIGURE 3
CHANGING WATER ENTRANCE LOCATION (FRONT TO REAR)
BY RELOCATING CONTROL PANEL

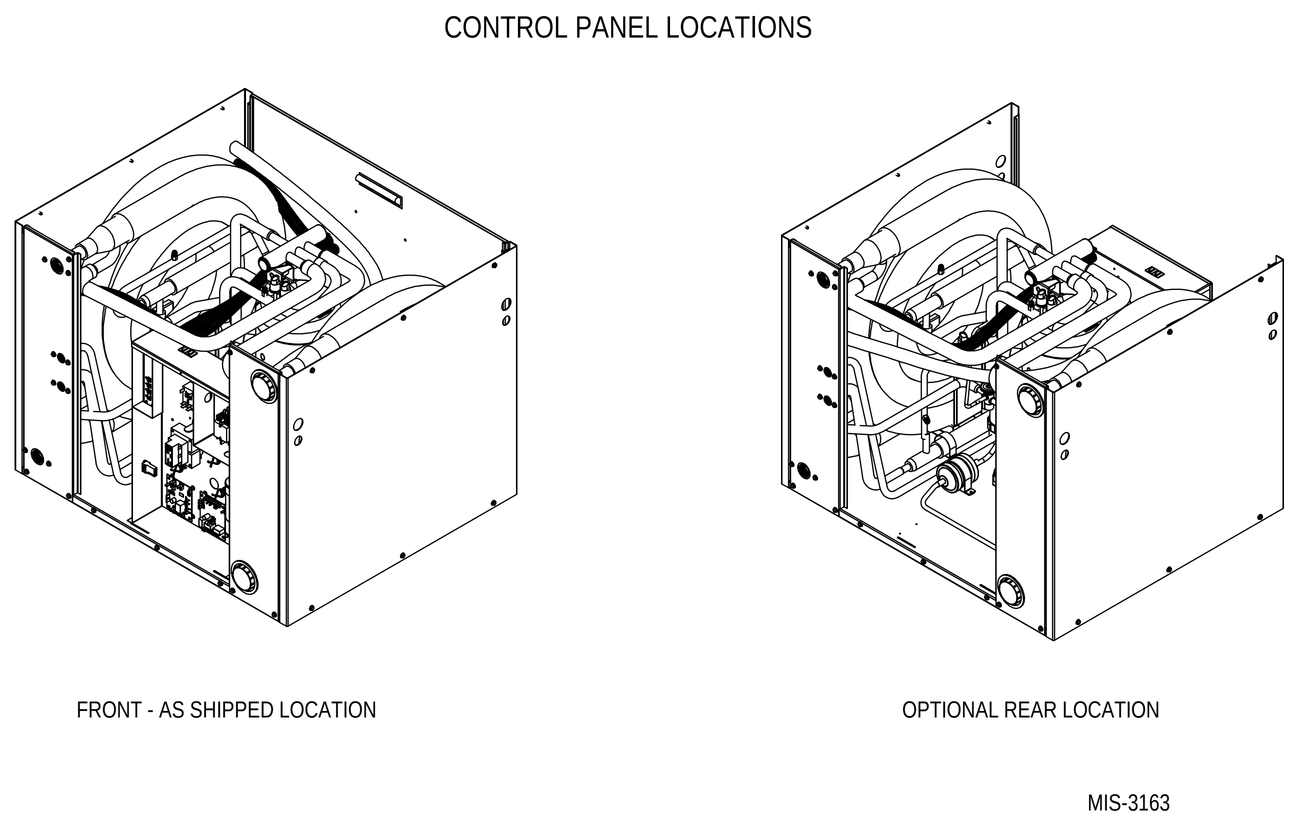
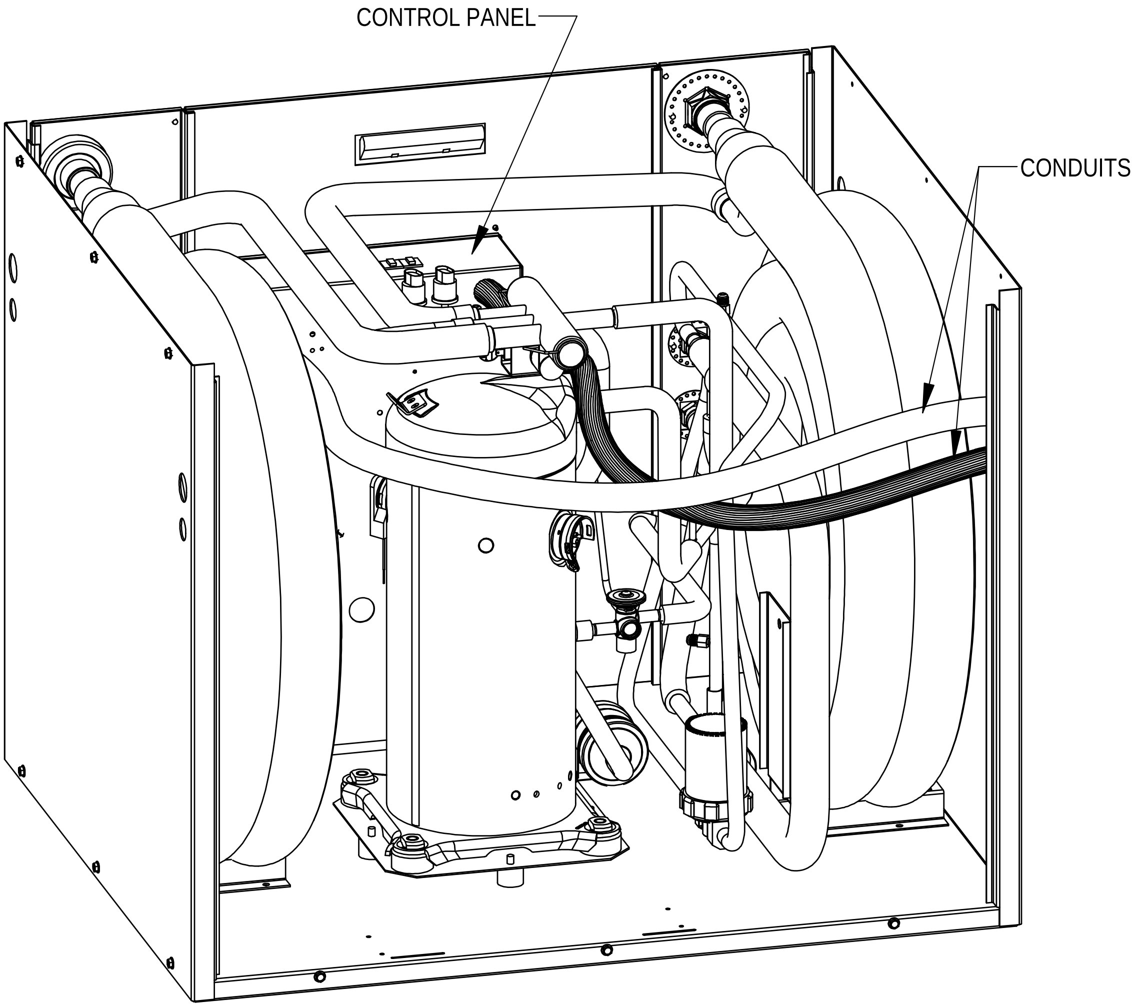


FIGURE 4
WIRE ENTRANCE CONDUITS



The GW-Series Geothermal Water-to-Water Heat Pumps contain 2-stage compressors. This will need to be thought through in planning and ordering the Aquastat control.

The two-stage compressor will not necessarily affect the net water temperature, but can give great benefit of reducing the required number of compressor cycles, especially under lower-load conditions.

In selecting the Aquastat, and depending upon the particular installation, there are different ways to utilize this.

1. Select an Aquastat with an outdoor temperature sensor, and program the Aquastat to only energize the “Y2” signal when outdoor temperatures fall below a certain level.
2. Program a length of time to offset Stage #2 being energized following Stage #1 call. This will increase system run time/thermal consistency, and minimize the start/stop cycles on the compressor, and minimize short cycling.
3. Program the Aquastat to only energize “Y2” when temperature of water cannot be held or increased with only “Y1” energized (only bring on “Y2” with further temperature fall).
4. A jumper can be installed from “Y1” to “Y2” changing the system to a single stage system. However, this is not recommended for longevity of equipment service life or energy efficiency.

WIRING – LOW VOLTAGE WIRING

UNIT MAIN POWER WIRING

This equipment requires a nominal 208/230-60-1 power supply for proper operation. Line voltage connections are made at the compressor contactor as noted by the wiring diagram. Unit main power will route into the control panel to the contactor through the supplied 3/4" Liquid Tite conduit from one of the four (4) selectable electrical entrance points.

230/208, 1-PHASE & 3-PHASE EQUIPMENT DUAL PRIMARY VOLTAGE TRANSFORMERS

All Equipment leaves the factory wired on 240 Volt transformer tap. For 208 Volt operation, reconnect from 240 Volt to 208 Volt tap. The acceptable operating voltage range for the 240V and 208V transformer taps are as noted in Table 4.

TABLE 4
OPERATING VOLTAGE RANGE

TAP	RANGE
240V	253 - 216
208V	220 - 187

NOTE: *The voltage should be measured at the field power connection point in the unit, and while the unit is operating at full load (maximum amperage operating conditions).*

For low voltage connections between the Aquastat and the geothermal heat pump, a low voltage terminal strip is factory mounted in the heat pump.

LOW VOLTAGE CONNECTIONS

These units use a grounded 24V AC low voltage circuit.

"R" terminal is 24 VAC hot.
"C" terminal is 24 VAC grounded.
"Y1" terminal is the *compressor part load input*.
"Y2" terminal is the *compressor full load input ("Y1" must also be energized along with "Y2")*.
"O" terminal is the reversing valve input. The reversing valve must be energized for cooling mode.
"A" terminal is 24 VAC output to external flow center control, or to source water solenoid coil.
"L" terminal is compressor lockout **output**. This terminal is activated on a high pressure, low pressure, or flow switch trip on the Geothermal Logic Control. This is a 24 VAC output.

LOW VOLTAGE CONNECTIONS FOR DDC CONTROLS	
Heating Part Load	Energize "Y1"
Heating Full Load	Energize "Y1", "Y2"
Cooling Part Load	Energize "Y1", "O"
Cooling Full Load	Energize "Y1", "Y2", "O"

Water Piping to and from the unit enters the unit cabinet on either the front or rear-side through the ability to relocate the control panel. See Figure 3 of the cabinet.

LOOP CONNECTIONS are a special double o-ring fitting with a retainer nut that secures it in place. (It is the same style of fitting used for the flow center connection on ground loop applications.)

NOTE: *All double o-ring fittings require "hand tightening only". Do not use a wrench or pliers as retainer nut can be damaged with excessive force.*

NOTE: *Apply provided petroleum jelly to o-rings to prevent damage and to aid in insertion.*

Various fittings are available so you may then connect to the unit with various materials and methods. These methods include 1" barbed fitting (straight and 90°), 1" MPT (straight and 90°), and 1-14" hot fusion fitting (straight only). See Product Specification Sheet.

LOAD CONNECTIONS are standard 1" Female Pipe Thread allowing for any standard 1" Male Pipe Threaded fittings to be utilized to make the connection.

DESUPERHEATER CONNECTIONS are standard ½" Female Pipe Thread allowing for any standard ½" Male Pipe Threaded fittings to be utilized to make the connection.

LOAD SIDE WATER CONNECTIONS

The use of a buffer tank is highly recommended on the load side of the GW-Series Water-to-Water heat pumps. If heat pump sizing at all the various conditions is not perfectly matched to the load, you are likely to short cycle the refrigerant system on high or low pressure controls. Buffer tanks provide thermal mass that allows the rate of generation by the heat source to be significantly different from the rate of dissipation by the distribution system. They are an essential component in any hydronic system that uses a low thermal mass on/off heat source in combination with a multiple-zone application.

SIZING BUFFER TANKS FOR ZONED SYSTEMS

The required volume of a buffer tank depends on the rate of heat input and release, as well as the allowed temperature rise of the tank from when the heat source is turned on, to when it is turned off. The greater the tanks volume, and the wide the operating temperature differential, the longer the heat source cycle length.

The following fomula can be used to calculate the volume necessary when given a specified minimum heat source on-time, tank operating differential, and rate of heat transfer:

$$v = \frac{t \times Qheatsource}{500 \times \Delta T}$$

Where:

v = required volume of the buffer tank (gallons)

t = desired duration of the heat source's "on cycle" (minutes)

Qheatsource = heat output rate of the heat source (Btu/h)

Qload = rate of heat extraction from the tank (Btu/h)

ΔT = temperature rise of the tank from when the heat source is turned on to when it is turned off (°F).

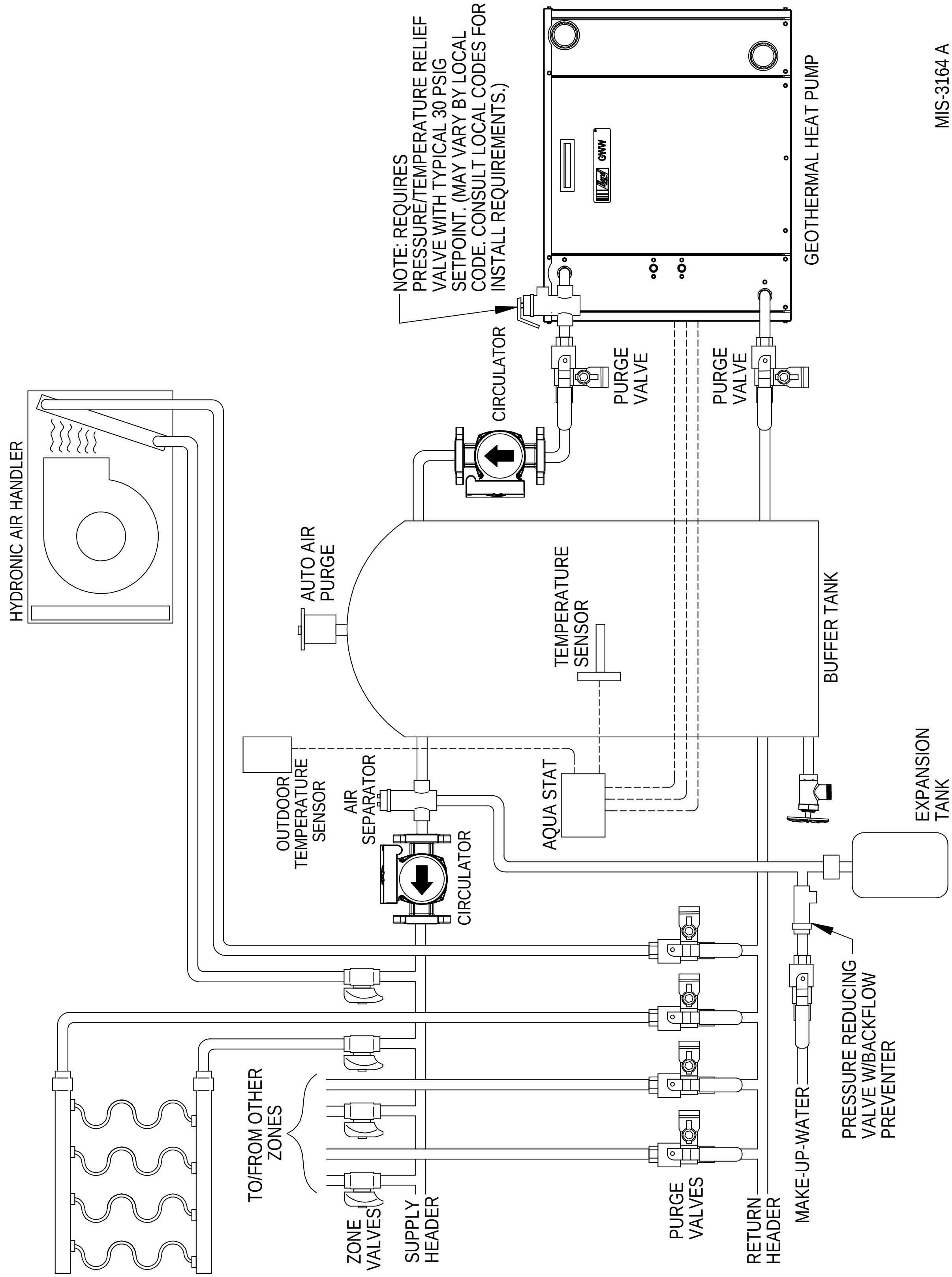
For example, assume it's desired that a heat pump operates with a minimum compressor on-cycle duration of 10 minutes. The heat pump, when on, supplies 50,000 Btu/h. The compressor turns on when the buffer tank drops to 100°F, and off when the tank reaches 120°F. What is the necessary buffer tank volume to accomplish this?

$$v = \frac{10 \times 50{,}000}{500 \times (120\text{-}100)} = 50 \textit{ gallons}$$

If a tank larger than the minimum required volume is used, the on-cycle length could be increased, or the temperature differential setpoint could be reduced

The wider the temperature differential, and the greater the volume of the tank, the longer the heat source on-cycle will be.

FIGURE 5
A TYPICAL LOAD SIDE HYDRONIC SYSTEM



GROUND LOOP (EARTH COUPLED WATER LOOP APPLICATIONS)

NOTE: ***Unit shipped from factory with 75 PSIG low pressure switch wired into control circuit and must be rewired to 55 PSIG low pressure switch for ground loop applications.*** *This unit is designed to work on earth coupled water loop systems, however, these systems operate at entering water (without antifreeze) temperature with pressures well below the pressures normally experienced in water well systems.*

THE CIRCULATION SYSTEM DESIGN

Equipment room piping design is based on years of experience with earth coupled heat pump systems. The design eliminates most causes of system failure.

The heat pump itself is rarely the cause. Most problems occur because designers and installers forget that a ground loop "earth coupled" heat pump system is NOT like a household plumbing system.

Most household water systems have more than enough water pressure either from the well pump or the municipal water system to overcome the pressure of head loss in ½ inch or ¾ inch household plumbing. A closed loop earth coupled heat pump system however, is separated from the pressure of the household supply and relies on a small, low wattage pump to circulate the water and antifreeze solution through the earth coupled heat pump and equipment room components.

The small circulator keeps the operating costs of the system to a minimum. However, the performance of the circulator MUST be closely matched with the pressure head loss of the entire system in order to provide the required flow through the heat pump. Insufficient flow through the heat exchanger is one of the most common causes of system failure. Proper system piping design and circulator selection will eliminate the problem.

FIGURE 6
CIRCULATOR SYSTEM DESIGN

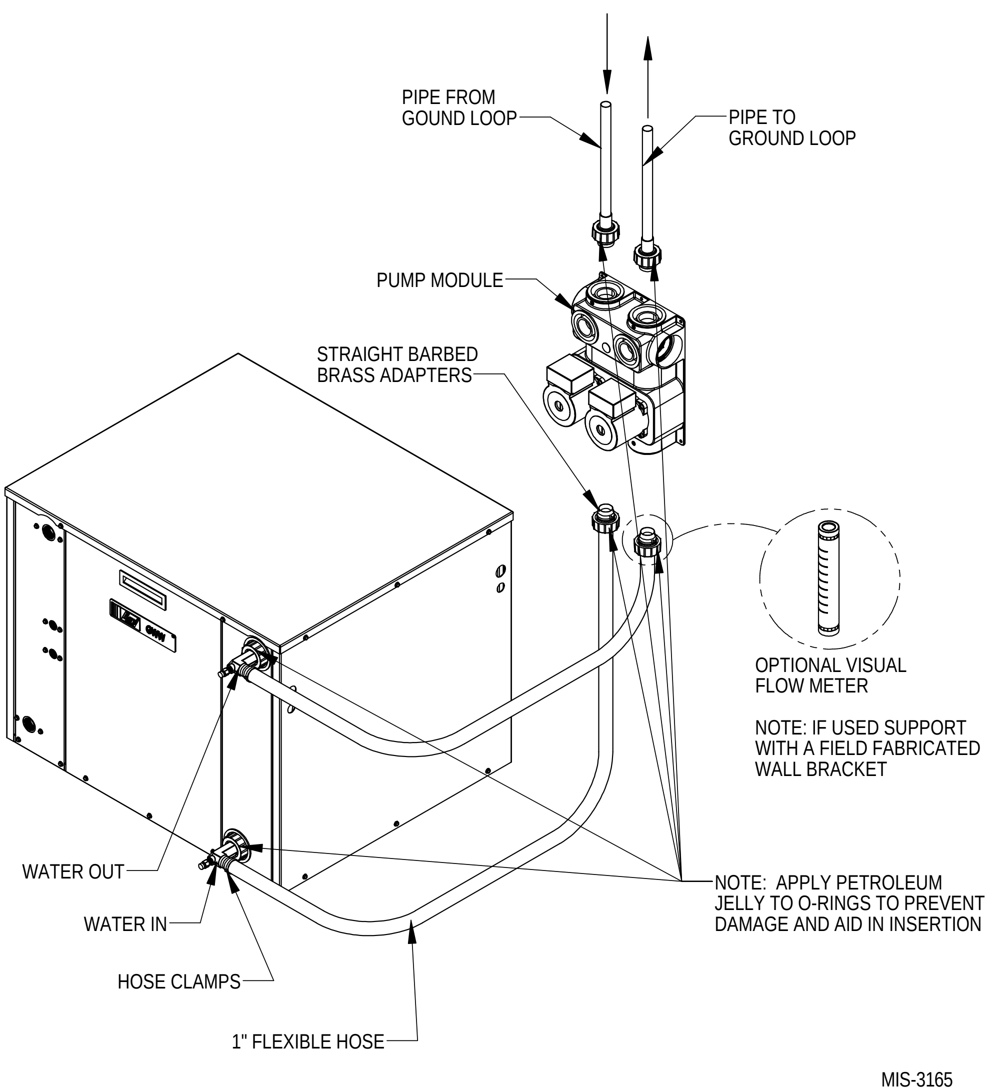


FIGURE 7A

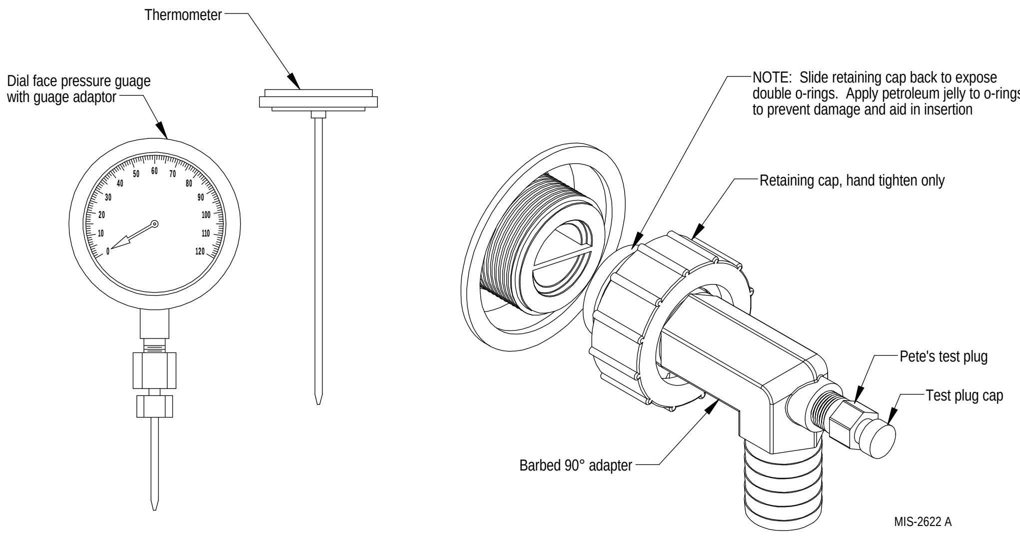


FIGURE 7B
PERFORMANCE MODEL DORFC-1 FLOW CENTER

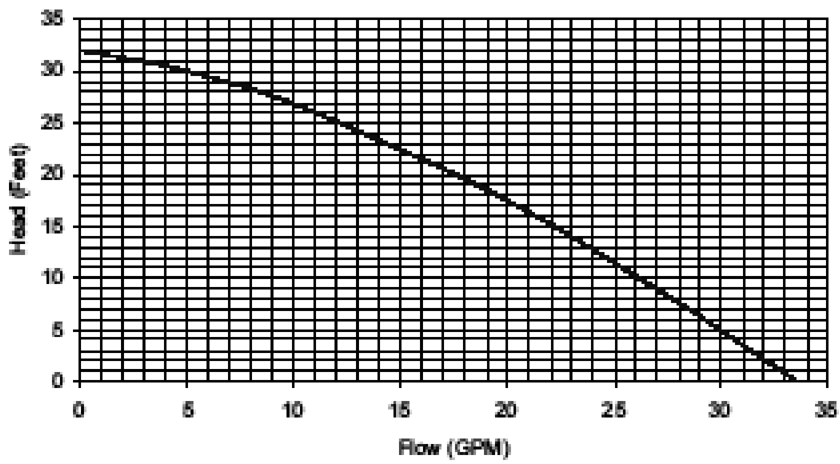
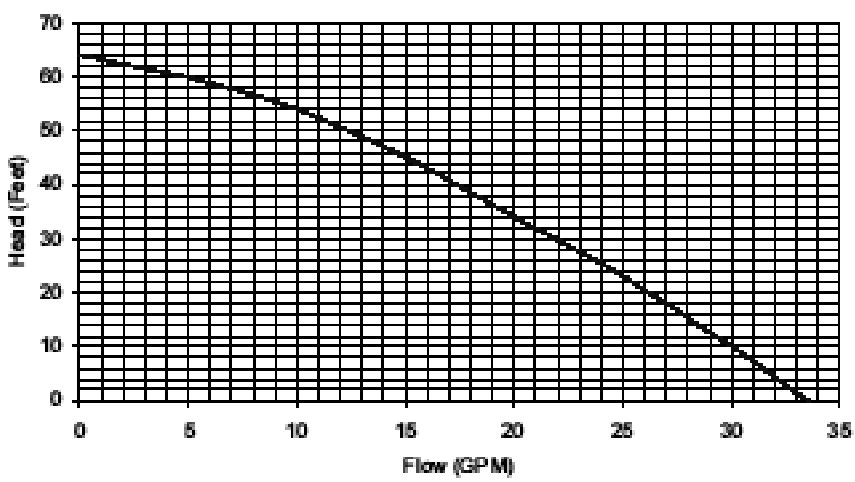


FIGURE 7C
PERFORMANCE MODEL DORFC-2 FLOW CENTER



GROUND WATER (WELL SYSTEM APPLICATIONS)

NOTE: ***It is highly recommended on ground water systems (pump & dump) that a cupronickel coaxial coil is utilized on the source side of the system. Not doing so, may void the product warranty due to aggressive/ corrosive/highly oxygenated water attacking the copper coaxial water coil.***

NOTE: ***Unit shipped from factory with 75 PSIG low pressure switch wired into control circuit for ground water applications.***

WATER CONNECTIONS

It is very important that an adequate supply of clean, non-corrosive water at the proper pressure be provided before installation is made. Insufficient water, in the heating mode for example, will cause the low pressure switch to trip, shutting down the heat pump. In assessing the capacity of the water system, it is advisable that the complete water system be evaluated to prevent possible lack of water or water pressure at various household fixtures whenever the heat pump turns on. All plumbing to and from the unit is to be installed in accordance with local plumbing codes. The use of plastic pipe, where pemissible, is recommended to prevent electrolytic corrosion of the water pipe. Because of the relatively cold temperatures encountered with well water, it is strongly recommended that the water lines connecting the unit be insulated to prevent water droplets from condensing on the pipe surface.

Refer to piping, Figure 8. Slow open/close Electrically Actuated Valve with ***End Switch*** (2), 24V, provides on/off control of the water flow to the unit. Refer to the wiring diagram for correct hookup of the valve solenoid coil.

Constant Flow Valve (3) provides correct flow of water to the unit regardless of variations in water pressure. Observe the water flow direction indicated by the arrow on the side of the valve body.

Strainer (8) installed upstream of ***water coil inlet*** to collect foreign material which would clog the flow valve orifice.

The figure shows the use of shutoff valves (4) and (5), on the in and out water lines to permit isoation of the unit from the plumbing system should future service work require this. Globe valves should not be used as shutof valves because of the excessive pressure drop inherent in the valve design. Instead, use either gate or ball valves as shutoffs, so as to minimize pressure drop.

Hose bib (6) and (7), and tees should be included to permit acid cleaning the refrigerant-to-water coil should such cleaning be required. See **WATER CORROSION**.

Hose bib (1) provides access to the system to check water flow through the constant flow valve to ensure adequate water flow through the unit. A water meter is used to check the water flow rate.

WELL PUMP SIZING

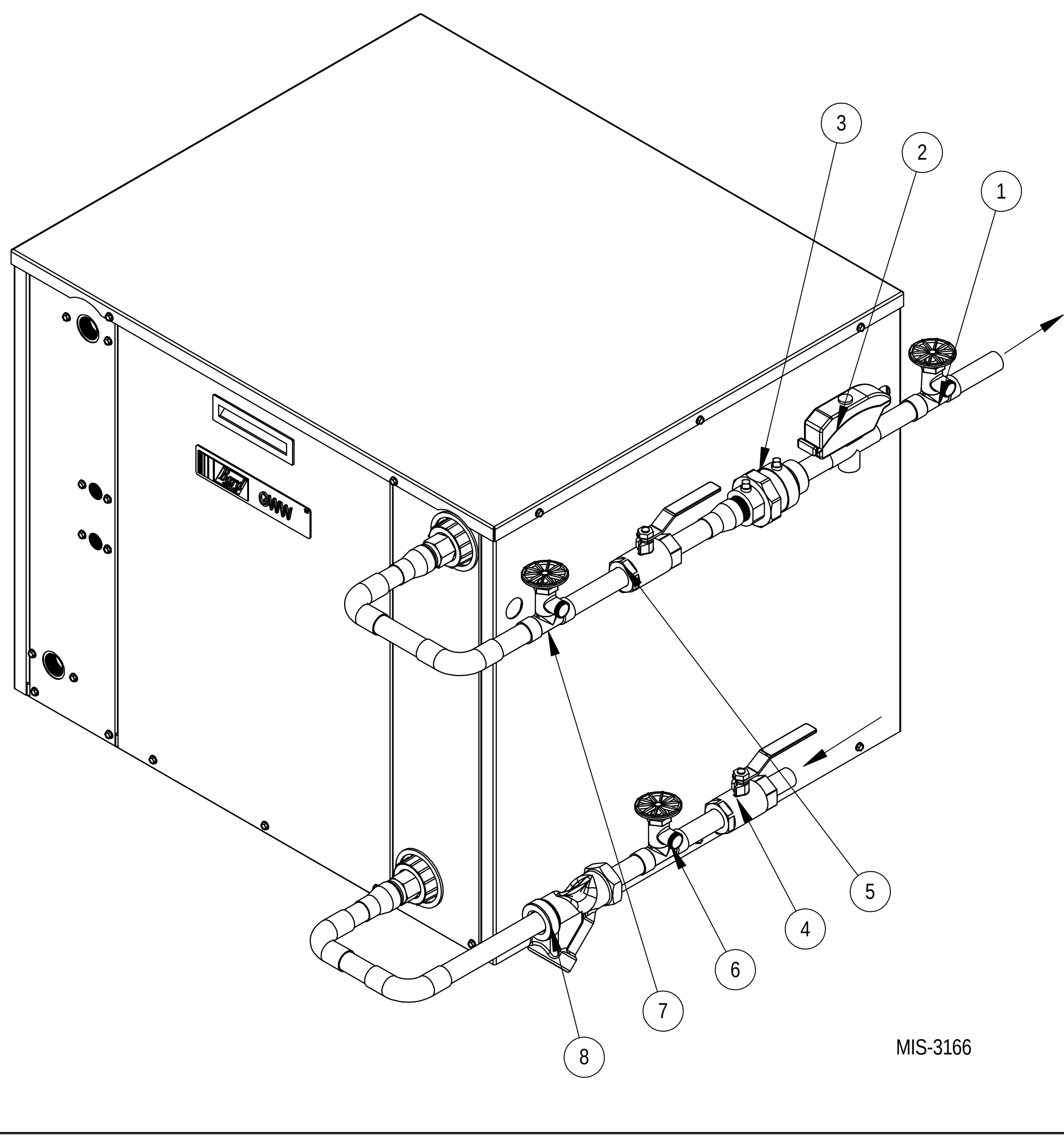
Strictly speaking, sizing the well pump is the responsibility of the well drilling contractor. It is important, however, the HVAC contractor be familiar with the factors that determine what size pump will be required. Rule of thumb estimates will invariably lead to under or oversized well pumps. Undersizing the pump will result in inadequate water to the whole plumbing system, but with especially bad results to the heat pump - NO HEAT/ NO COOL calls will result. Oversized pumps will short cycle and could cause premature pump motor or switch failures.

The well pump must be capable of supplying enough water and at an adequate pressure to meet competing demands of water fixtures. The well pump must be sized in such a way that three requirements are met:

1. Adequate flow rate in GPM.
2. Adequate pressure at the fixture.
3. Able to meet established flow rates and pressures from the depth of the well-feet of lift.

The pressure requirements put on the pump are directly affected by the diameter of pipe being used, as well as the water flow rate through the pipe. The worksheet included in Manual 2100-078 should guarantee the well pump has enough capacity. It should also ensure that the piping is not undersized, which would create too much pressure due to friction loss. High pressure losses due to undersized pipe will reduce efficiency and require larger pumps and could also create water noise problems.

FIGURE 8
WATER CONNECTION COMPONENTS



GROUND WATER (WELL SYSTEM APPLICATIONS)

SYSTEM START UP PROCEDURE FOR GROUND WATER APPLICATIONS

1. Be sure main power to the unit is OFF at disconnect.
2. Set thermostat system switch to OFF.
3. Move main power disconnect to ON. Except as required for safety while servicing – *DO NOT OPEN THE UNIT DISCONNECT SWITCH*.
4. Fully open the manual inlet & outlet valves, and manually open water solenoid valve on the source side.
5. Check water flow.
   a. Connect a water flow meter to the drain cock between the constant flow valve and the solenoid valve.
   b. Check the water flow rate through the constant flow valve and the solenoid valve. Run a hose from the flow meter to a drain or sink. Open the drain cock.
   c. When water flow is okay, close the drain cock and remove the water flow meter. The unit is now ready to start.
6. Start the unit in heating mode by switching on the Aquastat.
   a. Make sure the water solenoid valve actuated/ opened.
7. Check the system refrigerant pressures against the refrigerant pressure table located on the backside of the system service door at the corresponding source and load flow rates and enetering water temperatures. If the refrigerant pressures do not match, check for water flow issues, and then a refrigeration system problem.
8. Switch the Aquastat/thermostat to cooling mode and again verify water solenoid actuation, and refrigerant pressures.

NOTE: *If a charge problem is determined (high or low):*

A. Check for possible refrigerant loss.

B. Reclaim all remaining refrigerant.

C. Evacuate unit down to 29" of vacuum.

D. Recharge unit with refrigerant by weight to the serial plate, as this is the only way to ensure proper charge.

WATER CORROSION

Two concerns will immediately come to light when considering a water source heat pump, whether for ground water or for a ground loop application: Will there be enough water? And, how will the water quality affect the system?

Water quantity is an important consideration and one which is easily determined. The well driller must perform a pump down test on the well according to methods described by the National Well Water Association. This test, if performed correctly, will provide information on the rate of flow and on the capacity of the well. It is important to consider the overall capacity of the well when thinking about a water source heat pump because the heat pump may be required to run for extended periods of time.

The second concern, about water quality, is equally important. Generally speaking, if the water is not offensive for drinking purposes, it should pose no problem for the heat pump. The well driller or local water softening company can perform tests which will determine the chemical properties of the water.

Water quality problems will show up in the heat pump in one or more of the following ways:

- Decrease in water flow through the unit.
- Decreased heat transfer of the water coil (entering to leaving water temperature difference is less).

There are four main water qualtiy problems associated with ground water. These are:

1. **Biological Growth** This is the growth of microscopic organisms in the water and will show up as a slimy deposit throughout the water system. Shock treatment of the well is usually required and this is best left to the well driller. The treatment consists of injecting chlorine into the well casing and flushing the system until all growth is removed.

2. **Suspended Particles in the Water** Filtering will usually remove most suspended particles (fine sand, small gravel) from the water. The problem with suspended particles in the water is it will erode metal parts, pumps, heat transfer coils, etc. As long as the filter is cleaned and periodically maintained, suspended particles should pose no serious problem. Consult with your well driller.

3. **Corrosion of Metal** Corrosion of metal parts results from either highly corrosive water (acid water, generally not the case with ground water), or galvanic reaction between dissimilar metals in the presence of water. By using plastic plumbing or dielectric unions, galvanic reaction is eliminated. The use of corrosion resistant materials such as a Cupronickel Water Coil through the water system will reduce corrosion problems significantly.

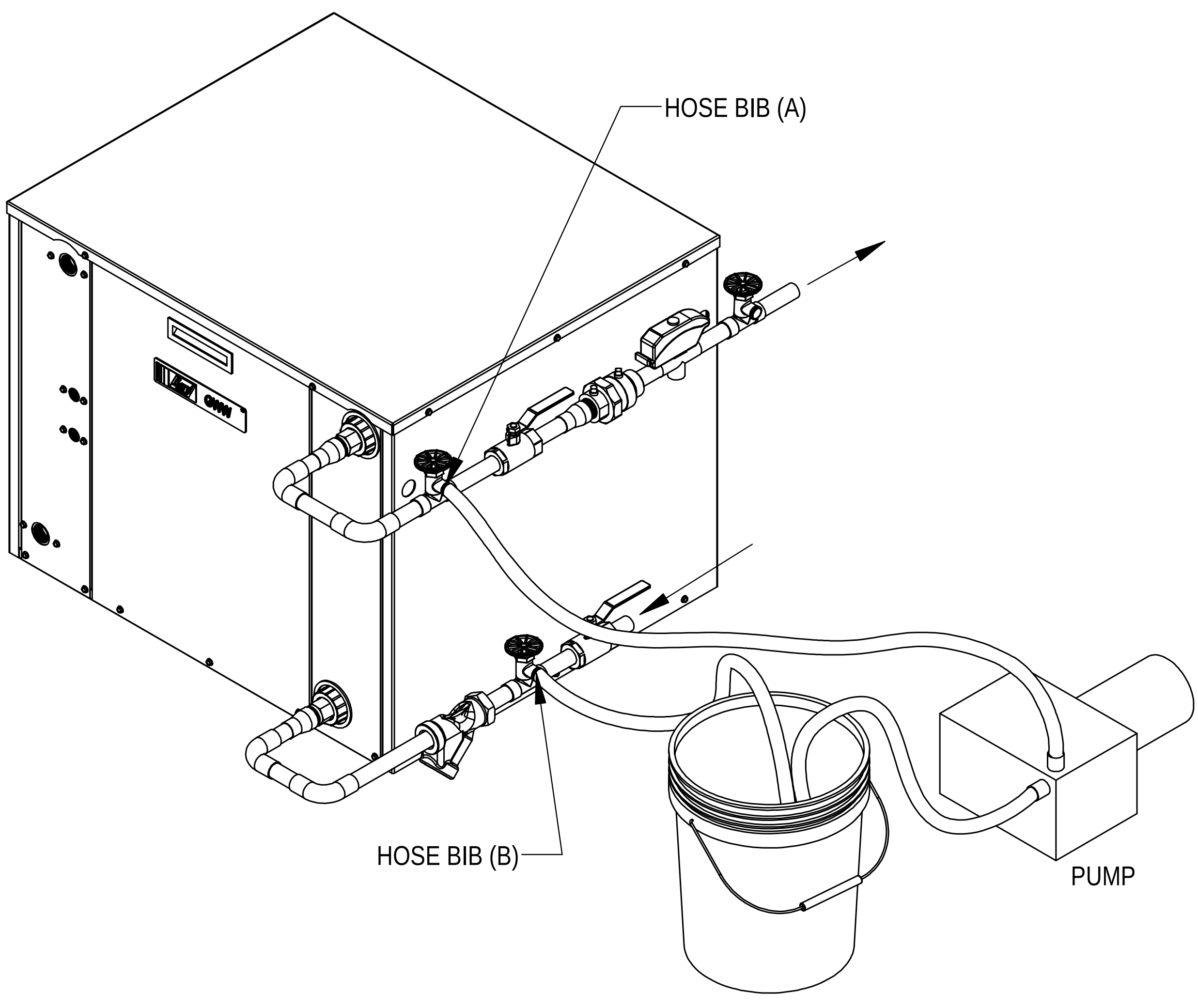
4. **Scale Formation** Of all the water problems, the formation of scale by ground water is by far the most common. Usually due to the formation of calcium carbonate, but magnesium carbonate or calcium sulfate may also be present. Carbon dioxide gas (CO_2), the carbonate of calcium and magnesium carbonate, is very soluble in water. It will remain dissoved in the water until some outside factor upsets the balance. This outside influence may be a large change in water temperature or pressure. When this happens, enough carbon dioxide gas combines with the dissolved calcium or magnesium in the water and falls out of solution until a new balance is reached. The change in temperature that this heat pump produces is usually not high enough to cause the dissoved gas to fall out of solution. Likewise, if pressure drops are kept to a reasonable level, no precipitation of carbon dioxide should occur.

REMEDIES OF WATER PROBLEMS

Water Treatment. Water treatment can usually be economically justified for water loop systems. However, because of the large amounts of water involved with a ground water system, water treatment is generally too expensive.

Acid Cleaning the Water Coil or Heat Pump Recovery Unit. If scaling of the coil is strongly suspected, the coil can be cleaned with a solution of Phosphoric Acid (food grade acid). Follow the manufacturer's directions for mixing, use, storage, etc. Refer to the "Cleaning Water Coil", Figure 9. The acid solution can be introduced in the heat pump coil through the hose bib A. Be sure the isolation valves are closed to prevent contamination of the rest of the system by the coil. The acid should be pumped from a bucket into the hose bib and returned to the bucket through the other hose bib B. Follow the manufacturer's directions for the product used as to how long the solution is to be circulated, but it is usually circulated for a period of several hours.

FIGURE 9
WATER COIL CLEANING



GROUND WATER (WELL SYSTEM APPLICATIONS)

LAKE AND POND INSTALLATIONS

Lakes and ponds can provide a low cost source of water for heating and cooling with a ground water heat pump. Direct usage of the water without some filtration is not recommended as algae and turbid water can foul the water to refrigerant heat exchanger. Instead, there have been very good results use a dry well dug next to the water line or edge. Normal procedure in installing a dry well is to backhoe a 15 to 20 foot hole adjacent to the body of water (set backhoe as close to water's edge as possible). Once excavated, a perforated plastic casing should be installed with gravel backfill placed around the casing. The gravel bed should provide adequate filtration of the water to allow good performance of the ground water heat pump.

The following is a list of recommendations to follow when installing this type of system:

A. A lake or pond should be at least 1 acre (40,000 square feet) in surface area for each 50,000 BTUs of ground water heat pump capacity or have 2 times the cubic feet size of the dwelling that you are trying to heat (includes basement if heated).

B. The average water depth should be at least 4 feet and there should be an area where the water depth is at least 12 to 15 feet deep.

C. If possible, use a submersible pump suspended in the dry well casing. Jet pumps and other types of suction pumps normally consume more electrical energy than similarly sized submersible pumps. Pipe the unit the same as a water well system.

D. Size the pump to provide necessary GPM for the ground water heat pump. A 12 GPM or greater water flow rate is required on all models when used on this type system.

E. A pressure tank should be installed in dwelling to be heated adjacent to the the ground water heat pump. A pressure switch should be installed at the tank for pump control.

F. All plumbing should be carefully sized to compensate for friction losses, etc., particularly if the pond or lake is over 200 feet from the dwelling to be heated or cooled.

G. Keep all water lines below low water level and below the frost line.

H. Most installers use 4-inch field tile (rigid plastic or corrugated) for water return to the lake or pond.

I. The drain line discharge should be located at least 100 feet from the dry well location.

J. The drain line should be installed with a slope of 2 inches per 10 feet of run to provide complete drainage of the line when the ground water heat pump is not operating. This gradient should also help prevent freezing of the discharge where the pipe terminates above the frost line.

K. Locate the discharge high enough above high water level so the water will not back up and freeze inside the drain pipe.

L. Where the local conditions prevent the use of a gravity drainage system to a lake or pond, instead run standard plastic piping out into the pond below the frost and low water level.

NOTICE

THIN ICE MAY RESULT IN THE VICINITY OF THE DISCHARGE LINE.

For complete information on water well systems and lake and pond applications, refer to Manual 2100-078 available through your distributor.

DESCRIPTION

The system is designed to heat domestic water using the heat recovered from a water source unit's hot discharge gas.

LOCATION

Because of potential damage from freezing or condensation, the unit must be located in a conditioned space, therefore the unit must be installed indoors. Locate the storage tank as close to the geothermal heat pump and pump module as the installation permits. Keep in mind that water lines should be a maximum of 25 feet long measured one way. Also, the vertical lift should not exceed 20 feet. This is to keep the pressure and heat losses to a minimum.

ELECTRICAL CONNECTION

The desuperheater logic control with the remote thermal sensors are built already hard-wired in the unit control panel (when purchased with desuperheater option). 208/230-60-1 power for the desuperheater pump is supplied with the same power as the compressor. The 24 volt signals needed are also tied in with the compressor call signals.

NOTICE

NEVER ALTER OR PLUG FACTORY INSTALLED PRESSURE RELIEF VALVE ON WATER HEATER OR AUXILIARY TANK

INSTALLATION PROCEDURE – GENERAL

Before beginning the installation, turn off all power supplies to the water heater and unit, and shut off the main water supply line.

TWO TANK – In order to realize the maximum energy savings from the heat recovery system, it is recommended that a second water storage tank be installed in addition to the main hot water heater. Fossil Fuel fired water heaters must be a two-tank installation.

Tanks specifically intended for hot water storage are available from water heater manufacturers (solar hot water storage tanks). A well insulated electric water heater without the electric heating elements will also make a suitable storage tank.

The size of the storage tank should be as large as space and economy permit but in no event should it be less than one-half of the daily water requirements for the occupants. As a guide in estimating the daily family water requirements, The Department of Energy recommends a figure of 16.07 gallons of hot water per day per individual. For example, a family of four would require 64.3 gallons per day (4 x 16.07).

ONE TANK – The single hot water tank may be a new hot water heater (sized to 100% of daily water requirements) or the existing water heater in the case of a retrofit installation. The existing water heater should be drained and flushed to remove all loose sediment. This sediment could damage the circulating pump. The bottom heating element should be disconnected.

NOTE: *Make sure water heater thermostats are set below 125°F on* ***One Tank Unit****.*

Water Piping - All water piping must adhere to all state and local codes. Refer to piping diagrams for recommended one and two tank installations. Piping connections are ½" nominal copper plumbing.

A cleanable "Y" type strainer should also be included to collect any sediment.

DESUPERHEATER (POTABLE HOT WATER ASSIST)

OPERATION OF THE HEAT RECOVERY UNIT

The pump module is a very simple device containing basic controls and a circulating pump. Heat is transferred from the hot refrigerant (discharge gas) to the cool water.

The operation of the Desuperheater Pump Module is controlled first by the operation of the Geothermal Heat Pump and secondly by internal controls with desuperheater logic control. A low voltage signal sent in tandem to the signal to energize the compressor contactor is connected to the desuperheater logic control board, and acts as the primary on/off switch for the circulating pump.

Also connected to this board is a temperature overlimit device which shuts down the desuperheater once inlet water has exceeded 125°F so the water cannot create a scald condition.

There are also two (2) thermistor sensors connected to the control board. These thermistors are measuring and controlling to ensure there is a positive heat differential across the water being circulated. When operating in Part Load Condition, there are certain conditions (source temperatures versus hot water temperatures) that potential exists where heat could transfer into the refrigeration system instead of the refrigeration system into the hot water. Through the control board logic, these thermistors ensure there is at least a 2° positive differential between entering/leaving water temperatures, and will shut down the pump accordingly.

START UP AND CHECK OUT

Be sure all shut off valves are open and all power supplies are on. Open a hot water faucet to permit any air to bleed from the plumbing.

NOTE: *The inherent design of this pump for maximum efficiency means this pump is not self-priming. It is imperative to check the air has been adequately bled from the system. There is a bleed-port built into desuperheater coil water system that should be utilized after the household water system has been fully restored. The bleed port is located on the water-tube on the top of the desuperheater exchange coil (above cooling expansion valve in the GW-Series products).*

Turn ON the heat pump system and verify the circulating pump will operate. Feel the “WATER TO UNIT” and “WATER FROM WATER HEATER” tubes for noticable difference in temperature. Turn OFF the system and verify that the circulating pump stops.

NOTE: *When checking the refrigerant operating pressures of the ground source heat pump the desuperheater must be turned off. With the desuperheater operating, a wide variance in pressure can result, giving the service technician the indication there is a charge problem when the unit is operating correctly.*

MAINTENANCE

CLEANING THE HEAT EXCHANGER – If scaling of the coil is strongly suspected, the coil can be cleaned with a solution of phosphoric acid (food grade acid or liquid ice machine cleaner {pre-mix phosphoric acid}). Follow the manufacturer’s directions for the proper mixing and use of cleaning agent.

FIGURE 10
DESUPERHEATER WIRING DIAGRAM

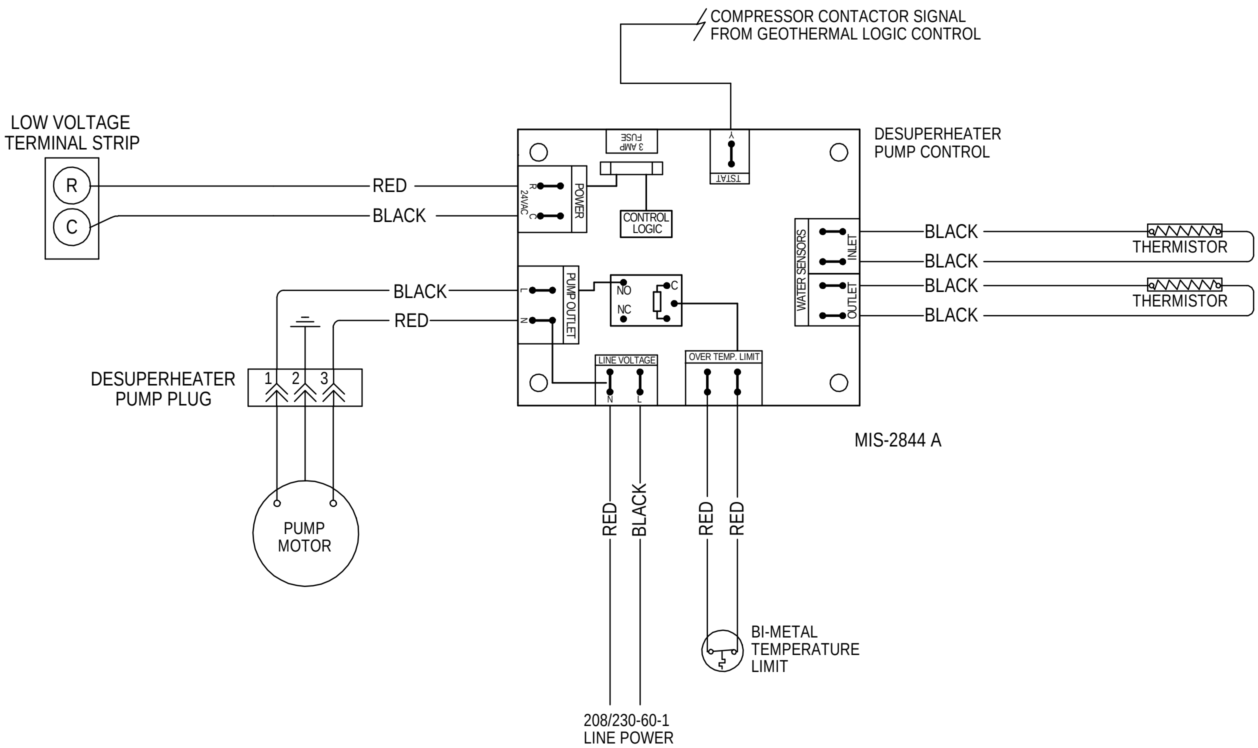


FIGURE 11
ONE-TANK DESUPERHEATER SYSTEM

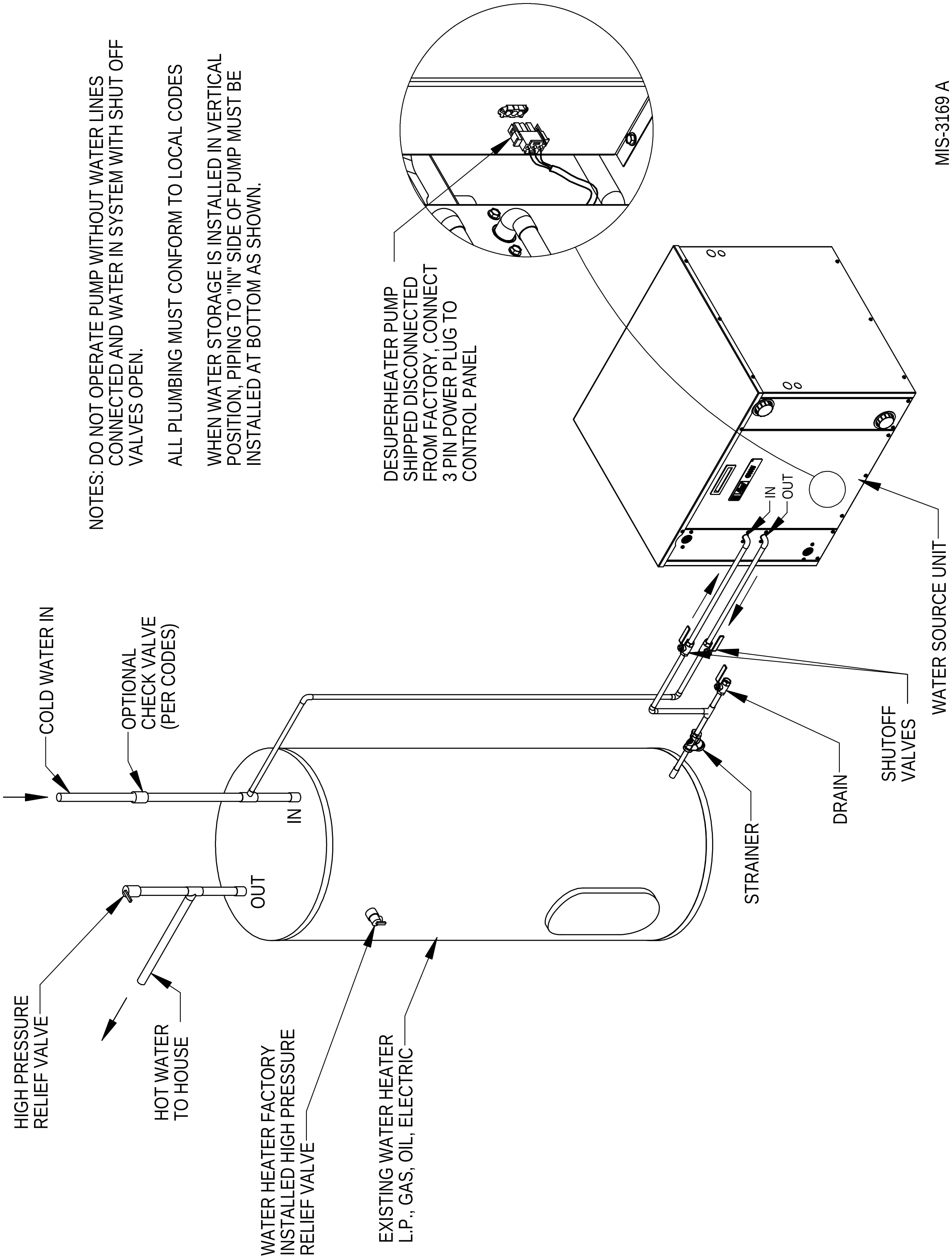
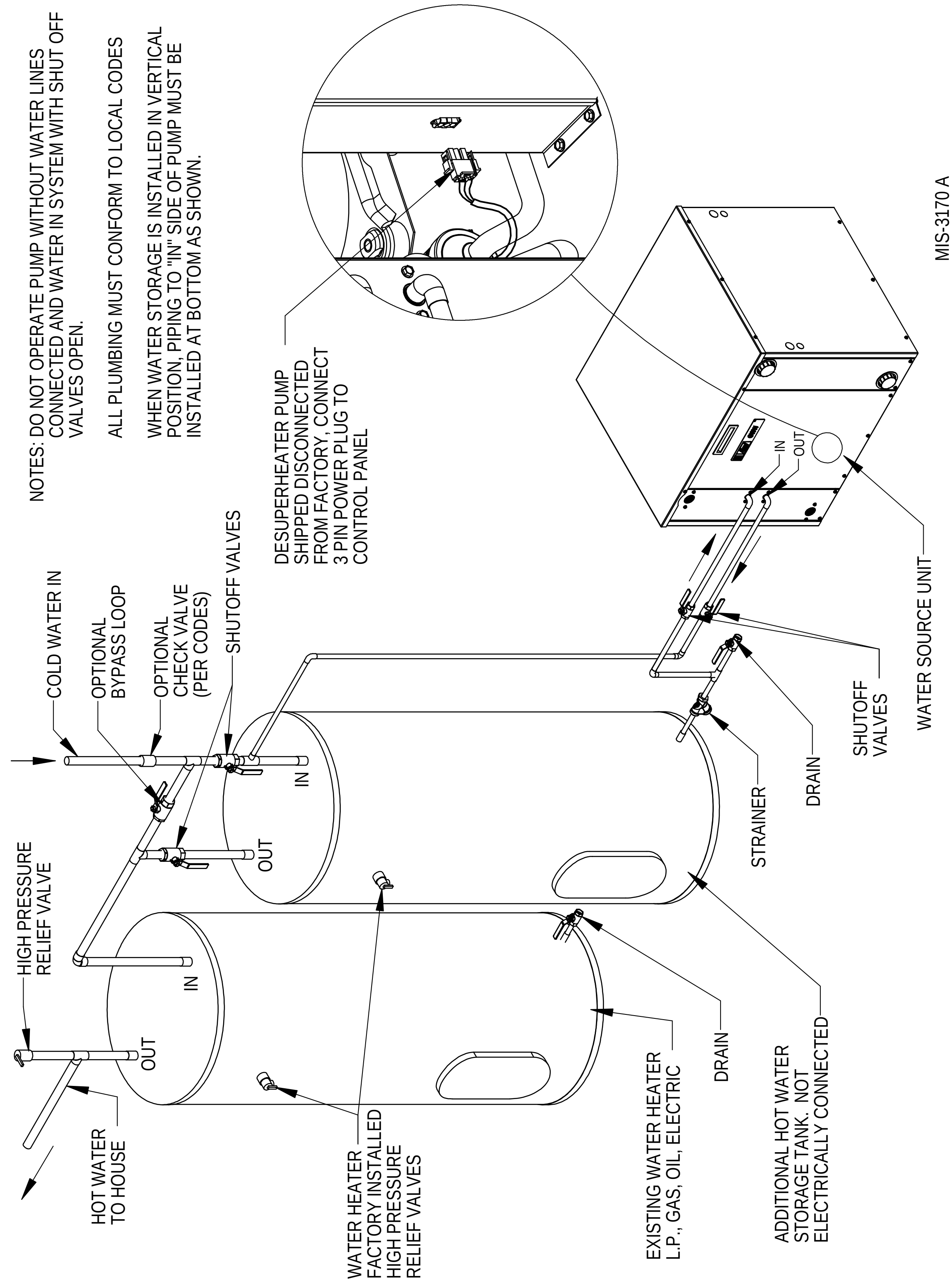


FIGURE 12
TWO-TANK DESUPERHEATER SYSTEM



DESUPERHEATER (POTABLE HOT WATER ASSIST)

DESUPERHEATER CONTROL BOARD SEQUENCE OF OPERATION

The desuperheating control board will make a determination whether or not to energize the pump relay inclusive on the control board.

A. It will constantly monitor inputs from two temperature sensors, Inlet & Outlet water sensors.

B. It will constantly monitor the "CC" Compressor Contactor Signal (only energized when compressor is operating).

C. Upon acknowledgement of "CC" signal, and following two minutes, the control board will energize the pump relay.

D. After 1½ minutes, based upon temperature difference between Outlet & Inlet sensors, and the presence of "CC" signal, the following will take place:

- If temperature difference is greater than 3°F, the control will continue to energize the pump relay.
- If temperature difference is less than 3°F, then the control will de-energize the pump relay.
- The control will next wait 10 minutes before repeating first bullet point.

E. The Over Temperature Limit Switch is placed in series with line voltage. Therefore, continuity between "L" of line voltage and "L" of pump output is forced broken when the Over Temperature Limit Switch opens (see wiring diagram).

F. The 3-amp fuse is put in series with the "R" connection to the board. Whenever the fuse is blown, the control board will lose power and consequently, the relay will disengage.

FIGURE 13
INLET & OUTLET THERMISTOR TEMPERATURE CURVES
TEMPERATURE F VS. RESISTANCE R OF TEMPERATURE SENSOR

F	R	F	R	F	R
51	19374	76	10247	101	5697
52	18867	77	10000	102	5570
53	18375	78	9760	103	5446
54	17989	79	9526	104	5326
55	17434	80	9299	105	5208
56	16984	81	9077	106	5094
57	16547	82	8862	107	4982
58	16122	83	8653	108	4873
59	15710	84	8449	109	4767
60	15310	85	8250	110	4663
61	14921	86	8057	111	4562
62	14544	87	7869	112	4464
63	14177	88	7686	113	4367
64	13820	89	7507	114	4274
65	13474	90	7334	115	4182
66	13137	91	7165	116	4093
67	12810	92	7000	117	4006
68	12492	93	6840	118	3921
69	12183	94	6683	119	3838
70	11883	95	6531	120	3757
71	11591	96	6383	121	3678
72	11307	97	6239	122	3601
73	11031	98	6098	123	3526
74	10762	99	5961	124	3452
75	10501	100	5827		

PART LOAD COOLING

When the thermostat system switch is placed in “COOL”, it completes a circuit from “R” to “O”, energizing the reversing valve solenoid. On a call for cooling, the thermostat completes a circuit from “R” to “Y1” sending the signal to the Geothermal Logic Control. The Geothermal Logic Control verifies that the High Pressure Switch, the Low Pressure Switch, and the Flow Switch control are all in the closed position. It then energizes the “A” terminal output to start the flow center (Ground Loop Applications) or energizes the water solenoid (Ground Water/Water Loop Applications). Following 10 seconds of the “A” terminal energization, the compressor contactor is energized.

FULL LOAD COOLING

The unit should already be operating in Part Load Cooling operation prior to Full Load Cooling being energized (see above). Additionally, what occurs, the thermostat completes a circuit from “R” to “Y2”. This sends a signal to the compressor staging solenoid (plug on side of compressor).

PART LOAD HEATING

When thermostat is placed in “HEAT”, the reversing valve solenoid is no longer energized. On a call for heating, the thermostat completes a circuit from “R” to “Y1” sending the signal to the Geothermal Logic Control. The Geothermal Logic Control verifies that the High Pressure Switch, the Low Pressure Switch, and the Flow Switch control are all in the closed position. It then energizes the “A” terminal output to start the flow center (Ground Loop Applications) or energizes the water solenoid (Ground Water/Water Loop Applications). Following 10 seconds of the “A” terminal energization, the compressor contactor is energized.

FULL LOAD HEATING

The unit should already be operating in Part Load Heating operation prior to Full Load Cooling being energized (see previous). Additionally, what occurs, the thermostat completes a circuit from “R” to “Y2”. This sends a signal to the compressor staging solenoid (plug on side of compressor).

GEOTHERMAL LOGIC CONTROL – If the controller operates in normal mode, the Green Status Light blinks. This indicates that 24 volt power is applied to the board and the controller is running in normal operation.

On initial power up and call for compressor operation, a 5-minute delay + a random start delay of 0 to 60 seconds is applied. After the random delay, the compressor relay is energized (Terminal “CC”). When the “Y” input opens the compressor de-energizes.

Water Solenoid – When “Y” signal is sent to Geothermal Logic Control, the water solenoid output “A” terminal will energize 10 seconds prior to “CC” output that starts compressor.

Anti-Short Cycle Timer – After compressor shut-down, or power disruption, a 5-minute timer is applied and prevents the compressor from operating.

SEQUENCE OF OPERATION

HIGH PRESSURE SWITCH

(Terminals HP1 & HP2) Circuit will be proved as "closed" prior to energizing "A" or "CC" terminals. If pressure switch opens, compressor will go into soft lockout mode and compressor operation will be terminated; green fault light illuminated. Logic control will then go through 5-minute delay on break + random start sequence. If no fault found on next run cycle, compressor will continue operation. If fault reoccurs, hard lockout occurs, and fault singal is sent to "L" terminal.

LOW PRESSURE SWITCH

(Terminals LP1 & LP2) Circuit will be proved as "closed" prior to energizing "A" or "CC" terminals. The condition of the LP terminals will then be ignored for the first 90 seconds after a demand for compressor operation. Following this 90 second period, if pressure switch opens, compressor will go into soft lockout mode and compressor operation will be termininated; orange fault light illuminated. The control board will then go through a 5-minute delay on break + random start sequence. If no fault found on next run cycle, compressor will continue operation. If fault recoccurs, hard lockout occurs, and the fault signal is sent to the "L" terminal.

FLOW SWITCH

(Terminals FS1 & FS2) Circuit will be proved as "closed" prior to energizing "A" or "CC" terminals. If either flow switch opens, compressor will go into soft lockout mode and compressor operation will be terminated; red fault light illuminated. Logic control will then go through 5-minute delay on break + random start sequence. If no fault found on next run cycle, compressor will continue operation. If fault reoccurs, hard lockout occurs, and fault signal is sent to "L" terminal.

OVER & UNDER VOLTAGE PROTECTION

When an an under or over voltage condition exists, the controller locks out the unit. When condition clears, the controller automatically releases the unit to normal operation and the compressor restarts after the random start and anti-short cycle timings are met. The under & over voltage protection starts at plus or minus 20% from nominal voltage and returns to operation at plus or minus 10% from nominal voltage. All four (4) LED fault lights will flash when an under or over voltage condition occurs. The over voltage protection can be disabled by removing the O/V jumper on the Geothermal Logic Control Board.

INTELLIGENT RESET

The Geothermal Logic Control has an intelligent reset feature after a safety control is activated. The controller locks out the unit for 5 minutes, at the end of this period, the controller checks to verify that all faults have been cleared. If faults have been cleared, the controller restarts the unit. If a second fault occurs, the controller will lockout the unit until the control is reset by breaking "Y" signal from thermostat. The last fault will be kept in memory after a full lockout; this is only cleared by cycling the unit power.

ALARM OUTPUT

The "L" terminal has 24 volts applied when a hard lockout occurs. This can be used to drive a fault light or a low voltage relay.

PRESSURE SERVICE PORTS

High and low pressure service ports are installed on all units so the system operating pressures can be observed. Pressure tables can be found later in this manual, and also applied to the backside of the service door of the unit. It is imperative to match the correct pressure table to the unit by model number, and to the correct conditions (temperature & flow rate). Also note that all pressure tables are without the desuperheater operational.

CHECKING REFRIGERANT CHARGE QUANTITY

The correct R-410A charge is shown on the unit rating plate. Reference Figure 18 – 22 to validate proper system operation. However, it is recommended that if incorrect charge is suspected, the system refrigerant charge be reclaimed, evacuated, and charge to nameplate charge quantity and type

The nameplate charge quantity is optimized for thermal performance and efficiency throughout all modes of operation.

The models covered by this manual require R-410A refrigerant, and Polyol Ester refrigerant oil.

GENERAL

1. Use separate service equipment to avoid cross contamination of oil and refrigerants.
2. Use recovery equipment rated for R-410A refrigerant.
3. Use manifold gauges rated for R-410A (800 psi high-side/250psi low-side).
4. R-410A is a binary blend of HFC-32 and HFC-125.
5. R-410A is nearly azeotropic – similar to R-22 and R-12. Although nearly azeotropic, charge with liquid refrigerant.
6. R-410A operates at 40-70% higher pressure than R-22, and systems designed for R-22 cannot withstand this higher pressure.
7. R-410A has an ozone depletion potential of zero, but must be reclaimed due to its global warming potential.
8. R-410A compressors use Polyol Ester Oil.
9. Polyol Ester is hydroscopic; it will rapidly absorb moisture, and strongly hold this moisture in the oil.
10. A liquid line dryer must be used – even a deep vacuum will not separate moisture from the oil.
11. Limit atmospheric exposure to 15 minutes.
12. If compressor removal is necessary, always plug compressor immediately after removal. Purge with small amount of nitrogen when inserting plugs.

R-410A

REFRIGERANT CHARGE

This unit was charged at the factory with the quantity of refrigerant listed on the serial plate. AHRI capacity and efficiency ratings were determined by testing with this refrigerant charge quantity.

The following pressure tables show nominal pressures for the units. Since many installation specific situations can affect the pressure readings, this information should only be used by certified technicians as a guide for evaluating proper system performance. They shall not be used to adjust charge. If charge is in doubt, reclaim, evacuate and recharge the unit to the serial plate charge.

TOPPING OFF SYSTEM CHARGE

If a leak has occurred in the system, reclaiming, evacuating (see previous criteria), and charging to the nameplate charge is recommended.

Topping off the system charge can be done without problems. With R-410A, there are no significant changes in the refrigerant composition during multiple leaks and recharges. R-410A refrigerant is similar to an azeotropic blend (it behaves like a pure compound or single component refrigerant). The remaining refrigerant charge, in the system, may be used after leaks have occurred and then "top-off" the charge by utilizing the charging charts on the service door of the unit or this manual as a guideline.

REMEMBER: *When adding R-410A refrigerant, it must come out of the charging cylinder/tank as a liquid to avoid any fractionation, and to ensure optimal system performance. Refer to instructions for the cylinder that is being utilized for proper method of liquid extraction.*

SAFETY PRACTICES

1. Never mix R-410A with other refrigerants.
2. Use gloves and safety glasses, Polyol Ester oils can be irritating to the skin, and liquid refrigerant will freeze the skin.
3. Never use air and R-410A to leak check; the mixture may become flammable.
4. Do not inhale R-410A – the vapor attacks the nervous system, creating dizziness, loss of coordination and slurred speech. Cardiac irregularities, unconsciousness and ultimate death can result from breathing this concentration.
5. Do not burn R-410A. This decomposition produces hazardous vapors. Evacuate the area if exposed.
6. Use only cylinders rated DOT4BA/4BW 400.
7. Never fill cylinders over 80% of total capacity.
8. Store cylinders in a cool area, out of direct sunlight.
9. Never heat cylinders above 125°F.
10. Never trap liquid R-410A in manifold sets, gauge lines, or cylinders. R-410A expands significantly at warmer temperatures. Once a cylinder or line is full of liquid, any further rise in temperature will cause it to rupture or burst.

COMPONENT LOCATION

FIGURE 14
SYSTEM COMPONENT LOCATIONS

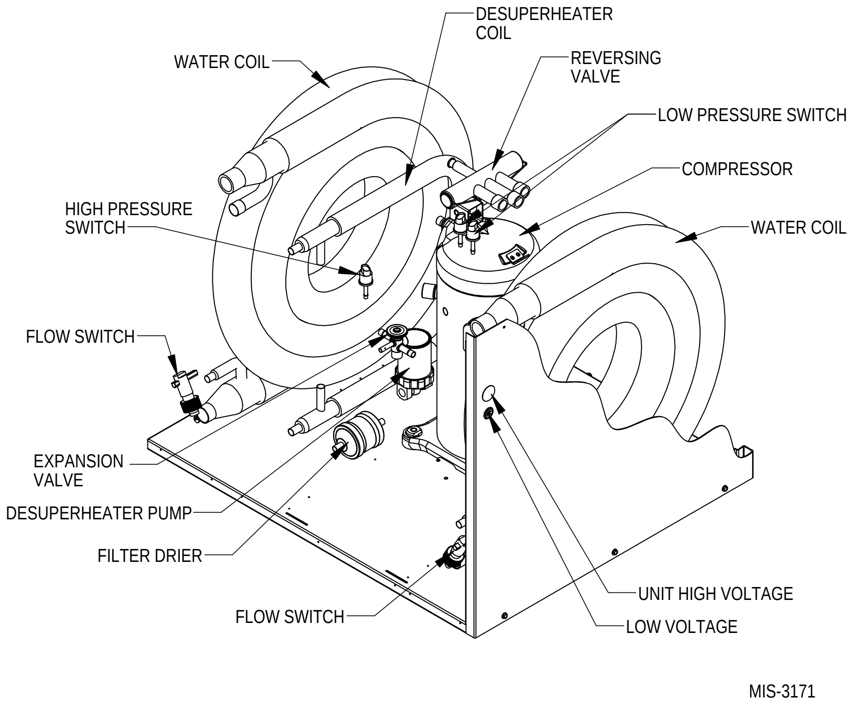


FIGURE 15
ELECTRICAL CONTROL LOCATIONS

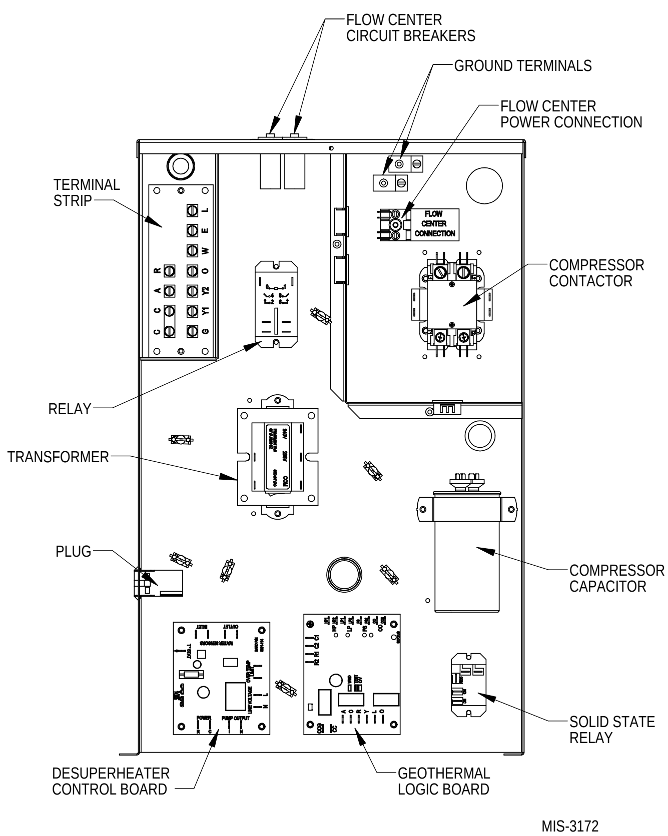


FIGURE 16
COOLING CYCLE DIAGRAM

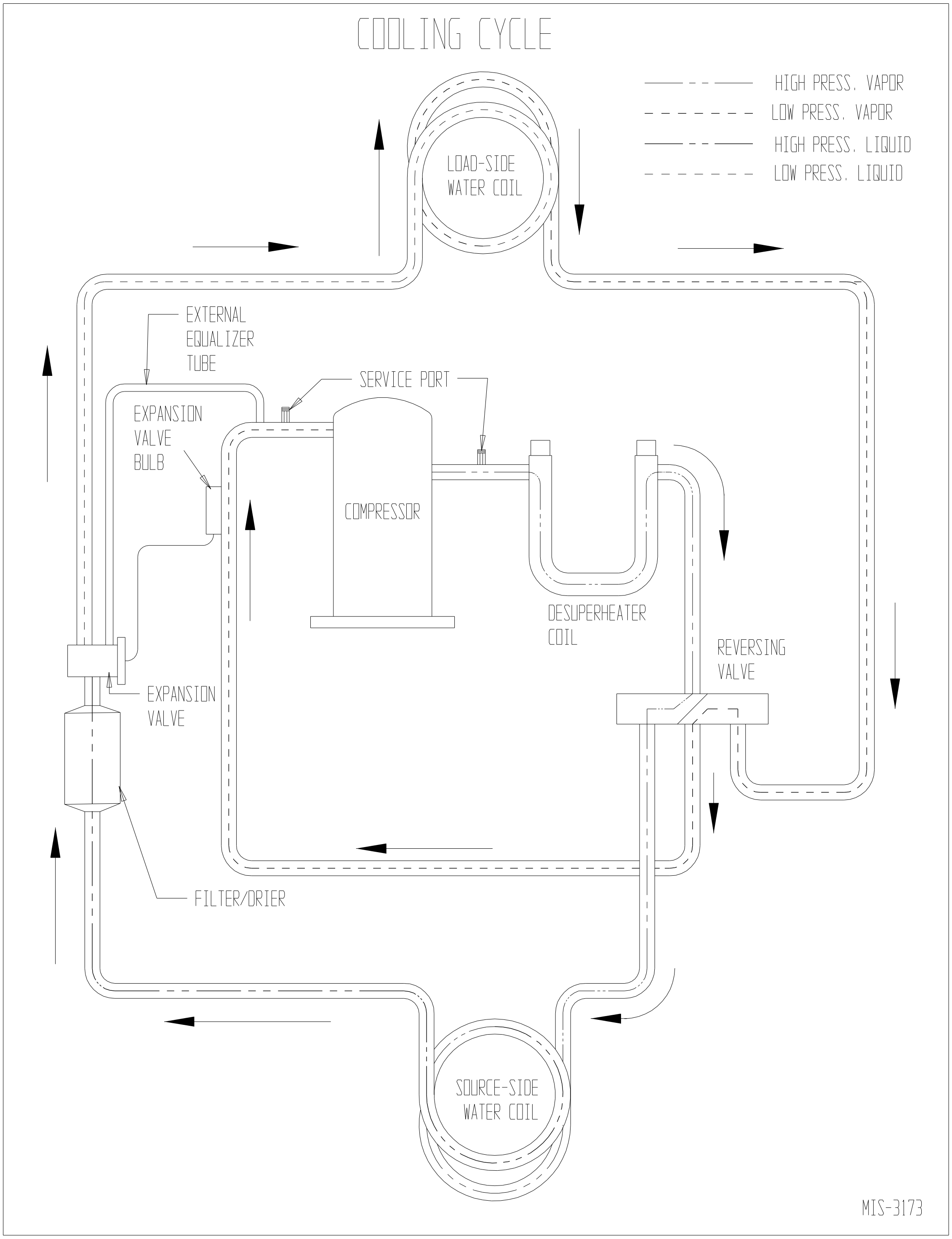


FIGURE 17
HEATING CYCLE DIAGRAM

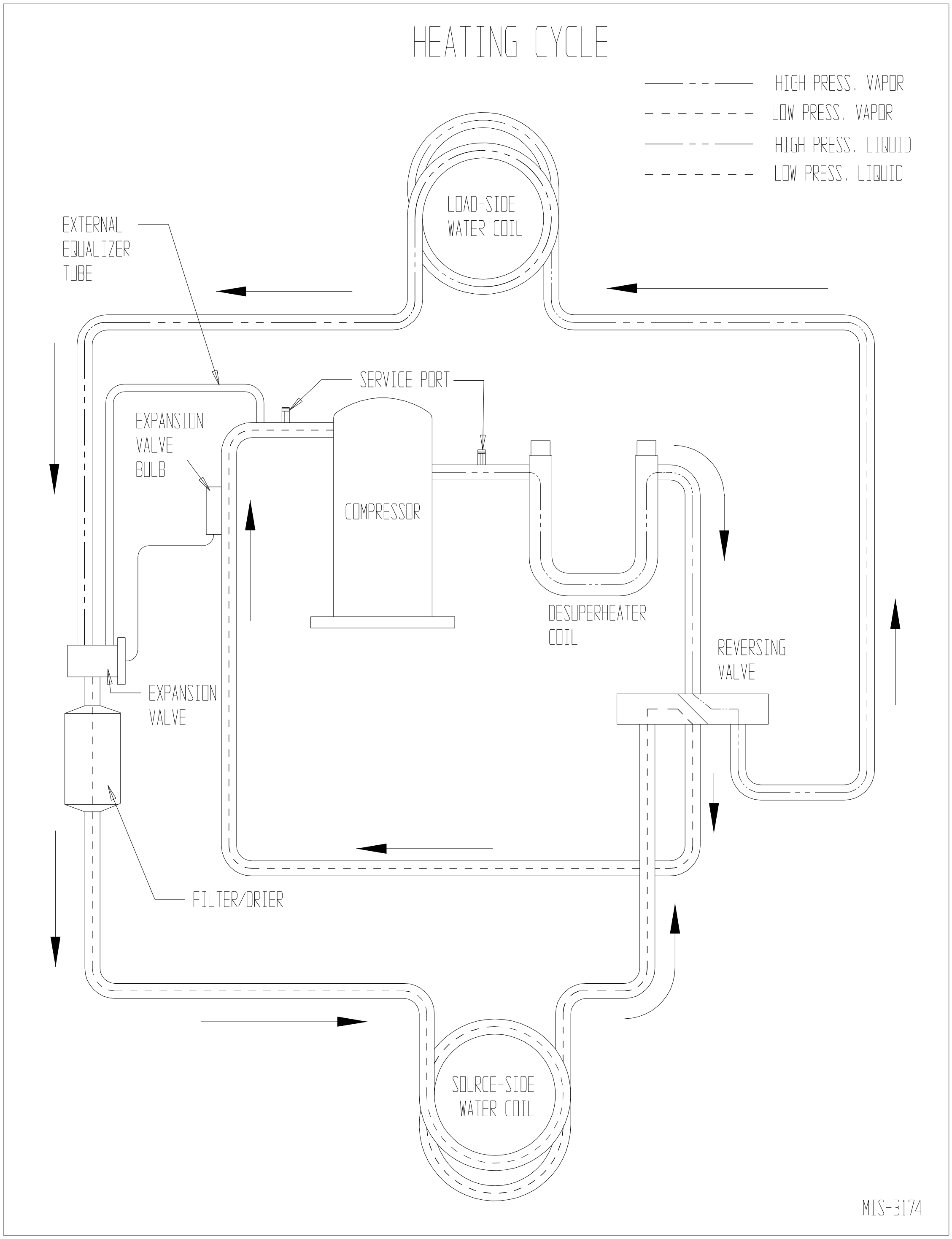


FIGURE 18A — GW024 PRESSURE TABLES

FULL LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	5	50	7**	117	191
		70		124	194
		90		162	181
	6	50		113	187
		70		120	190
		90		159	177
	7*	50		111	180
		70		118	184
		90		156	171
	8	50		123	182
		70		116	178
		90		154	165
60	5	50	7**	117	225
		70		134	231
		90		163	223
	6	50		115	220
		70		132	226
		90		160	218
	7*	50		113	214
		70		130	219
		90		158	212
	8	50		145	220
		70		128	215
		90		157	207
70	5	50	7**	118	259
		70		145	267
		90		164	265
	6	50		116	253
		70		143	261
		90		162	259
	7*	50		115	247
		70		141	255
		90		160	253
	8	50		166	259
		70		140	251
		90		159	249
80	5	50	7**	119	293
		70		155	304
		90		164	307
	6	50		117	286
		70		154	296
		90		163	299
	7*	50		117	281
		70		153	291
		90		162	294
	8	50		188	297
		70		152	287
		90		161	290
90	5	50	7**	120	337
		70		158	347
		90		175	352
	6	50		119	330
		70		157	340
		90		174	345
	7*	50		118	325
		70		156	335
		90		173	340
	8	50		193	341
		70		155	331
		90		173	336
100	5	50	7**	121	381
		70		161	391
		90		186	398
	6	50		120	374
		70		160	384
		90		185	391
	7*	50		120	369
		70		159	378
		90		184	386
	8	50		199	384
		70		159	374
		90		184	382
110	5	50	7**	122	426
		70		164	435
		90		197	444
	6	50		122	418
		70		163	427
		90		196	437
	7*	50		121	413
		70		162	422
		90		195	432
	8	50		204	427
		70		163	418
		90		196	427

PART LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	5	50	7**	123	175
		70		148	181
		90		149	181
	6	50		120	172
		70		145	178
		90		145	179
	7*	50		118	168
		70		143	174
		90		144	175
	8	50		164	178
		70		139	172
		90		140	172
60	5	50	7**	124	210
		70		154	217
		90		162	219
	6	50		121	206
		70		151	213
		90		160	215
	7*	50		120	202
		70		150	209
		90		158	211
	8	50		177	214
		70		147	207
		90		156	209
70	5	50	7**	125	244
		70		159	252
		90		176	257
	6	50		123	240
		70		158	248
		90		174	252
	7*	50		122	236
		70		156	244
		90		173	248
	8	50		190	249
		70		156	241
		90		172	246
80	5	50	7**	125	279
		70		165	288
		90		189	294
	6	50		125	274
		70		164	282
		90		189	289
	7*	50		124	270
		70		163	278
		90		188	285
	8	50		203	284
		70		164	276
		90		189	283
90	5	50	7**	127	323
		70		167	331
		90		198	338
	6	50		126	318
		70		167	326
		90		197	333
	7*	50		125	314
		70		166	322
		90		196	329
	8	50		207	328
		70		166	320
		90		197	327
100	5	50	7**	128	366
		70		170	375
		90		206	382
	6	50		127	361
		70		169	370
		90		205	377
	7*	50		126	357
		70		168	366
		90		204	374
	8	50		211	372
		70		169	363
		90		205	371
110	5	50	7**	129	409
		70		172	418
		90		214	426
	6	50		128	405
		70		172	414
		90		214	422
	7*	50		127	401
		70		171	410
		90		213	418
	8	50		214	416
		70		171	407
		90		213	415

FIGURE 18B — GW024 PRESSURE TABLES

FULL LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	5	60	7**	62	198
		90		64	305
		120		67	450
	6	60		63	199
		90		65	305
		120		67	450
	7*	60		64	198
		90		66	305
		120		68	450
	8	60		68	412
		90		66	306
		120		69	450
30	5	60	7**	78	203
		90		81	310
		120		84	455
	6	60		80	203
		90		82	311
		120		85	455
	7*	60		81	203
		90		83	311
		120		86	455
	8	60		87	419
		90		84	311
		120		87	455
40	5	60	7**	94	207
		90		98	315
		120		101	459
	6	60		96	208
		90		99	316
		120		103	460
	7*	60		98	208
		90		101	317
		120		105	461
	8	60		105	425
		90		102	317
		120		106	461
50	5	60	7**	110	211
		90		114	321
		120		119	464
	6	60		113	212
		90		117	321
		120		121	465
	7*	60		115	213
		90		118	322
		120		123	466
	8	60		124	432
		90		120	323
		120		124	466
60	5	60	7**	121	214
		90		134	326
		120		141	470
	6	60		124	215
		90		137	327
		120		144	470
	7*	60		125	216
		90		138	328
		120		145	471
	8	60		153	441
		90		140	328
		120		146	472
70	5	60	7**	131	216
		90		154	332
		120		163	475
	6	60		134	217
		90		157	333
		120		166	476
	7*	60		136	218
		90		159	334
		120		167	477
	8	60		182	450
		90		160	334
		120		169	477
80	5	60	7**	142	219
		90		174	338
		120		185	480
	6	60		145	220
		90		177	339
		120		188	481
	7*	60		146	221
		90		179	340
		120		190	482
	8	60		212	459
		90		179	340
		120		191	483

PART LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	5	60	7**	66	190
		90		68	296
		120		70	435
	6	60		66	190
		90		69	296
		120		71	436
	7*	60		67	190
		90		70	296
		120		72	436
	8	60		72	402
		90		69	296
		120		72	436
30	5	60	7**	83	194
		90		86	300
		120		89	441
	6	60		84	194
		90		87	301
		120		90	441
	7*	60		85	194
		90		88	301
		120		91	441
	8	60		91	407
		90		88	301
		120		91	441
40	5	60	7**	101	198
		90		104	305
		120		107	446
	6	60		102	198
		90		105	305
		120		109	447
	7*	60		103	198
		90		106	306
		120		110	447
	8	60		110	413
		90		107	305
		120		111	447
50	5	60	7**	118	202
		90		122	310
		120		126	452
	6	60		120	202
		90		123	310
		120		128	452
	7*	60		121	203
		90		125	310
		120		129	453
	8	60		129	418
		90		126	310
		120		130	453
60	5	60	7**	131	205
		90		143	314
		120		149	456
	6	60		134	206
		90		146	315
		120		151	457
	7*	60		135	206
		90		147	315
		120		153	457
	8	60		161	424
		90		149	315
		120		154	457
70	5	60	7**	145	209
		90		165	319
		120		172	461
	6	60		148	209
		90		168	320
		120		174	461
	7*	60		150	210
		90		170	320
		120		177	462
	8	60		192	431
		90		172	321
		120		178	462
80	5	60	7**	158	212
		90		187	324
		120		194	465
	6	60		161	213
		90		190	325
		120		198	466
	7*	60		164	214
		90		193	326
		120		200	467
	8	60		224	438
		90		195	326
		120		202	467

FIGURE 19A — GW036 PRESSURE TABLES

FULL LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	6	50	9**	93	192
		70		97	191
		90		101	192
	7	50		91	187
		70		94	186
		90		99	187
	9*	50		89	177
		70		92	177
		90		96	177
	11	50		93	177
		70		90	177
		90		94	178
60	6	50	9**	101	230
		70		106	231
		90		111	231
	7	50		99	224
		70		104	225
		90		108	226
	9*	50		96	214
		70		101	215
		90		105	216
	11	50		104	215
		70		99	214
		90		104	215
70	6	50	9**	108	267
		70		115	270
		90		120	271
	7	50		106	261
		70		113	264
		90		118	265
	9*	50		102	251
		70		109	254
		90		114	255
	11	50		115	254
		70		108	251
		90		113	252
80	6	50	9**	115	305
		70		123	309
		90		129	310
	7	50		114	298
		70		122	303
		90		128	304
	9*	50		109	288
		70		117	293
		90		123	294
	11	50		126	292
		70		117	288
		90		123	289
90	6	50	9**	116	349
		70		130	355
		90		137	357
	7	50		115	342
		70		128	348
		90		136	350
	9*	50		111	332
		70		125	338
		90		132	340
	11	50		138	338
		70		125	332
		90		132	334
100	6	50	9**	117	393
		70		137	400
		90		145	403
	7	50		116	386
		70		135	393
		90		143	396
	9*	50		113	375
		70		132	383
		90		141	385
	11	50		151	384
		70		132	377
		90		140	380
110	6	50	9**	118	437
		70		143	446
		90		153	449
	7	50		116	429
		70		142	438
		90		151	441
	9*	50		115	419
		70		140	428
		90		149	431
	11	50		164	430
		70		139	422
		90		148	425

PART LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	6	50	9**	119	182
		70		120	181
		90		123	182
	7	50		116	184
		70		117	183
		90		120	183
	9*	50		113	175
		70		114	174
		90		118	174
	11	50		115	169
		70		114	170
		90		117	170
60	6	50	9**	120	218
		70		132	220
		90		137	221
	7	50		118	217
		70		129	219
		90		134	220
	9*	50		115	208
		70		126	211
		90		132	212
	11	50		136	209
		70		124	206
		90		130	207
70	6	50	9**	121	253
		70		143	259
		90		150	261
	7	50		120	250
		70		141	255
		90		148	257
	9*	50		117	242
		70		138	247
		90		146	249
	11	50		156	248
		70		135	243
		90		142	245
80	6	50	9**	123	288
		70		154	297
		90		163	300
	7	50		121	283
		70		153	292
		90		162	294
	9*	50		119	275
		70		150	284
		90		160	287
	11	50		177	288
		70		145	279
		90		155	282
90	6	50	9**	124	332
		70		158	341
		90		173	345
	7	50		122	326
		70		157	335
		90		172	339
	9*	50		120	318
		70		155	327
		90		170	332
	11	50		185	332
		70		151	323
		90		166	327
100	6	50	9**	125	375
		70		161	384
		90		182	390
	7	50		124	369
		70		160	378
		90		181	384
	9*	50		122	362
		70		159	371
		90		180	376
	11	50		193	375
		70		156	366
		90		177	372
110	6	50	9**	126	418
		70		165	427
		90		192	434
	7	50		125	412
		70		164	421
		90		191	428
	9*	50		123	405
		70		163	414
		90		190	421
	11	50		201	419
		70		161	409
		90		188	416

FIGURE 19B — GW036 PRESSURE TABLES

FULL LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	6	60	9**	59	203
		90		60	311
		120		63	455
	7	60		59	204
		90		60	312
		120		64	456
	9*	60		60	204
		90		62	312
		120		65	456
	11	60		64	420
		90		63	312
		120		66	456
30	6	60	9**	72	208
		90		75	317
		120		79	460
	7	60		73	209
		90		76	317
		120		80	461
	9*	60		75	210
		90		78	318
		120		82	462
	11	60		83	427
		90		80	318
		120		84	462
40	6	60	9**	86	213
		90		91	322
		120		95	466
	7	60		87	214
		90		92	322
		120		97	466
	9*	60		90	215
		90		95	323
		120		99	467
	11	60		101	433
		90		96	324
		120		101	468
50	6	60	9**	99	218
		90		106	328
		120		111	471
	7	60		101	218
		90		108	328
		120		113	471
	9*	60		105	220
		90		111	329
		120		117	472
	11	60		120	439
		90		113	330
		120		119	474
60	6	60	9**	103	222
		90		117	334
		120		125	477
	7	60		105	222
		90		119	334
		120		128	478
	9*	60		108	223
		90		121	335
		120		130	479
	11	60		137	448
		90		123	336
		120		132	480
70	6	60	9**	107	225
		90		128	340
		120		140	484
	7	60		109	226
		90		130	341
		120		142	485
	9*	60		111	226
		90		132	341
		120		143	485
	11	60		153	457
		90		133	342
		120		145	486
80	6	60	9**	111	228
		90		139	346
		120		154	490
	7	60		114	229
		90		141	347
		120		156	491
	9*	60		114	230
		90		142	348
		120		157	492
	11	60		170	466
		90		143	348
		120		157	492

PART LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	6	60	9**	63	193
		90		66	300
		120		69	442
	7	60		64	193
		90		66	300
		120		69	442
	9*	60		65	193
		90		67	300
		120		70	443
	11	60		70	407
		90		67	300
		120		71	443
30	6	60	9**	79	198
		90		82	305
		120		86	447
	7	60		80	198
		90		83	305
		120		87	448
	9*	60		82	199
		90		85	306
		120		88	448
	11	60		88	413
		90		86	306
		120		89	448
40	6	60	9**	95	203
		90		99	310
		120		103	452
	7	60		97	203
		90		100	310
		120		105	453
	9*	60		99	204
		90		102	311
		120		107	453
	11	60		107	418
		90		104	311
		120		108	454
50	6	60	9**	112	208
		90		116	315
		120		120	457
	7	60		113	208
		90		117	315
		120		122	458
	9*	60		116	209
		90		120	316
		120		125	458
	11	60		126	424
		90		122	317
		120		127	459
60	6	60	9**	120	209
		90		133	320
		120		140	463
	7	60		121	210
		90		135	321
		120		142	463
	9*	60		124	211
		90		137	322
		120		144	464
	11	60		153	433
		90		139	322
		120		146	465
70	6	60	9**	128	211
		90		151	326
		120		160	469
	7	60		129	211
		90		152	326
		120		162	469
	9*	60		131	213
		90		154	327
		120		164	470
	11	60		179	443
		90		156	328
		120		165	471
80	6	60	9**	136	213
		90		168	331
		120		180	474
	7	60		137	213
		90		170	331
		120		181	475
	9*	60		139	214
		90		172	333
		120		183	476
	11	60		206	452
		90		173	334
		120		184	477

FIGURE 20A — GW048 PRESSURE TABLES

FULL LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	7	50	11**	107	207
		70		104	208
		90		108	210
	9	50		103	196
		70		100	198
		90		104	200
	11*	50		101	190
		70		98	191
		90		102	193
	13	50		93	189
		70		97	187
		90		101	189
60	7	50	11**	109	244
		70		115	249
		90		120	251
	9	50		105	232
		70		111	237
		90		116	240
	11*	50		103	225
		70		109	230
		90		114	232
	13	50		114	230
		70		107	226
		90		113	228
70	7	50	11**	111	281
		70		126	290
		90		132	293
	9	50		107	268
		70		122	277
		90		128	280
	11*	50		104	260
		70		120	269
		90		125	272
	13	50		134	272
		70		118	264
		90		124	267
80	7	50	11**	112	319
		70		137	330
		90		144	334
	9	50		109	304
		70		133	316
		90		140	320
	11*	50		106	296
		70		131	307
		90		137	311
	13	50		154	314
		70		129	302
		90		136	306
90	7	50	11**	112	363
		70		142	376
		90		153	381
	9	50		109	349
		70		139	361
		90		150	367
	11*	50		108	340
		70		137	352
		90		148	358
	13	50		165	359
		70		136	347
		90		147	353
100	7	50	11**	112	408
		70		146	421
		90		161	429
	9	50		110	394
		70		145	406
		90		160	415
	11*	50		109	385
		70		143	397
		90		158	405
	13	50		177	404
		70		143	392
		90		158	400
110	7	50	11**	112	453
		70		151	466
		90		170	476
	9	50		111	439
		70		150	452
		90		170	462
	11*	50		111	429
		70		150	442
		90		169	453
	13	50		189	449
		70		150	437
		90		169	447

PART LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	7	50	11**	120	195
		70		128	195
		90		132	194
	9	50		114	187
		70		122	187
		90		125	186
	11*	50		111	183
		70		119	183
		90		122	182
	13	50		125	183
		70		117	183
		90		120	182
60	7	50	11**	120	229
		70		138	233
		90		144	234
	9	50		115	220
		70		133	224
		90		139	226
	11*	50		113	215
		70		131	219
		90		137	221
	13	50		148	222
		70		129	218
		90		135	220
70	7	50	11**	119	263
		70		147	271
		90		155	275
	9	50		116	253
		70		144	261
		90		152	265
	11*	50		115	248
		70		143	256
		90		151	259
	13	50		171	261
		70		142	253
		90		150	257
80	7	50	11**	118	297
		70		156	309
		90		167	315
	9	50		117	287
		70		156	298
		90		166	305
	11*	50		116	280
		70		155	292
		90		166	298
	13	50		194	300
		70		155	288
		90		165	294
90	7	50	11**	119	341
		70		159	353
		90		179	361
	9	50		119	330
		70		158	342
		90		179	350
	11*	50		118	324
		70		158	336
		90		178	344
	13	50		198	344
		70		158	332
		90		178	340
100	7	50	11**	121	385
		70		162	397
		90		192	407
	9	50		120	374
		70		161	386
		90		191	396
	11*	50		120	368
		70		161	380
		90		191	390
	13	50		202	387
		70		161	375
		90		191	385
110	7	50	11**	122	428
		70		164	440
		90		205	452
	9	50		122	417
		70		164	430
		90		204	442
	11*	50		122	412
		70		164	424
		90		204	436
	13	50		206	431
		70		164	419
		90		204	431

FIGURE 20B — GW048 PRESSURE TABLES

FULL LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	7	60	11**	58	209
		90		59	326
		120		64	479
	9	60		62	211
		90		62	327
		120		68	481
	11*	60		58	209
		90		59	326
		120		64	479
	13	60		57	452
		90		57	336
		120		63	490
30	7	60	11**	72	216
		90		74	331
		120		79	483
	9	60		76	217
		90		77	333
		120		83	484
	11*	60		74	216
		90		76	332
		120		81	483
	13	60		80	448
		90		78	332
		120		84	484
40	7	60	11**	86	222
		90		89	336
		120		94	486
	9	60		89	223
		90		92	338
		120		98	488
	11*	60		90	223
		90		93	337
		120		98	487
	13	60		102	443
		90		100	329
		120		105	479
50	7	60	11**	99	228
		90		104	342
		120		109	490
	9	60		103	229
		90		107	343
		120		112	491
	11*	60		106	230
		90		110	343
		120		115	491
	13	60		125	439
		90		121	325
		120		126	473
60	7	60	11**	108	233
		90		122	349
		120		131	496
	9	60		112	234
		90		126	350
		120		135	498
	11*	60		114	235
		90		128	351
		120		138	498
	13	60		149	455
		90		136	339
		120		145	487
70	7	60	11**	117	237
		90		140	355
		120		154	502
	9	60		121	239
		90		144	358
		120		158	504
	11*	60		123	240
		90		146	359
		120		160	505
	13	60		173	472
		90		150	354
		120		164	500
80	7	60	11**	126	242
		90		159	362
		120		177	508
	9	60		130	244
		90		162	365
		120		180	511
	11*	60		131	246
		90		164	366
		120		182	512
	13	60		198	489
		90		165	368
		120		184	514

PART LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	7	60	11**	63	201
		90		66	309
		120		70	451
	9	60		64	201
		90		66	309
		120		71	451
	11*	60		64	202
		90		67	310
		120		71	452
	13	60		70	419
		90		67	310
		120		72	452
30	7	60	11**	78	205
		90		82	314
		120		87	457
	9	60		80	206
		90		83	315
		120		88	457
	11*	60		81	206
		90		84	315
		120		89	458
	13	60		89	424
		90		85	315
		120		90	458
40	7	60	11**	94	210
		90		98	319
		120		103	463
	9	60		96	210
		90		100	320
		120		105	464
	11*	60		98	210
		90		102	320
		120		107	464
	13	60		107	430
		90		103	320
		120		108	464
50	7	60	11**	110	214
		90		114	325
		120		120	470
	9	60		113	215
		90		117	325
		120		123	470
	11*	60		115	215
		90		119	325
		120		125	470
	13	60		125	435
		90		121	325
		120		126	470
60	7	60	11**	120	219
		90		134	330
		120		141	474
	9	60		125	220
		90		139	331
		120		146	475
	11*	60		128	220
		90		142	332
		120		149	476
	13	60		157	444
		90		143	332
		120		150	476
70	7	60	11**	131	223
		90		155	336
		120		163	479
	9	60		137	224
		90		160	337
		120		169	480
	11*	60		141	225
		90		164	339
		120		172	481
	13	60		189	452
		90		166	339
		120		175	481
80	7	60	11**	142	227
		90		175	342
		120		185	484
	9	60		149	229
		90		182	344
		120		192	485
	11*	60		153	231
		90		186	345
		120		196	487
	13	60		221	460
		90		189	345
		120		199	487

FIGURE 21A — GW060 PRESSURE TABLES

FULL LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	9	50	13**	105	208
		70		109	213
		90		114	217
	11	50		100	196
		70		104	200
		90		109	205
	13*	50		98	190
		70		102	194
		90		107	199
	15	50		104	196
		70		100	191
		90		105	196
60	9	50	13**	107	244
		70		119	252
		90		125	256
	11	50		103	232
		70		115	240
		90		121	244
	13*	50		100	226
		70		112	233
		90		119	237
	15	50		123	237
		70		111	229
		90		117	234
70	9	50	13**	108	280
		70		129	291
		90		136	295
	11	50		105	269
		70		125	279
		90		133	283
	13*	50		102	262
		70		123	272
		90		130	276
	15	50		142	278
		70		121	268
		90		129	272
80	9	50	13**	110	316
		70		139	329
		90		147	333
	11	50		107	305
		70		136	318
		90		144	322
	13*	50		105	298
		70		134	311
		90		142	315
	15	50		161	319
		70		132	306
		90		140	310
90	9	50	13**	110	360
		70		142	373
		90		156	380
	11	50		108	350
		70		140	362
		90		154	369
	13*	50		107	342
		70		139	355
		90		152	361
	15	50		170	362
		70		137	349
		90		151	356
100	9	50	13**	111	404
		70		146	417
		90		164	426
	11	50		109	394
		70		145	406
		90		163	415
	13*	50		108	386
		70		144	398
		90		162	407
	15	50		178	406
		70		143	393
		90		161	402
110	9	50	13**	111	448
		70		150	460
		90		173	472
	11	50		111	438
		70		149	451
		90		172	462
	13*	50		110	430
		70		149	442
		90		172	453
	15	50		187	449
		70		148	437
		90		171	449

PART LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	9	50	13**	115	192
		70		137	200
		90		137	200
	11	50		111	184
		70		133	193
		90		133	193
	13*	50		108	179
		70		130	188
		90		130	188
	15	50		149	193
		70		127	184
		90		128	184
60	9	50	13**	115	226
		70		142	236
		90		149	238
	11	50		112	219
		70		139	229
		90		146	231
	13*	50		110	214
		70		137	224
		90		144	226
	15	50		163	229
		70		136	220
		90		143	222
70	9	50	13**	116	261
		70		148	272
		90		161	276
	11	50		114	254
		70		146	264
		90		159	269
	13*	50		113	249
		70		145	259
		90		158	264
	15	50		176	266
		70		144	255
		90		157	260
80	9	50	13**	116	296
		70		153	307
		90		173	315
	11	50		116	288
		70		153	300
		90		172	307
	13*	50		115	283
		70		152	295
		90		171	302
	15	50		189	303
		70		152	291
		90		171	298
90	9	50	13**	118	340
		70		156	351
		90		181	359
	11	50		118	332
		70		155	343
		90		180	351
	13*	50		117	327
		70		155	338
		90		179	346
	15	50		193	345
		70		155	334
		90		179	342
100	9	50	13**	120	383
		70		159	394
		90		189	403
	11	50		120	375
		70		158	386
		90		188	395
	13*	50		119	370
		70		157	381
		90		187	390
	15	50		196	388
		70		157	377
		90		187	386
110	9	50	13**	123	427
		70		162	437
		90		197	448
	11	50		121	419
		70		161	429
		90		196	440
	13*	50		121	414
		70		160	424
		90		195	434
	15	50		199	430
		70		160	420
		90		195	430

FIGURE 21B — GW060 PRESSURE TABLES

FULL LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	9	60	13**	55	210
		90		58	322
		120		61	467
	11	60		57	211
		90		59	323
		120		62	467
	13*	60		57	211
		90		60	323
		120		62	468
	15	60		62	435
		90		60	323
		120		63	468
30	9	60	13**	69	216
		90		73	328
		120		76	472
	11	60		71	217
		90		74	328
		120		78	473
	13*	60		72	217
		90		75	329
		120		79	473
	15	60		80	441
		90		76	329
		120		80	474
40	9	60	13**	83	222
		90		87	333
		120		92	478
	11	60		85	223
		90		90	334
		120		95	478
	13*	60		87	223
		90		91	335
		120		96	479
	15	60		97	447
		90		93	335
		120		97	480
50	9	60	13**	97	227
		90		102	339
		120		108	483
	11	60		100	228
		90		105	340
		120		111	484
	13*	60		102	229
		90		107	341
		120		113	485
	15	60		114	453
		90		109	341
		120		115	485
60	9	60	13**	105	232
		90		119	346
		120		127	489
	11	60		107	233
		90		121	347
		120		130	491
	13*	60		109	234
		90		123	347
		120		131	491
	15	60		138	462
		90		124	348
		120		133	492
70	9	60	13**	113	236
		90		135	353
		120		146	496
	11	60		115	237
		90		137	354
		120		148	497
	13*	60		116	238
		90		138	354
		120		150	498
	15	60		162	472
		90		139	355
		120		151	498
80	9	60	13**	120	240
		90		151	359
		120		165	502
	11	60		122	242
		90		153	361
		120		167	504
	13*	60		123	242
		90		154	361
		120		168	504
	15	60		185	481
		90		155	362
		120		169	505

PART LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	9	60	13**	61	203
		90		63	309
		120		67	452
	11	60		62	203
		90		64	309
		120		68	452
	13*	60		62	204
		90		65	309
		120		69	453
	15	60		67	415
		90		65	309
		120		69	453
30	9	60	13**	77	207
		90		80	314
		120		84	457
	11	60		78	207
		90		81	314
		120		86	457
	13*	60		79	208
		90		82	315
		120		87	458
	15	60		86	422
		90		83	315
		120		87	458
40	9	60	13**	92	211
		90		97	319
		120		102	462
	11	60		94	211
		90		98	320
		120		103	462
	13*	60		96	212
		90		100	320
		120		105	462
	15	60		105	428
		90		101	320
		120		106	463
50	9	60	13**	108	215
		90		113	324
		120		119	466
	11	60		110	215
		90		115	325
		120		121	467
	13*	60		112	216
		90		117	325
		120		123	467
	15	60		124	435
		90		119	326
		120		125	468
60	9	60	13**	119	218
		90		133	330
		120		139	471
	11	60		121	219
		90		136	331
		120		142	472
	13*	60		124	219
		90		138	331
		120		144	473
	15	60		154	444
		90		140	332
		120		146	473
70	9	60	13**	129	221
		90		153	336
		120		160	477
	11	60		132	222
		90		156	337
		120		163	478
	13*	60		135	223
		90		158	337
		120		165	478
	15	60		184	453
		90		160	338
		120		167	479
80	9	60	13**	139	224
		90		172	342
		120		180	482
	11	60		143	226
		90		176	343
		120		184	483
	13*	60		146	226
		90		179	344
		120		187	484
	15	60		214	461
		90		181	344
		120		188	484

FIGURE 22A — GW070 PRESSURE TABLES

FULL LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	11	50	16**	104	218
		70		122	231
		90		125	232
	13	50		101	211
		70		120	224
		90		123	225
	15*	50		99	205
		70		118	218
		90		121	219
	17	50		135	228
		70		117	215
		90		120	216
60	11	50	16**	106	255
		70		129	270
		90		137	273
	13	50		104	247
		70		127	262
		90		135	265
	15*	50		102	241
		70		125	256
		90		133	259
	17	50		147	266
		70		124	252
		90		132	255
70	11	50	16**	108	293
		70		136	308
		90		149	314
	13	50		106	284
		70		134	300
		90		147	306
	15*	50		104	278
		70		132	294
		90		145	300
	17	50		159	304
		70		131	289
		90		143	295
80	11	50	16**	110	330
		70		144	347
		90		161	355
	13	50		108	321
		70		142	337
		90		159	346
	15*	50		106	315
		70		140	331
		90		157	340
	17	50		171	343
		70		138	326
		90		155	335
90	11	50	16**	112	374
		70		144	390
		90		162	399
	13	50		110	365
		70		143	380
		90		160	389
	15*	50		108	359
		70		141	374
		90		158	383
	17	50		172	385
		70		139	369
		90		157	378
100	11	50	16**	113	418
		70		145	433
		90		164	442
	13	50		111	409
		70		143	423
		90		162	432
	15*	50		110	403
		70		142	418
		90		160	426
	17	50		172	427
		70		140	413
		90		159	421
110	11	50	16**	115	463
		70		146	476
		90		165	485
	13	50		113	453
		70		144	466
		90		164	475
	15*	50		111	447
		70		143	461
		90		162	469
	17	50		173	469
		70		142	456
		90		161	465

PART LOAD COOLING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
50	11	50	16**	111	200
		70		140	213
		90		150	217
	13	50		109	196
		70		138	208
		90		148	212
	15*	50		107	193
		70		136	206
		90		146	209
	17	50		163	216
		70		134	203
		90		144	207
60	11	50	16**	113	236
		70		145	250
		90		160	256
	13	50		111	231
		70		143	245
		90		158	250
	15*	50		110	228
		70		141	241
		90		156	247
	17	50		171	252
		70		140	238
		90		155	244
70	11	50	16**	115	272
		70		149	286
		90		169	295
	13	50		114	267
		70		148	281
		90		168	289
	15*	50		112	262
		70		146	277
		90		166	285
	17	50		179	287
		70		145	273
		90		165	282
80	11	50	16**	118	308
		70		154	323
		90		179	333
	13	50		116	302
		70		153	317
		90		178	327
	15*	50		115	297
		70		151	312
		90		176	322
	17	50		187	323
		70		150	308
		90		175	319
90	11	50	16**	119	352
		70		156	366
		90		181	376
	13	50		118	346
		70		155	360
		90		180	370
	15*	50		116	341
		70		154	355
		90		178	365
	17	50		190	366
		70		153	352
		90		178	362
100	11	50	16**	121	395
		70		158	409
		90		183	419
	13	50		120	389
		70		157	403
		90		182	413
	15*	50		118	384
		70		156	398
		90		180	408
	17	50		194	409
		70		156	395
		90		180	405
110	11	50	16**	122	439
		70		161	452
		90		184	462
	13	50		121	432
		70		160	446
		90		184	456
	15*	50		120	427
		70		159	441
		90		182	451
	17	50		197	452
		70		158	438
		90		182	448

FIGURE 22B — GW070 PRESSURE TABLES

FULL LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	11	60 90 120	16**	54 57 62	218 331 478
	13	60 90 120		55 58 63	218 332 478
	15*	60 90 120		56 60 64	219 333 479
	17	60 90 120		64 60 64	447 333 479
30	11	60 90 120	16**	68 72 77	225 338 485
	13	60 90 120		70 74 79	226 339 486
	15*	60 90 120		71 75 80	226 340 486
	17	60 90 120		80 76 81	454 340 487
40	11	60 90 120	16**	83 88 93	232 345 492
	13	60 90 120		85 90 95	233 346 493
	15*	60 90 120		86 91 97	234 347 494
	17	60 90 120		97 92 98	461 348 495
50	11	60 90 120	16**	97 103 109	239 352 499
	13	60 90 120		100 105 111	240 353 501
	15*	60 90 120		102 107 113	241 355 502
	17	60 90 120		114 108 115	468 355 502
60	11	60 90 120	16**	105 116 122	244 358 504
	13	60 90 120		107 118 124	245 359 505
	15*	60 90 120		108 119 126	246 360 506
	17	60 90 120		131 121 127	475 361 507
70	11	60 90 120	16**	113 129 135	249 364 509
	13	60 90 120		114 130 137	250 365 510
	15*	60 90 120		115 132 138	251 366 511
	17	60 90 120		149 133 139	481 366 511
80	11	60 90 120	16**	120 142 149	254 370 514
	13	60 90 120		121 143 150	255 371 515
	15*	60 90 120		122 144 151	255 371 515
	17	60 90 120		166 145 152	488 372 515

PART LOAD HEATING

SOURCE		LOAD		SYSTEMS REFRIGERANT PRESSURES	
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
20	11	60 90 120	16**	61 64 68	207 316 457
	13	60 90 120		62 65 69	207 317 457
	15*	60 90 120		62 65 69	208 317 458
	17	60 90 120		69 66 70	427 317 458
30	11	60 90 120	16**	76 80 85	214 323 464
	13	60 90 120		77 81 86	214 323 465
	15*	60 90 120		78 82 87	215 323 465
	17	60 90 120		87 83 88	433 324 465
40	11	60 90 120	16**	91 96 102	221 329 471
	13	60 90 120		93 98 103	221 330 472
	15*	60 90 120		94 99 105	222 330 472
	17	60 90 120		105 100 105	438 330 473
50	11	60 90 120	16**	107 112 118	228 335 479
	13	60 90 120		109 114 120	229 336 479
	15*	60 90 120		110 116 122	229 336 480
	17	60 90 120		122 117 123	444 337 480
60	11	60 90 120	16**	117 129 135	233 342 485
	13	60 90 120		119 131 137	233 343 486
	15*	60 90 120		121 133 139	234 343 486
	17	60 90 120		146 134 140	453 343 486
70	11	60 90 120	16**	128 146 152	238 350 492
	13	60 90 120		130 149 154	238 349 492
	15*	60 90 120		131 150 156	238 349 492
	17	60 90 120		170 152 157	461 350 493
80	11	60 90 120	16**	138 164 169	243 357 499
	13	60 90 120		140 166 171	242 355 498
	15*	60 90 120		142 168 173	243 356 499
	17	60 90 120		194 169 174	470 357 499

	POWER SUPPLY - CONTROL SYSTEM ISSUE																MAIN SYSTEM ISSUES													
	Line Voltage						Low Voltage										Compressor						Refrigerant System							
	Power Failure	Blown Fuse or Tripped Breaker	Faulty Wiring	Loose Terminals	Low Voltage	Defective Contacts in Contactor	Faulty Wiring	Time Delay + Random Start Sequence Not Timed Out	Loose Terminals	Control Tranformer (has circuit breaker)	Voltage (Transfomer has 208 & 240V Taps & Geothermal Logic Control has over/under voltage protection)	Thermostat	Contactor Coil	High Pressure Trip (Green Diagnostic Light)	Low Pressure Trip (Orange Diagnostic Light)	Flow Switch Trip (Red Diagnostic Light)	Bad Compressor Capacitor	Compressor Internal Thermal Overload Open	Bearings Defective	Seized	Busted Internal Scroll	Motor Winding Defective	Refrigerant Charge Low	Refrigerant Overcharge	High Head Pressure	Low Head Pressure	High Suction Pressure	Low Suction Pressure	Non-Condensables	Faulty Expansion Valve
Compressor Will Not Run, No Line Power at Contactor	X	X	X	X																										
Compressor Will Not Run Power at Contactor			X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X						
Compressor "Hums" But Will Not Start			X	X		X											X		X	X		X		X						
Compressor Cycles on Overload			X	X		X											X		X	X		X	X	X					X	
Thermostat Check Light On, Unit in Lock-out Mode														X	X	X							X	X	X			X	X	
Compressor Off on High Pressure Control (Green Diagnostic Light Flashing)														X										X			X		X	X
Compressor Off on Low Pressure Control (Orange Diagnostic Light Flashing)															X								X					X		X
Compressor Off on Flow Switch (Red Diagnostic Light Flashing)																x														
Compressor Noisey			X			X											X		X		X	X		X	X			X	X	
Head Pressure Too High																								X	X				X	
Head Pressure Too Low																							X			X		X		X
Suction Pressure Too High																					X			X			X		X	X
Suction Pressure Too Low																							X							X
High Compressor Amps																														
Excessive Water Usage							X																							
Compressor Runs Continuously - No Cooling																					X		X							X
Liquid Refrigerant Flooding Back to Compressor																								X						X
Compressor Runs Continuously - No Heating																							X							X
Reversing Valve Does Not Shift							X																							
Liquid Refrigerant Flooding Back to Compressor																								X					X	X
Excessive Operation Costs																	X		X			X	X	X						X
Ice in Water Coil																							X							X

	MAIN SYSTEM ISSUES																							EXT. SYSTEM ISSUES						
	Rev.Valve			Source Water Coil										Load Water Coil										Water System						
	Leaking/By-Passing	Partially Shifting	Defective Valve or Coil	Scaled or Plugged Coil (Htg.)	Scaled or Plugged Coil (Clg.)	Water Volume Low (Htg.)	Water Volume High (Htg.)	Water Volume Low (Clg.)	Water Volume High (Clg.)	High Water Temperature (Clg.)	High Water Temperature (Htg.)	Low Water Temperature (Clg.)	Low Water Termperature (Htg.)	Scaled or Plugged Coil (Htg.)	Scaled or Plugged Coil (Clg.)	Water Volume Low (Htg.)	Water Volume High (Htg.)	Water Volume Low (Clg.)	Water Volume High (Clg.)	High Water Temperature (Clg.)	High Water Temperature (Htg.)	Low Water Temperature (Clg.)	Low Water Termperature (Htg.)	Solenoid Valve Stuck Closed (Htg.)	Solenoid Valve Stuck Closed (Clg.)	Solenoid Valve Stuck Open (Htg. or Clg.)	Source Water Pump Faltering (Htg.)	Source Water Pump Faltering (Clg.)	Load Water Pump Faltering (Htg.)	Load Water Pump Faltering (Clg.)
Compressor Will Not Run, No Line Power at Contactor																														
Compressor Will Not Run Power at Contactor																														
Compressor "Hums" But Will Not Start																														
Compressor Cycles on Overload		X																												
Thermostat Check Light On, Unit in Lock-out Mode		X																												
Compressor Off on High Pressure Control (Green Diagnostic Light Flashing)		X			X		X	X		X					X	X			X				X	X				X	X	
Compressor Off on Low Pressure Control (Orange Diagnostic Light Flashing)		X		X		X		X					X	X		X		X						X	X		X			X
Compressor Off on Flow Switch (Red Diagnostic Light Flashing)				X	X	X		X						X	X	X		X						X			X	X	X	X
Compressor Noisey	X																													
Head Pressure Too High		X			X			X		X	X			X		X					X			X	X			X	X	
Head Pressure Too Low	X			X		X			X				X		X		X				X									
Suction Pressure Too High	X	X					X				X								X		X									
Suction Pressure Too Low	X	X		X		X							X		X			X					X	X	X		X			X
High Compressor Amps																														
Excessive Water Usage																										X				
Compressor Runs Continuously - No Cooling	X	X						X										X												X
Liquid Refrigerant Flooding Back to Compressor				X		X							X		X			X				X		X			X		X	X
Compressor Runs Continuously - No Heating				X		X							X											X			X			
Reversing Valve Does Not Shift			X																											
Liquid Refrigerant Flooding Back to Compressor	X	X		X		X							X		X			X				X					X	X	X	X
Excessive Operation Costs	X	X		X	X		X	X						X	X		X	X			X	X					X	X	X	X
Ice in Water Coil				X		X																		X			X			

SERVICE

SERVICE HINTS

Check all power fuses or circuit breakers to ensure that they are all the correct rating.

UNBRAZING SYSTEM COMPONENTS

If the refrigerant charge is removed from a scroll equipped unit by bleeding the high side only, it is sometimes possible for the scrolls to seal, preventing pressure equalization through the compressor. This may leave low side shell and suction line tubing pressurized. If the brazing torch is then applied to the low side while the low side shell and suction line contain pressure, the pressurized refrigerant and oil mixture could ignite when it escapes and contacts the brazing flame. To prevent this occurence, it is important to check both the high and low side system pressures with manifold gauges before unbrazing. Removal of service port cores is highly recommended as secondary insurance that all system pressure has been relieved.

⚠WARNING

BOTH HIGH & LOW SIDE OF HIGH AND LOW SIDE OF THE SCROLL COMPRESSOR MUST BE CHECKED WITH MANIFOLD GAUGES BEFORE UNBRAZING SYSTEM COMPONENTS. FAILURE TO DO SO COULD CAUSE PRESSURIZED REFRIGERANT AND OIL MIXTURE TO IGNITE IF IT ESCAPES AND CONTACTS THE BRAZING FLAME CAUSING PROPERTY DAMAGE, BODILY HARM, OR DEATH.

COMPRESSOR SOLENOID

See Sequence of Operation on Pages 28 & 29 for function.

A nominal 24-volt direct current coil activates the internal compressor solenoid. The input control circuit voltage must be 18 to 28 volts ac. The coil power requirements is 5 VA. The external electrical connection is made with a molded plug assembly. This plug contains a full wave rectifier to supply direct current (dc volts) to the unloader coil.

COMPRESSOR SOLENOID TEST PROCEDURE – If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor amperage. Cycle the compressor solenoid on and off at 10-second intervals. The compressor amperage should go up or down at least 25 percent.

2. If Step #1 does not give the expected results, shut unit off. Apply 18 to 28 volts ac to the solenoid molded plug leads and listen for a click as the solenoid pulls in. Remove power and listen for another click as the solenoid returns to its original position.

3. If "clicks" cannot be heard, shut off power and remove the control circuit molded plug from the compressor and measure the solenoid coil resistance. The resistance should be 32 to 60 ohms depending on compressor temperature.

4. Next, check the molded plug:

   Voltage Check: Apply control voltage to the plug wires (18 to 28 volts ac). The measured dc voltage at the female connectors in the plug should be around 15 to 27 volt dc.

   Resistance Check: Measure the resistance from the end of the one molded plug lead to either of the two female connectors in the plug. One of the connectors should read close to zero ohms, while the other should read infinity. Repeat with other wire. The same female connector as before should read zero, while the other connector again reads infinity. Reverse polarity on the ohmmeter leads and repeat. The female connector that read infinity previously should now read close to zero ohms.

   Replace plug if either of these test methods does not show the desired results.

GROUND SOURCE HEAT PUMP
PERFORMANCE REPORT

DATE ____________________ TAKEN BY: ____

1. Unit Manufacturer _________________ Model No. _________________ Serial No. __________________

Thermostat Manufacturer ___________________ Model No. __________________

2. Company Reporting ____

3. Installed by ____ Date Installed _____________________

4. User's (Owner's) Name ____

Address____
____

5. Unit location ____

WATER SYSTEM INFORMATION

6. Open Loop System (Water Well) ______________ Closed Loop System _________________

A. If Open Loop, where is water discharged ?____

7. The following questions are for Closed Loop systems only!

A. Closed Loop system designed by: ____

B. Type of Antifreeze used ____________________________________ % Solution ___________________

C. System Type: Series ___________________ Paralled _____________________

D. Pipe Material ______________________________ Nominal Size ________________________________

E. Pipe Installed:

1. Horizontal ______________________ Total Length of Pipe __________________ ft.

No. Pipe in Trench _________________ Depth bottom pipe ____________________ ft.

2. Vertical ________________________ Total depth of bore hole ________________ ft.

THE FOLLOWING INFORMATION IS NEEDED TO CHECK PERFORMANCE OF UNIT.

	*Cooling	* Heating
LOOP SIDE DATA		
8. Entering fluid temperature	________	________
9. Entering fluid pressure	________	________
10. Leaving fluid temperature	________	________
11. Leaving fluid temperature	________	________
12. Pressure drop through coil	________	________
13. Gallons per minutes through water coil	________	________
14. Fluid temperature rise	________	________
15. Discharge Pressure	________	________
16. Suction Line Pressure	________	________
17. Voltage at Compressor (unit running)	________	________
18. Amperage draw at line side of contactor	________	________
19. Amperage draw of compressor common wire	________	________
20. Suction line temperature 6" from compressor	________	________
21. Superheat at compressor	________	________
22. Liquid line temperature at metering device	________	________
23. Coil subcooling	________	________
LOAD SIDE DATA		
24. Entering fluid temperature	________	________
25. Entering fluid pressure	________	________
26. Leaving fluid temperature	________	________
27. Leaving fluid temperature	________	________
28. Pressure drop through coil	________	________
29. Gallons per minutes through water coil	________	________
30. Fluid temperature rise	________	________

31. Other information about installation ____

____

____

* Make sure the desuperheater is de-activated if installed.