

# 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:2100-583ESupersedes:2100-583DDate:7-26-16

# **CONTENTS**

Getting Other Informations and Publications3
General Information Water Source Nomenclature4
Application and LocationGeneral7Shipping Damage7Application7Location7Unit Stacking7Additional Consideration7Required Steps after Final Placement7ANSI Z535.5 Definitions8
Power & Control Wiring         High Voltage Line Supply
Relocatable Control Panel 10
Wiring - Low Voltage Dual Primary & Low Voltage Connections
Piping Access to Unit Loop, Load & Desuperheater Connections
Load Side Water Connections Sizing Buffer Tanks for Zoned Systems
Ground Loop (Earth Coupled Water Loop App.) Circulation System Design16
Ground Water (Well System App.) Water Connections

Desuperheater (Potable Hot Water Assist) Description	23
Location	23
Electrical Connection	
Installation Procedure - General	
Operation of Heat Recovery Unit	
Start Up & Check Out	
Maintenance	
Control Board Sequence of Operation	28
Sequence of Operation	
Part Load Cooling	
Full Load Cooling	
Part Load Heating	
Full Load Heating	29
Geothermal Logic Control	29
High & Low Pressure Switch	
Flow Switch	
Over/Under Voltage Protection	
Intelligent Reset	
Alarm Output	
Pressure Service Ports	
Checking Refrigerant Quantity	30
Refrigerant Charge General	31
R-410A & Topping Off System Charge	
Safety Practices	
Troubleshooting Table	45
Service Hints, Unbrazing System Components & Compress Solenoid	
Ground Source HP Perf. Report & Checklist - Perform. Unit 47 &	48

# Figures

iguies	
Figure 1	Unit Dimensions
Figure 2	Wire Routing to Control Panel9
Figure 3	Changing Water Entrance Location 10
Figure 4	Control Wiring (Control Panel & Conduits) 11
Figure 5	Typical Load Side Hydronic System 15
Figure 6	Circulator System Design16
Figure 7A	Circulation System Design 17
Figure 7B	Model DORFC-1 Flow Center 17
Figure 7C	Model DORFC-2 Flow Center 17
Figure 8	Water Connection Components 19
Figure 9	Water Coil Cleaning21
Figure 10	Desuperheater Wiring Diagram25
Figure 11	One-Tank Desuperheater System26
Figure 12	Two-Tank Desuperheater System
Figure 13	Inlet & Outlet Thermistor Temp Curves 28
Figure 14	System Component Locations
Figure 15	Electrical Control Locations
Figure 16	Cooling Cycle Diagram
Figure 17	Heating Cycle Diagram
Figures 18	-22 Pressure Tables

# Tables

Table 1	Rated Flow Rates for Various Fluids4
Table 2	Electrical Specifications5
Table 3	Source Side Water Coil Pressure Drops 5
Table 4	Operating Voltage Range12
Table	Low Voltage Connections for DDC Controls . 12

# **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
	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

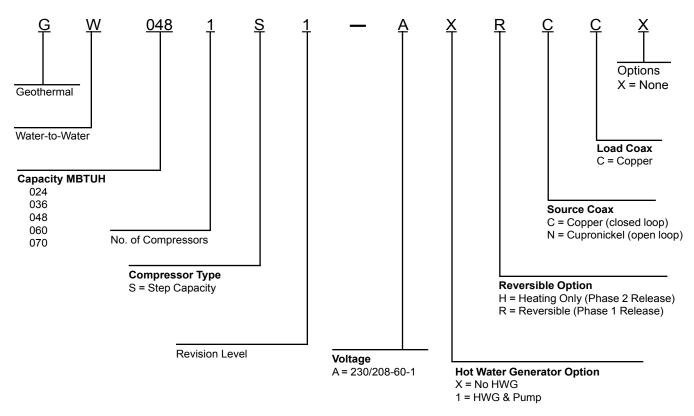
**EPA WaterSense Partner** www.epa.gov/watersense

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



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

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

TABLE 1 RATED FLOW RATES FOR VARIOUS FLUIDS

### TABLE 2 ELECTRICAL SPECIFICATIONS

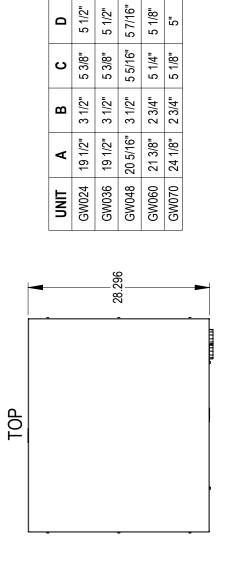
MODEL	GW024	GW036	GW048	GW060	GW070
Electrical Ratings (Volts/Hz/Phase)		-	208/230-60-1		
Operating Voltage Range			253-197 VAC		
Minimum Circuit Ampacity	16.9	21.4	28.8	36.1	39.4
+Field Wire Size	10	8	6	6	6
Ground Wire Size	12	12	10	10	10
++Delay Fuse of Circuit Breaker Max.	25	35	50	60	60
COMPRESSOR			•		
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)		<b>.</b>	<u>.</u>		
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

	(Based upon 15% Methanol in Heating Mode @ 50°F)									
Model	GW	/024	GW	036	GW	/048	GW	060	GW	/070
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

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

FIGURE 1 - UNIT DIMENSIONS



20 5/16" 3 11/16"

2 5/8"

21 3/8" 24 1/16"

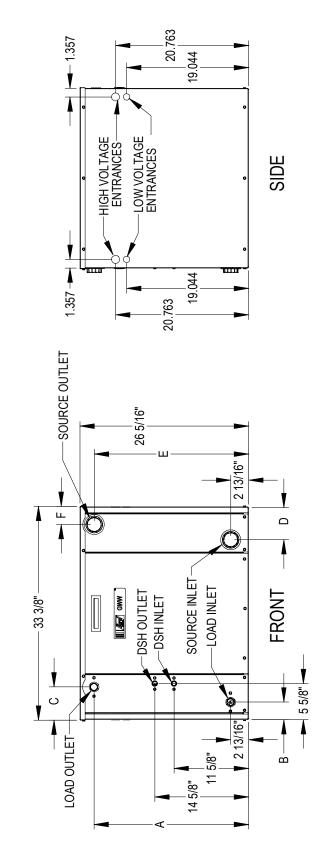
ť

3 9/16" 3 1/2"

19 7/16" 19 7/16"

ш

ш



MIS-3160

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

# GENERAL

Each unit is shipped internally wired, requiring both groundsource 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. *NOTE: The tie plates are secured to the front of the control panel cover for shipment.* 

# 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.

#### REQUIRED STEPS AFTER FINAL PLACEMENT

The compressor is secured to the unit base for shipping. Although the unit will perform as designed with the compressor secured in place, there may be noticeable additional noise and vibration. To obtain the lowest noise and vibration levels, remove the compressor shipping brackets after the unit is in its final operating location.

To gain access to the compressor shipping brackets, remove both the front and rear service panels. The brackets have "hot pink" labels and are located on the compressor double isolation base at the front and rear of the compressor. The brackets are secured to the unit base with two (2) screws, and secured to the isolation plate with a  $\frac{1}{4}$ " nut. Remove and dispose of the two (2) screws and brackets. Reinstall  $\frac{1}{4}$ " nut once bracket is removed.

# 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.

# 

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.



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.

# **ACAUTION**

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.

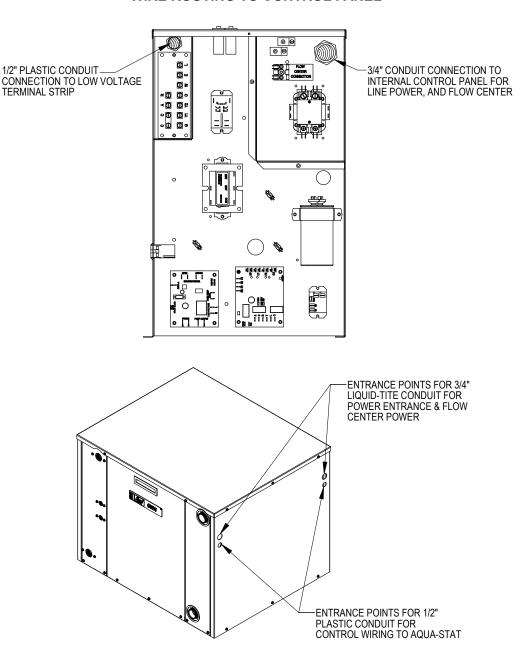
# NOTICE

# HIGH VOLTAGE LINE SUPPLY

Supplied with the unit is an adequate length of  $\frac{3}{4}$ " liquid-tite conduit and fittings to run internally within the sheet metal chassis from the control panel to one of four (4)  $1\frac{1}{8}$ " 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  $\frac{1}{2}$ " plastic conduit and fittings to run internally within the sheet metal chassis from the low voltage box to one of four (4)  $\frac{7}{8}$ " 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

MIS-3161

# **RELOCATABLE CONTROL PANEL**

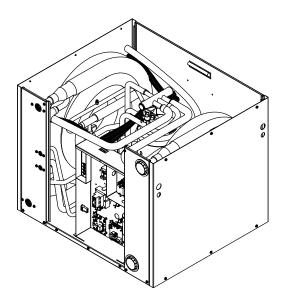
The control panel of the GW-Series products can be relocated to best suit the installation. It is factory shipped where the control panel is located on the same side of the unit the water connections are located. *NOTE: the control panel can be moved to the rear of the unit opposite to where the water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

- 1. Remove both front and rear service panels.
- 2. Remove control panel cover.

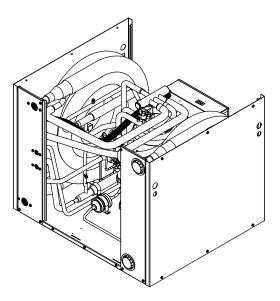
- 3. Remove four (4) screws securing control panel to unit base.
- 4. Lift and turn control panel sideways guiding it along the right side of the compressor toward the rear of the unit.
- 5. Re-secure to unit base at new location.



### CONTROL PANEL LOCATIONS



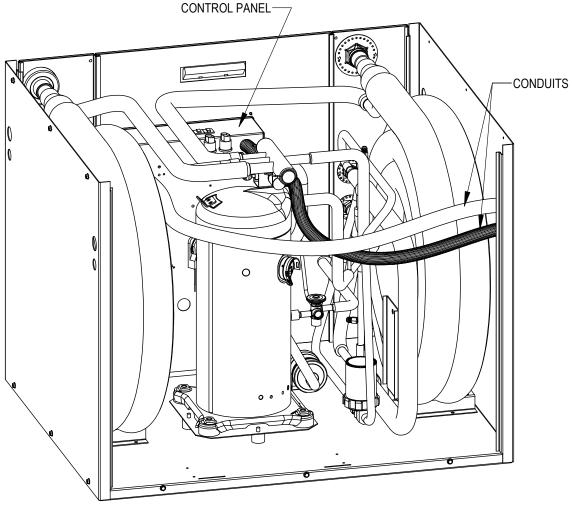
FRONT - AS SHIPPED LOCATION



OPTIONAL REAR LOCATION

MIS-3163

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).
- 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.

# 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 4OPERATING VOLTAGE RANGE

ТАР	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  $1\frac{1}{4}$ " 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 ontime, 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)

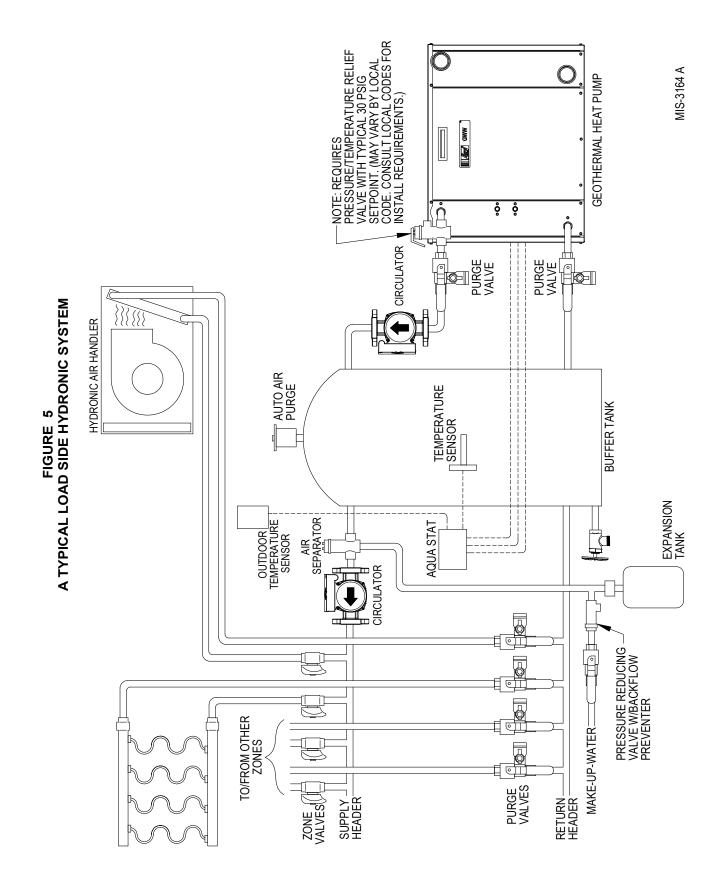
Qload = rate of heat extraction from the tank (Btu/h)

 $\Delta T$  = 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?

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.



# **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

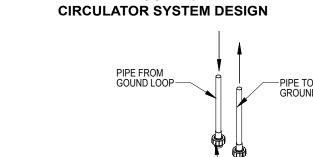
Equipment room piping design is based on years of experience with earth coupled heat pump systems. The design eliminates most causes of system failure.

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.

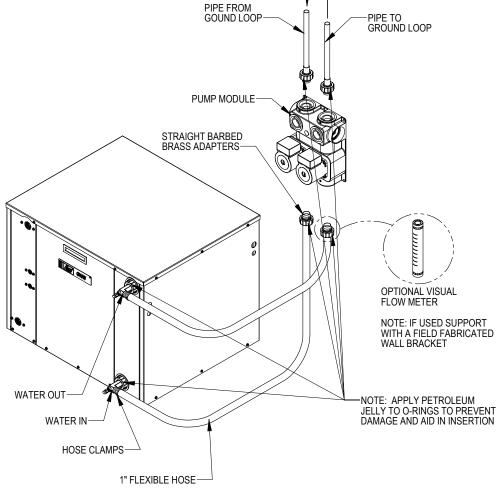
Most household water systems have more than enough water pressure either from the well pump or the municipal water system to overcome the pressure of head loss in  $\frac{1}{2}$ inch or <sup>3</sup>/<sub>4</sub> inch household plumbing. A closed loop earth coupled heat pump system however, is separated 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.

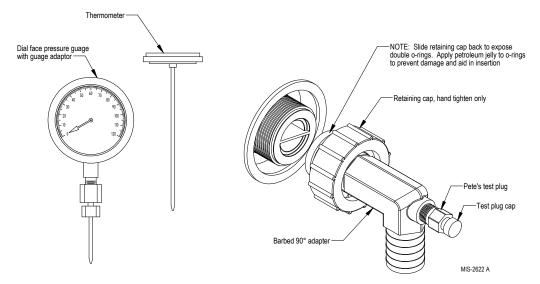
MIS-3165



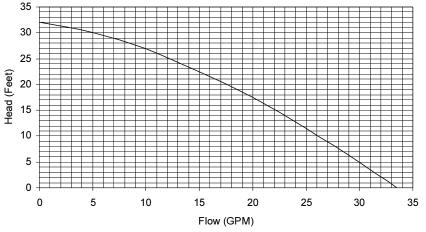
**FIGURE 6** 

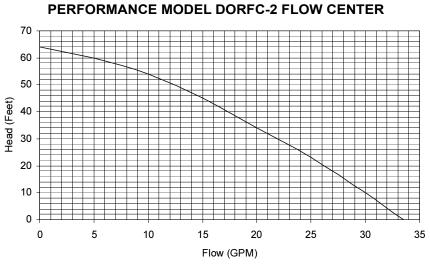












**FIGURE 7C** 

Manual 2100-583E Page 17 of 48

# **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 <u>Electrically</u> <u>Actuated Valve</u> 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.

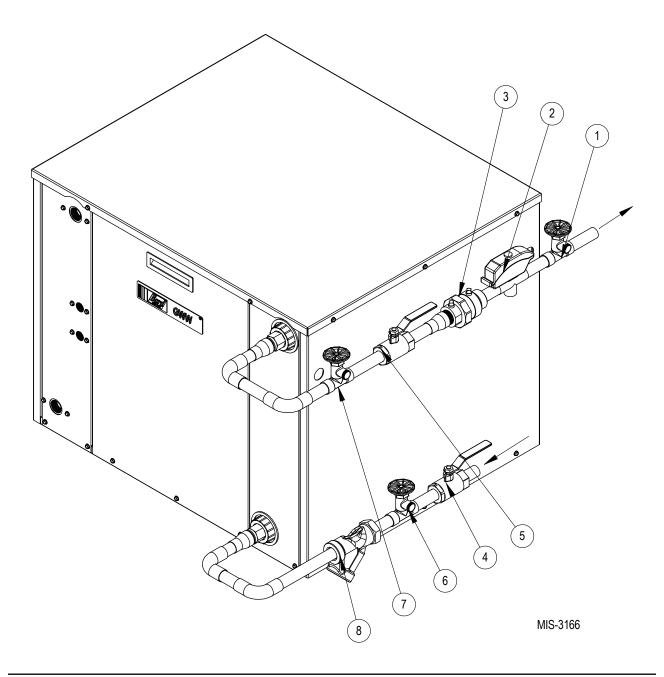
The well pump must be capable of supplying enough water and at an adequate pressure to meet competing demands of water fixtures. The well pump must be sized in such a way that three requirements are met:

- 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.

# **GROUND WATER (WELL SYSTEM APPLICATIONS)**

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.

 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 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.

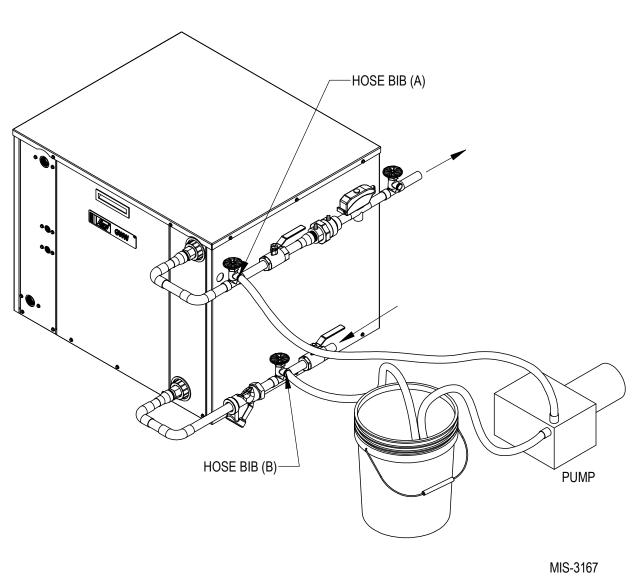
4. Scale Formation Of all the water problems, the formation of scale by ground water is by far the most common. Usually due to the formation of calcium carbonate, but magnesium carbonate or calcium sulfate may also be present. Carbon dioxide gas (CO2), the carbonate of calcium and magnesium carbonate, 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 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



# 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.



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 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 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  $\frac{1}{2}$  nominal copper plumbing.

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

# 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.

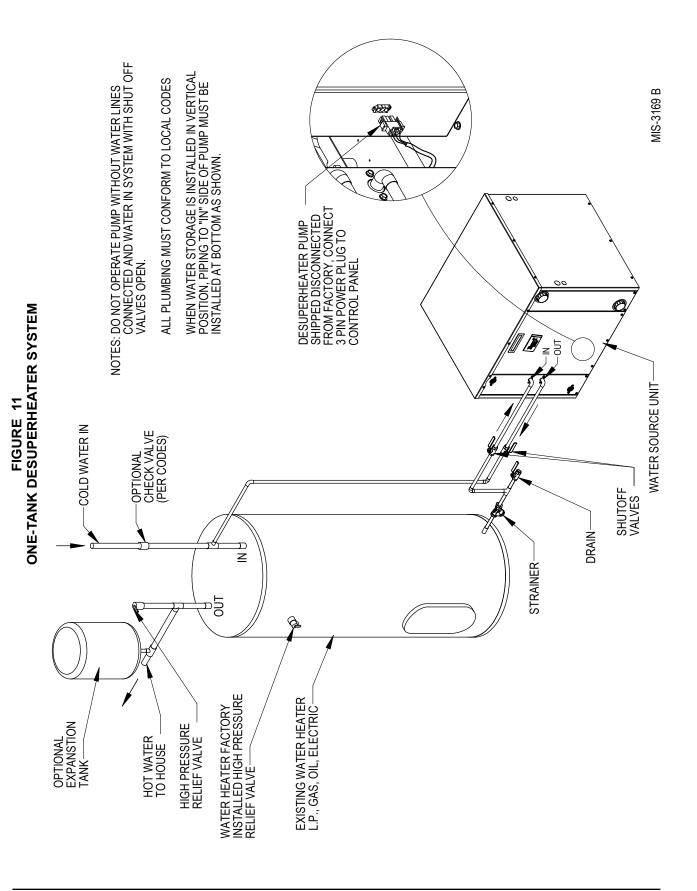
**NOTE:** When checking the refrigerant operating pressures of the ground source heat pump the desuperheater must be turned off. With the desuperheater operating, a wide variance in pressure can result, giving the service technician the indication there is a charge problem when the unit is operating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

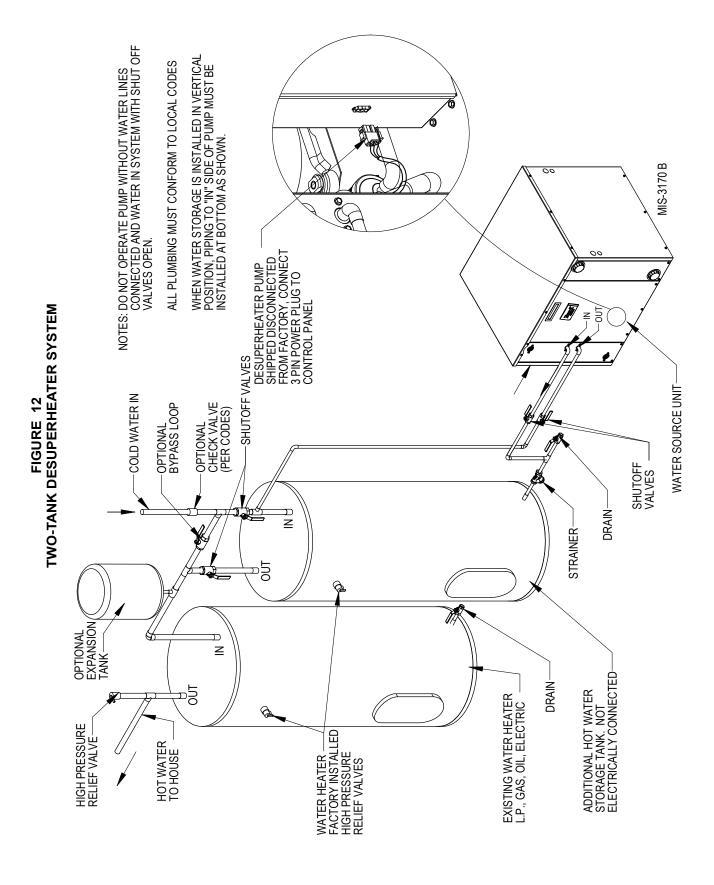
# MAINTENANCE

**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.

COMPRESSOR CONTACTOR SIGNAL LOW VOLTAGE TERMINAL STRIP DESUPERHEATER PUMP CONTROL 3 AMP 38U7 TAT2T Ο Ο Щ Ш R RED BLACK CONTROL LOGIC Ć -BLACK THERMISTOR WATER SENSORS -BLACK -BLACK THERMISTOR ----NO BLACK NC -BLACK RED LIMIT DESUPERHEATER 1,2,3 I Ο Î I Ο PUMP PLUG MIS-2844 A BLACK-RED RED RED PUMP MOTOR BI-METAL TEMPERATURE LIMIT (F) 208/230-60-1 LINE POWER

FIGURE 10 DESUPERHEATER WIRING DIAGRAM





# 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.

# **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.

This unit employs high-flow Coremax valves instead of the typical Shrader type valves.

#### WARNING! Do NOT use a Schrader valve core removal tool with these valves. Use of such a tool could result in eye injuries or refrigerant burns!

To change a Coremax valve without first removing the refrigerant, a special tool is required which can be obtained at <u>www.fastestinc.com/en/SCCA07H</u>. See the replacement parts manual for replacement core part numbers.

# 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.
- R-410A is nearly azeotropic similar to R-22 and R-12. Although nearly azeotropic, charge with liquid refrigerant.
- 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**

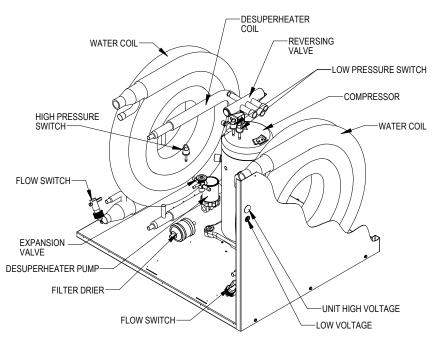
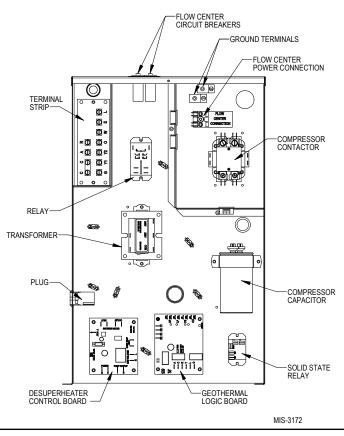


FIGURE 14 SYSTEM COMPONENT LOCATIONS

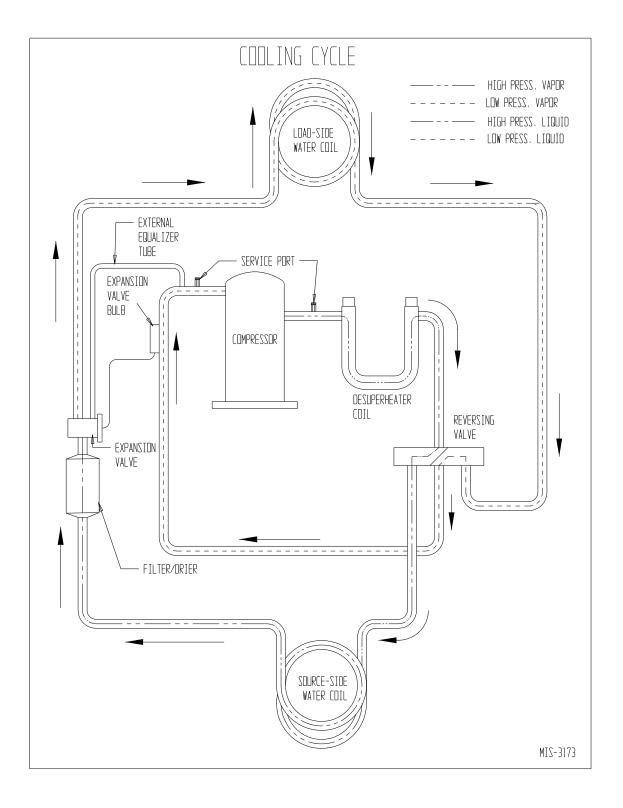
MIS-3171

#### FIGURE 15 ELECTRICAL CONTROL LOCATIONS



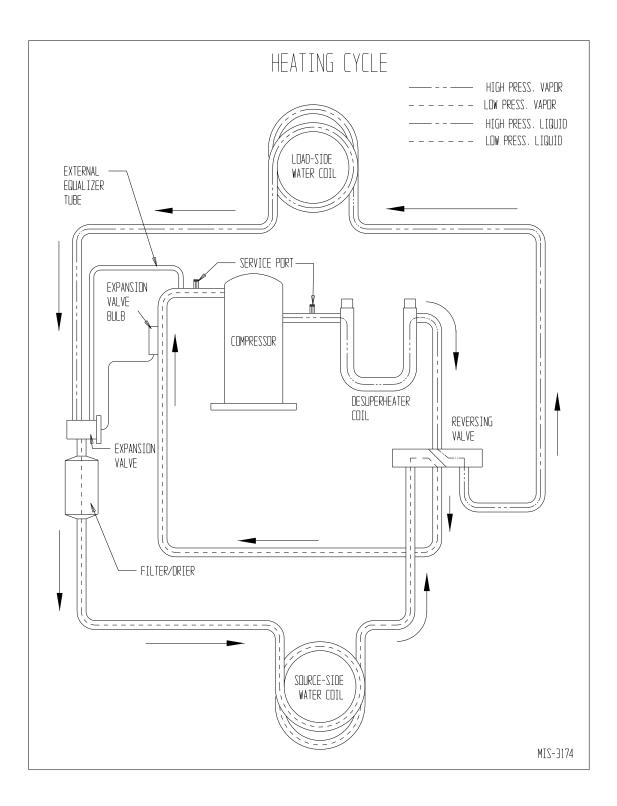
# **REFRIGERATION SYSTEM DIAGRAMS**

FIGURE 16 COOLING CYCLE DIAGRAM



# **REFRIGERATION SYSTEM DIAGRAMS**

FIGURE 17 HEATING CYCLE DIAGRAM



#### FULL LOAD COOLING

## FIGURE 18A — GW024 PRESSURE TABLES

### PART LOAD COOLING

SOURCE L			n	SYSTEMS REFRIGERANT PRESSURES			
		LOA EWT °F		Suction PSIG	Discharge PSIG		
		50	<u>.</u>	117	191		
	5	70		124	194		
		90		162	181		
		50	1	113	187		
	6	70		120	190		
50		90	7**	159	177		
50		50	'	111	180		
	7*	70		118	184		
		90		156	171		
		50		123	182		
	8	70		116	178		
	ļ	90		154	165		
	_	50		117	225		
	5	70		134	231		
		90		163	223		
		50		115	220		
	6	70 90		132 160	226 218		
60			7**	113	218		
	7*	50 70		130	214		
	l '	90		158	219		
		50		145	220		
	8	70		128	215		
	U U	90		157	207		
		50		118	259		
	5	70		145	267		
	ľ	90		164	265		
	<u> </u>	50	1	116	253		
	6	70		143	261		
70	-	90	-	162	259		
70		50	7**	115	247		
	7*	70		141	255		
		90		160	253		
		50	1	166	259		
	8	70		140	251		
		90		159	249		
		50		119	293		
	5	70		155	304		
		90		164	307		
		50		117	286		
	6	70		154	296		
80		90	7**	163	299		
00		50	'	117	281		
	7*	70		153	291		
		90		162	294		
		50		188	297		
	8	70		152	287		
		90		161	290		
	-	50		120	337		
	5	70 90		158 175	347 352		
				175	352		
	6	50 70		119 157	330 340		
		90		157	340		
90		90 50	7**	118	325		
	7*	70		156	335		
	l '	90		173	340		
		50		193	341		
	8	70		155	331		
	Ĭ	90		173	336		
	1	50		121	381		
	5	70		161	391		
		90		186	398		
		50	1	120	374		
	6	70		160	384		
100	L	90	7**	185	391		
100		50	7**	120	369		
	7*	70		159	378		
		90		184	386		
		50	7	199	384		
	8	70		159	374		
		90		184	382		
		50		122	426		
	5	70		164	435		
		90		197	444		
		50		122	418		
	6	70		163	427		
110		90	7**	196	437		
		50	.	121	413		
	7*	70		162	422		
		90		195	432		
	1	50		204	427		
	C .						
	8	70 90		163 196	418 427		

EWT °F         GPM         EWT °F         GPM         Suction F           5         50         123         148           90         149         149           6         70         145           90         7**         145           50         70         145           90         7**         145           90         144         143           90         144         143           90         162         164           8         70         151           6         70         151           6         70         151           6         70         151           6         70         151           6         70         151           6         70         151           90         158         125           5         70         159           90         7**         122           7         50         125           7         50         125           7         50         125           90         172         156           90         172	Discharge PSIG         Discharge PSIG           175         181           181         181           172         178           178         179           168         174           175         181           172         179           168         174           175         172           172         172           210         217           219         206           213         215           202         209           211         207           209         211           214         252           257         240           244         248           252         257           244         248           252         257           240         248           244         248           244         248           244         248           244         248           244         248           245         257           236         244           248         249           241         246
5         70 90         148 149           6         70 90         7**         145 145           7*         50 7*         7**         118 143           7*         50 70         7**         118 143           8         50 90         124           6         70 90         124           8         50 90         124           6         50 90         124           6         70 90         121           6         50 90         121           6         50 90         151           7*         50 90         151           7*         50 90         150           7*         50 90         125           7*         50 90         125           7*         50 90         125           7*         70         158           90         172         158           90         172         158           90         172         158           90         172         158           90         172         158           174         70         156           90         125         165	181           172           178           179           168           174           175           178           172           170           210           217           210           213           215           202           209           211           214           207           209           211           214           207           209           211           214           207           209           211           214           207           209           211           214           207           209           211           214           252           257           240           248           252           236           248           249           241           246           279           288
90         149           6         50         120           7*         50         7**           7*         50         184           8         70         139           90         140         145           7*         50         164           8         70         164           90         164         149           90         164         145           90         164         139           90         90         140           8         70         154           90         158         156           6         70         151           90         158         162           7*         50         120           7*         50         120           7*         50         125           8         70         121           166         70         120           90         125         158           90         125         158           90         173         156           90         172         165           90         125         <	181           172           178           179           168           174           175           178           172           172           172           172           172           210           217           219           206           213           215           202           209           211           214           207           209           211           214           207           209           211           214           207           209           214           252           257           240           248           252           236           244           248           249           241           246           279           288           294
6         50 70 90         7**         120 145 145 148 143 144 144 143 144 144 144 144 144           7*         70 90         7**         162 145 145 145 145 145 143 143 144           8         70 90         124 162         124 162           90         140         164           8         70         118           90         140         154           90         70         154           90         70         154           90         70         154           90         70         154           90         70         150           7*         50         120           7*         50         125           70         50         159           90         7**         158           90         174         122           7*         50         70           90         172         156           90         172         156           90         172         156           90         172         156           90         172         156           90         125         125           90	172           178           179           168           174           175           178           172           172           172           210           211           206           213           215           202           209           211           214           207           209           214           252           257           240           248           252           236           244           248           252           236           244           248           252           236           241           242           243           244           248           249           241           246           279           288           294
6         70 90         7**         145 145           7*         50 70         7**         145 143           8         50 90         164         143           90         164         143           90         164         143           90         164         144           8         70         154           90         90         140           90         50         121           6         70         151           90         7**         160           7*         70         150           7*         50         7**           8         50         121           90         156         120           7*         70         150           90         156         150           70         50         70           7*         70         150           90         7**         122           7*         50         70           90         172         156           90         125         165           90         7**         165           90	178           179           168           174           175           178           172           172           172           210           217           219           206           213           215           202           209           211           214           207           209           214           252           257           240           248           252           236           244           248           249           241           248           249           241           248           249           241           2426           279           288           294
50         7*         50         7**           7*         70         90         118           43         90         164           8         70         164           8         70         164           8         70         154           90         140         162           5         70         154           90         7*         154           90         7*         154           90         7*         154           90         7*         154           90         7*         154           90         7*         154           90         7*         151           90         7*         120           7*         50         7*           8         70         158           90         7*         159           90         7**         122           173         158           90         173           8         50         125           90         172           164         90           90         125           164 <td>168           174           175           178           172           172           172           172           210           217           219           206           213           215           202           209           211           214           207           209           211           214           207           209           211           214           207           209           211           214           252           257           240           248           252           236           248           249           241           246           279           288           294</td>	168           174           175           178           172           172           172           172           210           217           219           206           213           215           202           209           211           214           207           209           211           214           207           209           211           214           207           209           211           214           252           257           240           248           252           236           248           249           241           246           279           288           294
1         50         1         118           7*         70         143           90         144           8         50         164           8         70         139           90         90         140           8         50         124           6         70         139           90         90         140           6         70         124           6         70         121           6         70         151           90         7**         160           7*         70         151           8         50         121           7*         70         156           90         7**         160           158         50         125           8         50         125           90         7**         122           156         70         156           90         172         156           90         172         156           90         172         156           90         172         156           90         172 </td <td>174           175           178           172           172           172           210           217           219           206           213           215           202           209           211           214           207           209           214           252           257           240           248           252           236           244           248           252           236           244           248           252           236           244           248           249           241           246           279           288           294</td>	174           175           178           172           172           172           210           217           219           206           213           215           202           209           211           214           207           209           214           252           257           240           248           252           236           244           248           252           236           244           248           252           236           244           248           249           241           246           279           288           294
90         144           8         50         164           90         90         140           90         90         140           90         90         160           90         90         154           90         90         154           90         90         121           6         70         121           90         7*         160           7*         50         7*           7*         50         7*           7*         70         150           90         156         150           7*         70         150           90         156         123           7*         50         7*           7*         50         7*           7*         50         123           7*         50         125           90         172         156           90         172         156           90         172         165           90         125         165           90         125         165           90         124	175           178           172           172           210           217           219           206           213           215           202           209           211           214           207           209           214           252           257           240           248           252           236           244           248           249           241           248           249           241           248           249           241           248           249           241           242           243           249           241           242           243           244           248           249           241           2426           279           288           294
8         50 70 90         164 139 140           5         70 90         124 154 90           6         70 90         121 161           6         70 90         7**           6         70 90         151           7*         50 70         151           7*         50 70         7**           8         70         151           8         50         125           7*         50         125           8         50         125           6         70         147           90         123         158           7*         50         7**           6         70         158           90         7**         159           90         172         158           90         172         158           90         172         156           90         172         158           8         50         125           90         172         165           90         172         164           90         7**         164           90         125         126	178           172           172           210           217           219           206           213           215           202           209           211           214           207           209           211           214           207           209           211           214           207           209           211           214           252           257           240           243           252           236           248           249           241           246           279           288           294
8         70         139           50         50         124           5         70         154           90	172           172           210           217           219           206           213           215           202           209           211           214           207           209           214           252           257           240           248           252           236           244           248           249           241           248           249           241           248           249           241           248           249           241           248           249           241           246           279           288           294
90         140           5         50         124           5         70         154           90         70         162           6         50         121           6         50         120           7*         70         150           7*         70         150           7*         50         120           7*         70         150           90         7**         150           70         90         159           70         50         159           90         7**         159           70         50         159           7*         50         171           7*         50         159           7*         50         172           7*         50         172           7*         50         172           159         90         174           122         156         173           90         7**         125           166         70         189           90         7**         165           90         124 <t< td=""><td>172           210           217           219           206           213           215           202           209           211           214           207           209           214           252           257           240           248           252           236           244           248           252           236           244           248           252           236           244           248           252           236           249           241           248           249           241           246           279           288           294</td></t<>	172           210           217           219           206           213           215           202           209           211           214           207           209           214           252           257           240           248           252           236           244           248           252           236           244           248           252           236           244           248           252           236           249           241           248           249           241           246           279           288           294
5         50 70 90         124 154 162           6         70 90         121 151           6         70 90         7**           6         70 90         7**           7*         70 90         150 150           7*         70 90         156           8         70         147           90         55         125           7         50 90         7**         126           7         50 90         7**         125           6         70 90         7**         125           7*         70         156           90         7**         122           7*         70         156           90         7**         156           90         172         156           90         172         165           90         172         165           90         125         164           90         124         163           8         70         165           90         7**         164           90         189         189           184         90         188	210 217 219 206 213 215 209 211 214 207 209 211 214 207 209 244 252 257 240 244 252 257 240 244 248 252 252 236 244 248 249 241 248 249 241 248 249 241 248 249 241
5         70 90         154           6         70 90         151           7*         50 70         7**           8         50         120           90         158         150           8         50         177           90         158         165           7*         50         125           8         50         125           90         90         158           70         50         125           6         70         159           90         7**         159           90         7**         159           70         50         70           7*         50         70           7*         50         172           7*         50         125           90         172         165           90         172         165           90         125         164           90         125         164           90         7*         165           90         124         164           90         189         189           184	217 219 206 213 215 202 209 211 214 207 209 244 252 257 240 244 252 257 240 244 248 252 252 248 248 248 248 249 241 248 249 241 246 279 288 294
90         162           6         50         121           70         90         151           7*         50         7**           8         70         150           90         50         158           70         90         156           8         70         159           90         50         159           5         70         159           90         7**         156           70         50         159           6         70         159           7*         50         159           7*         50         173           7*         50         125           90         173         158           90         173         158           90         173         158           90         173         158           90         172         156           90         172         156           90         125         165           90         125         164           90         7*         165           90         164 <t< td=""><td>219 206 213 215 202 209 211 214 207 209 244 252 257 240 248 252 257 240 248 252 257 240 248 248 252 257 240 248 248 249 241 248 249 241 246 279 288 294</td></t<>	219 206 213 215 202 209 211 214 207 209 244 252 257 240 248 252 257 240 248 252 257 240 248 248 252 257 240 248 248 249 241 248 249 241 246 279 288 294
6         50 70 90         7**         121 151 160           7*         50 90         7**         120 150           7*         70 90         120         158           8         70         147         156           90         50         175         159           90         7**         122         156           70         50         70         159           90         7*         70         156           90         7**         122         158           70         7         70         156           90         7**         122         158           7*         70         156         123           8         70         156         123           90         7**         120         156           90         7**         126         150           8         70         125         166           90         7**         125         164           90         8         70         163           188         70         164         189           90         124         164         189	206 213 215 202 209 211 214 207 209 244 252 257 240 248 252 257 240 248 252 236 244 248 249 241 249 241 246 279 288 294
6         70 90         7**         160           7*         70 90         7**         160           7*         70 90         150         150           8         50         177           90         156         177           8         70         147           90         156         159           90         7**         159           90         7**         159           90         7**         123           6         70         156           90         7**         158           7*         70         156           90         7**         156           90         172         156           90         172         156           90         172         165           90         172         165           90         125         165           90         125         164           90         124         163           189         50         125           164         90         189           90         189         189           189         <	213 215 202 209 211 214 207 209 244 252 257 240 244 252 257 240 248 252 236 244 248 249 244 248 249 241 248 249 241 246
60         50         7**         120           7*         90         150         158           8         70         147           90         156         177           8         70         156           5         70         159           90         90         156           5         70         159           90         7**         123           6         70         178           90         7**         123           7         50         7**           7*         50         178           90         7**         122           7*         50         173           8         70         156           90         173         172           8         50         125           6         70         164           90         7**         165           189         124         163           90         125         164           90         7**         126           90         189         188           90         189         188	202 209 211 214 207 209 244 252 257 240 248 252 257 240 248 248 248 248 248 244 248 249 241 246 279 288 294
7*         50 90         120 150 150           7*         70 90         150 156           8         50 90         177           8         50 70         147           90         156           5         70 90         125           6         70 90         123           7*         70         174           7*         70         7**           7*         50 90         7**           7*         50 90         172           8         50 90         172           8         50 90         190           8         50 90         125           90         172         165           90         172         165           90         172         165           90         172         165           90         172         165           90         172         165           90         172         165           90         172         165           126         189         124           163         90         189           189         189         189	209 211 214 207 209 244 252 257 240 248 255 236 244 248 244 248 249 241 249 241 246 279 288 294
90         158           8         50         177           90         156         177           90         156         159           90         90         176           90         50         123           6         70         158           90         76         159           90         776         123           7*         70         156           90         7*         156           90         7*         156           90         172         156           90         172         156           90         172         156           90         172         156           90         172         165           90         172         165           90         125         165           90         125         164           90         124         124           7*         70         163           90         189         189           189         189         189           90         189         189           90         189	211 214 207 209 244 252 257 240 248 252 236 244 248 249 244 248 249 241 246 279 288 294
8         50 70         1177 147 90           5         70 90         125 159 90           6         50 90         123 158 90           70         50 70         123 158 90           6         70 90         173           7*         50 70         7**           7*         50 90         173           8         50 90         125           5         70 90         125           6         70 90         164 90           8         50 90         125           6         70 90         164 90           90         189           7*         70 164           90         189           8         50 70 90         125           6         70 90         164 90           90         189           8         50 70         167           90         189           188         188           90         189           90         189           189         189           189         189           189         189           189         189           189	214 207 209 244 252 257 240 248 252 236 244 248 248 249 241 248 249 241 246 279 288 294
8         70 90         147 156           5         50 90         125 159 90           6         50 90         123 158 90           7*         50 70         7**           7*         50 90         7**           7*         50 90         173           7*         50 90         173           8         70         156           90         173           8         70         125           5         70 90         173           8         50         125           6         70 90         125           6         70 90         125           6         70 90         164 90           8         70         165 189           90         125           6         70 90         164           90         189           8         70         164           90         189           90         189           90         189           90         189           90         189           90         189           90         198           90	207 209 244 252 257 240 248 252 236 244 248 249 241 249 241 246 279 288 294
90         156           50         50         125           90         90         176           6         90         178           70         50         158           90         7**         122           7*         70         156           90         7**         122           7*         50         173           90         50         170           8         70         156           90         172         156           90         172         156           90         172         156           90         172         156           90         125         166           90         125         164           90         125         164           90         124         124           7*         70         163           90         189         124           7*         70         164           90         189         124           7         50         127           164         90         189           90         189	209 244 252 257 240 248 252 236 244 244 248 249 241 249 241 246 279 288 294
5         50 90         125 159 90           6         70 90         176 123           6         70 90         123           7*         50 90         7**           7*         70         156 90           7*         70         156 90           90         7**         156           90         172         156           90         172         165           90         172         165           90         172         165           90         7**         165           90         7**         165           90         7**         164           90         189         189           50         50         125           6         70         163           90         189         189           124         7*         163           90         189         189           189         189         189           189         189         189           90         189         189           90         189         189           90         126         126	244 252 257 240 248 252 236 244 248 249 241 249 241 246 279 288 294
5         70 90         159 90           6         50 70         50 70         123 158 90           7*         50 70         7**         122 156 90           7*         50 70         173           8         50         190           8         50         125           90         173         125           5         70         165           90         125         165           90         125         165           90         164         90           8         50         125           6         70         164           90         189         189           7*         70         164           90         189         184           8         50         203           8         50         203           90         189         189           90         189         184           90         189         188           90         125         126           90         129         127           5         70         167           90         129	252 257 240 248 252 236 244 248 249 241 249 241 246 279 288 294
90         176           6         50         123           90         90         174           7*         50         174           7*         50         174           90         7**         156           90         174         122           7*         50         173           8         70         156           90         172           8         70         156           90         172           5         50         125           90         189         189           6         50         124           90         189         189           164         90         189           189         124         164           90         124         163           90         164         189           164         90         189           164         90         184           90         164         189           164         90         189           164         90         189           90         164         189	257 240 248 252 236 244 244 248 249 241 241 246 279 288 294
6         50 70         123 90           70         50 7*         7**           7*         70 90         122           7*         70 90         122           7*         70 90         122           8         70         156           90         173         156           90         172         156           90         156         190           8         70         165           90         7*         165           90         7*         165           90         7**         163           80         50         125           6         70         165           90         129         189           7*         70         163           90         189         124           7*         70         164           90         189         189           8         70         164           90         189         189           90         189         189           90         189         189           90         189         189 <td< td=""><td>240 248 252 236 244 248 249 249 241 246 279 288 294</td></td<>	240 248 252 236 244 248 249 249 241 246 279 288 294
6         70 90         7*         158 74           7*         70 90         7**         122 156 90           7*         50 90         172           8         50 90         172           5         50 90         172           5         50 90         172           6         70 90         163           7*         70 163         125           6         70 90         1489           7*         70 90         163           8         70 90         163           90         163         189           164         90         164           90         163         189           164         90         163           90         163         188           8         70         163           90         189         189           189         189         189           189         189         189           189         189         189           189         189         189           189         189         189           189         189         189           189 <td>248 252 236 244 248 249 241 249 241 246 279 288 294</td>	248 252 236 244 248 249 241 249 241 246 279 288 294
90         7**         174           70         50         7**         122           7*         70         173         176           90         90         173         190           8         70         156         190           90         90         173         125           5         70         165         189           6         70         164         189           90         7*         164         189           7*         50         7**         189           7*         70         164         189           90         189         184         184           8         50         203         184           90         189         184         184           90         189         189         184           90         189         184         184           90         189         189         189           5         70         167         184           90         189         189         189           90         50         7**         167           90         18	252 236 244 248 249 241 241 246 279 288 294
70         50         7*         122           7*         70         90         156           90         50         190           8         70         156           90         172         156           90         172         165           90         172         165           90         172         165           90         172         164           90         7**         164           90         7**         164           90         7**         164           90         7**         164           90         164         189           7*         70         164           90         164         189           8         70         164           90         164         188           90         164         189           164         90         189           164         90         164           90         164         163           90         164         164           90         164         164           90         164         164 <td>236 244 248 249 241 246 279 288 294</td>	236 244 248 249 241 246 279 288 294
7*         70 90         156 173           8         50 90         190           8         50 90         156           90         172           5         70 90         165           90         172           5         70 90         165           90         72           6         70 90         189           7*         70 90         164           90         7**         124           7*         70 90         188           8         70         163           90         189         124           90         189         124           90         189         124           90         163         188           8         70         164           90         189         126           189         126         189           90         189         189           189         126         189           90         189         189           189         189         189           90         189         189           90         198         126 <td>244 248 249 241 246 279 288 294</td>	244 248 249 241 246 279 288 294
90         173           8         50         190           90         50         156           90         172         165           90         172         165           90         172         165           90         125         165           90         70         165           90         7*         164           90         7*         70           7*         70         163           90         125         164           90         128         124           7*         70         163           90         188         188           90         189         189           90         189         189           90         163         189           90         163         189           90         50         127           166         70         167           90         50         126           90         50         126           90         50         126           166         70         167           90         90	248 249 241 246 279 288 294
8         50 70         190 156 90           50         125           5         70 90         125           6         70 90         164           90         125           6         70 90         164           90         7**         189           7*         70         164           90         189         188           8         50         203           8         70         164           90         189         189           55         70         167           90         189         189           6         70         164           90         189         189           90         189         189           90         189         189           90         189         189           90         189         189           90         127         167           90         128         126           90         126         167           90         90         126           90         126         166           90         166         <	249 241 246 279 288 294
8         70 90         156 172           5         50 90         125 165 189           6         90         125 165           90         125 165           90         189           7*         70 90         124           7*         70 90         124           7*         50 90         124           8         70         164           90         124         163           90         188         188           8         70         164           90         189         124           164         90         189           90         164         188           90         164         164           90         128         164           90         164         164           90         164         164           90         164         164           90         164         164           90         164         164           90         164         164           90         128         126           90         126         166           90 <t< td=""><td>241 246 279 288 294</td></t<>	241 246 279 288 294
90         172           5         50         125           90         125         165           90         125         165           90         70         165           90         7*         164           90         7**         189           7*         70         163           90         7**         189           7*         70         163           90         124         124           7*         50         203           8         70         164           90         189         189           90         189         189           90         189         126           90         189         189           90         108         189           90         189         189           90         189         189           90         189         189           90         189         189           90         189         189           90         198         126           90         198         126           90         166	246 279 288 294
5         50 70 90         125 165 189           6         70 90         125 165           70         125 164           7*         70           7*         70           90         189           80         50 7*           7*         70           90         188           8         70           90         189           90         163           90         168           90         189           50         127           5         70           164         90           90         189           8         70           164         90           90         189           90         189           90         189           90         127           167         198           90         126           90         196	279 288 294
5         70 90         165 189           6         70 90         125 164           7*         50 7*         7**           7*         70         124 163           7*         70         124 163           90         7**         124 163           8         70         164 90           90         189           55         70 90         189           50         127           5         70 90         189           90         189           90         189           7*         70           90         127           164         189           90         127           166         70           90         126           90         126           90         125           7*         70           166         90           90         196	288 294
90         189           6         50         125           90         90         125           90         90         7**           7*         50         124           7*         70         189           90         189         189           7*         70         164           90         189         124           7*         70         163           90         189         203           8         70         164           90         189         189           8         70         164           90         189         124           90         90         189           90         50         127           90         50         126           90         50         126           90         7**         197           90         90         125           7*         70         166           90         196         196	294
80         50 70 90         7**         125 164 189           7*         50 7*         7**         124 124           7*         70 90         124         189           7*         70 90         124         189           8         70         124         188           90         164         189         124           90         50         127         164           90         164         188         189           50         70         164         189           90         50         127         166           90         198         128         128           50         50         127         167           90         50         7**         197           7*         70         166         167           90         90         90         196         196	
6         70 90         7*         164 189           7*         70         163           7*         70         163           90         189         188           80         50         203           8         70         164           90         189         189           50         127         167           90         50         127           5         70         167           90         50         126           6         70         167           90         50         126           6         70         167           90         7*         167           90         126         126           7*         70         167           90         7*         70         167           90         90         126         166	
80 7* 90 50 50 50 50 203 164 90 164 90 189 50 164 90 189 190 190 190 190 190 190 190 19	282
90	289
90 188 90 203 8 50 203 90 189 5 50 127 5 70 167 90 198 6 70 197 90 7* 70 90 196 126 127 198 127 198 126 127 198 127 198 126 127 198 127 198 126 127 198 127 198 126 127 198 127 198 126 127 198 126 127 198 126 126 126 197 197 197 197 197 197 197 197	270
90	278
8         70 90         164 189           50         127           5         70           90         167           90         198           6         70           90         7**           77         70           7*         70           90         196	285
90 189 50 127 5 70 167 90 198 6 70 198 6 70 198 6 70 198 7* 70 7** 197 125 7* 70 196	284
90 5 50 90 5 70 90 5 70 90 5 50 6 70 90 7* 70 90 7* 70 90 127 198 126 167 198 126 127 198 126 127 198 126 127 198 126 127 198 126 127 198 126 127 198 126 127 198 126 127 198 126 127 198 126 127 198 126 127 128 126 127 128 126 127 128 126 127 128 126 126 127 126 127 126 126 126 126 127 126 126 126 127 126 127	276
90 5 70 90 50 6 70 90 7* 70 90 7* 70 90 167 198 126 167 198 126 167 198 126 167 198 126 167 198 126 167 198 126 167 198 126 167 198 126 167 198 126 167 198 126 167 198 126 167 198 126 167 197 197 197 125 126 125 125 125 125 125 125 125 125	283
90 90 90 90 90 90 7* 70 90 7* 125 166 167 197 125 166 167 197 125 166 167 197 125 166 196 197 196 197 197 196 196 197 197 196 197 197 196 197 197 196 196 197 197 196 196 197 197 196 196 197 197 196 196 197 196 197 197 196 196 197 197 197 196 196 197 197 197 196 196 196 197 197 196 196 196 197 197 197 196 196 196 197 197 197 196 196 196 197 197 196 196 196 196 197 197 196 196 196 196 196 197 197 196 196 196 196 196 196 196 196	323
90	331 338
90 6 70 90 7* 70 7* 70 90 167 197 125 166 197 125 166 197 125 166 197 197	318
90 90 7** 197 50 7* 125 7* 70 166 90 196	326
90 50 7** 125 7* 70 166 90 196	333
7*         70         166           90         196	314
90 196	322
	329
50 207	328
8 70 166	320
90 197	327
50 128	366
5 70 170	375
90 206	382
50 127	
6 70 169	361
90         7**         205           100         50         7**         126	370
7* 70 168	370 377
90 204	370 377 357
50 211	370 377 357 366
8 70 169	370 377 357 366 374
90 205	370 377 357 366
50 129	370 377 357 366 374 372
5 70 172	370 377 357 366 374 372 363
90 214	370 377 366 374 372 363 371
50 128	370 377 366 374 372 363 371 409
6 70 172	370 377 357 366 374 372 363 371 409 418 426 405
	370 377 357 366 374 372 363 371 409 418 426 405 414
110 90 7** 214	370 377 366 374 372 363 371 409 418 426 405 414 422
110 50 7 127	370 377 366 374 372 363 371 409 418 426 405 414 422 401
110         50         7^*         127           7*         70         171	370 377 357 366 374 363 371 409 418 426 405 414 422 401 410
110         50         7*         127           7*         70         171         171           90         213         213	370 377 357 366 374 372 363 371 409 418 426 405 414 422 401 410 418
110         50         7^*           7*         70         127           171         171	370 377 357 366 374 363 371 409 418 426 405 414 422 401 410

Manual 2100-583E Page 35 of 48

#### FIGURE 18B — GW024 PRESSURE TABLES

#### FULL LOAD HEATING

#### PART LOAD HEATING

SOUR		LOA			ERANT PRESSURES
VT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
		60		62	198
	5	90		64	305
		120		67	450
	6	60 90		63 65	199 305
	6	90 120		65 67	305 450
20		60	7**	64	198
	7*	90		66	305
	'	120		68	450
		60		68	412
	8	90		66	306
		120		69	450
		60		78	203
	5	90		81	310
		120		84	455
30		60		80	203
	6 7*	90		82	311
		120	7**	85	455
		60		81	203
		90		83	311
		120		86	455
		60		87	419
	8	90 120		84 97	311
		120		87	455
	5	60 90		94 98	207 315
	5	90 120		98 101	459
		60		96	208
	6	90		99	316
	Ĭ	120		103	460
40		60	7**	98	208
	7*	90		101	317
		120		105	461
	8	60		105	425
		90		102	317
		120		106	461
50		60	7**	110	211
	5	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
		60 90		124 120	432 323
	8	90 120		120	323 466
		60		124	214
	5	90		134	326
	5	120		141	470
		60		124	215
	6	90		137	327
20		120	7**	144	470
60		60	1	125	216
	7*	90		138	328
		120		145	471
		60		153	441
	8	90		140	328
		120		146	472
		60		131	216
70	5	90	7**	154	332
		120		163	475
	_	60		134	217
	6	90 120		157 166	333
				166 136	476 218
	7*	60 90		136 159	218 334
		90 120		167	477
	8	60		182	450
		90		160	334
		120		169	477
80		60		142	219
	5	90		174	338
		120	7**	185	480
	6	60		145	220
		90		177	339
		120		188	481
		60		146	221
		90		179	340
		120		190	482
		60		212	459
	8	90		179	340
		120		191	483

SOUR	CE	LOA	П	SYSTEMS REERIG	ERANT PRESSURES
EWT °F		EWT °F		Suction PSIG	Discharge PSIG
		60		66	190
	5	90		68	296
		120		70	435
		60		66	190
	6	90 120		69 71	296 436
20		60	7**	67	190
	7*	90		70	296
		120		72	436
		60		72	402
	8	90		69	296
		120		72	436
	5	60 90		83 86	194 300
	5	120		89	441
		60		84	194
	6	90		87	301
30		120	7**	90	441
0		60	ľ	85	194
	7*	90		88	301
		120		91	441
	8	60 90		91 88	407 301
		120		91	441
		60		101	198
1	5	90		104	305
1		120		107	446
1		60		102	198
1	6	90		105	305
40		120	7**	109	447
1	7*	60 90		103 106	198 306
	l '	120		110	447
	8	60		110	413
		90		107	305
		120		111	447
		60		118	202
	5	90		122	310
		120		126	452
	6	60		120	202
		90 120		123 128	310 452
50		60	7**	120	203
	7*	90		125	310
		120		129	453
		60		129	418
	8	90		126	310
		120		130	453
	5 6 7* 8	60 90		131 143	205 314
		120		143	456
		60		134	206
1		90		146	315
60		120	7**	151	457
		60	'	135	206
1		90		147	315
		120		153 161	457 424
1		60 90		149	315
1	Ĭ	120		154	457
		60		145	209
	5	90		165	319
1		120		172	461
1		60		148	209
1		90		168	320
70	7* 8	120 60	7**	<u>174</u> 150	461 210
1		90		170	320
1		120		177	462
1		60		192	431
1		90		172	321
L		120		178	462
1	5 6 7*	60		158	212
1		90 120		187 194	324 465
		60		161	213
		90		190	325
80		120	7**	198	466
00		60	/ "	164	214
		90	_	193	326
		120		200	467
1	8	60 90		224 195	438 326
		120		202	467
	L				

Manual 2100-583E Page 36 of 48

## FIGURE 19A — GW036 PRESSURE TABLES

## PART LOAD COOLING

SOUF	CE	LOA	D	SYSTEMS REFRIG	ERANT PRESSURES
EWT °F		EWT °F		Suction PSIG	Discharge PSIG
		50	1	93	192
	6	70		97	191
		90		101	192
	7	50	1	91	187
	7	70 90		94 99	186 187
50		50	9**	89	177
	9*	70		92	177
	Ŭ	90		96	177
		50	1	93	177
	11	70		90	177
		90		94	178
		50		101	230
	6	70		106	231
		90		111	231
	-	50		99	224
	7	70 90		104 108	225 226
60		50	9**	96	214
	9*	70		101	214
	Ŭ	90		105	216
		50	1	100	215
	11	70		99	214
		90		104	215
		50		108	267
	6	70		115	270
		90		120	271
	_	50		106	261
	7	70		113	264
70		90	9**	118	265
-	0*	50		102	251
	9*	70 90		109 114	254 255
		50		114	255
	11	70		108	254
		90		113	252
		50		115	305
	6	70		123	309
		90		129	310
		50		114	298
	7	70		122	303
80		90	9**	128	304
00		50		109	288
		70		117	293
		90		123	294
	11	50		126	292
	11	70 90		117 123	288 289
		50		116	349
	6	70		130	355
	Ŭ	90		137	357
		50	1	115	342
	7	70		128	348
00		90	9**	136	350
90		50	9	111	332
	9*	70		125	338
		90		132	340
		50		138	338
	11	70		125	332
		90		132	334
	6	50 70		117 137	393 400
	0	90		137	400 403
		50		145	386
	7	70		135	393
	'	90		143	396
100		50	9**	113	375
	9*	70		132	383
		90		141	385
		50		151	384
	11	70		132	377
	L	90		140	380
		50		118	437
	6	70		143	446
		90		153	449
	7	50 70		116	429
	<sup>′</sup>	70 90		142 151	438 441
110		90 50	9**	151	441
	9*	50 70		115	419
		90		140	431
		50	1	164	430
	11	70		139	422
		10			

SOUR	CE	LOA	D	SYSTEMS REFRIG	ERANT PRESSURES
EWT °F				Suction PSIG	Discharge PSIG
	_	50		119	182
	6	70		120	181
		90 50		123 116	182 184
	7	70		117	183
	'	90		120	183
50		50	9**	113	175
	9*	70		114	174
		90		118	174
		50		115	169
	11	70 90		114 117	170 170
		90 50		117	218
	6	70		132	220
	-	90		137	221
		50		118	217
	7	70		129	219
60		90	9**	134	220
	<b>^</b> *	50	Ű	115	208
	9*	70 90		126 132	211
		50		132	212 209
	11	70		124	205
		90		130	207
		50		121	253
	6	70		143	259
		90		150	261
	_	50		120	250
	7	70 90		141	255
70		50	9**	148 117	257 242
	9*	70		138	242
	Ŭ	90		146	249
		50		156	248
	11	70		135	243
		90		142	245
	_	50		123	288
	6	70		154	297
		90 50		163 121	300 283
	7	50 70		153	203
	'	90		162	294
80		50	9**	119	275
	9*	70		150	284
		90		160	287
		50		177	288
	11	70 90		145 155	279 282
		50		124	332
	6	70		158	341
	-	90		173	345
		50		122	326
	7	70		157	335
90		90	9**	172	339
	~	50		120	318
	9*	70 90		155	327
		90 50		170 185	332 332
	11	70		151	323
		90		166	327
		50		125	375
	6	70		161	384
		90		182	390
	-	50		124	369
	7	70 90		160 181	378 384
100		90 50	9**	122	362
	9*	70		159	371
		90		180	376
		50		193	375
	11	70		156	366
		90	L	177	372
	6	50 70		126 165	418 427
	6	70 90		192	434
		50		125	412
	7	70		164	421
110		90	9**	191	428
110		50	9	123	405
	9*	70		163	414
	9	70 90			
				190	421
	11	90 50 70		201 161	421 419 409

Manual 2100-583E Page 37 of 48

#### FIGURE 19B — GW036 PRESSURE TABLES

#### FULL LOAD HEATING

#### PART LOAD HEATING

SOUR	RCE	LOA	D	SYSTEMS REFRIG	ERANT PRESSURES
		EWT °F		Suction PSIG	Discharge PSIG
		60		59	203
	6	90		60	311
		120		63	455
7	60		59	204	
	7	90		60 64	312
20	-	120	9**	64	456
	9*	60		60	204
	9	90 120		62 65	312 456
		60		64	430
	11	90		63	312
		120		66	456
		60		72	208
	6	90		75	317
	-	120		79	460
		60		73	209
	7	90		76	317
~~		120	0.**	80	461
30		60	9**	75	210
	9*	90		78	318
		120		82	462
		60		83	427
	11	90		80	318
		120		84	462
	1	60		86	213
	6	90		91	322
		120		95	466
		60		87	214
	7	90		92	322
40		120	9**	97	466
40		60	9	90	215
	9*	90		95	323
		120		99	467
		60		101	433
	11	90		96	324
		120		101	468
		60		99	218
	6	90		106	328
		120		111	471
50 7		60		101	218
	7	90		108	328
		120	9**	113	471
50		60	9	105	220
9*	9*	90		111	329
		120		117	472
		60		120	439
	11	90		113	330
		120		119	474
		60		103	222
	6	90		117	334
	<u> </u>	120		125	477
	_	60		105	222
	7	90		119	334
60		120	9**	128	478
	<b>6</b> -	60		108	223
	9*	90		121	335
		120		130	479
	44	60		137	448
	11	90		123	336
		120		132	480
	6	60		107	225
	6	90		128	340
		120		140	484
	-	60		109	226
	7	90 120		130 142	341 485
70			9**	142	485 226
	9*	60 90		111 132	226 341
	а.	90 120			
				143	485
	11	60		153	457
	11	90 120		133	342
		120	<u> </u>	145	486
	e	60		111	228
	6	90 120		139 154	346
		120		154	490
	-	60		114	229
	7	90		141	347
80		120	9**	156	491
	0.*	60		114	230
	9*	90 120		142 157	348 492
		1 120			
	11	60		170 143	466 348
	11			170 143 157	466 348 492

SOUR	CE	LOA	D	SYSTEMS REERIG	ERANT PRESSURES
EWT °F		EWT °F		Suction PSIG	Discharge PSIG
		60		63	193
	6	90		66	300
		120		69	442
	_	60		64	193
	7	90		66	300
20		120	9**	69	442
	9*	60 90		65 67	193 300
	9	120		70	443
		60		70	407
	11	90		67	300
		120		71	443
		60		79	198
	6	90		82	305
		120		86	447
	_	60		80	198
	7	90		83	305
30		120	9**	87	448
	9*	60		82	199
	9"	90 120		85 88	306 448
		60		88	440
	11	90		86	306
		120		89	448
		60		95	203
	6	90		99	310
		120		103	452
	-	60	1	97	203
	7	90		100	310
40		120	9**	105	453
40		60	9.,	99	204
	9*	90		102	311
		120		107	453
		60		107	418
	11	90		104	311
		120		108	454
		60		112	208
	6	90		116	315
		120		120	457
	7	60 90		113 117	208 315
	l '	120		117	458
50		60	9**	116	209
	9*	90		120	316
	Ű	120		125	458
		60	1	126	424
	11	90		122	317
		120		127	459
		60		120	209
	6	90		133	320
		120		140	463
	-	60		121	210
	7	90 120		135 142	321
60			9**	142	463 211
	9*	60 90		124 137	322
		120		144	464
		60	1	153	433
	11	90		139	322
		120		146	465
		60		128	211
	6	90		151	326
		120		160	469
	Ι.	60		129	211
	7	90		152	326
70		120	9**	162	469
	9*	60		131	213
	9	90 120		154 164	327 470
		60	1	179	470
	11	90		156	328
	''	120		165	471
		60		136	213
	6	90		168	331
		120		180	474
		60		137	213
	7	90		170	331
80		120	9**	181	475
00		60	3	139	214
	9*	90		172	333
			1	183	476
		120			
		60		206	452
	11				

Manual 2100-583E Page 38 of 48

## FIGURE 20A — GW048 PRESSURE TABLES

## PART LOAD COOLING

SOUR EWT °F		LOA EWT °F		Suction PSIG	ERANT PRESSURES
				Suction Paile	Discharge PSIG
		50		107	207
	7	70		104	208
		90		108	210
		50		103	196
	9	70 90		100 104	198 200
50		50	11**	104	190
	11*	70		98	190
		90		102	193
		50		93	189
	13	70		97	187
		90		101	189
	_	50		109	244
	7	70 90		115 120	249
		90 50		120	251 232
	9	70		105	232
	Ŭ	90		116	240
60		50	11**	103	225
	11*	70		109	230
		90		114	232
		50		114	230
	13	70		107	226
	<u> </u>	90		113	228
	7	50 70		111 126	281 290
	( <sup>(</sup>	70 90		126	290 293
	<u> </u>	50		107	293
	9	70		122	200
70		90	11++	128	280
70		50	11**	104	260
	11*	70		120	269
		90		125	272
		50		134	272
	13	70		118	264
		90		124	267
	7	50 70		112 137	319 330
	· /	90		137	334
		50		109	304
	9	70		133	316
00		90	11**	140	320
80		50		106	296
	11*	70		131	307
		90		137	311
		50		154	314
	13	70		129	302
		90 50		136 112	306 363
	7	70		142	376
		90		153	381
		50	1	109	349
	9	70		139	361
90		90	11**	150	367
90		50		108	340
	11*	70		137	352
		90		148	358
	13	50 70		165 136	359 347
	13	90		136	347 353
		50		112	408
	7	70		146	421
		90		161	429
		50		110	394
	9	70		145	406
100		90	11**	160	415
	14+	50		109	385
	11*	70 90		143 158	397 405
		90 50		158	405
	13	50 70		143	404 392
		90		158	400
		50		112	453
	7	70		151	466
		90		170	476
		50		111	439
	9	70		150	452
110		90	11**	170	462
	44+	50		111	429
	11*	70 90		150	442 453
		90 50		169 189	453
	13	50 70		150	449 437
		90	I	169	447

SOUR		LOA			ERANT PRESSURES
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
		50		120	195
	7	70		128	195
		90		132	194
		50	1	114	187
	9	70		122	187
50		90		125	186
50		50	11**	111	183
	11*	70		119	183
		90		122	182
		50		125	183
	13	70		117	183
	15	90		120	182
		50		120	229
	7	70		138	233
	'	90		130	233
				115	234
	~	50			
	9	70		133	224
60		90	11**	139	226
		50		113	215
	11*	70		131	219
		90		137	221
		50		148	222
	13	70		129	218
		90		135	220
		50		119	263
	7	70		147	271
		90		155	275
		50		116	253
	9	70		144	261
	-	90		152	265
70	<u> </u>	50	11**	115	248
	11*	70		143	248
	''	90		143	259
		50		171	259
	13	50 70		142	253
	13				253
	<u> </u>	90		150	
	_	50		118	297
	7	70		156	309
		90		167	315
		50		117	287
	9	70		156	298
80		90	11**	166	305
00		50	''	116	280
	11*	70		155	292
		90		166	298
		50		194	300
	13	70		155	288
		90		165	294
		50		119	341
	7	70		159	353
		90		179	361
		50		119	330
	9	70		158	342
	-	90		179	350
90		50	11**	118	324
	11*	70		158	336
		90		178	344
		50		178	344
	13	50 70		158	344 332
	13			158 178	
	<u> </u>	90	<u> </u>	-	340
	_	50		121	385
	7	70		162	397
		90		192	407
		50		120	374
	9	70		161	386
100		90	11**	191	396
100		50		120	368
	11*	70		161	380
		90		191	390
		50		202	387
	13	70		161	375
	Ē	90		191	385
		50		122	428
	7	70		164	428
	· '	90		205	440
		50		122	417
	9	70		164	430
110		90	11**	204	442
		50		122	412
	11*	70		164	424
		90		204	436
		50		206	431
	13	50 70		206 164	431 419 431

Manual 2100-583E Page 39 of 48

#### FIGURE 20B — GW048 PRESSURE TABLES

#### FULL LOAD HEATING

#### PART LOAD HEATING

SOUR		LOA		SYSTEMS REFRIG	ERANT PRESSURES
		EWT °F		Suction PSIG	Discharge PSIG
	7	60 90		58 59	209 326
	· /	120		59 64	479
		60		62	211
	9	90		62	327
20		120	11**	68	481
	11*	60 90		58 59	209 326
		120		59 64	479
		60		57	452
	13	90		57	336
		120		63	490
	-	60		72	216
	7	90 120		74 79	331 483
		60		79	217
	9	90		77	333
30		120	11**	83	484
30		60		74	216
	11*	90		76	332
		120		81	483 448
	13	60 90		80 78	332
		120		84	484
	Ì	60		86	222
	7	90		89	336
		120		94	486
	<u> </u>	60		89	223
	9	90 120		92 98	338 488
40		60	11**	90	223
	11*	90		93	337
		120		98	487
		60		102	443
	13	90 120		100	329
		60		105 99	479 228
	7	90		104	342
	·	120		109	490
9		60		103	229
	9	90		107	343
		120	11**	112	491
	11*	60 90		106 110	230 343
	''	120		115	491
		60		125	439
	13	90		121	325
	L	120		126	473
	_	60		108	233
	7	90 120		122 131	349 496
		60		131	234
	9	90		12	234 350
60		120	11**	135	498
60		60	11**	114	235
	11*	90		128	351
		120		138	498
	13	60 90		149 136	455 339
	13	120		145	487
		60		117	237
	7	90		140	355
		120		154	502
		60		121	239
	9	90		144	358
70		120 60	11**	158 123	504 240
	11*	90		123	359
		120		160	505
		60		173	472
	13	90		150	354
		120		164	500
	7	60		126 159	242
	'	90 120		159 177	362 508
		60		130	244
	9	90		162	365
80		120	11**	180	511
00		60		131	246
	11*	90		164	366
'		120 60		182 198	512 489
		00		190	
	13	90		165	368

SOUR	CE	LOA	D	SYSTEMS REFRIG	ERANT PRESSURES
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
	_	60		63	201
	7	90		66	309
		120		70	451
	9	60 90		64 66	201 309
	3	120		71	451
20		60	11**	64	202
	11*	90		67	310
		120		71	452
		60		70	419
	13	90		67	310
		120		72	452
	-	60		78	205
	7	90 120		82 87	314 457
		60		80	206
	9	90		83	315
	-	120		88	457
30		60	11**	81	206
	11*	90		84	315
		120		89	458
		60		89	424
	13	90		85	315
		120		90	458
	_	60		94	210
	7	90		98	319
		120		103	463
	9	60		96 100	210
	9	90 120		100	320 464
40		60	11**	98	210
	11*	90		102	320
		120		102	464
		60		107	430
	13	90		103	320
		120		108	464
		60		110	214
	7	90		114	325
		120		120	470
	_	60		113	215
	9	90		117	325
50		120	11**	123	470
	11*	60 90		115 119	215 325
		120		125	470
		60		125	435
	13	90		121	325
		120		126	470
		60		120	219
	7	90		134	330
		120		141	474
		60		125	220
	9	90 120		139 146	331
60		120 60	11**	146 128	475 220
	11*	90		128	332
		120		142	476
		60		157	444
	13	90		143	332
		120		150	476
		60		131	223
	7	90		155	336
		120		163	479
		60		137	224
	9	90		160	337
70		120	11**	169 141	480
	11*	60 90		141 164	225 339
		120		172	481
		60		189	452
	13	90		166	339
		120		175	481
		60		142	227
	7	90		175	342
		120		185	484
		60		149	229
	9	90 120		182	344
80		120	11**	192	485 231
	11*	60 90		153 186	231 345
		120		196	487
		60		221	460
	13	90		189	345

## FIGURE 21A — GW060 PRESSURE TABLES

### PART LOAD COOLING

SOUR	CE	LOA	D	SYSTEMS REFRIG	ERANT PRESSURES
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
		50 70		105 109	208 213
	9	90		114	213
		50		100	196
	11	70		104	200
50		90	13**	109	205
50		50	13	98	190
	13*	70		102	194
		90		107	199
	15	50 70		104 100	196 191
	15	90		105	196
		50		107	244
	9	70		119	252
		90		125	256
		50		103	232
	11	70		115 121	240 244
60		90 50	13**	100	226
	13*	70		112	233
	10	90		119	237
		50		123	237
	15	70		111	229
		90		117	234
		50		108	280
	9	70		129 136	291
		90 50		136 105	295 269
	11	70		105	269 279
		90		133	283
70		50	13**	102	262
	13*	70		123	272
		90		130	276
		50		142	278
	15	70		121	268
		90 50		129 110	272 316
	9	70		139	329
		90	13**	147	333
		50		107	305
	11	70		136	318
80		90		144	322
00		50		105	298
	13*	70		134	311
		90 50	142 161	315 319	
	15	70		132	306
	10	90		140	310
		50		110	360
	9	70		142	373
		90		156	380
		50		108	350
	11	70		140	362
90		90	13**	154	369 342
	13*	50 70		107 139	342 355
		90		159	361
		50	1	170	362
	15	70		137	349
		90		151	356
		50		111	404
	9	70		146	417
		90		164	426
	11	50 70		109 145	394 406
		90		145	408
100		50	13**	108	386
	13*	70		144	398
		90		162	407
		50		178	406
	15	70		143	393
		90		161	402
	9	50 70		111 150	448 460
	5	90		173	400
		50	1	111	438
	11	70		149	450
110	Ľ	90	10**	172	462
110		50	13**	110	430
	13*	70		149	442
		90	ļ	172	453
	45	50		187	449
	15	70 90		148 171	437 449
15	1 10				

SOUR	CE	LOA	п	SYSTEMS REERIG	ERANT PRESSURE
EWT °F		EWT °F		Suction PSIG	Discharge PSIG
		50		115	192
	9	70		137	200
		90		137	200
		50		111	184
	11	70		133	193
50		90	13**	133	193
	40*	50		108	179
	13*	70 90		130 130	188
		50		149	<u>188</u> 193
	15	50 70		149	193
	15	90		127	184
		50		115	226
	9	70		142	236
		90		149	238
		50		112	219
	11	70		139	229
60		90	13**	146	231
00		50	13	110	214
	13*	70		137	224
		90	144	226	
		50		163	229
	15	70		136	220
		90		143	222
T	-	50		116	261
	9	70		148	272
		90		161	276
		50		114	254
	11	70		146	264
70		90	13**	159	269
	40*	50		113	249
	13*	70		145	259
		90		158	264
	15	50 70		176 144	266 255
	15	90		157	260
		50		116	296
	9	70		153	307
	5	90		173	315
		50		116	288
	11	70		153	300
		90		172	307
80		50	13**	115	283
	13*	70		152	295
		90		171	302
		50		189	303
	15	70		152	291
		90		171	298
		50		118	340
	9	70		156	351
		90		181	359
		50		118	332
	11	70		155	343 351
90		90 50	13**	180	
	13*	50 70		117 155	327 338
	13	90		179	346
}		50		193	345
	15	70		155	334
		90		179	342
		50		120	383
	9	70		159	394
		90		189	403
		50		120	375
	11	70		158	386
100		90	13**	188	395
100		50	13	119	370
	13*	70		157	381
ļ		90		187	390
		50	196	388	
	15	70		157	377
		90	<u> </u>	187	386
	~	50		123	427
	9	70		162	437
		90		197	448
	44	50 70		121	419
	11	70 90		161 196	429 440
110		90 50	13**	196	440
		50 70		121	414
	1:4*			100	747
	13*			195	434
	13*	90		195 199	434
	13*			195 199 160	434 430 420

Manual 2100-583E Page 41 of 48

## FIGURE 21B — GW060 PRESSURE TABLES

## FULL LOAD HEATING

PART LOAD HEATING

WT °F	CDM				ERANT PRESSURES
	GFW		GPM	Suction PSIG	Discharge PSIG
	9	60 90		55 58	210 322
	9	90 120		58 61	322 467
		60		57	211
	11	90		59	323
20		120	13**	62	467
20		60	15	57	211
	13*	90		60	323
		120		62	468
	15	60 90		62 60	435 323
	15	90 120		63	468
		60		69	216
	9	90		73	328
		120		76	472
		60		71	217
	11	90		74	328
30		120	13**	78	473
	13*	60 90		72	217 329
	13	90 120		75 79	329 473
		60		80	441
	15	90		76	329
		120		80	474
		60		83	222
	9	90		87	333
		120		92	478
	11	60 90		85 90	223 334
	11	90 120		90 95	334 478
40		60	13**	87	223
	13*	90		91	335
		120		96	479
		60		97	447
	15	90		93	335
		120	<u> </u>	97	480
	9	60 90		97 102	227 339
	3	90 120		102	483
		60		100	228
	11	90		105	340
50		120	13**	111	484
50		60	13	102	229
	13*	90		107	341
		120 60		113 114	485 453
	15	60 90		114 109	453 341
	13	120		115	485
		60		105	232
	9	90		119	346
		120		127	489
		60		107	233
	11	90 120		121	347
60		120 60	13**	130 109	491 234
	13*	90		123	234 347
		120		131	491
		60		138	462
	15	90		124	348
		120		133	492
		60		113	236
	9	90 120		135	353
		120		146	496 237
	11	60 90		115 137	237 354
		120		148	497
70		60	13**	116	238
	13*	90		138	354
		120		150	498
		60		162	472
	15	90 120		139	355
		120		151	498
	9	60 90		120 151	240 359
	5	120		165	502
		60		103	242
	11	90		153	361
80		120	13**	167	504
80		60	13**	123	242
	13*	90		154	361
		120		168	504
		~~	-		
	15	60 90		185 155	481 362

EWT *F         GPM         EWT *F         GPM         Suction PSIG         Discharg           9         90         60         61         200           11         90         60         63         300           11         90         66         62         200           13*         90         66         67         445           60         13*         90         68         452           13*         90         66         300         67         446           15         90         65         300         67         446           15         90         80         314         314         314           100         13**         86         457         314         314           120         60         77         207         314	FRANT DESCUDES			SOURCE LOAI		SOUE	
9         90         60         61         20           11         90         63         300           11         90         64         300           13*         90         64         300           13*         90         65         300           15         90         65         300           15         90         65         300           11         90         65         300           11         90         65         300           11         90         65         300           11         90         80         31           11         90         82         31           11         90         83         31           120         87         456           13*         90         82         31           11         90         83         31           120         87         456         457           13*         90         97         31           100         13*         96         212           11         90         13*         32           101         1							
20         120 11         60 120 120 13*         13**         67 62 64 63 68 66 67 13*         452 62 66 67 67 67 67 67 67 67 67 67 67 67 67		203			•		
20         11         90 120         13**         62 64 300         20 64 65 300           13**         60 120         13**         62 65 300         20 65 300           13*         90 120         66 65 300         30 67 415         60 90 45 300         77 207 81 13*         20 66 300           9         90 120         80 40 120         77 82 82 315         207 83 30         31 40 40         60 13*         13**           9         90 120         80 86 45 30         31 40 86 45 30         80 31 40         31 40 40         60 13*         90 90 90 90 90 120         92 97 31 40 40         91 92 91 100 46 40 110         21 40 94 94 40         21 40 40 40         92 41 40 40 40         92 41 40 40 40 40 40 40 40 40 40 40 40 40 40		309				9	
11         90 13*         13** 90 120         64 68 68 68 69 69 69 69 69 66 67 67 67 67 67 67 67 66 69 66 69 67 67 67 67 67 67 67 67 67 67 67 67 67							
20         120 13*         13** 60 120         68 65 69         452 65 69           15         90 120         69         453 665         300 69           15         90 120         69         453 665         300 69           11         90 120         69         453 665         300 69         453 665           11         90 120         87         453 86         457 778         301 86         457 779         301 86         457 779         301 86         457 779         301 87         456 778         301 87         456 778         301 87         456 778         301 87         456 779         301 87         456 778         301 77         301 77 <td></td> <td></td> <td></td> <td></td> <td></td> <td>11</td> <td></td>						11	
20         13*         60         13**         62         204           13*         90         60         65         300           15         90         65         300           120         69         455         300           11         90         69         455           11         90         67         415           10         120         69         455           11         90         77         200           11         90         77         200           11         90         77         200           15         90         13**         86         457           15         90         87         456           11         90         120         87         456           11         90         120         87         456           13*         90         100         320         102         466           11         90         100         320         103         466           15         90         101         320         105         466           11         90         13*         3						''	
120         69         453           15         90         65         305           120         69         453           9         90         69         453           120         69         453           120         84         457           11         90         80         314           120         84         453           11         90         81         344           120         87         456           15         90         82         315           15         90         83         316           11         90         92         211           9         90         92         211           9         90         92         211           11         90         13**         96         212           11         90         13**         100         322           13*         90         13**         103         462           13*         90         13**         100         322           10         120         105         462           11         90         13* </td <td></td> <td>204</td> <td></td> <td>13**</td> <td></td> <td></td> <td>20</td>		204		13**			20
15         60 120         67 65 300         415 65 300           9         90 120         89 80         314 84           11         90 120         84         457 84           60         13*         90         84         457 84           11         90 120         13**         86         457 79         200 81           13*         90 120         13**         86         457 79         200 82         315 87           15         90 9         90 90         97         316 97         316 83         316 83           11         90 120         13**         92         211 99         92         211 99           11         90 120         13**         96         212 105         462 99         102           13*         90 120         13**         96         212 105         462 105         422 105           13*         90 120         13**         111         322 105         466 110         215 115           11         90 120         13**         13**         111         322 115         326 115           11         90 120         13**         111         324 115         325 125         466 116		309				13*	
15         90         65         309           9         90         0         77         200           10         120         80         314           10         120         80         314           11         90         13**         84         455           11         90         13**         84         455           11         90         13**         86         457           13*         90         13**         86         457           13*         90         13**         86         457           15         90         13**         92         211           11         90         97         313         322           11         90         13**         98         322           11         90         13**         96         92         211           9         90         91         101         322         105         462           13*         90         101         322         105         462         105         422         105         462         105         422         105         115         322         105							
120         69         453           9         90         90         80         344           120         84         453           11         90         13**         86         342           11         90         13**         86         453           13*         90         13**         79         206           13*         90         87         456           15         90         83         316           11         90         87         456           15         90         87         456           11         90         97         315           9         90         97         315           11         90         13**         100         322           11         90         13**         102         460           13*         90         101         322         100         322           13*         90         113**         113         324           11         90         13**         113         324           120         13**         113         324           120         13**						15	
9         90         77         207           120         80         314           11         90         13**         86         314           11         90         13**         86         457           13*         90         13**         86         457           15         90         81         314*           15         90         83         315           15         90         87         456           15         90         87         456           11         90         97         315           11         90         97         316           11         90         97         316           11         90         13**         96         212           100         322         211         98         322           101         120         13**         96         212           102         460         105         462           15         90         101         322           11         90         13**         111         324           120         13**         1111         326     <						15	
120         84         457           11         90         81         314           120         13**         60         81         314           120         13**         86         457           13*         90         87         466           15         90         87         456           86         422         315           15         90         87         456           15         90         87         456           15         90         97         315           10         90         97         315           11         90         94         211           11         90         98         322           11         90         13**         96         212           13*         90         13**         96         212           15         90         100         322         103         462           11         90         101         322         103         462           111         90         115         325         116         325           111         90         13**		207					
30         11         90 120         13**         78 81         207 81           13**         90 13*         13**         86         457           13*         90         82         315           15         90         83         316           15         90         83         316           10         120         87         456           15         90         83         316           10         90         97         313           11         90         102         466           11         90         13**         96         211           11         90         13**         96         211           13*         90         103         462           13*         90         101         322           15         90         101         322           15         90         101         322           11         90         113         324           120         106         463           1120         111         324           121         467         324           120         1115 <td< td=""><td></td><td>314</td><td></td><td></td><td></td><td>9</td><td></td></td<>		314				9	
30         11         90 12°         13**         81 86         314 866         314 866           13*         90 120         87         456 87         315 87         315 87           15         90 9         83         315 87         315 87         315 87           9         90 9         97         316 97         316 97         316 97         316 97           11         90 120         13**         94         211 102         462 102         316 97           11         90 120         13**         94         211 102         462 102         316 99           13*         90 120         13**         96 100         322 100         322 100         322 100           15         90 110         322 120         106         463 110         216 113         324 113           50         60 11         120         111         324 113         324 113         324 113         324 111           50         60 1120         13**         1112         216 111         326 111         336 336 337 120         336 120         336 120         336 120         336 120         336 120         336 120         337 139         337 139         337 144         337 139         336 137		-	8				
30         120 13*         13**         86 79         457 82           13**         60 15         90         82         315 87           15         90         83         315 87           15         90         87         456           120         87         456           11         90         97         315           9         90         94         211           11         90         94         212           11         90         13*         96         212           13*         90         13**         96         212           13*         90         13**         96         212           13*         90         101         322           15         90         101         322           11         90         113         324           11         90         113         324           11         90         113         324           11         90         115         325           120         13*         112         216           13*         90         1119         333 <td< td=""><td></td><td></td><td></td><td></td><td></td><td>11</td><td></td></td<>						11	
30         60         13**         79         206           13*         90         82         315           120         87         455           15         90         83         315           15         90         83         315           120         87         456           15         90         87         456           9         90         97         316           11         90         102         462           11         90         97         316           11         90         13**         96         212           13*         90         13**         96         212           13*         90         13**         96         212           15         90         101         322           15         90         101         322           11         90         113         324           120         106         462           111         90         113         324           120         13**         1113         324           13         90         13**         1121							
120         87         456           15         90         83         315           120         87         456           120         87         456           9         90         92         211           9         90         97         319           11         90         120         102         462           11         90         13*         96         212           13*         90         13**         966         212           15         90         101         322         100           15         90         101         322         100         322           15         90         101         322         100         322           15         90         101         322         106         462           11         90         113         322         113         322           11         90         111         322         113         322           11         90         138         211         467           1120         13**         1112         216         467           121         120		208		13**			30
40         15         90 120         86 83 83 83 83 83 83 83 83 83 90           9         90 120         97 315 97 120         37 86 94         92 102         211 98 94 94 94           11         90 120         13**         96 94         212 102         36 94         212 102           13*         90 96         212 103         462 102         36 96         212 103         36 22 103         36 22 103         36 22 103         36 22 103         36 22 103         36 22 103         36 22 103         36 22 103         36 21 105         32 22 113         32 22 113         32 22 113         32 22 113         36 21 113         32 22 113         36 21 113         36 21 113         32 22 22 21 113         36 21 113         36 21 113         36 21 113         36 21 113         36 21 113         36 21 114         37 21 114         37 21 114         37 21 114         37 21 114         37 21 114         37 21 114         37 21 21         37 21		315				13*	
15         90         83         315           9         90         87         455           9         90         97         316           11         90         97         312           11         90         97         312           11         90         102         462           11         90         13**         96         212           13*         90         13**         96         212           13*         90         13**         96         212           15         90         103         466           15         90         101         322           15         90         101         322           15         90         101         322           11         90         113         322           120         106         465           111         90         113         322           11         90         13**         112         216           13*         90         13**         112         216           13*         90         13**         119         325		458					
120         87         456           9         90         92         211           120         102         466           11         90         97         319           11         90         94         211           11         90         13**         98         322           13*         90         13**         96         211           13*         90         103         462           13*         90         101         322           15         90         101         322           15         90         101         322           11         90         101         322           11         90         113         324           120         106         463           110         120         111         322           11         90         111         322           11         90         111         322           120         124         467           13*         90         111         324           120         124         121         467           121         120						45	
9         60 120 120 120 11         92 97 316 97 316 94         211 316 94           40         11 11         90 60 13*         13**         94 94         211 98 96 212 103           13*         90 120         13**         96 96 105         212 103           13*         90 120         13**         96 105         212 105           15         90 120         105         462 120           15         90 101         322 105         105           9         90 120         106         463           11         90 120         118         216 115           60         108         215 112           13*         90 113         332 120         119           15         90 119         226 123         467 124           15         90 119         126 133         133 139           60         13**         138         331 120           142         472 15         460 138         138 138         331 120           142         144         473 142         144           15         90 153         138 120         146           146         475 160         132         222 163           11 <t< td=""><td></td><td></td><td></td><td></td><td></td><td>15</td><td></td></t<>						15	
9         90         97         319           120         120         462           11         90         94         211           11         90         13**         96         212           13*         90         13**         96         212           13*         90         13**         96         212           13*         90         100         320           15         90         105         462           15         90         101         322           15         90         101         322           15         90         101         322           11         90         113         324           120         106         466           11         90         113         324           11         90         115         322           120         13**         112         216           15         90         133         333           15         90         133         333           120         125         466           119         216         138         331						9	
40         120 11         90 120 120 13*         102 94 94 98 320 103 103 96 212 100 105 462 100 100 100 105 462 100 105 462 100 105 462 100 105 462 100 105 462 100 105 462 100 105 462 100 105 462 100 105 462 100 105 462 106 462 106 465 108 215 99 9 9 9 9 9 9 113 322 119 466 110 120 118* 120 111 90 115 325 121 466 112 121 467 122 123 467 124 433 333 333 477 120 124 425 466 119 225 466 119 120 123 467 121 120 123 467 121 120 123 467 121 120 123 467 121 120 123 467 121 120 123 467 121 120 123 467 121 120 123 467 121 120 123 467 121 120 125 466 337 138 333 477 142 142 477 142 144 475 120 138 334 335 120 124 124 225 466 337 120 124 124 225 466 337 120 124 124 225 466 337 138 333 337 120 144 477 142 142 142 142 124 225 466 337 138 333 337 120 144 477 138 333 337 120 146 477 138 337 120 146 477 138 337 120 146 477 138 337 120 146 477 138 337 120 146 477 138 337 120 146 477 138 337 120 146 477 138 337 120 146 477 138 337 120 146 477 138 337 120 146 477 138 337 137 120 146 477 138 337 137 137 120 146 477 138 337 137 137 137 137 137 137 137		319				9	
40         11         90 120         13** 120         98 103         320 466           13*         90 120         13** 120         96 105         212 105           15         90 120         105         462 120           15         90 101         320 105         462 105           15         90 9         101         320 105           15         90 120         106         463 113           11         90 120         118         113           11         90 120         119         466 115           13*         90 117         122         111           15         90 117         122         124           15         90 119         124         435 120           15         90 119         133         337 120           11         90 120         138         331 139           11         90 120         138         331 142           11         90 120         138         331 120           11         90 153         133         336 120           11         90 153         136         337 140           120         146         477 15           9	62	462	102				
40         120 13*         13**         103 96         462 212 100           13*         90         1013         462 212 100         212 100         320 462           13*         90         100         320 100         320 462           15         90         105         462           15         90         101         320 105         462           9         90         101         322           15         90         106         466           11         90         113         324           11         90         115         322           11         90         115         322           120         13**         121         466           15         90         117         325           15         90         122         123           15         90         119         326           15         90         133         333           11         90         136         331           120         13**         142         472           13         90         138         331           120         144         473 </td <td></td> <td>211</td> <td></td> <td></td> <td></td> <td></td> <td></td>		211					
40         60         13**         96         212           13*         90         100         320           120         105         462           15         90         101         320           15         90         101         320           15         90         101         320           15         90         101         320           9         90         101         320           120         106         466           11         90         113         322           11         90         113         322           11         90         113         322           120         13**         112         216           13*         90         13**         112         216           13*         90         13**         112         216           15         90         119         326         120           120         125         466         133         333           11         90         136         331         133         332           11         90         13**         142         472<		320		13**		11	40
13*         90 120         100 105         320 460           15         90         101 120         105         462 428           15         90         101 120         106         463           9         90         101 120         106         463           11         90         1113         324           11         90         113         324           11         90         113         324           11         90         113         324           11         90         113         324           11         90         113         324           11         90         1119         326           11         90         121         467           13*         90         1117         325           15         90         119         326           15         90         119         326           120         125         466         331           120         125         466         331           120         138         331         332           131         90         134         472           13							
120         105         462           15         90         105         422           15         90         101         320           120         106         463           9         90         101         320           120         106         463           120         106         463           120         113         324           11         90         113         324           11         90         115         325           13*         90         115         325           15         90         117         325           15         90         117         325           15         90         119         326           15         90         119         326           15         90         119         326           120         124         433           133         333         336           120         138         331           130         134         333           120         142         472           134         90         153         336						13*	
15         90         101         320           9         120         106         465           9         90         1113         322           11         90         113         322           11         90         113         322           11         90         113*         110         215           11         90         13**         111         322           11         90         13**         111         322           11         90         13**         112         216           13*         90         13**         112         216           15         90         13**         112         216           15         90         123         467           120         125         466           119         326         129         216           120         13**         133         333         333           11         90         136         331         133         332           13**         120         13**         142         472         144         475           120         144         475		462					
120         106         463           9         90         108         215           120         1108         216           120         1108         216           11         90         113         324           11         90         113         324           11         90         113         324           11         90         113         324           11         90         115         325           11         90         115         325           60         13**         121         467           13*         90         117         325           15         90         119         326           15         90         119         326           120         125         466           11         90         133         330           120         138         331         336           120         13**         138         331           131         90         138         331           120         13**         124         216           13*         90         138         333<	28	428	105	1	60		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		320				15	
9         90 120         113 120         324 119           60 11         90 120         1119         466 110           11         90 120         1115         322 121           13**         90         1115         322 121           13**         90         1117         325 123           15         90         112         467           15         90         117         325           15         90         119         326           15         90         119         326           15         90         119         326           120         125         466           11         90         133         330           120         13**         142         472           11         90         136         331           11         90         136         331           120         13**         142         472           13*         90         138         331           120         144         473           120         146         473           120         146         473           120         160 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>							
120         119         466           11         90         115         325           120         13**         110         215           13*         90         13**         112         216           13*         90         13**         112         216           13*         90         13**         112         216           13*         90         13**         112         216           15         90         123         467           15         90         123         467           15         90         123         467           15         90         124         435           9         90         133         333           11         90         138         331           11         90         13**         142         472           13*         90         13**         144         473           120         144         444         473           120         144         475         146           155         90         156         337           120         146         477         166						a	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						3	
120         13**         121         467           13*         90         13**         112         216           13*         90         117         325           120         123         466           15         90         119         326           15         90         119         326           15         90         119         326           9         90         133         330           120         120         139         477           11         90         136         333           120         13**         142         472           11         90         136         333           120         13**         124         215           13*         90         136         333           120         13**         124         215           13*         90         138         331           120         144         473           120         146         473           120         146         473           120         160         477           120         160         477 <td></td> <td>215</td> <td></td> <td></td> <td></td> <td></td> <td></td>		215					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	25	325	115		90	11	
60         112         216           13*         90         117         322           120         123         465           15         90         119         326           15         90         119         326           9         90         124         435           9         90         125         466           9         90         133         330           120         125         466           11         90         133         330           11         90         138         331           11         90         136         333           120         13**         142         472           13*         90         138         331           120         13**         142         472           15         90         140         332           120         144         473           120         146         473           9         90         153         336           120         160         477           11         90         156         337           120		467		13**			50
120         123         467           15         90         119         326           15         90         119         326           120         125         466           9         90         123         467           9         90         129         326           120         125         466           9         90         133         330           120         139         471           11         90         136         333           11         90         138         331           120         13**         142         472           13*         90         138         331           120         13**         144         473           15         90         140         332           15         90         153         336           120         146         477           120         146         477           120         160         477           11         90         156         337           120         163         476           163         476         444						10*	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						13	
120         125         466           9         90         119         216           120         133         330           120         139         477           11         90         136         331           11         90         138         331           11         90         13**         142         472           60         13**         142         472           13*         90         138         331           13*         90         138         331           120         144         475           60         154         444           15         90         154         444           15         90         153         336           120         146         475         156         337           120         146         475         160         477           11         90         153         336         132         222           11         90         156         337         156         337           120         163         476         163         477           163         1		435					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	26	326				15	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		468					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						9	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		219	-				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	31	331			90	11	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		472		13**		<u> </u>	60
$\begin{array}{c c c c c c c c c c c c c c c c c c c $						10*	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						13^	
15         90         140         332           120         146         473           9         90         153         336           120         160         477           120         160         477           120         160         477           11         90         156         337           120         163         476           135         223         222		444					
60         129         221           9         90         153         336           120         160         477           60         132         222           11         90         156         337           120         163         476           60         13**         163         225		332	140		90	15	
9         90         153         336           120         160         477           60         132         222           11         90         156         337           120         163         477           132         222         163         327           163         135         223		473		ļ		ļ	
120         160         477           60         132         222           11         90         156         337           120         13**         163         477		221					
60         132         222           11         90         156         337           120         13**         163         478           135         223         223						9	
11         90         156         337           70         120         13**         163         478           135         223         235         235		222		1			
120         163         476           70         60         13**         135         223		337				11	
00 135 223		478		13**			70
		223				10*	. •
		337 478				13^	
		470		1			
		338				15	
120 167 479	79	479					
		224					
		342 482				9	
		482					
		343				11	
120 184 483		483		12**			00
		226		13^^			80
		344				13*	
		484					
		461 344				15	
		484					

## FIGURE 22A — GW070 PRESSURE TABLES

## PART LOAD COOLING

SOURCE LOAD		D	SYSTEMS REERIG	ERANT PRESSURES	
EWT °F	·	EWT °F		Suction PSIG	Discharge PSIG
		50		104	218
	11	70		122	231
		90		125	232
	13	50 70		101 120	211 224
	13	90		120	224
50		50	16**	99	205
	15*	70		118	218
		90		121	219
		50		135	228
	17	70		117	215
		90		120	216
	11	50 70		106 129	255 270
		90		137	273
		50		104	247
	13	70		127	262
60		90	16**	135	265
		50		102	241
	15*	70		125	256
		90 50		133 147	259 266
	17	70		124	252
		90		132	255
		50	Ì	108	293
	11	70		136	308
70		90		149	314
		50		106	284
	13	70		134	300
		90	16**	147	306 278
	15*	50 70		104 132	278 294
	10	90		145	300
		50		159	304
	17	70		131	289
		90		143	295
		50		110	330
	11	70		144	347
		90		161	355
	13	50 70		108 142	321 337
	15	90		159	346
80		50	16**	106	315
	15*	70		140	331
		90		157	340
		50		171	343
	17	70		138	326
		90 50		155 112	335 374
	11	70		144	390
		90		162	399
		50	1	110	365
	13	70		143	380
90		90	16**	160	389
		50		108	359
	15*	70		141	374
		90 50	ł	158 172	383 385
	17	50 70		172	369
	''	90		155	378
		50		113	418
	11	70		145	433
		90		164	442
		50		111	409
	13	70		143	423
100		90	16**	162	432
	15*	50 70		110 142	403 418
		90		142	418
		50	1	172	427
	17	70		140	413
		90		159	421
		50		115	463
	11	70		146	476
		90		165	485
	12	50 70		113	453
	13	70 90		144 164	466 475
110		90 50	16**	104	475
	15*	70		143	461
	-	90		162	469
		50	1	173	469
	1 4 7	70	I	142	456
	17	70 90		161	465

				SYSTEMS REFRIGERANT PRESSU	
EWT °F		EWT °F		Suction PSIG	Discharge PSIG
		50		111	200
	11	70		140	213
		90		150	217
50	13	50 70		109 138	196 208
	10	90		148	208
50		50	16**	107	193
	15*	70		136	206
		90		146	209
		50		163	216
	17	70		134	203
		90		144 113	207 236
	11			113	236 250
	50 11 70 90 50 13 70 90		143	256	
60				111	231
	13	70		143	245
60		90	16**	158	250
00		50	10	110	228
	15*	70		141	241
		90		156	247
	17	50 70		171 140	252 238
		90		140	238
		50		115	272
	11	70		149	286
		90		169	295
		50		114	267
70	13	70		148	281
		90	16**	168	289
	15*	50 70		112 146	262 277
	10	90		146	285
		50		179	287
	17	70		145	273
		90		165	282
		50		118	308
	11	70		154	323
		90		179	333
	13	50 70		116 153	302 317
	13	90		153	317 327
80		50	16**	115	297
	15*	70		151	312
		90		176	322
		50		187	323
	17	70		150	308
	<u> </u>	90 50	<u> </u>	175 119	319 352
	11	50 70		156	352 366
90		90		181	376
		50		118	346
	13	70		155	360
		90	16**	180	370
	1.5	50		116	341
	15*	70 90		154	355
		90 50		178	365
	17	50 70		190 153	366 352
		90		178	362
		50		121	395
	11	70		158	409
		90		183	419
		50		120	389
	13	70		157	403
100		90	16**	182	413
	15*	50 70		118 156	384 398
	13	90		180	408
		50		194	400
	17	70		156	395
		90		180	405
		50		122	439
	11	70		161	452
		90		184	462
	13	50 70		121 160	432 446
	13	90		184	446 456
			16**	120	430
110		50			
110	15*	50 70		159	441
110	15*			159 182	451
110		70 90 50		159 182 197	451 452
110	15* 17	70 90		159 182	451

## FIGURE 22B — GW070 PRESSURE TABLES

#### FULL LOAD HEATING

PART LOAD HEATING

	CE	LOA			ERANT PRESSURES
VT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
		60		54	218
	11	90		57	331
		120 60		62 55	478 218
	13	90		55	332
	15	120		63	478
20		60	16**	56	219
	15*	90		60	333
	10	120		64	479
		60		64	447
	17	90		60	333
		120		64	479
	Ì	60		68	225
	11	90		72	338
		120		77	485
		60		70	226
	13	90		74	339
30		120	16**	79	486
	4.54	60		71	226
	15*	90		75	340
		120		80	486
	17	60 90		80 76	454 340
		90 120		76 81	487
		60		81	232
	11	90		83	345
		120		93	492
		60		85	233
	13	90		90	346
40		120		95	493
		60	16**	86	234
	15*	90		91	347
		120		97	494
		60		97	461
	17	90		92	348
		120		98	495
		60		97	239
	11	90		103	352
		120		109	499
		60		100	240
	13	90		105	353
50		120	16**	111	501
		60		102	241
	15*	90		107	355
		120 60		113 114	502 468
	17	90		108	355
		120		115	502
		60		105	244
	11	90		116	358
		120		122	504
		60		107	245
	13	90		118	359
20		120	16**	124	505
60		60	16**	108	246
	15*	90		119	360
		120		126	506
		60		131	475
	17	90		121	361
		120	L	127	507
		60		113	249
	11	90		129	364
		120		135	509
	10	60		114	250
	13	90 120		130 137	365
0		120	16**	137 115	510
	15*	60 90		115	251 366
	10	90 120		132	511
		60		130	481
	17	90		149	366
	''	120		139	511
		60		120	254
	11	90		142	370
		120		149	514
		60		121	255
	i i	90		143	371
	13			150	515
	13	120			
30	13	120 60	16**	122	255
10	13 15*	120 60 90	16**	122 144	255 371
80		60	16**		
10		60 90	16**	144	371
0		60 90 120	16**	144 151	371 515

	CE	LOA			ERANT PRESSURES
EWT °F	GPM	EWT °F	GPM	Suction PSIG	Discharge PSIG
		60		61	207
	11	90		64	316
		120		68	457
		60	1	62	207
	13	90		65	317
		120		69	457
20		60	16**	62	208
	15*	90		65	317
	15	120		69	458
			1		
	17	60		69	427
	17	90		66	317
		120		70	458
		60		76	214
	11	90		80	323
	-	120		85	464
		60		77	214
	13	90		81	323
30		120	16**	86	465
50		60		78	215
	15*	90		82	323
		120	]	87	465
		60		87	433
	17	90		83	324
		120		88	465
		60		91	221
	11	90		96	329
		120		102	471
	<u> </u>	60	1	93	221
	13	90		93 98	330
	10	120		103	472
40			16**		
	45+	60		94	222
	15*	90		99	330
		120	ł	105	472
		60		105	438
	17	90		100	330
		120		105	473
		60		107	228
	11	90		112	335
		120		118	479
		60		109	229
	13	90		114	336
50		120	10**	120	479
50		60	16**	110	229
	15*	90		116	336
		120		122	480
		60	1	122	444
	17	90		117	337
		120		123	480
		60		117	233
	11	90		129	342
	''	120		129	485
	<u> </u>	60	1	119	233
	13	90		119	233 343
	13				
60		120	16**	137	486
	4.5-	60		121	234
	15*	90		133	343
		120	4	139	486
	4-	60		146	453
	17	90		134	343
	L	120	L	140	486
		60		128	238
	11	90		146	350
		120		152	492
		60		130	238
	13	90		149	349
70		120	16**	154	492
70		60	10	131	238
	15*	90		150	349
		120		156	492
		60	1	170	461
	17	90		152	350
		120		152	493
		60		138	243
	11	90		138	243 357
		120		169	499
	<u> </u>		1		
	40	60		140	242
	13	90		166	355
80	L	120	16**	171	498
00		60		142	243
	15*	90		168	356
		120	]	173	499
		60		194	470
	17	90		169	357
		120	1	174	499

# TROUBLESHOOTING

	POWER (	SUPPLY .	POWER SUPPLY - CONTROL SYSTEM	L SYSTEN	A ISSUE							ΜA	MAIN SYSTEM ISSUES	TEM IS:	SUES							EXT.	EXT. SYSTEM ISSUES	ISSU
	Line Voltage	ge	Ľ	Low Voltage	e		Compressor	sor	Refrig	Refrigerant System	/stem	Rev.Valve	alve	Sou	Source Water Coil	ter Coil			Load Wa	Load Water Coil		3	Water System	stem
	Power Failure Blown Fuse or Tripped Breaker Faulty Wring 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 (Transformer 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 Overhoad Open Bearings Defective Seized	Busted Internal Scroll Motor Winding Defective Refrigerant Charge Low	Reingerant Overcharge Refrigerant Overcharge High Head Pressure	Low Head Pressure High Suction Pressure	Low Suction Pressure Non-Condensables Faulty Expansion Valve	consection of the section of the sec	Defective Valve or Coil Scaled or Plugged Coil (Htg.)	Scaled or Plugged Coil (Clg.) Water Volume Low (Htg.)	Water Volume High (Clg.) Water Volume Lich (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.) 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 (Cig.) 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.)
Compressor Will Not Run, No Line	× × × ×																							
Compressor Will Not Run Power at Contactor	××	×	× × ×	×	××	× × ×	× × ×	×	×															
Compressor "Hums" But Will Not Start	××	×				×	××	×	×															
Compressor Cycles on Overload	××	×				×	××	×	×		×	×												
Thermostat Check Light On, Unit in Lock-out Mode					×	××		×	×××		××	×												
Compressor Off on High Pressure Control (Green Diagnostic Light Flashing)					×				×	×	××	×		×	××	×		××		×	×	×		××
Compressor Off on Low Pressure Control (Orange Diagnostic Light Flashing)						×		×			×	×	×	×	×		×	×	×			××	×	
Compressor Off on Flow Switch (Red Diagnostic Light Flashing)						×							×	××	×			× × ×	×			×	×	××
Compressor Noisey	×	×				×	×	×			×	×		Ħ	╞									
Head Pressure Too High					+			>	× ×	>	> × >	-	>	> ×	×	×	>	× × ×	>		× >	×		× ×
Suction Pressure Too High								< ×	×	< ×	< × × <	× < ×	<	<	×	×	<	<	<	×	< ×			
Suction Pressure Too Low											×	×	×	×			×	×	×		×	×	×	
High Compressor Amps																								
Excessive Water Usage		×																					×	
Compressor Runs Continuously - No Cooling								×			×	××			×				×					
Liquid Refrigerant Flooding Back to Compressor									×		×		×	×			×	×	×		×	×	×	×
Compressor Runs Continuously - No Heating								×			×		×	×			×					×	×	
Reversing Valve Does Not Shift		×											×	╞				╞┥						
Liquid Refrigerant Flooding Back to Compressor									×		×	××	×	×			×	×	×		×		×	××
Excessive Operation Costs						×	×	×	×		×	××	×	-	×			×	× ×		×		×	× ×
Ice in Water Coil		_					-	×			^		×	×						_	_	×	×	_

Manual 2100-583E Page 45 of 48

## 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.



## **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	ТАК	EN BY:	
1. Unit Manufacturer	Model No	Serial No	
Thermostat Manufacturer	Moo	del 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 L	oop System	
A. If Open Loop, where is water disc			
7. The following questions are for Closed	Loop systems only!		
A. Closed Loop system design	ed by:		
B. Type of Antifreeze used		% Solution	
C. System Type: Series	3	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.

8. Entering fluid temperature		*Cooling	* Heating
9. Entering fluid pressure	LOOP SIDE DATA		
10. Leaving fluid temperature	8. Entering fluid temperature		
11. Leaving fluid temperature	9. Entering fluid pressure		
12. Pressure drop through coil	10. Leaving fluid temperature		
13. Gallons per minutes through water coil	11. Leaving fluid temperature		
14. Fluid temperature rise	12. Pressure drop through coil		
15. Discharge Pressure	13. Gallons per minutes through water coil		
16. Suction Line Pressure	14. Fluid temperature rise		
17. Voltage at Compressor (unit running)	15. Discharge Pressure		
18. Amperage draw at line side of contactor	16. Suction Line Pressure		
19. Amperage draw of compressor common wire	17. Voltage at Compressor (unit running)		
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	18. Amperage draw at line side of contactor		
21. Superheat at compressor	19. Amperage draw of compressor common wire		
22. Liquid line temperature at metering device	20. Suction line temperature 6" from compressor		
23. Coil subcooling	21. Superheat at compressor		
LOAD SIDE DATA         24. Entering fluid temperature         25. Entering fluid pressure         26. Leaving fluid temperature         27. Leaving fluid temperature         28. Pressure drop through coil	22. Liquid line temperature at metering device		
24. Entering fluid temperature	23. Coil subcooling		
24. Entering fluid temperature			
25. Entering fluid pressure	LOAD SIDE DATA		
26. Leaving fluid temperature    27. Leaving fluid temperature    28. Pressure drop through coil	24. Entering fluid temperature		
27. Leaving fluid temperature	25. Entering fluid pressure		
28. Pressure drop through coil	26. Leaving fluid temperature		
	27. Leaving fluid temperature		
	28. Pressure drop through coil		
29. Gallons per minutes through water coll	29. Gallons per minutes through water coil		
30. Fluid temperature rise	30. Fluid temperature rise		
31. Other information about installation	31. Other information about installation		

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