MANUAL 2100-048

INSTALLATION INSTRUCTIONS

Bard® SINCE 1914

HIGH EFFICIENCY WATER SOURCE PACKAGED HEAT PUMPS

MODELS

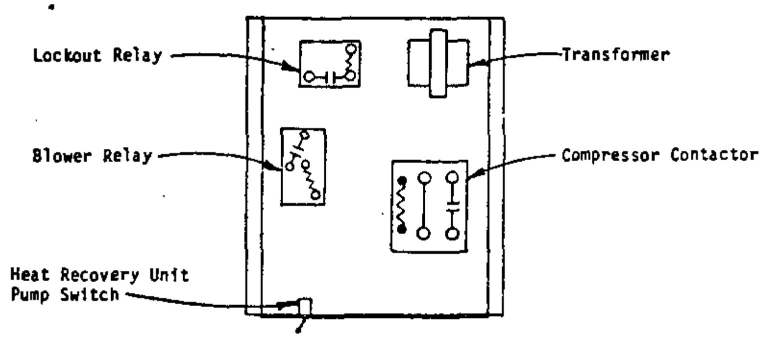
WPV30
WPV36
*WPVD30
*WPVD36

* Built-in hot water heat exchanger.

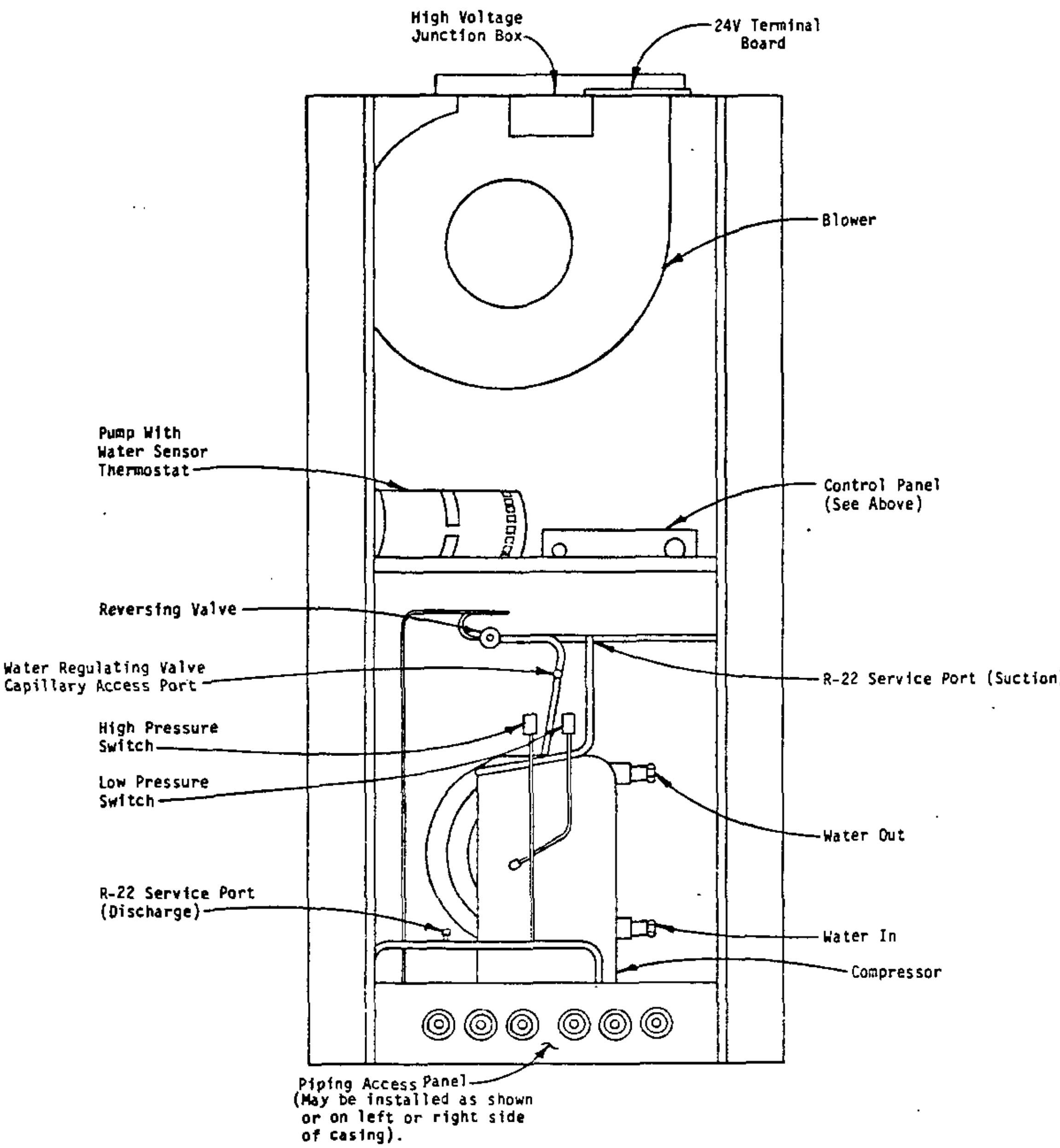
GROUND WATER TEMPERATURES 45-75°F

BARD MANUFACTURING CO. • BRYAN, OHIO 43506

Dependable quality home equipment . . . since 1914



CONTROL PANEL



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1.0 GENERAL

Units are shipped completely assembled and internally wired, requiring only duct connections, thermostat wiring, 230-208 volt AC power wiring, and water piping. The equipment covered in this manual is to be installed by trained, experienced service and installation technicians. Any heat pump is more critical of proper refrigerant charge and an adequate duct system than a cooling only air conditioning unit.

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 supersede any national and/or local codes. Authorities having jurisdiction should be consulted before the installation is made.

2.0 UNPACKING

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.

3.0 INSTALLATION

3.1 BTUH CAPACITY SELECTION

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, formerly National Warm Air Heating and Air Conditioning Association. The air duct system should be sized and installed in accordance with Standards of the National Fire Protection Association For The Installation of Air Conditioning and Ventilating Systems of Other Than Residence Type, NFPA No. 90A, and Residence Type Warm Air Heating and Air Conditioning Systems, NFPA No. 90B.

3.2 SITE SELECTION

The unit may be installed in a basement, closet or utility room provided adequate service access is insured. Ideally, three sides of the unit should have a minimum access clearance of two feet but the unit can be adequately serviced if two or only one side has the minimum two feet clearance. The unit should be located in the conditioned space to prevent freezing of the water lines and to permit proper, automatic shut off of the water regulating valves. See water piping section.

Clearance to combustible materials is 0 inches for the heat pump. If an optional duct heater is installed, follow the instructions packed with the duct heater for specifications regarding clearance to combustible material.

Before setting the unit, consider ease of piping, drain and electrical connections for the unit. Also, for units with heat recovery unit, 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.

3.3 DUCTWORK

If the unit is to be installed in a closet or utility room which does not have a floor drain, a secondary drain pan under the entire unit is highly recommended.

Do not install the unit in such a way that a direct path exists between any return grille and the unit. Rather, insure that the air entering the return grille will make at least one turn before entering the unit air coil. This will reduce possible objectionable compressor and air noise from entering the occupied space.

Design the ductwork according to methods given by the National Warm Air Heating and Air Conditioning Association. When duct runs through unconditioned spaces, it should be insulated with a minimum of two inches fiberglass insulation with vapor barrier. It is recommended that flexible connections be used to connect the duct work to the unit in order to keep the noise transmission to a minimum.

3.4 FILTER

This unit must not be operated without a filter. It comes equipped with a permanent 24x22x1 filter which should be checked often and cleaned in hot soapy water as needed. Insufficient air flow due to undersized duct systems or dirty filters can result in nuisance tripping of the high or low pressure controls. Refer to the accompanying Table 8.3 for correct airflow and static pressure requirements.

3.5 ELECTRICAL WIRING

All electrical connections are made through the top of the unit. High voltage connections are made with wire nuts to the factory-provided pigtail leads in the junction box. Low voltage connections are made to the terminal strip mounted on the top of the unit. Refer to the wiring diagram for connecting the terminals.

3.5.1 MAIN POWER

Refer to the unit serial plate for wire sizing information and correct overcurrent protection size. Each unit is marked with a "Minimum Circuit Ampacity." This means that field wiring conductors must be sized to carry that amount of current. Each unit and/or wiring diagram is also marked "Use Copper Conductors Only," meaning the leads provided are <u>not</u> suitable for aluminum wiring. Refer to the National Electric Code for complete current-carrying capacity data on the various grades of wiring material.

The unit rating plate lists "Maximum Overcurrent Protective Device" that is to be used with the equipment. This device may be a time delay fuse or HACR type circuit breaker. The correct size overcurrent protective device must be used to provide for proper circuit protection and to avoid nuisance trips due to the momentary high starting current of the compressor motor.

3.5.2 CONTROL CIRCUIT —LOW VOLTAGE WIRING

A 24 volt terminal strip is mounted on the top of the unit. Two types of thermostats are available:
1) Single stage heat, single stage cool to operate the heat pump alone—without backup duct style electric heaters. This thermostat is equipped with a signal light to indicate when the unit is "locked out" because of the low or high pressure control. Refer to the wiring diagrams at the end of this manual for correct connection of the terminals. 2) Two stage heat, single stage cool to operate the heat pump or duct heaters on heating or the heat pump on cooling. This thermostat is also equipped with a signal light to indicate when the unit is "locked out" because of operation of the low or high pressure control. In addition, a second signal light tells when the unit has been placed in Emergency Heat. Refer to the wiring diagram at the end of this manual and to the wiring diagram packed with the duct heater for correct connection of the low voltage terminals.

3.6 CONDENSATE DRAIN

Determine where the drain line will run. This drain line contains cold water and must be insulated to avoid droplets of water from condensing on the pipe and dropping on finished floors or the ceiling under the unit. A trap <u>MUST BE</u> installed in the drain line and the trap <u>filled with</u> water prior to start up. The use of plugged tees in place of elbows to facilitate cleaning is highly recommended.

Drain lines must be installed according to local plumbing codes. It is not recommended that any condensate drain line be connected to a sewer main. The drain line enters the unit through the water access panel and connects to the FPT coupling under the condensate drain pan.

3.7 PIPING ACCESS TO THE UNIT

Water piping to and from the unit enters the unit casing through the water access panel. *Piping connections are made directly to the heat exchanger coil and are 3/4* inch FPT. The access panel can be installed on any one three sides (any side of the casing except the air coil side). The photos show the three possible access panel locations. The table accompanying the figures details what fittings and pipe lengths are required if the suggested pipe routes of the figure are followed. It is highly recommended that the piping from the water coil to the outside of the casing be installed while the unit is *completely accessible* and before it is *finally* set in position.

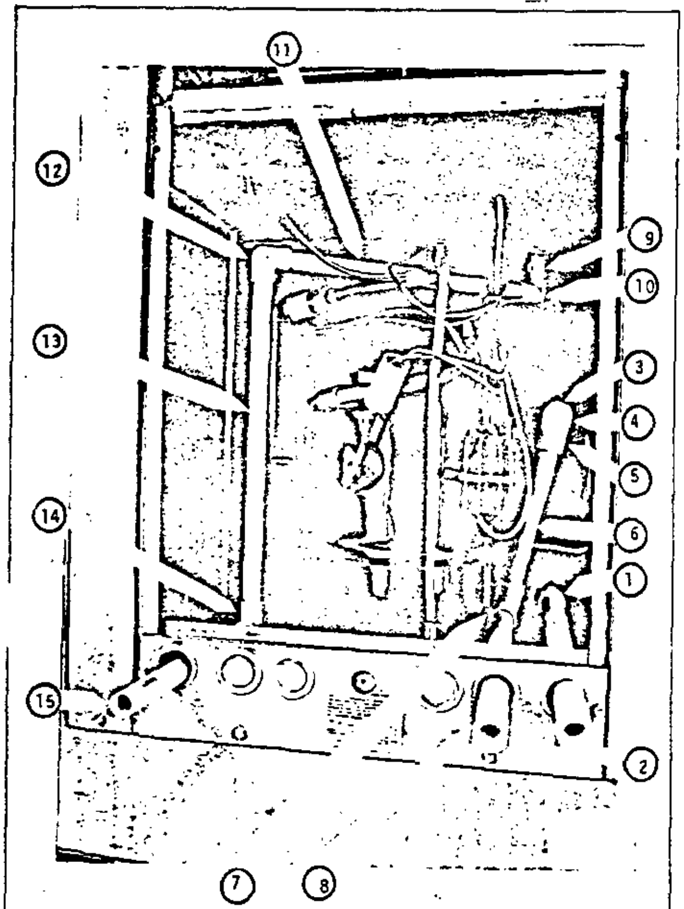


FIGURE 1

FRONT ENTRANCE

All pressure pipe and fittings - 3/4 inch Schedule 40 PVC
All condensate drain pipe and fittings - 3/4 inch CPVC
WPV30 shown (WPV36 in parentheses).

WATER IN

1	Male Adapter	- Slip x 3/4 MPT
2	Pipe	- 3/4 x to suit

WATER OUT

3	Male Adapter	- Slip x 3/4 MPT
4	Pipe	- 3/4 x 3-1/2
5	90° Elbow	- Slip x Slip
6	Pipe	- 3/4 x 8-3/4 (9-7/8)
7	90° Elbow	- Slip x Slip
8	Pipe	- 3/4 x to suit

CONDENSATE DRAIN

9	Male Adapter	- Slip x 3/4 MPT
10	Street Elbow	- 90°
11	Pipe	- 3/4 x 15-1/2 (17)
12	90° Elbow	- Slip x Slip
13	Pipe	- 3/4 x 15-1/2
14	90° Elbow	- Slip x Slip
15	Pipe	- 3/4 to suit

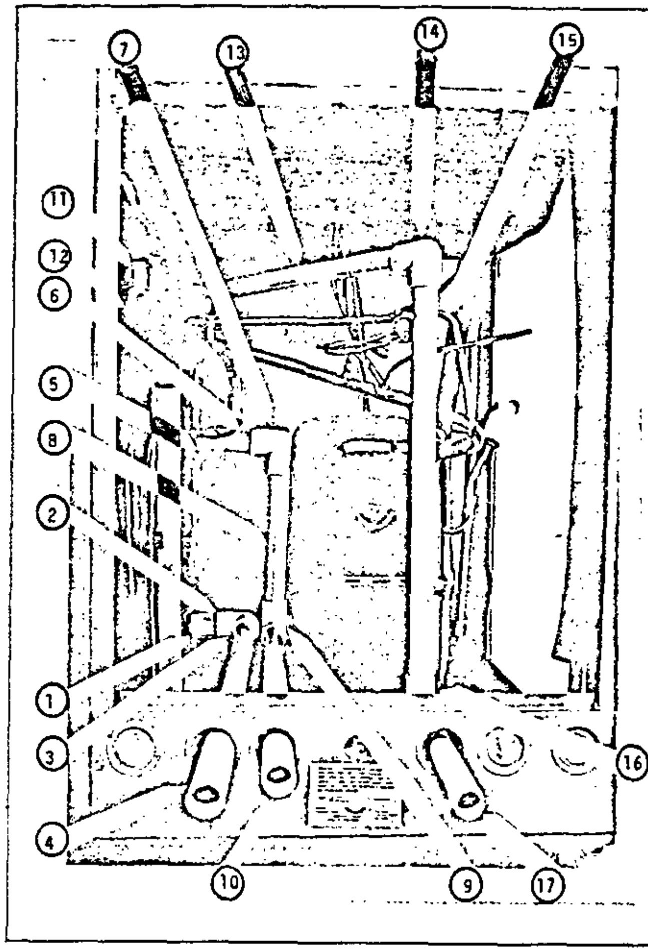


FIGURE 2

LEFT SIDE ENTRANCE

All pressure pipe and fittings - 3/4 inch Schedule 40 PVC
All condensate drain pipe and fittings - 3/4 inch CPVC
WPV30 shown (WPV36 in parentheses).

WATER IN

1	Male Adapter	- Slip x 3/4 MPT
2	Pipe	- 3/4 x 2
3	90° Elbow	- Slip x Slip
4	Pipe	- 3/4 x to suit

WATER OUT

5	Male Adapter	- Slip x 3/4 MPT
6	Pipe	- 3/4 x 3-1/2
7	90° Elbow	- Slip x Slip
8	Pipe	- 3/4 x 8-1/2 (9-7/8)
9	90° Elbow	- Slip x Slip
10	Pipe	- 3/4 x to suit

CONDENSATE DRAIN

11	Male Adapter	- Slip x 3/4 MPT
12	Street Elbow	- 90°
13	Pipe	- 3/4 x 16-1/2
14	90° Elbow	- Slip x Slip
15	Pipe	- 3/4 x 15-1/2 (17)
16	90° Elbow	- Slip x Slip
17	Pipe	- 3/4 x to suit

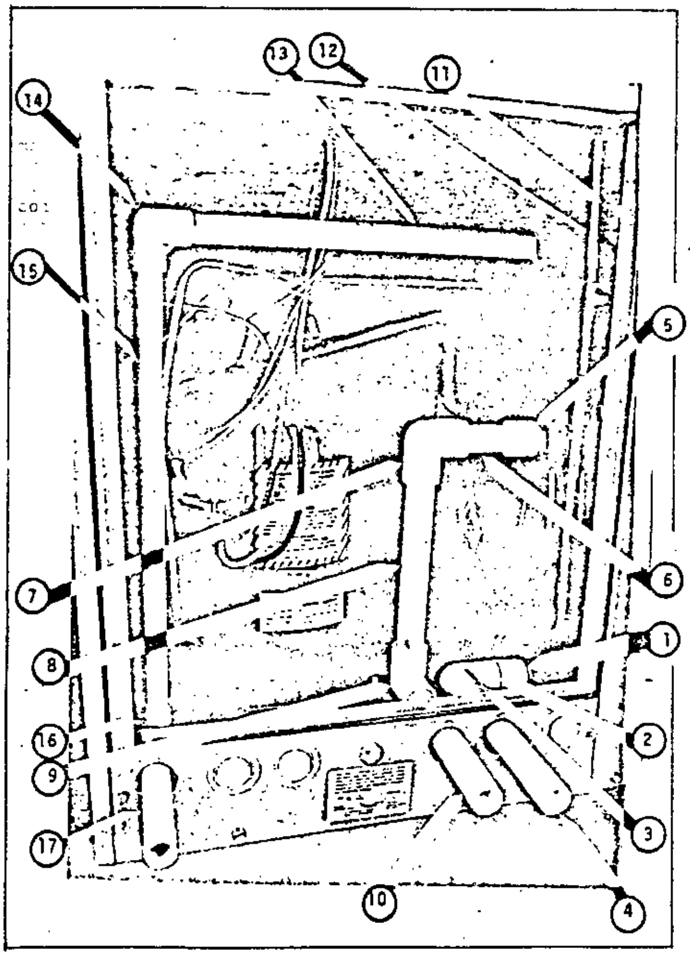


FIGURE 3

RIGHT SIDE ENTRANCE

All pressure pipe and fittings - 3/4 inch Schedule 40 PVC
All condensate drain pipe and fittings - 3/4 inch CPVC
WPV30 shown (WPV36 in parentheses).

WATER IN

1	Male Adapter	-	Slip x 3/4 MPT
2	Pipe	-	3/4 x 2
3	90° Elbow	-	Slip x Slip
4	Pipe	-	3/4 x to suit

WATER OUT

5	Male Adapter	-	Slip x 3/4 MPT
6	Pipe	-	3/4 x 3-1/2
7	90° Elbow	-	Slip x Slip
8	Pipe	-	3/4 x 8-1/2 (9-7/8)
9	90° Elbow	-	Slip x Slip
10	Pipe	-	3/4 to suit

CONDENSATE DRAIN

11	Male Adapter	-	Slip x 3/4 MPT
12	Street Elbow	-	90°
13	Pipe	-	3/4 x 17-1/4
14	90° Elbow	-	Slip x Slip
15	Pipe	-	3/4 x 15-1/2 (17)
16	90° Elbow	-	Slip x Slip
17	Pipe	-	3/4 x to suit

3.8 WATER CONNECTIONS

It is very important that an adequate supply of clean, non-corrosive water at the proper pressure be provided before the installation is made. Insufficient water, in the heating mode for example, particularly at low water temperatures, will cause the low pressure control 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 permissible, 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.

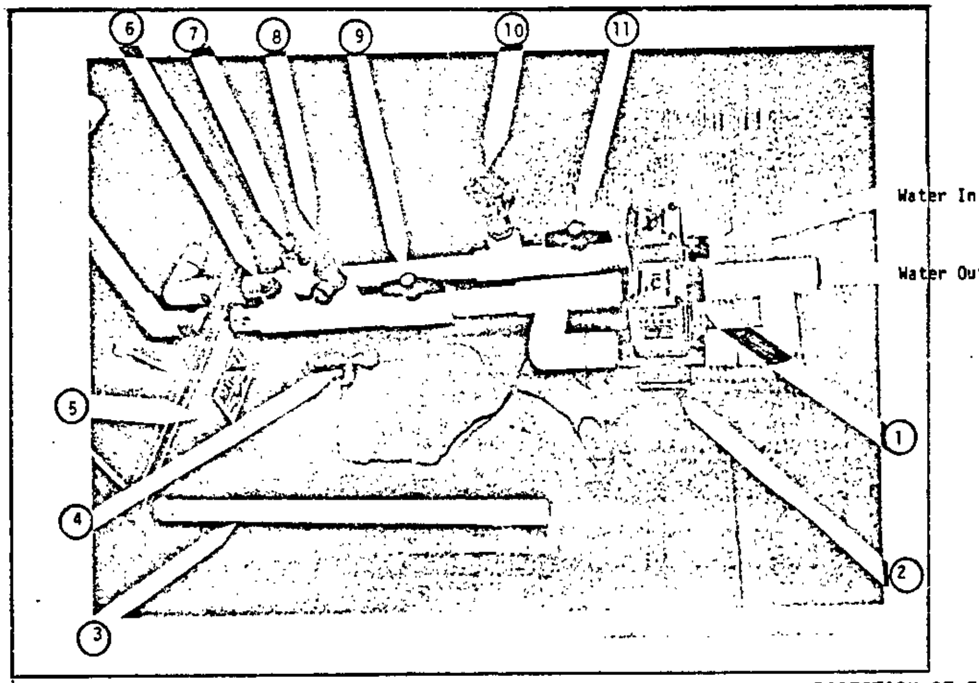
Refer to piping Figure 4. Test points (6) and (7), to measure water temperature and water pressure entering and leaving the unit, must be included in the piping installation. Either the self-sealing threaded test plugs (available from Bard) or more conventional gauge tees and thermometer wells can be used. These test points will aid in the initial start-up of the equipment as well as in the future service work. Water regulating valves 1 and 2, are required on all ground water heat pump installations and on all installations having a hot water desuperheater. These valves insure that the proper water flow is maintained to the heat pump in response to variations in the refrigerant pressure. Two valves are manifolded together as shown in Figure 4. One valve, V46AC, opens in response to an increase in discharge pressure during the cooling cycle. The other valve, V46NC, opens in response to a decrease in suction pressure during the heating cycle. One valve only opens during cooling, the other valve only opens during heating. The valves should be installed on the LEAVING SIDE of the unit as shown. The reason for this location is to maintain pressure on the water system (including the unit water coil) when the unit shuts down. Constant water pressure will help prevent solids, dissolved in the water, from precipitatin and causing scaling.

Steps to connect water regulating valve capillaries to unit:

1. The capillaries from the two valves are connected to a field supplied 1/4 inch SAE tee and length of 1/4 inch tubing.
2. Route the tubing through the pipe access panel,(5) through the 7/8 inch hole in the center of the panel.
3. Connect the other end of the 1/4 inch tubing to the branch (no valve core) of the 1/4 inch flare tee with depressor. Avoid having the tubing touch other piping or components inside the unit as constant vibration will weaken the tubing and could cause leaks.
4. THIS STEP MUST BE DONE LAST TO AVOID LOSS OF REFRIGERANT CHARGE. Connect the tee's female end (with valve depressor) to the refrigerant port located in the tubing which joins the reversing valve to the water coil.

The figure shows the use of shut-off valves (9)and (11), on the in and out water lines to permit isolation of the unit from the plumbing system should future service work require this. Globe valves should not be used as shut off valves because of the excessive pressure drop inherent in the valve design. Instead use gate or ball valves as shut-offs so as to minimize pressure drop.

Drain cocks, (8) and (10), and tees have been included to permit acid cleaning the refrigerant-to-water coil should such cleaning be required. See WATER CORROSION.



OBSERVE THE DIRECTION OF FLOW ARROW ON SIDE OF VALVE BODY WHEN INSTALLING REGULATING VALVES (1 & 2).

FIGURE 4

3.9 WELL PUMP SIZING

Strictly speaking, sizing the well pump is the responsibility of the well drilling contractor. It is important, however, that 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 failure.

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 fixtures.
3. Able to meet the above from the depth of the well-feet of lift.

The pressure requirements put on the pump are directly affected by the diameter of pipe being used as well as by the water flow rate through the pipe. The worksheet included in these instructions should guarantee that 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 -sure losses due to undersized pipe will reduce ciency and require larger pumps and could also te water noise problems.

3.10 The worksheet assumes a residence having a submersible pump and three branches in the water system, (1) well pump to the pressure tank branch, (2) the household plumbing branch, and (3) the water source heat pump branch. If your installation requires more branches (and therefore more peak demand for water flow), these additional branches must be included in the calculations for sizing the well pump.

3.11 Most household water systems will require 30 psig pressure to work dishwashers, clotheswashers, etc. It is reasonable to assume a 30 psig pressure requirement for the household and avoid pipe sizing calculations for an entire household plumbing system.

Most well systems include a pressure storage tank connected to the well pump. The purpose of this tank is to maintain adequate pressure for the plumbing while avoiding turning on the well pump every time a small amount of water is required.

Hydropneumatic water storage tanks should not be used. These tanks are partially filled with air which is compressed as the water is pumped into the tank. Thus, the compressed air maintains a constant pressure on the water. However, air under pressure will dissolve into the water requiring more and more water to maintain pressure. Additionally, the air and water mixture can be somewhat more corrosive.

Instead, diaphragm or bladder type pressure tanks must be installed. This type of tank separates the water from the air with a heavy rubber diaphragm inside the metal tank and prevents the water and compressed air from mixing.

The pressure tank setting of the water storage tank should be selected to provide adequate pressure for that branch of the water system having the highest pressure requirement. This could be the household plumbing branch or the heat pump branch.

4.0 SEQUENCE OF OPERATION

4.1 COOLING WITH OR WITHOUT DUCT HEATERS

Whenever the system lever is moved to COOL, thermostat system switch completes a circuit R to O, energizing the reversing valve solenoid. On a call for cooling, the cooling bulb completes a circuit from R to G, energizing the blower relay coil. The blower relay contacts complete a 230 volt circuit to the blower motor and the blower operates. R to Y circuit is completed at the same time as the fan circuit and current flows from Y to terminal 4 at the lockout relay. Terminal 4 of the lockout relay provides two paths for current flow:

1. Through the lockout relay coil which offers the resistance of the lockout relay coil.

2. Through the normally closed contacts of the lockout relay to terminal 5 of the lockout relay and then through the high and low pressure switches to the compressor contactor coil.

If the high and low pressure switches remain closed (refrigerant pressure remains normal), the path of least resistance is through these safety controls to the compressor contactor coil. The contacts of the compressor contactor complete a 230 volt circuit to the compressor and the compressor runs. If discharge (suction) pressure reaches the set point of the high (low) pressure control, the normally closed contacts of the high (low) pressure control open and current no longer flows to the compressor contactor coil—the coil drops out. Current now can take the path of least resistance through the lockout relay coil, energizing the lockout relay coil and opening terminals 4 and 5 of the lockout relay. The lockout relay will remain energized as long as a circuit is completed between R and Y at the thermostat. In the meantime, since the compressor is not operating, refrigerant pressure will equalize and the high (low) pressure switch will automatically reset. However, the circuit to the compressor contactor will not be complete until the lockout relay is de-energized by moving the thermostat system switch to OFF, breaking the circuit from R to Y, dropping out the lockout relay coil and permitting terminals 4 and 5 to make. When the high (low) pressure switch closes, a circuit is completed to L at the thermostat, energizing the signal light to indicate a malfunction. When the system switch is moved from OFF to COOL, the cycle is repeated.

4.2 SINGLE STAGE HEAT WITHOUT DUCT HEATERS

Compressor circuit R to Y including lockout relay and pressure controls is the same as cooling. Blower circuit R to G is the same as cooling. With system switch set to HEAT, no circuit is completed between R and O and reversing valve solenoid is not energized. Unit is in heating.

4.3 TWO STAGE HEAT WITH DUCT HEATERS

First stage heat is the same as single stage heating without duct heater. When the second stage thermostat bulb makes, a circuit is completed from R to W2 and W3, energizing the duct heater heat contactor, R1, through the automatic thermal cutout (TCO). The contacts of R1 close a circuit to the heat pump blower relay and, through the manual reset thermal cut-off device, to the elements. Elements and blower remain energized as long as R to W2 and W3 are made.

4.4 EMERGENCY HEAT

When the system switch is moved to EMER, the compressor circuit R to Y is disconnected. Control of the electric heaters is from R to W2 and W3 through the thermostat second stage heating bulb. Blower operation is controlled by the second stage heating bulb. Operation is the same as above, "Two Stage Heat With Duct Heaters."

5.0 SYSTEM START UP PROCEDURE

5.1 Be sure main power to the unit is OFF at the disconnect.

5.2 Set thermostat system switch to OFF, fan switch to AUTO.

5.3 Move main power disconnect to ON. Power should be on to unit for a minimum of four hours or sixty minutes per pound of refrigerant. This allows the crankcase heater to drive any refrigerant liquid out of the compressor sump. This procedure should be followed whenever the power has been off for twelve hours or longer. Except as required for safety while servicin DO NOT OPEN THE UNIT DISCONNECT SWITCH.

5.4 Check system air flow for obstructions.

5.4.1 Move thermostat fan switch to ON. Blower runs.

5.4.2 Be sure all registers and grilles are open.

5.4.3 Move thermostat fan switch to AUTO. Blower should stop.

5.5 Cooling cycle. *(NOTE: If unit is equipped with a heat recovery unit, temporarily disconnect the hot water circulating pump from the electrical circuit by moving pump switch to OFF).*

5.5.1 Open manual inlet and outlet water flow valves of the unit.

5.5.2 Move thermostat switch to COOL—fan should be set for AUTO.

5.5.3 Open the cooling regulating valve (V46AC) by turning range adjusting screw clockwise until the valve is fully open.

5.5.4 Turn the heating regulating valve screw clockwise (V46NC) until the valve is closed. Throttle manual outlet valve closed until rated water flow is achieved. An approximate flow rate may be determined by water pressure drop through the coil, Table 8.9. A more precise measure of water flow may be determined by timing the discharge from the pipe into a container of known volume, or by reading entering and leaving water temperatures and discharge pressure of the compressor. Compare the readings obtained with temperatures given in Figure 5 or 6 for temperature, and Table 8.13 or Table 8.14 for discharge pressure.

5.5.5 Check refrigerant suction and discharge pressures for cooling against Table 8.13 or 8.14. V ations in pressures of one or two pounds should be nored. Larger variations should be checked for prob cause: Incorrect air or water flow; incorrect air or water temperature, incorrect refrigerant charge.

5.5.6 Adjust manual outlet valve to full open.

5.5.7 Adjust cooling regulating valve (V46AC) by turning range adjustment screw counterclockwise until water temperatures drop, Figure 5 or 6, and refrigerant pressures, Tables 8.13 or 8.14, all match.

5.5.8 Move thermostat switch to OFF. Check that cooling water regulating valve shuts off water.

5.6 Heating cycle heat recovery unit circulating pump should still be disconnected per step 5.5).

5.6.1 Manual inlet and outlet water flow valves of the unit should still be open per step 5.5.6.

5.6.2 Move thermostat switch to HEAT. Fan should be set for AUTO.

5.6.3 Open the heating regulating valve (V46NC) by turning the range adjusting screw counterclockwise until the entering water temperature and leaving water temperature compare to Figures 5 or 6 for the model installed. Compare suction pressure to Table 8.13 or 8.14 for the model installed.

5.6.4 Check refrigerant suction and discharge pressure for heating against Table 8.13 or 8.14. Variations in pressures of one or two pounds should be ignored. Larger variations should be checked for probable cause: Incorrect air or water flow; incorrect air or water temperature; incorrect refrigerant charge.

3.12 - WATER SYSTEM WORKSHEET

(METHOD APPLICABLE TO SUBMERSIBLE PUMPS. CONSULT WELL DRILLER FOR SIZING OF OTHER TYPES OF PUMPS)

WELL PUMP SIZING

Branch "A" - Well Pump	-	Piping from pump in well to pressure tank.
Branch "B" - Domestic Water Supply	-	Piping from tank to the fixtures throughout house.
Branch "C" - Heat Pump Water Supply	-	Piping from tank through heat pump coil to drain.

1. Determine household water needs from Table 8.4, Column 1. Enter here. ________ gpm Branch B

2. Enter gpm flow rate for unit to be installed from Table 8.5. ________ gpm Branch C

3. Add lines 1 and 2 for total water flow rate required. ________ gpm Branch A

   NOTE: IF PIPING LAYOUT HAS MORE BRANCHES, DETERMINE THE FLOW RATE FOR THESE FROM TABLE 8.4, COLUMN 1, AND INCLUDE IN TOTAL.

B. DETERMINING WATER PRESSURE REQUIREMENTS PIPE SIZING FOR EACH PIPE BRANCH—Household plumbing, Branch B, may be assumed to have a total pressure requirement of 30 psig.

	Branch A	Branch C	
4. Tentatively select a pipe size and enter here. Table 8.6 or 8.7.			inch pipe
5. Consult Table 8.8 and enter equivalent feet of pipe for one elbow of the size selected in step 4 above using gpm of the branch. Enter here.			equiv. feet
6. From the piping layout, determine the number of elbows needed for the branch. Enter here.			elbows
7. Multiply line 5 by line 6. Enter total here.			equiv. feet
8. From piping layout, determine total lineal feet of pipe in the branch. Enter here.			lineal feet
9. Add lines 7 and 8. Enter here.			total feet
10. Consult Table 8.6 and 8.7 for total feet (line 9) and total gpm needed (for each branch determined from Section A above) and enter friction loss here.			ft.hd/100 ft.
11. Multiply line 10 by line 9, divide by 100 and enter here as total piping friction loss.			ft. hd.
12. Multiply line 11 by 0.433 to convert to psig. Enter here.			psig
13. Consult Table 8.9 for the unit to be installed and enter unit pressure drop here. Branch C only.			psig unit
14. Consult Table 8.10 for the pressure drop of the water regulating valve using the appropriate size and flow rate (line 2). Branch C.			psig regulating valves
15. Calculate total pressure drop, Branch C, by adding lines 12, 13 and 14. Enter here. Branch A pressure drop is the same as line 12 Branch A and should be entered here.			psig

16. From the piping layout, determine parallel flow among the branches. Beginning at the well pump, add the friction loss in psig for the well pump branch (Branch A) to the branch having the higher pressure drop (Branch B or Branch C). Note: If more than three branches are required by the piping layout, select that branch which has the highest pressure drop and add this pressure drop to Branch A. Enter in line 16 the number obtained as total piping pressure loss due to pipe friction. ________ psig

17. To the branch having the higher pressure drop (Branch B or C used in line 16), add 20 psig to obtain the pressure switch cut out point. Enter this value here. ________ psig Tank cut-out setting

18. Pump requirements will be: ________ gpm (line 3) at ________ psig (line 17)

    at ________ feet lift (Vertical distance to water in the well)

REFER TO PUMP MANUFACTURER'S TABLE TO ACTUALLY SELECT THE PUMP MODEL BASED ON REQUIREMENTS ENTERED IN LINE 18.

FORM 1001-1081

-OVER-

C. WATER TANK SIZING (Applicable to bladder or diaphragm type tanks only - recommended type).

19. Enter desired minimum off time of the well pump in minutes and fractions of minutes. Never less than two minutes. ____________ minutes

20. Enter pressure switch cut-in point psig. At least as great a pressure as required for Branch B or C. ____________ psig

21. Enter pressure cut-out point psig. Usually 20 psig higher than value in line 20. ____________ psig

CALCULATE TANK SIZE

22. Multiply line 3 by line 19 to determine minimum acceptance volume. ____________ gals.

23. Refer to Table 8.11. Find the tank pressure factor for lines 20 and 21. ____________ P.F.

24. Divide line 22 by line 23 and enter the minimum total tank volume corrected for pressure. ____________ gals.

25. Refer to Table 8.12 and select a tank model that is greater than line 24 for "Total Volume" and equal to or greater than line 25 for "Acceptance Volume." (Refer to water tank manufacturer's specifications).

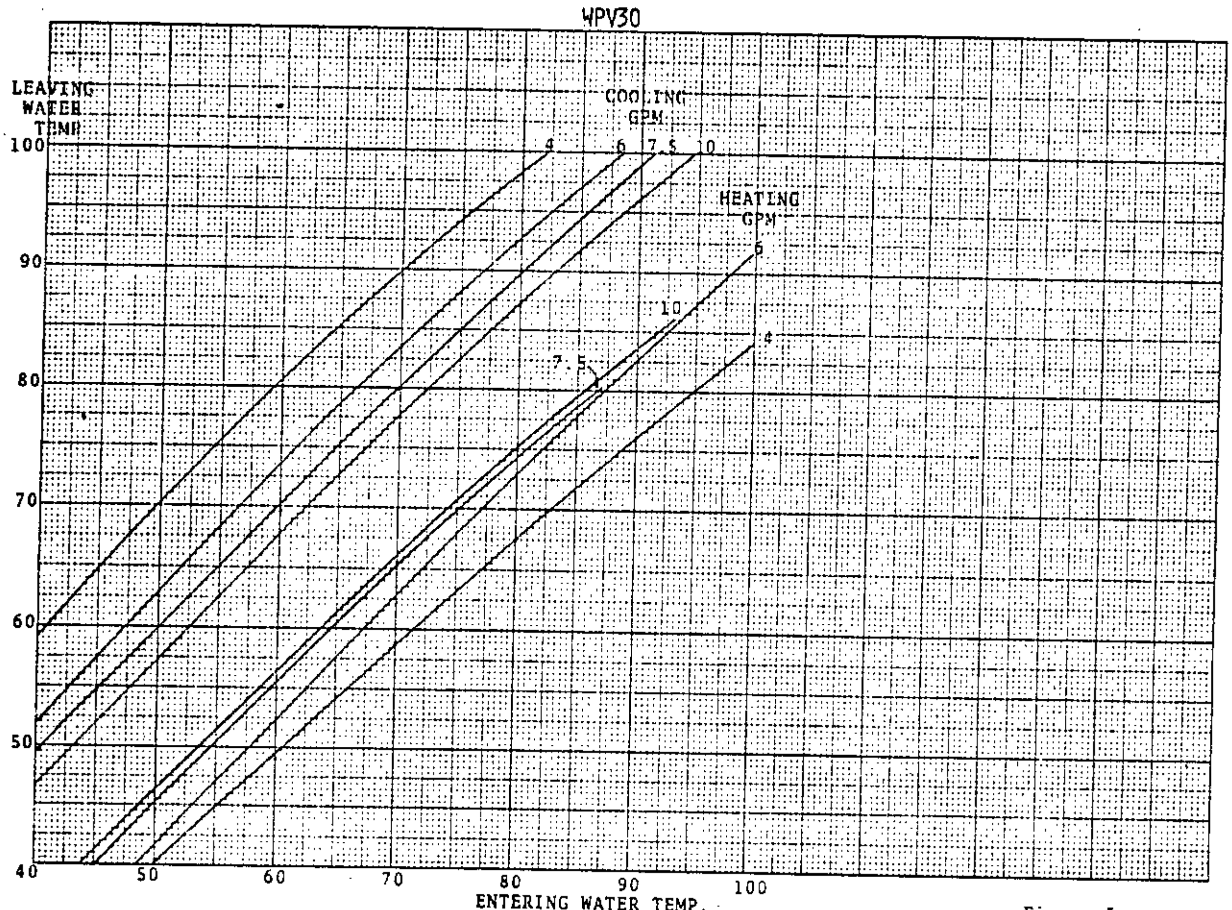


Figure 5

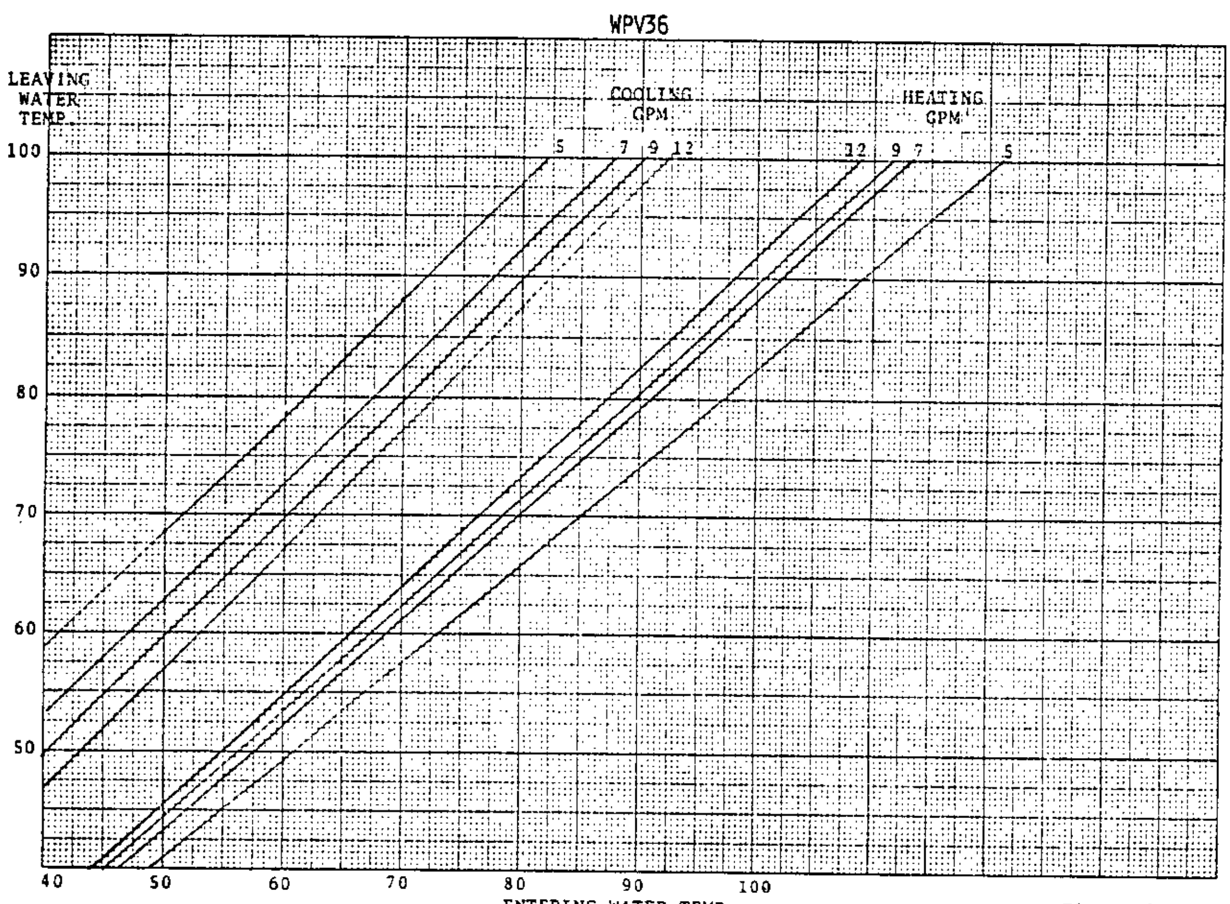


Figure 6

6.0 UNIT WITH HEAT RECOVERY FOR HEATING DOMESTIC HOT WATER --- WPVD SERIES

6.1 GENERAL

Units having a heat recovery coil should only be installed by trained refrigeration technicians. These instructions serve as a guide to the technician installing the heat recovery portion of the unit. They are not intended as a step-by-step procedure with which the mechanically inclined owner can install the unit.

6.2 DESCRIPTION

Units with the heat recovery coil mounted at the factory are designed to recover the "waste" heat from the compressor discharge gas and use this "waste" heat to heat domestic hot water. Units so equipped may be identified by the letter "D" in the model number. In addition to the components already described for the heat pump, these units are equipped with an additional water-to-refrigerant coil, a circulating pump and a thermostat to control the operation of the circulating pump. The water-to-refrigerant coil is constructed of two tubes. Water flows through the center tube, refrigerant flows through a surrounding tube, totally separated from the water tube. The space between these two tubes is vented to atmosphere. In the unlikely event a leak should develop, no leakage can occur between the water and the refrigerant.

6.3 WATER REQUIREMENTS

Units with the Heat Recovery Unit installed at the factory will have different water requirements, depending upon how much work the Heat Recovery Unit is doing. The actual amount of heat extracted by the recovery unit is a function of water flow rate (circulator pump) and temperature difference (into and out of the Heat Recovery Unit). Since this temperature difference will vary, depending upon domestic hot water usage, storage tank losses, etc., units with Heat Recovery Units MUST EMPLOY WATER REGULATING VALVES on the heat pump water system. Additionally, it should be pointed out that water flow requirements for the heat pump will increase in winter (from 5 gpm to as much as 13 gpm for a three ton heat pump) when the Heat Recovery Unit is operating. Conversely, in the cooling season the heat pump water flow requirements will decrease (from 5 gpm to approximately 3 gpm for a three ton unit) when the heat recovery unit is in operation.

6.4 INSTALLATION

6.4.1 TWO TANK. In order to realize the maximum energy savings from the domestic hot water heat recovery unit, it is recommended that a second water storage tank be installed in addition to the main hot water heater. Fossil fuel fired water heaters must be a two tank installation. If the existing water heater is electric, the two tank installation is still the best approach, however, a one tank installation is satisfactory. Tanks specifically intended for hot water storage are available from water heater manufacturers (solar hot water storage tanks). These tanks have special dip tube arrangements, are built without heaters and are constructed with heavier insulation. However, a well insulated electric water heater without the electric heating elements connected will also make a suitable storage tank.

The size of this 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).

6.4.2 ONE TANK. Where space or first cost economy dictates only one hot water heater, a single tank installation is permissible. It should be noted, however, that the amount of savings realized is reduced.

The single hot water tank may be a new hot water heater (sized in this case to 100% of daily water requirements) or the existing water heater in the case of a retrofit installation. The existing hot water heater should be carefully inspected and any sediment removed by draining the water heater and flushing it until all loose sediment has been flushed away. The sediment, besides cutting down on the efficiency of the water heater and heat recovery unit, could damage the circulating pump, or clog the strainer and stop water flow.

6.5 LOCATION

In determining the location of the storage tank (and the water heater) keep in mind that small temperature differences between the storage tank water temperature and the refrigerant temperature permit this unit to function. It is consequently necessary that all tubing be kept as short and direct as possible and that the tubing be adequately and thoroughly insulated.

Locate the storage tank as close to the heat pump and water heater as the installation permits. Be sure to provide adequate service access to all components.

6.6 INSTALLATION PROCEDURE - GENERAL

6.6.1 Turn off the water heater electric power (if electric hot water heater) or close the fuel supply line (if fossil fuel water heater).

6.6.2 Shut off the main water supply line by closing the water valve at the well pressure tank (if a well system) or the water meter (if city water is being used for domestic purposes).

6.6.3 Connect a garden hose to the water heater drain valve (bottom of the water heater tank) and drain the water heater to a floor drain or other convenient drain.

6.6.4 If the water heater has been in service for some time, inspect it for sediment. Remove all sediment and thoroughly flush the water heater tank.

6.6.5 Turn off the electric power to the water source heat pump.

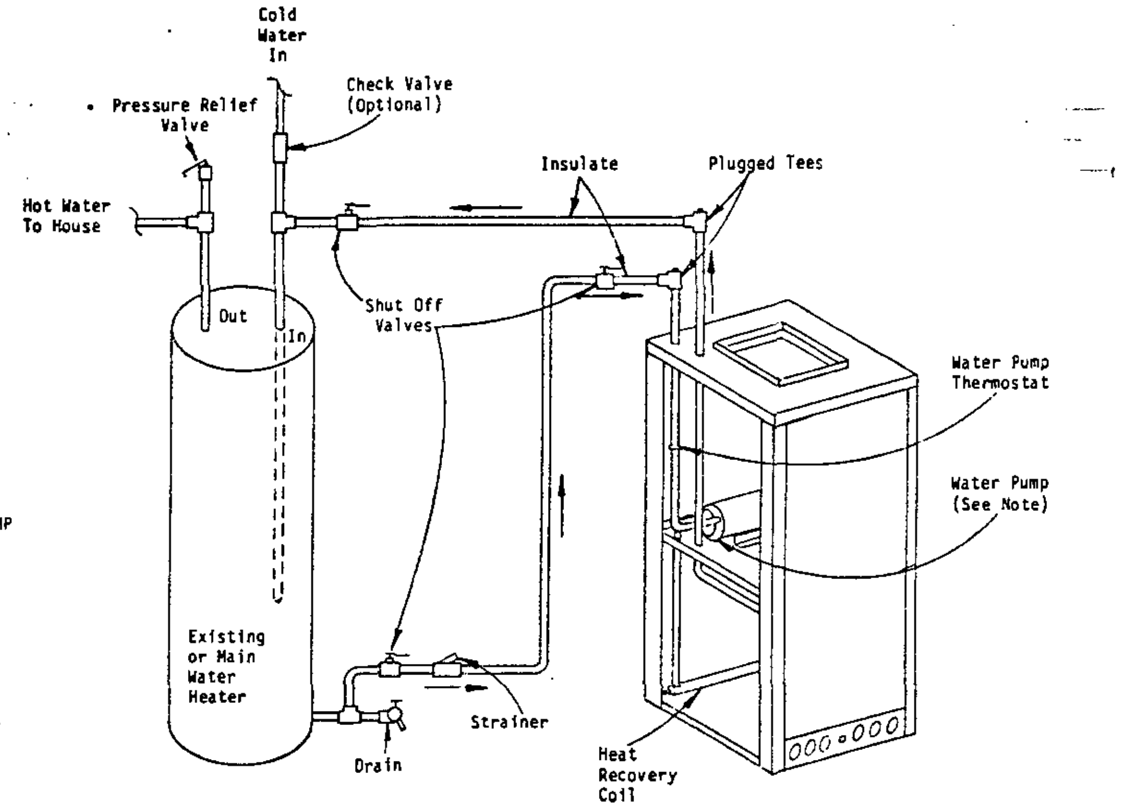
6.7 WATER PIPING

Two tank installation, refer to Piping Diagram, Figure 7 and steps 6.7 to 6.7.3 and 6.8 to 6.8.6. One tank installation, refer to Piping Diagram, Figure 8 and steps 6.7 to 6.7.3 and 6.9 to 6.9.4. Follow all local plumbing codes. Piping connections are 1/2 inch O.D. copper pipe, Type K or L, and are made inside the unit. Route the copper through the top of the heat pump through the holes provided.

6.7.1 A plugged tee and shut off valve should be provided near the heat pump unit. This will make it easy if it ever becomes necessary to clean the desuperheater coil. A suitable cleaner is mentioned below, "Water Corrosion" section. The shut off valves will isolate the unit from the rest of the plumbing and the plugged tees will provide access to the coil and pump for the cleaner.

6.7.2 A strainer is included in both figures to collect any sediment which may accumulate in the storage tank or water heater. This strainer should be of the cleanable "Y" type. It is more important that the strainer be included on one tank retrofit installation where the hot water heater may be suspected of sedimentation.

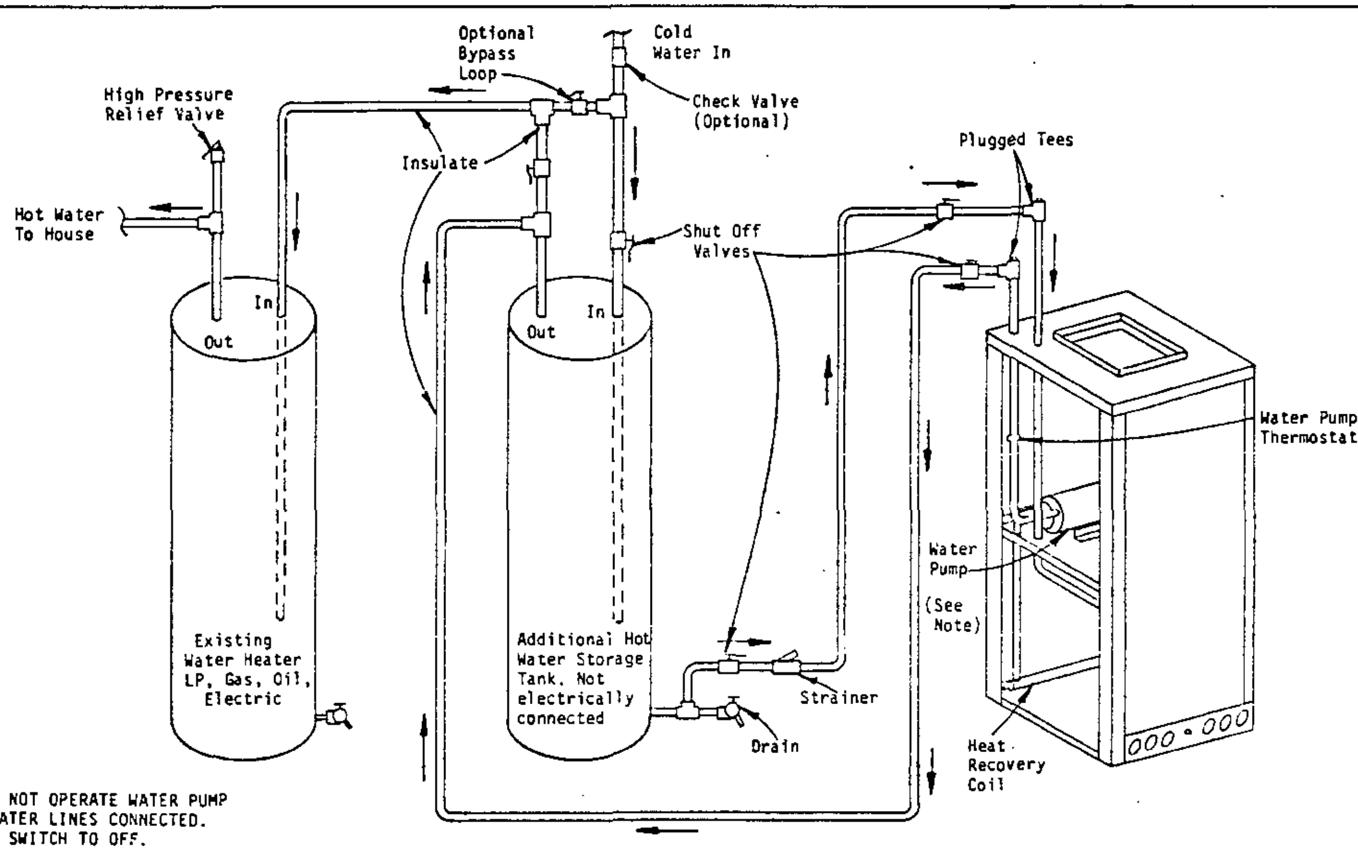
6.7.3 A check valve is shown in both figures as an option. The purpose of the check valve is to prevent any contamination of the water system in the unlikely event that the heat exchanger develops a leak. Check the local plumbing code as this check valve may be required.



NOTE: DO NOT OPERATE WATER PUMP WITHOUT WATER LINES CONNECTED. TURN PUMP SWITCH TO OFF.

ONE TANK INSTALLATION
(PERMISSIBLE)

Figure 8



DO NOT OPERATE WATER PUMP .UT WATER LINES CONNECTED. TURN PUMP SWITCH TO OFF.

TWO TANK INSTALLATION
(PREFERRED)

Figure 7

6.8 TWO TANK INSTALLATION - FIGURE 7

6.8.1 Water into the heat recovery unit is taken from the bottom of the storage tank. This location will insure that the coldest water will always be circulated to the recovery unit.

6.8.2 If a solar type water storage tank is being used (specifically designed for storing but not heating water), insert the dip tubes according to the manufacturer's instructions.

6.8.3 If a second water heater is being used for storage, install a pipe thread tee and a suitably sized pipe nipple in the water heater drain connection (bottom of the tank). The run of the tee is connected between the water heater and a drain valve. Brass or bronze fittings are recommended for these fittings. Check the local plumbing code—brass or bronze may be required. The branch of the tee is connected to the recovery unit "water in" copper tube. Use a pipe thread to sweat adapter to connect the tubing between the tee and recovery unit.

6.8.4 The "water out" tubing from the recovery unit is connected through a tee to the storage tank and to the normal "water in" of the main water heater.

6.8.5 Cold water into the storage tank is connected to the "water in" of the storage tank.

6.8.6 An optional bypass loop with valve is shown in Figure 7 between the water into the storage tank and the "water out" of the storage tank. The loop will make future service work easier should it become necessary to drain the storage tank. In normal operation the valve in the bypass loop should be closed.

6.9 ONE TANK INSTALLATION. FIGURE 8
NOT RECOMMENDED FOR FOSSIL FUEL FIRED WATER HEATER

6.9.1 Unless the single hot water heater is new, it should be thoroughly inspected and cleaned of sediment. Flush the tank several times and inspect it after each flushing. Be sure the tank is free of sedimentation.

6.9.2 Water from the hot water heater is connected to the domestic hot water supply as any conventional hot water heater would be connected.

6.9.3 Water to the heat recovery unit is connected through a tee at the drain valve connection of the hot water heater as described in step 6.8.3 above.

6.9.4 Water from the recovery unit is connected at the "water in" connection of the hot water heater through a tee.

6.10 OPERATION OF THE HEAT RECOVERY UNIT

The circulating pump is wired in parallel with the heat pump compressor (230 VAC circuit). Thus, no water can be circulated to the water-to-refrigerant coil unless the compressor is in operation.

In addition, a thermostat, attached to the entering water tube of the pump, is wired in series with the pump motor. The thermostat is normally closed and opens when the tube temperature reaches 150°F. This will stop further heating of the water by the recovery unit and is intended to prevent overheating the water. The thermostat will reset at approximately 120°F.

Heat for domestic hot water is obtained from the discharge gas of the compressor. This heat would ordinarily be rejected to the ground water in the cooling mode or to the room air in the heating mode. With the recovery unit this heat is transferred to the storage tank or water heater.

6.11 START UP AND CHECK OUT

6.11.1 Be sure all shut off valves are open. If optional bypass valve, see Figure 7, has been installed, this valve should be closed.

6.11.2 Open a hot water faucet to permit any air to bleed from the plumbing.

6.11.3 Turn off the heat pump disconnect.

6.11.4 Temporarily remove compressor wire from load side of contactor and insulate.

6.11.5 Turn heat pump disconnect ON.

6.11.6 Set the wall thermostat to cool.

6.11.7 Inspect for water leaks and verify pump is operating.

6.11.8 Again turn off the heat pump disconnect.

6.11.9 Re-install compressor wire on compressor contactor terminal.

6.11.10 Repeat steps 6.11.5 and 6.11.6. Feel the "water in" and "water out" tubes. There should be a noticeable temperature difference. How much temperature difference you measure will depend upon tubing length, flow rate, storage tank temperature and could vary from 2°F to 20°F.

6.11.11 Move thermostat system to OFF. Verify that water pump stops.

7.0 WATER CORROSION

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

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

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

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

1. Increased water flow to the unit.
2. Decreased heat transfer of the water coil (entering to leaving water temperature difference is less).

There are four main water quality 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 up 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 that it will erode metal parts, pumps, heat transfer coils, etc. So 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 di-electric unions galvanic reaction is eliminated. The use of corrosion resistant materials (such as the Cupro nickel coil) throughout 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 this scale is due to the formation of calcium carbonate but magnesium carbonate or calcium sulfate may also be present. Carbon dioxide gas (CO_2), the carbonate of calcium and magnesium carbonate, is very soluble in water. It will remain dissolved 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 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 dissolved gas to fall out of solution. Likewise if pressure drops are kept to a reasonable level, no precipitation of carbon dioxide should occur.

7.1 REMEDIES OF WATER PROBLEMS

WATER TREATMENT. Water treatment can usually be economically justified for closed loop systems. However, because of the large amounts of water involved with a ground water heat pump, water treatment is generally too expensive.

ACID CLEANING THE WATER COIL OR HEAT RECOVERY UNIT.

If scaling of the coil is strongly suspected, the coil can be cleaned up with a solution of Sulfamic Acid (toxic) or Phosphoric Acid (food grade acid). Follow the manufacturer's directions for mixing, use, etc. Refer to the, Cleaning Water Coil, Figure 9. The acid solution can be introduced into the heat pump coil through the hose bib (Part 8 of Figure 9.) Be sure the isolation valves (Parts 9 and 11 of Figure 9) 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 (Part 8, Figure 9) and returned to the bucket through the other hose bib (Part 10, Figure 9). 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.

UNDER NO CIRCUMSTANCES SHOULD THE HEAT PUMP BE OPERATED IN SUCH A WAY AS TO FREEZE THE COIL IN AN ATTEMPT TO BREAK SCALE FREE.

While no damage is expected to be done to the coil from freezing, undue strain is put on the refrigeration system and this practice should not be attempted.

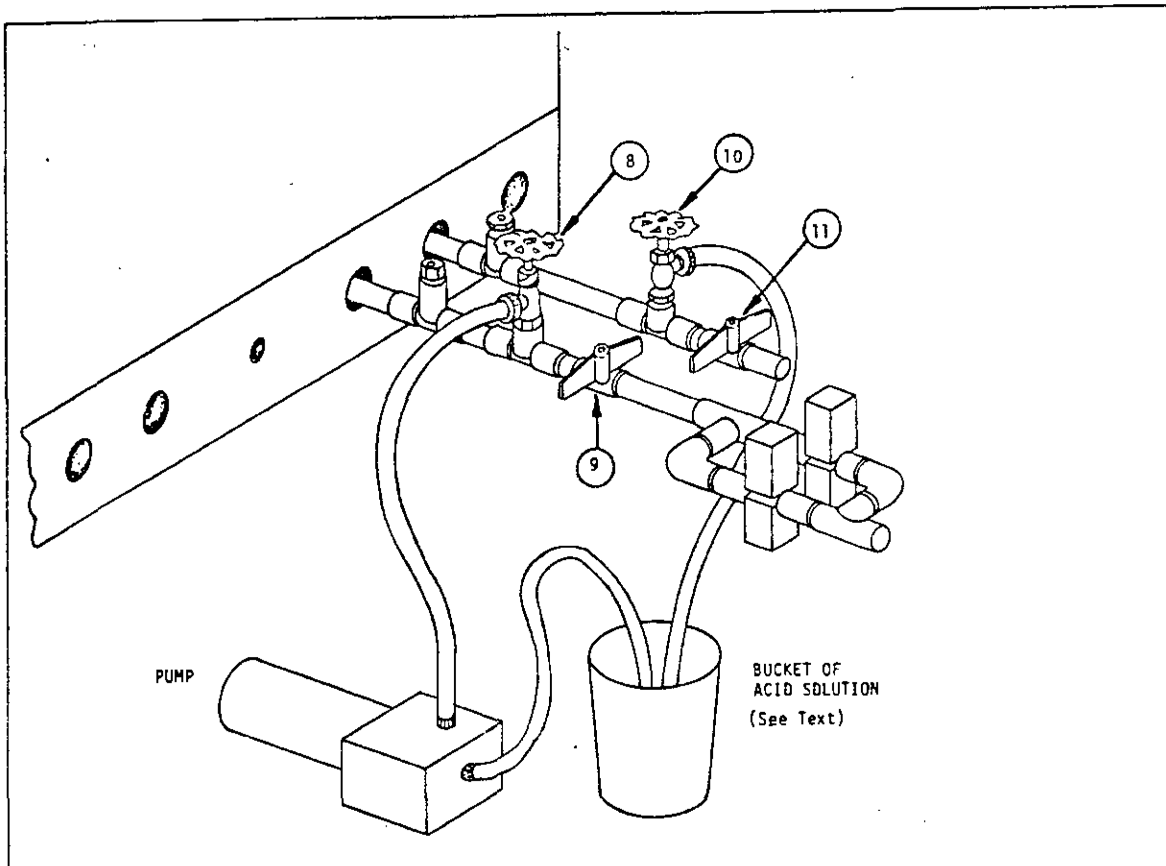


Figure 9

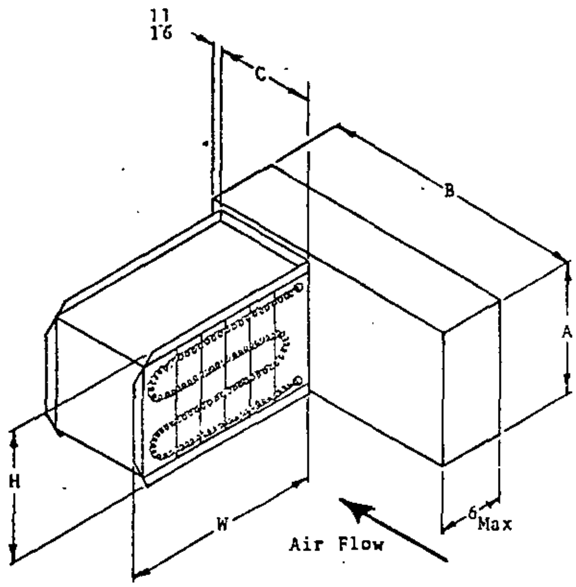


TABLE 8.2			
WATER REGULATING VALVES			
MODEL	VALVE SIZE	COOLING VALVE	HEATING VALVE
WPV30 WPVD30 WPV36 WPVD36	3/4"	8603-001	8603-002

TABLE 8.1											
ACCESSORY ITEMS - DUCT HEATER											
PART NO.	PH	VOLTS	KW	MINIMUM AMPACITY	WIRE SIZE ⚠1 Cu	WIRE SIZE ⚠1 Al	MAX. FUSE	DIMENSIONS H&A	DIMENSIONS W	DIMENSIONS B	DIMENSIONS C
8604-067	1	240	4.8	25	#10	#8	25	12	18	24	9
8604-068	1	240	9.6	50	#6	#4	50	8	16	17	6
8604-069 ⚠2	1	240	15.0	79	#3	#1	80	12	18	27	12
8604-070 ⚠2	1	240	19.2	100	#1	#0	100	12	18	27	12

⚠1 Use wire suitable for at least 90°C.
⚠2 Fused units (over 48 amperes).

TABLE 8.3			
INDOOR BLOWER PERFORMANCE *CFM - Dry Coil			
E.S.P. in H_2O	WPV30, WPVD30, WPV36, WPVD36 MOTOR SPEED High	Medium	Low
.00	1400	1270	1210
.10	1345	1230	1170
.20	1280	1180	117[illegible]
.30	1210	1110	10[illegible]
.40	1130	1070	104[illegible]
.50	1050	1000	980
.60	970	890	900

*Filter included. See unit specifications for rated CFM.

TABLE 8.4		
Water Uses	Peak Demand Allowance for Pump	Individual Fixture Flow Rate
	gpm Column 1	gpm Column 2
Household Uses		
Bathtub or tub-and-shower combination	2.00	8.0
Shower only	1.00	4.0
Lavatory	.50	2.0
Toilet--flush tank	.75	3.0
Sink, kitchen—including garbage disposal	1.00	4.0
Dishwasher	.50	2.0
Laundry Sink	1.50	6.0
Clothes Washer	2.00	8.0
Irrigation, Cleaning and Miscellaneous		
Lawn irrigation (per sprinkler)	2.50	5.0
Garden irrigation (per sprinkler)	2.50	5.0
Automobile washing	2.50	5.0
Tractor and equipment washing	2.50	5.0
Flushing driveways and walkways	5.00	10.0
Cleaning milking equipment & milk storage tank	4.00	8.0
Hose cleaning barn floors, ramps, etc.	5.00	10.0
Swimming pool (initial filling)	2.50	5.0

TABLE 8.5	
WATER COIL RATED FLOW	
MODEL	GPM
WPV30	4
WPVD30	10.6
WPV36	5
WPVD36	12.7

GPM	1/2" ID = .622" Steel Ft	Lbs	Plastic Ft	Lbs	3/4" ID = .824" Steel Ft	Lbs	Plastic Ft	Lbs	1" ID = 1.049" Steel Ft	Lbs	Plastic Ft	Lbs
2	4.8	2.1	4.1	1.8								
3	10.0	4.3	8.7	3.8	2.5	1.1	2.2	1.0				
4	17.1	7.4	14.8	6.4	4.2	1.8	3.7	1.6				
5	25.8	11.2	22.2	9.6	6.3	2.7	5.7	2.5	1.9	.8	1.8	.8
6	36.5	15.8	31.2	13.5	8.9	3.9	8.0	3.5	2.7	1.2	2.5	1.1
7	48.7	21.1	41.5	18.0	11.8	5.1	10.6	4.6	3.6	1.6	3.3	1.4
8	62.7	27.2	53.0	23.0	15.0	6.5	13.5	5.9	4.5	2.0	4.2	1.8
9	78.3	34.0	66.0	28.6	18.8	8.2	16.8	7.3	5.7	2.5	5.2	2.3
10	95.9	41.6	80.5	34.9	23.0	10.0	20.4	8.9	6.9	3.0	6.3	2.7
12					32.6	14.1	28.6	12.4	9.6	4.2	8.9	3.9
14					43.5	18.9	38.0	16.5	12.8	5.6	11.8	5.1
16					56.3	24.4	48.6	21.1	16.5	7.2	15.1	6.6
18					70.3	30.5	60.5	26.3	20.6	8.9	18.7	8.1
20					86.1	37.4	73.5	31.9	25.1	10.9	22.8	9.9
22					104.0	45.1			30.2	13.1	27.1	11.8
24									35.6	15.5	31.1	13.5
25									38.7	16.8	34.6	15.0
30									54.6	23.7	48.1	20.9
35									73.3	31.8	64.3	27.9
40									95.0	41.2	82.0	35.6

Areas above the heavy lines are recommended for normal operation.

TABLE 8.6

Friction loss Tables 8.6 and 8.7 for common pipe diameters and materials. Figures given are friction loss in feet of head per one hundred feet of pipe. Doubling the diameter of a pipe increases its capacity four times, not two times.

GPM	1¼" ID - 1.380" Steel Ft	Lbs	Plastic Ft	Lbs	1½" ID = 1.610" Steel Ft	Lbs	Plastic Ft	Lbs	2" ID = 2.067" Steel Ft	Lbs	Plastic Ft	Lbs
10	1.8	.8	1.7	.7								
12	2.5	1.1	2.3	1.0	1.2	.5	1.1	.5				
14	3.3	1.4	3.1	1.3	1.5	.7	1.4	.6				
16	4.2	1.8	4.0	1.7	2.0	.9	1.9	.8				
18	5.2	2.3	4.9	2.1	2.4	1.1	2.3	1.0				
20	6.3	2.7	6.0	2.6	2.9	1.3	2.8	1.2				
25	9.6	4.2	9.1	3.9	4.5	2.0	4.3	1.9	1.3	.6	1.3	.6
30	13.6	5.9	12.7	5.5	6.3	2.7	6.0	2.6	1.8	.8	1.8	.8
35	18.2	7.9	16.9	7.3	8.4	3.6	8.0	3.5	2.4	1.0	2.4	1.0
40	23.5	10.2	21.6	9.4	10.8	4.7	10.2	4.4	3.1	1.3	3.0	1.3
45	29.4	12.8	28.0	12.2	13.5	5.9	12.5	5.4	3.9	1.7	3.8	1.6
50	36.0	15.6	32.6	14.1	16.4	7.1	15.4	6.7	4.7	2.0	4.6	2.0
60	51.0	22.1	45.6	19.8	23.2	10.1	21.6	9.4	6.6	2.9	6.4	2.8
70	68.8	29.9	61.5	26.7	31.3	13.6	28.7	12.5	8.9	3.9	8.5	3.7
80	89.2	38.7	77.9	33.8	40.5	17.6	36.8	16.0	11.4	5.0	10.9	4.7
90	112.0	48.6	96.6	41.9	51.0	22.1	45.7	19.8	14.2	6.2	13.6	5.9
100	138.0	59.9			62.2	27.0	56.6	24.6	17.4	7.6	16.5	7.2
120					88.3	38.3			24.7	10.7	23.1	10.0
140					119.0	51.6			33.2	14.4	30.6	13.2
160					156.0	67.7			43.0	18.7	39.3	17.1
180									54.1	23.5	48.9	21.2
200									66.3	28.8	59.4	25.8
220									80.0	34.7		
240									95.0	41.2		
260									111.0	48.2		

Areas above the heavy lines are recommended for normal operation.

TABLE 8.7

TABLE 8.8

FRICTION LOSSES THROUGH FITTINGS IN TERMS OF EQUIVALENT LENGTHS OF PIPE

T[illegible] Fitting & [illegible]lication	Pipe & Ftg. Material (Note 1)	Equivalent Length of Pipe Nominal Size Fitting & Pipe						
		1/2	3/4	1	1¼	1½	2	2½
Insert [illegible]ing	Plastic	3	3	3	3	3	3	3
Threade[illegible]dapter Plastic [illegible] Copper to Thread	Copper Plastic	1 3	1 3	1 3	1 3	1 3	1 3	1 3
90° Standard Elbow	Steel Copper Plastic	2 2 4	3 3 5	3 3 6	4 4 7	4 4 8	5 5 9	6 6 10
Standard Tee Flow Thru Run	Steel Copper Plastic	1 1 4	2 2 4	2 2 4	3 3 5	3 3 6	4 4 7	5 5 8
Standard Tee Flow Thru Side	Steel Copper Plastic	4 4 7	5 5 8	6 6 9	8 8 12	9 9 13	11 11 17	14 14 20
Gate Valve	Note (2)	2	3	4	5	6	7	8
Swing Check Valve	Note (2)	4	5	7	9	11	13	16

Friction loss tables for fittings (Table 8.8). Figures given are friction losses in terms of equivalent length (in feet) of straight pipe. Note: (1) Loss figures are based on equivalent lengths of indicated pipe material and (2) Loss figures are for screwed valves and are based on equivalent lengths of steel pipe.

TABLE 8.9

WATER COIL PRESSURE DROP

MODEL	WPV30-WPVD30		WPV36-WPVD36	
GPM	Psig	Ft.Hd.	Psig	Ft.Hd.
4	2.0	4.6	1.9	[illegible]
5	3.0	6.9	2.0	[illegible]
6	4.2	10.0	2.4	[illegible]
7	5.7	13.1	3.0	6.9
8	7.5	17.3	3.9	9.0
9	9.5	21.9	5.5	12.7
10	12.0	27.7	7.6	17.5
11	14.8	34.1	10.4	24.0
12	17.6	40.6	15.3	35.3
13	20.3	46.8	20.6	47.5

TABLE 8.10

MINIMUM WATER REGULATING VALVE PRESSURE DROP

	1/2"		3/4"		1"	
GPM	Psi	Ft.Hd.	Psi	Ft.Hd.	Psi	Ft.Hd.
4	4	9.2	1	2.3	-	-
5	6	13.9	1.3	3.0	-	-
10.6	9.5	22.0	3	6.9	1.5	3.5
12.7	15	34.6	4.2	9.7	2	4.6

TABLE 8.11 - PRESSURE FACTORS

PUMP CUT-IN PRESSURE — PSIG (columns); PUMP CUT-OUT PRESSURE — PSIG (rows)

	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
30	.22														
35	.30	.20													
40	.37	.27	.18												
45	.42	.34	.25	.17											
50	.46	.39	.31	.23	.15										
55	.50	.43	.36	.29	.22	.14									
60	.54	.47	.40	.33	.27	.20	.13								
65		.50	.44	.38	.31	.25	.19	.13							
70		.53	.47	.41	.35	.30	24	.18	.12						
75			.50	.45	.39	.33	.28	.22	.17	.11					
80			.53	.48	.42	.37	.32	.26	.21	.16	.11				
85				.50	.45	.40	.35	.30	.25	.20	.15	.10			
90				.53	.48	.43	.38	.33	.29	.24	.19	.14	.10		
95					.50	.46	.41	.36	.32	.27	.23	.18	.14	.09	
100					.52	.48	.44	.39	.35	.31	.26	.22	.17	.13	.09

TABLE 8.12

TOTAL VOLUME AND ACCEPTANCE VOLUME

Nominal Tank Size (Total Vol.Gals)	Maximum (Acceptance Volume)
2.0	0.9
4.4	2.4
8.6	3.2
14.0	11.3
20.0	11.3
32.0	11.3
44.0	34.0
62.0	34.0
86.0	34.0

TABLE 8.13

WPV30 REFRIGERANT PRESSURES

COOLING*

EWT °F	Low Side Suction Pressure			High Side Discharge Pressure		
	4 GPM	6 GPM	8 GPM	4 GPM	6 GPM	8 GPM
45	69-74	66-71	62-67	139-141	126-128	120-122
50	71-76	68-73	64-69	149-151	137-139	127-129
55	73-78	70-75	66-71	161-163	149-151	135-137
60	74-79	72-77	68-73	172-174	160-162	144-146
65	76-80	74-79	70-75	183-185	171-173	153-155
70	77-82	76-81	72-77	194-196	182-184	164-166
75	79-84	77-82	74-79	205-207	193-195	176-178

HEATING**

EWT °F	4 GPM	6 GPM	8 GPM	4 GPM	6 GPM	8 GPM
45	50-55	52-57	53-58	198-200	202-204	203-205
50	54-59	56-61	57-62	206-208	211-213	212-214
55	57-62	60-65	61-66	211-213	216-218	217-219
60	60-65	62-67	63-68	214-216	218-220	219-221
65	63-68	65-70	66-71	216-218	219-221	220-222
70	65-70	66-71	67-72	217-219	220-222	221-223
75	67-72	67-72	68-73	220-222	229-231	229-231

*At rated air flow and 80 DB/ 67WB return air temperature.
**At rated air flow and 70 DB return air temperature.

TABLE 8.14

WPV36 REFRIGERANT PRESSURES

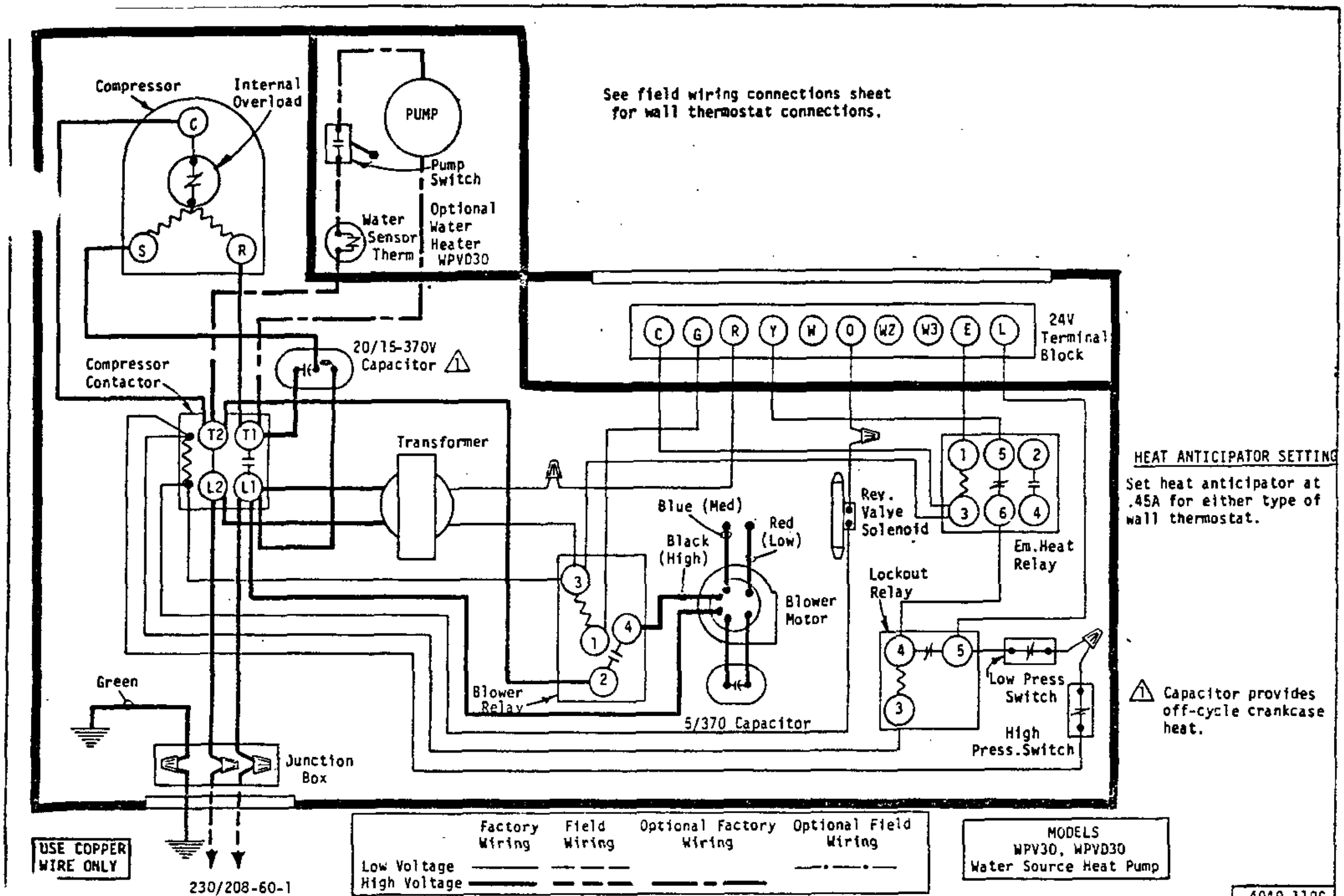
COOLING*

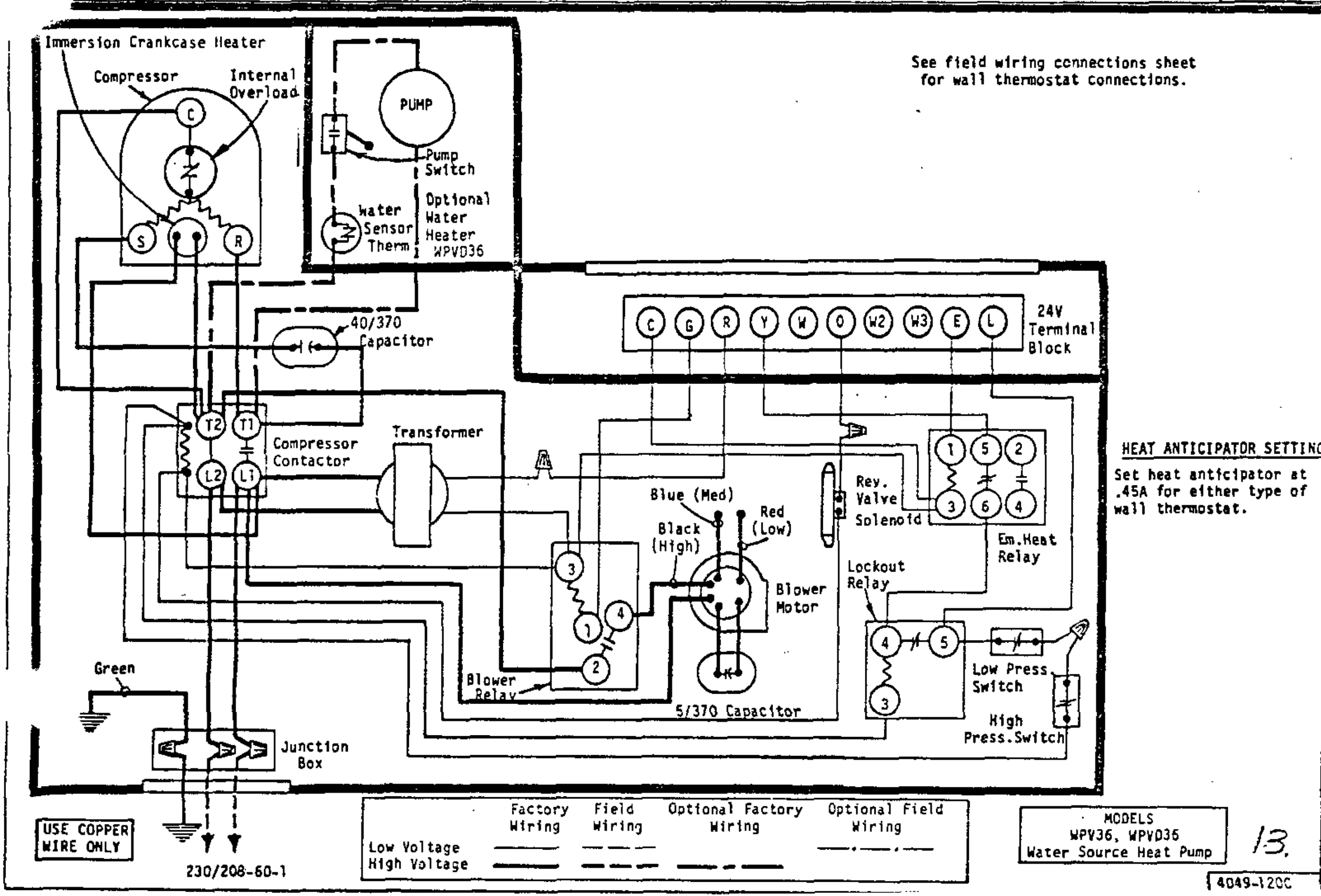
EWT °F	Low Side Suction Pressure			High Side Discharge Pressure		
	5 GPM	7 GPM	9 GPM	5 GPM	7 GPM	9 GPM
45	48-53	58-63	58-63	129-131	129-131	120-122
50	52-57	60-65	60-65	141-143	137-139	129-131
55	55-60	62-67	61-66	153-155	145-147	137-139
60	59-63	63-68	63-68	165-167	155-157	147-149
65	63-68	65-70	65-70	177-179	165-167	159-161
70	67-72	67-73	68-73	189-191	177-179	171-173
75	70-75	69-74	71-76	201-203	192-194	185-187

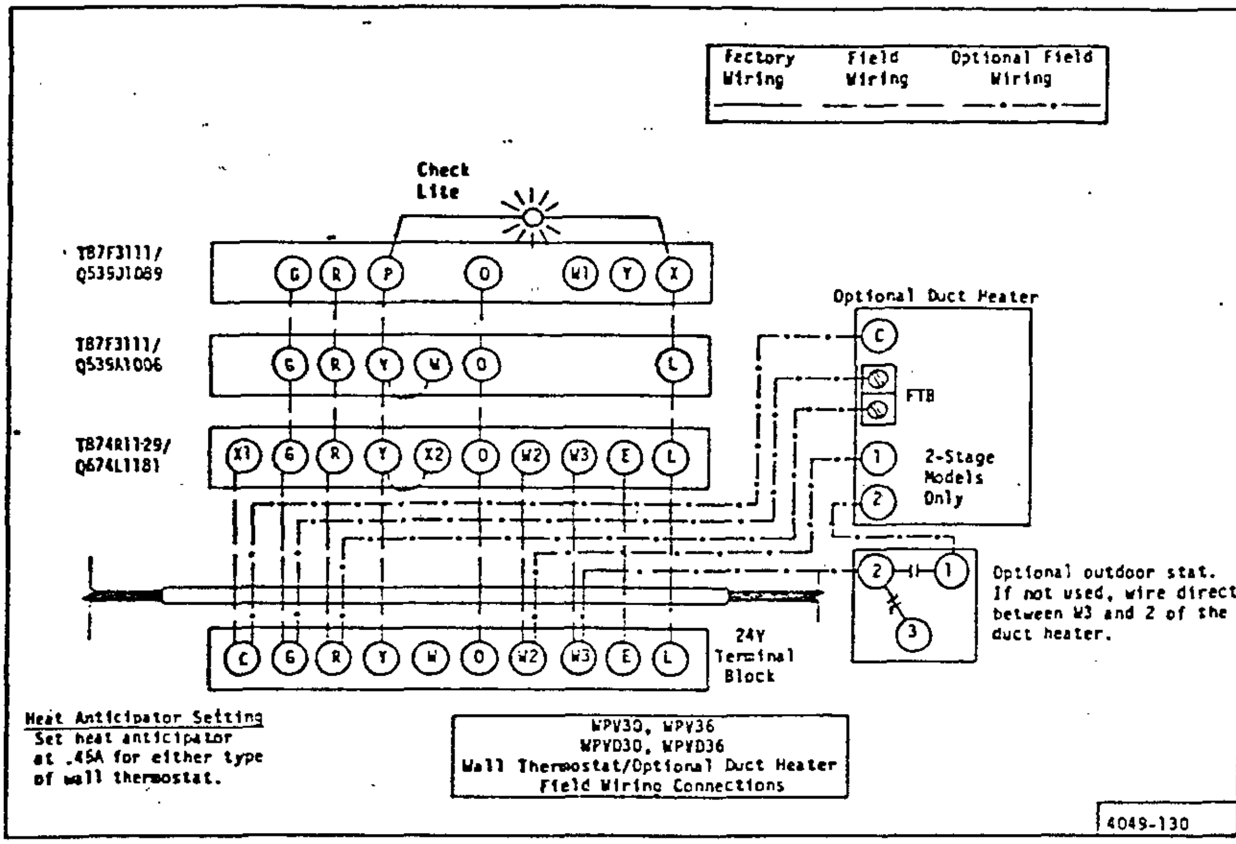
HEATING**

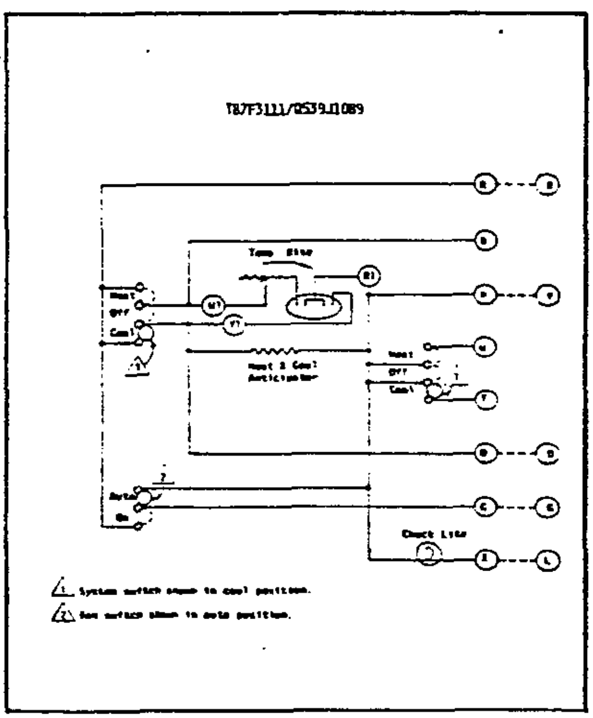
EWT °F	5 GPM	7 GPM	9 GPM	5 GPM	7 GPM	[illegible]
45	48-53	51-56	53-58	208-210	212-214	[illegible]
50	52-57	54-59	56-61	213-215	217-219	[illegible]
55	56-61	56-61	58-63	219-221	222-224	223-225
60	58-63	59-64	61-66	224-226	227-229	227-229
65	61-66	63-67	64-69	229-231	231-233	232-234
70	64-69	65-70	66-71	234-236	236-238	237-239
75	66-71	66-71	69-74	239-241	242-244	242-244

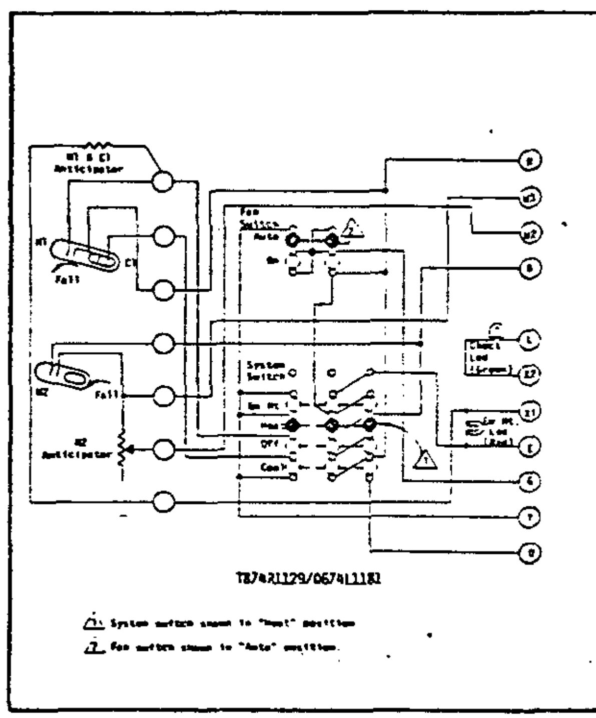
*At rated air flow and 80 DB/67 WB return air temperature.
**At rated air flow and 70 DB return air temperature.

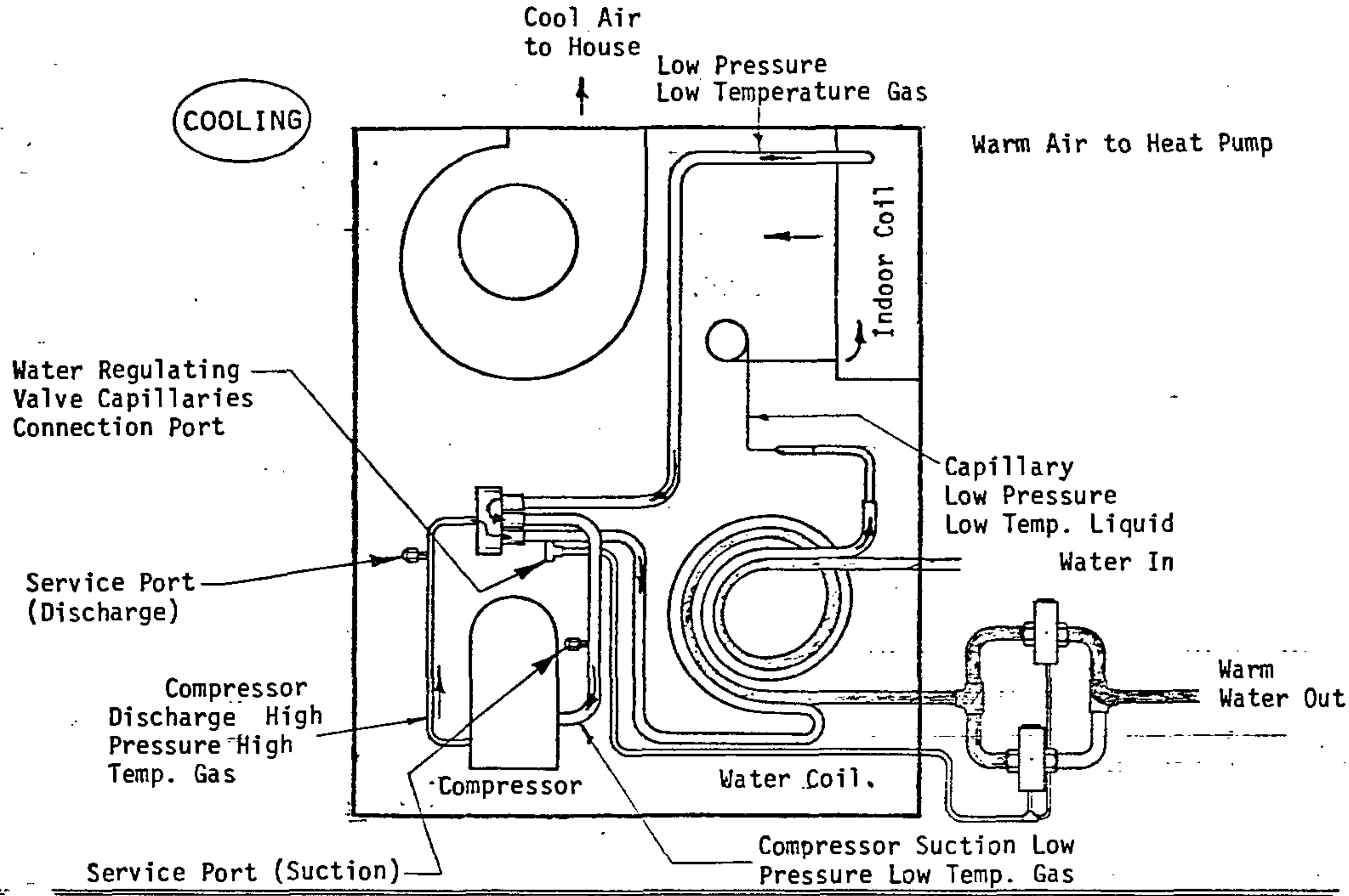

Compressor
Internal Overload
C
S
R
PUMP
Pump Switch
Water Sensor Therm
Optional Water Heater WPVD30
See field wiring connections sheet for wall thermostat connections.
C G R Y W O W2 W3 E L
24V Terminal Block
20/15-370V Capacitor
Compressor Contactor
T2 T1 L2 L1
Transformer
Blue (Med)
Red (Low)
Black (High)
Blower Motor
Rev. Valve Solenoid
Em.Heat Relay
Lockout Relay
Blower Relay
5/370 Capacitor
Low Press Switch
High Press.Switch
Green
Junction Box
USE COPPER WIRE ONLY
230/208-60-1
Factory Wiring
Field Wiring
Optional Factory Wiring
Optional Field Wiring
Low Voltage
High Voltage
MODELS WPV30, WPVD30 Water Source Heat Pump
HEAT ANTICIPATOR SETTING
Set heat anticipator at .45A for either type of wall thermostat.
Capacitor provides off-cycle crankcase heat.
4049-110C

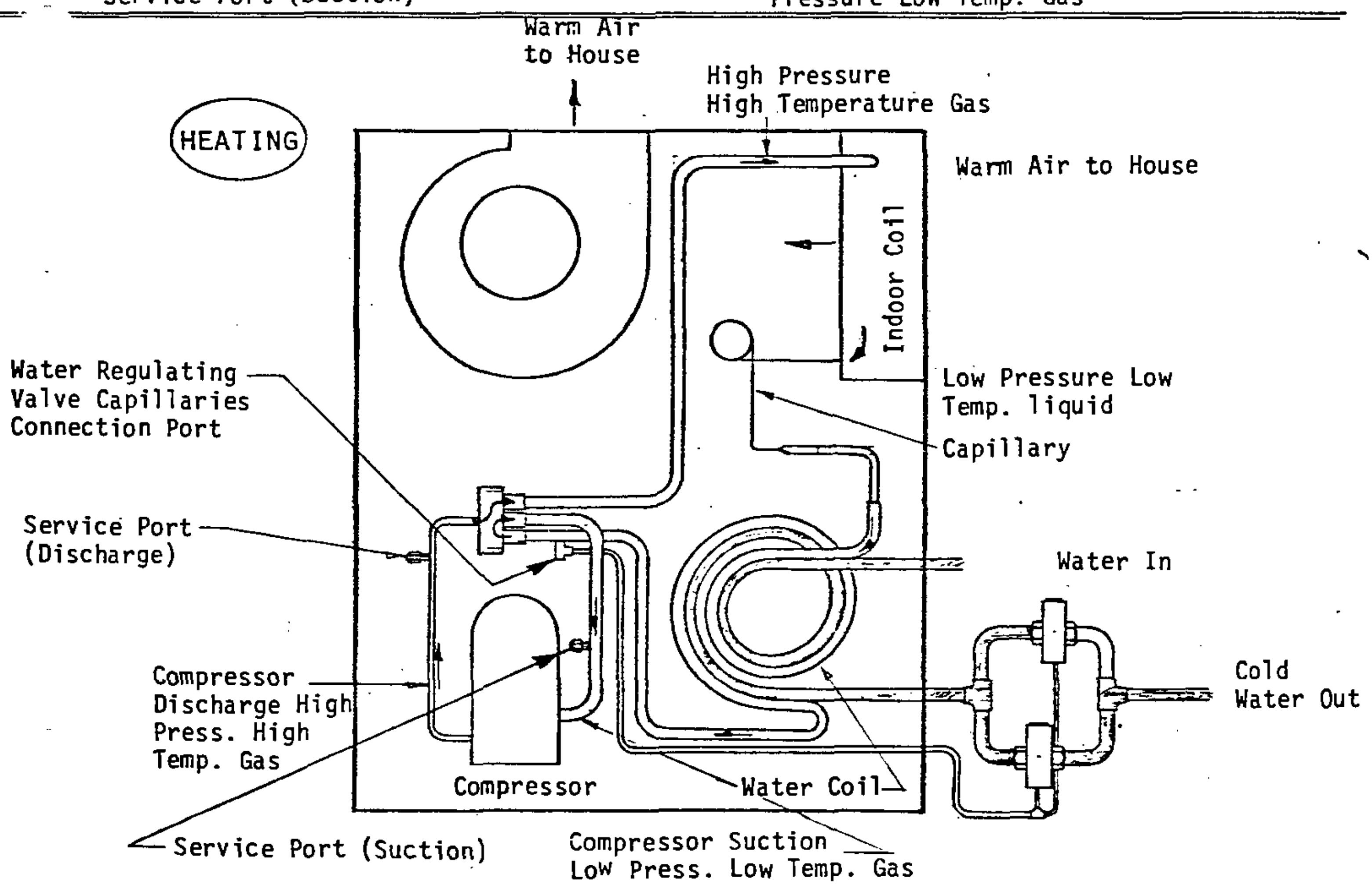

Immersion Crankcase Heater
Compressor
Internal Overload
C
S
R
PUMP
Pump Switch
Water Sensor Therm
Optional Water Heater WPVD36
See field wiring connections sheet for wall thermostat connections.
C G R Y W O W2 W3 E L
24V Terminal Block
40/370 Capacitor
Compressor Contactor
T2 T1 L2 L1
Transformer
Blue (Med)
Red (Low)
Black (High)
Blower Motor
Rev. Valve Solenoid
Em.Heat Relay
Lockout Relay
Blower Relay
5/370 Capacitor
Low Press Switch
High Press.Switch
Green
Junction Box
USE COPPER WIRE ONLY
230/208-60-1
Factory Wiring
Field Wiring
Optional Factory Wiring
Optional Field Wiring
Low Voltage
High Voltage
MODELS WPV36, WPVD36 Water Source Heat Pump
HEAT ANTICIPATOR SETTING
Set heat anticipator at .45A for either type of wall thermostat.
4049-120C


Factory Wiring
Field Wiring
Optional Field Wiring
Check Lite
T87F3111/ Q535J1089
T87F3111/ Q535A1006
T874R1129/ Q674L1181
G R P O W1 Y X
G R Y W O L
X1 G R Y X2 O W2 W3 E L
Optional Duct Heater
C
FTB
1 2
2-Stage Models Only
Optional outdoor stat. If not used, wire direct between W3 and 2 of the duct heater.
C G R Y W O W2 W3 E L
24V Terminal Block
Heat Anticipator Setting
Set heat anticipator at .45A for either type of wall thermostat.
WPV30, WPV36
WPVD30, WPVD36
Wall Thermostat/Optional Duct Heater
Field Wiring Connections
4049-130


Check Lite




COOLING
Cool Air to House
Low Pressure Low Temperature Gas
Warm Air to Heat Pump
Indoor Coil
Water Regulating Valve Capillaries Connection Port
Capillary Low Pressure Low Temp. Liquid
Water In
Service Port (Discharge)
Warm Water Out
Compressor Discharge High Pressure High Temp. Gas
Compressor
Water Coil.
Compressor Suction Low Pressure Low Temp. Gas
Service Port (Suction)


Warm Air to House
HEATING
High Pressure High Temperature Gas
Warm Air to House
Indoor Coil
Water Regulating Valve Capillaries Connection Port
Low Pressure Low Temp. liquid
Capillary
Service Port (Discharge)
Water In
Compressor Discharge High Press. High Temp. Gas
Cold Water Out
Compressor
Water Coil
Service Port (Suction)
Compressor Suction Low Press. Low Temp. Gas

QUICK REFERENCE TROUBLE-SHOOTING CHART FOR WATER TO AIR HEAT PU[illegible]

BARD SINCE 1914

DENOTES COMMON CAUSE: O

DENOTES OCCASIONAL CAUSE: ▲

POSSIBLE CAUSE — POWER SUPPLY (LINE VOLTAGE; CONTROL CIRCUIT)

PROBLEM CONDITION	Line Voltage: POWER FAILURE	BLOWN FUSE OR TRIPPED BREAKER	FAULTY WIRING	LOOSE TERMINALS	LOW VOLTAGE	DEFECTIVE CONTACTS IN CONTACTOR	COMPRESSOR OVERLOAD	POTENTIAL RELAY	RUN CAPACITOR	START CAPACITOR	Control Circuit: FAULTY WIRING	LOOSE TERMINALS	CONTROL TRANSFORMER	LOW VOLTAGE	THERMOSTAT	CONTACTOR COIL	PRESSURE CONTROLS (HIGH OR LOW)	INDOOR BLOWER RELAY
Heating or Cooling Cycles: COMPRESSOR WILL NOT RUN NO POWER AT CONTACTOR	O	O	O	O		▲	▲				O	O	O	▲	▲	O	O	
COMPRESSOR WILL NOT RUN POWER AT CONTACTOR			O	O	O		O	O	O	O								
COMPRESSOR "HUMS" BUT WILL NOT START			O	O	O	▲		O	O	O								
COMPRESSOR CYCLES ON OVERLOAD			O	O	O	▲	O	O	O	O								
THERMOSTAT CHECK LIGHT LITE-LOCKOUT RELAY																	O	
COMPRESSOR OFF ON HIGH PRESSURE CONTROL																	▲	O
COMPRESSOR OFF ON LOW PRESSURE CONTROL																		▲
COMPRESSOR NOISY																		
HEAD PRESSURE TOO HIGH																		
HEAD PRESSURE TOO LOW																		
SUCTION PRESSURE TOO HIGH																		
SUCTION PRESSURE TOO LOW																		
I.D. BLOWER WILL NOT START	O	O	O	O							O	O	O	▲	▲			O
I.D. COIL FROSTING OR ICING																		
HIGH COMPRESSOR AMPS					O				O									
EXCESSIVE WATER USAGE																		
Cooling Cycle: COMPRESSOR RUNS CONTINUOUSLY—NO COOLING																		
LIQUID REFRIGERANT FLOODING BACK TO COMPRESSOR																		
Heating Cycle: COMPRESSOR RUNS CONTINUOUSLY—NO HEATING																		
REVERSING VALVE DOES NOT SHIFT			O	O														
LIQUID REFRIGERANT FLOODING BACK TO COMPRESSOR																		
AUX. HEAT ON I.D. BLOWER OFF			O	O							O	O			▲			O
[illegible] OPERATING COSTS			▲	▲											▲			
[illegible]			▲	▲														

POSSIBLE CAUSE — WATER COIL SECTION (COMPRESSOR; REFRIGERANT SYSTEM)

PROBLEM CONDITION	Compressor: DISCH. LINE HITTING INSIDE OF SHELL	BEARINGS DEFECTIVE	SEIZED	VALVE DEFECTIVE	MOTOR WINDINGS DEFECTIVE	Refrigerant System: REFRIGERANT CHARGE LOW	REFRIGERANT OVERCHARGE	HIGH HEAD PRESSURE	LOW HEAD PRESSURE	HIGH SUCTION PRESSURE	LOW SUCTION PRESSURE	NON-CONDENSABLES	UNEQUALIZED PRESSURES
Heating or Cooling Cycles: COMPRESSOR WILL NOT RUN NO POWER AT CONTACTOR													
COMPRESSOR WILL NOT RUN POWER AT CONTACTOR		▲	O		O								O
COMPRESSOR "HUMS" BUT WILL NOT START		O	O		O								O
COMPRESSOR CYCLES ON OVERLOAD		▲		▲	▲	O	O	▲		▲		O	
THERMOSTAT CHECK LIGHT LITE-LOCKOUT RELAY													
COMPRESSOR OFF ON HIGH PRESSURE CONTROL							O					O	
COMPRESSOR OFF ON LOW PRESSURE CONTROL						O			O		O		
COMPRESSOR NOISY	▲	▲		O									
HEAD PRESSURE TOO HIGH							O					O	
HEAD PRESSURE TOO LOW				O		O					O		
SUCTION PRESSURE TOO HIGH				O			O	O					
SUCTION PRESSURE TOO LOW						O			▲				
I.D. BLOWER WILL NOT START													
I.D. COIL FROSTING OR ICING						O					O		
HIGH COMPRESSOR AMPS		O	O		▲		O	O		O		O	
EXCESSIVE WATER USAGE													
Cooling Cycle: COMPRESSOR RUNS CONTINUOUSLY—NO COOLING				O		O					O		
LIQUID REFRIGERANT FLOODING BACK TO COMPRESSOR							O	O					
Heating Cycle: COMPRESSOR RUNS CONTINUOUSLY—NO HEATING				O		O					O		
REVERSING VALVE DOES NOT SHIFT						▲			▲				
LIQUID REFRIGERANT FLOODING BACK TO COMPRESSOR							O	O					
AUX. HEAT ON I.D. BLOWER OFF													
[illegible] OPERATING COSTS						O	O						
[illegible]						O							

POSSIBLE CAUSE — WATER COIL SECTION (WATER REG. VALVE; REV. VALVE; CHECK VALVE; WATER COIL)

PROBLEM CONDITION	Water Reg. Valve: WATER REG. VALVE STUCK CLOSED (HTG)	WATER REG. VALVE STUCK CLOSED (CLG)	WATER REG. VALVE STUCK OPEN (HTG or CLG)	Rev. Valve: LEAKING	DEFECTIVE VALVE OR COIL	Check Valve: STICKING CLOSED	LEAKING OR DEFECTIVE	Water Coil: PLUGGED OR RESTRICTED CAP TUBE (HTG)	SCALLED OR PLUGGED COIL (HTG)	SCALLED OR PLUGGED COIL (CLG)	WATER VOLUME LOW (HTG)	WATER VOLUME LOW (CLG)	LOW WATER TEMPERATURE (HTG)
Heating or Cooling Cycles: COMPRESSOR WILL NOT RUN NO POWER AT CONTACTOR													
COMPRESSOR WILL NOT RUN POWER AT CONTACTOR													
COMPRESSOR "HUMS" BUT WILL NOT START													
COMPRESSOR CYCLES ON OVERLOAD				▲					▲	▲	▲	▲	
THERMOSTAT CHECK LIGHT LITE-LOCKOUT RELAY													
COMPRESSOR OFF ON HIGH PRESSURE CONTROL		O				O		▲		▲		O	
COMPRESSOR OFF ON LOW PRESSURE CONTROL	O		▲						▲		O		▲
COMPRESSOR NOISY													
HEAD PRESSURE TOO HIGH		O			▲	▲		▲		O		O	
HEAD PRESSURE TOO LOW	▲		▲	▲			▲		O		O		O
SUCTION PRESSURE TOO HIGH				▲			▲						
SUCTION PRESSURE TOO LOW	O					▲		▲	O		O		▲
I.D. BLOWER WILL NOT START													
I.D. COIL FROSTING OR ICING						▲							
HIGH COMPRESSOR AMPS						▲		▲		O		O	
EXCESSIVE WATER USAGE			O						▲	▲			
Cooling Cycle: COMPRESSOR RUNS CONTINUOUSLY—NO COOLING										▲		▲	
LIQUID REFRIGERANT FLOODING BACK TO COMPRESSOR													
Heating Cycle: COMPRESSOR RUNS CONTINUOUSLY—NO HEATING	O			▲				▲	O		O		▲
REVERSING VALVE DOES NOT SHIFT					O								
LIQUID REFRIGERANT FLOODING BACK TO COMPRESSOR	O			▲	▲				O		O		O
AUX. HEAT ON I.D. BLOWER OFF													
[illegible] OPERATING COSTS	▲	▲	▲	O	O				▲	▲	▲		
[illegible]	O				O				▲		O		

POSSIBLE CAUSE — INDOOR SECTION (INDOOR BLOWER MOTOR & COIL; CHECK VALVE); AUX. HEAT

PROBLEM CONDITION	Indoor Blower Motor & Coil: PLUGGED OR RESTRICTED CAP TUBE (CLG)	FINS DIRTY OR PLUGGED	MOTOR WINDING DEFECTIVE	AIR VOLUME LOW	AIR FILTERS DIRTY	UNDERSIZED OR RESTRICTED DUCTWORK	Check Valve: STICKING CLOSED	LEAKING OR DEFECTIVE	Aux. Heat: AUX. HEAT UPSTREAM OF COIL	OUTDOOR THERMOSTAT (SPLIT SYSTEM)
Heating or Cooling Cycles: COMPRESSOR WILL NOT RUN NO POWER AT CONTACTOR										
COMPRESSOR WILL NOT RUN POWER AT CONTACTOR										
COMPRESSOR "HUMS" BUT WILL NOT START										
COMPRESSOR CYCLES ON OVERLOAD		▲	▲	▲	O	▲				
THERMOSTAT CHECK LIGHT LITE-LOCKOUT RELAY										
COMPRESSOR OFF ON HIGH PRESSURE CONTROL	▲	O	O	O	O	O	O		O	
COMPRESSOR OFF ON LOW PRESSURE CONTROL	O									
COMPRESSOR NOISY										
HEAD PRESSURE TOO HIGH	▲	▲	▲	O	O	▲	▲		O	
HEAD PRESSURE TOO LOW								▲		
SUCTION PRESSURE TOO HIGH								▲		
SUCTION PRESSURE TOO LOW	▲	O	▲	O	O	▲	▲			
I.D. BLOWER WILL NOT START										
I.D. COIL FROSTING OR ICING	▲	O	O	O	O	▲				
HIGH COMPRESSOR AMPS	▲	O	O	O	O	▲	▲		▲	
EXCESSIVE WATER USAGE										
Cooling Cycle: COMPRESSOR RUNS CONTINUOUSLY—NO COOLING	▲	O	O	O	O	▲				
LIQUID REFRIGERANT FLOODING BACK TO COMPRESSOR		O	O	O	O	▲		▲		
Heating Cycle: COMPRESSOR RUNS CONTINUOUSLY—NO HEATING										
REVERSING VALVE DOES NOT SHIFT										
LIQUID REFRIGERANT FLOODING BACK TO COMPRESSOR										
AUX. HEAT ON I.D. BLOWER OFF			O							
[illegible] OPERATING COSTS		▲	▲	▲						O
[illegible]										

PERFORMANCE CHECK

WATER SOURCE HEAT PUMPS

INSTALLER PLEASE FILL OUT AND RETAIN WITH UNIT

DATE OF INSTALLATION____________ MODEL NO(S).____________ SERIAL NO(S).____________

ITEM	COOLING	HEATING	JOB NUMBER
1. HEAD PRESSURE			NAME OF INSTALLER
2. SUCTION PRESSURE			NAME OF OWNER
3. WATER TEMP.(IN)			ADDRESS
4. WATER TEMP. (OUT)			CITY STATE
5. WATER PRESSURE (IN)			
6. WATER PRESSURE (OUT)			FIELD COMMENTS:
7. WATER FLOW (GPM)			
. AMPERES (BLOWER)			
9. AMPERES (COMPRESSOR)			
10. LINE VOLTAGE (COMPRESSOR RUNNING)			
11. AIR TEMP.(IN) D.B.			
W.B.			
12. AIR TEMP.(OUT) D.B.			
W.B.			
13. DESUPERHEATER H_2O TEMP. (IN)			
14. DESUPERHEATER H_2O TEMP. (OUT)			

This PERFORMANCE CHECK SHEET should be filled out by installer and retained with unit.

Bard Manufacturing Company
P.O. Box 607
Bryan, Ohio 43506

PARTS LIST

WATER SOURCE
PACKAGE HEAT PUMPS

PART NO.	DESCRIPTION	WPV30	WPVD30	WPV36	WPVD36
5152-046	Blower Assembly	x	x	x	x
8552-035	Capacitor 40 MFD - 370V 2" Round			x	x
8552-040	Capacitor 20/15 MFD - 370V 2" Oval	x	x		
8552-002	Capacitor - Blower 5MFD 370V	x	x	x	x
5811-034	Capillary Tube - Heating	(2)	(2)		
5811-016	Capillary Tube - Heating			(2)	(2)
5811-012	Capillary Tube - Cooling	(3)	(3)		
5811-014	Capillary Tube - Cooling			(3)	(3)
5651-006	Check Valve	x	x	x	x
8000-071	Compressor AB225HT-015-A4	x	x		
8000-052	Compressor CRG1-0250-PFV-270			x	x
5052-001	Condenser Coil	x	x		
5052-002	Condenser Coil			x	x
8401-007	Contactor - Compressor	x	x	x	x
5052-003	Desuperheater Coil		x		x
5060-012	Evaporator Coil	x	x	x	x
7003-011	Filter 22 x 23-1/2 x 1	x	x	x	x
8406-016	High Pressure Switch	x	x	x	x
8406-015	Low Pressure Switch	x	x	x	[illegible]
8105-010	Motor - Blower 1/3 hp	x	x	x	
8200-003	Motor Mount	x	x	x	x
5451-011	Motor Mounting Parts	x	x	x	x
8201-008	Relay - Blower	x	x	x	x
8201-034	Relay - Lockout	x	x	x	x
5650-005	Reversing Valve	x	x		
5650-009	Reversing Valve			x	x
5650-008	Reversing Valve Solenoid	x	x	x	x
5210-003	Strainer-Cooling	x	x	x	x
5210-004	Strainer-Heating	x	x	x	x
8607-011	Terminal Board 24V	x	x	x	x
8407-015	Transformer	x	x	x	x
8300-001	Water Pump		x		x
8408-007	Water Pump Thermostat		x		x
<u>OPTIONAL ITEMS:</u>					
8604-067	Duct Heater 4.8Kw	x	x	x	x
8604-068	Duct Heater 9.6Kw	x	x	x	x
8604-069	Duct Heater 15.0Kw	x	x	x	x
8604-070	Duct Heater 19.2Kw	x	x	x	x
8603-005	Gauge Adapter	x	x	x	x
8603-001	Regulating Valve-Cooling	x	x	x	x
8603-002	Regulating Valve-Heating	x	x	x	x
5810-006	Tee - 1/4 inch flare w/valve depressor	x	x	x	x
8603-003	Test Plug	x	x	x	x