

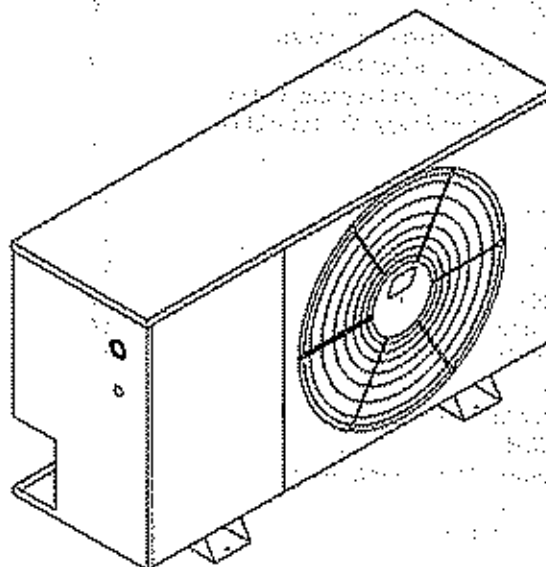
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# Installation Instructions

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## Split Heat Pump Outdoor Section

Models: HHP501-F  
HHP601-F



Bard Manufacturing Company  
Bryan, Ohio 43506

*Since 1914...Moving ahead, just as  
planned.*

Manual: 2100-298  
File: Volume I, Tab 6  
Date: 04/01/97

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FIGURE 1 - NOMENCLATURE EXPLANATION

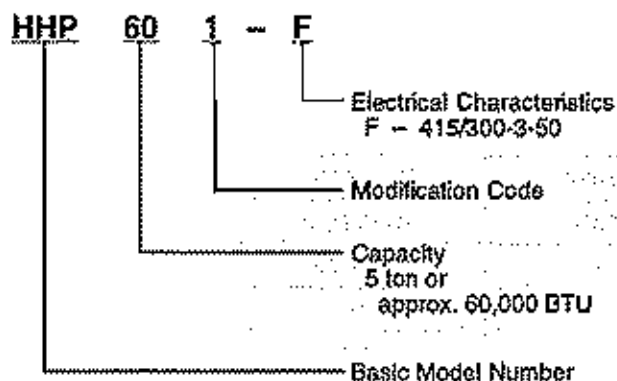
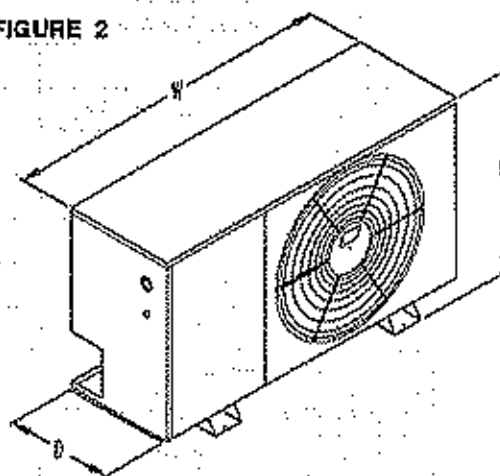


TABLE 1 - DIMENSIONS

Basic Model No.	"W" Width	"D" Depth	"H" Height
HHP501-F	50"	15"	32"
HHP601-F			

FIGURE 2



MRS-B17

TABLE 2 - RATED CFM and AIRFLOW DATA (WET COIL - COOLING)

Condensing Unit Model Number	Evaporator Coil Model Number	Rated Airflow		Rated ESP ②	Motor Speed Tap	Recommended Air Flow Range	System Orifice Required
		CFM	Pressure Drop H <sub>2</sub> O ①				
HHP501-F	BC48C	1500		.20	HIGH	1300-1725	.081 ◀
HHP601-F	BC60C	1800		.20	HIGH	1530-2050	.087 ◀

- ① Measured across the evaporator coil assembly, including drain pan.
- ② External static pressure available for the duct system - supply and return. All blower coils have multi-speed motors, and value shown is at the recommended rated speed. Consult specification airflow charts with the blower coil units for complete information at other speeds.
- ◀ **IMPORTANT** - Proper sized orifice is not factory installed in indoor section. Proper orifice size is shipped with outdoor unit packaged with its installation instructions for indoor sections listed on this page. The orifice must be replaced with the proper orifice shown above.

**TABLE 3 - ELECTRICAL DATA**

<b>MODELS</b>	<b>HHP501-F</b>	<b>HHP-601-F</b>
Electrical Rating (50Hz/V/Ph)	415/380-3	415/380-3
Operating Voltage Range	342-456	342-456
Minimum Circuit Ampacity	17	19
① Field Wire Size	#12	#12
② Delay Fuse Max. or Ckt. Bkr.	25	30
Total Unit Amps	9.5	10.5
<b>COMPRESSOR</b>		
Volts	415/380	415/380
Rated Load Amps	8	9
Branch Ckt. Selection Current	12.4	14
Lock Rotor Amps	63	70
<b>FAN MOTOR AND CONDENSER</b>		
Fan Motor HP/RPM	1/4 825	1/4 825
Fan Motor Amps	1.5	1.5
Fan DIA/CFM	24" 2500	24" 2500
Face Area Sq.Ft/Row/ Fins Per Inch	7.7 / 4 / 11	7.7 / 4 / 11
<b>REFRIGERANT CONNECTION and CHARGE</b>		
Suction Line	7/8"	7/8"
Liquid Line	3/8"	3/8"

# Application and Location

## General

These instructions explain the recommended method to install the air cooled remote type outdoor unit, the interconnecting refrigerant tubing and the electrical wiring connections to the unit.

The outdoor units are to be used in conjunction with the matching indoor coils or indoor blower coil for comfort cooling/heating applications as shown in the specification sheet.

These instructions and any instructions packaged with any separate equipment required to make up the entire system should be carefully read before beginning the installation. Note particularly "Connecting Quick-Connect Couplings, Starting Procedure" and any tags and/or labels attached to the equipment.

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

## Shipping Damage

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

## Application

Size of unit and duct system for a proposed installation should be based on heat loss and heat gain calculation made according to methods of Air Conditioning Contractors of America. The air duct should be installed in accordance with the 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. Where local regulations are at a variance with instructions, installer should adhere to local codes.

For applications in Canada, the installation of the system must be made in accordance with CSA Standards C22.1, Canadian Electrical Code, Part I; C273.5 Installation Requirements for Air-To-Air Heat Pumps; and B52, Mechanical Refrigeration Code.

## Location

The outdoor unit is designed to be located outside with free and unobstructed outdoor coil air inlet and discharge. It must

also permit access for service and installation. Refrigerant and electrical connections are made from the front of the unit as shown in Figure 3 with electrical service access on the left side or rear.

## Setting The Unit

**GENERAL**—The unit must be located outside, or in a well ventilated area. It must not be in the space being heated or cooled. A sound absorbing material should be considered if the unit is to be installed in such a position or location that might cause transmission of sound or vibration to the living area or adjacent buildings.

## Slab Mounting

In areas where winter temperatures do not go below 32°F for periods over twelve hours, the unit may be slab mounted at grade level. When installing the unit at grade level, install on a concrete slab at least four inches above finished grade level. Slab should have a slope tolerance away from the building structure of at least 1/4 inch per foot, while being level from side to side. This will prevent ice buildup under the unit during defrost cycles. Place slab in a location where runoff water from higher ground will not collect around unit. See Figure 3.

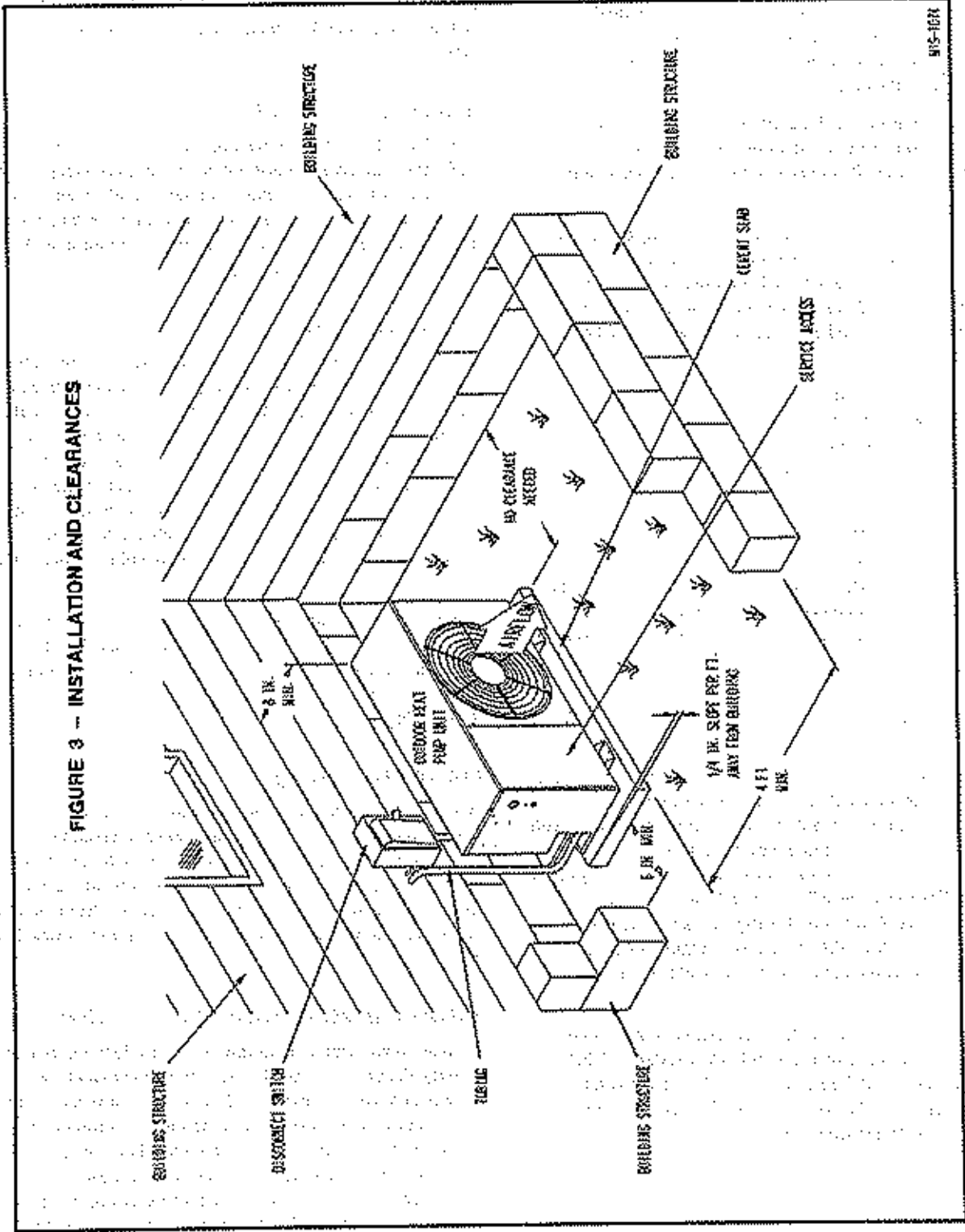
A minimum clearance should be provided between the coil inlet and any building surfaces. Provide at least 4 feet between coil outlet and any structures. Provide a minimum of 6 inches clearance on the service access side of the unit. Refer to Figure 3.

## Roof Mounting

When a unit is installed in areas where low ambient temperatures or strong winter winds exist, it should be placed so prevailing winter winds are not in direct line with the heat pump coil. If this is not possible, a wind barrier should be constructed. Place barrier 40 inches from the front of the unit and in the direction of the prevailing winds. See Figure 4.

## Winter Installation Below 32°F

In areas where winter conditions go below 32°F for extended periods, the unit must be elevated above the mounting surface to prevent snowfall or defrost ice accumulation from interfering with the operation of the unit. A minimum of twelve inch elevation is recommended, while greater elevation may be required for areas of high snow accumulation. Poured concrete, steel framework, brick, cement block, etc. can be utilized to construct a suitable raised mounting platform. See Figure 5.



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FIGURE 3 - INSTALLATION AND CLEARANCES

FIGURE 4 - PREVAILING WINDS AND INSTALLATION

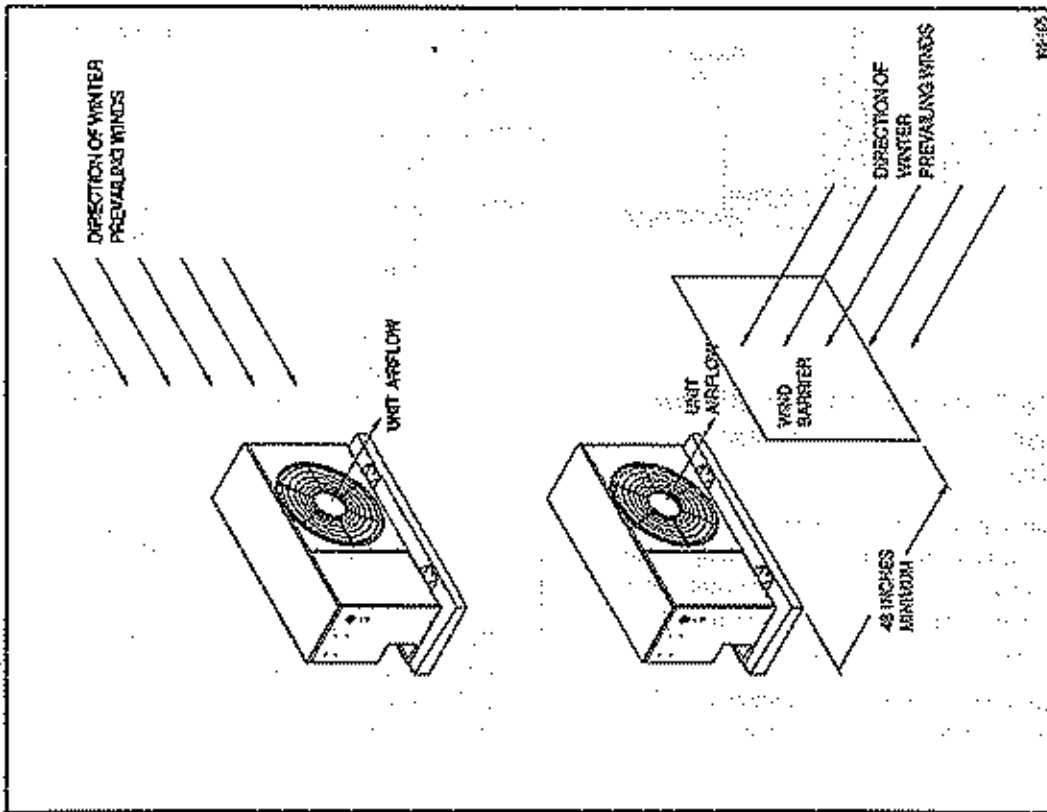
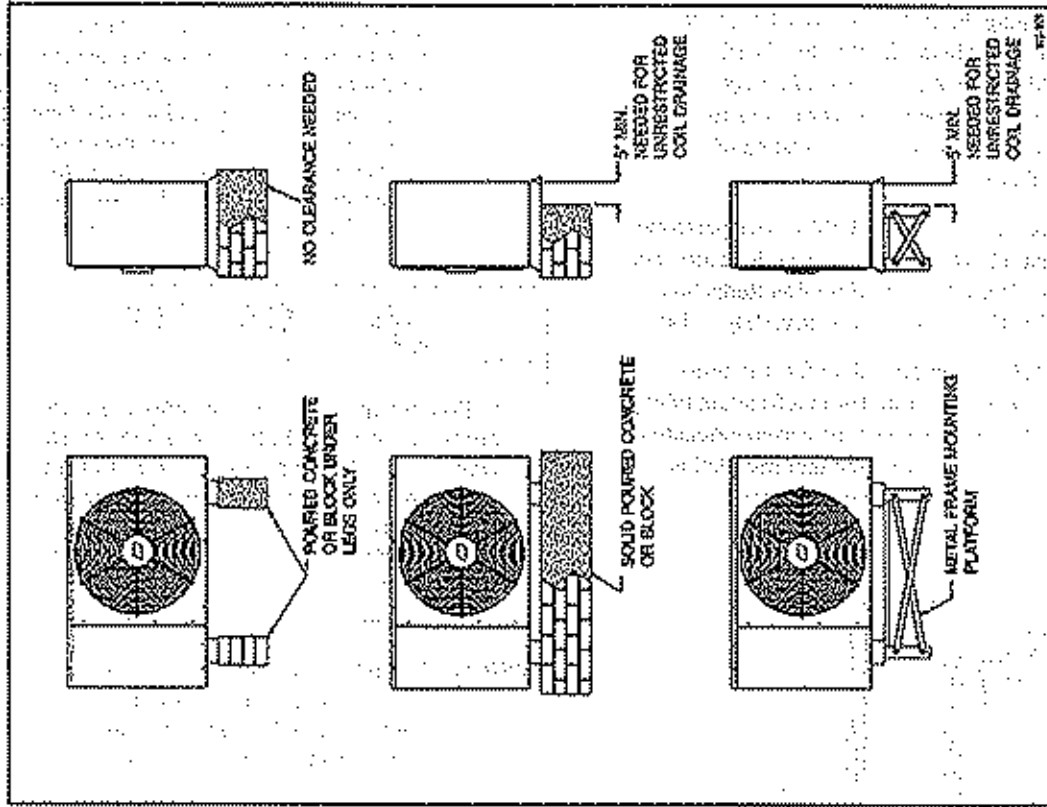


FIGURE 5 - INSTALLATIONS AND CLEARANCES



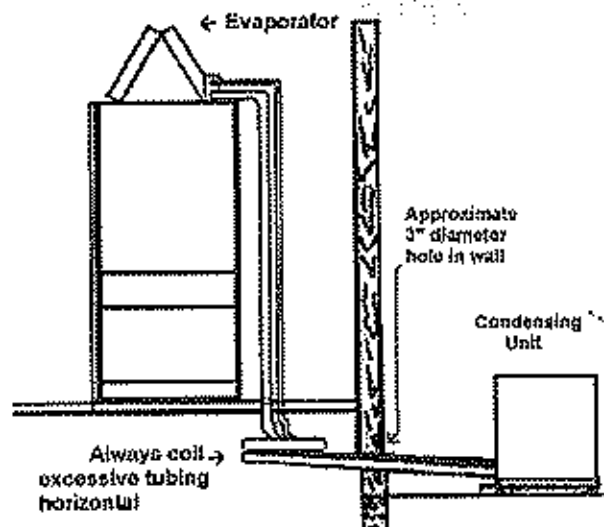
## Installing Refrigerant Tubing

The information that follows on installing refrigerant tubing and for changing the system orifice (if required) covers applications listed in the front of this installation instruction only. Although other indoor units may be of similar construction, the installation instructions for these units should be consulted for proper installation of those units prior to installation.

This information is provided for the field service personnel to install refrigerant tubing in compliance with Section 608 of Title VI National Recycling and Emission Reduction Program for the U.S. Clean Air Act effective July 1, 1992.

Consult manual 2100-002 on procedure for leak test—evacuation—charging before installation refrigerant tubing that requires any refrigerant recovery or system evacuation. Manual 2100-002 is included with the unit installation instruction package when shipped from the factory.

FIGURE 6



### Sweat Style Tubing Connections: Sweat Indoor Unit and Sweat Outdoor Unit.

Use only refrigeration grade (dehydrated and sealed) copper tubing. Care must be taken to insure that the tubing is kept clean and dry before and during installation. Do not remove the plugs from the tubing ends, coil connections or base valves until the connection is ready to be brazed.

The suction line must be insulated with a minimum of 3/8" Armaflex or equivalent before cutting and making connections.

**STEP 1—** Being careful not to kink, route both the suction line and liquid line between the indoor unit and outdoor unit. Use a tubing bender to make any necessary bends in tubing. When necessary to bend the insulated tube suction line, cut the insulation around its circumference at a distance far enough beyond the point of the bend so as to clear the tubing bender. Slip the insulation back together and vapor seal the joint with tape. Coil any excess tubing in a horizontal plane with the slope of the tubing toward the condensing unit.



### CAUTION

1. Be careful not to tear the insulation when pushing it through hole in masonry or frame walls.
2. When sealing the tube opening in house wall, use a soft material to prevent tube damage and vibration transmission.
3. Avoid excessive bending in any one place to avoid kinking.

**STEP 2—** The tubing ends should be cut square. Make sure it is round and free of burrs at the connecting ends. Clean the tubing to prevent contaminants from entering the system.

**NOTE: DO NOT BRAZE LINE TO UNITS!** If orifice needs to be changed, change out orifice first.

If the orifice does not have to be changed, skip the instructions outlined further in Step 3 and proceed to Step 8.

**STEP 3—** Disassemble Flow Control Assembly by turning body hex.

**STEP 4—** If existing orifice has not dropped out of the body when disassembled, remove by using a pin or paper clip. Discard this original orifice.

**STEP 5—** Insert proper sized orifice fully into the flow control body with rounded "bullet" nose towards the unit as shown in Figure 7. Insure the orifice stays inserted in body before connecting mating half. See chart in the outdoor unit installation instructions for proper size.

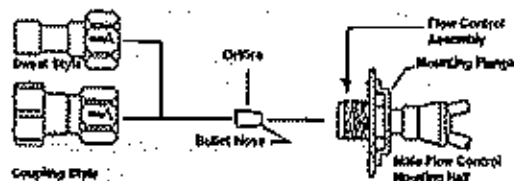


### CAUTION

Be sure there is no dirt introduced into the flow control—orifice assembly. Be sure to install the orifice with the bullet nose pointing in the proper direction as shown in Figure 7. Failure to do so will result in improper operation.



**FIGURE 7 — Flow Control Assembly Field Orifice Replacement Instructions**



**STEP 6**— Thread assembly halves together by hand to insure proper mating of threads and tighten until bodies "bottom" or a definite resistance is felt.

**STEP 7**— Using a marker pen or ink pen, mark a line lengthwise from the union nut to the bulkhead. Then tighten an additional 1/6 turn (or 1 hex flat). The misalignment of the line will show the amount the assembly has been tightened. This final 1/6 turn is necessary to insure the formation of the leakproof joint.

**STEP 8**— Wrap a wet rag around the copper stub before brazing.

**STEP 9**— Flux the copper tube and insert into the stub. Braze the joint using an alloy of silver or copper and phosphorus with a melting temperature above 1100°F for copper to copper joints. The phosphorus will act as a flux, therefore, no flux will be required.

A copper-silver alloy with a high silver content should be used when iron or steel material is involved in the joint. These alloys require the use of silver solder flux. Alloys containing phosphorus should not be used with iron or steel. Phosphorus reacts with the iron, forming iron phosphate which is extremely brittle.

	<b>CAUTION</b>
<p>1. Brazing alloys with a melting temperature below 700° should not be used. 2. Lead-tin or tin-antimony solders should not be used due to their low melting point and necessity of corrosive fluxes.</p>	

To further prevent the formation of copper oxide inside the tubing, dry nitrogen may be purged through the refrigerant system during brazing.

	<b>WARNING</b>
<p>Never purge or pressurize a system with oxygen. An explosion and fire will result causing physical damage, injury or death.</p>	

**STEP 10**—After brazing, quench with wet rag to cool the joint and remove any flux residue.

**STEP 11**—Leak test all connections using an electronic leak detector or a halide torch.

**STEP 12**—Evacuate suction line, liquid line, and indoor unit through outdoor unit base valves.

**STEP 13**—Open both the suction and liquid base valves to the fully open position. Refer to section later in installation instructions for details on setting proper system charge.

### Field Fabricated Tubing Connections: Quick Connect Indoor Unit and Sweat Outdoor Unit Using CTO Kit

Use only refrigeration grade (dehydrated and sealed) copper tubing. Care must be taken to insure that the tubing is kept clean and dry before and during installation. Do not remove the plugs from the tubing ends, coil connections or base valves until the connection is ready to be brazed.

The suction line must be insulated with a minimum of 3/8" Armaflex or equivalent before cutting and making connections.

**STEP 1**—Being careful not to kink, route both the suction line and liquid line between the indoor unit and outdoor unit. Use a tubing bender to make any necessary bends in tubing. When necessary to bend the insulated tube suction line, cut the insulation around its circumference at a distance far enough beyond the point of the bend so as to clear the tubing bender. Slip the insulation back together and vapor seal the joint with tape. Coil any excess tubing in a horizontal place with the slope of the tubing toward the condensing unit.

	<b>CAUTION</b>
<p>1. Be careful not to tear the insulation when pushing it through hole in masonry or frame walls. 2. When sealing the tube opening in house wall, use a soft material to prevent tube damage and vibration transmission. 3. Avoid excessive bending in any one place to avoid kinking.</p>	

**STEP 2**—The tubing ends should be cut square. Make sure it is round and free of burrs at the connecting ends. Clean the tubing to prevent contaminants from entering the system.

**NOTE:** DO NOT make any tubing connection at indoor unit at this time. Make all brazing of joints and evacuate both suction and liquid line first.

**STEP 3**— Wrap a wet rag around the copper stub before brazing.

**STEP 4**— Flux the copper tube and insert into the stub. Braze the joint using an alloy of silver or copper and phosphorus with a melting temperature above 1100°F for copper to copper joints. The phosphorus will act as a flux, therefore, no flux will be required.

A copper-silver alloy with a high silver content should be used when iron or steel material is involved in the joint. These alloys require the use of silver solder flux. Alloys containing phosphorus should not be used with iron or steel. Phosphorus reacts with iron, forming iron phosphate which is extremely brittle.



## CAUTION

1. Brazing alloys with a melting temperature below 700°F should not be used. 2. Lead-tin or tin-antimony solders should not be used due to their low melting point and necessity for corrosive fluxes.

To further prevent the formation of copper oxide inside the tubing, dry nitrogen may be purged through the refrigerant system during brazing.



## WARNING

Never purge or pressurize a system with oxygen. An explosion and fire will result causing physical damage, injury or death.

**STEP 5**— After brazing, quench with wet rag to cool the joint and remove any flux residue.

**STEP 6**— Leak test all connections using an electronic leak detector or a halide torch.

**STEP 7**— Evacuate suction line and liquid line through outdoor unit base valves.

If orifice does not have to be changed, skip the instructions outlined further in Step 8 and proceed to Step 15.

**STEP 8**— Recover charge from the indoor unit.

- A. Connect the suction line only to the indoor unit as outlined in Steps 15, 16 and 17.
- B. Recover indoor unit and suction line unit charge through service port located on outdoor unit base valve.

**STEP 9**— Disassemble Flow Control Assembly by turning body hex.

**STEP 10**—If existing orifice has not dropped out of the body when disassembled, remove by using a pin or paper clip. Discard this original orifice.

**STEP 11**—Insert proper sized orifice fully into the flow control body with rounded "bullet" nose towards the unit as shown. Insure the orifice stays inserted in body before connecting mating half. See chart in the outdoor unit installation instructions for proper size.



## CAUTION

Be sure there is no dirt introduced into the flow control - orifice assembly. Be sure to install the orifice with the bullet nose pointing in the proper direction as shown in Figure 7. Failure to do so will result in improper operation.

**STEP 12**—Thread assembly halves together by hand to insure proper mating of threads and tighten until bodies "bottom" or a definite resistance is felt.

**STEP 13**—Using a marker pen or ink pen, mark a line lengthwise from the union not to the bulkhead. Then tighten an additional 1/6 turn (or 1 hex flat). The misalignment of the line will show the amount the assembly has been tightened. This final 1/6 turn is necessary to insure the formation of the leakproof joint.

**STEP 14**—Evacuate the suction line and indoor unit through the outdoor unit base valve before connecting all other tubing. Refer to section later in installation instructions for details on setting the proper refrigerant charge.

**STEP 15**—Remove (remaining) protector caps and plugs (if orifice was changed). Inspect fittings and if necessary carefully wipe coupling seats and threaded surfaces with a clean cloth to prevent the inclusion of dirt or any foreign material in the system.

**STEP 16**—Lubricate male half diaphragm and synthetic rubber seal with refrigerant oil. Thread coupling halves together by hand to insure proper mating of threads. Be sure to hold the coupling firmly to prevent movement of the coupling and tubing. Failure to do so could tear out the diaphragm causing a blockage of the system. Use proper size wrenches (on coupling body hex and on union nut) and tighten until coupling bodies "bottom" or a definite resistance is felt.



## CAUTION

After starting to tighten up the fitting, never try to back it off or take it apart.

**STEP 17**—Using a marker or ink pen, mark a line lengthwise from the coupling union nut to the bulkhead. Then tighten and additional 1/4 turn. The misalignment of the line will show the amount the coupling has been tightened. This final 1/4 turn is necessary to insure the formation of a leak proof joint. If a torque wrench is used, the following torque values are recommended:

**TABLE 4**

Coupling Size	Ft. lbs.
-6	10 - 12
-10	35 - 45
-11	35 - 45
-12	50 - 65

**STEP 18**—Leak test all connections using an electronic leak detector or a halide torch.

**STEP 19**—When tubing is installed in attics or drop ceilings, insulate the couplings on the larger tube thoroughly with 3/8" wall thickness, closed cell sponge tube insulation or equivalent. Failure to insulate will result in water damage to ceiling since the filling will "Sweat" and drop water on the ceiling.

**STEP 20**—Open both the suction and liquid base valves to the fully open position. Refer to section later in installation instructions for details on setting proper system charge.

# Wiring Instructions

## General

All wiring must be installed in accordance with the National Electrical Code and local codes. In Canada, all wiring must be installed in accordance with the Canadian Electrical Code and in accordance with the regulations of the authorities having jurisdiction. Power supply voltage must conform to the voltage shown on the unit serial plate. A wiring diagram of the unit is attached to the inside of the electrical cover. The power supply shall be sized and fused according to the specifications supplied. A ground lug is supplied in the control compartment for equipment ground.

The control circuit is a 24 volt circuit. "Typical" wiring diagrams illustrating some of the various circuits which could be encountered can be found in the installation instructions of the indoor section.

The unit rating plate lists a "Maximum Time Delay Fuse" or "HACR Type" circuit breaker that is to be used with the equipment. The correct size must be used for proper circuit protection and also to assure that there will be no nuisance tripping due to the momentary high starting current of the compressor motor.

## Control Circuit Wiring

For split systems, the minimum control circuit wiring gauge needed to insure proper operation of all controls in both indoor and outdoor units will depend on two factors.

1. The rated VA of the control circuit transformer.
2. The maximum total distance of the control circuit wiring. (This is the distance between the wall thermostat to the indoor unit plus the distance between the indoor unit to the outdoor unit.)

The following table should be used to determine proper gauge of control circuit wiring required.

TABLE 5

Rated VA of Control Circuit Transformer	Transformer Secondary FLA @ 240V	Maximum Total Distance of Control Circuit Wiring in Feet
40	1.6	20 gauge 85
		18 gauge 90
		16 gauge 145
		14 gauge 230
50	2.1	20 gauge 45
		18 gauge 60
		16 gauge 100
		14 gauge 160
80	2.7	20 gauge 40
		18 gauge 55
		16 gauge 85
		14 gauge 135
		12 gauge 210

For control circuit transformers rated other than those listed, use the next lower rated transformer listed.

Example: 1. Control circuit transformer rated at 55VA.

From table, use 50VA transformer.

There are two (2) separate control diagrams for fossil fuel furnaces with heat pump. Control diagrams for matching blower coils can be found in the blower coil installation instructions.

TABLE 6

Heat Pump System	Gas Furnace Control Diagram	Oil Furnace Control Diagram
All Models	4091-200	4091-201

## Wall Thermostats

The following wall thermostats and subbases should be used as indicated, depending on the application.

TABLE 7 - THERMOSTATS AND SUBBASES

Part No.	Model No.	Description
8403-017	T874R1129	Thermostat 1 stg. cool, 2 stg. heat, 1st stage fixed 2nd stg. adj. heat anticipators
8404-009	Q674L1181	Subbase System switch: EM-HT-Heat-Off-Cool Fan switch: On-Auto Special Feature: Manual changeover (non-cycling valve) EM-HT. light and system check light
8403-018	T874R1024	Thermostat 1 stg. cool, 2 stg. heat, 1st stage fixed 2nd stg. adj. heat anticipators
8404-010	Q674F1281	Subbase System switch: Off-Cool-Auto-Heat-EM-HT. Fan switch: On-Auto Special Feature: Auto system changeover, EM-HT. light and system check light
8403-024	IF94-45	Thermostat 1 stg. cool, 2 stg. heat, 1st stage fixed, 2 stg. adj. heater System switch: EM-HT-Heat-Off-Cool Fan switch: On-Auto
8403-034	IF94-80	Thermostat Subbase 2 stg. cool, 2 stg. heat, electronic Manual or automatic changeover, 2 setpoint/back periods per day, 5 or 7 day programming

**IMPORTANT NOTE:** All thermostat and subbase combinations except IF94-80 shown above incorporate the following features: Man-Auto fan switch, Off-Heat-Cool-Em. Heat Switch, and two (2) indicator lamps—one for emergency heat and one for compressor malfunction.

## Thermostat Indicator Lamps

The red lamp marked "EM-HT." comes on and stays on whenever the system switch is placed in the emergency heat position. The green lamp marked "check" will come on if the high pressure switch opens and that prevents the compressor from running. To reset high pressure switch, place thermostat in off position then back to on position.

## Emergency Heat Position

The operator of the equipment must manually place the system switch in this position. This is done when there is a known problem with the outdoor section, or when the green "check" lamp comes on indicating a problem.

## Outdoor Thermostat

Heat pump compressor operation at outdoor temperatures below  $-5^{\circ}\text{F}$  are neither desirable nor advantageous in terms of efficiency. Since most equipment at time of manufacture is not designated for any specific destination of the country and most of the equipment is installed in areas not approaching this low outdoor temperature range, an outdoor thermostat (used as a compressor cutoff) is a field installed option.

Outdoor thermostats are available to hold off various stages of electric heat or fossil fuel furnace, until needed as determined by outdoor temperature. The set point of the thermostat(s) is variable with geographic region and sizing of the heating equipment to the structure. Utilization of the Heating Application Data and the heat loss calculation of the building is required in determining the correct set points.

## Sequence of Operation When Used with Indoor Blower Coil

**COOLING**—Circuit R-Y makes at thermostat pulling in compressor contactor starting the compressor and outdoor motor. The G (indoor motor) circuit is automatically completed on any call for cooling operation, or can be energized by manual fan switch on subbase for constant air circulation.

**HEATING**—A 24V solenoid coil on reversing valve controls heating cycle operation. Two thermostat options, one allowing "Auto" changeover from cycle to cycle and the other constantly energizing solenoid coil during heating season and thus eliminating pressure equalization noise except during defrost, are to be used. On "Auto" option, a circuit is completed from R-W1 and R-Y on each heating "on" cycle, energizing reversing valve solenoid and pulling in compressor contactor starting compressor and outdoor motor. R-G also make starting indoor blower motor. Heat pump heating cycle is now in operation. The second option has no "Auto" changeover position, but instead energizes the reversing valve solenoid constantly whenever the system switch on subbase is placed in "heat" position, the "B" terminal being constantly energized from R. A thermostat demand for heat completes R-Y circuit, pulling in compressor contactor starting compressor and outdoor motor. R-G also make starting indoor blower motor.

## General Operation—Heat Pump/ Fossil Fuel Furnace

This type of system is a one-stage heating system, even though a two-stage heat wall thermostat is used. The thermostats specified for use are special thermostats for heat

pumps with extra switches, signal lights, and special circuitry for heat pumps, and by design are two-stage heating thermostats. Since the extra features are also required for the special heat pump/fossil fuel systems, the same thermostats are used, but the second stage circuit is not used. This is further explained in the next paragraph.

While it would be possible to electrically connect the furnace to the second stage of the thermostat, the heat pump coil is located downstream from the furnace heat exchanger, and continuous simultaneous operation of the furnace and heat pump will result in excessive high discharge pressures and temperatures at the compressor and resultant overload tripping problems. For this reason, the control circuit wiring diagrams shown later in this manual will not allow the furnace to operate except during defrost cycles unless an outdoor thermostat is added to the circuit. The addition of an outdoor thermostat used as a changeover thermostat will switch the system from heat pump heating to furnace heating based on the outdoor temperature. At no time will continuous operation of the heat pump and furnace be allowed.

An outdoor thermostat is used as a changeover thermostat, properly set to control at or just above the balance point, will allow the most economical operation of the system. The changeover (outdoor) thermostat switches off the heat pump on the fossil fueled furnace, based on the outdoor temperature. There is a  $5^{\circ}\text{F}$  differential in the changeover (outdoor) thermostat, so when the heat pump is de-energized and the furnace is activated, the outdoor temperature must rise  $5^{\circ}\text{F}$  above the set point of the thermostat to stop the furnace and start the heat pump again.

**NOTE:** See manual 2100-057 "Heat Pump Sizing" for procedure to determine correct balance point.

The emergency heat switch allows for manual cutoff of the heat pump and operation of the furnace at any outdoor temperature.

## Note on Blower Operation

Because of the design of the heat pump wall thermostats, and the fact that a cooling blower relay is installed in parallel with the fan side of the combination fan/limit control found on most gas or oil furnaces, the furnace blower will start as soon as the wall thermostat calls for heat. This is required for the heat pump and will also occur during the time when the heat pump is off and the furnace is operating. This is contrary to normal blower operation on a gas or oil furnace and is sometimes misunderstood, but an inherent part of the system operation. While in the gas or oil furnace mode of operation, there will still be a run-on in blower operation until the bonnet temperature cools down to the blower off setting of the fan/limit switch.



# Charging Instructions

## Pressure Service Ports

High and low pressure service ports are installed on all units so that the system operating pressures can be observed. Pressure tables can be found later in the manual covering all models. It is imperative to match the correct pressure table to the unit by model number.

The pressure service ports on the split system heat pump are located on the interconnecting tubing base valve fittings. An additional low side service port is located on the inside unit for low side pressure during heating operation.

## Three Phase Scroll Compressor Start Up Information

Scroll compressors, like several other types of compressors, will only compress in one rotational direction. Direction of rotation is not an issue with single phase compressors since they will always start and run in the proper direction.

However, three phase compressors will rotate in either direction depending upon phasing of the power. Since there is a 50-50 chance of connecting power in such a way as to cause rotation in the reverse direction, verification of proper rotation must be made. Verification of proper rotation direction is made by observing that suction pressure drops and discharge pressure rises when the compressor is energized. Reverse rotation also results in an elevated sound level over that with correct rotation, as well as, substantially reduced current draw compared to tabulated values.

There is no negative impact on durability caused by operating three phase Compliant Scroll compressors in the reversed direction. However, after several minutes of operation, the compressor's internal protector will trip. Reverse operation for over one hour may have a negative impact on the bearings.

All three phase compressors are wired identically internally. As a result, once the correct phasing is determined for a specific system or installation, connecting properly phased power leads to the same Fusite terminals should maintain proper rotation direction.

The direction of rotation of the motor may be changed by reversing any two line connections to the unit.

## System Start Up

- STEP 1**—Close Disconnect switch(es) and set the thermostat to cool and the temperature to the highest setting.
- STEP 2**—Check for proper airflow across the indoor coil by referring to indoor unit installation instructions.
- STEP 3**—Connect the service gauges and allow the unit to run for at least 10 minutes or until pressures are stable. Check pressures to the system pressure table attached to the outdoor unit service panel.

For optimum system performance in cooling, go to Step 4.

These start up instructions are for charging system in cooling mode only at 70° outdoor temperature or higher. For outdoor temperatures below 70° and for heating mode, system should only be charged by weight method (see Table 11).

**STEP 4**—Install a thermometer on the suction line approximately 6" to 10" from the compressor. Optimum system performance will occur with a refrigerant charge resulting in a suction line superheat as determined from the following calculations.

- A. Measure outdoor air dry temp. \_\_\_\_\_ °F
- B. Measure indoor air wet bulb temp. \_\_\_\_\_ °F
- C. Measure suction pressure \_\_\_\_\_ psig
- D. Measure suction line temp. \_\_\_\_\_ °F
- E. Determine optimum system superheat from TABLE 10 using outdoor air dry bulb (Step B) and indoor air wet bulb (Step A). \_\_\_\_\_ °F
- F. Determine saturated suction pressure using TABLE 9 \_\_\_\_\_ °F
- G. Determine system superheat:  
 Suction line temp. (Step D) \_\_\_\_\_ °F  
 - Saturated suction temp (Step F) - \_\_\_\_\_ °F  
 = System superheat = \_\_\_\_\_ °F
- H. Adjust the system superheat (Step G) to the optimum system superheat (Step E) by adding charge to lower the superheat or removing charge to raise the superheat.
- I. Check final system operating pressures to the system pressure tables as was done in Step 3.

**TABLE 7 – SATURATED SUCTION TEMPERATURE (R-22)**

Saturated Suction Pressure PSIG	Temperature (°F)
50	26
53	28
55	30
58	32
61	34
63	36
65	38
67	39
70	41
73	43
76	45
79	47
82	49
86	51

**TABLE 8 - SYSTEM SUPERHEAT**

Outdoor Ambient Temperature ( F Dry Bulb)	Return Air Temperature F Wet Bulb			
	59	63	67	71
105	1	1	5	
95	1	3	8	20
90	1	7	14	26
85	3	9	19	33
80	8	14	25	39
75	10	20	30	42

**Total System Charge for Split Systems**

**TABLE 9**

Outdoor Section	Indoor Section	Total R-22 Charge (Oz.)
HHP501-F	BC48C	224 oz.
HHP601-F	BC60C	234 oz.

The above includes 25' of 3/8" diameter liquid line. For other than 25' and other tube sizes, adjust the total charge according to the following schedule.

**TABLE 10**

Liquid Line Diameter	Oz. R-22 Per Ft. ①
3/8"	.6
1/2"	1.2

**Installer Note:** Stamp or mark the final system charge determined above on the outdoor unit serial plate.

① These values should only be applied during initial system charging. System operating charge should be adjusted in cooling mode for optimum performance outlined in the installation instructions for that model outdoor section.

**TABLE 11 - TUBING CHART**

Basic Condensing Unit Model	Refrigerant Line Length (Ft.)					
	0 20		21 60		61 100	
	Liquid	Suction	Liquid	Suction	Liquid	Suction
HHP501-F	3/8"	7/8"	3/8"	7/8"	1/2"	1-1/8"
HHP601-F	3/8"	7/8"	3/8"	7/8"	1/2"	1-1/8"

The basis for selection is to maintain adequate velocity which assures adequate oil return to the compressor, an acceptable pressure drop to assure compressor capacity, and minimum tubing costs.

These recommendations are based on the use of standard refrigeration tubing.

Line sizes listed are outside tube dimensions.

These suggestions do not include consideration for additional pressure drop due to elbows, valves, or reduced joint sizes.

These recommendations are to be applied to approved combinations of Bard outdoor and indoor sections only.



# Service

## Service Hints

1. Caution homeowner to maintain clean air filters at all times. Also, not to needlessly close off supply and return air registers. This reduces air flow through the system, which shortens equipment service life as well as increasing operating costs.
2. Switching to heating cycle at 75°F or higher outside temperature may cause a nuisance trip of the reset high pressure switch.
3. The heat pump wall thermostats perform multiple functions. Be sure that all function switches are correctly set for the desired operating mode before trying to diagnose any reported service problems.
4. Check all power fuses or circuit breakers to be sure that they are the correct rating.
5. Periodic cleaning of the outdoor coil to permit full and unrestricted air flow circulation is essential.

## Fan Blade Setting Dimensions

Shown in Table 12 are the correct fan blade setting dimensions for proper air delivery across the outdoor coil.

Any service work requiring removal or adjustment in the fan and/or motor area will require that the dimensions below be checked and blade adjusted in or out on the motor shaft accordingly.

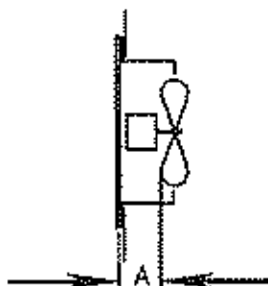


FIGURE 8

TABLE 12 — FAN BLADE SETTING DIMENSIONS

Model	Dimension A (Inches)
HHP501-F HHP601-F	3-1/4

## Crankcase Heaters

Some 3 phase models have a wraparound type heater located on the lower section of the compressor housing. This heater draws only enough power to maintain the compressor at a safe temperature when the compressor is not running.

Some form of crankcase heat is essential to prevent liquid refrigerant migrating to the compressor causing oil pump out on compressor start-up.

The decal in Figure 9 is affixed to all outdoor units detailing start-up procedure. This is very important. Please read carefully.

FIGURE 9

**IMPORTANT**

**THESE PROCEDURES MUST BE FOLLOWED AT INITIAL START-UP AND AT ANY TIME POWER HAS BEEN REMOVED FOR 12 HOURS OR LONGER.**

TO PREVENT COMPRESSOR DAMAGE WHICH MAY RESULT FROM THE PRESENCE OF LIQUID REFRIGERANT IN THE COMPRESSOR CRANKCASE.

1. MAKE CERTAIN THE ROOM THERMOSTAT IS IN THE "OFF" POSITION (THE COMPRESSOR IS NOT TO OPERATE).
2. APPLY POWER BY CLOSING THE SYSTEM DISCONNECT SWITCH THIS ENERGIZES THE COMPRESSOR HEATER WHICH EVAPORATES THE LIQUID REFRIGERANT IN THE CRANKCASE.
3. ALLOW 4 HOURS OR 60 MINUTES PER POUND OF REFRIGERANT IN THE SYSTEM AS NOTED ON THE UNIT RATING PLATE, WHICHEVER IS GREATER.
4. AFTER PROPERLY ELAPSED TIME THE THERMOSTAT MAY BE SET TO OPERATE THE COMPRESSOR.
5. EXCEPT AS REQUIRED FOR SAFETY WHILE SERVICING — DO NOT OPEN SYSTEM DISCONNECT SWITCH.

7961-061

## Compressor Short Cycle Protection

The solid state heat pump control included with this model has a built in compressor short cycle protection that will prevent the compressor from restarting until compressor has been off for at least five minutes. There is a speed up jumper on the heat pump control that can be used to reduce this time for service of equipment.

## Defrost Cycle

The defrost cycle is controlled by temperature and time on the solid state heat pump control.

When the outdoor temperature is in the lower 40°F temperature range or colder, the outdoor coil temperature is 32°F or below. This coil temperature is sensed by the defrost thermostat mounted near the bottom of the outdoor coil. Once the coil temperature reaches 32°F or below, the defrost thermostat closes and the defrost timer will start.

After 60 (90 or 30) minutes at 32°F or below, the heat pump control will place the system in the defrost mode.

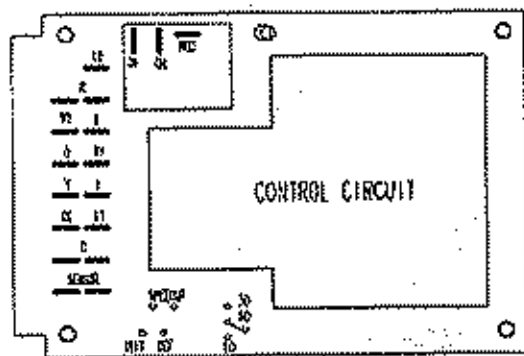
During the defrost mode, the refrigerant cycle switches back to the cooling cycle, the outdoor motor stops, electric heaters are energized, and hot gas passing through the outdoor coil melts any accumulator frost. When the temperature rises to approximately 57°F, the defrost thermostat will open which will return the system to heating operations automatically.

If some abnormal or temporary condition such as high wind causes the heat pump to have a prolonged defrost cycle, the heat pump control will restore the system to heating operation automatically after 10 minutes.

There are three settings on the heat pump control—30 minutes, 60 minutes, and 90 minutes. Most models are shipped wired on the 60 minute setting for greatest operating economy. If special circumstances require a change to another time, remove wire connected to terminal 60 and reconnect to desired terminal.

There is a cycle speed up jumper on the control. This can be used to reduce the time between defrost cycle operation without waiting for time to elapse.

FIGURE 10 — Control Circuit



## Solid State Heat Pump Control Troubleshooting Procedure

1. Turn on AC power supply to indoor and outdoor units.
2. Turn thermostat blower switch to fan on—the indoor blower should start. (If it doesn't, troubleshoot indoor unit and correct problem.)
3. Turn thermostat blower switch to auto position. Indoor blower should stop.
4. Set system switch to heat or cool. Adjust thermostat to call for heat or cool—the indoor blower, compressor, and outdoor fan should start.

**NOTE:** If there was no power to 24 volt transformer, the compressor and outdoor fan will not start for 5 minutes. This is because of the compressor short cycle protection.

TABLE 13 -- TROUBLESHOOTING PROCEDURES

SYMPTOM	POSSIBLE CAUSES	WHAT TO CHECK	HOW TO CHECK or REPAIR
Compressor contactor does not energize (cooling or heating).	Control circuit wiring	Check for R connection at outdoor unit, and 24V between R-C. 1. Check for 24V between L1-C on heat pump control.	Run R connection to outdoor unit to power heat pump control. 1. If no voltage between L1-C, turn thermostat off and on again to reset high pressure switch. 2. If high pressure switch is open and will not reset, replace high pressure switch.
	Compressor lock out	2. Check across high pressure switch	
	Compressor short cycle protection	Check for 24V between CC-C and Y-C on heat pump control.	If no voltage between CC-C, jumper speed up terminal and within 10 seconds power should appear between CC-C. Remove speed up jumper after 10 seconds. Replace heat pump control.
	Heat pump control defective	Check all other possible causes. Manual 2100-065	
Fan outdoor motor does not run (cooling or heating except during defrost).	Contactors defective	Check for open or shorted coil winding.	Replace contactor.
	Motor defective	Check for open or shorted motor winding.	Replace motor.
Reversing valve does not energize (heating only).	Motor capacitor defective	Check capacitor rating. Check for open or shorted capacitor.	Replace capacitor.
	Heat pump control defective	Check across fan relay on heat pump control. (Com-NC)	Replace pump control.
Unit will not go into defrost (heating only).	Reversing valve solenoid coil defective	Check for open or shorted coil.	Replace solenoid coil.
	Heat pump control defective	Check for 24V between RV-C and B-C.	1. Check control circuit wiring. 2. Replace heat pump control.
Unit will not come out of defrost (heating only).	Heat pump control defective	Disconnect defrost thermostat and jumper across sensor terminals. This should cause the unit to go through a defrost cycle within one minute.	1. If unit goes through defrost cycle, check defrost thermostat. 2. If unit does not go through defrost cycle, replace heat pump control.
	Heat pump control defective	Jumper across speed up terminals. This should cause the unit to come out of defrost within one minute.	1. If unit comes out of defrost cycle, check defrost thermostat. 2. If unit does not come out of defrost cycle, replace heat pump control.

OUTDOOR MODEL: HHP501-F



Bard Manufacturing Company  
Bryan, Ohio 43506

COOLING			Air Temperature Entering Outdoor Coil°F									
Indoor Model	Return Air Temperature	Pressure	75°	80°	85°	90°	95°	100°	105°	110°	115°	
BC48C	75° DB	Low Side	86	67	68	69	70	71	72	73	74	
	62° WB	High Side	220	243	266	288	311	334	356	379	402	
	80° DB	Low Side	71	72	73	74	75	76	77	78	79	
	67° WB	High Side	206	277	248	269	290	311	332	353	374	
	85° DB	Low Side	69	70	71	72	73	74	75	76	77	
	72° WB	High Side	213	234	256	278	300	321	344	362	387	

HEATING			Air Temperature Entering Outdoor Coil°F												
Model	Return Air Temperature	Pressure	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°
BC48C	70° DB	Low Side	10	15	20	25	29	32	36	41	46	51	56	61	66
		High Side	152	161	171	180	189	199	208	217	226	236	245	254	264

Low side pressure ± 2 PSIG (suction service port @ outdoor unit base valve)

High side pressure ± 5 PSIG (location line @ outdoor unit base valve)

Tables are based upon rated CFM (airflow) across the evaporator coil and should be found under section titled "Refrigerant Charge" elsewhere in manual. If there is any doubt as to correct operating charge being in the system, the charge should be removed, system evacuated, and recharged to serial plate instructions.

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OUTDOOR MODEL: HHP801-F



Bard Manufacturing Company  
Bryan, Ohio 43506

COOLING			Air Temperature Entering Outdoor Coil°F									
Indoor Model	Return Air Temperature	Pressure	75°	80°	85°	90°	95°	100°	105°	110°	115°	
BC80C	75° DB	Low Side	68	68	69	71	72	74	75	77	79	
	62° WB	High Side	229	255	281	307	333	359	385	411	437	
	80° DB	Low Side	72	73	75	77	78	79	81	83	84	
	67° WB	High Side	213	237	262	285	310	334	359	382	407	
	85° DB	Low Side	70	71	73	75	76	78	79	81	82	
	72° WB	High Side	219	244	270	295	320	345	371	396	421	

HEATING			Air Temperature Entering Outdoor Coil°F												
Model	Return Air Temperature	Pressure	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°
BC80C	70° DB	Low Side	10	12	16	20	25	29	34	38	43	47	52	56	61
		High Side	143	149	155	162	169	174	181	187	193	199	206	212	218

Low side pressure ± 2 PSIG (suction service port @ outdoor unit base valve)

High side pressure ± 5 PSIG (location line @ outdoor unit base valve)

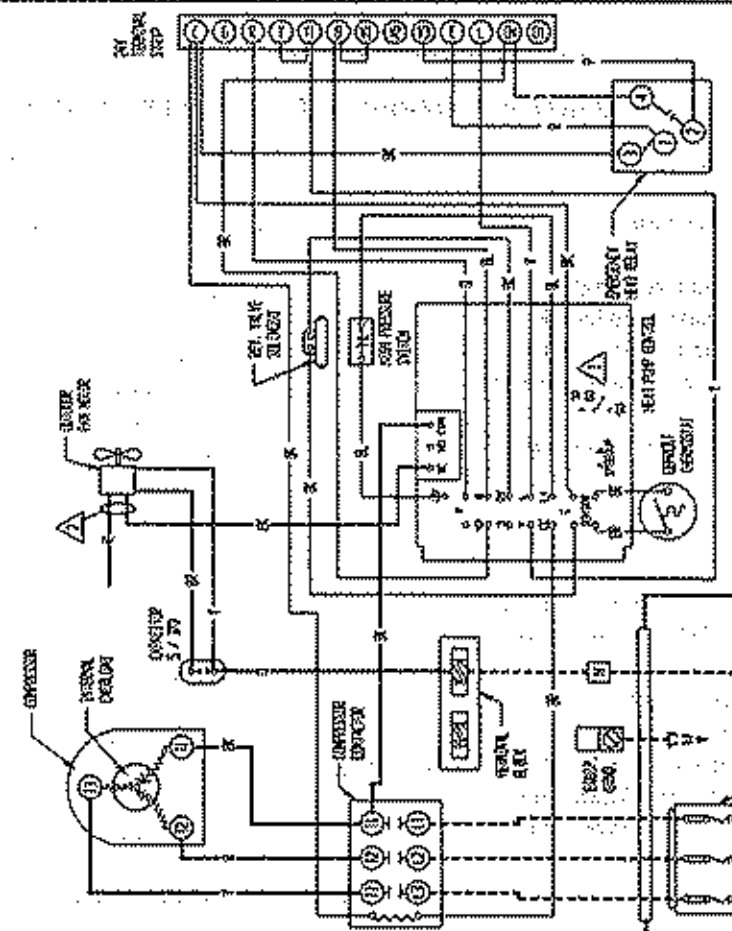
Tables are based upon rated CFM (airflow) across the evaporator coil and should be found under section titled "Refrigerant Charge" elsewhere in manual. If there is any doubt as to correct operating charge being in the system, the charge should be removed, system evacuated, and recharged to serial plate instructions.

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**CONNECTION DIAGRAM**

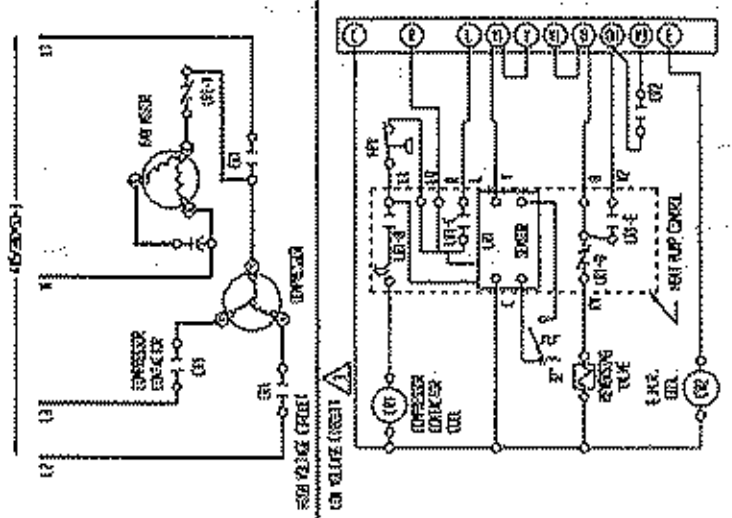
**WARNING: ELECTRICAL SHOCK HAZARD. DISCONNECT POWER BEFORE SERVICING.**



**FACTORY WIRING**  
 (see factory wiring diagram)

**WARNING: ELECTRICAL SHOCK HAZARD. DISCONNECT POWER BEFORE SERVICING.**

**LADDER DIAGRAM**



WIRING	WIRING
WIRING	WIRING
WIRING	WIRING
WIRING	WIRING

**WARNING: ELECTRICAL SHOCK HAZARD. DISCONNECT POWER BEFORE SERVICING.**

# Air Source Heat Pump Performance Report

This performance check report should be filled out by installer and retained with unit.

DATE: \_\_\_\_\_ TAKEN BY: \_\_\_\_\_

1. **OUTDOOR UNIT:**  
 Mfgr. \_\_\_\_\_ Model No. \_\_\_\_\_ S/N \_\_\_\_\_  
 INDOOR UNIT (Split System):  
 Mfgr. \_\_\_\_\_ Model No. \_\_\_\_\_ S/N \_\_\_\_\_
2. Person Reporting \_\_\_\_\_
3. Company Reporting \_\_\_\_\_
4. Installed By \_\_\_\_\_ Date Installed \_\_\_\_\_
5. User's (Owner's) Name \_\_\_\_\_  
 Address \_\_\_\_\_
6. Unit Location \_\_\_\_\_

**THE FOLLOWING INFORMATION IS NEEDED TO CHECK PERFORMANCE OF UNIT.**

OUTDOOR SIDE DATA	Cooling	Heating	
7. Entering temperature	_____	_____	F
8. Liquid or discharge line pressure	_____	PSIG _____	
9. Suction line pressure	_____	PSIG _____	
10. Voltage at compressor (unit running)	_____	_____	V
11. Amperage draw at line side of contactor	_____	_____	A
12. Amperage at compressor common terminal	_____	_____	A
13. Suction line temperature 6" from compressor	_____	_____	F
14. Superheat at compressor	_____	_____	F
15. Liquid line temperature at metering device	_____	_____	F
16. Coil subcooling	_____	_____	F

INDOOR SIDE DATA	Cooling	Heating	
17. Dry bulb temperature at air entering indoor coil	_____	_____	F
18. Wet bulb temperature of air entering indoor coil	_____	_____	F
19. Dry bulb temperature of air leaving indoor coil	_____	_____	F
20. Wet bulb temperature of air leaving indoor coil	_____	_____	F
21. Indoor fan motor operating voltage (split system only)	_____	_____	V
22. Indoor fan motor operating amperage	_____	_____	A
23. *Static pressure drop across indoor coil (split system only)	_____	_____	WC
24. *Supply air static pressure (packaged unit)	_____	_____	WC
25. *Return air static pressure (packaged unit)	_____	_____	WC

26. Other information about installation \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_