MANUAL 2100-024D

SPLIT SYSTEM HEAT PUMP
COIL ONLY INDOOR SECTION

INSTALLATION INSTRUCTIONS

FOR USE WITH:
OIL
GAS
ELECTRIC
FURNACES

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GENERAL

The Bard add-on heat pump coil-only indoor sections were designed for use with certain Bard outdoor heat pump units. The selection of the matching outdoor unit should be primarily based on the cooling capacity required for the application, as is standard practice when sizing a heat pump system. Reference should be made to the specification sheets for performance values of the following approved matching combinations:

	COMPRESSOR UNIT	INDOOR COIL SECTION
Air Source	18HPQ2	H18QS1
	18HPQ2	H24QS1
	24HPQ2	H18QS1
	24HPQ2	H24QS1
	30HPQ4	H3AQ1
	36HPQ4	H3AQ1
	42HPQ	H5AQ
	48HPQ2	H5AQ
	60HPQ3	H5AQ
Water Source	WQS30	H3AQ1
	WQSD30	H3AQ1
	WQS36	H3AQ1
	WQSD36	H3AQ1

NOTE: ONLY the above combinations are approved for use. DO NOT attempt to mix and match to build up a special system.

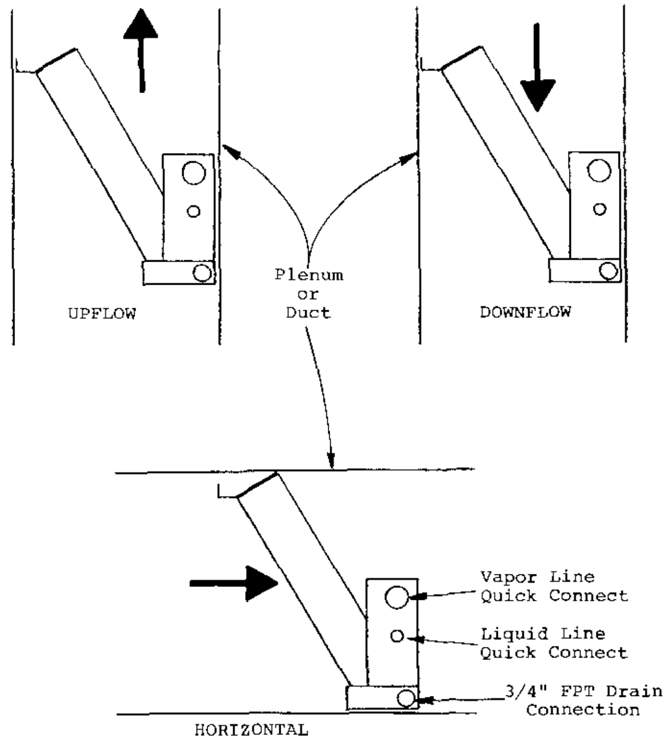
The heat pump add-on coils were initially designed to be used with Bard EFC Series electric furnace for counterflow applications. It can also be utilized as an add-on heat pump system to existing electric furnace installations to reduce operating costs.

Another increasingly popular concept is to use a heat pump system in conjunction with natural gas, manufactured gas, or fuel oil furnaces. The theme here is to take advantage of the heat pump efficiency during the large number of days when the outdoor temperature is in the mid 40° range or higher, and heating is required as dictated by the indoor wall thermostat. The fossil fuel furnaces are tremendously oversized for the 40° and higher outdoor temperature conditions, and utilization of the heat pump during this temperature range provides a very practical and economical heating system, while also offering the advantages of cooling operation during the summer months.

Each of the above applications demands special installation and control circuit wiring considerations. The instructions contained in this manual pertaining to indoor coil location with respect to the type of heating system should be adhered to when matching with either the air source or water source compressor sections. Briefly, the rule is that the coil is located downstream (outlet or supply air side) on gas and oil; and upstream (inlet or return air side) on electric furnace. More details on the importance of this are contained later in the manual under those specific types of furnace applications. Specific wiring information for the WQS Series water source compressor units is contained in the installation instructions packaged with the WQS units. Specific wiring information for the HPQ series air source compressor units is located later in this manual.

AIRFLOW DIRECTION — MODELS H18QS1 AND H24QS1

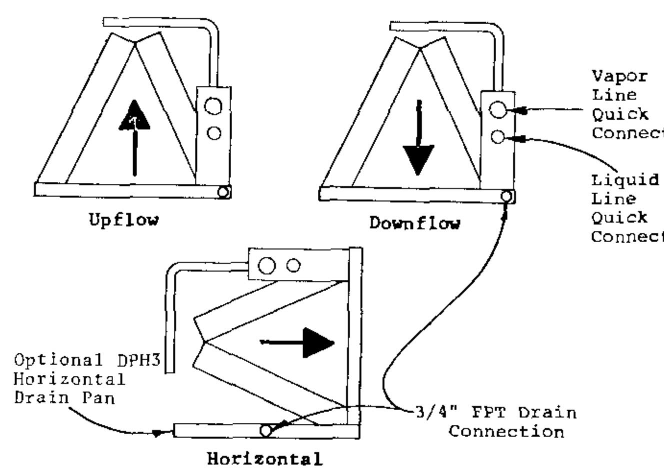
Models H18QS1 and H24QS1 are a slant-coil design, and can be used in all three installation positions with respect to airflow: upflow, downflow and horizontal. The following illustrations show the correct airflow directions across the coil.



AIRFLOW DIRECTION — MODEL H3AQ1

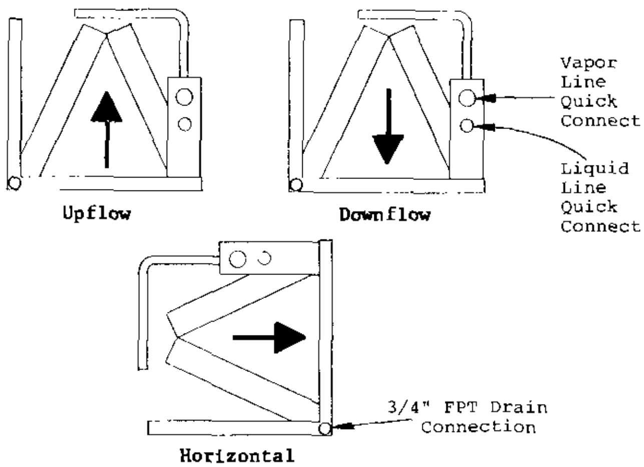
Model H3AQ1 is an A-coil designed for two mounting positions with respect to airflow: upflow and downflow. By using DPH3 horizontal drain pan (optional), the H3AQ1 is easily adaptable to horizontal air flow installations.

The three mounting positions and correct airflow directions across the coil are shown in the following illustrations:



AIRFLOW DIRECTION — MODEL H5AQ

Model H5AQ is an A-coil designed for three mounting positions with respect to airflow: upflow, downflow, and horizontal. The coil is equipped with a dual condensate collector which permits one A-coil assembly to meet these three mounting positions, and no accessory parts are required. The three mounting positions and correct airflow directions across the coil are shown in the following illustrations:



AIRFLOW RATINGS IN CFM

Listed below are the rated airflow and also minimum/maximum airflows for each system combination:

System Combination	Rated Airflow	Airflow Range
18HPQ2 - H18QS1	620	550 - 675
18HPQ2 - H24QS1	635	550 - 700
24HPQ2 - H18QS1	730	625 - 800
24HPQ2 - H24QS1	800	650 - 880
30HPQ4 - H3AQ1	1080	875 - 1200
36HPQ4 - H3AQ1	1300	1050 - 1425
42HPQ - H5AQ	1625	1335 - 1750
48HPQ2 - H5AQ	1625	1335 - 1750
60HPQ3 - H5AQ	1575	1335 - 1750
WQS30 - H3AQ1	1150	980 - 1250
WQSD30 - H3AQ1	1150	980 - 1250
WQS36 - H3AQ1	1250	1025 - 1375
WQSD36 - H3AQ1	1250	1025 - 1375

CONDENSATE DRAIN

A single 3/4" FPT drain connection is supplied on all the add-on heat pump coil sections. The same drain connection is used regardless of installation position, with the exception of the H3AQ in horizontal position. In this instance the drain connection on the DPH3 optional horizontal drain pan is used.

INSTALLATION ACCESSORIES

There are optional plenums and filter racks available for all the indoor coil sections. The optional filter racks as shown or some other means of air filtering are required on any application where the coil is installed upstream from the original filter location, which should be removed so excessive restriction is not placed on the system blower.

INDOOR COIL MODEL	PLENUM	FILTER RACK
H18QS1	HP3 (1) (2)	FR3 (2)
H24QS1	HP2 (3) (1)	FR3 (2)
H3AQ	HP3	FR3
H5AQ	HP5	FR5

(1) Contains adapter plate for slant coils.

(2) HS152 plenum will also fit these coils. No filter rack is available. Desirable for use with H61-81 Series gas furnace.

(3) HS20 plenum will also fit this coil for use with H61-81 series gas furnaces.

NOTE: The HP3 plenum and FR3 filter rack were designed to mate with the EFC series electric furnace. There are 3/4" flanges on both the top and bottom of the plenum which permit the plenum to fit on top (return air inlet) of an inverted EFC furnace for downflow application, or support an EFC furnace for upflow application. The FR3 filter rack mates with either end of HP3 plenum, as required.

The HP5 plenum and FR5 filter rack are similar in design to the HP3 plenum and FR3 filter rack as described above, but are not designed to fit any particular furnace.

Both the HP3-FR3 combination or HP5-FR5 combination can be used for any application, as they have duct flanges on each end and existing duct work can be adapted.

ELECTRIC FURNACE APPLICATION — GENERAL

The only add-on heat pump coils generally considered for use with the Bard EFC series electric furnaces are the H18QS1 (1-1/2 ton), H24QS1 (2 ton) and H3AQ1 (2-1/2 and 3 ton). This is because the standard indoor blower coil units available for these Btu size systems are not designed for downflow application. The EFC series furnace is designed for upflow, downflow and horizontal, and therefore a downflow installation can be achieved by using an EFC furnace in combination with either an H18QS1, H24QS1 or H3AQ coil section.

The H5AQ is designed for use with 42HPQ (3-1/2 ton), 48HPQ2 (4 ton) and 60HPQ3 (5 ton) outdoor units. However, since the B48EHQ indoor blower coil (with or without installed electric heaters—used with 42HPQ and 48HPQ2) and B60EHQ indoor blower coil (with or without installed electric heaters—used with 60HPQ3) are both designed for upflow, downflow and horizontal use, there should be no reason to attempt to match the H5AQ coil assembly to an electric furnace. A possible exception to this would be an add-on to an existing furnace installation. If this is the case, there are a few important items for consideration.

1. Only the Bard EFC25 or EFC30 should be considered for use. These are the only two furnace models with sufficient blower capacity to meet the airflow requirements for the heat pump system.
2. The HP5 plenum does not mate exactly with the EFC furnace cabinet, and a sheet metal transition would be required.

ELECTRIC FURNACE APPLICATION — INSTALLATION

The heat pump A-coil must be installed on the return air side of any electric furnace application. This is mandatory so that the heat output from the electric strip heaters, energized at the lower outdoor temperatures, does not drive into the heat pump coil and cause the refrigerant condensing pressure and temperature to raise to points well beyond the design limitations of a heat pump system, and cause the compressor to be de-energized by the manual reset high pressure switch.

CONTROL CIRCUIT WIRING - CONTROL CIRCUIT DIAGRAMS

Each different Kw size EFC electric furnace requires some variations in wiring, because of the different amount of sequencer controls on the EFC. Listed below are the appropriate control circuit wiring diagrams based upon EFC size and also the number of field installed A-22 thermostats, Bard Part No. 8408-001 or 8408-005 recommended for each application.

HEAT PUMP SYSTEM	FURNACE MODEL	CONTROL DIAGRAM	QUANTITY (1) OF A-22's
18HPQ2-H18QS1 18HPQ2-H24QS1 24HPQ2-H18QS1 24HPQ2-H24QS1	EFC10-1	CDEF-1	1
30HPQ4-H3AQ1 36HPQ4-H3AQ1	EFC10-B-1	CDEF-2	1
30HPQ4-H3AQ1 36HPQ4-H3AQ1	EFC15-1 EFC20-1	CDEF-3	1
42HPQ-H5AQ 48HPQ2-H5AQ 60HPQ3-H5AQ	EFC25-1 EFC30-1	CDEF-4	2

(1) A-22 outdoor thermostats are optional. See notes on control diagrams.

The circuitry covered by the Control Diagrams allows for heat pump on 1st stage of wall thermostat, with option for compressor cut-off at 0°F or higher as field selected. It also allows for a maximum of 10Kw to be controlled by W2 (second stage) of the wall thermostat, any installed Kw over that amount being controlled by an A-22 acting as 3rd stage heat thermostat.

GAS OR OIL FURNACE APPLICATION

Application of heat pump coil only sections to fossil fuel furnaces require certain special considerations. The first is that return air applications are generally termed unacceptable because of: a) Local codes do not permit, b) may void heat exchanger warranty of furnace manufacturer, and c) past experience with return air applications generally very poor.

If we were concerned with heating cycle only, the reasons stated above would present no problems. However, during the cooling cycle the heat exchanger becomes chilled or cooled well below surrounding space temperatures due to the low air temperature coming off of the coil, and induces condensation to form on the heat exchanger.

As we consider placing the coil on the more traditional outlet (or leaving) air side of the furnace, we are faced with a new set of circumstances which must be considered.

Balance Point. The point at which the heat pump output capacity and the heat loss from the building being heated are equal is called the balance point, with the heat pump operating 100 per cent of the time. As the outdoor temperature goes down, the Btu capacity of the heat pump falls off while at the same time the heat loss from the structure increases. A means of placing the fossil fueled furnace in operation at outdoor temperatures below the balance point must be provided. In all instances, the gas or oil furnace must be of sufficient capacity to heat the building even under the most extreme outdoor temperature, without the aid of the heat pump.

There is no one given outdoor temperature at which the balance point will occur, it will be different for each application of heat pump to a building, and can even vary from day to day based upon cloud cover, relative humidity outdoors, and wind conditions. Of course, the design of the building (insulation, types of windows, doors, etc., and other items that affect the heat loss) also determine where the balance point will occur for a given size heat pump system.

Generally speaking, the balance point will be somewhere between 25°F - 40°F outdoor temperature. Unless there is some reason not to (see paragraph titled "Breakeven Point"), the heat pump should be allowed to operate down to the projected balance point. The balance point can be plotted on the respective heat pump performance curve if the heat loss for the structure is known for the outdoor design temperature for the area, which must be done to correctly select the gas or oil furnace to begin with. Operation of the heat pump down to the projected balance point is permissible, as long as nuisance compressor cycling problems are not encountered during defrost cycle.

Defrost Cycle. Heat pumps operating during outdoor temperatures below the low 40°F range and colder will gradually accumulate a frost build-up on the outdoor coil. A defrost cycle control system is built into all outdoor heat pump sections that will periodically and automatically clear the outdoor coil of this frost accumulation. This is accomplished by the heat pump system temporarily reverting back to the cooling cycle, using the hot refrigerant gas flowing through the outdoor coil to melt the frost. The outdoor fan motor also stops during this period to speed up the process. During this time of defrost cycle operation, there will be a cooling effect taking place at the indoor coil section, the same as would occur during the summer cooling system.

It is desirable to supply supplemental heat during the defrost cycle period, so as to avoid the discharging of cool air into the building. Laboratory and field testing has shown that firing of the gas or oil furnace during the defrost cycle is permissible and can in fact even shorten the time required for defrosting the outdoor coil because of the introduction of heat immediately ahead of the indoor coil assembly.

IMPORTANT: Since the size of the fossil fueled furnace is known only to the installer of the system, it is possible that there could be an excessively large Btu capacity furnace involved, especially in an add-on situation (it is not uncommon for some fossil fueled furnaces, especially oil-fired, to be vastly oversized). Should this instance be encountered, it is possible that because of the furnace Btu output involved, an excessively fast temperature rise air temperature entering the refrigerant coil mounted on the furnace may result in higher discharge pressures and temperatures than the compressor protective devices will tolerate and cause tripping of these protective devices.

It is the responsibility of the installer to understand this operation of the system in detail, and should this occur, set the temperature of the changeover thermostat to a higher temperature. This will lessen the amount of frost accumulation, shorten the length of the actual defrost cycles and thus the time of simultaneous operation of heat pump and furnace.

An alternative to this is to not allow the furnace to cycle "on" during the defrost period. See "Control Diagram" wiring page on gas and oil furnaces on how to defeat the supplemental heat during defrost. Notes 4 and 5

Breakeven Point. Another factor to be considered is one of economics. There is a "breakeven point" which could be calculated for all situations, based on actual values of gas or oil cost per unit, electric rates, published Btu and power consumption data of the heat pump system, and estimated efficiency of the furnace involved. To operate the heat pump at outdoor temperatures below this "breakeven point" would result in a higher operating cost for that amount of Btu being supplied by the heat pump.

It is possible, where the electric rates are high and the alternate fuel, be it gas or oil, still at a low rate, to be more economical to operate the heat pump only at the outdoor temperatures above 45°F. It is at outdoor temperatures above 45°F where the heat pump becomes very efficient, there is no need for defrost cycles, and fossil fueled furnaces are least efficient because of being oversized for the heat loss requirement and resultant short-cycling.

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 stats for heat pumps with extra switches, signal lights, and special circuitry for heat pumps, and by design are two-stage heating stats. Since the extra features are also required for the special heat pump/fossil fuel systems, the same stats are used, but the 2nd stage circuit is not used. This is further explain ed in the next paragraph.

While it would be possible to electrically connect the furnace to the 2nd stage of the stat, 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.

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 thermostat switches off the heat pump and on the fossil fueled furnace, based on the outdoor temperature. There is a 5°F differential in the changeover thermostat, so when the heat pump is de-energized and the furnace is activated, the outdoor temperature must rise 5°F above the set-point of the thermostat to stop the furnace and start the heat pump again.

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

NOTE ON INDOOR BLOWER OPERATION: Because of the design of the heat pump wall thermostats, and the fact that a cooling blower relay must be installed in parallel with the fan side of the combination fan/limit control on the gas or oil furnace, the furnace blower will start as soon as the wall stat 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.

CONTROL CIRCUIT WIRING

There are four (4) separate control disgrams for fossil fuel furnaces with heat pumps. One each for gas and oil furnaces with 18HPQ2/H18QS1, 18HPQ2/H24QS1, 24HPQ2/H18QS1, 24HPQ2/H24QS1, 30HPQ4/H3AQ and 36HPQ3/H3AQ, and one each for 42HPQ/H5AQ, 48HPQ2,H5AQ and 60HPQ3/H5AQ.

HEAT PUMP SYSTEM	GAS FURNACE CONTROL DIAGRAM	OIL FURNACE CONTROL DIAGRAM
18HPQ2/H18QS1 18HPQ2/H24QS1 24HPQ2/H18QS1 24HPQ2/H24QS1 30HPQ4/H3AQ1 36HPQ4/H3AQ1	CDG-1	CDO-1
42HPQ/H5AQ 48HPQ2/H5AQ 60HPQ3/H5AQ	CDG-2	CDO-2

CFM FOR ADD-ON HEAT PUMPS

The furnace that you are going to add a heat pump to must be able to deliver enough air to satisfy the heat pump's requirements, usually 400 CFM/Ton.

When the heat pump is in the heating mode, the indoor coil becomes the condensing coil, this is why the amount of air is so critical. Not enough air results in too high of high side pressures and temperatures. The furnace CFM can be calculated by using the following formula:

$$\text{CFM} = \frac{\text{Output (Btu/h)}}{1.08 \times \text{Temp. Rise}}$$

When adding a heat pump to an existing GAS FURNACE, proceed as follows to determine the gas input to the furnace. Shut off all other gas appliances in the home, then set the indoor wall thermostat to call for heat. Go to the gas meter and clock the gastest moving dial, then refer to the chart below.

Seconds for one Rev.	¼ cu ft	½ cu.ft	1 cu.ft	2 cu ft	5 cu.ft.
10	90	180	360	720	1800
11	82	164	327	655	1636
12	75	150	300	600	1500
13	69	138	277	555	1385
14	64	129	257	514	1286
15	60	120	240	480	1200
16	56	113	225	450	1125
17	53	106	212	424	1059
18	50	100	200	400	1000
19	47	95	189	379	947
20	45	90	180	360	900
21	43	86	171	343	857
22	41	82	164	327	818
23	39	78	157	313	783
24	37	75	150	300	750
25	36	72	144	288	720
26	34	69	138	277	692
27	33	67	133	267	667
28	32	64	129	257	643
29	31	62	124	248	621
30	30	60	120	240	600
31			116	232	581
32	28	56	113	225	563
33	–	·	109	218	545
34	26	53	106	212	529
35	–		103	206	514

Seconds for one Rev.	¼ cu ft.	½ cu.ft.	1 cu.ft	2 cu ft	5 cu ft
36	25	50	100	200	500
37		–	97	195	486
38	23	47	95	189	474
39			97	185	462
40	22	45	90	180	450
41		–	-	176	439
42	21	43	86	172	429
43	-		-	167	419
44	-	41	82	164	409
45	20	40	80	160	400
46		–	78	157	391
47	19	38	76	153	383
48	–		75	150	375
49	–			147	367
50	18	36	72	144	360
51		–	–	141	355
52	·		69	138	346
53	17	34	·	136	340
54	--		67	133	333
55	-	–	·	131	327
56	16	32	64	129	321
57			–	126	316
58		31	62	124	310
59		·	--	122	305
60	15	30	60	120	300

Example: Most gas utilities use 1000 Btu per cubic foot of gas. If you were to clock the 1 cubic foot dial and found it took 36 seconds for one revolution, then in one hour the furnace would use 100,000 Btu, but we all know that no furnace is 100% efficient, so suppose we assume this furnace to be 70% efficient, then we should have approximately 70,000 Btu per hour output. Using that figure our formula would look like this:

$$\text{CFM} = \frac{\text{Output}}{1.08 \times \text{T.R.}} \quad \text{or} \quad \text{CFM} = \frac{70,000}{1.08 \times ?}$$

We must still obtain a temperature rise through the furnace. This is done by measuring the return air temperature and the supply air temperature. Let's again assume we were able to measure a 60°F temperature rise through the furnace. Now we can complete our formula.

$$\text{CFM} = \frac{70,000}{1.08 \times 60} \quad \text{or} \quad \text{CFM} = \frac{70,000}{65}$$

Then, our CFM for this furnace would be 1076 CFM.

If the furnace is equipped with a direct drive motor, make sure you have it wired to the high speed tap. If it is a belt drive motor, then read the motor's nameplate amps. Then, hook on an amp probe and see if it is possible to speed the blower up by adjusting the variable pulley.

If you are at the limits of the motor, then check with the furnace manufacturer to see if a larger horsepower motor can be installed and also if the blower will give you the needed CFM with a larger motor.

When you have determined that your furnace can handle the required CFM for your heat pump, the indoor coil must be installed and your CFM calculation must be rechecked with the coil in place.

When adding to an OIL FURNACE, you must determine what size nozzle the unit has in the burner and then install a pressure gauge in the oil delivery pumps discharge port and set the pressure at 100 psig. An example might be that we find the burner equipped with a one gallon per hour nozzle, operating at 100 psi. This nozzle will deliver one G.P.H. and a gallon of #2 fuel oil has approximately 140,000 Btu of heat.

The 140,000 Btu is our input and again let us assume that this furnace is operating at 70% efficiency. Then our Btu output is 98,000 Btu, and if we use the rule of thumb that an oil furnace should operate with an 85°F temperature rise, then our formula would look like this:

$$\text{CFM} = \frac{98,000 \text{ Btu/h}}{1.08 \times 85°\text{F}} \quad \text{or} \quad \frac{98,000 \text{ Btu/h}}{92} = 1065 \text{ CFM}$$

When adding on to an electric furnace we must also take one more thing into consideration and that is the heat pump coil must be installed on the return side of the electric furnace. To find out what CFM the electric furnace can deliver, we must measure the voltage and amperage of each heating element or Volts x Amp = Watts. The total Watts x 3.4 Btu - Btu Output. An example might look like this with a 15Kw electric furnace.

240 Volts	x 21 Amps	= 5040 Watts
5040 Watts	x 3 Elements	= 15120 Watts
15120 Watts	x 3.4 Btu/Watt	= 51408 Btu

One word of caution, never go by nameplate rating. Always measure volts and amps.

One more item that is different with an electric furnace and that is, never obtain a supply air temperature reading in sight of the electric element (because of the radiant effect). Now our formula looks like this again:

$$\text{CFM} = \frac{51408 \text{ Btu/h}}{1.08 \times 44°\text{F}} \quad \text{or} \quad \frac{51408 \text{ Btu/h}}{48} = 1071 \text{ CFM}$$

"ADD-ON" APPROVED MATCHING COMBINATIONS

OUTDOOR SECTION	INDOOR SECTION
18HPQ2	H18QS1 or H24QS1
24HPQ2	H18QS1 or H24QS1
30HPQ4	H3AQ1
36HPQ4	H3AQ1
42HPQ	H5AQ
48HPQ2	H5AQ
60HPQ3	H5AQ

REQUIRED HOOK-UP COMPONENTS

GAS FURNACE HOOK-UP

H/P SYSTEMS	BARD PART NO.	QTY	DESCRIPTION
18HPQ2, 24HPQ2, 30HPQ4, 36HPQ4	8403-017	1	T874R1129 Thermostat (1)
	8404-009	1	Q674L1181 Subbase (1)
	8408-001	1	A-22 ODT
	8201-007 (2)(3)	1	R8239C1009 or 175-210304-10 Fan Center
42HPQ, 48HPQ2, 60HPQ3	8403-017	1	T874R1129 Thermostat
	8404-009 (1)	1	Q674L1181 Subbase
	8408-001	1	A-22 ODT
	8201-007 (3)	1	R8239C1009 or 175-210304-10 Fan Center
	8201-015	1	184-50114-406 Relay

OIL FURNACE HOOK-UP

H/P SYSTEMS	BARD PART NO.	QTY.	DESCRIPTION
18HPQ2, 24HPQ2, 30HPQ4, 36HPQ4	8403-017	1	T874R1129 Thermostat (1)
	8404-009	1	Q674L1181 Subbase (1)
	8201-007 (3)	1	R8239C1009 or 175-210304-10 Fan Center
	8201-015	1	184-50114-406 Relay
	8408-001	1	A-22 ODT
42HPQ, 48HPQ2, 60HPQ3	8403-017	1	T874R1129 Thermostat
	8404-009 (1)	1	Q674L1181 Subbase
	8408-001	1	A-22 ODT
	8201-007	1	R8239C1009 or 175-210304-10 Fan Center
	8201-015	2	184-50114-406 Relay

ELECTRIC FURNACE HOOK-UP

H/P SYSTEMS	BARD EFC MODEL	BARD PART NO.	QTY.	DESCRIPTION
18HPQ2, 24HPQ2, 30HPQ4, 36HPQ4	EFC10-1, EFC15-1	8403-017	1	T874R1129 Thermostat
		8404-009	1	Q674L1181 Subbase
		8408-001	1	A-22 ODT
	EFC25, EFC30	8403-017	1	T874R1129 Thermostat
		8404-009	1	Q674L1181 Subbase
		8408-001	2	A-22 ODT
42HPQ, 48HPQ2, 60HPQ3	EFC25, EFC30	8403-017	1	T874L1129 Thermostat
		8404-009 (1)	1	Q674L1181 Subbase
		8408-001	1	A-22 ODT
		8201-015	1	184-50114-406 Relay

(1) This stat and subbase combination are manual changeover from heat to cool, and incorporate a non-cycling reversing valve circuit. Alternate parts are 8403-018, T874N1024 thermostat and 8404-010, Q674F1261 subbase which allows automatic changeover from heat to cool and has cycling reversing valve operation.

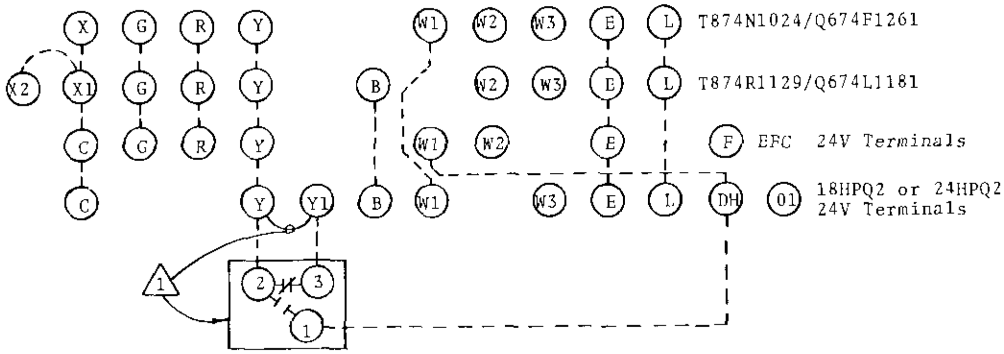
IMPORTANT: Whichever type of operation is desired, the stat and subbase must be matched as shown above.

(2) Not required for gas furnaces factory built with heating/cooling blower relay. Not required for Bard models H81SD3, H81SD3E, H106SD3E, H121SD4, H121SD4E, C106SD3, C106SD3E.

(3) Typical wiring for the 115V connections into the gas or oil furnace are shown on the pages titled "Typical Fan Center Wiring."

CONTROL DIAGRAM
CDEF-1

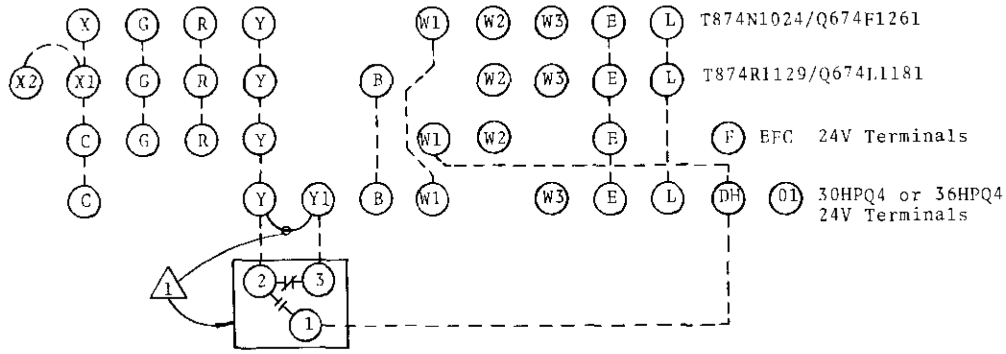
Heat Pump Models
18HPQ2/H18QS1
18HPQ2/H24QS1
24HPQ2/H18QS1
24HPQ2/H24QS1
Matched With EFC10-1



CONTROL DIAGRAM
CDEF-2

Heat Pump Models
30HPQ4/H3AQ1
36HPQ4/H3AQ1

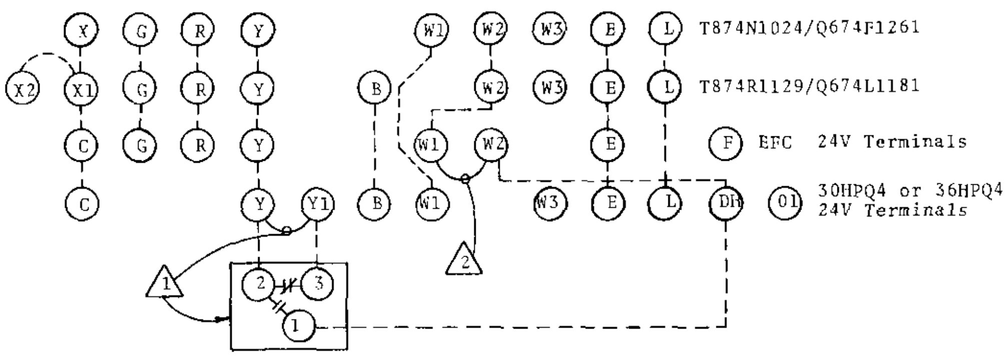
Matched With EFC10-B-1



CONTROL DIAGRAM
CDEF-3

Heat Pump Models
30HPQ4/H3AQ
36HPQ4/H3AQ

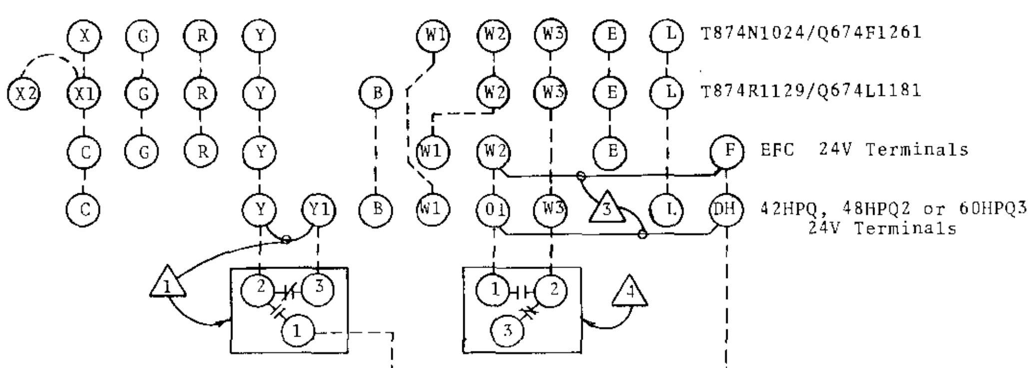
Matched With EFC15-1
or EFC20-1



CONTROL DIAGRAM
CDEF-4

Heat Pump Models
42HPQ/H5AQ
48HPQ2/H5AQ
60HPQ3/H5AQ

Matched With EFC25-1
or EFC30-1

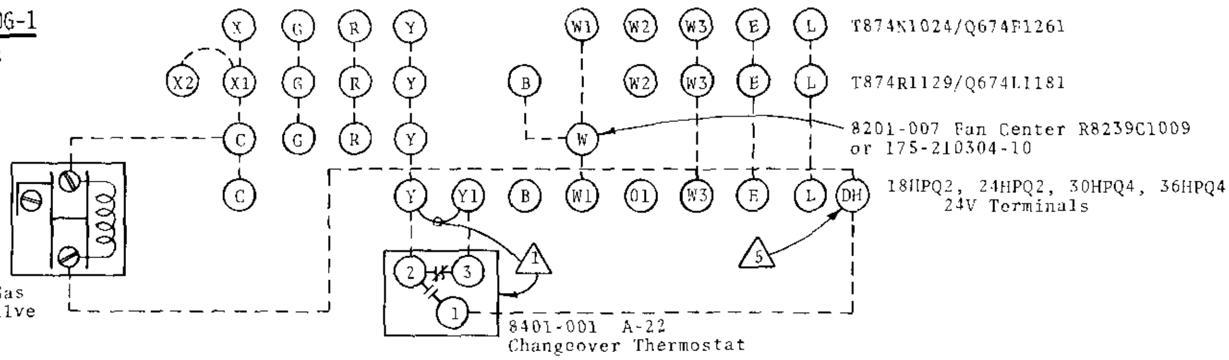


NOTES:

1. If optional compressor cut-off, Part No. 8408-001 or -005 is used, remove jumper Y-Y1.
2. Remove jumper W1-W2 to allow last 5 or 10Kw to operate only during defrost or during compressor cut-off. If jumper is left in place all 15 or 20Kw will operate from 2nd stage of wall stat.
3. Remove jumper W2-F and 01-DH to allow last 5 or 10Kw to operate only during defrost or during compressor cut-off. If jumper is left in place, 15 or 20Kw will operate from 3rd stage ODT. See Note 4.
4. 3rd stage ODT wired as shown will allow 2nd 10Kw stage to be controlled by 2nd stage of wall stat and ODT. If not used, W3 from stat must be connected to W2 at EFC 24V terminals. First 20Kw now controlled as one stage of wall stat. Note 3 still applies.

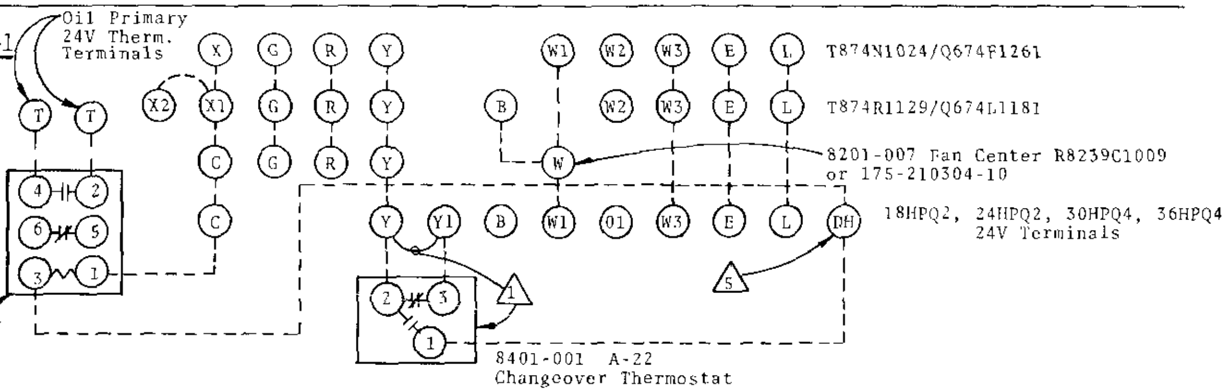
CONTROL DIAGRAM CDG-1

HEAT PUMP MODELS
18HPQ2/H18QS1
18HPQ2/H24QS1
24HPQ2/H18QS1
24HPQ2/H24QS1
30HPQ4/H3AQ1
36HPQ4/H3AQ1
Matched With Gas Furnace



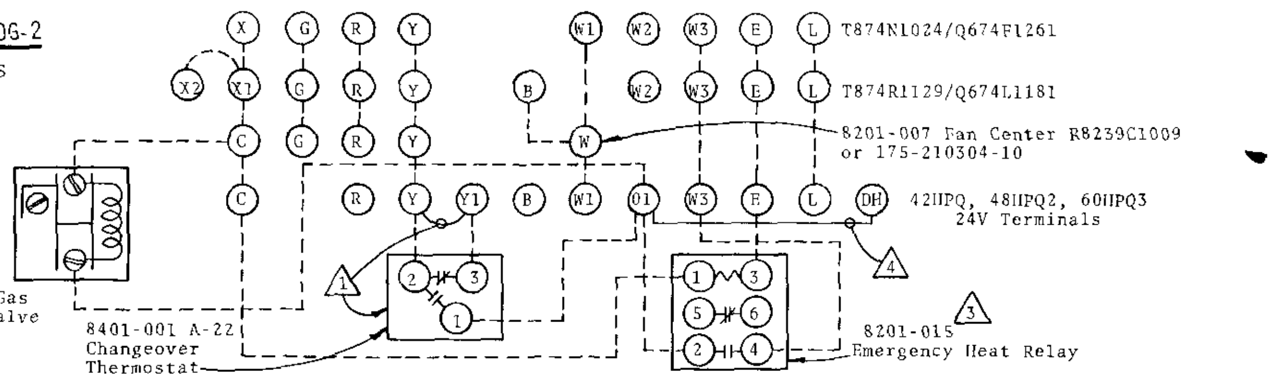
CONTROL DIAGRAM CDO-1

HEAT PUMP MODELS
18HPQ2/H18QS1
18HPQ2/H24QS1
24HPQ2/H18QS1
24HPQ2/H24QS1
30HPQ4/H3AQ1
36HPQ4/H3AQ1
Matched With Oil Furnace



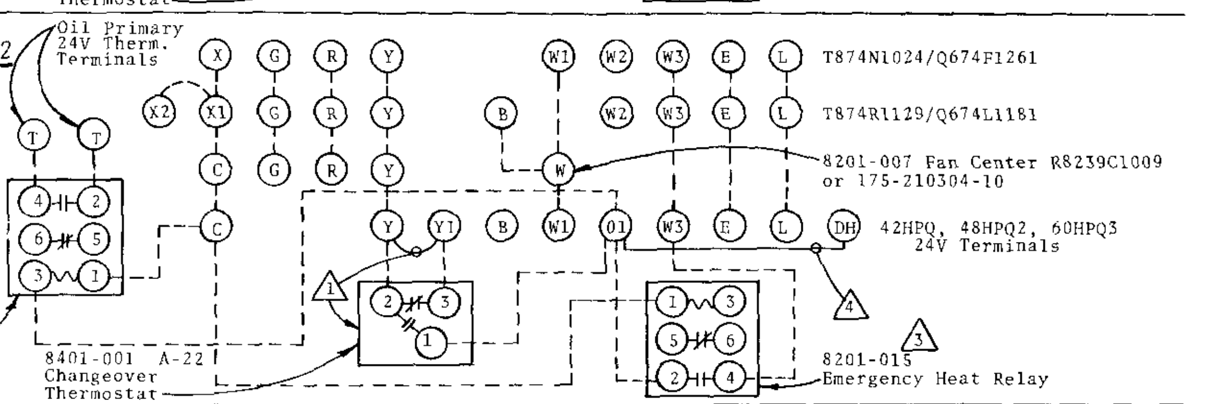
CONTROL DIAGRAM CDG-2

HEAT PUMP MODELS
42HPQ/H5AQ
48HPQ2/H5AQ
60HPQ3/H5AQ
Matched With Gas Furnace



CONTROL DIAGRAM CDO-2

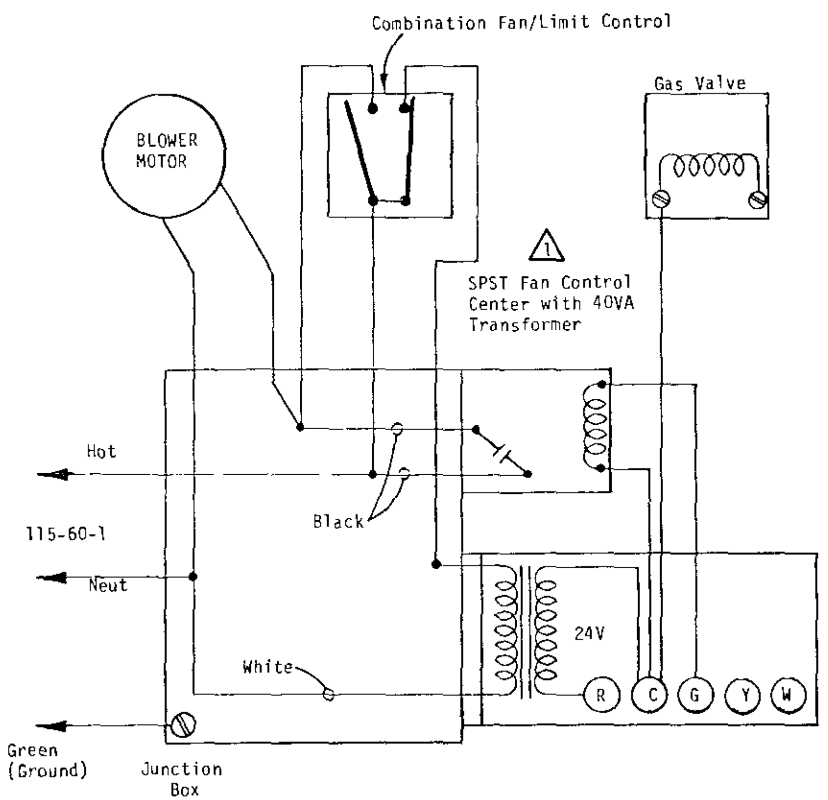
HEAT PUMP MODELS
42HPQ/H5AQ
48HPQ2/H5AQ
60HPQ3/H5AQ
Matched With Oil Furnace



NOTES:

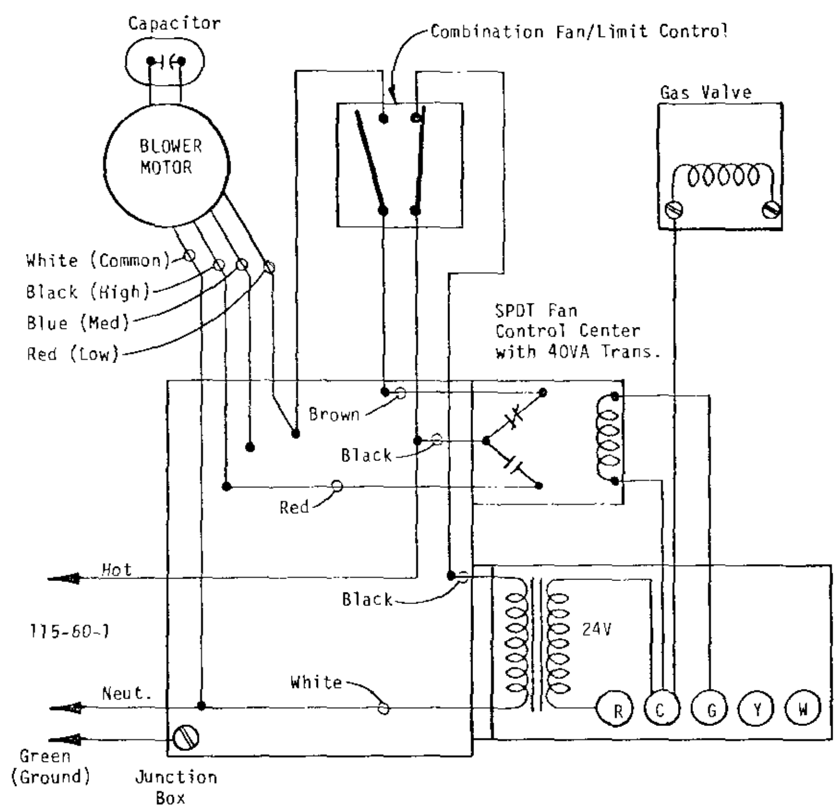
1. 8401-001 outdoor thermostat, range +10 to +45°F. Normally set at 40-45°. Changes operation from heat pump to fossil fuel furnace as outdoor temperature falls below set-point. Cut-in approximately 5°F differential (switches on temperature rise approximately 5°F above set-point). Locate in outdoor unit control box, leaving sensing capillary coiled at thermostat (make sure it does not touch any electrical terminals). See section "Gas or Oil Furnace Applications" before any other setting is used. Remove Jumper Y-Y1.
2. 8201-015 relay used as isolating relay. Necessary to separate 24V power supply of heat pump from 24V supply built into oil burner primary control. Locate in outdoor unit control box.
3. 8201-015 relay used as emergency heat relay. Locate in outdoor unit control box.
4. Remove this wire if it is desired NOT to allow furnace to cycle "on" during defrost cycles. See section in manual on "Defrost Cycles."
5. If it is desired to NOT allow furnace to cycle "on" during defrost, a 24V factory wire between terminal 3 of defrost relay and terminal 4 on Emergency Heat Relay must be removed. See section in manual on defrost cycles.

TYPICAL APPLICATION — GAS FURNACE WITH SINGLE SPEED MOTOR



Remove original (existing) 24V transformer from furnace.

TYPICAL APPLICATION — GAS FURNACE WITH MULTI-SPEED MOTOR



TYPICAL APPLICATION — OIL FURNACE