INSTALLATION INSTRUCTIONS

SPLIT SYSTEM
HEAT PUMP COIL ONLY
INDOOR SECTION

FOR USE WITH:

OIL
GAS
FURNACES

INDEX

INDEX OF FIGURES AND TABLES

SPLIT SYSTEM
HEAT PUMP EVAPORATOR COIL INSTALLATION INSTRUCTIONS

GENERAL

The indoor cooling coils are designed for use with outdoor section listed in Table 2. They are designed for use with gas or oil furnaces. Optional coil casing plenums are also available.

These instructions cover the indoor coil sections listed in Table 2, all of which are supplied less blower. The outdoor compressor units shown can also be matched with blower coil indoor sections, and those are covered by separate installation manuals shipped with the respective blower coil units.

TABLE 1

COIL DIMENSIONS (Inches)					
Coil	A	B	C	Drain Pan Opening (W&L)	Coil Type
H18QS1	13	20-1/2	17	None	Slant
H24QS1	13	23	18	None	Slant
H3AQ1	18	20-1/2	16-1/2	12-1/4 & 15-1/4	"A"
H4AQ1	23-3/4	24-7/8	20-1/4	12-1/8 & 19-3/4	"A"
H5AQ1	23-3/4	24-7/8	24	12-1/8 & 19-3/4	"A"

TABLE 2

APPROVED MATCHED COMBINATIONS, RATED CFM STATIC PRESSURE DROP ①				
Condensing Unit Model Number	Evaporator Coil Model Number	CFM	Rated Airflow Pressure Drop "H2O" ②	Recommended Air Flow Range
18HPQ5	H18QS1 ③	625	.25	550 - 675
	H24QS1 ③	625	.20	550 - 700
24HPQ5	H18QS1 ③	730	.30	625 - 800
	H24QS1 ③	800	.30	650 - 880
WQS30 WQSD30	H3AQ1 ④	1150	.15	980 - 1250
WQS36 WQSD36	H3AQ1 ④	1250	.25	1025 - 1375
42HPQ4	H4AQ1 ④	1450	.25	1160 - 1575
48HPQ5	H4AQ1 ④	1450	.25	1160 - 1575
60HPQ5	H5AQ1 ④	1800	.25	1600 - 1850
WQS50 WQSD50	H4AQ1	1625	.30	1500 - 1885

① All coils are suitable for up or down airflow direction.
② Measured across the evaporator coil assembly, including drain pan.
③ Coil suitable for horizontal airflow direction.
④ Coil suitable for horizontal airflow direction only when optional horizontal drain pan is used.

FIGURE 1

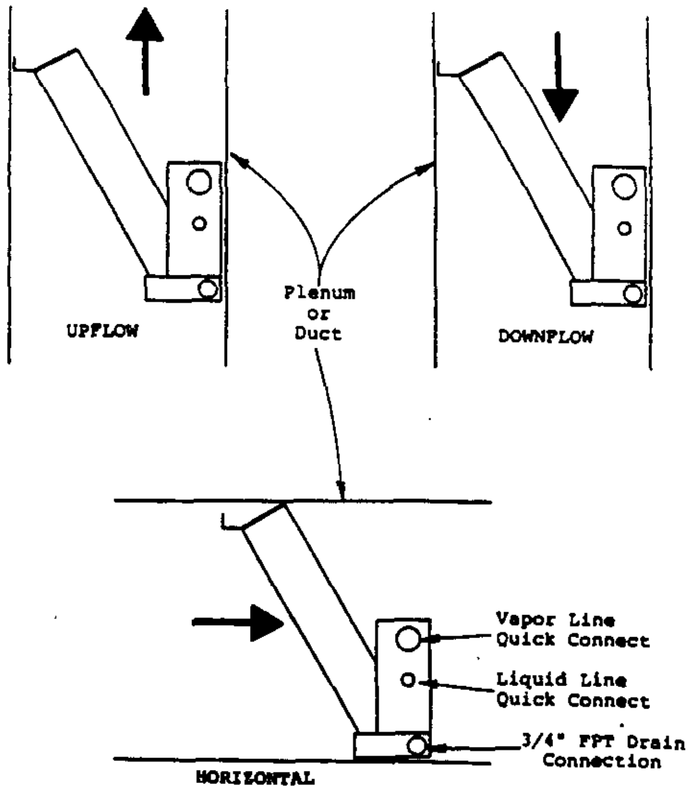
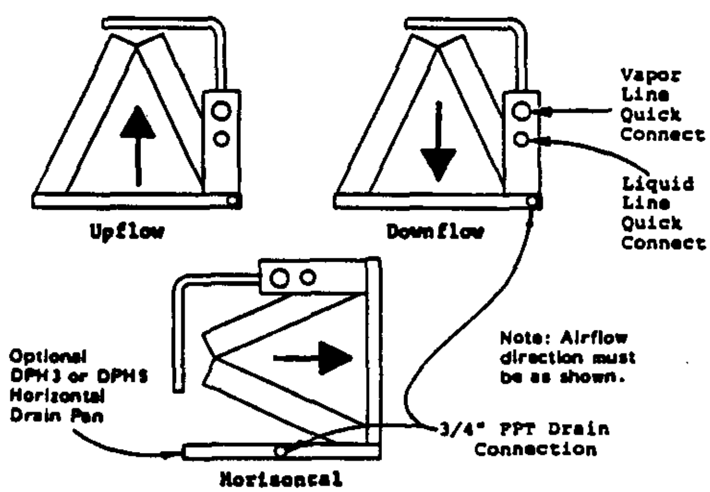


FIGURE 2



CLEARANCES

Every coil must have the required minimum clearance between furnace heater exchanger and bottom of coil, and not exceed a maximum of two inches between the top of coil and bottom of horizontal ductwork.

When the ductwork takes off from only one side of the plenum, the minimum distance from top of coil to top of plenum is six inches.

A duct should never be located between the coil and the source of air supply. If your coil is larger than the top of your furnace, a transition is required with a minimum of three inches.

CAUTION: Be sure to seal area on all sides between coil drain pan and plenum to prevent air from bypassing coil.

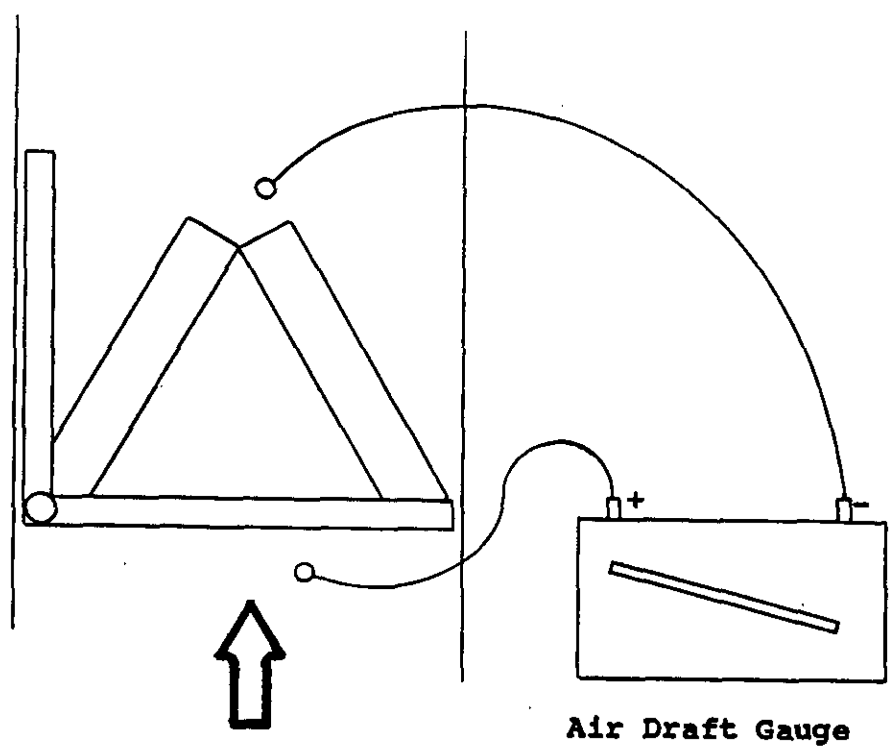
It is important to provide a removable access door in the plenum slightly larger than the coil for servicing or cleaning the coil.

AIRFLOW PRESSURE DROP MEASUREMENT

A manometer or air draft gauge is required to check the air pressure drop across the indoor evaporator coil section.

The pressure (or positive) side of the gauge should connect to the air inlet (entering) side of the coil, and the suction (or negative) side of the gauge to the downstream (leaving) side of the coil. See Figure 3.

FIGURE 3

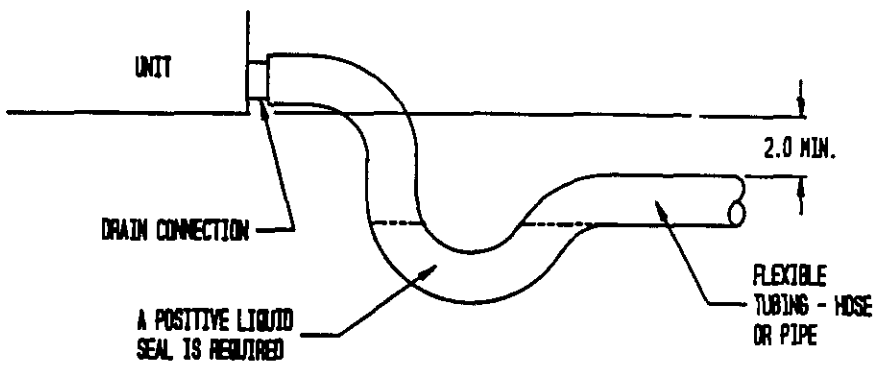


CONDENSATE DRAIN TRAP

It is very important to provide a trap in the condensate drain line to allow a positive liquid seal in the line and assure correct drainage from the coil condensate pan.

Install condensate drain trap shown below. Use drain connection size or larger. Do not operate unit without trap. Unit must be level or slightly inclined toward drain.

FIGURE 4



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.

THERMAL 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 percent 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.

The Fuel Saver Module in conjunction with the wall thermostat will automatically sense and respond to all of the variable factors that influence the heating requirements for any given structure.

DEFROST CYCLE--Heat pumps operating during outdoor temperatures below the low 40 degree 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 refrigeration 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 affect 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 outdoor coil assembly.

IMPORTANT:

Since the size of the fossil furnace is known only to the installer of the system, it is possible that there would 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 pressure and temperature then the compressor protective devices will tolerate and cause tripping of these protective devices.

It is 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 not to allow the furnace to cycle "on" during the defrost period. The Fuel Saver Module wiring diagram shows which 24V wiring connection is not to be made to defeat the supplemental heat during defrost.

ECONOMIC BALANCE POINT--There is an "economic balance point" or "break even point" which can be calculated for all situations based upon actual energy rates for the various fuels and the efficiency ratings of the add-on heat pump and the furnace involved.

Depending upon the local electrical rates and the cost of the other fuel involved, the use of an outdoor thermostat may be desirable to control the changeover from heat pump to furnace at the most cost effective outdoor temperature. The procedure to make this determination is quite simple and outlined below. The tables referenced are located later in this manual, and the same information is also shown in the Fuel Saver Module Installation Instructions. To determine the economic balance point using a module, do the following steps:

1. Locate the table for fossil fuel used by furnace. (Table 3--Natural Gas; Table 4--Propane; and Table 5--Fuel Oil)

2. Now locate the furnace AFUE efficiency rating for the furnace on the bottom of table the heat pump is being matched with.

3. Next draw a line straight up until it intersects the fuel unit cost curve for the fuel in your area. (Fuel unit cost scale on right side of table.)

4. Then draw a horizontal line from the intersection point to the BTUH per $1.00 column on left side of table. You now have determined the BTUH output of heating per one dollar of energy cost for that fuel.

Example 1 (Table 5):

An oil furnace with a 65 percent AFUE efficiency at $1.30 per gallon would equal 70,000 BTUH per dollar of energy (oil) cost.

5. Now go to Table 6 (air source or water source heat pump) and locate the BTUH per dollar (step 4 above) on left side of table. Draw a horizontal line from the BTUH per $1.00 until it intersects the cost per KW in your locality.

6. Then draw a vertical line down to the heat pump COP (Coefficient of Performance) scale at bottom of table. You now have found the lowest COP at which the heat pump should be operated economically.

Example 2 (Table 6):

A 65 percent AFUE efficient oil furnace will supply 70,000 BTUH per dollar of fuel cost, at a fuel cost of $1.30 per gallon. A heat pump also will produce 70,000 BTUH output per dollar at an electric rate of $.06 per kw. The heat pump will produce this at a COP of 1.21.

7. Refer to the "Heating Application Data" section of the heat pump specification sheet to determine at what outdoor temperature the heat pump will produce a 1.21 COP. This temperature is the "Economic Balance Point" at which the outdoor temperature is set at to shut the heat pump off and operate entirely on the furnace.

8. Now set the outdoor thermostat to turn off the compressor at the "Economic Balance Point" temperature determined in (step 7) above.

TABLE 3

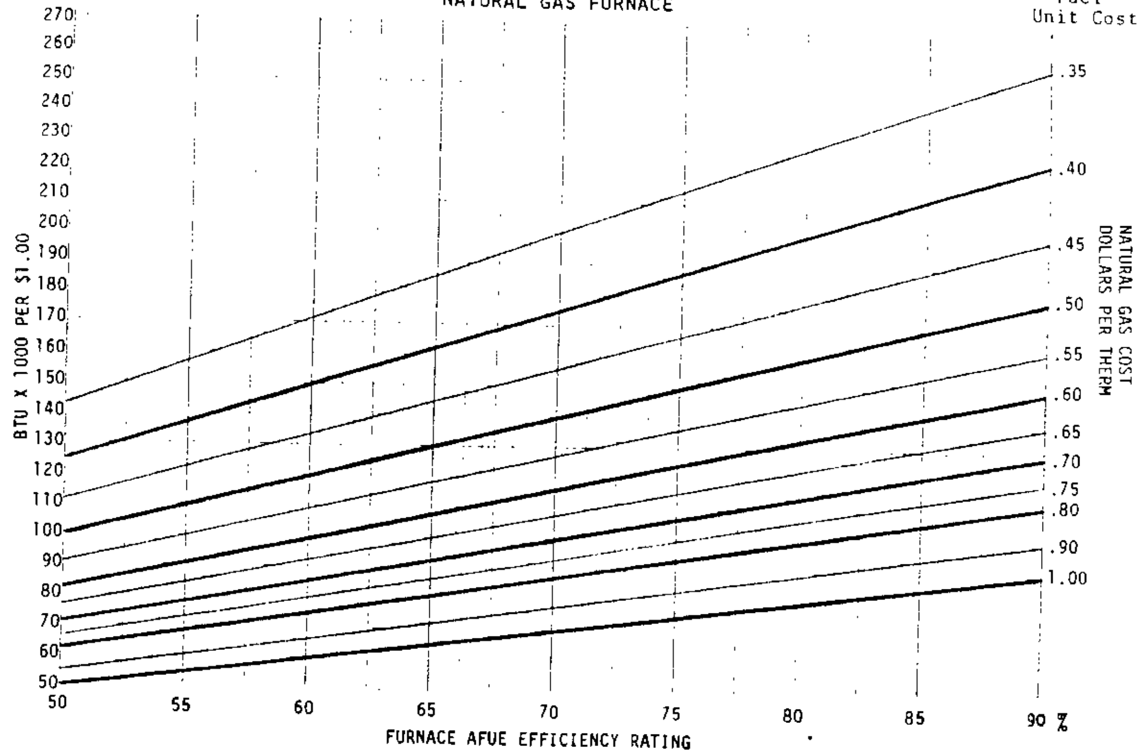


TABLE 4

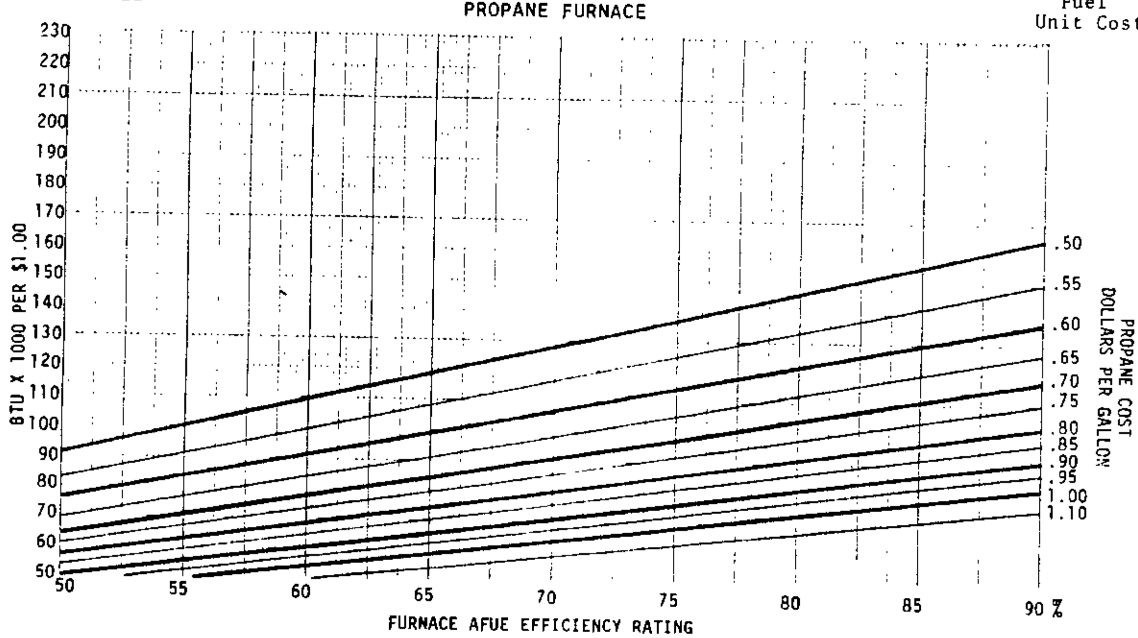
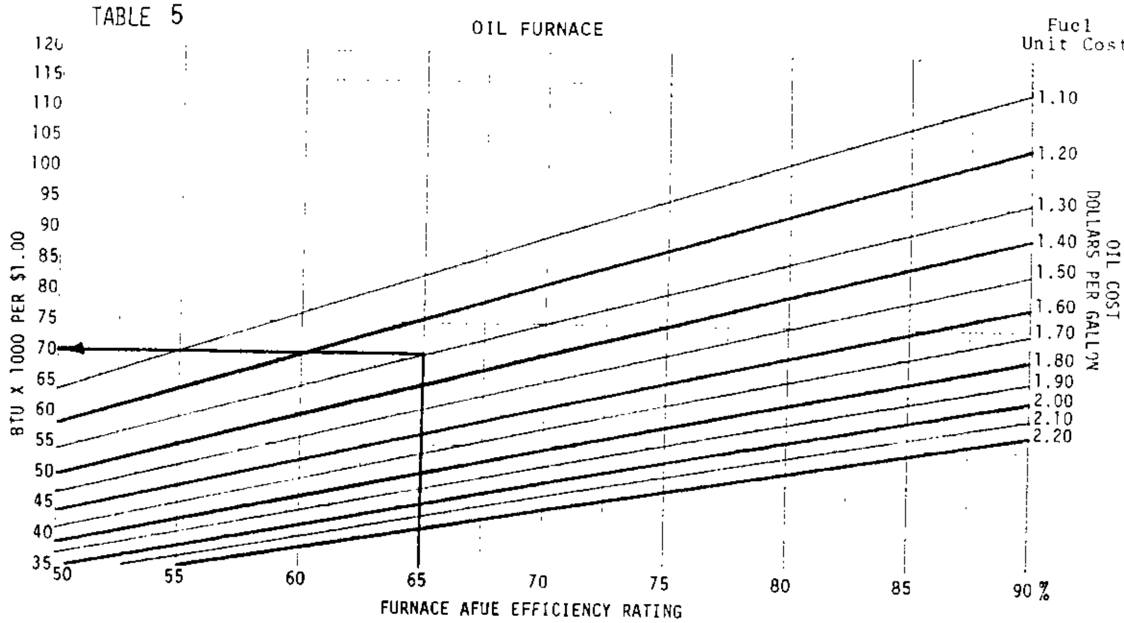
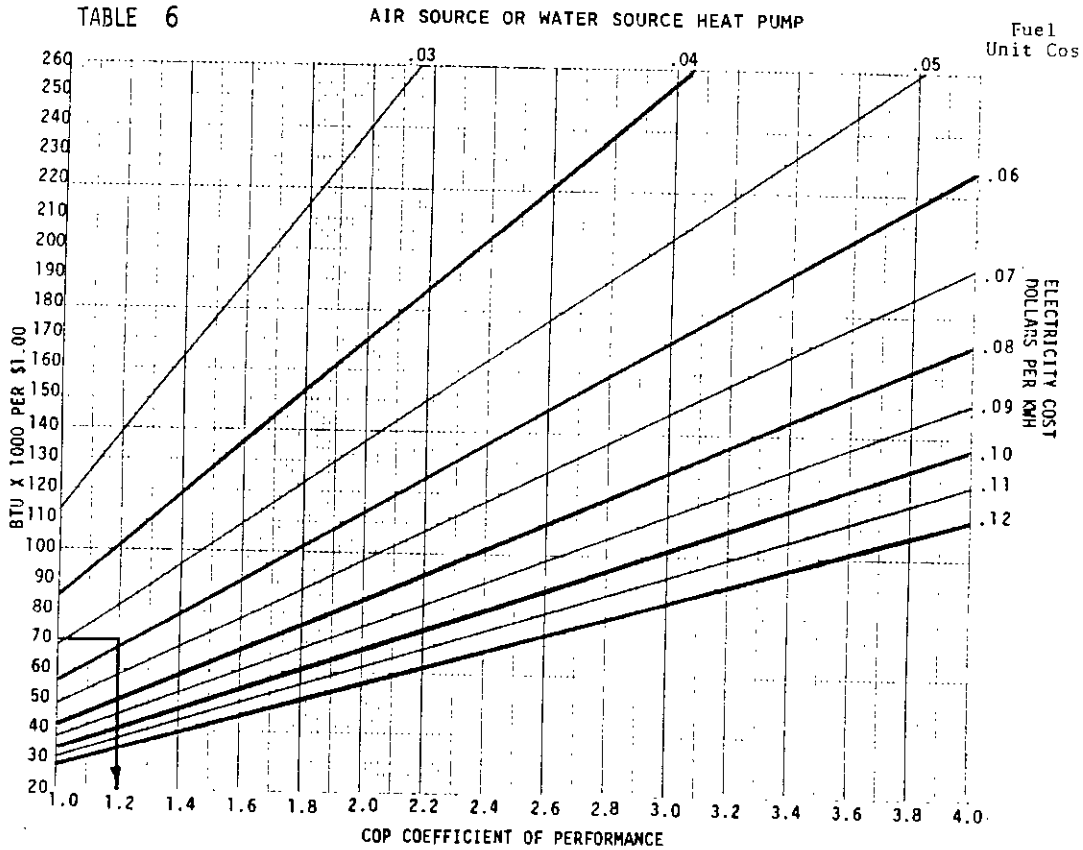


TABLE 5



Example 1. Assume a 65% AFUE oil furnace at $1.30 per gallon.

TABLE 6



Example 2. Determine Economic Balance Point for Heat Pump when used with an oil furnace of 65% AFUE @ $1.30 per gallon for oil from example 1 (oil furnace 70,000 Btuh/$) and electric rate of .06 kWh. A 1.21 COP, heat pump and oil is equal in operating cost.

SEQUENCE OF OPERATION--HEAT PUMP/FOSSIL FUEL FURNACE

1. Fan AUTO-ON function and operation in cooling mode remain the same as in any air conditioning or heat pump system.

2. When in heating mode, each initial call for heat will place heat pump in operation.

3. If the heat pump cannot handle the heating requirements of the structure during any given cycle, the space temperature will begin to drop. If it drops approximately 1-1/2 degree F, the second stage of the wall thermostat will activate the Fuel Saver Module, turning off the heat pump and starting the furnace.

4. The furnace will continue to operate, supplying heat until the wall thermostat (both stages 1 and 2) are satisfied. When the thermostat is satisfied, the module resets and the next call for heat will start over with heat pump operating as the primary heating system and the furnace on standby as described above.

5. The module allows for activation of the furnace during the defrost cycle of the heat pump "if desired." It is usually desirable to provide this supplemental heat during the brief defrost cycle period to avoid discharging cool air into the building. A complete discussion on this subject can be found in the installation instructions packaged with the Add-On Heat Pump Coil. Connection of a single 24V wire at the module will allow the furnace to cycle on during the defrost cycle. Refer to module wiring diagram.

6. "Emergency heat" function is available on command from the wall thermostat. This locks out the heat pump from operating under any condition and allows furnace operation only. Only during "emergency heat" operation is the heating system under control of the second stage of wall thermostat and in this mode of operation structure is controlled at 1-1/2 degree F below thermostat set point.

IMPORTANT: Only in emergency heat mode does furnace blower operate from combination fan/limit switch in furnace. In all other modes, the furnace blower is controlled by the cooling blower relay and starts as soon as there is a call for heat or cool operation. There is additional information on "Indoor Blower Operation" contained in the installation instructions for the add-on heat pump coil.

7. Any time the wall thermostat is set for heating and a large change to a higher temperature setting is made or the system is turned on after being off and the actual space temperature is lower than the thermostat set point, the second stage will be closed (calling for heat) and the control system will lock out the heat pump and activate the furnace until the desired space temperature is reached. At that time, the control system will reset and the next call for heat will again be heat pump.

CONTROL CIRCUIT WIRING--FUEL SAVER MODULE

All wiring is 24V. An eight (8) wire color coded thermostat cable is recommended. The electrical connection to the module is quite easy. Simply cut the thermostat cable, with the wires coming from the furance connected to the terminal block designated "FURANCE CONNECTIONS", and the wires from the heat pump to terminal block designated "HEAT PUMP CONNECTIONS". Refer to wiring diagram for complete details. The wiring diagram is attached to the cover of the module and a copy is included later in this manual as well as the module instructions.

CFM FOR ADD-ON HEAT PUMP

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:

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

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 fastest moving dial, then refer to the chart below.

EXAMPLE: Most gas utilities use 1000 BTU per cubic foot of gas. If you were to clock the one 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 percent efficient, so suppose we assume this furnace to be 70 percent efficient, then we should have approximately 70,000 BTU per hour output. Using the figure our formula would look like this:

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

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 degree F temperature rise through the furnace. Now we can complete our formula.

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

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

TABLE 7

Seconds For One Rev.	SIZE OF TEST DIAL 1/4 Cu. Ft.	1/2 Cu. Ft.	1 Cu. Ft.	2 Cu. Ft.	5 Cu. Ft.	Seconds For One Rev.	SIZE OF TEST DIAL 1/4 Cu. Ft.	1/2 Cu. Ft.	1 Cu. Ft.	2 Cu. Ft.	5 Cu. Ft.
10	90	180	360	720	1800	36	25	50	100	200	500
11	82	164	327	655	1636	37	--	--	97	195	486
12	75	150	300	600	1500	38	23	47	95	189	474
13	69	138	277	555	1385	39	--	--	92	185	462
14	64	129	257	514	1286	40	22	45	90	180	450
15	60	120	240	480	1200	41	--	--	--	176	439
16	56	113	225	450	1125	42	21	43	86	172	429
17	53	106	212	424	1059	43	--	--	--	167	419
18	50	100	200	400	1000	44	--	41	82	164	409
19	47	95	189	379	947	45	20	40	80	160	400
20	45	90	180	360	900	46	--	--	78	157	391
21	43	86	171	343	857	47	19	38	76	153	383
22	41	82	164	327	818	48	--	--	75	150	375
23	39	78	157	313	783	49	--	--	--	147	367
24	37	75	150	300	750	50	18	36	72	144	360
25	36	72	144	288	720	51	--	--	--	141	355
26	34	69	138	277	692	52	--	--	69	138	346
27	33	67	133	267	667	53	17	34	--	136	340
28	32	64	129	257	643	54	--	--	67	133	333
29	31	62	124	248	621	55	--	--	--	131	327
30	30	60	120	240	600	56	16	32	64	129	321
31	--	--	116	232	581	57	--	--	--	126	316
32	28	56	113	225	563	58	--	31	62	124	310
33	--	--	109	218	545	59	--	--	--	122	305
34	26	53	106	212	529	60	15	30	60	120	300
35	--	--	103	206	514						

If the furnace is equipped with a direct drive motor, make sure you have it wired to 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 No. 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 percent 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 degree F temperature rise, then our formula would look like this:

$$CFM = \frac{98{,}000\ BTU/H}{1.08 \times 85\ degree\ F} \quad or \quad \frac{98{,}000\ BTU/H}{92} = 1065\ CFM$$

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 - 5,040 Watts
5,040 Watts x 3 Elements - 15,120 Watts
15,120 Watts x 3.4 BTU/Watt - 51,408 BTU

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

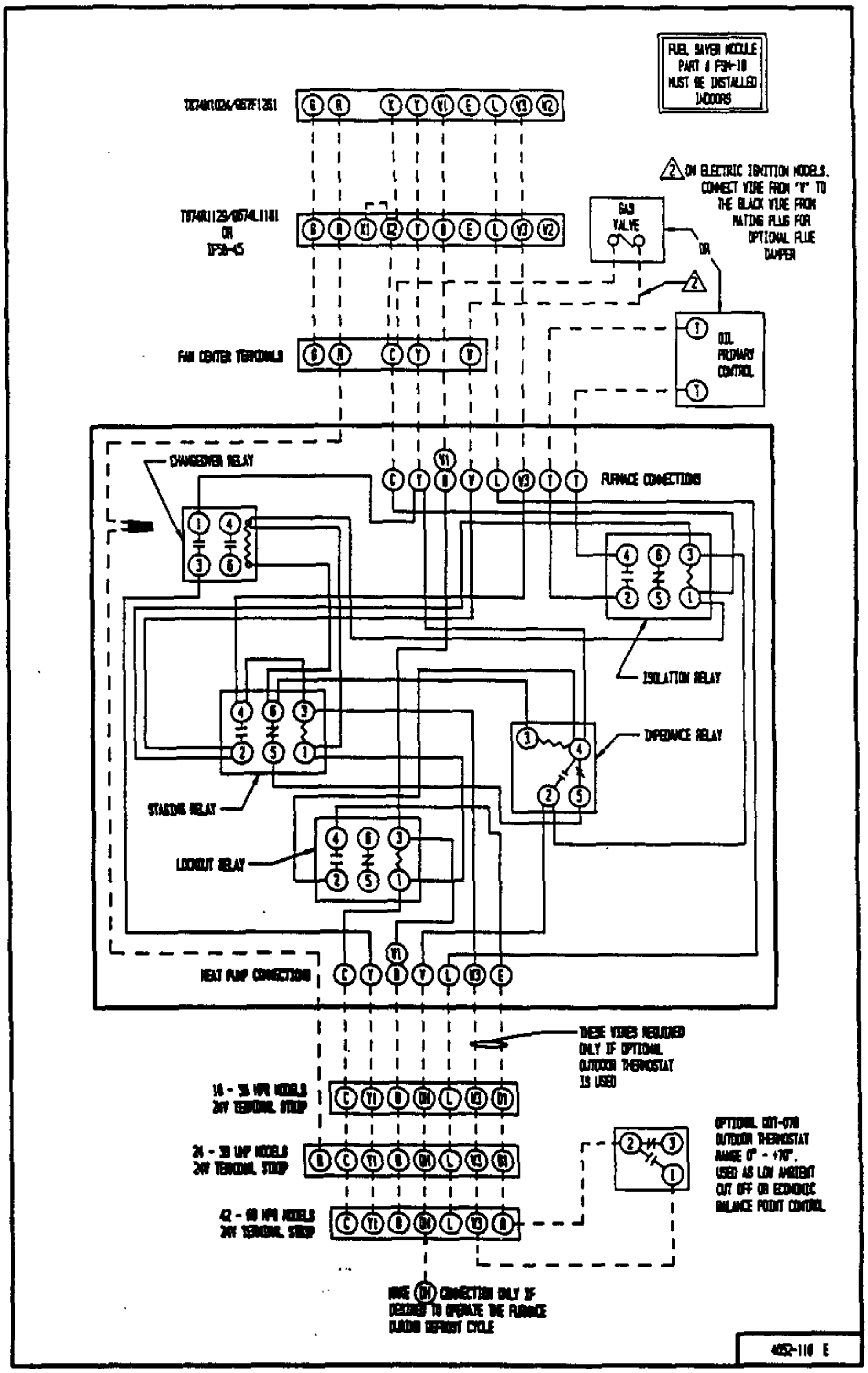
One more item that is different with an electric furnace and that is, never obtain a supply air temperature reading in sight of the electric element (because of the radiant affect). Now our formula looks like this again:

$$CFM = \frac{51408\ BTU/H}{1.08 \times 44\ degree\ F} \quad or \quad \frac{51408\ BTU/H}{48} = 1071\ CFM$$

FSM-1B FUEL SAVER MODULE

WIRING DIAGRAM

FIGURE 5



ALTERNATE WIRING FOR HEAT PUMPS NOT USING FUEL SAVER MODULE

A less economical alternative (from the energy cost standpoint) to the Fuel Saver Module is to use the individual components as shown below and to field install and wire using wire and necessary materials supplied by the installer.

This concept allows for a "fixed" changeover from heat pump to backup furnace system at a single, pre-selected outdoor temperature. Since this temperature setting must be calculated and the changeover control set high enough to compensate for all occupant and weather related variables, it is not as energy conscious as the Fuel Saver Module.

Listed below are the components required to make the necessary electrical connections when the Fuel Saver Module is not used.

CONTROL CIRCUIT WIRING

There are four (4) separate control diagrams for fossil fuel furnaces with heat pumps.

TABLE 8

Heat Pump System	Gas Furnace Control Diagram	Oil Furnace Control Diagram
18HPQ5 24HPQ5	CDG-1	CDO-1
WQS30 WQSD30 WQS36 WQSD36 WQS50 WQSD50	See installation instructions for these models.	
42HPQ4 48HPQ5 60HPQ5	CDG-2	CDO-2

WALL THERMOSTATS

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

TABLE 9

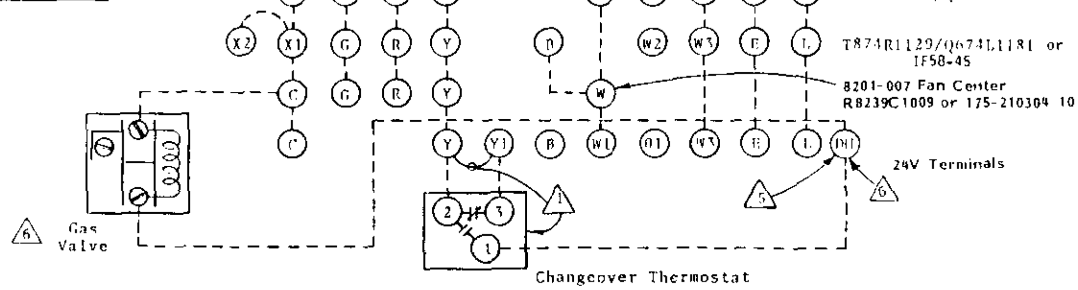
HEAT PUMP THERMOSTATS		
Part No.	Model No.	Description
8403-017	T874R1129	THERMOSTAT--1 stg. cool, 2 stg. heat, 1st stage fixed, 2nd stg. adj. heat anticipators
8404-009	Q674L1181	SUBBASE --System switch: Em. Heat-Heat-Off-Cool Fan switch: On-Auto SPECIAL FEATURE: Manual Changeover (Non-Cycling Rev. Valve) Em. heat light and System check light
8403-018	T874N1024	THERMOSTAT--1 stg. cool, 2 stg. heat, 1st stage fixed, 2nd stg. adj., heat anticipators
8404-010	Q674F1261	SUBBASE --System switch: Off-Cool-Auto-Heat-Em.Ht. Fan switch: On-Auto SPECIAL FEATURE: Auto system changeover, Em. heat light and System check light
8403-024	1F58-45	THERMOSTAT--1 stg. cool, 2 stg. heat, 1st stage fixed, 2nd stg. adj. heater System switch: Em. Heat-Heat-Off-Cool Fan Switch: On-Auto

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

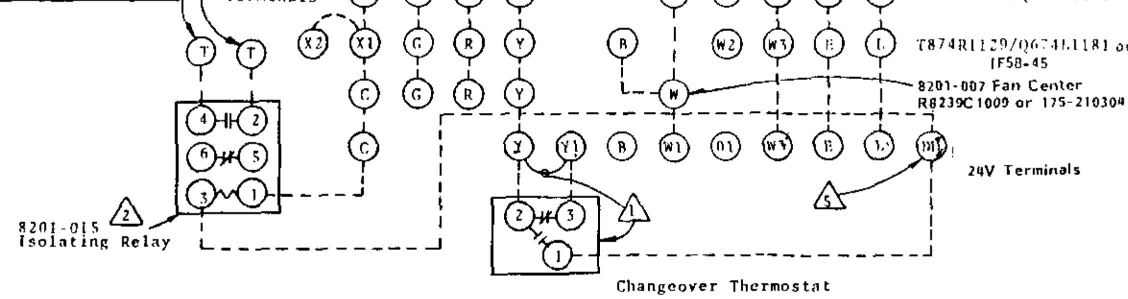
ALTERNATE WIRING FOR HEAT PUMPS NOT USING FUEL SAVER MODULE

FIGURE 6

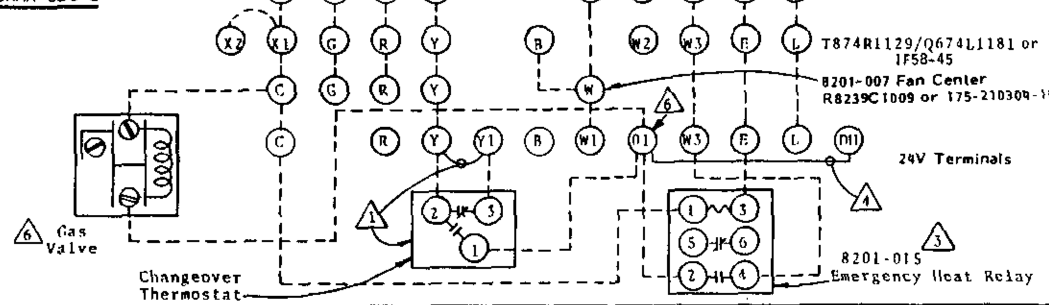
CONTROL DIAGRAM CDG-1



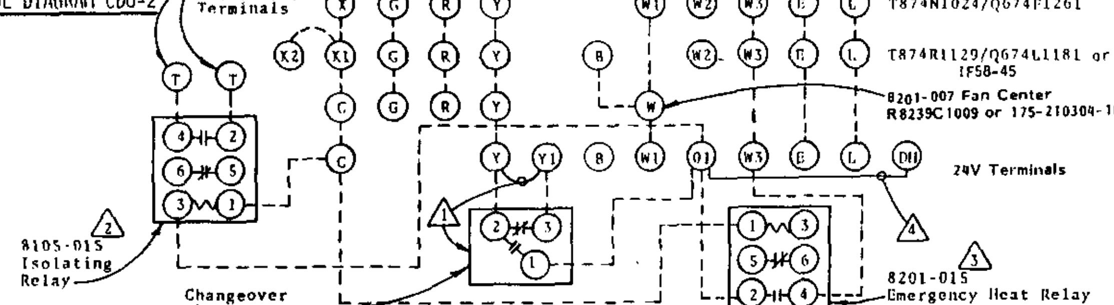
CONTROL DIAGRAM CDO-1



CONTROL DIAGRAM CDG-2



CONTROL DIAGRAM CDO-2



① Outdoor thermostat range 0 to 70 degrees F. Normally set at 40 - 45 degrees F. Changes operation from heat pump to fossil fuel furnace as outdoor temperature falls below setpoint. Cut-in approximately 5 degrees F differential (switches on temperature rise approximately 5 degrees F above setpoint). Locate in outdoor unit control box. See section "Gas or Oil Furnace Applications" before any other setting is used. Remove jumper Y-Y1.

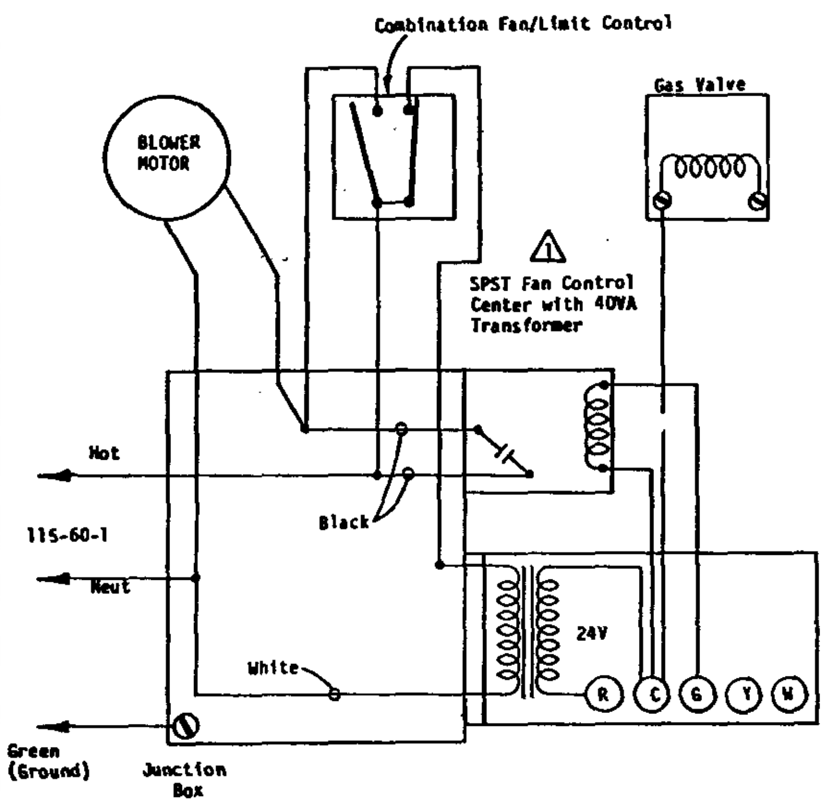
② 8201-015 relay used as isolating relay. Necessary to separate 24V power supply of heat pump from 24V supply built into oil burner primary control. Locate in outdoor unit control box.

③ 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.

④ Gas valve shown is standing pilot. For electric ignition models, make this connection to black wire from mating plug for optional flue damper.

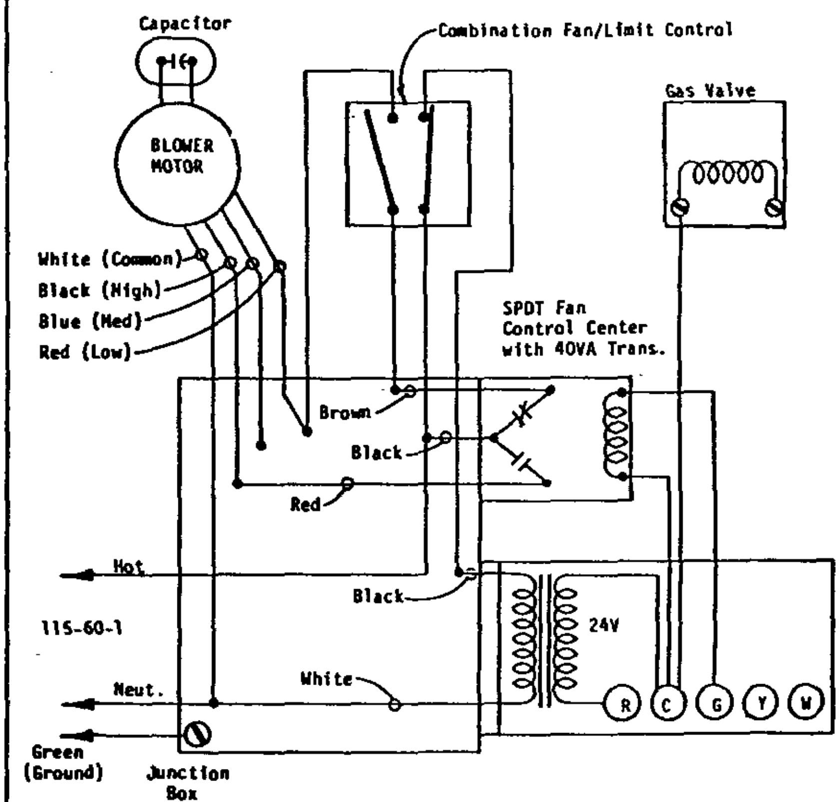
⑤ Connection to "R" terminal on outdoor sections 24UHPQA, 30UHPQA, and 36UHPQA only.

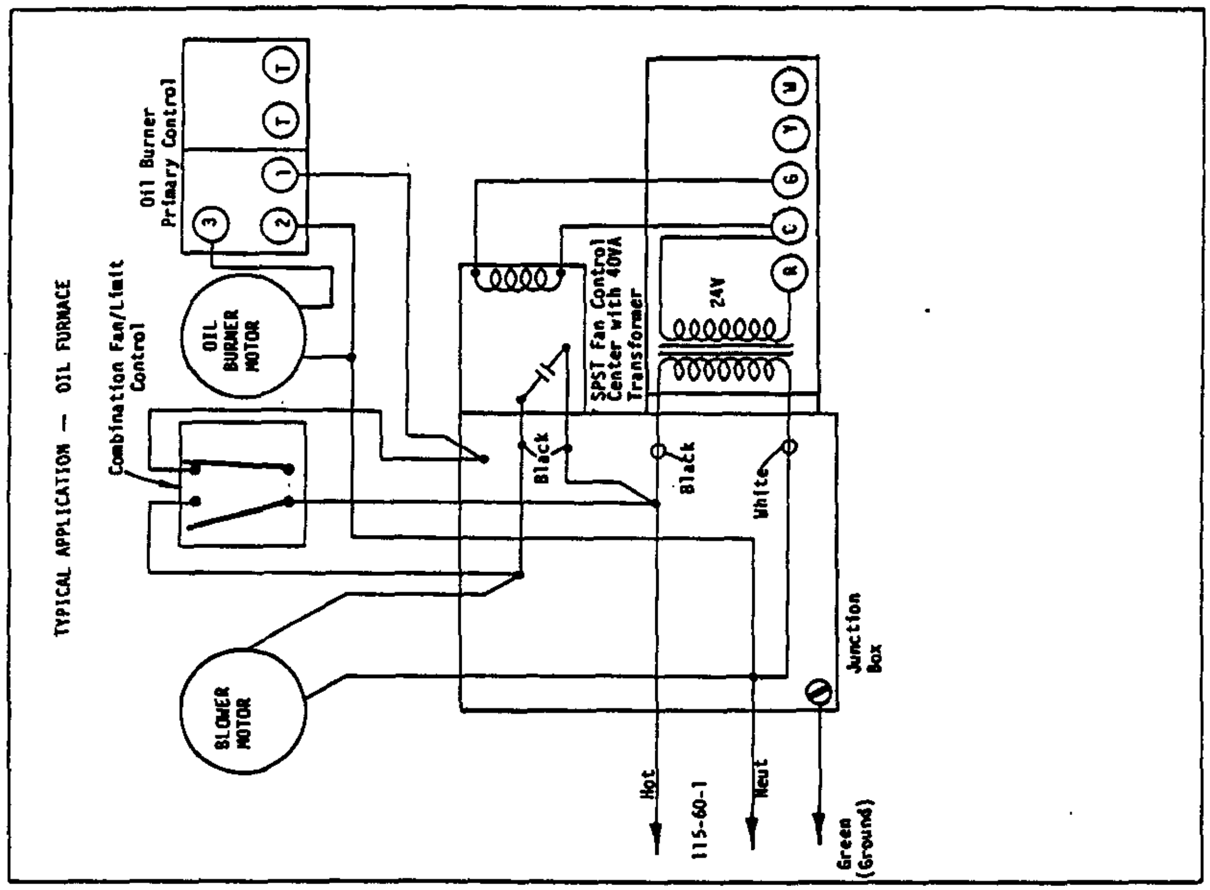
TYPICAL APPLICATION — GAS FURNACE WITH SINGLE SPEED MOTOR



⚠1 Remove original (existing) 24V transformer from furnace.

TYPICAL APPLICATION — GAS FURNACE WITH MULTI-SPEED MOTOR




TYPICAL APPLICATION — OIL FURNACE
Combination Fan/Limit Control
Oil Burner Primary Control
3
2
1
T
T
OIL BURNER MOTOR
BLOWER MOTOR
SPST Fan Control Center with 40VA Transformer
24V
R
C
G
Y
W
Black
Black
White
Junction Box
Hot
115-60-1
Neut
Green (Ground)