Notes on Auxiliary Heat Controls and Thermostats

Section 5 of the PTCS specifications places great emphasis on control of auxiliary ("strip") heat. In many parts of the NW, if the system is sized properly, the ducts are tight, and the airflow is good, the number of hours that backup heat SHOULD operate is expected to be relatively few. The last thing needed in this chain, though, is reliable lockout of auxiliary heat operation when outdoor temperature is relatively mild. "Relatively mild" in PTCS terms is 35° F.

Note we are not talking about use of strip heat on a normal, stage 1 heating call. This is ~~definitely~~ not allowed in the program, whether it is via hard-wiring or the result of a discharge air sensor (discussed below).

Control of auxiliary heat ~~cannot~~ be left up solely to the indoor thermostat through adaptive recovery or similar means. Adaptive recovery is effective if the homeowner does not use deep setback and does not adjust the thermostat frequently during occupied periods. Thermostat studies tend to show, however, that people do all sorts of things with the controls. With heat pumps, this tends to encourage strip heat usage even when it is not needed to keep the house at setpoint. Since PTCS is primarily about energy efficiency, more needs to be done to control strip heat.

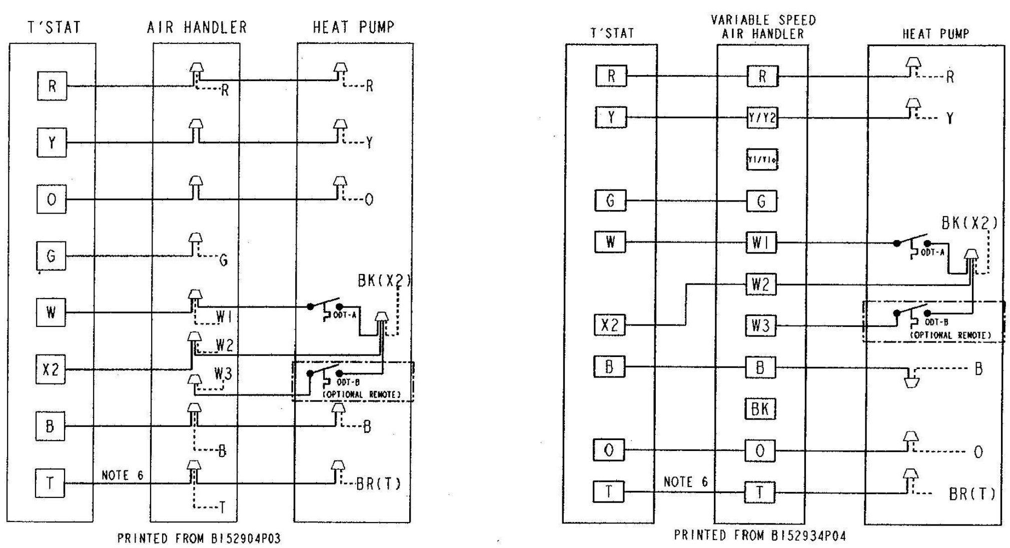
Control will differ depending on the type of thermostat or overall control package. Many newer thermostats are equipped with an outdoor sensor (or it can be added as an option) and the temperature at which the elements can come on is programmed at the thermostat. In these cases, the installer needs to make sure the sensor works (usually by testing resistance vs. measured temperature; a common sensor is a thermistor), hook up the sensor, program in the cut out temp, and then confirm the strips don't operate (assuming the ambient testing temperature is above the cut-out temperature). See table at end of this document for a listing of ohms vs outdoor temperature for the most commonly used sensor. If the ambient temperature is below the cut-out temperature, it will be necessary to warm up the sensor to make sure it has the intended effect.

Another option is use of an after-market close-on-fall switch, whether adjustable or fixed-temperature. The switch must be wired in series with the auxiliary heat circuit, so there needs to be a spare control wire between indoor and outdoor unit to allow this if it is installed in the usual way. The installer must keep this in mind during installation.

Before this control is installed, its operation must be confirmed; the best way to do this is to place its sensing bulb in a solution of ice cubes and dilute salt water (temperature near 32° F), attach an

Ohmmeter between the control terminals, and turn the adjustment dial until the circuit is closed (resistance on ohmmeter goes from infinite to 0 or near 0). If the circuitry does not make/break right around 32° F, the control will have to be exchanged for another control.

TYPICAL FIELD HOOK-UP DIAGRAMS



Notes:
1. Be sure power supply agrees with equipment nameplate.
2. Power wiring and grounding of equipment must comply with local codes.
3. Low voltage wiring to be No. 18 AWG minimum conductor.
4. ODT-B must be set lower than ODT-A.
5. If outdoor thermostats (ODT) are not used, connect W1 to W2 and W3.
6. N/A to programmable thermostat.

LEGEND

- - - - - FACTORY WIRING

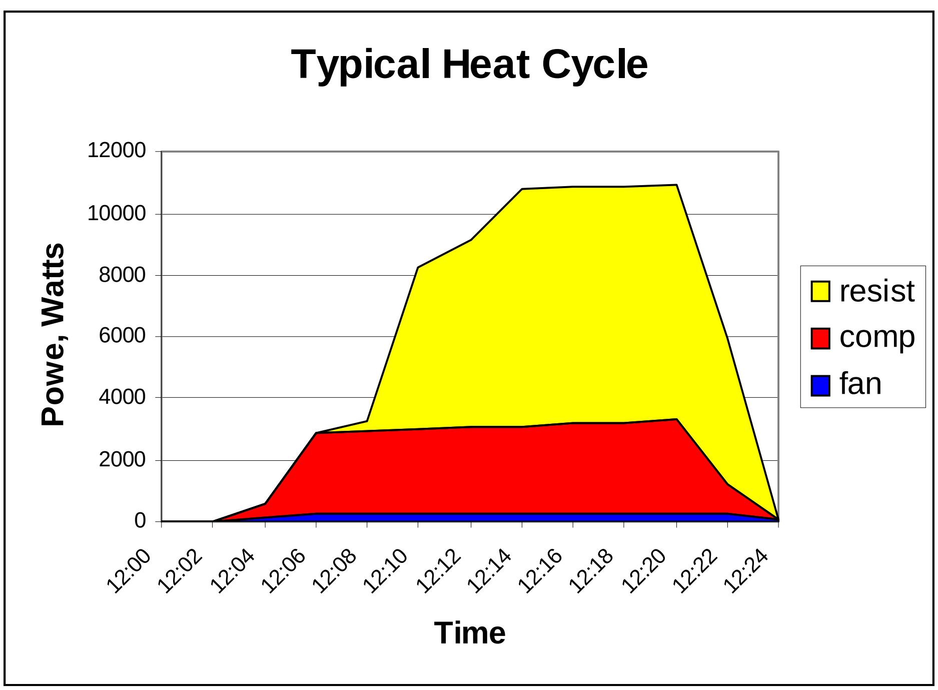
——— FIELD WIRING

Before installation is considered complete, confirm the emergency heat circuit energizes the strips. Also, as part of this installation, make sure the auxiliary and emergency heat circuits are controlled separately; if they are not, a different thermostat or other wiring work-around will be needed.

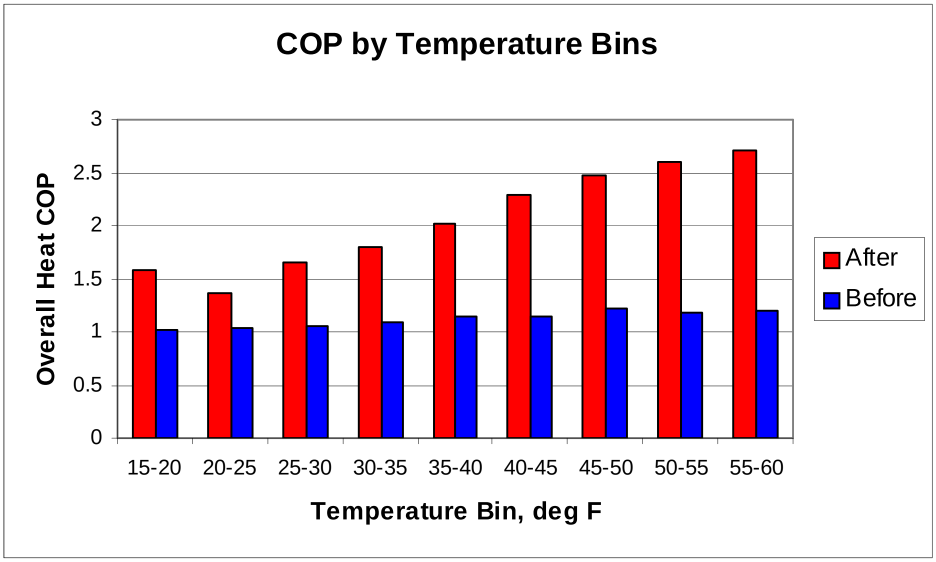
An alternate method of getting the same effect (and one not requiring an extra wire before indoor and outdoor units) is an additional thermostat installed inside the house (and set to 35° F) in series with the auxiliary heat circuit. This is somewhat unorthodox but avoids having to get into the outdoor and indoor unit control wiring.

Some new systems rely on discharge air sensors to control the transition from compressor-only heating. Typically these sensors operate on a 4-5 minute delay before bringing on strip heat. The PTCS specifications do not allow use of these sensors in single-stage compression systems.

The picture (below) shows the effect of including a discharge air sensor control. This site is located in central Oregon. The ducts are tight and well-insulated. The house is very efficient and the heat pump doesn't run very often. The return duct system runs in the attic and (even with R-11 insulation) cools off between cycles.



The COP of this system with the discharge sensor in play was very poor (around 1, or close to the COP of electric resistance alone). When the discharge sensor was disabled, the house stayed at setpoint and the COP improved to what is expected for a heat pump.



On systems with multiple compression stages or air zones, discharge sensors are often required. In these cases, PTCS offers two paths for meeting specifications. First is to use a maximum setting of 85° F for the sensor to maximize compressor-only heating. If a warmer staging temperature is chosen, an outdoor thermostat or equivalent control must be installed to keep strip heat off when outdoor temperature is above 35º F.

If a zoning control is used, follow instructions to make sure dampers open properly (since they can be wired backward). If the system depends on a discharge air sensor for staging, it may be necessary to cool down the sensor to get both stages of compression in multi-stage systems.

Thermostats have changed drastically in the last couple of years. Honeywell and others have introduced touch-screen technology to the residential and commercial markets and it is proving very successful, primarily because of ease of programming and adjustment. The price point (around $100) is also attractive. In addition, communicating (three or four wire) thermostats are becoming more popular. Whichever thermostat is chosen, it is critical to assure proper operation of Stage 1 heating (compressor-only), Stage 2 heating (usually compressor plus auxiliary heat but second stage of compressor operation in some systems) and emergency heat. Some of the newer thermostats, most notably the Honeywell TH8321 series, have a dedicated test mode in the installer set-up that can be used. This feature speeds up the performance check.

Table of Resistance (Ohms) vs outdoor temperature for Honeywell C7089B sensor

°F	KΩ
11	61.85
12	59.96
13	58.13
14	56.37
15	54.66
16	53.01
17	51.41
18	49.87
19	48.38
20	46.94
21	45.54
22	44.19
23	42.88
24	41.62
25	40.40
26	39.21
27	38.07
28	36.96
29	35.89
30	34.85
31	33.84
32	32.87
33	31.94
34	31.04
35	30.18
36	29.33
37	28.52
38	27.73
39	26.97
40	26.22
41	25.51
42	24.81
43	24.14
44	23.48
45	22.85
46	22.23
47	21.64
48	21.06
49	20.50
50	19.96
51	19.43
52	18.92
53	18.42
54	17.94
55	17.47
56	17.02
57	16.58
58	16.15
59	15.74
60	15.33
61	14.94
62	14.56
63	14.19
64	13.83
65	13.49
66	13.15
67	12.82
68	12.50
69	12.19
70	11.89
71	11.60
72	11.31
73	11.03
74	10.76
75	10.50
76	10.25
77	10.00
78	9.759
79	9.525
80	9.297
81	9.076
82	8.860
83	8.650
84	8.446
85	8.247
86	8.054
87	7.866
88	7.682
89	7.504
90	7.330
91	7.161
92	6.996
93	6.836
94	6.680
95	6.528
96	6.380
97	6.235
98	6.095
99	5.958
100	5.824
101	5.694
102	5.567
103	5.444
104	5.323
105	5.206