

Heat Pump Thermostats: O/B, AUX vs E, and Dual Fuel

YES Electric • Arc Workforce Academy HVAC Apprenticeship

Draft 1 (October 2026). This lesson is under review. Videos are made by other companies, not YES Electric; follow this lesson and your journeyman where they differ. Boxes marked "Shop photo coming" will get real photos from our shop in a later version.

Unit 6 • Electrical for HVAC II • Appendix A Comp 9 COMPLETES HERE (with 6.3) Class time: ~4 hrs (1 video + 3 bench)

1. What you'll be able to do

- Wire and configure the **heat pump terminal set** beyond 6.3's five: **O/B** (reversing valve), **W2/AUX** (strips WITH compressor), **E** (strips INSTEAD of compressor) — and say what each rung actually energizes.
- Get **O vs B right by brand**: most brands energize the valve in COOLING (= "O", Trane/Carrier/Goodman/Lennox); Rheem/Ruud heritage energizes in HEATING (= "B"). **The wrong setting heats on a cool call** — the scratchpad's trap, now a graded drill.
- Explain why **Y runs in BOTH modes** on a heat pump (compressor always; O/B picks the direction) — the single concept that makes HP diagnosis sane.
- Configure a smart stat for a heat pump completely: system type, O or B, aux type (electric vs the dual-fuel question), compressor & aux lockout temps, cycle rates.
- Wire **dual fuel** correctly: heat pump + gas furnace, never both heat sources together, changeover by stat logic or outdoor sensor (the fossil-fuel-kit world).

2. Tools & materials

- HP training board: stat base (full terminal set) → air handler board w/ strip relay → outdoor unit sim (contactor + reversing valve solenoid + defrost board from the parts wall)
- Donor dual-fuel pair (furnace + HP coil setup) or the sim board; outdoor temp sensor kit
- 18/8 wire stock; the program smart stats; meters

3. Watch first

Order	Video	Channel	Length	Why
1	Heat Pump Thermostat Wiring Explained — Terminals, Circuit Path	AC Service Tech	9:34	The terminal set, decoded
2	Wiring HP Stat → Air Handler → Outdoor Unit	AC Service Tech	15:52	The three-box wiring job
3	Understanding & Wiring HP Stats w/ AUX & E	AC Service Tech	9:25	The two strip terminals split
4	Dual Fuel Hybrid Heat Wiring	AC Service Tech	15:24	The combo system
5	Understanding Dual Fuel w/ Jim Fultz	HVAC School	52:13	The logic, deep
6	HP Stat Testing + Bypass/Jump 6 Combos	AC Service Tech	9:23 / 3:05	Diagnosis + the jumper drill

4. The idea

The expanded terminal contract

HEAT PUMP THERMOSTAT — THE EXPANDED CONTRACT

**O/B SET WRONG
→ HEATS ON A
COOL CALL**

check the **MENU**
before condemning
the compressor

DUAL FUEL RULE

compressor heat and gas
heat **NEVER** together —
changeover at the economic
balance point →

(~35–40°F Birmingham)

Terminal	Energizes	The story
Y	Contactors (compressor) — in BOTH heat and cool	The HP's compressor IS the heater; Y just means "run"
O/B	Reversing valve solenoid	O = energize in COOL (most brands) / B = energize in HEAT (Rheem/Ruud line) — the valve picks the direction (8.1 does the refrigerant side)
G	Indoor blower	Same as 6.3
W2 / AUX	Electric strips WITH the compressor running	Capacity helper when the HP falls behind (and during defrost — 8.2)
E	Strips INSTEAD of the compressor	Emergency: compressor dead/locked out; human-selected at the stat
L/X	Fault light from the defrost board	The "something's wrong outside" messenger

AUX vs E is a philosophy exam: AUX = automatic assistance (stat calls it when stages can't hold); E = manual lifeboat (the customer flips it when the outdoor unit died Saturday night — and pays resistance-heat prices until you arrive, 2.2's math). Wiring them to the same strip bank through different logic paths is normal; KNOWING which path fired is diagnosis (8.3).

O vs B — the trap with a brand map

The valve solenoid (one coil, 3.6's three questions apply) sits in the outdoor unit; the stat's O/B output feeds it. **Configured backwards: a call for cooling parks the valve in heat → hot air on a 95°F day** — and a panicked "compressor's broken!" call that's actually a menu setting. Brand heuristic: see the table; TRUTH source: the unit's diagram (3.7) — the defrost board's terminal marking (O or B) tells you what IT expects. New-equipment reality: almost everything current is O; B survives in Rheem/Ruud heritage and oddball replacements.

Dual fuel — two heat sources, one rule

HP + gas furnace (the 1.7 type 5): heat pump handles mild weather (cheap heat, 2.2's COP math); gas takes over below the **economic balance point**. THE RULE: **compressor heat and gas heat never run together** (the furnace's heat exchanger would dump hot air across the indoor coil = head pressure spike = compressor abuse). Implementation: a **dual-fuel-capable stat** (configured: aux type = furnace, changeover temp w/ outdoor sensor) or a **fossil fuel kit** between a standard HP stat and the furnace. The changeover temp is a DECISION (gas price vs kWh — we set ~35–40°F default in Birmingham and tell the customer why), not a factory constant.

Configuration completeness (the 8.4 preview)

System = heat pump → O or B → aux type → **compressor lockout** (below X°F use aux only — efficiency choice) and **aux lockout** (above Y°F never strips — bill protection) → cycle rate. The

defaults are wrong for half of installs (the line); the five menu items take four minutes and define the system's whole personality.

5. Bench procedure

1. **Terminal mapping:** wire stat → AHU board → outdoor sim on the training board: full 8-wire hookup, every wire narrated by FUNCTION. Meter-verify O/B output in each mode.
2. **The O/B trap, lived:** instructor flips the config to B on the O-expecting sim → student runs a cool call, reads the valve energized... in heat → diagnoses from SYMPTOM (warm air, normal pressures-reversed) back to the menu. The drill that inoculates.
3. **AUX vs E paths:** force each: watch AUX bring strips WITH Y still held; watch E drop Y and run strips alone. Clamp the sim's "strip" load both times; narrate the philosophy.
4. **Dual-fuel wiring:** the donor pair with the fossil-fuel kit OR native dual-fuel stat: wire, set changeover at 38°F, then chamber-test (sensor in ice water vs warm hand): watch the source swap, verify the never-both rule with both "heat" loads metered.
5. **The jumper drill (the 3:05 video):** at the AHU board, jump the 6 combos (R-Y, R-G, R-O...) to drive functions WITHOUT a stat — the field triage skill that splits "stat problem" from "equipment problem" in two minutes.
6. **Full smart-stat config:** the five menu items set for a stated scenario ("Birmingham, all-electric, customer hates high bills") — defend each choice.

Checkout: unaided full HP stat wiring + config on the board (scrambled colors, naturally) + the O/B trap caught from symptoms + one dual-fuel changeover demonstrated. **Comp 9 SIGNED (full).**

6. Field gotchas

- **"New thermostat, now it blows hot in cool mode"** = O/B config, 95 times in 100. Check the menu before the truck leaves the driveway.
- **Strips running with the compressor in mild weather** (the \$600 bill call): stuck sequencer (8.3), mis-set aux logic, or a stat calling AUX on a 2°F droop — config + clamp finds it.
- **E selected and forgotten** after last winter's "emergency": the bill arrives in March. Check the mode switch FIRST on high-bill calls.
- **Dual fuel without the interlock** (both heat sources together): head pressure trips, melted supply plenums in bad cases — never leave a dual-fuel job without proving the never-both rule.
- **8-wire minimum for heat pumps** (R C Y G O/B W2 E + spare) — the 5-wire existing pull means a kit or a fish (6.3's clinic), plan the quote accordingly.
- **L terminal ignored** = the customer's "little light" that's been on since 2024 was the defrost board waving. Ask about lights.

7. Competency link

- **Comp 9 — SIGNED (full)** (6.3 conventional + 6.4 heat pump).
- Direct feed: 8.2 (defrost calls W2 itself), 8.3 (strip staging), 8.4 (the system-level wiring walk), dual-fuel returns in 8.7's capstone options.

8. Check yourself

1. Why does Y run in both modes on a heat pump, and what actually picks the direction?
2. O vs B: define each, name the brand camps, and the truth source when unsure.
3. The backwards-O/B symptom on a cooling call — and where the fix lives.
4. AUX vs E — the philosophy split, who/what triggers each, and what each costs to run (2.2).
5. Which terminal still runs the compressor during AUX? During E?
6. Dual fuel's one rule and the physical reason behind it.
7. What sets the changeover temperature, and our Birmingham default + rationale?
8. The five config items and one wrong-default consequence each.
9. Jumper triage: which combo proves the blower? The reversing valve? Compressor?
10. High-bill February call on an all-electric HP: your first three checks, in order.

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