

Thermostat Wiring: Conventional R/W/Y/G/ C + Adding a C Wire

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 — "Wire and replace thermostats and basic low-voltage controls" — SIGNS over 6.3 + 6.4 **Class time:** ~4 hrs (1 video + 3 bench)

1. What you'll be able to do

- Recite and wire the **conventional letter code** cold: **R** (24 V hot), **C** (common), **Y** (cooling/compressor), **G** (fan), **W** (heat) — plus Rc/Rh splits and Y2/W2 staging.
- **Replace any conventional thermostat** with the professional ritual: photo → label wires → kill 24 V → swap base → land by FUNCTION not color → configure → test every mode.
- Solve the **no-C-wire problem** three ways and pick correctly: spare conductor in the bundle, an add-a-wire/Fast-Stat kit, or a new 18/5+ pull (the fishing video's craft).
- Wire from scratch: furnace board → stat, condenser hookup (Y+C to the contactor — 3.6 full circle), with drip loops, staples that don't bite, and a labeled base.
- Diagnose the classics: blank stat (dead C/power — 3.4's fuse first), heat-but-no-cool (Y path), fan-always-on (G short or switch), wrong-terminal disasters from previous owners.

2. Tools & materials

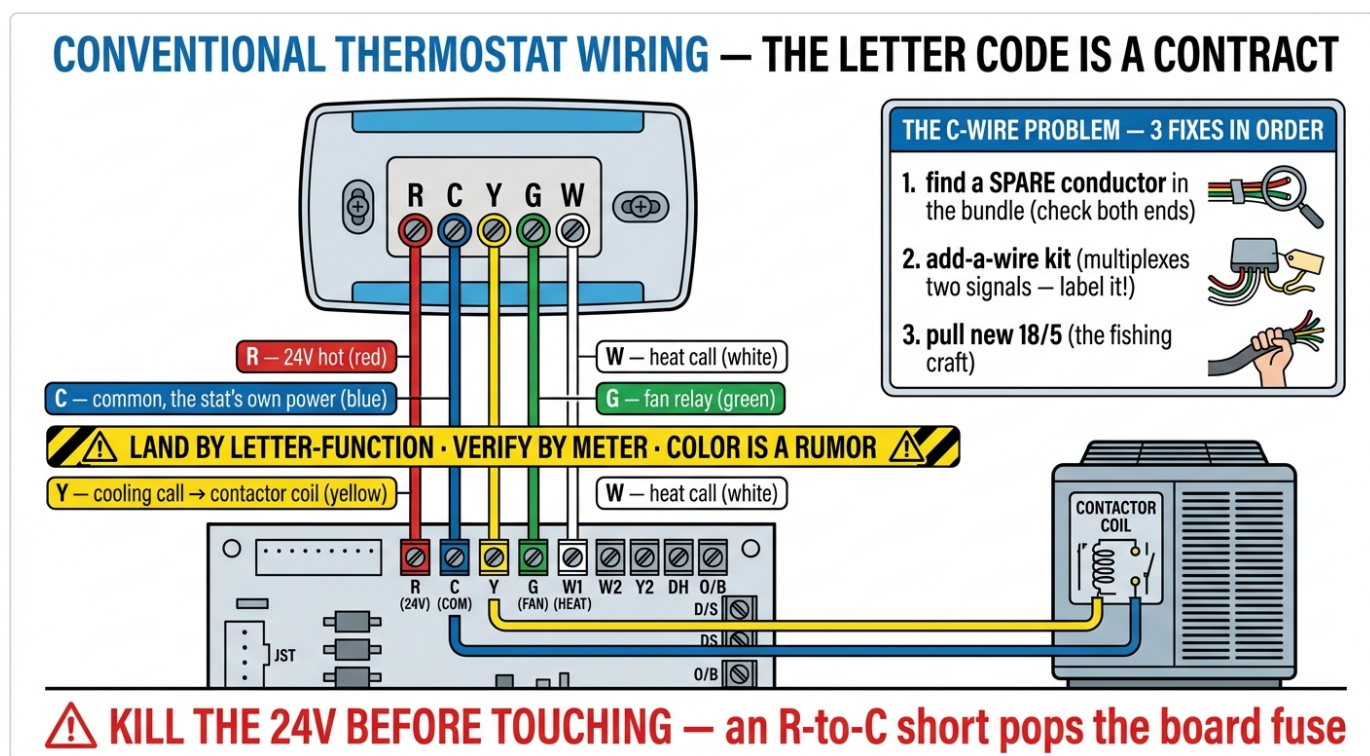
- Stat museum: mercury relic (display + disposal note), digital battery basic, common smart stats (program standard), the 10-diagram laminate (ACST's)
- Training board (stat bases pre-mounted), donor furnace + condenser; 18/5 and 18/8 wire stock
- Fast-Stat/add-a-wire kit; fish tape/rods, magnetic chain (the wall-fishing kit)

3. Watch first

Order	Video	Channel	Length	Why
1	Thermostat Wiring — Color Code, How It Works, Diagram	AC Service Tech	5:39	The base case
2	Thermostat Wiring Diagrams — 10 Most Common	AC Service Tech	6:04	The whole landscape on one card
3	Thermostat Wiring & Replacement — Colors, Letters	AC Service Tech	7:14	The swap ritual
4	The Simplest Way to Add Control Wires	HVAC School	6:48	The C-wire problem, solved
5	How to Fish Thermostat Wire in a Finished Wall	AC Service Tech	16:55	The craft half
6	Top 12 Thermostat Install/Replace Mistakes	AC Service Tech	13:14	The error catalogue

4. The idea

The letter code is a **CONTRACT** (colors are a rumor)



Terminal	Job	Conventional color	The rung it closes (3.3/3.7)
R (Rc/Rh)	24 V hot rail IN	red	the left rail itself
C	common — completes the stat's own power loop	blue/brown	the right rail
Y / Y2	cooling call (contactor coil) / stage 2	yellow	R→Y→(safeties)→CC coil→C
G	indoor fan	green	R→G→fan relay→C
W / W2	heat call / stage 2	white	R→W→board heat sequence→C

Land by **letter-function**, verify by **meter** (3.2), treat color as a hint from a possibly-deranged previous tech (3.1's rule). Rc/Rh: split systems with two transformers (or separate cool/heat appliances) keep rails separate — the jumper between them exists **ONLY** when one transformer feeds both; pulling/leaving that jumper wrong is a top-5 swap error.

Why C went from optional to mandatory

Mechanical and battery stats switched R to the call terminals and asked nothing for themselves. Smart stats are computers: they need a continuous R-to-C supply (3.4's "R and C are the rails"). No C = stats stealing power through call circuits ("power sharing" — causes ghost clicking, chattering relays, dead batteries) or just a blank screen. The three fixes, in order of preference:

1. **Spare conductor already in the wall** (check the bundle BOTH ends — the 5-wire pull with 4 used is common): land it on C at the board, done in 10 minutes.
2. **Add-a-wire / Fast-Stat kit**: multiplexes two signals on one conductor — legit, follow the kit diagram exactly, label what you did for the next tech.
3. **Pull new 18/5 (or 18/8 for heat pumps — 6.4)**: the fishing craft — drip loop at the stat box, plates not staples-through-jacket, and the magnet-chain trick from the video for closed walls.

The replacement ritual

Photo → label each wire with the kit flags (by **TERMINAL**, not color) → **kill 24 V** (board fuse or door switch — a shorted flag across R-C while live pops the 3.4 fuse, the classic self-inflicted service call) → wires secured so they can't fall in the wall (clothespin/clip — losing the bundle is a wall-fishing penalty round) → new base level + anchored → land by function → configure (system type, stages, fan type GAS vs ELECTRIC — gas furnaces want the FURNACE to run the fan in heat; electric AHUs want the stat to) → **test every mode + fan** before the van moves.

5. Bench procedure

1. **Code drills:** the wall board with scrambled colors — students land 5 stats by FUNCTION with meter verification. Includes the deranged-colors board (red on G, green on W...) — meters beat assumptions.
2. **Full swap reps:** old-for-new on the donor furnace with the complete ritual, every student, timed second pass (15-min standard incl. testing).
3. **C-wire clinic:** three rigs — one with a spare conductor (find it!), one for the Fast-Stat (wire it per kit), one needing the pull (fish the practice wall: top plate drill, magnet chain, drip loop, plate). All three solved, costs/tradeoffs discussed.
4. **Diagnosis round:** blank stat (3.4's fuse — find the chafed wire that killed it), no-cool-but-heat (Y flagged off at the board), fan-runs-forever (G-to-R short rigged) — meter-driven verdicts.
5. **Configuration trap:** instructor sets "electric" fan type on the gas furnace — student must catch why the blower starts instantly with the burners cold (comfort complaint in waiting) and fix it.

Checkout: unaided complete replacement on the scrambled-color rig + one C-wire solution chosen and executed + all modes tested with narration. **Comp 9 (conventional half) signed — completes with 6.4's heat pump half.**

6. Field gotchas

- **The R-C short while live** pops the board fuse and turns a stat swap into an hour of 3.4. Kill the 24 V first. Every time. (You will be tempted at "it's just two wires." So was everyone before you.)
- **The falling bundle:** wires un-clipped slither into the wall the moment you look away. Clip first, then unscrew.
- **Two-transformer homes** (furnace + separate AHU/boiler): Rc/Rh discipline + 3.4's phasing note. The jumper question decides whether you make smoke.
- **Gas-vs-electric fan setting** is the most common silent misconfiguration — heat feels "cold-blowing" or burners cycle on limit (7.x ties in).
- **Smart stat checklists:** many need C, some need their app provisioning to even output calls — finish the SOFTWARE before condemning your wiring.
- **Mercury stats** go to hazardous disposal (we keep the museum one sealed) — never the dumpster.

7. Competency link

- **Comp 9 begins signing** (conventional). Heat pump terminals (O/B, AUX/E) and dual fuel = 6.4 completes it.

- The C-wire craft + ritual feed every install (7/8/9) and the smart-stat upsells the company actually sells.

8. Check yourself

1. The five core letters with each one's rung.
 2. Rc vs Rh — when does the jumper live, when does it die?
 3. Three C-wire solutions in preference order, one tradeoff each.
 4. The replacement ritual — and what does killing the 24 V protect (be specific: which part, from 3.4)?
 5. Gas vs electric fan setting: who runs the blower in heat on each, and the symptom of the wrong pick?
 6. Stat is blank. First THREE checks, in order, with lesson references.
 7. Heat works, no cooling. Trace the Y rung and name three checkpoints.
 8. Why label by terminal instead of color? Quote the program's rule on colors.
 9. The wall has 4 conductors, all used, customer wants a smart stat. Walk the options + your recommendation script.
 10. What two configuration items must be set before ANY function testing?
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