

Blower Motor Diagnosis & Replacement (PSC and ECM)

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 20 (continues) Class time: ~5 hrs (1.5 video + 3.5 bench)

1. What you'll be able to do

- Diagnose a dead/misbehaving **PSC blower** completely: tap voltage present → capacitor (3.5's exam) → windings (ohm common-to-taps, thermal overload) → bearings (shaft test) — verdict in minutes.
- Diagnose an **ECM** the right way: verify **constant high voltage** (line to the module at all times) AND the **command** (24 V signals on X13; data on variable) — then split module-vs-motor: three equal phase windings = motor good → module's the patient.
- Replace a blower motor start to finish: capture the wheel position, hub depth, rotation direction; swap without bending the wheel; set taps/program; verify amps vs nameplate.
- Replace a **condenser fan motor** with blade depth set correctly (the mark-and-measure ritual) and rotation right.
- Read belt-drive basics for the commercial bridge (tension, alignment, sheave wear — 12.2 preview).

2. Tools & materials

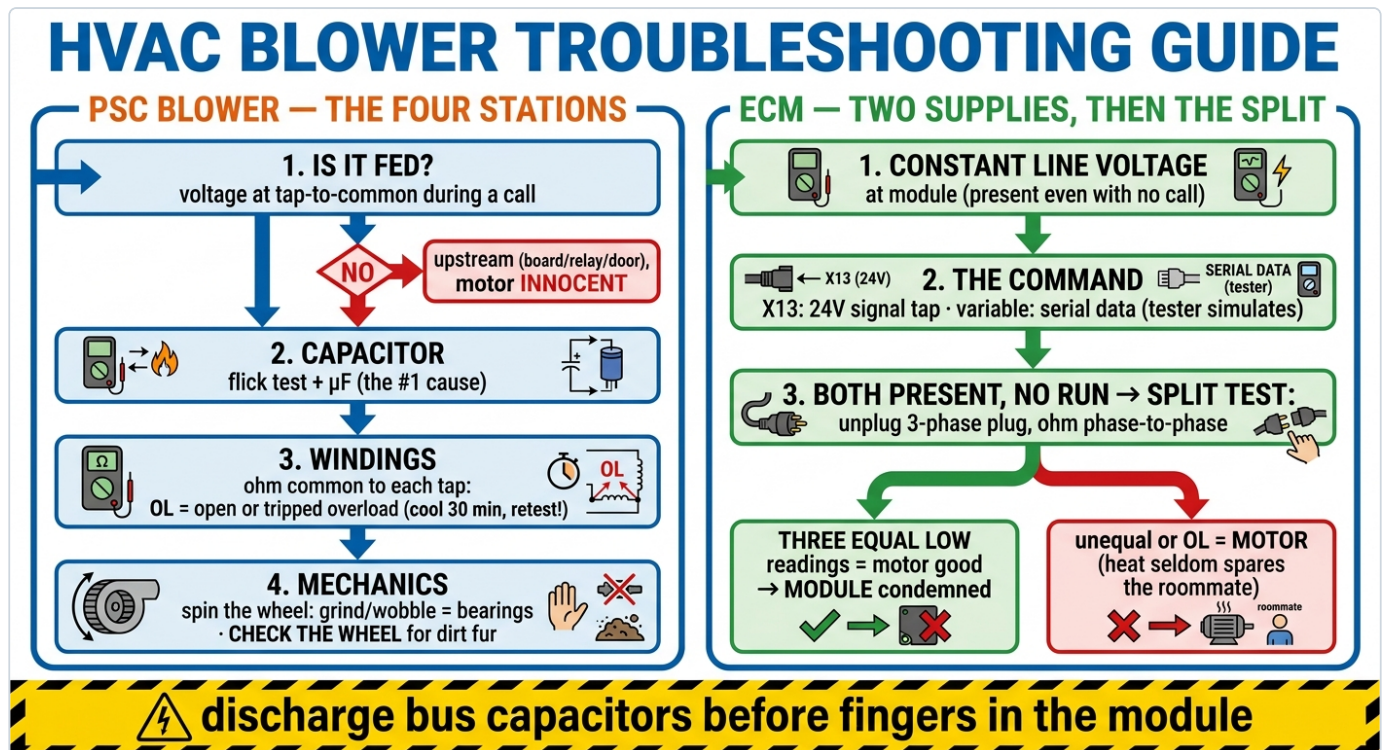
- The 6.1 motor wall + dead-motor bin (open winding, tripped overload, seized bearing, dead module)
- ECM tester (or the DIY tester from the video), meters; puller set, hub gauge/marker
- Donor furnace + condenser for full swaps; belt-drive demo board

3. Watch first

Order	Video	Channel	Length	Why
1	Blower Motor Not Working — Resistance & Thermal Overload Testing	AC Service Tech	9:33	The PSC autopsy
2	ECM Won't Turn On or Won't Shut Off — Testing Board & Motor	AC Service Tech	17:53	The ECM split test
3	Fast Easy ECM Troubleshooting — Spade Terminal Motors	AC Service Tech	5:41	X13s, fast
4	Variable-Speed ECM Tester — Make Your Own	AC Service Tech	4:30	Command simulation
5	ECM Blower Diagnosis on a Carrier Infinity	HVAC School	13:58	A real communicating system
6	How to Replace a Condensing Fan Motor	HVAC School	9:48	Blade depth ritual
7	3 HP Blower Replacement	HVAC School	14:07	The commercial-size flavor

4. The idea

PSC diagnosis — the four-station exam



1. **Is it FED?** Line voltage at the energized tap-to-common during a call (3.3's loop logic — no volts = board/relay/door switch upstream, motor innocent).

2. **The capacitor** (3.5 verbatim — the #1 cause; a humming, non-starting blower that spins up when you flick the wheel = cap, almost always).
3. **Windings:** common-to-each-tap resistance (graduated values per 6.1's tap map; OL anywhere = open winding/tripped **thermal overload** — cool it 30 min and re-test before condemning: auto-reset overloads acquit themselves).
4. **Mechanics:** spin the wheel by hand — grinding/wobble/seizure = bearings; check the wheel itself for dirt-loading (a filthy wheel can halve airflow and cook motors — the 7.x furnace lesson's "CHECK THE WHEEL").

ECM diagnosis — two supplies, then the split

The module needs BOTH at once: - **Constant line voltage** (high-voltage plug — present even with no call; that's by design). - **A command** — X13: 24 V on a signal tap; variable: serial data (live data needs the tester/board; the DIY tester video simulates it).

Both present + no run → **split the patient**: unplug the 3-phase motor connector and ohm the windings phase-to-phase: **three equal low readings = motor windings good → module condemned**. Unequal/OL = motor (or both — heat seldom spares the roommate). Bearings check same as PSC. Bus-capacitor discharge rules before fingers in the module (3.5/6.1).

Replacement craft (where pros separate)

Blower: photo + **mark the wheel hub depth on the shaft** BEFORE pulling; note rotation arrow + mounting orientation; pull the assembly, don't pry the wheel by its blades (they bend, then they whoosh forever); transfer/replace the wheel with hub screw on the FLAT of the new shaft; set the same depth (centered in housing); taps/programming set; THEN verify with the amp clamp (vs FLA) and the restriction fingerprint sanity (6.1) — a motor pulling far under nameplate may be a wheel set too shallow moving thin air.

Condenser fan: measure blade depth from the motor-mount face / shroud rim BEFORE pulling (a tape measure photo — blade height in the venturi is engineered: wrong depth = airflow loss + amp drift); rotation right (blows UP through the top, sucks across the coil); new motor's rotation tag + wiring (3-vs-4 wire, 3.5's capacitor logic); drip plugs DOWN; blades on with the leading edge correct.

Universal replacements (PSC and X13/ECM universals): legit when configured right — match HP, RPM/speeds, frame, rotation, shaft; program torque/airflow per the kit's tables. The "right universal, wrong setup" install works badly forever — commission it like a new system (amps + temp split + static if in doubt).

5. Bench procedure

1. **PSC autopsy bin:** four dead motors — run the four stations, name each cause of death with the meter evidence. (One is the trap: a tripped overload that ACQUITS after cooling — patience is graded.)

2. **ECM split-test reps:** the dead-module motor and the dead-motor module (we keep both): every student runs supplies-then-split on each and renders opposite verdicts with narration.
3. **Tester time:** command the variable ECM with the tester/DIY rig — watch it obey without any furnace attached; understand "the motor is a slave to the data."
4. **Full blower swap:** donor furnace — the complete craft sequence incl. hub-depth mark, wheel inspection (it WILL be dirty — clean it, weigh the dust, log airflow gain), tap/program setup, amp verification.
5. **Condenser fan swap:** donor condenser — depth ritual, rotation, 3-vs-4-wire decision, drip plugs, amp check against plate.
6. **Belt-drive ten minutes:** tension (deflection rule), alignment (straightedge), sheave groove wear (the glasses-on-the-groove check) — the 12.2 bridge.

Checkout: one unknown dead blower (instructor's pick, PSC or ECM) — correct verdict with evidence + one full swap with depth/taps/amps verified. **Comp 20 advances** (board half completes in 6.6).

6. Field gotchas

- **The flick test** (wheel spins up with a push) convicts the capacitor BEFORE the meter does — but verify with μF anyway; a marginal cap that "worked today" strands the customer Friday.
- **Condemning ECMs for board sins:** no command $\neq$ dead module. Half of "bad ECM modules" replaced in the field were starving for a signal the dead board never sent (6.6 next).
- **Wheel dirt is a stealth epidemic:** a 1/8" fur coat on blades = double-digit CFM loss. Every blower pull includes a wheel verdict; every gas furnace lesson (7.x) repeats it.
- **Swapped rotation on 3-phase commercial** (12.2): blowers move SOME air backwards — temp rise/static numbers catch what eyes miss.
- **Set screws on the flat, torqued** — a wheel that walks the shaft eats the housing on day 30.
- **Aftermarket motor HP "upgrades"** ("it kept dying so I put a bigger one") usually mask static disease and raise the bill — measure the duct (Unit 11), don't armor the victim.

7. Competency link

- **Comp 20 advances** (motors complete; boards 6.6, compressors 6.7 finish it).
- Wheel/airflow craft feeds 7.9 (temp rise setup) and Unit 11; the ECM data concepts feed Unit 9's inverter boards.

8. Check yourself

1. The PSC four stations, in order, with the meter move at each.
2. The flick test: what does it suggest and what confirms it?
3. ECM: what TWO things must be present before the motor owes you motion?

4. The split test: readings that condemn the module; readings that condemn the motor.
 5. Why mark hub depth before pulling a wheel? What goes wrong shallow vs deep?
 6. The condenser blade-depth ritual and what wrong depth costs.
 7. Tripped thermal overload: how do you avoid wrongly condemning the motor?
 8. A universal X13 installed without programming "works." What's wrong and how does it show?
 9. Why is "put a bigger motor in" malpractice for a static problem?
 10. The wheel is filthy but the motor tests fine. What's the full fix and what numbers prove it?
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