

Evacuation: Pulling to 500 Microns with a Decay Test (Unit 4 Capstone)

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 4 • Copper, Brazing & System Integrity • Comp 5 SIGNS HERE — curriculum gap #1, second half Class time: ~5 hrs (1.5 video + 3.5 bench) — the Unit 4 capstone runs through this lesson

1. What you'll be able to do

- Explain what evacuation removes (**air AND water**) and why microns are the only honest scale (2.3 paid off).
- Rig a **fast, deep vacuum setup**: core removal tools, large-bore hose direct to the pump, **micron gauge at the system far from the pump** — and say why each choice matters.
- Pull a system below **500 microns** and run the **decay test** that separates DRY-AND-TIGHT from wet from leaking — reading the three signature curves.
- Maintain the pump (oil = its blood), and troubleshoot the stuck-at-1,500-microns afternoon.
- Run the complete **Unit 4 capstone**: your brazed assembly → pressure tested (4.5) → evacuated and decay-passed → **Comp 5 signed**.

2. Tools & materials

- Vacuum pumps (one per team) + fresh oil stock; large-bore vacuum-rated hoses; core removal tools (VCRTs)
- **Micron gauges** (one per team + spares); manifold for the do-it-wrong comparison
- The pressure-passed assemblies from 4.5; practice system; a deliberately "wet" test vessel (instructor's water-drop rig)
- Log sheets (same program log — evacuation columns)

3. Watch first

Order	Video	Channel	Length	Why
1	HVAC Full Vacuum Procedure From Start to Finish	AC Service Tech	15:09	The complete ritual
2	How to Evacuate an AC System — Full Procedure	HVAC School	27:35	Same skill, deeper dive
3	40 Vacuum Procedure Tips	AC Service Tech	27:12	The frustration-savers
4	Vacuum Best Practices	HVAC School	29:25	The doctrine
5	VCRT Step by Step	AC Service Tech	7:42	Core tools — the speed secret
6	Can You Freeze Water in a Vacuum?	HVAC School	8:55	Why stuck-at-1500 happens
7	Evacuation 101 / Advanced w/ Jim Bergmann	HVAC School	55:39	Reference deep-dive

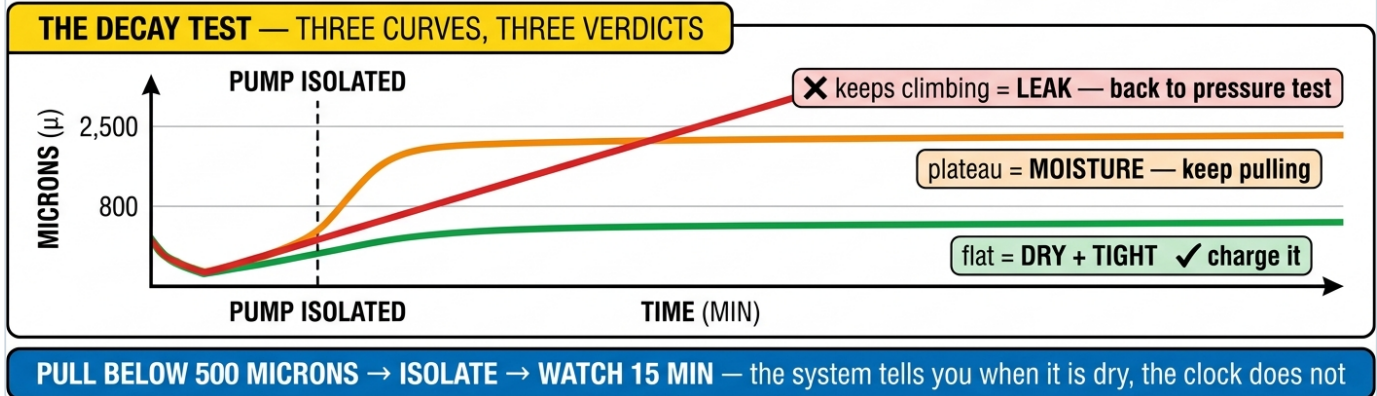
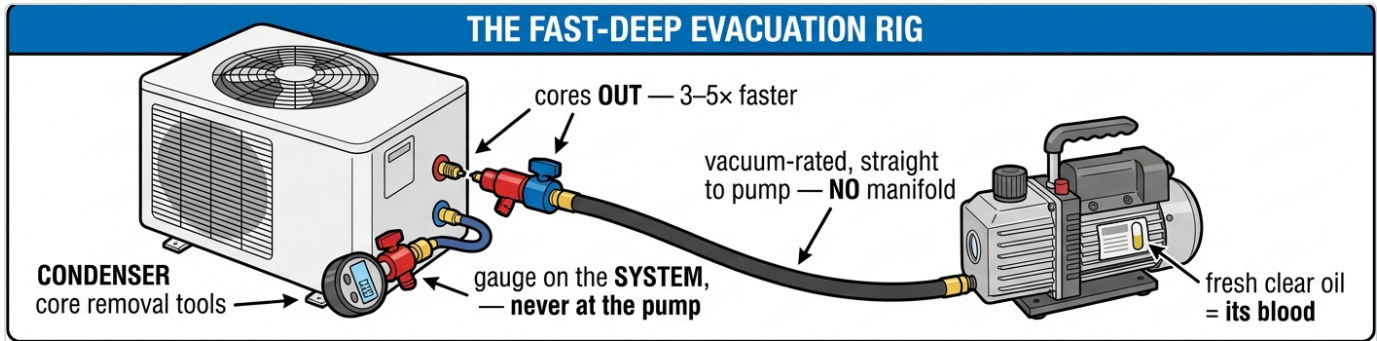
4. The idea

What you're removing (and what the enemy does)

- **Air (non-condensables):** parks in the condenser, raises head pressure, eats efficiency, accelerates oil breakdown.
- **Water:** flashes to acid with POE oil and heat (the 4.1 villain, full origin) → kills compressors years before their time; freezes in the metering device TODAY (the intermittent-TXV ghost).

Boiling water off at ambient temperature requires deep vacuum (2.3's scale: water boils at ~73°F at ~20,000 microns) — which is WHY the micron gauge exists: **all the work happens in the last half-inch of mercury.**

The fast-deep rig (why each piece)



- **Cores OUT with VCRTs** (both ports): the Schrader core is a soda-straw restriction; removing it can cut evacuation time 3-5x. (And the VCRT lets you isolate the system later without the cores back in — the decay test's secret weapon.)
- **Short, fat, vacuum-rated hoses, straight to the pump** — skip the manifold (every gasket is a leak-in path at 500 microns; the manifold is a charging tool, not a vacuum tool).
- **Micron gauge on the SYSTEM, far from the pump** (opposite port, or a core-tool side port): next to the pump it reads the pump's vacuum, not the system's — the classic false-pass.
- **Fresh pump oil** (clear, not milky): the pump can only pull as deep as its oil is dry. Hot pump + milky oil = oil change NOW; big/wet jobs may take mid-job changes. Gas ballast cracked early helps the oil shed moisture.

Targets and the decay test (the verdict)

1. Pull until the gauge reads **below 500 microns** (program standard; some specs say 300 for POE/A2L — tighter never hurts).
2. **Valve off the pump (core tools closed), pump OFF. Watch 10-15 minutes:**

Curve	Reading	Verdict
Flat-ish (rises a bit, levels under ~500-800)	DRY + TIGHT	Charge it
Rises, then PLATEAUS (e.g., climbs to 1,500-3,000 and parks)	Moisture still boiling off	Keep pulling (heat helps; nitrogen sweep on stubborn ones: break vacuum with dry N ₂ , re-pull)
Rises and KEEPS climbing toward atmosphere	LEAK	Back to 4.5 — pressure-test and hunt (a vacuum can't tell you WHERE)

That three-curve read is the whole exam — it's also the answer to "is it done?" forever: **the system tells you when it's dry; the clock doesn't.**

The stuck-at-1,500 troubleshooting tree

Wet system (most common — see plateau curve) → pump oil saturated (change it) → leak-in at YOUR rig (tighten/grease gaskets, the hose o-ring you dragged through gravel) → gauge sensor contaminated (clean per manufacturer) → genuinely huge moisture load (deep-frozen slug: the freeze video — break with N₂, sweep, re-pull). In that order of likelihood.

5. Bench procedure — THE UNIT 4 CAPSTONE

- Pump prep:** oil check/change on every pump (see milky vs clear), gas ballast tour.
- Rig race (the lesson in contrast):** Team A rigs classic manifold + cores-in; Team B rigs VCRT + direct fat hose. Same volume, simultaneous pull. Log both time-to-500. (B wins by a lot. Always.) Gauge placement demo: read at the pump vs at the system on the same pull — watch the lie.
- The wet vessel:** instructor's rig with three drops of water inside. Pull it, watch the plateau curve live, watch the gauge fall again as the water finally clears. The most instructive 40 minutes in the unit.
- CAPSTONE RUN (each student, on their own pressure-passed assembly):** - VCRT rig, direct hose, gauge far-side → pull to <500 → isolate → **15-min decay logged with verdict** → instructor reviews curve + log. - One assembly per class gets the instructor's hidden pinhole (re-used from 4.5 stock) — somebody's decay will climb; their (correct) response: "back to pressure testing" = full marks, not failure.
- Sign-off:** capstone passed = **Competency 5 signed in full** (cut/bend/swage/flare/braze/test/evacuate — the whole copper craft, proven on one artifact the student built start to finish). The assembly gets a name tag and goes on the shop shelf — the program's growing trophy wall.

6. Field gotchas

- **"I pulled it for 45 minutes" is not a measurement.** Microns + decay or it didn't happen (2.3 promised this would be the rule; here it is in writing).

- **Gauge at the pump = false pass.** The single most common evacuation lie in the field. Far side, always.
- **Cores back IN before charging** (torqued with the core tool) — and caps on. A perfect vacuum charged through a leaky core seat is a 4.5 do-over with refrigerant money.
- **Pump left running overnight unattended** can pull oil INTO the system on shutdown if it lacks a check valve (and they fail) — isolate before stopping the pump, every time. That's also WHY the decay test procedure has the order: valve off FIRST, pump off second.
- **Cold weather evacuations** take longer (water vapor pressure drops) — heat the lineset/coil gently (heat gun, sun, run the furnace blower) and be patient; the curve tells the truth in any weather.
- **A2L/POE-era spec sheets** increasingly demand documented decay tests — same log-sheet armor as 4.5.

7. Competency link

- **Comp 5 — SIGNED (full)** via the capstone.
- Evacuation discipline reappears verbatim in every install capstone (7.x, 8.7, 9.2) and every open-system repair forever. The decay-test three-curve read is the foundation for charge-integrity thinking in Unit 5.

8. Check yourself

1. The two things evacuation removes and one damage path for each.
 2. Why microns, not minutes? (Connect 2.3's scale to today's targets.)
 3. Four pieces of the fast-deep rig and the WHY of each.
 4. Where does the micron gauge go and what happens if you cheat?
 5. The three decay curves and their verdicts.
 6. Stuck at 1,500 — the troubleshooting tree, in order.
 7. What's the nitrogen sweep and when do you reach for it?
 8. The shutdown order (isolate vs pump-off) and the disaster it prevents.
 9. Pump oil: what color is healthy, what does milky mean, what's the fix?
 10. Your decay climbed steadily to 5,000 over ten minutes. What is it, what ISN'T the vacuum able to tell you, and which lesson do you re-run?
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