

Leak Detection: Electronic, Ultrasonic, Bubbles & Where Leaks Hide

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 • Appendix A Competency 17 — "Perform refrigerant leak detection using electronic and UV methods" **Class time:** ~4 hrs (1 video + 3 hunt bench) — closes Unit 4

1. What you'll be able to do

- Run the **leak-search hierarchy** in order: history & visual → electronic sniffer → bubbles to pinpoint → ultrasonic/UV for the stubborn ones → nitrogen + standing test as the referee (4.5).
- Use an **electronic heated-diode detector** properly: warm-up, zeroing in clean air, probe SPEED (slow!), bottom-of-fitting bias, confirm-by-return.
- Name the **top-10 leak spots** before the unit's panel is even off — and search them in probability order.
- **Pinpoint with bubbles** what electronics can only neighborhood-ize.
- Make the find-vs-document call like a professional: EPA context (full rules in 5.2), repair quote, the "it just needs a top-off" conversation killed with evidence.

A low charge IS a leak (Lesson 1.1's rule). This lesson is how you turn "it's low" into a circled spot on copper — the difference between a tech and a refrigerant dealer.

2. Tools & materials

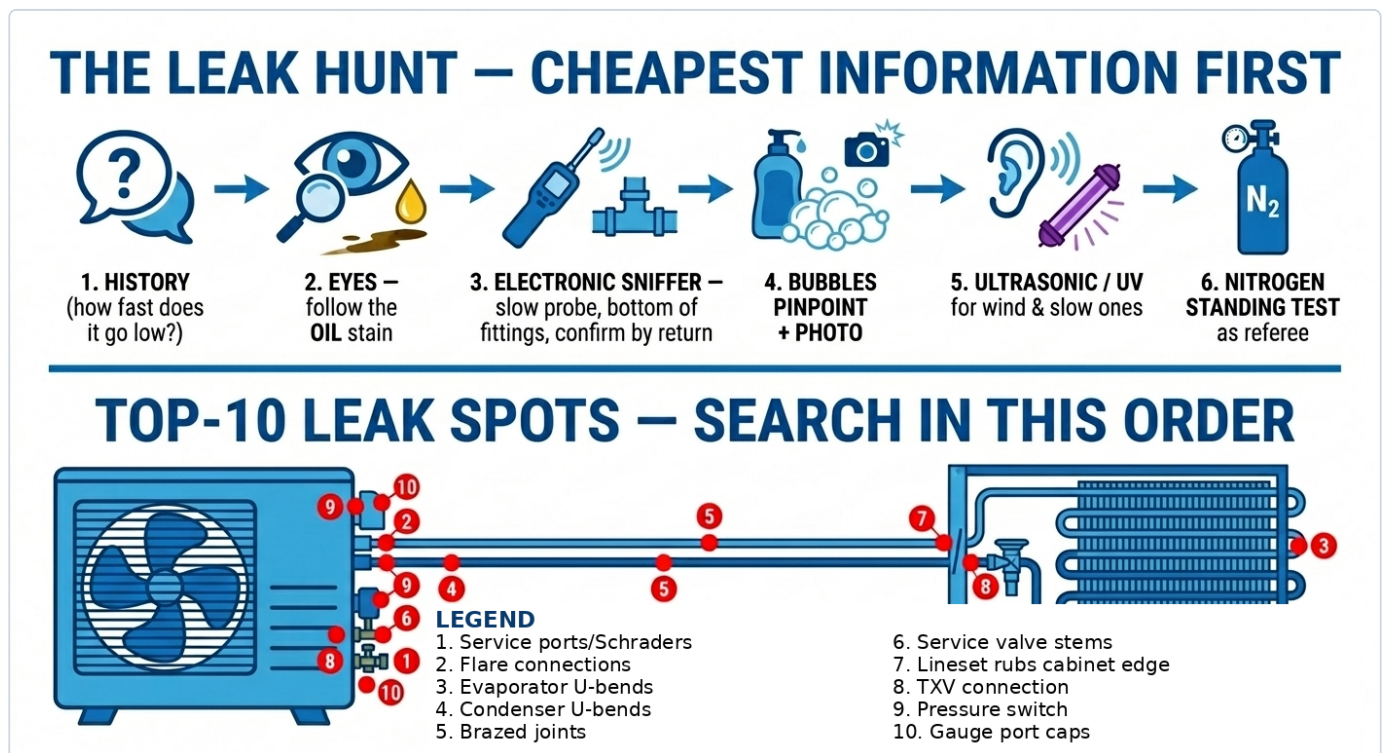
- Heated-diode electronic detectors (program standard) + an ultrasonic (AccuTrak-style) + UV kit (dye, light, glasses — for the demo/discussion)
- Bubble solution, mirrors, flashlights
- **The leak board:** instructor-built practice rig with valved, hideable calibrated leaks (port core, flare, braze pinhole, coil rub-through, Schrader cap seat) under nitrogen — our most-used training prop from here on
- Scrap evaporator with a real rub-through; the soap pot

3. Watch first

Order	Video	Channel	Length	Why
1	Where to Find R-22 & R-410A Leaks — Top 10 Spots	AC Service Tech	14:46	The probability map
2	Refrigerant Leak Detection Tips	HVAC School	22:29	Technique doctrine
3	Electronic Heated Diode Detectors — DR58 & NML1	AC Service Tech	10:15	The tool, used right
4	Which Method Is Best? Craig vs Bryan "Cage Fight"	ACST × HVAC School	35:27	Methods compared by our two backbone instructors
5	Leak Search Tips from Bert	HVAC School	17:50	Field craft
6	Ultrasonic Find in the Field	HVAC School	4:40	When sound beats smell

4. The idea

The hierarchy (cheapest information first)



1. **History interview:** how fast does it go low — a season (small leak) or a week (find it today)? Ever "topped off" before? Where, who, when?
2. **Eyes first — follow the oil.** Refrigerant leaks carry oil; oil catches dust; a grimy stain on copper is a flag planted on the leak. Check the classic stains: coil U-bends, lineset rub points, valve bonnets.

3. **Electronic sniffer** (the workhorse): warms up FULLY → zero in clean air (not next to the suspected leak — the meter needs a baseline) → probe moves ~**1 inch/second, bottom of every fitting** (refrigerants are heavier than air) → on alarm: pull away, let it clear, RETURN to confirm (one beep is noise; repeatable beeps at one spot is a find).
4. **Bubbles pinpoint:** electronics say "this fitting"; bubbles say "this thread, 7 o'clock." Photograph the bubble cluster — that's your quote evidence.
5. **Ultrasonic** when wind/refrigerant-saturated air defeats sniffers (it hears the hiss, immune to smell); **UV dye** as the long-game tool (inject, run, return with the light — finds slow evaporator leaks; adds dye permanently, some OEMs frown — know your warranty terms).
6. **Nitrogen + standing test (4.5) as the referee:** when the system's too low to push detectable refrigerant, recover the rest (5.3), pressurize with N₂ (+ trace refrigerant where legal/practical), and hunt at 350 PSI where every leak is louder.

The top-10 probability map (search in this order)

1. **Schrader cores & caps** (your 60-second first check — and sometimes the whole repair)
2. **Flares** (mini-splits: it's flares until proven otherwise — Unit 9's drum)
3. **Evaporator coil** (formicary corrosion in copper coils — the slow indoor killer; U-bends and rub points)
4. **Condenser coil** U-bends and where the lineset rubs the cabinet
5. **Brazed joints** (especially factory stubs and previous "repairs")
6. **Service valve bonnets/stems** (back-seat packing)
7. **Lineset rub-throughs** (against ductwork edges, hangers, each other — 4.1 warned)
8. **TXV/distributor connections**
9. **Pressure switches & their capillaries**
10. **The previous tech's gauge ports** (tightened cores, missing caps)

The professional verdict

EPA appliance rules and the repair-vs-top-off ethics get their full treatment in 5.2 — today's working rule: **find it, photograph it, quote the fix.** "Just top it off" without a leak conversation is (a) often unlawful above thresholds, (b) always bad medicine, and (c) a subscription you sold to someone who trusted you. The customer-facing line you'll use weekly: "Refrigerant doesn't wear out — your system is leaking oil and refrigerant at THIS spot [photo]. Here's the repair, here's what topping off actually costs per year."

5. Bench procedure — the hunts

1. **Detector school:** warm-up, zero, speed drills on the leak board's ONE open leak — learn your tool's voice (tick rate vs alarm), practice the pull-away-and-return confirm.
2. **The oil-stain gallery:** scrap parts with real stains — find each leak by EYES ONLY first; sniffer confirms. (Half the class's finds will need no electronics. That's the point.)

3. **Hunt rounds (the main event):** leak board configured fresh per team — 3 hidden leaks among 12 candidate spots. Scored: leaks found, false accusations (-points!), time. Round 2 with a fan blowing (wind!) — watch sniffer struggle, switch to ultrasonic/bubbles, adapt.
4. **Pinpoint discipline:** every electronic find MUST end with a bubble photo. "The sniffer beeped near the coil" is not a find.
5. **The verdict roleplay:** present one find to the "customer" (instructor): photo, plain-English explanation, repair path, the top-off conversation. Graded on honesty + clarity, not vocabulary.

Checkout (closes Unit 4): on a fresh board config — find 2 of 2 leaks with zero false accusations, each pinpointed with bubbles and photographed, one presented in customer language. **Comp 17 signed at guided level** (UV method credited via demo + written; field reps in Units 5–9).

6. Field gotchas

- **Wind is the sniffer's kryptonite** — block it, shield with your body/jacket, or switch methods. Roof units on breezy days = ultrasonic country.
- **A saturated mechanical room** (big leak indoors) maxes the detector everywhere — ventilate first or you'll chase your own air.
- **Don't sniff the bubble solution** — many detectors alarm on soap chemistry. Bubbles AFTER electronics, or rinse before re-sniffing.
- **Formicary coil leaks** are pinholes in the middle of nowhere (no joint!) — household chemistry attacks copper from inside the home's air. Finding one usually means more are coming: that's a coil-replacement (or system) conversation, not a braze.
- **A2L detectors:** R-32/R-454B require A2L-rated detection settings/units — check yours; the old pump won't see them well (5.8 covers the toolkit changeover).
- **Document even the no-finds:** "searched 45 min, electronic + bubbles, no leak located at accessible points; recommend dye/return visit" — honest, billable, and the trail your warranty stands on.

7. Competency link

- **Comp 17 — signed (guided).** Comp 18 (leak REPAIR) accrues through brazed repairs in Units 5–9 field work.
- Closes Unit 4: the copper craft complete — make it, join it, prove it, find its failures.

8. Check yourself

1. The hierarchy, in order, with the "cheapest information first" logic.
2. Why does oil mark the spot?

3. Four rules of electronic detection technique (warm-up, zero, speed, position) + the confirm move.
 4. Top-10 spots — recite seven.
 5. When does ultrasonic beat the sniffer? When does UV dye earn its place?
 6. Why must every electronic find end in bubbles?
 7. The customer line that kills "just top it off" — deliver it.
 8. What is formicary corrosion and what conversation does it trigger?
 9. System's nearly empty — how do you make the leak findable, and which two prior lessons does that use?
 10. What do you write when you DON'T find it, and why is that documentation valuable?
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