

Multi-Zone Systems + Cleaning & Maintenance

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 9 • Ductless Mini-Splits • Job Function 18 • Appendix A Competency 50 (completes) — "Service multi-zone mini-split and light-commercial ductless VRF systems; identify refrigerant charge faults" **Class time:** ~6 hrs (1.5 video/discussion + 4.5 bench)

1. What you'll be able to do

By the end of this lesson you will be able to:

- Explain how a multi-zone system's refrigerant piping, branch boxes, and connected-capacity rules differ from the single-zone install you mastered in Lesson 9.2.
- Calculate a multi-zone weigh-in charge across multiple branch lines and identify charge faults that show up differently than they would on a single-zone system.
- Describe where light-commercial ductless VRF sits relative to the residential multi-zone equipment this unit focuses on, and know when a job is beyond single/multi-zone scope into full VRF territory (Unit 12).
- Perform a correct **in-place coil cleaning** on an indoor head without damaging the unit or the surrounding wall/ceiling.
- Diagnose and correct the blower-wheel mold/mildew smell complaint properly — a deep clean, not a spray-and-pray.
- Build a customer-appropriate maintenance schedule for washable filters, coil cleaning, and condensate line flushing.

This is the unit's capstone lesson — it also closes Job Function 18 entirely. Everything from 9.1's inverter theory through 9.8's component testing shows up here in service context.

2. Tools & materials

- Multi-zone shop unit or reference diagrams/manuals (branch box, multiple indoor heads) if a live multi-zone system isn't available on the bench
- Coil cleaning kit: no-rinse or rinse coil cleaner appropriate for aluminum fin coils, a catch bag/bib system sized for the shop unit's indoor head model, spray bottle, soft brush

- Blower wheel cleaning tools: brush set, shop vac, cleaning solution safe for plastic fan wheels
- Digital scale (from Lesson 9.6) for multi-zone weigh-in practice
- PPE: gloves, eye protection (coil cleaner chemicals)

3. Watch first

Order	Video	Channel	Length	Why
1	Multi-Zone Mini Split, Mini-VRF, and VRF System Differences Explained!	AC Service Tech	6:15	Re-watch from Lesson 9.1 — today the distinctions become practical
2	Installing a 3 ZONE Ductless HVAC System	Quality HVACR	16:52	Full multi-zone install for topology reference
3	Mini Split Multi Zone Pipe Connection HVAC Basics	Taddy Digest	10:42	Branch piping/branch box connection basics
4	Ductless Mini Split Cleaning! Outdoor Coil, Indoor Coil, Fan Wheel, Blower Housing, Methods!	AC Service Tech	31:48	THE cleaning procedure reference — full method, every component
5	Mini-Split Cleaning & Maintenance	HVAC School	30:06	Second full-length cleaning session, different technique details worth comparing
Reference	Highwall Ductless Blower Wheel Cleaning	HVAC School	4:31	Quick blower-wheel-specific reference for the mold/smell complaint

4. The idea

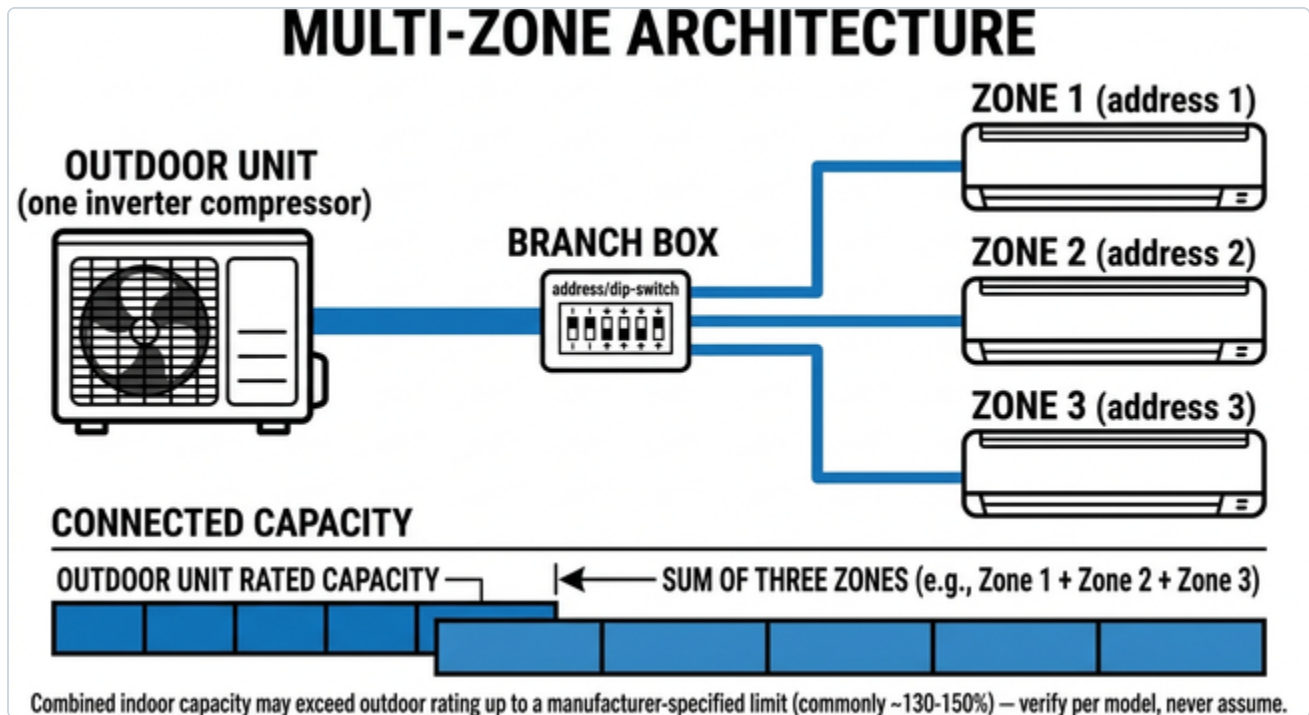
Multi-zone architecture — one outdoor unit, several conversations at once

A single-zone system (Lesson 9.2) is one indoor head talking to one outdoor unit over one interconnect cable. A **multi-zone system** is one outdoor unit serving two or more indoor heads, connected through refrigerant piping that branches — either through simple branch/joint fittings for smaller multi-zone systems, or through a dedicated **branch box** on larger or VRF-adjacent systems that distributes refrigerant and communication to each zone.

- **Each indoor head still has its own EEV/LEV** (Lesson 9.8) and makes its own local capacity decision — the outdoor unit's single inverter compressor has to satisfy the COMBINED demand of every zone calling at once.
- **Connected capacity rules are real limits, not suggestions:** manufacturers publish a maximum combined indoor capacity relative to the outdoor unit's rating — often expressed as a percentage (commonly in the 130–150% range depending on brand/model, always verify the specific unit's spec) reflecting that not every zone calls for full capacity simultaneously in real-world use (a diversity assumption). Exceed the connected capacity limit and you're

guaranteed comfort complaints on the worst-case day when every zone actually does call at once.

- **Each zone needs a home-run or addressed connection back to the outdoor unit or branch box** — larger multi-zone systems use address dip switches on each indoor head so the system knows which physical unit is which; **label everything during install**, because sorting out unlabeled zone wiring on a service call years later is a miserable way to spend an afternoon.



The oil-return problem, and why "multiple singles" sometimes wins

Refrigerant carries compressor oil through the system as it circulates. On a long or heavily branched multi-zone circuit — especially when only one or two zones are calling at low modulation while others sit idle — refrigerant velocity in parts of the circuit can drop low enough that oil doesn't return reliably to the compressor. This is a real engineering constraint, not a theoretical one, and it's part of why Lesson 9.1's install-expert notes say: **when budget allows, multiple single-zone systems can outperform one multi-zone system** for oil return reliability and per-zone redundancy (one compressor failure doesn't take down every room at once). Multi-zone still wins on installation simplicity and often cost — know the trade-off and make it explicit to the customer rather than defaulting to whichever quote is smaller.

Non-simultaneous heat/cool — a real limitation on standard multi-zone

Most standard residential multi-zone systems (as opposed to true VRF/heat-recovery systems) can only run **all connected zones in the SAME mode at once** — all cooling or all heating, not some of each simultaneously. A customer asking to cool the upstairs bedrooms while heating a downstairs office on the same multi-zone system is asking for heat-recovery VRF capability, not

standard multi-zone. Know this limitation before you sell or install — it's a common point of customer disappointment when it isn't set expectations correctly up front.

Where light-commercial ductless VRF fits

VRF (Variable Refrigerant Flow) systems are the larger, more sophisticated sibling of the multi-zone equipment in this lesson — more zones, larger branch selector boxes, and on true heat-recovery VRF, the ability to simultaneously heat some zones and cool others by recovering rejected heat from one zone to serve another. Competency 50's scope is **light-commercial ductless VRF at survey level** — recognizing the equipment family, understanding it's built on the same inverter/EEV/communication fundamentals from Lessons 9.1–9.8 scaled up, and knowing when a project has grown beyond single/multi-zone residential scope into full VRF design territory. **Full VRF commissioning and diagnosis is Unit 12 content** — this lesson's job is making sure you can recognize VRF-class equipment and know where the boundary is, not commission one solo.

Refrigerant charge faults on multi-zone — what's different

The weigh-in method from Lesson 9.6 still applies, but now you're calculating trim charge across **every branch line to every zone**, not one run:

Total trim charge = sum of (each branch's actual length – that branch's base allowance) × that branch's charge factor, per the manufacturer's multi-zone charging chart — branch line sizes are often smaller than main trunk lines and carry their own charge factor.

Charge fault symptoms look different on multi-zone:

- A single undercharged or restricted branch often shows as ONE zone underperforming while others run fine — don't assume a whole-system low charge when the symptom is isolated to one head. (Compare against Lesson 9.8's stuck-EEV symptom, which looks similar — service data and component testing separate the two.)
- A true whole-system low charge (a leak somewhere in the shared main trunk, or an undercharge from a miscalculated weigh-in) tends to affect ALL zones' capacity somewhat, especially under combined high demand.
- **Diagnose per-zone using each indoor head's own service data** (Lesson 9.6 method) before concluding it's a system-wide charge problem — pulling data from just the "loudest complaint" zone can mislead you if the real fault is elsewhere in the branch topology.

5. Bench procedure

Part A — Multi-zone:

1. **Architecture walkthrough.** Using the shop's multi-zone unit or reference manual, trace the refrigerant path from outdoor unit through the branch box/joints to each indoor head. Identify each zone's addressing method.
2. **Connected capacity check.** Given a sample outdoor unit rating and a set of indoor head capacities, calculate whether the proposed combination is within the manufacturer's connected capacity limit — show the math.
3. **Multi-branch trim charge calculation.** Given branch lengths and base allowances for a 3-zone example, calculate the total system trim charge, branch by branch.
4. **Charge fault scenario drill.** Instructor presents a symptom description (one zone weak, others fine, vs. all zones weak under high demand). Students state which is more likely a single-branch issue vs. a system-wide charge issue, and what service data (Lesson 9.6) they'd pull to confirm.

Part B — Cleaning & Maintenance:

1. **Indoor coil cleaning, in place.** Fit the catch bag/bib system correctly around the indoor head per the shop unit's specific model, apply coil cleaner per label instructions, rinse/catch runoff completely — zero cleaner or rinse water should escape onto the customer's wall or floor. This is graded as strictly as any refrigerant procedure: a sloppy coil cleaning that drips down a customer's wall is a callback and a relationship-ender.
2. **Blower wheel deep clean.** Remove/access the blower wheel per the shop unit's service procedure, physically clean each fin of the wheel (not just spray-and-hope) — mold and biofilm buildup on a blower wheel is the classic "musty smell when the AC kicks on" complaint, and a surface spray alone rarely resolves it. **Removal/reinstall mechanics that matter:** the wheel is secured to the motor shaft by a small set screw, accessible through a gap between two of the wheel's fins — loosen it (don't force it if it's seized; a wheel that's been over-tightened in the past sometimes won't budge, which is where a bib-kit in-place clean becomes the fallback instead). On reinstall, the motor shaft has an alignment groove the set screw needs to seat into, not just clamp onto bare shaft — line it up by feel before tightening, spin the wheel by hand to confirm it doesn't scrape the housing on either side, and don't over-torque the set screw (it's small and easy to strip). **Put a little silicone grease on the shaft and on the bearing at the wheel's opposite end** — skipping this is exactly how a unit that ran silently for years develops a new squeak right after "just" a cleaning, which reads to the customer as something you broke.
3. **Filter and general cabinet cleaning.** Remove, wash, and dry washable filters per manufacturer guidance; wipe down the cabinet interior accessible without full disassembly.
4. **Condensate line flush.** Tie back to Lesson 9.5 — flush the condensate line as part of the same service visit, checking for the slow biofilm clog Lesson 9.5 warned about.

5. **Outdoor coil cleaning.** Clean the outdoor coil fins from the inside out where possible (per the shop's established coil-cleaning technique from earlier units), being careful not to bend fins.
6. **Build a maintenance schedule.** For a sample customer/equipment combination, write a maintenance interval recommendation covering filter cleaning, coil cleaning, blower wheel inspection, and condensate line flush — realistic for Alabama's humidity and pollen load, not a generic "once a year" answer.

Checkout (graded, pass/redo): Student completes an in-place indoor coil cleaning with zero uncontained runoff, correctly performs a blower wheel deep clean (not a surface spray), and produces a written multi-zone connected-capacity calculation and a written maintenance schedule for a sample job. This completes Competency 50 and closes out Job Function 18.

6. Field gotchas

- **Exceeding connected capacity "because the customer wants five zones on this outdoor unit"** produces a system that disappoints on exactly the days it matters most (everyone home, every zone calling). Do the math and say so before the sale, not after the install.
- **Ignoring oil-return risk on a long, heavily branched multi-zone run** is how a system nickel-and-dimes itself to an early compressor failure — this is a real design consideration, not paranoia.
- **Promising simultaneous heat/cool on standard multi-zone equipment** sets an expectation the hardware can't meet — know the difference between multi-zone and heat-recovery VRF before you make that promise.
- **Assuming one weak zone means a system-wide charge problem** sends you chasing the wrong fault — check that zone's service data and EEV (Lesson 9.8) before you touch the whole system's charge.
- **Spray-and-pray on a blower wheel mold complaint** is a callback generator — the fix is physical removal of buildup, not a stronger-smelling spray.
- **Sloppy coil cleaning runoff onto a customer's finished wall or floor** turns a routine maintenance visit into a damage claim — contain it completely, every time.
- **Skipping the shaft/bearing grease on a blower wheel reinstall** turns a clean, quiet unit into one with a brand-new squeak — a maintenance visit should never leave the equipment worse in some other way than it found it.

7. Competency link

- **Competency 50 (completes here)** — "service multi-zone mini-split and light-commercial ductless VRF systems; identify refrigerant charge faults" — architecture, connected capacity, multi-branch charging, and charge-fault diagnosis are this lesson's core; cleaning/maintenance rounds out the servicing half.

- Directly extends Lesson 9.6 (weigh-in charging), Lesson 9.7 (fault diagnosis), and Lesson 9.8 (component testing) into multi-zone-specific application.
- **This lesson closes Job Function 18 entirely** — Competencies 48, 49, and 50 are now all covered across Lessons 9.1–9.9.

8. Check yourself

1. What's the fundamental architectural difference between a single-zone and a multi-zone mini-split system?
2. Why do manufacturers publish a connected capacity LIMIT rather than allowing unlimited zones on one outdoor unit?
3. Explain the oil-return concern on long/heavily branched multi-zone circuits in your own words.
4. Why might multiple single-zone systems be the better choice over one multi-zone system, even at higher install cost?
5. Can a standard residential multi-zone system cool one room while heating another at the same time? What equipment class CAN do that?
6. Write the multi-zone trim charge calculation logic in your own words.
7. One zone on a 4-zone system runs weak while the other three are fine. Is this more likely a system-wide charge problem or a single-branch/component issue? What would you check first?
8. What makes an indoor coil cleaning "graded as strictly as a refrigerant procedure" in this lesson's bench checkout?
9. Why does a musty smell on startup usually require physically cleaning the blower wheel rather than just spraying a stronger cleaner?
10. Name the three competencies this lesson, combined with 9.1–9.8, completes for Job Function 18.
11. Describe the blower wheel's set-screw and shaft-alignment mechanics, and name the one step that prevents a post-cleaning noise complaint.

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