

Single-Zone Install, Start to Finish

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 48 (completes) — "Install single-zone ductless mini-split systems (indoor head, outdoor unit, lineset, and electrical)" **Class time:** ~8 hrs (2 video/discussion + 6 bench, full mock install)

1. What you'll be able to do

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

- Run a **complete single-zone mini-split install from bare wall to running system**, in the correct order, without skipping a step.
- Choose correct locations for the indoor head and outdoor unit BEFORE any tool touches the wall, based on airflow throw, condensate path, service clearance, and line-set length limits.
- Mount the indoor wall plate level and correctly positioned, cut and seal the wall penetration, and route a line set that a homeowner would be proud to see uncovered.
- Set and level an outdoor unit on a pad or wall bracket correctly, with vibration isolation.
- Sequence pressure test → evacuation → charge verification → startup correctly, and explain why that order is non-negotiable.
- Hand a customer a finished install with a walkthrough, not just a running unit.

This lesson is the spine of the unit — 9.3 (flares), 9.4 (electrical), 9.5 (condensate) go deep on three steps that only get a summary treatment here. Read this lesson first, then go do the deep-dive on each specialty skill, then come back and run the whole sequence again on the bench.

2. Tools & materials

Layout & mounting: tape measure, level (torpedo + 2ft), stud finder, pencil, indoor wall mounting plate (comes with unit), core drill (2–2.5") or long masonry/wood bit for the wall sleeve, hole saw kit, caulk gun + exterior sealant, wall anchors/screws appropriate to substrate

Line set & piping: pre-insulated line set (correct diameters for the model — check spec sheet), tube cutter, reamer, eccentric flaring tool + torque wrench (full detail in 9.3), Nylog, line-hide/lineset cover kit, UV-resistant tape or armaflex for outdoor runs

Electrical: per Lesson 9.4 — whip/cable for outdoor unit, disconnect, interconnect cable (indoor↔outdoor), wire nuts/connectors rated for the terminal block

Condensate: per Lesson 9.5 — drain hose/tubing, condensate pump if gravity isn't available, insulation for the drain line

Vacuum/charge: micron gauge, two-stage vacuum pump, digital scale, refrigerant manifold/hoses rated for the system's refrigerant, nitrogen tank + regulator for pressure test

Outdoor mounting: pre-formed composite pad OR wall bracket kit rated for the unit's weight, rubber vibration isolation pads, level

Safety: safety glasses, gloves, fall protection if working above ground level, PPE per Lesson 3.8/4.3

3. Watch first

Order	Video	Channel	Length	Why
1	Installing a Mini Split Wall Bracket and Mounting the Unit!	AC Service Tech	3:10	Quick visual anchor for the outdoor unit before the long-format videos
2	Mini Split Replacement and Install Process! Wall Mounted Indoor Unit! All the Small Important Steps!	AC Service Tech	58:41	The full sequence, indoor-unit-focused, with every "small important step" named — this IS today's lesson on video
3	Full Installation of Mini Split Ductless Unit, Step by Step!	AC Service Tech	1:28:33	The complete job, start to finish, including outdoor unit and startup — watch this end to end before your own bench install
4	Ductless System Install and Maintenance	HVAC School	1:15:40	Second full-length install from a different installer/brand — compare the sequence against video 3
5	This is NOT how to Install a DUCTLESS unit Time to get it RIGHT!!	Quality HVACR	11:49	Common install mistakes — watch AFTER you've seen a correct install once, so the mistakes actually register
Reference	Mitsubishi Mini Split Installation Tips!	AC Service Tech	5:36	Brand-specific gotchas — good habit to check for your specific brand before every real job

4. The idea

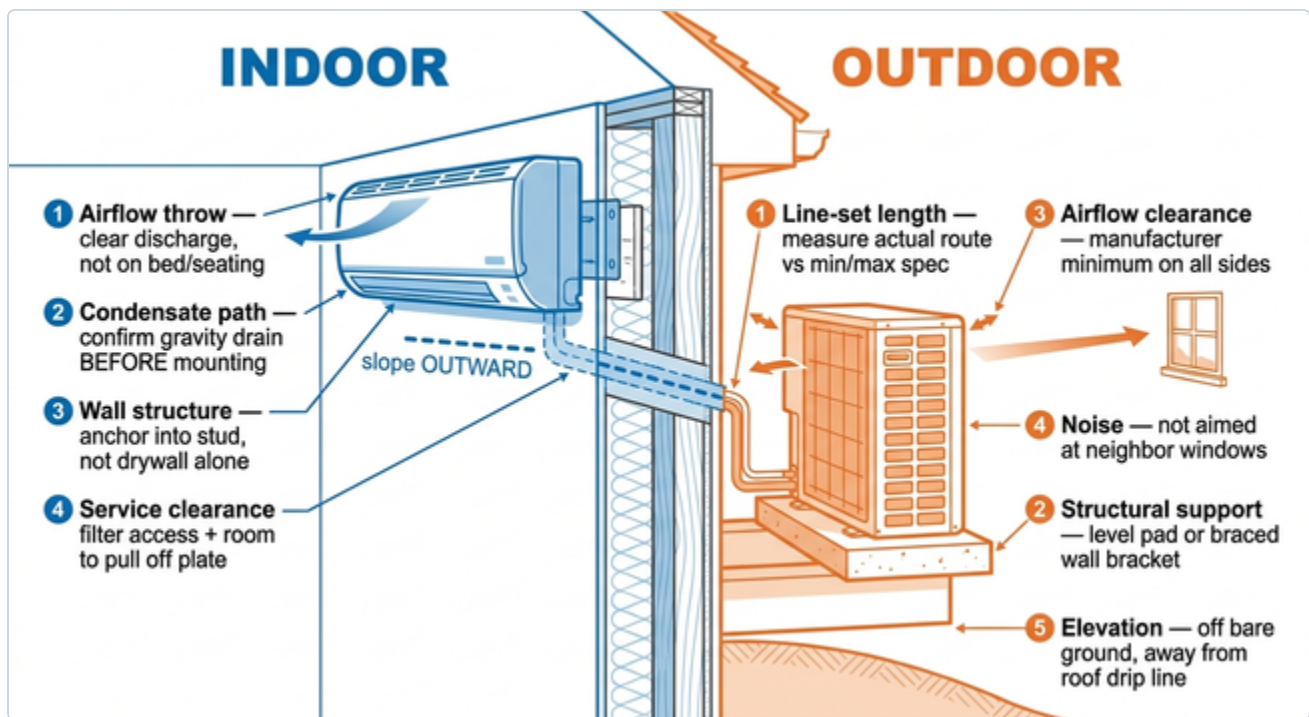
The install is a sequence, and the sequence is the whole skill

A mini-split install isn't a pile of tasks done in any order — it's a sequence where **each step either protects or ruins the next one**. Mount the indoor unit before you've confirmed the outdoor unit location and you might discover the line-set run is too long. Charge the system before you've pressure tested and you're chasing a leak with expensive refrigerant already in the lines. This lesson's whole job is to burn the correct order into your hands so it becomes automatic — the same way "compressor → condenser → metering device → evaporator" became automatic in Lesson 1.1.

The two big planning decisions come BEFORE any tool touches anything

Indoor head placement is not "wherever looks good." Get it right by checking, in order: 1. **Airflow throw** — high on a wall (7ft+ typical), nothing blocking discharge for the first several feet, not blowing directly on a bed or a seating spot, not blocking the return-air path with furniture. 2. **Condensate path** — can this location drain by gravity to the outside, or will it need a pump (Lesson 9.5)? Decide the drain BEFORE you decide the head location, not after — moving a mounted head because "the drain won't work" is a callback waiting to happen, done twice. 3. **Wall structure** — enough clear wall for the mounting plate, a stud or blocking to anchor into (never just drywall anchors for the full weight), enough depth behind the wall for the sleeve to run straight through with a slight OUTWARD slope (so any condensate that does form in the sleeve drains outside, not inside). 4. **Service clearance** — filter access, the manual's minimum clearance to ceiling/side walls, room to pull the unit off the plate later for cleaning (Lesson 9.9).

Outdoor unit placement — check, in order: 1. **Line-set length** — measure the ACTUAL route (not straight-line distance) from the planned indoor location to every candidate outdoor spot. Compare against the model's MIN and MAX line-set length and MAX lift (vertical rise) in the spec sheet. Going over max length or lift without the right accessory kit costs you capacity and can void warranty. 2. **Structural support** — pad on solid, level, well-drained ground OR a wall bracket rated for the unit's weight into structural framing, not siding alone. 3. **Airflow and clearance** — the manual's minimum clearances on all sides for intake/discharge air, away from dryer vents, away from where snow/leaf debris piles up, not under a roof edge that dumps water/ice on it. 4. **Noise and neighbors** — outdoor units are quieter than legacy equipment but still audible; don't aim discharge air or vibration at a neighbor's window or a bedroom wall. 5. **Elevation** — off bare ground (pad, feet, or riser legs) so mowing debris, standing water, and eventually ice don't sit against the base pan.

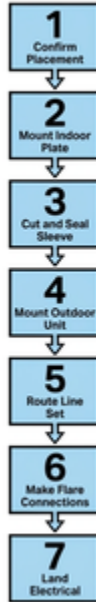


What "min/max line-set length" actually looks like on a real spec sheet: pulled from an actual manufacturer's install manual, a small single-zone lineup shows max allowable line length climbing with capacity — roughly 50 ft on the smallest 9K unit up to 98 ft on a 36K unit — but **max elevation (lift) stays flat at 33 ft across every size in that lineup**, in both directions (indoor-over-outdoor or outdoor-over-indoor). That flat elevation number regardless of capacity is a real, checkable fact worth knowing: bigger capacity buys you more horizontal reach, but it does NOT automatically buy you more vertical lift — verify lift separately, every time, even on a "big" unit that seems like it should handle anything.

The install sequence (memorize this order)

1. Confirm placement (above) → 2. Mount indoor wall plate → 3. Cut/seal wall penetration → 4. Mount outdoor unit → 5. Route line set + interconnect wire + condensate line together → 6. Make flare connections (Lesson 9.3) → 7. Rough in electrical (Lesson 9.4).

INSTALL SEQUENCE — PART 1 OF 2



1. Rough in condensate (Lesson 9.5) → 9. Pressure test with nitrogen → 10. Evacuate to spec, decay test → 11. Release factory charge / weigh in trim charge → 12. Power up, functional test all modes → 13. Commission and record baseline data (Lesson 9.6) → 14. Customer walkthrough.

INSTALL SEQUENCE — PART 2 OF 2



Why THIS order matters: pressure test and evacuation must happen before any refrigerant is released into the lines — reversing that order means you're pressure-testing (and possibly venting) refrigerant into the atmosphere, which is both wasteful and, on larger charges, an EPA

608 violation (Lesson 5.2). Functional test and commissioning happen dead last because you need a fully assembled, charged, powered system to get real data.

Replacement vs. new install — a different job with a step bolted onto the front

Everything above assumes new construction: bare wall, no existing equipment. A **replacement/changeout** — pulling out a dead or dying mini-split and putting a new one in the same spot — is genuinely different work, not just "the same steps with old parts in the way":

- **Recovery comes first, before anything else is disconnected.** The old system's refrigerant charge has to come out of it properly (Lesson 5.3's recovery procedure, unchanged) before you touch a single fitting. In practice: weigh your recovery tank BEFORE you start (know how much room you have, don't overfill it), remove the Schrader valve core with a valve-core-removal tool before recovering — the core is a real restriction that slows recovery dramatically, and pulling it first is standard practice, not a shortcut. Recover, let the pressure rise as trapped liquid flashes to vapor in the accumulator, recover again, repeat until the pressure stays down. This is Unit 5 material applied specifically to a changeout — if it's rusty, review Lesson 5.3 before the job, not during it.
- **You may inherit code violations from the original install.** Real example: a tech doing a changeout found the original whip wired with a white conductor carrying one of the two 120V legs instead of the required red/black hot-leg coloring — a miswire that had been live and wrong since day one. Finding something like that isn't a reason to walk away, but it IS something you fix and document, not something you wire back the same wrong way because "that's how it was."
- **Existing holes and line sets are a judgment call, not an automatic reuse.** If the existing wall penetration and line-set routing are in good shape and the new unit's connection sizes match, reusing them saves real time. But "it was already there" isn't a pass on inspecting it — check insulation condition, check for kinks or rub-through, and if the new equipment uses different line diameters, you're running new line set regardless.
- **Everything after removal is the same sequence as a new install** — Steps 2–14 above don't change. The only real addition is the recovery-and-removal work bolted onto the front.

5. Bench procedure — the full install, step by step

Instructor pre-selects a mock wall section and outdoor mounting point with a defined line-set run. Work in pairs. This procedure assumes flare-making, electrical terminations, and condensate routing are done to the DETAILED standards taught in Lessons 9.3–9.5 — those lessons cover the "how," this one covers the "when" and "why in this order."

1. **Site check.** Walk both candidate locations. Measure the actual line-set route. Confirm it's within the model's min/max length and lift. Confirm a condensate path exists from the planned indoor location. Write down your line-set length and lift before touching a tool — this number decides your trim charge later (Lesson 9.6).

2. **Mount the indoor wall plate.** Level it (check BOTH axes — a plate that's level side-to-side but tipped front-to-back will drain wrong). Anchor into structure, not just drywall. Mark the sleeve hole location per the plate's template — normally offset to one side, never dead center, so the indoor head can hang on the plate's hooks with the piping clearing the wall.
3. **Cut the wall sleeve.** Drill/core from inside to outside where possible for a cleaner exterior finish; sleeve is sloped slightly DOWN toward the outside (a level bubble held against the sleeve should show outside-low) — a real manufacturer manual quantifies this exactly: the outside hole should be at least 1/2" (13mm) LOWER than the inside hole, "so it slants slightly downward." Deburr the hole edges — sharp edges will cut line-set insulation over years of thermal movement. **Insert a short length of PVC pipe into the finished hole** (filed smooth on the inside edge with a round file, sealed around the outside with silicone or exterior sealant, held in place with a single screw so it can't push out) — this gives you a clean, protected channel to fish the line-set bundle through and permanently seals the wall penetration against heat loss, insects, and moisture, since you won't get easy access to this hole again once the indoor head is mounted.
4. **Set the outdoor unit.** Pad leveled on compacted/drained ground, or bracket anchored into structural framing. Rubber vibration-isolation feet under the unit — skipping this is how vibration transmits into bedroom walls and becomes a customer complaint six months later. Confirm manual clearances on all sides.

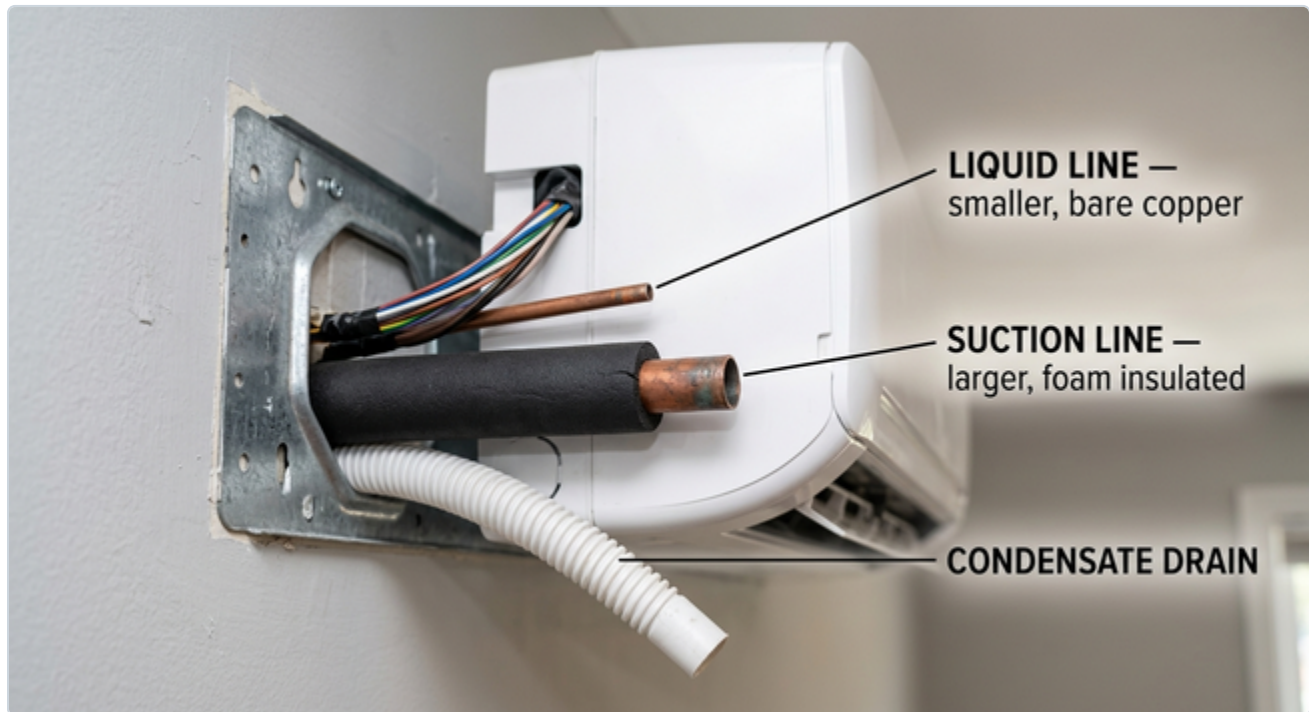
Wall-bracket mounting, in practice (high-wind locations, elevated installs, or anywhere a pad isn't practical): heavy-duty wall bracket kits (e.g. Diversitech-style) ship with leveling inserts in the hardware pack — screw the anchor plate to the wall first, snug but not fully tight, then thread the plastic leveling inserts in behind each mounting foot. Set a bubble level ON the bracket itself (not just eyeballing the wall) in both directions — side-to-side AND front-to-back — and back individual inserts in or out until it's true both ways before you fully tighten anything. Position the bracket using the unit's OWN dimensions, not a guess: measure the unit's width and the offset from its edge to its service-valve/line-set connections, then mark the wall so the line set lands where you actually want it to exit, not wherever the bracket happened to go. Four anchors minimum, into structural framing (masonry anchors in block/brick, lag bolts into studs in frame construction) — hold the bracket in place until every anchor is fully seated; a bracket that's "mostly" fastened while you check level is a bracket that can shift and drop a running compressor.

5. **Route the line set, interconnect wire, and condensate line together** through the sleeve, taped as a bundle (per manufacturer — usually NOT with metal ties that can crimp lines), from indoor head to outdoor unit. Support the bundle outdoors so it doesn't sag or rub (rubbing = the #1 hidden refrigerant leak point over time, alongside flares). **Before you cut the factory caps off the indoor unit's line stubs, crack one loose and listen/feel for the nitrogen holding pressure most factory-charged line sets ship with** — pressure escaping confirms no leak occurred in shipping or handling; no pressure escaping is a reason to inspect further before you build the rest of the install on top of it.

6. **Make the flare connections** at both ends per Lesson 9.3's standard (cut square, deburr, eccentric flare tool, Nylog on the flare face, torque wrench to spec). Do not tighten past spec "for good measure" — over-torqued flares crack. **Insulate BOTH lines, not just the suction line** — unlike the standard split systems in Units 5–7, where only the suction line runs cold because the metering device sits at the indoor

coil, most mini-splits locate the EEV in the OUTDOOR unit. That means the line reaching the indoor coil is already past the metering device and running cold too, in cooling mode. Leave either line bare and you've built in a future condensation-damage callback.

This is what the indoor head's connection point actually looks like once the unit is lifted off its mounting plate — liquid line, suction line, and condensate drain, all in the same tight space Lesson 9.3 warned you about:



7. **Land the electrical** per Lesson 9.4: dedicated circuit to the outdoor unit sized from nameplate MCA/MOP, disconnect within sight of the outdoor unit, interconnect cable terminals landed in the CORRECT S1/S2/S3 order at both ends (mismatched terminal order is the single most common "it never worked right" mini-split callback). 8. **Rough in the condensate** per Lesson 9.5: gravity slope confirmed with a level over the full run, or condensate pump mounted and wired with its safety interlock. 9. **Pressure test with nitrogen** (review Lesson 4.5's procedure — it applies here unchanged): pressurize to test pressure, hold time per spec, watch for pressure drop. Do NOT skip this because "it's a small line set" — small line sets leak too, and finding it now costs you five minutes; finding it after charging costs you a full recovery and re-do. 10. **Evacuate to 500 microns with a decay test** (Lesson 4.6's procedure, unchanged) — vacuum pump on the LOW side, micron gauge as far from the pump as possible, isolate and watch for 10+ minutes to confirm the reading holds. 11. **Release the factory charge** (open the service valves per manufacturer sequence — brands differ, check the unit's label) and, if your line-set length exceeds the factory-allowed base length, **weigh in the calculated trim charge** using the digital scale (full charging procedure in Lesson 9.6). Back the valve stems out with the correct Allen wrench ONLY until they stop against the body — forcing a stem past its stop can pop the valve's internal retaining ring and release refrigerant uncontrolled. Full detail in Lesson 9.6. 12. **Power up and run a full functional test:** cooling call, heating call (if heat pump model), fan-only, and — critically — a forced defrost or at minimum confirm the unit reports

normal operation with no fault code on the display/remote. 13. **Commission and record baseline data** per Lesson 9.6 — this is what makes the NEXT tech's life possible when this unit has a problem in year 6. 14. **Customer walkthrough:** filter cleaning schedule, what normal operation sounds/looks like (a swoosh or brief steam during defrost is normal, not a leak), how to use the remote/app, and "leave the setpoint alone — don't toggle it on and off trying to make it work faster."

Checkout (graded, pass/redo): Student pairs run a complete mock install from Step 1 to Step 14 on the bench mock-up, narrating each decision point (why this indoor location, why this outdoor location, why this order) to the instructor as they go. This is the full Competency 48 checkout.

6. Field gotchas

- **The #1 callback on ANY mini-split install is a flare leak — and it's always found by the guy who didn't cut it square or skipped the torque wrench.** Full depth in Lesson 9.3; the discipline starts here in the plan.
- **Undersized or missing service clearance turns every future filter cleaning into a fight.** Plan clearance now; the tech who has to clean this unit in three years might be you.
- **Wrong terminal order at S1/S2/S3 is the classic "installed fine, never worked right" call.** Land both ends the SAME order, verify against the manual's diagram before powering up — not after.
- **Skipping the pressure test "because it's a small system" is how techs learn the hard way.** Nitrogen and 10 minutes cost nothing; a callback after charging costs a recovery, a new evacuation, and your credibility.
- **Outdoor unit set flat on bare ground WILL settle, tip, and eventually stress the line-set connections.** A pad, level, on compacted or well-drained ground is not optional in Alabama clay.
- **Oversizing the head for the room** (see Lesson 9.1) undoes the entire comfort/efficiency pitch — check the manufacturer's room-size/BTU guidance against ACTUAL load, not "the old window unit was bigger so let's go bigger."
- **Ignoring line-set max length/lift without ordering the right accessory** (larger line set, additional charge, or a model-specific long-line kit) causes chronic undercharge symptoms that look like a leak but aren't.
- **Insulating only the suction line out of Unit 5/7 habit** leaves the second cold line bare on equipment where the EEV sits in the outdoor unit — a slow, hidden condensation problem that shows up as a mystery stain months later.
- **Skipping the crack-the-cap nitrogen check on a new indoor unit** means you could build an entire install on top of a line set that was already damaged in shipping.

7. Competency link

- **Competency 48 (completes here)** — full single-zone install: indoor head, outdoor unit, line set, and electrical, per this lesson's Step 1-14 sequence.
- Feeds directly into 9.3 (flares), 9.4 (electrical), 9.5 (condensate) — the deep-dives on three steps in this sequence — and 9.6 (commissioning), which is Step 13 done in full detail.
- Cross-references: Lesson 4.5 (nitrogen pressure test), Lesson 4.6 (evacuation), Lesson 5.2 (EPA 608 — never vent refrigerant), Lesson 5.3 (recovery procedure — applied here to changeout jobs), Lesson 9.1 (why oversizing costs you the inverter benefit).

8. Check yourself

1. List the 14-step install sequence from memory, in order.
 2. Name the four things you check BEFORE choosing an indoor head location, in the order you check them.
 3. Name the five things you check BEFORE choosing an outdoor unit location.
 4. Why must the wall sleeve slope slightly toward the outside?
 5. Why does pressure testing have to happen BEFORE releasing any refrigerant charge?
 6. What happens if you exceed a model's maximum line-set length or lift without the correct accessory kit?
 7. Why is the terminal order (S1/S2/S3) at both ends of the interconnect cable so easy to get wrong, and what's the consequence?
 8. What's wrong with setting an outdoor unit flat on bare, ungraded ground?
 9. A customer wants the indoor head mounted in the "perfect" spot for looks, but there's no way to gravity-drain condensate from there. What do you tell them, and what are the options?
 10. Why does customer walkthrough belong on this checklist at all — isn't the job done once it's running?
 11. What single procedure gets bolted onto the FRONT of the install sequence when a job is a replacement instead of new construction, and why must it happen before any disconnection?
 12. During a changeout, you discover the original installer used white wire on a hot leg instead of red/black. What do you do?
 13. What can happen if you force a service valve stem past its stop with the Allen wrench?
 14. Why does a mini-split typically need BOTH refrigerant lines insulated, unlike the standard split systems from Units 5-7?
 15. What's the quick pre-install check for a shipping-damaged line set, and what does it tell you?
 16. Why insert a piece of PVC into the wall penetration instead of just leaving the drilled hole as-is?
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