

Flares That Never Leak (Field Application)

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 — "Install single-zone ductless mini-split systems (indoor head, outdoor unit, lineset, and electrical)" **Class time:** ~4 hrs (1 video/discussion + 3 bench/field mock-up)

1. What you'll be able to do

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

- Make a leak-free flare **under real field conditions** — line set already run through a wall sleeve, valve stub in an awkward position, tube supported only by your hand and a bracket, not a comfortable bench vise.
- Explain **why the mini-split flare specifically is the #1 leak point in the entire ductless trade**, with the numbers to back it up (industry callback data, not just "be careful").
- Inspect a suspect flare found on a service call and decide, correctly, whether to re-torque, re-make, or leave it alone.
- Recognize and reject low-quality shortcuts (bad factory quick-connect fittings, reused flares, skipped backup wrench) before they become your callback.
- Field-verify a completed flare with nitrogen and bubble solution before you ever pull a vacuum on it.

This lesson assumes Lesson 4.2's flare ritual is already in your hands. If cut-deburr-nut-height-form-inspect isn't reflexive yet, go back and get more reps on the bench before this lesson — today is about applying that exact ritual where it actually counts: on a customer's wall, on refrigerant lines that will run for fifteen years unattended.

2. Tools & materials

- Full field flaring kit: eccentric flaring tool, tube cutter, reamer/deburr tool, torque wrench with crowfoot adapter, backup wrench, Nylog Blue
- Nitrogen tank + regulator + hose, bubble solution and brush
- The unit 9.2 mock install (line set already routed through the wall sleeve, valve stubs mounted at realistic height/position)
- Flare inspection gauge/loupe

- A collection of "suspect" pre-made flares (some good, some deliberately bad) for the inspection drill
- Extra soft copper for do-overs — field mistakes cost inches, not the whole run, IF you planned extra length

3. Watch first

Order	Video	Channel	Length	Why
1	How to Make Ductless Flares That Won't Leak	HVAC School	24:44	The mini-split-specific version of the 4.2 ritual — same fundamentals, ductless-specific pressures and valve stubs
2	Flaring and Preventing Leaks on Ductless Systems	HVAC School	23:31	Field failure analysis specific to this equipment class
3	How To: Properly FLARE Refrigerant Pipes On A DUCTLESS Mini Split	Quality HVACR	5:08	Fast field-jobsite version — what it actually looks like on a real install
4	How To Get PERFECT Flares For Ductless Mini Splits Navac Powered Flaring Tool!	Quality HVACR	15:41	Power-flaring-tool option — useful for volume install work
5	Why Eccentric Flaring Tools Make The Best Mini-Split FLARES!	AC Service Tech	5:36	Quick refresher on WHY this tool, specific to mini-split pressure
Reference	Mini-Split Refrigerant Leak? Here's How to Find It	Taddy Digest	14:53	The other end of the story — field leak-finding when a flare has already failed

4. The idea

Why the flare owns the mini-split callback statistics

Every refrigeration system has joints that can leak — but a residential split system typically has ONE field joint per line (a single braze at each end, or none if it's a factory-precharged quick-connect). A mini-split has **at minimum four flare joints** (two at the indoor head, two at the outdoor unit) and often more on a multi-zone job — and unlike a brazed joint, a flare is a **mechanical seal that depends entirely on geometry and torque**, not metallurgy. Every brand's tech support line and every distributor's warranty data says the same thing: **flares are the single largest source of ductless refrigerant leak callbacks in the industry**. That's not a scare tactic — it's why this lesson exists as its own lesson instead of a bullet point inside 9.2.

The physics: R-410A and R-32 systems run at meaningfully higher pressures than the R-22 systems flares were originally standardized around — 400–600+ psi on the high side isn't unusual. A flare that would have "probably been fine" on old equipment gets found out fast on modern refrigerant pressures.

On a heat-pump mini-split, "high side" isn't fixed to the outdoor unit the way Lesson 8.1's reversing-valve content might make you assume. In heat mode, the indoor coil becomes the condenser — meaning it sees high-side pressure, and so does every joint in the line set carrying refrigerant to it. That's part of why this equipment's flares get pressure-tested harder than you might expect from a "small" system: the whole line set has to be built to handle high-side pressure in heat mode, not just cooling-mode pressure. When you pull the nitrogen test pressure from the unit's data plate (rather than assuming a number), remember the actual pressure-limited weak point on most systems isn't the line set at all — it's the compressor shell, protected by a fusible plug rated well below the line set's real capability. Testing to the data plate's stated design pressure keeps you safely under that limit without under-testing the joints you actually made today.

This is what a correct flare and the nut that seats it actually look like up close — the geometry the whole ritual exists to protect:



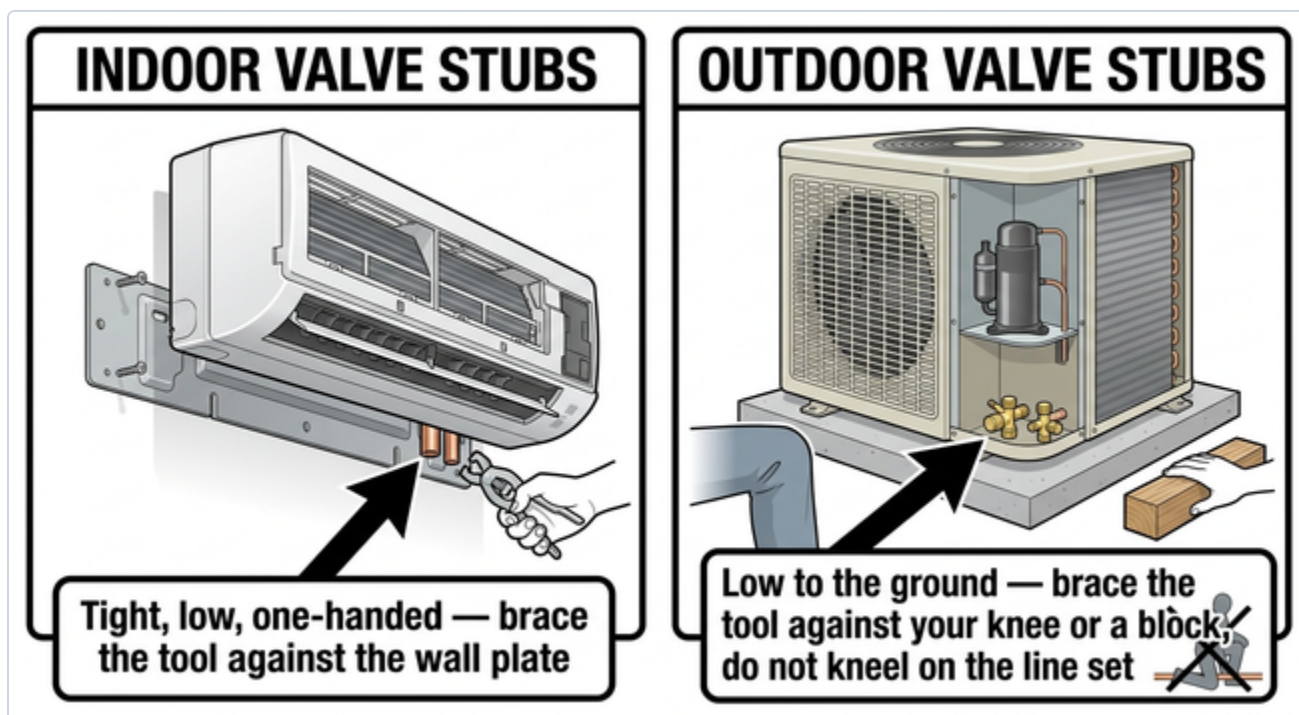
The field problem the bench doesn't teach you

Lesson 4.2 taught the ritual in a vise, at a comfortable bench height, with both hands free. On a real job:

- The tube is already routed and taped into a bundle with the interconnect wire and condensate line — you're forming a flare on a tube you can't freely rotate or pull out to a comfortable position.
- The valve stub might be low, high, behind the unit, or in a tight sleeve opening — you're working one-handed half the time, bracing the tool against your body.

- You often don't get a do-over without cutting BACK into your line-set length — which is why Lesson 9.2's step 1 (measure the actual route, and always run a little extra) matters here specifically.

The fix is not a different ritual — it's the same ritual, done more carefully, with the tube properly supported and braced even when the position is awkward. Rushing a field flare because "it's hard to get to" is exactly how the statistic above gets made.



Factory quick-connect fittings — know them, and know why we don't default to them

Some manufacturers and some line-set kits offer pre-flared, pre-charged quick-connect fittings marketed as "no flaring required." **Treat these with real skepticism on a professional install:**

- The factory flare quality on cheap kits is inconsistent — you're trusting a seal you didn't make and can't inspect.
- Many manufacturers explicitly warn against or void warranty on quick-connect fittings for anything but the shortest, simplest runs.
- They remove your ability to trim the line set to the ACTUAL route length — you're stuck with whatever length the kit shipped with, coiling excess (which causes oil-return problems, Lesson 9.9) or falling short.

Program standard: field-made flares, cut to actual length, every time, unless a specific manufacturer's install manual calls for a quick-connect on a specific short-run model. When in doubt, flare it yourself.

Real torque numbers vary by brand — proof, not just a warning

Lesson 4.2 gave you one torque table to build reps on. Pull the actual install manuals for five different mini-split brands and lay their torque tables side by side, and you get real proof of why this lesson keeps saying "verify against THIS unit's manual":

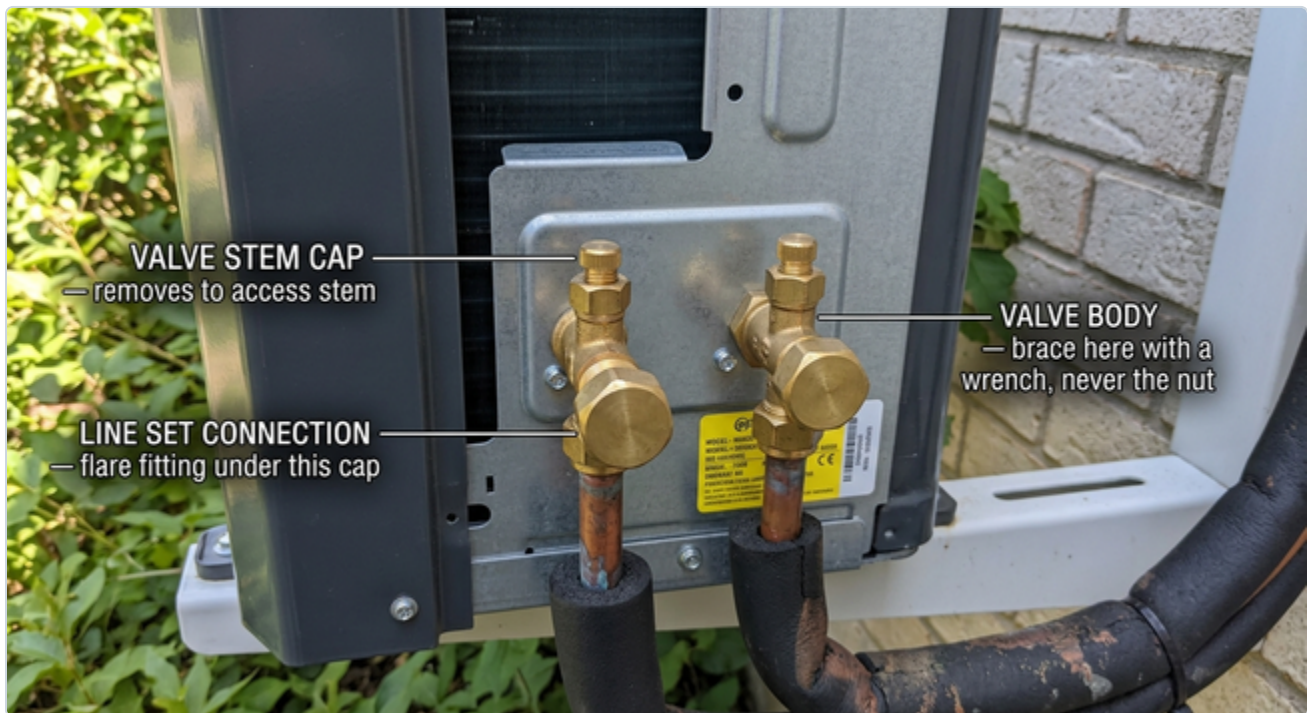
Line OD	ComfortStar	Trane	Midea-built (Comfort-Aire/GE)	IRP/Innovair	Lennox (FJM)
1/4"	13.3-14.8 ft·lb	11.1-14.8 ft·lb	13.3-14.8 ft·lb	11-15 ft·lb	10.3-13.3 ft·lb
3/8"	23.6-28.8 ft·lb	22.9-25.8 ft·lb	22.1-25.8 ft·lb	25-30 ft·lb	25.1-31.0 ft·lb
1/2"	36.1-43.5 ft·lb	33.2-36.9 ft·lb	33.2-36.9 ft·lb	36-42 ft·lb	36.1-45.0 ft·lb
5/8"	—	44.3-48.0 ft·lb	44.3-48.0 ft·lb	54-58 ft·lb	50.2-60.5 ft·lb

Every brand is in the same neighborhood, but **none of them are identical**, and the 5/8" column shows a real spread (44 ft·lb low end to 60.5 ft·lb high end across brands — that's not rounding error, that's a genuinely different spec). A torque wrench set to a number memorized from one brand's chart, used on a different brand's flare, is either under-torqued or over-torqued by a margin that matters. Pull the specific unit's manual every time — this table exists to prove the point with real numbers, not to give you one to memorize instead.

This is the two-wrench technique the table above assumes you're already using — backup wrench on the valve body, torque wrench doing the actual work on the nut:



And this is what you're protecting on the other end of that line set — the outdoor unit's service valve assembly, brass caps over the stem and the line-set connection itself:



A real manufacturer prohibition worth knowing

At least one major mini-split manufacturer's install manual states, in bold capital letters: **"DO NOT INSTALL A LIQUID LINE SIGHT GLASS OR FILTER DRIER IN THE SYSTEM."** If your only refrigeration experience before this program was residential split-system service, where field-installed filter driers are routine, this is a real habit to unlearn — factory-charged inverter mini-splits are engineered as a sealed system, and adding aftermarket components not called for in the manual can introduce exactly the kind of restriction or contamination path this unit's design is trying to avoid. When in doubt, install nothing the manual doesn't call for.

Inspecting a suspect flare on a service call

You'll spend as much career time inspecting OTHER people's flares as making your own. The decision tree:

What you find	What it means	What you do
Slight seep, flare face looks clean, correct torque mark visible	Under-torqued	ONE quarter-turn with a torque wrench, re-check. Past that, re-make (per 4.2's rule)
Visible crack at the rim	Over-torqued or work-hardened copper	Cut it off, re-flare fresh — never re-tighten a cracked flare
Scored or pitted flare face	Contamination or a damaged cone was used	Cut it off, re-flare with a clean tool
Nut backed off, valve body rotated	No backup wrench was used originally	Re-make the flare AND check the valve body/service port for internal damage before trusting it again
Flare looks perfect, unit still leaking there	Rare, but happens — pressure-test to confirm before you condemn the flare and disturb a joint that wasn't the problem	Nitrogen + bubble test that SPECIFIC joint before touching it

5. Bench/field procedure

Work on the Lesson 9.2 mock install — line set already routed and taped through the wall sleeve, valve stubs mounted at realistic height.

1. **Brace before you cut.** With the tube already routed, identify how you'll support it during cutting, deburring, and forming without kinking or stressing the run. Narrate your plan to your partner before starting.
2. **Cut to the length the actual route requires** — not a convenient bench length. Cut square (4.1 skill), light passes.
3. **Deburr and ream, chips pointing away from the tube** — in a tight space this is easy to rush; don't.
4. **Slip the nut on. Check it twice** — in an awkward position it's even easier to forget than on the bench.
5. **Set tube height and form the flare** using the eccentric tool, braced against the wall/ bracket/your body as needed, one drop of Nylog on the cone and flare face.
6. **Inspect with the loupe** — even witness ring, correct OD, no cracks or scoring. If it's not right, cut it off (you planned extra length) and do it again. **Do not install a flare you wouldn't pass on the bench just because it was hard to make.**
7. **Repeat at all four valve stub locations** (indoor liquid, indoor suction, outdoor liquid, outdoor suction) — each one a slightly different position and challenge.
8. **Assemble to torque spec with backup wrench** at every joint (table is in Lesson 4.2 — it applies unchanged here).
9. **Field pressure-verify:** nitrogen to test pressure, bubble solution on every flare face and nut, watch for a full minute per joint before moving to the next. Any bubbles = stop, cut, re-make that joint — do not "snug it a little more" on a bubbling flare.

10. **The suspect-flare drill:** instructor hands each student pairing 3 pre-made flares (mix of good and deliberately bad). Student inspects each using the decision table above and states verdict + action out loud.

Checkout (graded, pass/redo): Student makes and installs all four flares on the mock install in realistic field positions, passes nitrogen+bubble verification on all four, and correctly calls the verdict on all three suspect-flare drill samples. This closes out the hands-on portion of Competency 48 alongside Lesson 9.2.

6. Field gotchas

- **"It's hard to get to" is not a reason to skip a step — it's a reason to slow down.** Every shortcut in the flare ritual gets easier to justify in a cramped attic or a tight sleeve opening. That's exactly where it matters most.
- **Carry extra line-set length on every job.** A botched field flare costs you inches; running out of tube because you cut exactly to the measured length costs you a trip back to the supply house.
- **Reused/re-pinched flares are never acceptable** — if a flare has to come apart for any reason (wrong torque, inspection failure, valve swap), cut it off and make a fresh one. A copper flare face doesn't reform cleanly a second time.
- **Cold-weather field flares crack more** — the same 4.2 rule applies doubled outdoors in winter: warm the tube before forming.
- **Quick-connect kits look like a time-saver and become a callback generator** on anything but the shortest, manufacturer-approved runs — see above.
- **A "textbook perfect" flare that still leaks is rare but real** — before you assume you're losing your mind, confirm with nitrogen+bubble on that specific joint rather than tearing apart three good connections looking for a ghost.

7. Competency link

- **Competency 48** — field flare-making is a core, non-negotiable skill inside "install single-zone ductless mini-split systems"; this lesson is the field-application checkout that pairs with Lesson 9.2's full install sequence.
- Direct extension of Lesson 4.2 (bench flare ritual) and Lesson 4.5 (nitrogen pressure test procedure) — nothing new to learn mechanically, only the discipline to apply it under field conditions.
- Feeds Lesson 9.7/9.8 in reverse: most inverter "low charge" fault codes trace back to a flare leak, so the inspection discipline here is also a diagnostic skill.

8. Check yourself

1. Why does a mini-split install have so many more flare joints than a typical residential split system?

2. Name three reasons flares are the #1 ductless callback source, beyond "people are careless."
 3. What's different about making a flare on a routed, taped line-set bundle versus on a bench vise?
 4. You find a slightly seeping flare with a visible torque mark and a clean face. What's your first move, and what's the limit before you re-make it instead?
 5. You find a cracked flare rim. Is re-tightening ever the right call? Why or why not?
 6. What are two real risks of relying on factory quick-connect fittings instead of field-made flares?
 7. Why do we carry extra line-set length on every mini-split job?
 8. Describe the field pressure-verification step for a completed flare — what are you testing with, and how long do you watch each joint?
 9. A flare inspects as visually perfect but the joint is still leaking. What do you do before condemning it?
 10. What's the ONE thing this lesson insists you never do to a cracked or damaged flare?
 11. Why does the indoor-unit end of the line set need to handle high-side pressure in heat mode, even though it's "the indoor coil"?
 12. What's the actual pressure-limited weak point on most systems, and why does that matter when you're setting your nitrogen test pressure?
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