

Brazing with Flowing Nitrogen: The Only Way

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 5 — (brazing portion — the heart of it) **Class time:** ~6 hrs (1.5 video + 4.5 torch bench) — the most hands-on lesson in the unit

1. What you'll be able to do

- **Braze copper-to-copper joints that pass nitrogen pressure testing:** correct fit-up, heat pattern, rod timing, capillary draw all the way around.
- **Flow nitrogen through every joint you braze** — rig the regulator/flow setup (2–5 SCFH), explain what it prevents, and show the inside-the-pipe difference.
- Pick filler correctly: **phos-copper (Sil-Fos 15) for copper-to-copper (no flux); 45% silver WITH flux for copper-to-brass/steel** (service valves, driers).
- Braze the real-world joints: lineset to service valve (heat-shielded), filter drier in, evaporator stub — protecting everything nearby (4.3 discipline).
- Judge your own joints: full fillet ring, no overheat crystallization, no rod blobs bridging, no pinholes — then prove them with pressure.

The doctrine in one line: if the torch is lit on refrigerant pipe, nitrogen is flowing through it. No exceptions, no "quick ones."

2. Tools & materials

- The 4.3 rigs (checkout passed = rod privileges)
- **Nitrogen bottle + regulator + flow restrictor/flowmeter** (SCFH scale), hoses, purge tees
- Filler: Sil-Fos 15% sticks, 45% silver + white flux; sandcloth, fitting brushes
- Joint stock: couplings, 90s, swaged ends from 4.2, service valves (sacrificial + good), filter driers, a scrapped evaporator
- The cut-open demo pair from the comparison videos (we make our own: one joint brazed dry, one with N₂ — sawn open)

3. Watch first

Order	Video	Channel	Length	Why
1	Braze Without Nitrogen — Deadly Consequences for Compressors	HVAC School	53:10	The WHY, exhaustively — watch before bench week
2	How to Flow Nitrogen While Braze	HVAC School	11:40	The rig and the flow numbers
3	How to Braze with Nitrogen — Up Close, Start to Finish	AC Service Tech	6:04	The complete joint, on camera
4	With/Without Nitrogen Comparison	AC Service Tech	9:10	The inside-the-pipe evidence
5	Braze Lineset to Service Valves — Full Procedure	AC Service Tech	10:16	The job you'll do most
6	Braze in the Evaporator Coil & Filter Drier	AC Service Tech	12:37	The delicate ones
7	45% Silver for Steel/Brass	HVAC School	5:29	When flux enters
8	Braze Required Practices P2 (Roman Baugh)	HVAC School	55:12	The professional polish

4. The idea

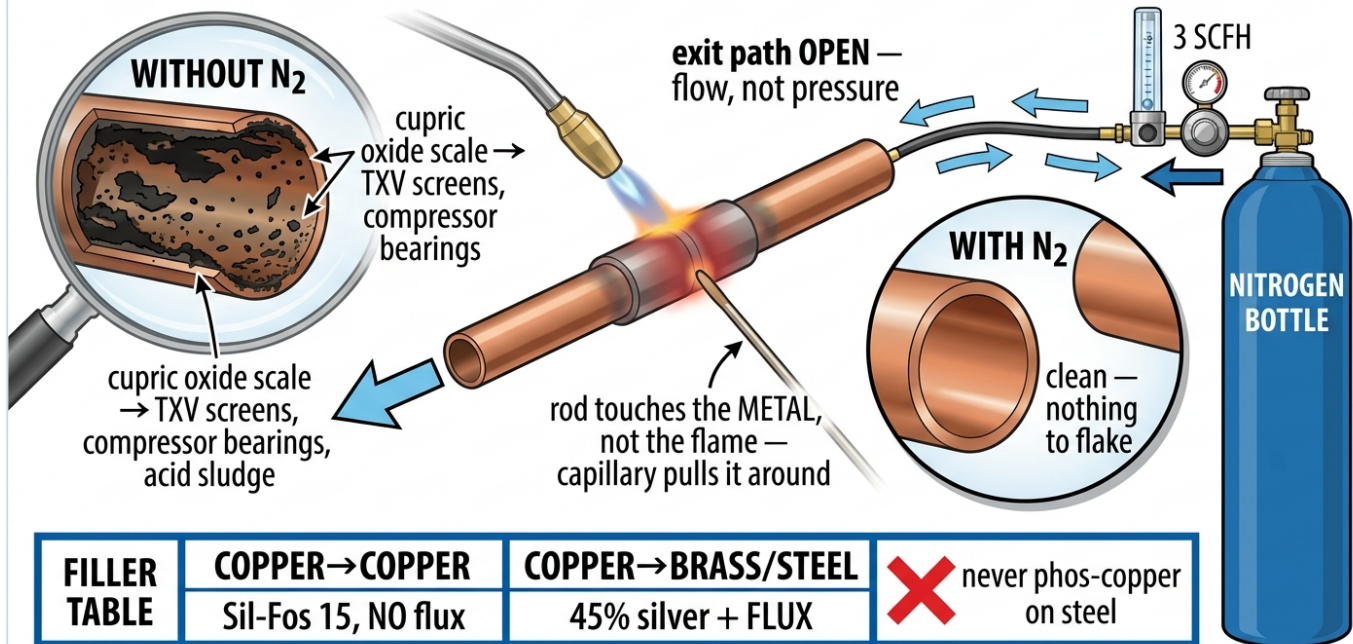
Why nitrogen — the cupric oxide story

Heat copper past ~800°F with air inside and the inner wall grows **black cupric oxide scale**. It flakes off into the refrigerant stream and: packs TXV/EEV screens (the mystery restriction in Unit 5's diagnosis matrix), scores compressor bearings, and turns POE oil into sludge-acid soup.

Flowing nitrogen displaces the oxygen — no oxygen, no oxide. The sawn-open comparison says it better than any paragraph: dry joint = black snowstorm inside; N₂ joint = shiny clean copper.

Flow, not pressure: **2-5 SCFH whispering through the pipe**, exiting somewhere (never braze a sealed, pressurized line — the rod blows out molten at you). If you can hear it hiss at the far end, that's about right.

BRAZING WITH FLOWING NITROGEN — THE FULL PICTURE



Filler decision table

Joint	Rod	Flux?	Notes
Copper → copper	Phos-copper 5–15% Ag (Sil-Fos)	No (phosphorus self-fluxes on copper)	Our bread and butter; 15% flows nicer on sloppy gaps
Copper → brass (service valves)	45% silver	Yes	Lower temp, flux cleans the brass; valve body shielded/wet-ragged
Copper → steel (driers, some stubs)	45% silver	Yes	Phos-copper is BRITTLE on steel — never
Aluminum coil repair	Al-specific rod (AlloySol etc.)	Per rod	Different animal entirely — lower temps, different technique (the two repair videos; advanced elective)

The joint, step by step (copper-to-copper)

- Fit-up:** clean both surfaces to bright metal (sandcloth/brush), proper swage/coupling clearance — capillary action needs a thin, even gap (.002–.006"); sloppy fit begs for blob bridges.
- Nitrogen flowing** (rigged through the circuit, exit path open, 2–5 SCFH).
- Heat the joint, not the rod:** slightly reducing flame (4.3), inner cone just off the metal. Heat the TUBE first, then the FITTING (fitting mass differs), walking the torch around — the whole joint to dull cherry (~1,200°F) **evenly**.
- Rod at temperature:** touch rod to the joint (not the flame) — at temp it flows INSTANTLY and capillary action sucks it around and IN. Chase the rod around the joint with the flame.

You're done when a thin fillet rings the whole circumference — more rod is weight, not strength.

5. **Let it cool gray-dull before moving;** quench rags only when the manufacturer allows (thermal shock cracks fittings). Keep N₂ flowing until the joint is below scale temp.
6. **Inspect:** complete ring, no pits/pinholes, no crystallized (overheated, orange-peel) surface, no solder stalactites inside elbows.

The real-world specials

- **Service valves:** valve body is brass + contains seals — **45% + flux, wet rag/WetRag on the body, core removed or valve mid-seated per design**, heat aimed up-tube, get in and out fast (the cap-n-hook tip earns its keep).
- **Filter driers:** arrow with flow direction, braze QUICKLY (desiccant inside cooks), and it goes in LAST (after all other torch work, right before evacuation — it's the system's kidney, don't make it filter your construction debris).
- **Near a TXV / inside the coil cabinet:** shield everything (4.3), consider wrapping the TXV in WetRag entirely, or unsweat/re-sweat with the bulb removed.

5. Bench procedure

1. **The evidence build:** first 30 minutes — two identical coupling joints, one dry, one with N₂. Saw both open at end of day. Photograph for your notebook. (This pair converts every doubter permanently.)
2. **N₂ rig assembly:** each student rigs bottle → regulator → flowmeter → purge tee → workpiece, sets 3 SCFH, proves exit flow.
3. **Joint ladder (the volume block):** with N₂ flowing on every single one — ① 3/8 coupling ② 5/8 swage-to-tube ③ 3/8 90° ④ vertical-up joint ⑤ vertical-down (the drip teacher) ⑥ 7/8 to a tee. Minimum 10 joints/student; instructor saw-tests random samples.
4. **45% + flux station:** copper stub into a sacrificial brass valve, full shielding ritual. Then the real thing: lineset pair onto a GOOD service valve set, graded.
5. **Drier install:** cut in a liquid-line drier, both joints, fast and clean, arrow correct.
6. **Pressure proof (the reckoning):** every student's ladder assembly gets capped, pressurized with nitrogen to 350 PSI, soap-bubbled at every joint. Leaks get cut out, re-brazed, re-proven — the lesson isn't over until your assembly holds.

Checkout (Comp 5 braze portion): one coupling + one valve joint, full ritual (N₂ flowing, shielding, correct rod), passing the 350 PSI bubble test, narrated. Signed at guided level; the FULL Comp 5 signs after 4.6's capstone.

6. Field gotchas

- **"It's just one quick joint" is how oxide gets in.** The N₂ rig takes four minutes. The TXV screen cleanout it prevents takes two hours and an explanation to the customer.

- **Overheated phos-copper turns crystalline and brittle** — if the joint surface looks like orange peel or the rod "balled up," you were too hot or heating the rod instead of the metal. Cut it out; don't cap a bad braze with more rod.
- **Wind is a heat thief** (rooftops, breezy yards): shield the work or double your patience — half-heated joints make cold-flow gaps that pass a glance and weep at pressure.
- **Old joints repaired over paint/oil residue** spit and pit — clean to bright metal or cut back to virgin tube.
- **Flux is corrosive residue:** on 45% joints, wipe/wash flux remains after cooling or it keeps eating.
- **A2L changeover reminder:** recovered + nitrogen-purged BEFORE flame, always (4.3's rule — repeated because it's now industry law, not just craft).

7. Competency link

- **Comp 5 (brazing)** at bench level; full Comp 5 completes with 4.5–4.6 capstone (pressure test + evacuation of a student-built assembly).
- Joint count keeps accruing in Units 7–9 installs; the N₂ doctrine is graded on EVERY future torch appearance.

8. Check yourself

1. What does flowing nitrogen prevent, chemically, and where does the damage land if you skip it (three destinations)?
 2. Flow rate and the "exit path open" rule — why never braze a sealed line?
 3. Rod for copper-to-copper? Flux? Why not?
 4. Rod for the service valve? What else does that joint demand (three protections)?
 5. Why does phos-copper fail on steel?
 6. Describe "at temperature" — how do you know, and what does the rod do when you're right?
 7. What does a crystallized/orange-peel joint surface confess?
 8. Why does the filter drier go in LAST, and what's on its label that matters?
 9. Your vertical-down joint grew a stalactite inside. What happened and why does Unit 5 care?
 10. The doctrine, one line.
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