

Charging by Total Superheat (Fixed-Orifice Systems)

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 5 • Refrigerants, EPA 608 & Charging • Appendix A Comp 15 — "Charge systems using superheat method (fixed metering devices)" **Class time:** ~4.5 hrs (1 video + 3.5 bench) — requires EPA cert (5.2 gate)

1. What you'll be able to do

- Confirm the system is actually a **fixed-orifice/piston** system (1.2's ID skill — the method depends on it).
- Find **TARGET superheat** from the two air-side numbers: **outdoor dry bulb + indoor wet bulb** (1.6's measurement, now mandatory) via the chart/app/built-in probe math.
- Measure **actual** total superheat (1.4's skill at the outdoor unit) and **adjust the charge toward target**: add to LOWER superheat, recover to RAISE it — in small, patient moves.
- Run the complete professional sequence: airflow verified FIRST → conditions measured → target found → actual measured → charge adjusted → settle time → re-verify → document.
- Recite the guardrails: never below ~5°F superheat (flood risk), the method dies in low ambient (<~55–60°F outdoor), and a TXV system gets a different lesson (5.5).

2. Tools & materials

- Fixed-orifice donor system (our piston-metered bench unit), R-410A supply, scale
- Probes: outdoor DB, indoor WB psychrometer (the 1.6 meter), pipe clamp, gauges/wireless probes
- Target superheat chart laminates + the calculator apps (measureQuick/Fieldpiece built-ins)
- Charging worksheet (our standard — becomes the service-ticket habit)

3. Watch first

Order	Video	Channel	Length	Why
1	Superheat & Total Superheat Explained	AC Service Tech	11:05	The concept, complete
2	Finding Target Superheat to Check the Charge	AC Service Tech	10:44	The chart workflow
3	Finding Target Superheat	HVAC School	15:58	Same skill, deeper why
4	Total Superheat Method — Practice Examples	AC Service Tech	13:20	Worked numbers
5	Superheat Method — 5 Scenarios	AC Service Tech	6:28	The quiz reel — pause-and-answer in class
6	7 Tools to Measure Wet Bulb	AC Service Tech	8:20	The mandatory input (1.6 rewind)

4. The idea

Why superheat charges a fixed orifice

A piston is a dumb hole (1.2): feed it more refrigerant → more liquid into the coil → the liquid front advances → **superheat falls**. Less refrigerant → starved coil → **superheat rises**. Charge level IS the superheat dial on these systems — which is exactly why it can't charge a TXV (the valve fights you to hold superheat constant; that story is 5.5).

Why the target moves (the part bad techs skip)

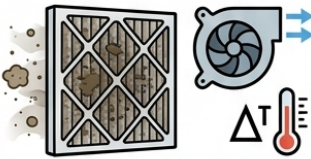
The "right" superheat isn't one number — it depends on the heat load the coil sees:

- **Indoor wet bulb** (heat + moisture entering the coil — 1.6's "one number that bundles both")
- **Outdoor dry bulb** (condenser's working conditions)

Humid 75°F WB indoor air on a 95°F day wants a different liquid front than dry 60°F WB air on an 80°F day. The **target superheat chart** (or app) crosses those two numbers and hands you the spec: anywhere from ~5 to ~25°F. **No wet bulb = no target = you're guessing in public.**

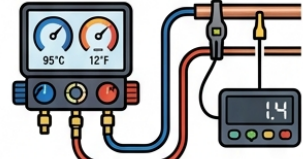
CHARGING BY TOTAL SUPERHEAT – FIXED ORIFICE ONLY

1 AIRFLOW FIRST



filter, blower, ΔT — never charge into bad airflow

5 MEASURE ACTUAL



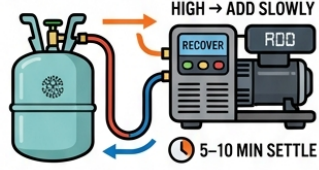
suction sat temp vs line temp (1.4 method)

2 STABILIZE



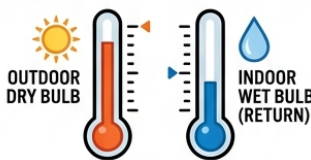
10–15 min runtime

6 ADJUST



HIGH → ADD SLOWLY
5–10 MIN SETTLE
HIGH → add slowly · LOW → recover, never vent · settle 5–10 min between moves

3 MEASURE CONDITIONS



outdoor DRY bulb + indoor WET bulb at return

7 RE-VERIFY



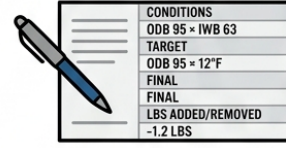
superheat at target $\pm 3^\circ\text{F}$ + sanity: subcool, amps, ΔT

4 FIND TARGET



chart/app: ODB 95 × IWB 63 → TARGET 12°F
chart/app: ODB 95 × IWB 63 → target 12°F — write it down first

8 DOCUMENT



conditions, target, final, lbs added/removed



NEVER below $\sim 5^\circ\text{F}$ SH · method dead below $\sim 55\text{--}60^\circ\text{F}$ outdoor · TXV system? use **SUBCOOLING** instead

The professional sequence

- Airflow first** (the Unit 11 drum, beaten again): clean filter, right blower speed, reasonable ΔT — charging into bad airflow calibrates the charge to a broken condition.
- Stabilize**: 10–15 min runtime, doors/windows as found.
- Measure conditions**: outdoor DB (shade, at the condenser intake), indoor WB at the return.
- Find TARGET** (chart/app). Write it down BEFORE measuring actual — no anchoring on what you hope.

5. **Measure ACTUAL** total superheat (suction pressure → sat temp; clamp temp at the suction line near the condenser; subtract — 1.4 verbatim).
6. **Adjust in small moves:** actual HIGH → add vapor charge slowly (bottle upright; throttle; watch the trend). Actual LOW → recover into a cylinder (never vent — 5.2). **Wait 5-10 min between moves** — the coil's liquid front is slow; chasing a moving number overshoots every time.
7. **Re-verify after settle** + sanity checks (subcool reasonable? amp draw? ΔT ?).
8. **Document:** conditions, target, final actual, refrigerant added/removed (the scale!), on the ticket.

Guardrails

- **Never leave a fixed-orifice system below ~5°F superheat** — flood-back territory (1.4's compressor killer), even if "the chart said 5": verify at the compressor, mind the conditions drifting.
- **Low ambient kills the method** (below ~55–60°F outdoor the chart runs out and condensers loaf): winter charge checks on these systems = weigh-in logic (5.6) or come back warm.
- **Mixed metering** (piston at the coil you can see... TXV someone added later) — verify before trusting the method (1.2's "identify BEFORE you charge").

5. Bench procedure

1. **The quiz reel:** the 5-scenario video, paused per scenario, every student writes the verdict (correct/over/under) before Craig reveals. Score it.
2. **Target drills:** 10 condition pairs → targets from the chart AND the app (they should agree $\pm 1^\circ\text{F}$; learn both because phones die).
3. **The full sequence, undercharged:** instructor pre-sets the bench unit low. Each student runs steps 1–8: finds high superheat, computes target, adds charge in throttled vapor moves with settle time, lands within $\pm 3^\circ\text{F}$ of target, documents. (The scale logs what each student added — and the next round starts from a fresh instructor reset.)
4. **The overcharge round:** unit set heavy → student recovers (5.3 skill, small bottle) to raise superheat to target. Both directions, owned.
5. **The trap round:** unit set with a BLOCKED FILTER and a correct charge. The student who starts adding refrigerant before checking airflow flunks the round (publicly, kindly) — the most valuable fail in Unit 5.
6. **Conditions roulette:** heat lamps / humidifier on the return change WB mid-class — watch the TARGET move while the charge didn't. Why the ticket records conditions.

Checkout: unaided full sequence from cold start on an unknown-state bench unit — airflow verified, target computed from measured conditions, charge corrected the right DIRECTION in patient moves, landed $\pm 3^\circ\text{F}$, documented. **Comp 15 SIGNED** (guided).

6. Field gotchas

- **The trap round IS the field:** most "needs freon" calls with high superheat are airflow calls. The sequence's step 1 isn't a formality — it's the diagnosis.
- **Charging by "beer can cold" suction lines** went extinct with R-22 and was wrong then. Numbers or nothing.
- **Vapor-charge throttling on 410A-class blends:** liquid feed through a throttling device is the clean way to add blends (bottle markings say how) — slugging liquid into the suction line is compressor abuse. Know your bottle's orientation rules per refrigerant (5.6 deepens).
- **Sun on the suction clamp** = lying thermometer (insulate over the clamp — 1.4's note, forever).
- **The chart caps at conditions extremes** — off-chart conditions mean don't-charge-now, not extrapolate-bravely.
- **Wind across the condenser** during measurement scatters numbers; shield or note it.

7. Competency link

- **Comp 15 — SIGNED** (guided); field reps through Units 7-8 service tickets.
- Pairs with 5.5 (subcooling/TXV) to complete the charging pair; 5.7 builds the diagnosis matrix on top of both.

8. Check yourself

1. Why does charge level control superheat on a piston but not on a TXV?
 2. The two inputs to target superheat and the tool that measures each.
 3. Target 12°F, actual 22°F. Direction? Method? Pace?
 4. Target 12°F, actual 5°F. Direction? What rule is nearby?
 5. Why does the sequence start at the filter, not the gauges?
 6. Conditions: 95°F ODB / 63°F IWB vs 85°F ODB / 70°F IWB — which wants the higher target, roughly, and why? (Use the chart.)
 7. Why wait between charge moves?
 8. What goes on the ticket, and which two instruments' numbers are non-negotiable?
 9. When is this method simply unavailable, and what's the winter alternative?
 10. The suction line is icy cold and the homeowner is thrilled. Your read?
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