

Pressure, Temperature & Saturation: Reading the P/T Chart

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 1 • HVAC Fundamentals • Appendix A Competency 3 (supports 15-16) Class time:
~4 hrs (1 video + 1 classroom drill + 2 bench)

1. What you'll be able to do

- Explain **saturation**: when refrigerant is boiling or condensing, its pressure and temperature are locked together — know one, know the other.
- Use a **P/T chart** (card or app) to convert any pressure to its saturation temperature for R-410A, R-32, R-454B, and R-22.
- Connect gauges to a running system and read the **two saturation temperatures** (evaporator and condenser) off the gauge set — the first real measurement of the program.
- State the **target relationships**: evap saturation ~35–45°F below return air; condensing saturation ~15–30°F above outdoor air.

This is the bridge lesson — after this, gauges stop being mystery dials and become two thermometers pointed inside the pipes.

2. Tools & materials

- Manifold gauge set (analog) + digital probes — students use BOTH this lesson
- Laminated P/T cards (one per student, theirs to keep) + Refrigerant Slider app installed on phones
- Running shop unit (R-410A), plus an R-32 or R-454B unit if available
- Jug of water + hot plate (saturation demo)

3. Watch first

Order	Video	Channel	Length	Why
1	Saturated Refrigerant Temperature Basics, the P/T Chart & Reading the Gauge Set	AC Service Tech	10:41	The core skill, start to finish
2	How to Read the HVAC P/T Chart	AC Service Tech	11:00	Chart drills with real numbers
3	Basics of Refrigerant Class — Bottles, Saturation, P/T, Pressures	AC Service Tech	9:08	Saturation inside the bottle = saturation inside the coil
4	Refrigerant Slider P/T App	AC Service Tech	7:12	The free app that replaces the card (use both anyway)

4. The idea

Saturation: the locked dance

Put liquid and vapor of a refrigerant together in one container and they reach a truce: a single pressure for every temperature. That state is **saturation** — refrigerant boiling or condensing, both phases present. While saturated:

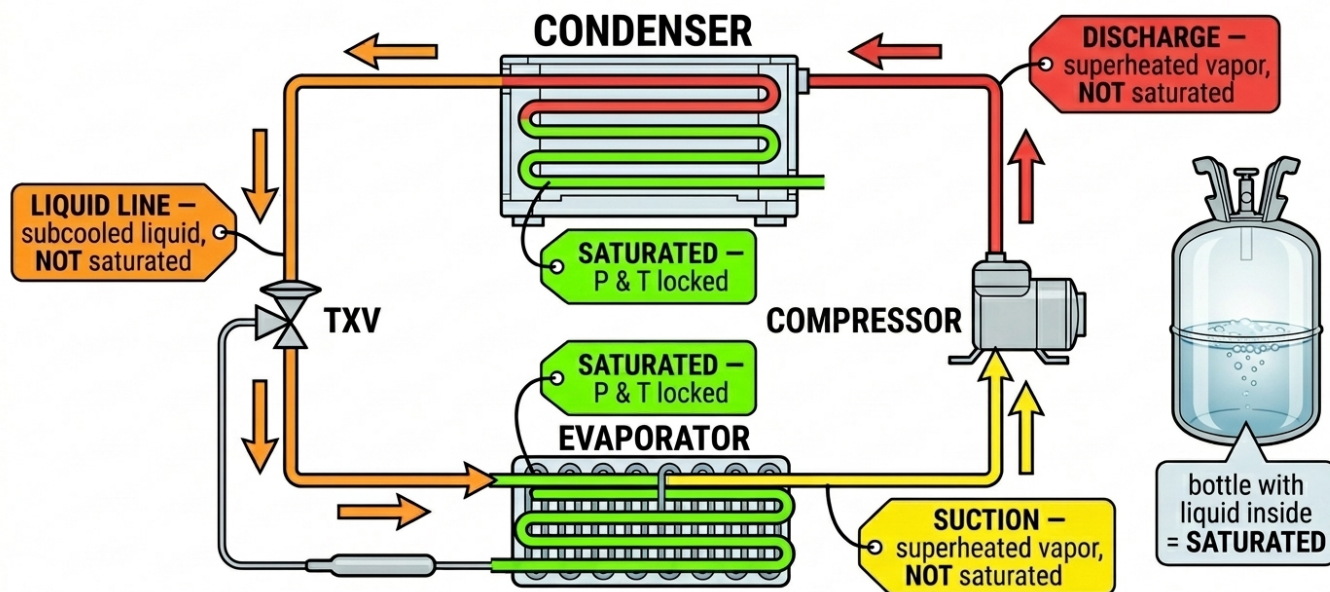
Pressure and temperature are LOCKED. Know one → know the other. That's the entire P/T chart.

Where is refrigerant saturated in a running system? Exactly where the work happens:

- **Inside the evaporator** — boiling (liquid + vapor present) → saturated
- **Inside the condenser** (middle section) — condensing → saturated
- **Inside any refrigerant bottle** with liquid in it → saturated (this is why a bottle's pressure tells you its temperature, and why you can't judge a bottle's fullness by pressure)

Where is it NOT saturated? The suction line (pure vapor — superheated) and the liquid line (pure liquid — subcooled). That's Lesson 1.4 — and it's why charging works at all.

WHERE IS THE REFRIGERANT SATURATED?



BOTH PHASES PRESENT = SATURATED. PURE VAPOR OR PURE LIQUID = NOT.

The P/T chart

THE P/T CHART – KNOW ONE, KNOW THE OTHER

SAT TEMP °F	R-410A psig	R-22 psig
40°F	118	121
70°F	201	196
100°F	317	226
110°F	365	278
125°F	445	

healthy evaporator
on a cooling day



Refrigerant Slider
app = same chart

SATURATED REFRIGERANT: PRESSURE AND TEMPERATURE ARE LOCKED TOGETHER

Rows = temperature. Columns = refrigerant. Cells = saturation pressure (psig). Anchor numbers to memorize for **R-410A**:

Saturation temp	Pressure (psig)	Meaning
40°F	~118	healthy evaporator on a cooling day
70°F	~201	a bottle sitting in a 70°F garage
100°F	~317	low-normal condensing temp
110°F	~365	typical condensing on a 95°F day
125°F	~445	condenser running hot — something's wrong

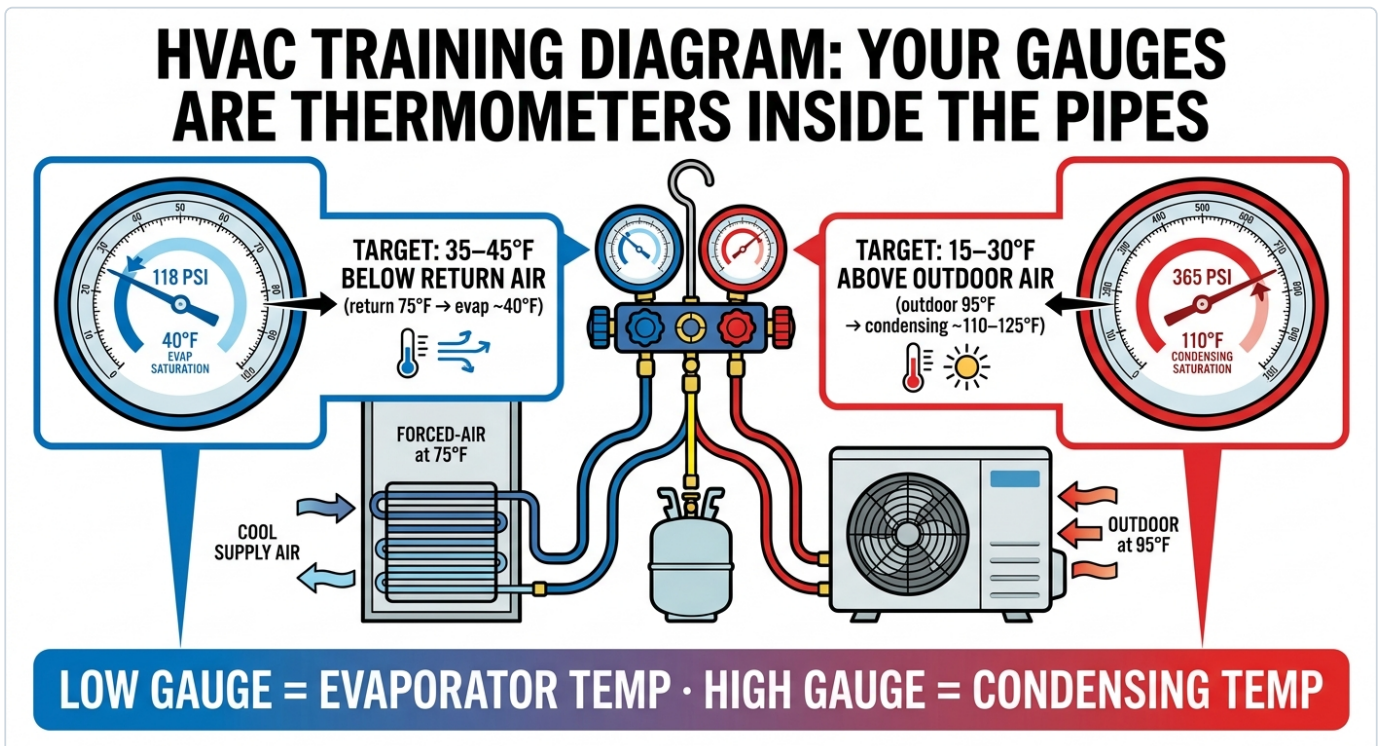
R-32 runs slightly higher pressure than R-410A at the same temp; R-454B slightly lower; R-22 (old systems) roughly 100 psi lower across the board. Never memorize four charts — memorize R-410A anchors and **look the rest up**. Blends like R-454B also have glide (bubble vs dew point) — flagged now, handled properly in Unit 5.

Your gauges are thermometers

A manifold gauge reads pressure — but the gauge face (and every digital probe) converts it to saturation temperature for your refrigerant. So on a running system:

- **Low-side gauge → evaporator saturation temp** ("evap temp"). Want: **35–45°F below the return air temp**. Return air 75°F → evap sat 30–40°F... target ~40°F.
- **High-side gauge → condensing saturation temp**. Want: **15–30°F above outdoor air** (the "condensing temperature over ambient" — CTOA). Outdoor 95°F → condensing sat 110–125°F.

Those two relationships are the skeleton of every charge check you will ever do.



5. Bench procedure

Part A — chart drills (classroom, 30 min). Card first, app second, race format: 1. R-410A at 118 psig — saturation temp? (40°F) 2. R-410A bottle reads 201 psig in the truck — bottle temperature? (70°F — and what does that NOT tell you? How full it is.) 3. R-22 system, low side 69 psig — evap temp? (~40°F. Same coil job, way lower pressure — why you must know the refrigerant before judging any pressure.) 4. R-32 at 40°F evap — expected pressure? (look it up — slightly above R-410A's 118) 5. Instructor calls 10 more, mixed refrigerants, until conversion is reflex.

Part B — gauges on a live unit (bench, supervised). 1. **Connection ritual** (learn it once, never improvise): verify refrigerant from the rating plate (Lesson 1.2) → caps off → low-loss fittings finger-tight on service ports — blue LOW/suction, red HIGH/liquid → crack open. (Full hose hygiene and purging in Unit 5 — today is reading, not charging.) 2. Read low-side pressure → write the PRESSURE and the SATURATION TEMP. Confirm with the P/T card that the gauge needle's inner scale agrees. 3. Read high-side → same two numbers. 4. Measure return air temp and outdoor air temp with a probe. 5. Compute: return air — evap sat = ____ (in the 35–45 window?). Condensing sat — outdoor = ____ (in the 15–30 window?). 6. Repeat on the second unit (different refrigerant if available). Disconnect properly — instructor demonstrates getting hoses off without losing a charge-worth of refrigerant.

Checkout: student connects, reads both saturation temps, states both relationships and whether they're in range, and converts three P/T values cold — card, no app.

6. Field gotchas

- **"The pressure is low" means nothing alone.** 118 psig is perfect on R-410A and catastrophically overcharged on R-22. Refrigerant first, then pressure, then saturation temp — in that order.
- **Bottle pressure ≠ bottle fullness.** A nearly-empty bottle with one drop of liquid reads the same pressure as a full one at the same temperature. Weigh bottles (Unit 5).
- **Saturation only applies where both phases exist.** A gauge on the suction line reads the EVAPORATOR's saturation, not the suction line's actual temperature — the difference between those two numbers is superheat, next lesson.
- **Gauge needle bounce** usually = compressor pulses on analog gauges; a digital probe jumping wildly = moisture flashing or a real problem (Unit 5).
- **Every connection bleeds a little refrigerant.** On A2L systems and tiny mini-split charges this matters — probes-on-only-when-needed is the modern habit (and why Lesson 1.1 taught touch-and-IR first).

7. Competency link

- **Competency 3** — deepened (saturation is the cycle's operating logic).

- Direct setup for **Comps 15-16** (charging by superheat/subcooling — Lessons 1.4, 5.4, 5.5) and every gauge reading in the program.

8. Check yourself

1. Define saturation in one sentence. Where in a running system is refrigerant saturated (3 places)?
 2. R-410A low side reads 118 psig. Evaporator saturation temp? Is that healthy if return air is 75°F?
 3. Why can't you tell how full a refrigerant bottle is from its pressure?
 4. Outdoor air 95°F, high-side saturation 112°F on the gauge. Compute CTOA — in range?
 5. An R-22 system and an R-410A system both have 40°F evaporators. Roughly what does each low-side gauge read?
 6. Which line is NOT at saturation: middle of the condenser, suction line, middle of the evaporator?
 7. Blue hose goes to which line? Red to which?
 8. Your buddy says "it's got 130 pounds of suction, that's low." What two questions do you ask before agreeing?
 9. What is the inner temperature scale on an analog gauge face actually showing you?
 10. Return air 75°F, evap saturation 28°F. In the healthy window? What lesson covers what you'd check next? (1.4 — and the answer will be superheat.)
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