

Sensible vs Latent Heat, Delta T, and What "Cooling" Really Is

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 Class time: ~3 hrs (1 video/classroom + 2 bench)

1. What you'll be able to do

- Explain the two jobs every air conditioner does: **lower the temperature** (sensible) and **wring out moisture** (latent) — and why a system can be great at one and lousy at the other.
- Measure **Delta T (temperature split)** across a coil correctly and judge it against the honest answer: it depends on humidity — roughly 18–22°F in our Alabama summer mix, lower when it's muggier.
- Explain where condensate comes from and predict how much (a lot, here).
- Stop confusing **Delta T** (air, across the coil) with **TD** (refrigerant-to-air design difference) — different numbers, different jobs.

This is the lesson that makes you an Alabama tech: in our climate, latent load is half the battle, and a tech who only thinks in temperature will misjudge systems all summer.

2. Tools & materials

- Two air probes (dry-bulb) + one wet-bulb/RH probe (psychrometer)
- Running shop unit with accessible return and supply
- Clear cup of ice water (the dew point demo), towel
- Worksheet with Delta T table

3. Watch first

Order	Video	Channel	Length	Why
1	Heat and Comfort Basics 3D	HVAC School	10:33	Sensible vs latent, animated
2	Air Conditioning Basics Class — CFM, Sensible & Latent, Dew Point, Condensate, Delta T	AC Service Tech	8:27	The whole lesson in one field class
3	HVAC Delta T Explained — What Should It Be?	AC Service Tech	8:34	The measurement and the ranges
4	What Should the Air Delta T Be? (Temperature Split)	HVAC School	9:17	Same question, humidity-adjusted answer
5	Don't Confuse TD & Delta T	HVAC School	4:34	The vocabulary trap, killed early

4. The idea

Two kinds of heat in the same air

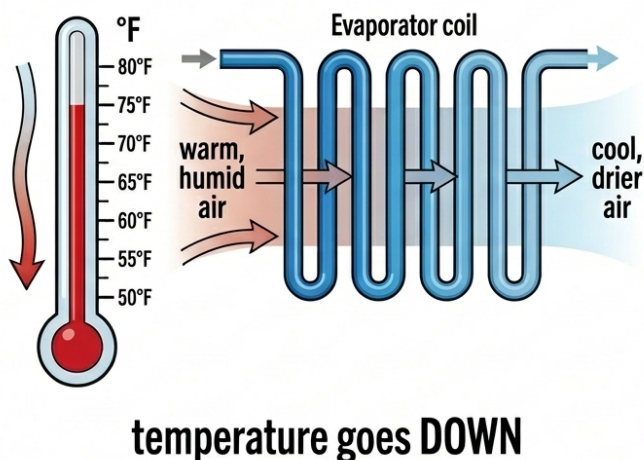
- **Sensible heat** — what a thermometer feels. Remove it → the number drops. 75°F air becomes 55°F air.
- **Latent heat** — heat hiding in water vapor. Removing it doesn't change the thermometer at all; it changes water from vapor to liquid. That's the condensate stream out of every Alabama AC from May to September.

A pound of condensed water ≈ **~970 BTU of latent work** that never showed up on a thermometer. On a muggy Birmingham day, a 3-ton system might spend a third or more of its capacity wringing water — capacity that does NOT lower the air temperature.

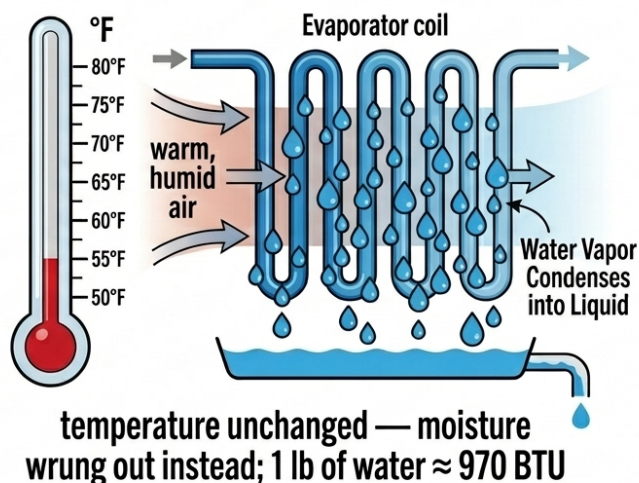
Comfort = temperature AND dryness. 75°F at 45% RH feels great; 75°F at 70% RH feels like a locker room. Half of what customers call "not cooling" in July is really "not dehumidifying."

TWO KINDS OF HEAT IN THE SAME AIR

SENSIBLE HEAT — what the thermometer feels



LATENT HEAT — hiding in water vapor



MUGGY ALABAMA AIR = THE SYSTEM SPENDS UP TO ⅓ OF ITS CAPACITY ON WATER

Where the water comes from — dew point at the coil

The evaporator runs ~40°F (Lesson 1.3). Air at 75°F/50% RH has a **dew point** around 55°F. Any surface colder than the dew point condenses water — exactly like the ice-water cup sweating on the bench. The coil is far below dew point, so it sweats hard, and that's BY DESIGN. The drain pan, trap, and float switch (Lesson 11.4) exist because the machine manufactures water on purpose.

Delta T — the 60-second health check

Delta T (temperature split) = return air temp – supply air temp, measured across the coil.

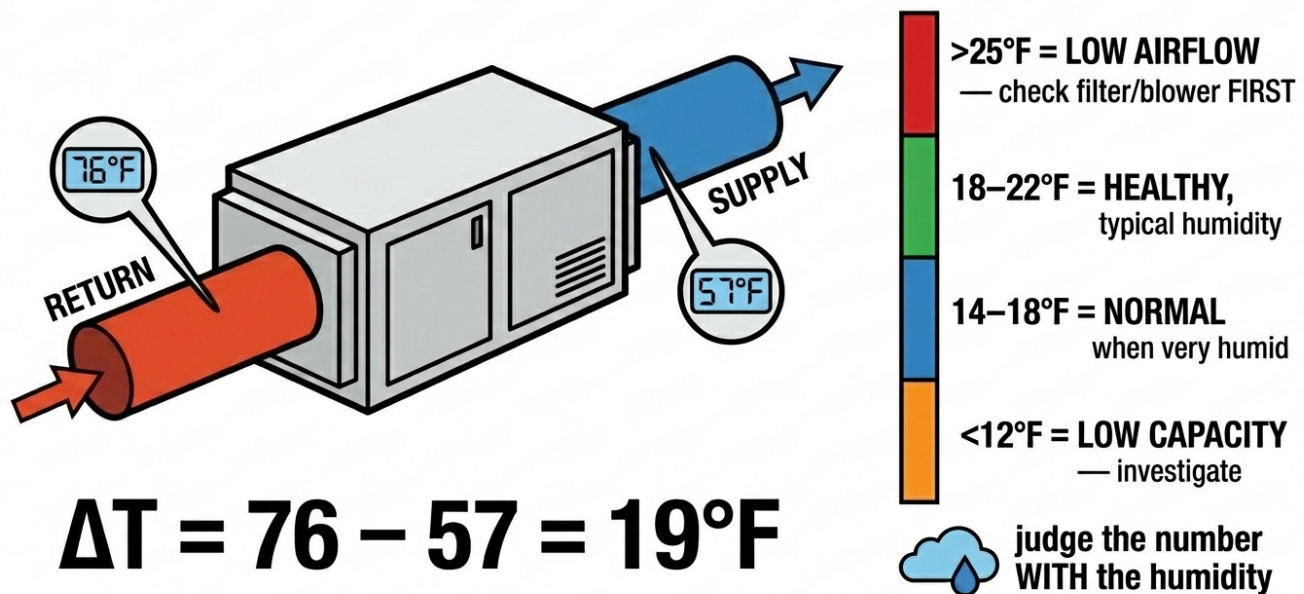
Conditions	Expected ΔT
Dry day / low humidity	20–24°F
Typical AL summer mix	18–22°F
Very humid (post-storm muggy)	14–18°F — and that's NORMAL

Why humidity lowers it: on muggy days more of the capacity goes to latent (water) work, so less is left to drop the temperature. **A 15°F split on a soupy August afternoon is not a low-charge diagnosis.** ΔT is a screening number — it tells you whether to look deeper, never which part failed.

- ΔT very low (<12°F): suspect low capacity (charge? airflow too high? compressor?) — but check humidity first.

- ΔT very high ($>25^{\circ}\text{F}$): almost always LOW AIRFLOW (filter, blower, ducts) — the air is crawling across the coil getting over-cooled. Most techs guess "needs freon"; the high split says the opposite.

DELTA T — THE 60-SECOND HEALTH CHECK



Delta T vs TD — don't mix them up

- **Delta T / temperature split** = air in vs air out across the coil (today's number).
- **TD (design temperature difference)** = return air vs **evaporator saturation** (refrigerant) — the $35-45^{\circ}\text{F}$ relationship from Lesson 1.3.

Different comparisons, both useful, constantly confused on job sites. Say "split" for air and "TD" for refrigerant-to-air, and you'll out-communicate half the trade.

5. Bench procedure

1. **Dew point demo (5 min):** ice-water cup on the bench. While it sweats, find today's shop dew point with the RH probe. Every surface below that number sweats — including, later in your career, uninsulated ducts in crawl spaces (Unit 10 callback).
2. **Measure ΔT right:** one probe in the **return grille**, one in a **supply register close to the unit** (not the far bedroom — duct gains pollute the number). Let the system run 10+ min. Record both, compute split.
3. **Record humidity** at the return with the RH probe. Judge the split against the table — write the verdict WITH the humidity, e.g. " $\Delta T 17^{\circ}\text{F}$ @ 68% RH return — in range for conditions."
4. **Watch the water:** pull the panel, watch condensate form and run. Estimate the drip rate. Then check it against the drain (foreshadow 11.4).

5. **Break it, read it:** instructor blocks half the return with cardboard → remeasure. Split goes UP (low airflow over-cools the air) — the counterintuitive one. Then restore and partially block the condenser → split sags as capacity falls. Two failures, opposite fingerprints, same thermometer.
6. **Sticker drill:** compute TD as well (return temp – evap sat from gauges) and state both numbers in one breath: "split 19, TD 35 — air side and refrigerant side both healthy."

Checkout: measure ΔT + RH unaided, state the verdict with the humidity caveat, and answer one curveball ("split is 26 — what's your first move?" → airflow, not refrigerant).

6. Field gotchas

- **The #1 misdiagnosis in the South:** low split on a muggy day read as low charge. Hook gauges only AFTER the humidity sanity-check.
- **Probe placement:** supply register right next to the air handler can read low from radiant coil effects; the far room reads high from duct gain. First register a few feet downstream is the honest spot.
- **High split feels like winning** ("look how cold!") but it's an airflow red flag, and in July it also means the coil may be headed below freezing → ice (the freeze-up tree, Lesson 7.10).
- **New construction / fresh drywall** humidifies the house for months — splits run low, condensate runs heavy, nothing is broken.
- **Oversized equipment** (Unit 12 / Manual J) cools fast but cycles off before doing latent work → cold clammy house. When a customer says "it's cold but sticky," think sizing, not charge.

7. Competency link

- **Competency 3** — completed (heat transfer + moisture side of the cycle).
- Feeds: condensate management (11.4), airflow diagnosis (11.1–11.3), charging conditions (Unit 5 — target superheat needs wet bulb!), psychometrics (1.6), Manual J latent loads (12.1).

8. Check yourself

1. Define sensible and latent heat in one sentence each.
2. Why can a system remove a ton of heat and barely change the air temperature?
3. Where does condensate come from? Why is the coil below the dew point on purpose?
4. Return 76°F, supply 59°F. Compute the split. Verdict at 50% RH? At 75% RH?
5. ΔT measures air-to-air. What does TD compare, and what's its healthy range from Lesson 1.3?
6. Split = 27°F. What system is your prime suspect and why is "add refrigerant" exactly backwards?

7. A customer's house is 72°F and clammy. Equipment short-cycles. What's the likely root cause category?
 8. Roughly how many BTU does condensing one pound of water represent?
 9. Why does blocking the RETURN raise the split while blocking the CONDENSER lowers it?
 10. It rained all night; calls say "AC can't keep up," splits read 15–16°F across town. What do you tell the dispatcher?
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