CRAWL SPACE SCIENCE · WHITE PAPER

Why Crawl Space Ductwork Sweats in the Coastal Southeast

A building science explanation of condensation on supply ducts in vented crawl spaces, why insulation and duct replacement don't solve it, and what does.

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Summary

- Supply ducts carry air at about 55°F. In a coastal Virginia summer, outdoor air has a dew point in the low to mid 70s. A vented crawl space brings that air into direct contact with the ducts, and water condenses.
- Duct insulation changes where the water forms, not whether it forms. Torn, compressed or gapped insulation makes it worse.
- The vented crawl space is a national default that performs poorly in the high-dew-point Southeast. The failures are a regional design mismatch, not isolated house defects.
- Ventilation fans and duct replacement without changing the crawl space both repeat the failure.
- The fix is to stop outdoor air entry, control ground moisture, and keep the crawl space dew point low. Then repair damaged materials.

1 The problem

$5–6K
Typical duct replacement that can be sweating again within a season

600+
Crawl spaces inspected per year by the author in coastal Virginia

A homeowner spends five or six thousand dollars replacing the ductwork under the house. A few months later, the brand-new ducts are dripping water. In most of these cases nothing is wrong with the air conditioner, nothing is wrong with the new ductwork, and nothing is uniquely wrong with the house.

In July and August in Hampton Roads, sweating supply ducts are found in nearly every vented crawl space inspected by the author, who inspects more than 600 crawl spaces a year in coastal Virginia. It occurs in high-value and modest homes alike. It is one of the most consistent and most expensive summer failure patterns in the region.

2 The physics

55°F
Typical AC supply air temperature

70s°F
Coastal Virginia summer outdoor dew point

15°F+
How far a supply duct sits below that dew point

The dew point is the temperature at which air can no longer hold its water vapor. Any surface colder than the surrounding air's dew point collects condensation.

Air conditioning supply air leaves the air handler at roughly 55°F. That is normal operation. On a typical July day in coastal Virginia, outdoor air carries a dew point in the low to mid 70s. When that air enters a vented crawl space and cools even slightly, its relative humidity rises sharply. Crawl space air can sit only a few degrees above its own dew point.

A 55°F duct in that air is more than 15°F below the dew point. Water condenses on it. The floor framing above is cooled from the conditioned house and sits in the mid to high 60s, also below the dew point. The ground under the house stays near 60°F.

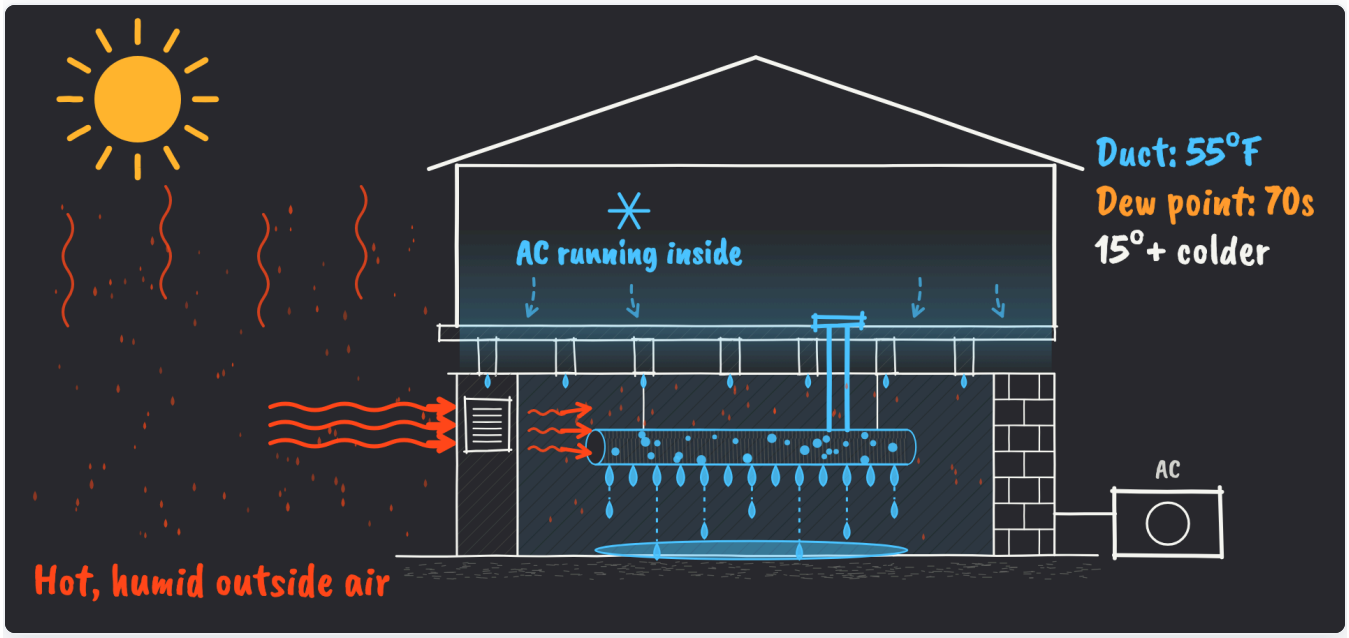

Figure 1. Hot, humid outdoor air enters a vented crawl space below an air-conditioned house. The cooled floor framing and the 55°F supply duct sit below the air's dew point, and water forms on both. Temperatures from the author's field observations in coastal Virginia.

Table 1. Typical July temperatures in a vented crawl space, coastal Virginia

Surface or air	Typical summer temperature	Relative to a low-70s dew point
Outdoor air	**high 80s–90s°F**	Above (carries the moisture)
Supply duct and jacket	**55°F and up**	Well below: condensation
Floor framing	**mid to high 60s°F**	Below: condensation, high wood moisture
Ground surface	**~60°F**	Below

3 A regional climate band

High summer dew points are not a national condition. The 30-year normal July mean dew point map shows the highest values across the Gulf Coast, Florida, the Mississippi Delta and up the Atlantic coast into southeastern Virginia. That band is where vented crawl spaces fail this way every summer.

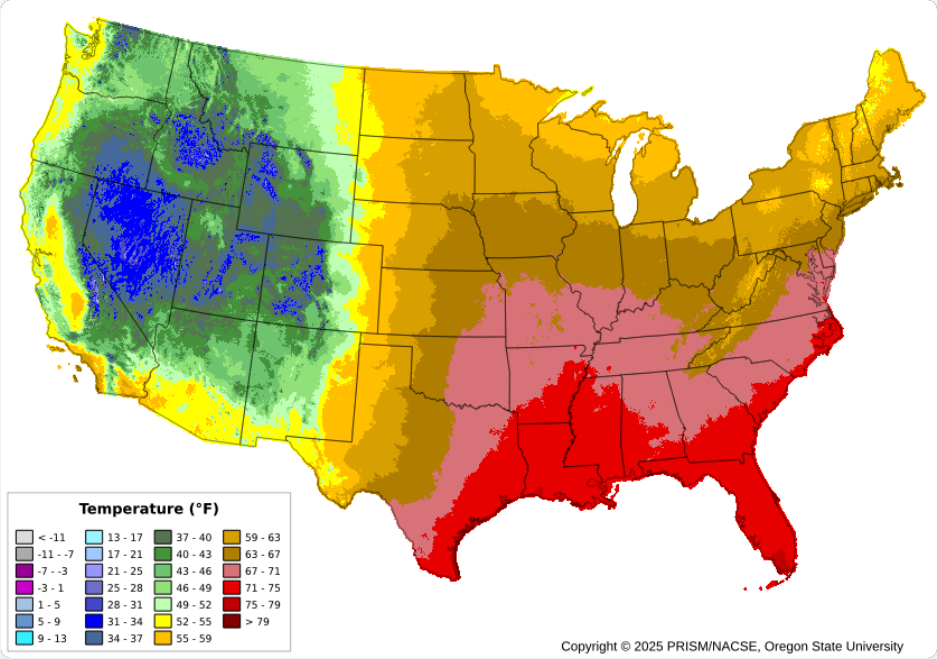

Figure 2. 30-year normal July mean dew point, 1991–2020. Red: 71–75°F. Pink: 67–71°F. Source: PRISM Climate Group / NACSE, Oregon State University (prism.oregonstate.edu).

4 Why duct insulation doesn't stop it

Insulation keeps the outer jacket warmer than the inner liner, but the jacket is still cooled by the 55°F air moving through the duct. It always runs slightly cooler than the surrounding air. In a crawl space already near saturation, that small difference is enough for water to form on the jacket.

Where insulation is torn, compressed, missing at fittings or poorly sealed, humid air reaches much colder surfaces. Water collects inside the insulation, out of sight. The insulation gains weight, sags, supports mold growth and eventually fails. The duct is replaced, the new duct goes back into the same crawl space, and the cycle repeats.

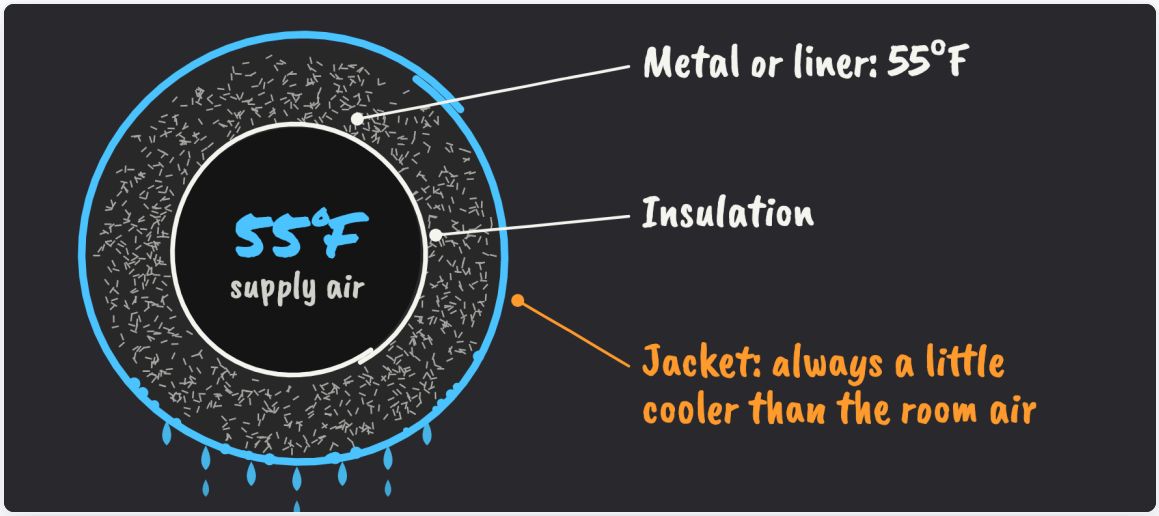

Figure 3. Insulated duct cross-section. The jacket runs slightly cooler than the surrounding air, so near the dew point condensation forms on it.

Figure 4. Saturated duct insulation that has sagged to the crawl space floor, with water staining on the ground cover. Coastal Virginia.

5 The design mismatch

The vented crawl space remains the default in American residential construction. That default comes from national model building codes, written for the United States as a whole and adopted by states with relatively few climate-specific changes.

In much of the country a vented crawl space performs acceptably. In the high-dew-point Southeast, the same design repeatedly produces the conditions that make ductwork sweat, insulation fail and framing sit in humid air for months. These are not isolated house defects. They are the predictable result of a nationally standardized approach applied to a climate that covers only part of the country.

> *Sweating ductwork in this climate is usually not a ductwork problem first. It is a crawl space condition problem that the ducts are revealing.*

6 What the research found

~90%
Summer relative humidity, wall-vented crawl spaces[1]

<60°F
Year-round dew point, closed crawl spaces[1]

19%
Homes with confirmed crawl-to-house spore transmission[2]

Advanced Energy's DOE-funded field study compared wall-vented and closed crawl spaces in 12 otherwise identical homes in Princeville, North Carolina. The wall-vented crawl spaces ran near 90% relative humidity in summer, with dew points above 70°F for most of the season. The vented crawl spaces were cooler than the outdoor dew point, so bringing in outdoor air added moisture rather than removing it. The closed crawl spaces held dew points below 60°F year-round.[1]

A separate Duke University study of 238 North Carolina homes tested whether mold spores move from the crawl space into the living space through the HVAC system and ductwork. Transmission was confirmed in 19% of homes; 45% showed no transmission and 36% were indeterminate.[2]

7 Two responses that make it worse

Crawl space ventilation fans

Fans are often sold to "dry out" a crawl space. During a humid coastal summer they pull in more outdoor air with a dew point in the 70s. As that air cools under the house, the fan continuously adds moisture.

Replacing ducts without changing the crawl space

Saturated or moldy insulation may need replacement. New ducts installed in the same vented, high-dew-point crawl space are returned to the conditions that destroyed the old ones, and many begin sweating in the first summer.

8 The fix

1. **Stop outdoor air entry.** Seal vents and openings so high-dew-point outdoor air no longer enters continuously.
2. **Control ground moisture.** Install a ground vapor barrier.
3. **Keep the crawl space dew point low.** Provide dry air with a dehumidifier or supply air so the dew point stays below duct and framing temperatures.

Then repair or replace damaged materials. Correcting conditions first is what prevents paying for the same failure twice.

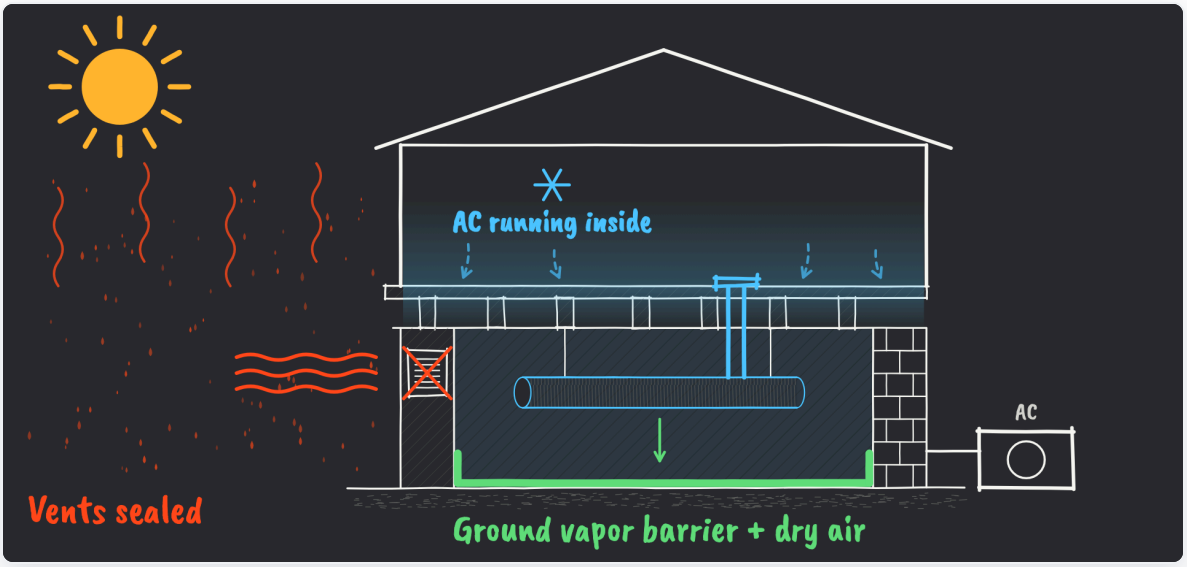

Figure 5. Vents sealed, ground vapor barrier installed and dry air supplied. Outdoor heat and humidity stay outside, and the ducts and framing stay dry.

9 The diagnostic question

When ducts drip in summer, the useful question is not "What's wrong with my HVAC system?" It is "Why is the air under my house routinely sitting near saturation in July and August, and what do I do about it?" In the coastal Southeast the answer is usually the same: a nationally standardized design is being asked to perform in a climate it was never optimized for.

About the author

Robbie McCarty owns Patriot Crawl Space Repairs in Smithfield, Virginia, serving Hampton Roads and coastal Virginia. He personally inspects more than 600 crawl spaces a year and has worked with crawl spaces for nearly 30 years, including 15 years as a full-time real estate broker.

He holds a Virginia Class A contractor license, a master plumber license, a pest control operator license and MICRO mold remediation certification. He teaches building science grounded in what actually happens under real houses in the humid coastal Southeast through the Crawl Space Science series on YouTube.

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