Air Conditioning for Humid Climates

Air-sealing, right-sizing, and smart controls are the keys

BY CURT KINDER

I manage a full-service HVAC contracting company in the Jacksonville, Fla., market. I'm a trained and experienced engineer, and I got into the air conditioning business after I contracted with a local builder, Dan Hovis of Hovis Custom Builders, to build a custom ICF (insulating concrete form) house for me about 10 years ago. Dan told me that local HVAC contractors wouldn't bid on systems for his custom homes because they didn't believe that a three-ton system could easily handle a 3,000-square-foot house.

"Well," I said, "I'll design it myself." So I did. Out of that experience, Dan and I formed Greener Solutions as a joint venture. My company now designs and installs the HVAC systems for all of Dan's ICF homes. We also install systems for some quality stick-frame builders in our area, and we do system replacements in existing homes of all types and ages.

Whether it's a new home or a retrofit, we insist on right-sizing the systems. We do a room-by-room load calculation using the Air Conditioning Contractors of America (ACCA) Manual J, we specify the ducts supplying each room using ACCA Manual D (if we're installing new ductwork), and we choose mechanical equipment to match those loads and that ductwork. We believe in trusting our numbers—we do the calculation right, and we build the system to match.

Photos by Ted Cushman

The author blower-door tests each home's insulated shell at an early stage in the construction, to identify and seal air leaks. Above, technician Adam Hovis temporarily masks an energy recovery ventilator (ERV) outlet in preparation for a blower-door test **(1)**, while the author tapes over an open drain **(2)**.

ENVELOPE QUALITY CONTROL

For right-sized equipment to perform reliably, we have to be able to count on the building envelope to also perform as designed. So even though I'm the air conditioning contractor and not the framer, the window installer, the insulator, or the siding contractor, I insist on quality control for the envelope details. And in this case, I don't trust: I verify.

I tell my builders that I want to be at the house with my blower-door rig as soon as we have an envelope to test. Ideally, we like to have the attic insulated with spray foam on the underside of the roof sheathing, so our ductwork can be in the conditioned space. And we want to test the home's airtightness as soon as the roof is sprayed but before the walls are insulated—and before there's any drywall loaded into the house to block our access to the walls.

At this point, we're not trying to get a number for anybody's checklist. We just want to find the leaks. So we tape up all the known holes: missing door knobs, dryer vents, bath vents, fireplaces, and the like. Then we crank up the blower door. When you depressurize the house to 100 pascals, you can hear the leaks—they howl.

It's hard to get the pressure cranked down that low if the house is full of holes. But we've learned that air-sealing is iterative. The big leaks hide the small ones. So first you find and fix the big leaks, and then you go back through, with the higher air pressure working in your favor. Now the fans can do more, and the smaller leaks will start to reach out and touch you.

We like to run our test while the foam contractor is still on site. We flag issues using spray paint, and the foam guys come back in to hit the low spots and point-seal the leaks. Then we may take a second (and even a third) run through with a different color paint.

Our main reason for plugging the air leaks is to control moisture.

Technician Jack Hogan zeros the electronic manometer before the blower-door test **(3)**. Hogan points out an air leak near the patio door **(4)**. Hovis marks a gap in the foam insulation for correction by the foam crew **(5)**.

In Florida, humidity is the 800-pound gorilla in the room. I'm particularly concerned about the attic, because even if it's air-sealed and insulated, it usually does not have supply and return registers, so it's indirectly conditioned. I don't want moisture entering that space where it could condense on the ducts.

But I especially don't want excess moisture infiltration in the occupied rooms of the house—in part because of how humidity affects occupant behavior. I'm trying to save the occupants from themselves. If the homeowners are uncomfortable because of the humidity, they will do the only thing that they know how to do: reduce the thermostat set point. The problem there is that we run an outdoor dew point in the 70s for four or five months of the year in Florida, and if your interior temperature measures much below the outdoor dew point, you run a good risk of condensation in the wall cavity behind the drywall—and that's asking for serious trouble.

QUALITY DUCTWORK

Once our Manual J design for the house has given us a room-by-room estimate of the heating and cooling loads, the next step is to use Manual D to specify the airflow needed to meet all those loads on the design day. Then we can make a duct plan.

If I input a room's design load in our Manual D software, it will supply me with the duct sizing: "That room needs one 6-inch duct or two 4-inch ducts." But when in doubt, we increase the duct diameter. If we arrive at the site and we see that we're installing a 60-foot run of 10-inch duct, we may decide to bump it up to 12 inches. This reduces the friction losses and makes sure we have enough air going to the room.

In some cases, however, we may prefer a small-diameter duct. As far as I know, we're the only company in town that uses 3-inch-diameter flex duct. Most companies bottom out at 4 inches, because

Above, installer Luis Ventura inserts a tap collar for a flex-duct connection to a duct board box **(6)**, then tape-seals the collar to the box **(7)**. He butters the inner liner of the flex duct with mastic **(8)**, slips the duct liner over the collar, and tightens a cable tie over the joint using a tensioner **(9)** before taping the flex duct outer liner to the box **(10)**.

that's what the suppliers sell. But we stock 3-inch flex duct by special order so that we can right-size the airflow to walk-in closets, pantries, commode closets, and other very-low-load spaces.

A classic example of this situation is a house with the air handler in the garage, and a laundry room by the entry door from the garage—the first room you hit coming into the house after parking your car. That laundry room will have almost no load, because it has no windows and it's mostly connected to the interior. But it's the first room coming off the air handler, so if you provide it with a 4-inch duct, the register will blow about 60 cfm even though the room only needs 10 cfm. In mid-summer you could hang meat in there—and in the winter when you're heating, it's much warmer than it needs to be.

People may not care a lot, because they don't spend much time in there doing laundry. But you've sacrificed air that is needed elsewhere, and created a comfort issue and sometimes even a noise issue in the laundry room. It's better to use a 3-inch duct, not a 4-inch one, so that you can keep that chilled air backed up in the system for where it's needed—like in the family room, the kitchen, or the southwest bedroom.

Like everyone else in our market, we use a box and flex-duct distribution system, because there isn't the budget to run hard metal duct in a house. And flex duct works fine—as long as you install it correctly. But as with the roof insulation, quality control is what determines whether the duct system works the way it was designed to work.

So our installers are trained to fully stretch the duct out before they connect it, so that the steel wire coil in the duct doesn't crumple inward and create friction in the air path. They know to support it properly, and to seal it carefully at every connection. We are also the only company I know of in our market using Smart Elbows from

Ventura attaches a Hart and Cooley "Smart Flow Elbow" to ensure good airflow through a curved section of flex duct **(11)**. Besides enforcing a smooth bend, the Smart Elbow helps to hold ducts away from obstructions **(12)**. Hogan butters an inner liner with mastic **(13)**, wraps a cable tie around the connection **(14)**, and butters the seams of a register boot with mastic to ensure airtightness **(15)**.

Hart and Cooley. This product is a plastic brace that supports and stiffens flex duct when it has to go around a bend, enforcing the proper radius and keeping the duct from folding in on itself.

In an extreme case where we need a lot of air to flow easily around a corner, we use a hard elbow. I'm looking at an example right now where a design studio is located at the end of a 50-foot run of 12-inch duct, with two 90-degree bends. The duct is properly sized, but to be safe, we're going to use hard steel 90s so we will know that there won't be wire creating turbulence in the air path. It costs a little more for the elbow and its insulation wrap, and for the labor to splice it to the flex duct run, but it buys peace of mind.

EQUIPMENT OPTIONS

The last step in designing an air conditioning system is choosing the equipment. This decision isn't about brand names; just like with Ford or Chevy trucks, people have their favorites, but either maker can supply roughly equivalent products, whether you want the basic economy model or the luxury model with all the accessories. Trane, Carrier, Bryant, American Standard, or Lennox—they're all solid, and I'm probably leaving out a few good ones that I just don't have experience with. Right now, I mainly install systems from Bryant and Trane.

Let's take a look at the choices, starting at the bottom end and assuming that the house needs a three-ton system. Suppose a landlord wants the basic minimum system for a rental house. The code-required minimum Seasonal Energy Efficiency Rating (SEER) is 14. We price a properly sized and installed three-ton code-minimum system at about $4,500. That system has a single-stage compressor and a single-speed blower motor. When the thermostat calls, it will turn on or turn off—that's it. But it will cool the house.

A preapplied paper ruler helps foam installers and inspectors verify application thickness **(16)**. In this high-end system in an insulated attic, three zone supply ducts coming out of a distribution box are equipped with motor-controlled dampers **(17)**; illuminated LEDs on the control device indicate which zones are active **(18)**. Heat from the geothermal system also preheats hot water **(19)**.

The next step up is to a SEER 15 or 15.5 system, which we install for about $5,300. For that money, you get a variable-speed air handler and a touch-screen thermostat with integrated humidity control. If the house is too humid, the air handler can slow down to keep the coil colder and remove more moisture. I recommend this $800 upgrade; it's quieter and it provides better comfort.

The next upgrade is to SEER 16 or SEER 17, a system with a two-stage compressor as well as a variable-speed air handler, which costs about $6,500 in our market. This three-ton system can drop down to its two-ton mode when the loads are lower (which is 90% of the time). It can also handle up to three zones; the low stage is called upon when only one or two zones need cooling. This is the minimum system we'll install if there is zoning in the mix.

Finally, at the top end is a system with a true variable-speed compressor as well as a variable-speed blower, such as the Bryant Evolution Extreme or the equivalent Carrier GreenSpeed. This equipment is rated at SEER 20 and goes in for about $9,000. These systems can dial way, way back to a whisper for low loads—low enough to handle a single small zone when needed. In summer, they'll run almost continuously—but so quietly that you barely notice them. They offer superb dehumidification. The system shown on this page is an equivalent Water Furnace geothermal unit.

Each step up delivers an improvement in comfort and in humidity control. In states like Florida, where electric rates are moderate, the energy savings associated with higher SEER ratings won't typically justify the investment as they might in a higher-priced power market. Still, the comfort gains and the reduced risk of moisture damage and mold are strong arguments in favor of the upgrades.

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