

Air-Sealing for Hot Climates

by Matt Risinger



Excluding heat and humidity
saves energy, improves comfort,
and increases durability

I'm a builder in Austin, Texas. My company does four to six projects each year, split more or less evenly between new homes and whole-house remodels. Most are architect-driven, and we do a lot of high-end finish work, including making our own interior and exterior doors and staircases. An increasingly important selling point for us over the past few years has been the level of care we put into air-sealing our projects, which reduces heating and cooling costs and greatly

improves homeowner comfort.

That's helped us to stand out from our competitors, because few builders in our area gave much thought to air-sealing until recently. (We're located in hot-humid climate zone 2a, with about 3,000 cooling degree days and 1,700 heating degree days annually.) Since 2008, the city building code has required a blower-door test for all new homes, with a pass/fail threshold set at 7 ACH at 50 pascals. While that's a step in the right direction, it's still set-

ting the bar pretty low. We're now achieving between 2 and 4 ACH50, and plan to reduce that to 1 ACH50 in the coming year. That might not seem very tight to some — it's well above the .60 leakage figure required for Passive House certification, for example — but I feel that the 1-ACH50 level is about right for our market. It provides a comfortable, efficient home without requiring a lot of complicated details that might push prices higher than our customers would be willing to pay.



Figure 1. Water vapor from humid outdoor air has condensed on the cold surface of the interior poly in this 10-year-old home, creating a zone of chronic dampness. Note the black patches of mold on the fiberglass batts.



Figure 2. To exclude outdoor air as well as bulk water, this dryer-vent pipe (right) was sealed to the house-wrap with a flexible flashing panel and butyl tape. The same approach was used for a demand water heater's rough-in (above); the gas line is on the right in the photo and the hot and cold water lines are at left.



Air Conditioning and Moisture

Air-sealing didn't matter much in the days before air conditioning, because the indoor and outdoor temperature and humidity were often fairly similar. In an air-conditioned house, by contrast, the indoor air may be 20 degrees cooler than the air outside, and also much drier. That's great from a comfort standpoint, but it can mean trouble when humid outdoor air finds its way through the building envelope, encounters a surface chilled below the dewpoint, and condenses there like the beads of moisture on a cold glass of lemonade.

Unfortunately, a lot of early building-science research focused on the potential for condensation in cold climates, where the goal was to prevent warm, moist indoor air from migrating outward — the exact opposite of the problem in air-conditioning climates. (I've always wondered whether this is because most building sci-

entists live in the North.) One result of this bias was the development of wall systems with warm-side “vapor barriers.” These might work well in heating climates, but often lead to mold, rot, and termite damage in regions where air conditioning is used for much of the year — something I see all the time in my remodeling work, even in fairly new homes (see Figure 1).

Housewrap and Penetrations

The first line of defense against those kinds of problems is a tight outside envelope. Most of our homes are stick-framed structures on slab-on-grade foundations, sheathed with OSB and wrapped in a $\frac{3}{4}$ -inch layer of polyiso board. Outside that, we add a primary air barrier of Tyvek Commercial Wrap, which I like because it’s tougher than most residential housewraps. It’s also less permeable, with a perm rating of about 15, compared with 59 for the residential version of Tyvek. We lap the material where necessary, and tape any seams with Tyvek tape.

Penetrations for things like pipes, wires, and dryer vents are a common source of both air leaks and bulk water leaks if they’re not sealed correctly. We use QuickFlash flashing panels in such areas (quickflashproducts.com); these plastic panels have flexible rubber seals and come in a wide variety of configurations (Figure 2).

Framing Leaks and Sealed Attics

In remodeling projects, it’s not uncommon to find framing problems that allow unconditioned air to pour directly into the living space. These can usually be sealed off with some combination of plywood, sheet foam, and canned spray foam (Figure 3). After taking care of these trouble spots, we seal any middle-sized holes where pipes and wires pass through the framing. Our favorite material for this is a black-colored polyurethane foam called “koi foam” (used in our area for



Figure 3. The gap between the subfloor and wall sheathing in this home (top) allowed unconditioned air to flow through a basement closet equipped with an outside door and into the living space above it. Smaller gaps between the framing and sheathing at the eaves — and around pipe and wire penetrations in partitions — were sealed with black canned foam (above).



Figure 4. A proprietary spray rig (top) is used to apply flexible latex foam to potential leak points between framing members, between framing and panel edges (above), and at wire penetrations (right).



adhering ornamental stones to the liners of koi ponds). We like it because it doesn't degrade from UV exposure.

We also take time to apply targeted amounts of canned foam to penetrations even in areas that will later be insulated with spray foam, such as around the eaves. Our insulation sub ordinarily doesn't spray these areas until after the siding is in place, so "prefoaming" any potential leaks to the outside prevents the spray foam from poking through the exterior finish.

A conventionally insulated attic — with a drywall ceiling buried in insulation — represents a huge zone of potential leakage, especially if there are light cans, wires, and ceiling fans to contend with. Rather than trying to seal these on a piecemeal basis, we foam the entire roof deck and eaves from the inside to bring the whole attic inside the home's thermal envelope. To minimize heat buildup in the resulting "hot roof," we cover the outside of the deck with 2 inches of polyiso board, a continuous layer of Ice & Water Shield, and a vented standing-seam metal roof on diagonal furring strips.

In addition to sealing leaks around the eaves — which can be difficult to deal with otherwise — this approach prevents indirect leaks by locating all the hvac ducts in conditioned space. Although our hvac guy seals our ductwork and performs a duct-blast test, there's no way to avoid some leakage. Even a fairly tight system might leak 50 to 100 cfm into an unconditioned attic, placing the rest of the house under negative pressure and inducing humid outside air to find its way in — a potential problem that goes away when the ducts are moved inside. Keeping the ductwork out of a blazing-hot attic also minimizes heat transfer and may make it possible to use a smaller AC unit.

We only use open-cell for insulating roof decks. That way, any water that might find its way through the roofing will eventually soak or drip through the foam and let the homeowner know there's a problem.

Insulating a roof deck with impermeable closed-cell foam is asking for trouble, in my opinion, since a small leak could go undetected for months or years, allowing rot to develop.

Sealing and Insulating Wall Cavities

Cracks between adjoining framing members or framing members and sheathing are another major source of air leaks. The crack between the bottom plate and slab or floor sheathing is the most obvious of these, and most builders now use flexible plastic sill sealer in this area. That's better than nothing, but for a reliable air seal, the joint should also be caulked all the way around the building.

Our preferred wall system for new construction uses 2x6 walls with advanced framing insulated with Owens-Corning's EnergyComplete blown-in fiberglass, which is designed to combine the air-sealing ability of foam with the low cost of fiberglass. The air-sealing component is provided by a fast-curing, flexible latex foam that can quickly be sprayed over the edges of ganged studs or double plates to form a thin, easily compressed layer that doesn't interfere with the drywall (**Figure 4**). It's also used to air-seal butt joints between sheets of plywood or OSB sheathing, or between framing and sheathing.

After methodically spraying potential air leaks with the latex foam, our insulation sub nets and blows the wall cavities (**Figure 5**). Combined with $\frac{3}{4}$ inch of exterior rigid foam, that gives us an R-23 wall, which is well beyond the code-minimum 2x4 wall with R-13 batts.

Because the wall between the garage and living space lacks the layer of house-wrap on the exterior walls, we air-seal and insulate this critical area by foaming the wall cavities, rather than using netted fiberglass. But spray foam has one limitation when used as a cavity fill: Because it's trimmed flush with the edges of the framing, it doesn't address leaks between



Figure 5. Once the air-sealed framing is covered with staple-up netting, the cavities are filled with blown fiberglass, which the author finds more reliable than batts. According to the manufacturer, the latex sealant is designed for use with either material.



Figure 6. Potential leak points in the framing of this partition between a living space and garage were sealed with sprayable caulk before the foam sub sprayed the cavities and overhead roof deck. Ductwork will be installed in the conditioned space between the roof deck and ceiling, which should improve the performance of the home's air conditioning and heating.



Figure 7. The 2x4 framing adjacent to the doorway (top) has been sprayed with a thin layer of closed-cell foam, which will later be covered with a thicker layer of spray cellulose, already visible on the taller wall at right in the photo. Note how the ceiling above the doorway has been insulated with open-cell foam. Cracks between the slab and bottom plates are sealed with flexible caulk (above); to prevent interference with the drywall and trim, caulk at framing members is immediately tooled flat (right).



framing members, which must be sealed some other way.

The easiest way to do this, we've found, is to have our fiberglass sub spray the framing in this area with EnergyComplete sealant before the spray-foam sub fills the cavities (**Figure 6, previous page**). This is an approach that Owens-Corning probably isn't too enthusiastic about. The sealant can only be applied by OC-trained applicators, and the company developed the system to compete with spray foam, not to enhance it. Officially, OC won't recommend using its latex foam with anything but its own brand of fiberglass. But since he's blowing glass into the rest of the walls, our sub doesn't mind sealing this limited foamed area as well, and field experience has shown us that our "off-label" approach is very effective.

Closed-Cell Foam and Caulk

If we're working with 2x4 framing — as is often the case in remodeling projects — we insulate the walls with open-cell foam throughout. We also work with one architect who often specs 2x4 walls insulated and air-sealed with an inch of closed-cell foam followed by 2½ inches of spray cellulose.

In either case, there's no fiberglass applicator on the job, so we have to seal cracks between framing members manually. We do this with a highly flexible commercial-grade caulk called Dymonic, made by Tremco (tremcosealants.com). After squeezing out a bead of caulk with a sausage gun, we immediately tool it flat with a painter's tool so the drywall or trim will lie flat over it (**Figure 7**). Depending on the size of the house, it can take two workers two or three days to go over all the framing this way. My carpenters were initially responsible for this part of the job, but I've recently trained my painting sub to take it over, freeing up the carpenters for more demanding work.

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