

**IAQ IQ: Fall, 2014: AIR IN, AIR OUT**

©2014, Jeffrey C. May

Just as we breathe in and out, a house “breathes” as air flows from the outside to the inside, and from the inside back to the outside. When we breathe, we can inhale pollen, pet dander, mold spores, and gases like formaldehyde and carbon monoxide – substances that can be injurious to our health. Likewise, air flowing into and out of a building can carry unhealthy substances.

If a residence is located near a busy city street, or over a parking garage, combustion gases and diesel-fuel soot and fumes can be carried into the structure through open windows, construction gaps and other openings. At certain times of year, allergenic pollen can settle on window sills and furniture surfaces near open windows.

We all recognize these perils. What people don’t often realize, however, is that some of the mechanical equipment that may be installed in a home in order to “help the home breathe” and thus improve air quality actually does the reverse.

Exhaust-only basement “dehumidifiers” depressurize the basement. In theory, the make-up air is supposed to come from the upper floors of the house. But what if the basement itself is leaky? Old windows? Gaps in the bulkhead? Then humid exterior air will flow into the basement, and moisture will condense on cool foundation walls, leading to mold growth. What if the air on upper floors is hot and humid? The same basement mold problem could occur.

I’ve also seen basements that had such “dehumidifiers,” and transfer grilles had been installed in first-level floors to allow for airflow from the first floor into the basement or crawl space. When the “dehumidifier” wasn’t running (or the depressurization was not adequate), those openings allowed moldy basement or crawl-space air to flow upstairs. And in one home, two such “dehumidifiers” caused the boiler to back draft. In my opinion, the “fan only dehumidifier” is a scam.



*Mold growing in dust on Humidex intake*



*Mold growth on the intake side of an old-style HRV*

What about air-to-air heat exchangers? All of these devices lack adequate filtration, so are often moldy. And sometimes, they lack proper drainage...dust, moisture...voila! Mold.

And fresh-air intakes? Always check the location of the intake. I received a call from a woman who lived in New Jersey. Every time she spent more than a few minutes in the basement laundry, she got a headache. Her husband thought she was imagining things, and so didn’t support the idea of paying someone to investigate the problem. Luckily, my wife Connie and I were driving through that area the following week, so could stop by for an hour or so to try to figure out what was going on. This greatly reduced my fee.

The two-story house, less than 20 years old, was built in an “L” shape with a significant roof overhang. At the interior corner of the “L,” close to the ground where the garage met the house, I could see piping from a direct-vented boiler. I could see another intake vent nearby.

The laundry area was housed in the basement mechanical room. Once in the basement, I could see that the intake vent next to the boiler exhaust was part of a fan-powered combustion-air supply for the mechanical room. Due to the stalled outdoor air and lack of dilution, combustion gases from the boiler were drafting back into the basement through that combustion-air supply pipe.

Every time the woman spent time in the basement, folding laundry or ironing, she was exposed to elevated levels of combustion products, including a high level of carbon monoxide. It was a very unhealthy situation. The husband, who had been quite verbal in his objections to this site visit, became quiet as I explained the situation to both of them. When we left, the woman broke into sobs and embraced us both as we stood in the driveway. She wasn’t crazy, after all!

Ventilation in attics: some old timers think gable-end vents are best. Newbies prefer ridge and soffit vents. I’m an oldie, so I prefer gable-end vents.

I can't tell you how many times I've had clients remark that they've been told that they needed more attic ventilation to prevent attic mold growth. This simply isn't the case.

I've seen well-ventilated attics that were full of mold growth, and other attics with no ventilation or with minimum ventilation, that didn't contain any signs of mold growth.

Mold requires moisture to grow. In attics, this moisture can be supplied by moist house air migrating into the attic (or, rarely, moisture from roof leaks). In the summer, the attic heat prevents the moisture from condensing. From late fall to early spring, however, the sheathing is cool, especially at night. The moisture then condenses on these surfaces, and mold will grow on surface sugars (wood sap), stored starch, cellulose, and/or on surface dust. Mold growth is often heaviest on the north-facing or east-facing side of the attic, because here, the sheathing is that much cooler.

What are some of the sources of attic moisture, and pathways for moist house air to flow up into the attic? Some are obvious: warped and leaky pull-down stairs, an ill-fitting attic hatch, bathroom exhausts venting directly into the attic, a leaky attic furnace, leaky attic ducts, or a basement furnace with a humidifier.

Other sources and pathways are less obvious. In a house with baseboard heat and a separate air conditioning system in the attic, occupants don't always close supplies and returns in the heating season. Then warm moist house air flows up into the ducts. If attic ducts or an attic air handler is leaky, the air can flow into the attic. (How many times have you seen a return in a second-floor hallway ceiling, outside of a bathroom? All that moisture from showering!) And in some cases, the moisture condenses within the air handler or ducts, and mold grows in the dust within the ducts, or in the dust captured in exposed fibrous lining material in the return plenum.



*Condensation in attic A/C supply duct*



*Leak stains under duct from condensation within*

Many soffit vents are too small or have been painted over, so they are restrictive. Depending on wind direction, the air pressure can be greater outside the attic than inside the attic. Air always follows the path of least resistance. In one odd case that I observed, the exhaust was vented properly to the exterior, but the vent kit was oriented so that moisture flowed back into the attic through the soffit.



*Mold growth due to air back-drafting into attic soffit*

More common is the situation of a bathroom exhaust fan vented into the soffit, and some but not all of the air flows to the exterior. Much of the air flows by convection up between the rafters to the peak of the roof, then cools and drops down toward the attic floor, rather than flowing out through a restrictive ridge vent.

#### Advice to give your clients:

1. In an air-to-air heat exchanger, the interior filters should be removed and be replaced with MERV 8, in-line filters on both the house-air and exterior-air intakes.
2. If the house has steam or hot water heat and a separate air conditioning system, the returns and supplies to the attic should be closed in the heating season.
3. Bathroom exhausts should always vent directly to the exterior, and not into the attic or soffit.
4. That "fan-only dehumidifier" should be removed, and openings created during the device's installation should be sealed. Only a condensing dehumidifier should be used.
5. Air intakes should not be located near direct-venting piping.
6. Don't paint over soffit vents!