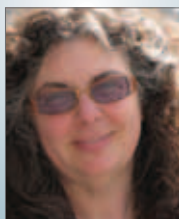


Safe Air at Home



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Many home performance contractors think indoor air quality (IAQ) problems result from pollutants in the house that are too concentrated, due to inadequate ventilation. This is correct thinking but not a complete picture. At my home performance company, Pure Energy, we are finding more and more IAQ problems caused by pollutants that are supposed to be *outside* the living space, but are being drawn *into* the living space by unbalanced house pressures. Home performance contractors should fix these imbalances whenever possible. To do so requires proper diagnostic testing and a solid understanding of how occupants control their energy and how a house, and everything in it, acts as a system. This is a story about one recent home performance job that didn't go very well.

Pure Energy Coach LLC, in Lancaster, Pennsylvania, is a leading provider of training, energy auditing, and quality assurance services for home improvement professionals and energy efficiency programs. We are well known for our skilled problem solving. In late January 2011, a program administrator of a public housing program in our area asked us to inspect a house occupied by a woman who was having what she called allergy attacks. She claimed that her breathing problems,



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The home had recessed lights near the return.



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Garage ductwork in the home.

itching eyes, and itching body started the day the home performance contractor insulated her attic almost two months earlier, and she thought she was having a reaction to the caulk. By the time we made our troubleshooting inspection, a whole lot of other things had happened.

- At her request, the contractor returned, found the caulk dry, and sent her the material safety data sheet (MSDS), showing her that the caulk might take 14 days to cure completely.
- She asked the contractor to put her up in a hotel and put her dog up in a kennel for the weekend. The contractor agreed.
- She returned home. Her symptoms continued.

- She consulted a doctor, who told her to avoid staying in her home.
- She contacted an air-testing service and the local poison control center, and asked them both about the caulk.
- She stayed in a hotel again.
- She contacted the contractor, who now thought she might be having a reaction to the cellulose or some foam used in her home. So the contractor returned and arranged for a cleaning service to clean part of the house near where the cellulose and foam were installed.
- The cleaning took place, and the cleaning service conducted a room-by-room walk-through with the client. The room where the woman's symptoms had been the worst before the cleaning now caused no symptoms.
- Five days later, the woman contacted the contractor again, saying that she was having breathing problems and that the air purifier she had attempted to use wasn't doing her any good. She said that in her computer room, in particular, she couldn't breathe or talk easily. She asked the contractor to return to "get this out of my carpets and out of my air."
- She claimed that her dog was itching and rolling around scratching herself.
- An air-testing service tested for mold or bacteria and found none.
- She called her insurance company to find out how it could help. The company sent an adjuster, who told her that the house was covered for damages, but not the people in the house. The insurance adjuster told her that he had worked in fiberglass when he was younger, and he thought her problem was fiberglass in her attic.
- She told the contractor that she must be "that one in a hundred who has a high

allergic reaction to the insulation.” She said that she just wanted the problem resolved.

- The program administrator agreed to split the costs associated with housing the woman and her dog, and with the other attempts to fix the problem. The contractor wanted to consider the job finished.
- The woman called her congressman to complain that the contractor wasn’t solving her problem.
- She reported to the contractor that her chimney was “smoking,” and her roof was “smoking” out of the newly installed roof vent.

■ The congressman’s staff contacted the program administrator. The program administrator asked us to inspect the house. By the time she welcomed us into her home, the woman was very frustrated and ready to sue the contractor. We were able to figure out the cause of her symptoms pretty quickly. Here are the steps we took to figure out what happened:

- We *listened* to what she was saying. We asked her when the symptoms started, where in her body she felt symptoms, and where in her house she felt the symptoms.
- We *looked* around her house, especially where she said she felt the most sick.
- We *applied* our building science knowledge to analyze her problem.
- We saw the problem.
- We *told* the truth about what we saw.
- We *acted* on the findings.
- The house was partially *fixed*, and she is better.

Here is the rest of the story.

We contacted the contractor and asked for a list of all the work performed in and on the building, as well as all test-in and test-out results. We received the available information quickly and noticed that there were no zonal pressure test results and no duct test results. These tests should have been done during the blower door test sessions; they would have given the contractor feedback about how well he sealed the pressure barrier. Giving the contractor the benefit of the doubt, and believing that the tests had been done but simply hadn’t been recorded, we called again asking for the test results. We were told that the tests had not been done.

Within two days, we made an appointment with the customer and we did our third-party quality assurance and troubleshooting visit. These are the results, taken from our inspection notes:

The rooms where the woman’s reactions were the strongest were rooms with recessed light fixtures and an attic hatch.

The recessed lights were covered and packed with fiberglass. They were not air sealed at the ceiling or over the lights; they were not insulation contact (IC) rated, and they were not protected properly from overheating.

- The furnace fan ran constantly, even when the fan switch on the thermostat was in the auto position.
- The return air was bypassing the furnace filter, which was poorly installed.
- There were air fresheners in the basement rooms.
- The new cellulose in the attic was damp around the attic hatch, and there was condensation on the roof over the hatch. There was frost and what appeared to be mold on the roof deck near the eaves.
- The relative humidity (RH) in the problem rooms was low.

The woman had deliberately blocked some of the return and supply registers because she felt cold air and saw mouse droppings.

Because of her symptoms, we didn’t do air leakage testing, which would have verified what, by this time, we believed was happening. I bet a lot of you are already saying, “I know, I know!” So here is our tentative diagnosis:

- Since the furnace fan ran continuously, the woman had blocked some supply registers because she was cold. The recessed lights were not air sealed, so attic air was being sucked into the house in areas where the house pressures were unbalanced.
- Since the recessed lights and the attic hatch were not air sealed, house air was being pushed into the attic in areas where the blocked return registers increased house pressures.
- The attic air was probably dirty—laden with fiberglass fibers at the minimum, and probably with mold and other contaminants as well.
- These contaminants were causing the woman and her dog to itch and feel sick.



This photo shows the frost and evidence of the mold on the roof deck.



Fiberglass insulation is shown around an unsealed, dammed recessed light.

An HVAC contractor was called in to fix the fan switch on the furnace. It had been stuck in the on position during a recent oil filling when the technician bleeding the oil lines hit a relay switch that kept the fan running constantly. Even before then, the stack effect and the leaky attic plane pressure barrier probably drove the warm, moist house air into the attic, contributing to the attic moisture problems. Now, with the fan stuck in the on position, the rooms with blocked return vents became even more pressurized and the rooms with the blocked supply vents became more depressurized.

The home performance contractor returned to seal and dam the recessed lights, and fix the furnace filter slot so the filter actually performed. About a week after the fixes, the woman reported that she was feeling better, but not 100% better. We asked if we could return to do diagnostic tests and asked her to leave while we did our testing, so the air



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The fiberglass is shown around an unsealed, dammed non-IC recessed light.

movement and air changes caused by the blower door would not exacerbate her problems. When we did our diagnostic tests, we found that the return ducts in the garage (outside the thermal boundary) were leaky, sucking garage air into the living space.

We earlier confirmed that some of the furnace return air had come from the attic through the leaky recessed lights when the blocked supply registers depressurized the


room. Now we confirmed that the leaky ductwork from the garage brought bad air into the breathing space. This was happening because the blocked return registers were causing higher suction pressure in the leaky garage ducts. When the woman closed off the supply registers, she caused the house to be under higher negative pressure with reference to the outside. Therefore, the makeup air from the unbalanced system came from the garage and the attic through the unsealed recessed lights and attic hatch. When she closed off the return registers, she caused those rooms to be under higher positive pressure, pushing warm and moist air into the attic. This in turn caused moisture to condense and create wet cellulose, frost, and mold.

Since the contractor had returned to seal the leaky recessed lights, what was left to seal was the leaky garage ductwork. We asked the contractor to do this, but the program administrator refused to pay for it, so the ducts are probably still leaky.

The woman claims that her health has improved, but she still wants air testing done on

her home. When the program administrator refused to pay for testing, she told him that she was going to call the local television station and her attorney to complain.

The ordeal to date has taken three months and cost thousands of dollars. The program administrator and the contractor split the nine nights of hotel stays for the woman, and the 17 kennel days for her dog. They paid us for two comprehensive inspections.

This is an example of Pure Energy's business model for working with clients and customers. We call this the Coaching Model, and we've shared it at ACI conferences and other trade conferences over the past five years. We have found the model to be effective, even in very difficult cases such as this one. 

>> learn more

Pure Energy Coach, LLC, offers Safe Air at Home® inspection services for homeowners and renters that can lead to a Pure Energy Home Certification. Find out more at <http://pureenergycoach.com>.