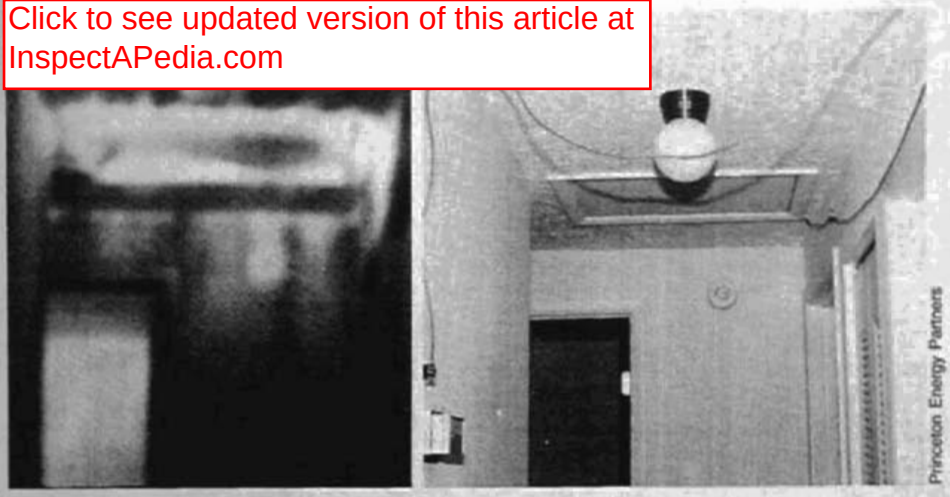

Princeton Energy Partners

Viewed through an infrared scanner, hot air leaks (light-colored areas) appear around the attic hatch and within the top of the hall-end partition. This thermogram was taken in summer with the house depressurized.

For my benefit, PEP house doctor Ed Minch holds a smoke gun near a joint in the hardwood flooring on the second floor and, again, at various points around the sweeping formal stairwell. As the smoke disappears into the internal structure of the house, PEP principal Ken Gadsby asks rhetorically, "Where are you going to seal? If you seal here at the stairs, the leak will just shift to the floor or baseboard and you won't see a bit of change on the blower door or your heating bill."

"What you're seeing," explains Gadsby, adopting his tutorial role, "is a convective loop that ties into the stairwell, the second floor joist cavity, and probably a number of interior partitions. Sealing here would be just treating the symptom, but ignoring the illness."

This demonstration is a prelude to our visit to the attic, where, they've told me, the real action is. In fact, in many of their jobs half of the time is spent in the attic, followed by 30 to 40 percent in the basement. Caulking and weatherstripping the shell, the bread and butter of their competitors, is the last and least priority of PEP, taking less than a tenth of their time. It's just not cost-effective, they maintain.

Up the attic hatch goes the three-man PEP crew, toting monitoring instruments and an array of tapes, poly, foam, and flashings. Scanning with the infrared viewer across the floor, which is covered with a few inches of old perlite, one of them quickly locates the top of a balloon-framed partition and sweeps aside the old insulation. A quick application of poly, caulk, and staples seals the top of the uncapped wall. Next, the chimney chase is sealed off with caulking and strips of aluminum flashing. Meanwhile, the other workers comb the attic recesses for telltale signs. Off in a remote dormer, they find more uncapped walls—this time the exterior walls are open to the eaves. "That explains the peeling paint outside the dormer," says Minch. "Moisture is being carried up the stud bays and dumped into the cold attic."

Piece by piece, a focused picture emerges from the many observations and measurements made. The picture is not of a house as we usually conceive it, but of a network of interconnected chambers exchanging air, heat, and moisture in accordance with shifting temperature and pressure differences and the laws of physics. Proud of his scientific roots, Gadsby reminds me more than once that the group "got started in rocket research."

An hour or so later, in the basement, they find and seal the bottom end of a plumbing chase and a missing window artfully concealed behind a makeshift panel. An archaic hopper is pawed over. An old coal chute, they speculate. Seal it up!

Last, they attack the house proper. The owner had complained about a cold corner bedroom—a piece of evidence warranting further investigation. With the house pressurized, a thick wisp of smoke disappears into the heating supply duct. "The duct system," says Minch, "should be a closed circuit with the same induced pressure throughout. The smoke shows that there's a leak in the system; some of the hot air is never reaching the room."

"How do you fix that one?" I ask.

"That's a tough one. We can't perform miracles."

Finally, a couple of door thresholds are installed and a little caulking strategically placed—in this case, around a plumbing access panel on the second floor. A little later, they proudly announce that the blower door reading is down to 24 ach. In less than half a day, the three-man crew has cut the air infiltration rate by 25 percent—and without touching one of the 38 double-hung windows, they are quick to point out. What little caulking and weatherstripping they do perform, they assure me, is more for comfort's sake than for energy savings.

Going for the big ones

What distinguishes PEP from other retrofit businesses, its principals say, is their systems' approach. While their competitors caulk and weatherstrip, PEP looks at the whole house—moisture, air quality, heating and ventilation equipment—and do what is most cost-effective for that particular building. In older multifamily projects with primitive heating controls, says Gadsby, shell tightening may fail to lower fuel costs. For example, after weathersealing, the tenant on the south side of a building gets too warm and opens her windows, increasing the draft through the building. Consequently, the tenant on the north side jacks up the thermostat even higher. The correct solution is a more intelligent heating control.

Similarly, they have seen situations in which increasing attic ventilation worsened an attic moisture problem and cases where stuffing insulation in a cathedral ceiling eliminated a moisture problem. Their analytical method gives them an edge on such complex and sometimes counterintuitive problems.

When they do set their sights on controlling heat loss, which is still the bulk of their work, they don't waste their time on labor-intensive window work; nor do they lay miles of caulk. "Doors and windows," Gadsby points out, "account for only 20 to 30 percent of air leakage in most cases. We go after the 70 or 80 percent that must be coming from elsewhere."

A little detective work up front allows them to find the one or two "big hitters" that often account for the bulk of the leakage. In a house style familiar to them, diagnosing the problem may be routine. Split-levels, Cape Cods, and townhouses each have their typical problems. Still, they assure me, there are always surprises.

One townhouse baffled a three-man crew until the scanner revealed that heat was going right through a cabinet full of dishes. Reluctantly, they removed the cabinets (hung fortunately with only a handful of drywall screws), cut away a section of drywall, and sealed off the connection between the cabinet soffit and outside wall. This resulted in a 20-percent reduction in leakage, worth half of the reduction they were after. For that particular housing built by that developer, this retrofit became standard practice.

Since PEP may contract to house-doctor multifamily projects for as little as $300 per unit, finding these generic problems and solutions can be essential for profits.

Loops and leaks

Because they go after the major thermal paths in the house, PEP contractors claim that their work consistently saves the homeowner considerably more money than is predicted by the reductions in infiltration alone. This seeming magic they attribute to the elimination of "thermal bypasses," that is, the myriad ways heat gets out of the building other than through wall and ceiling components following the rules and regulations of ASHRAE. Prominent among these are *convective loops*—wall and ceil-