Is There an Easier Approach to Air-Sealing?

Bring a house to code-required airtightness in just hours with AeroBarrier

BY ROSS MACPHERSON

I first learned about AeroBarrier in 2018 from a segment on This Old House. At the time, I was working as a Home Energy Rating System professional, or HERS rater, helping builders create energy-efficient homes and satisfy the airtightness requirements Massachusetts put in place in 2014—less than 3 air changes per hour at 50 Pascals (<3 ACH50). I was impressed with how quickly AeroBarrier sealed a house and how the sealing could be measured in real time. About two weeks later, I signed up to be one of the country's early AreoBarrier dealers. Since then, I've air-sealed more than 85 projects with the system, and I've learned a lot along the way. This article follows a typical installation.

Developed at the University of California, Davis in 2013, AreoBarrier is an air-sealing system that uses an atomized water-based acrylic sealant that's forced into gaps and cracks in the building envelope with air movement created by a blower door. Collectively, all these tiny gaps contribute a huge amount to a home's air leakage. The sealant closes off these tiny holes, greatly improving a home's airtightness.

Currently AeroBarrier is almost exclusively used in single- and multi-family new homes under construction. The most common time to air-seal with AeroBarrier is after the drywall is finished and before trim is installed. Existing houses are a challenge, because it's labor intensive to protect a finished home from sealant overspray.

The largest gap the process can seal is ½ in., so it won't by itself seal big leaks and it doesn't work as well in older, occupied multi-family buildings because it's nearly impossible to keep the sealant contained inside one or two units. But for a builder who is already building reasonably airtight single- or multi-family homes, it's often faster and less expensive than meeting the airtightness requirements other ways.

Why use AeroBarrier?

As an AeroBarrier dealer, I sometimes feel like I'm a victim of my own success as a HERS rater. My job was helping builders meet their energy targets without AeroBarrier. Now, when I pitch AeroBarrier to builders, they often ask, "Why should I use AeroBarrier when I've been meeting 3 ACH50 without it?" The answer is that we can use the HERS rating to value-engineer the project without hurting—and possibly improving—its energy performance.

A HERS rating analyzes a home's energy performance compared to a reference house built to the 2006 energy conservation code, which is assigned a rating of 100. The lower the number, the better the home's performance, which is represented as a HERS score. HERS Index scores tell you how much better or worse a home performs compared to the reference home—the Massachusetts building code calls for a HERS score of 55, or equivalent home performance calculated through other methods. The number takes into account insulation, windows, HVAC, appliances, solar orientation, and airtightness, among other things. Better-performing

Inset photo facing page: courtesy of New England Air Barrier

components can offset lesser-performing products in a trade-off scenario. For builders who aren't already hitting the 3-ACH50 airtightness, AeroBarrier provides a guaranteed path to get there. And even for those who are, it provides a more cost-effective, less fussy, and much faster way to hit the target.

With a reasonably airtight building, AeroBarrier can meet tightness levels lower than 3 ACH50 in an hour or two. And AeroBarrier guarantees a tight building

SEAL THE GAPS
AeroBarrier uses atomized sealant that's forced through gaps and cracks in the building envelope by the pressure of a blower door. As the sealant builds, it closes off or shrinks the gaps, resulting in a tighter house. (The orange is spray foam that was previously installed; the white is the AeroBarrier that came after.)

envelope, allowing builders to substitute a less-expensive building component without sacrificing the home's overall energy performance. In many cases, the savings are more than the cost of AeroBarrier.

The house featured in this article is a 3410-sq.-ft. custom home with a conditioned volume (the volume inside the thermal envelope) of 33,182 cu. ft. It has a complex shape and lots of glazing, two factors that adversely affect airtightness and HERS scores. With AeroBarrier, the builder was able to switch from flash-and-batt insulation—1 in. of closed-cell foam on the sheathing followed by a fiberglass batt—to all fiberglass batts.

How does it work?

AeroBarrier can seal gaps from ½ in. down to the width of a human hair. Many of these openings are not accessible or visible, making them difficult to seal with caulk or canned foam. The AeroBarrier sealant is pumped into the building and mixed with compressed air at several spray heads to create a fog of tiny sealant particles suspended in the air. At the same time, 100 Pascals of pressure from a blower door force the air and the sealant particles through the building shell.

The force of the leaking air makes the sealant particles stick to the edges of the leak locations; as the air stream continues, the leaks get smaller. The sealant doesn't coat exposed surfaces, though some will settle on subfloors. I've found that reducing the number of spray heads and moving them around during the seal reduces overspray considerably.

What can go wrong?

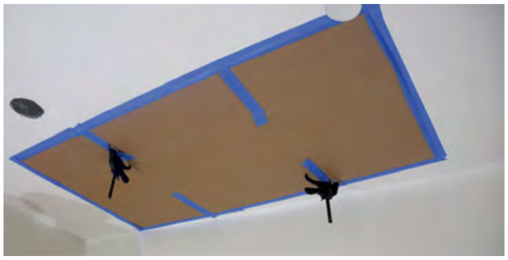
When using AeroBarrier, it's important to understand how blower-door tests are performed and how the protective measures for windows and mechanical systems impact air leakage. If you don't, you may not make the house tight enough during the sealing process. For example, to protect double-hung windows, we cover the entire sash and frame, making the windows artificially airtight. To compensate, we measure the amount of air leakage before and after covering the windows, so we know how much additional sealing we need to do to account for the additional leakage when the plastic and tape covering the windows is removed.

You also need to pay attention to the outside and indoor air temperature and wind. All these factors can affect blower-door testing and the AeroBarrier process. We also

PREP FOR A SEAL

Before using the sealant, we cover the things that shouldn't be sealed: windows, HVAC ducts, exhaust ducts, bath fans, and finished surfaces. We also cover the open ends of pipes so we don't get sealant in them. Traps and supply lines will later be filled with water, so their leakage doesn't factor into the building's airtightness. Once we've closed any openings that would prevent us from pressurizing the envelope, we run an initial blower-door test to measure the tightness of the structure before installing plastic over the windows and exterior doors.

COVER WINDOWS
In our area, double-hung windows are ubiquitous. Because they are weatherstripped with a brush seal, the seal would become clogged with sealant during the AreoBarrier process. To avoid this, we cover the entire window with painter's plastic and tape, protecting the sashes and weatherstripping but allowing the sealant to get between the frame and the rough opening.



COVER OPENINGS
At the time AeroBarrier is installed, the home is generally missing attic access panels, basement doors, and garage entry doors. We cover attic hatches with cardboard and use self-adhesive plastic to cover HVAC dusts and exhaust vents. For missing entry doors, I use a blower-door frame fitted with a tarp. All of these temporary covers stand in for the real building components that will come later.

COVER WALLS NEAR THE BLOWER DOOR

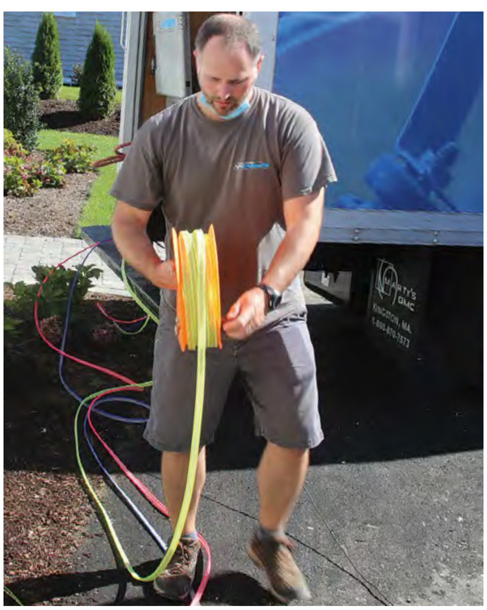
The sealant doesn't readily stick to vertical surfaces—it needs the pressure of moving air. While we're sealing, we use a blower door to pressurize the space, which can provide enough turbulence to make the sealant stick to nearby walls, so I cover any walls that are near the fan. The sealant can easily be wiped off with water shortly after the sealing process, but it gets more difficult with time.

SET UP THE HEADS

Line sets that carry compressed air and sealant terminate at tripod-mounted spray heads, where the sealant and compressed air are mixed to create the fog of sealant. The tripods are spread throughout the structure—I used four on this 3400-sq.-ft. house. Once the spray head is connected to the line set, I cover the tripod with a plastic trash bag to keep it clean, leaving the head exposed.

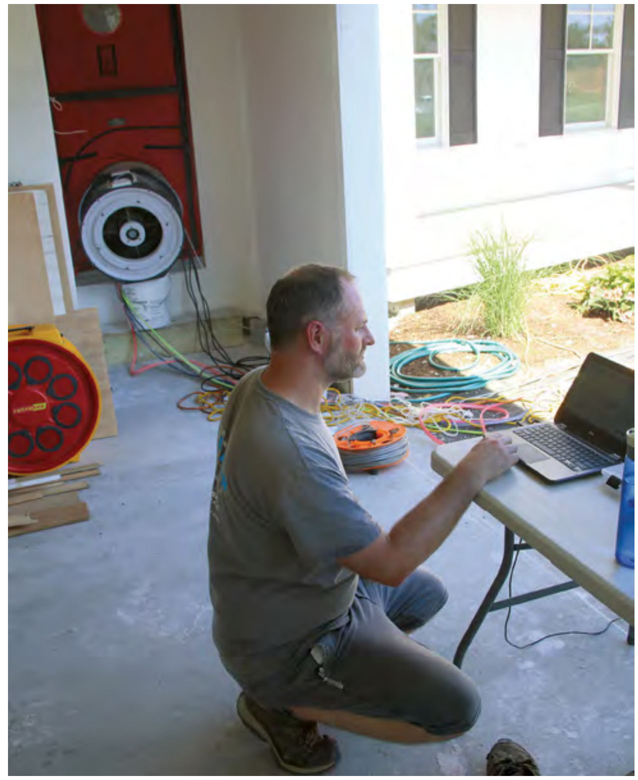
RUN THE LINES

The AreoBarrier machine is the heart of the system. It pumps the sealant at a controlled rate based on the temperature and humidity inside the house. The line sets and the temperature and humidity sensors connect to the back of the machine. There are also connections for the control computer, the blower door, and the blower door's resistance heating. The truck's onboard generator produces 240v of power.



TIME TO SEAL

Some parts of a structure seal faster than others, and smaller leaks seal faster than larger leaks. The sealant doesn't travel easily through the building on its own, so I move the tripods four or five times during the sealing process. After we hit our target airtightness, we flush the lines with hot water. We follow the water with compressed air to empty the line sets. We then run our post-seal test on the AeroBarrier software, and double-check with another blower door to ensure that the airtightness numbers are accurate.



MONITOR AND CONTROL
The sealing process is initiated and monitored in real time from a laptop connected to the AeroBarrier machine in the truck. The software speeds and slows the pump depending on temperature and humidity inside the house. Warmer temperatures and lower humidity speed up the process.

REDUCE OVERSPRAY
Using fewer spray heads results in less overspray on floors and horizontal surfaces and less wasted sealant. The trade-off is needing to move the heads a few more times during the sealing process. A full-face respirator prevents breathing in the sealant.

CLEAR THE AIR
With the blower door still running, we remove the temporary protection and ventilate the space to bring down the humidity. I use the trash bags that formerly covered the tripods to bag up the trash.

add 10% to the total leakage amount we're aiming for, per HERS protocol, to compensate for doing a single-point blower-door test instead of a more accurate multipoint test. (Many HERS raters use a single-point test, but we want our results to stand up regardless of the test method.)

Ready to seal

Our two AeroBarrier machines are mounted in our two box trucks, along with a 12,000w generator and a 39 CFM (cu. ft. per min.) at 100 psi (lb. per sq. in.) gas-powered air compressor. Hoses that supply a stream of 80-psi air from the compressor and the sealant connect the AeroBarrier machine to the spray heads. Also running from the machine is a sensor array to monitor temperature and humidity inside the building and a network cable that connects the machine to a laptop that controls it.

The sealant comes in 5-gal. buckets and must be mixed thoroughly before sealing. Once everything is set up, we prime the lines with air and sealant and ensure that all the spray heads are functioning. Once I've confirmed everything is working, the blower door is ramped up until the house is under 100 Pascals of pressure, and then the pump starts injecting sealant into the space. The pump speed is controlled by the computer and is adjusted based on temperature and humidity inside the house.

The blower door we use to pressurize the house has 4500w of electric-resistance heat in front of the fan. The additional heat lowers relative humidity as we introduce moisture into the house via the sealant. Lower humidity and higher temperatures speed the air-sealing process.

If all goes according to plan, our final blower door should be at or below our hard target. For our final blower-door test, we swap the fan that we use for air-sealing with another to check that our results are accurate. This ensures that our air-sealing target has been achieved before the whole house is evaluated a second time by a HERS rater as part of the occupancy permitting process. □

Ross MacPherson is the operations manager for New England Air Barrier in Sagamore Beach, Mass. Photos by Patrick McCombe, except where noted.

Air-sealing by the numbers

The air-sealing goal for this project was 3 ACH50, but our target reading while installing AeroBarrier was about 2.75 ACH50 to allow for some leakage at the attic hatch and entry doors that will be installed later. ACH50 stands for air changes per hour at 50 Pascals of pressure, and is the metric most commonly used to measure the airtightness of a home. However, HERS raters and weatherization workers often work with cubic feet per minute (CFM) as their metric until the end of the process. The main differences between the metrics is that ACH50 converts the leakage amount to hours instead of minutes, and also takes into consideration the building's volume.

The first thing we do is test the house for a baseline air-leakage number. Once all of our prep work is complete, we run another blower-door test to determine the post-prep air leakage. Subtracting the post-prep CFM from the pre-prep CFM tells us exactly how many CFM of window and HVAC air leakage we covered with plastic sheeting and tape. We then subtract that number from our goal to determine our target CFM.

Once we finish all of these calculations, we have a target leakage amount expressed in CFM. The AeroBarrier software calculates an approximate sealing target based on inputs of the building, and I find it to be fairly accurate, but I prefer to measure these things myself and use the AeroBarrier software to double-check. Every 60 seconds, the system measures the CFM at 50 Pascals and plots the reduction on a graph along with the elapsed time. The system also displays the temperature and humidity inside and outside and airflow through the fan.

2684 CFM50

BASELINE TEST
Results before covering windows and HVAC with plastic

2376 CFM50

SECOND TEST
Leakage reduced by 308 CFM50 after covering windows and HVAC with plastic

1361 CFM50

FINAL TEST
With plastic removed, leakage reduced overall by 1323 CFM50

1535 CFM50

ADJUSTED RESULTS
A post-seal airtightness of 1535 CFM50, or 2.77 ACH50, measured with a single-point test that includes a 10% penalty and temperature differential corrections (85°F ambient; 75°F interior)

THE FINAL TEST
The sealing process usually takes about an hour or two with an average-size, reasonably airtight building. The last step is to swap the AeroBarrier blower-door fan for another one for a final airtightness test. This double-checks the leakage amount to make sure results are accurate.