



# HVAC'S INVISIBLE ENERGY DRAIN—

## AND THE EASIEST WAY TO STOP IT

BY APRIL FRAKES, DIRECTOR, AEROSEAL

*Aeroseal Duct being implemented in an RTU application*

**W**ith the increasing demand for better performance and energy efficiency in commercial buildings, and higher standards being implemented in more places with greater frequency, meeting efficiency requirements is becoming more and more challenging. One large, but traditionally difficult to address challenge is HVAC inefficiency, and the unseen waste due to duct leakage. Aeroseal's duct sealing technology addresses this issue with a scientifically driven approach that not only reduces energy wastage but also improves the overall performance of HVAC systems and occupant comfort—all with little to no disruption to the building or the people in it. This article delves into the technical mechanisms behind Aeroseal's duct-sealing technology, the methodology used to achieve energy savings, and its application in Energy Service Company (ESCO) projects.

### THE TECHNICAL CHALLENGE: DUCT LEAKAGE IN HVAC SYSTEMS

In commercial buildings, HVAC systems typically account for nearly half of the total energy consumption. A significant portion of this energy is lost due to duct leakage, where conditioned air escapes through gaps, cracks, and holes in the ductwork before it reaches the intended spaces. According to studies, up to 75% of duct systems exhibit leakage levels of 10-25%, with some systems losing up to 40% of their heating and cooling energy. This not only reduces the efficiency of the system but also increases the operational load on HVAC components, particularly fans and compressors, which work harder to maintain the desired airflow and temperature.

Duct leakage also impacts indoor air quality (IAQ), allowing unconditioned air to infiltrate the system, which can introduce pollutants, humidity, and temperature inconsistencies. This creates a dual problem: energy waste and compromised air quality. Addressing this leakage is critical for improving both energy efficiency and occupant comfort in commercial settings.

### THE AEROSEAL PROCESS: SEALING DUCTS FROM THE INSIDE OUT

Aeroseal's duct-sealing technology takes a novel approach to solving the issue of duct leakage. Rather than relying on traditional external sealing methods that are labor-intensive and often ineffective in hard-to-reach areas, Aeroseal employs a method that seals leaks remotely from the inside of the ducts.

We start by pressurizing the duct system, and then our patented technology and software assesses duct air loss, determining the quantity of sealant required before the sealing process. Then the automated system remotely injects aerosolized sealant into the ductwork and monitors the process in real-time through a computer-controlled system that continuously measures airflow and leakage. Because the ductwork is pressurized, the particles rush to escape through any cracks or holes, accumulating at these leaks and forming a tenacious but pliable air-tight seal. This process effectively seals any leaks up to 5/8" without compromising other areas in the ductwork. The sealant itself is safe and non-toxic, with no danger posed to building occupants.

This internal sealing process is non-invasive, meaning it does not require extensive access to the ducts themselves, making it particularly advantageous in retrofit applications where ducts may be embedded in walls or ceilings. The sealing is tracked in real-time, allowing technicians to monitor the reduction in leakage and ensure that the system achieves the desired level of airtightness.

## AN ADVANTAGE IN RETROFIT PROJECTS

As big as the problem of duct leakage and HVAC inefficiency is for energy optimization, in most buildings, it is difficult or impossible to address the problem. Traditional HVAC sealing methods call for manual sealing by hand – using either duct tape or mastic or a combination of both, that requires full access to the ductwork. However, in most existing buildings, the ductwork is behind walls and ceilings. Therefore, to reduce duct leakage, improve the performance of the HVAC system, and reduce energy consumption, traditionally requires demolition of walls and ceilings to reach the ductwork, and may require disrupting or dismantling the ductwork or HVAC system itself.

Because Aeroseal is designed to quickly and efficiently seal leaks remotely from the inside of the ductwork, it can:

- Seal leaks throughout the entire duct system, including those in hard-to-reach areas or hidden behind walls—avoiding the costs and labor of demolition and construction.
- Vastly improve the performance of the HVAC system without requiring extensive disassembly or replacement.
- Avoid the human pitfalls of manual air sealing—which may not effectively seal all leaks or accurately assess the extent of leakage.
- Reach tiny cracks and gaps that may be difficult to detect and seal with traditional methods

## ENERGY SAVINGS: THE TECHNICAL MECHANISMS BEHIND EFFICIENCY GAINS

The energy savings achieved through Aeroseal's duct-sealing process are primarily driven by two key factors: improved airflow management and reduced fan power consumption.

### 1. RESTORING AIRFLOW EFFICIENCY

In a typical duct system with leakage, a portion of the air supplied by the HVAC system never reaches the occupied spaces. For example, in a duct system handling 26,000 cubic feet per minute (CFM) of air, up to 6,000 CFM could be lost through leaks, meaning that only 20,000 CFM reaches the conditioned space. This requires the HVAC system to compensate for the lost air by increasing the airflow from the supply fan, which in turn increases energy consumption.

By sealing the ducts, Aeroseal restores the system's ability to deliver the intended volume of air to the occupied spaces. This improvement in airflow efficiency translates directly to energy savings because the HVAC system no longer needs to overwork to compensate for leakage. After sealing, a 90% reduction in leakage can be achieved, which restores the airflow and reduces the need for additional fan power.

### 2. REDUCING FAN POWER CONSUMPTION

The second major source of energy savings comes from reducing the power required by the supply and exhaust fans. The relationship between fan speed and energy consumption follows the fan affinity laws, which state that fan power is proportional to the cube of the airflow. In other words, small reductions in airflow result in disproportionately large reductions in fan power.



*How Aeroseal technology works. For demonstration purposes only. Actual application may vary based on the type of HVAC system and ductwork*

For instance, after sealing leaks in a system handling 26,000 CFM of air, the leakage is reduced from 6,000 CFM to 600 CFM, allowing the system to meet its airflow requirements at a significantly lower fan speed. This reduction in fan speed can lead to a 30% or more decrease in fan power consumption, depending on the size of the system and the severity of the initial leakage.

In addition to direct energy savings from reduced fan power, sealing duct leaks also reduces the energy required for heating or cooling the air. In systems with significant leakage, unconditioned air can infiltrate the ducts, increasing the load on the HVAC system to maintain temperature and humidity levels. By eliminating this leakage, the system requires less energy to condition the air, further enhancing overall efficiency.

## MEASUREMENT AND VERIFICATION OF ENERGY SAVINGS

Aroseal's approach to energy savings is not only effective but also measurable. The process begins with an initial audit to quantify the extent of duct leakage and the potential energy savings. After the sealing process is complete, the system is re-evaluated to verify the reduction in leakage and the corresponding improvements in airflow and energy efficiency. Aeroseal provides clients with detailed reports that document the pre- and post-sealing performance, including fan power reductions, airflow improvements, and estimated energy savings. This level of transparency is particularly valuable in ESCO projects, where performance-based contracts often require measurable and verifiable energy savings.

## CONCLUSION: A TECHNICAL SOLUTION FOR A WIDESPREAD PROBLEM

Aroseal's duct-sealing technology offers a scientifically grounded solution to the persistent problem of duct leakage in HVAC systems. By sealing ducts from the inside, the technology restores airflow efficiency, reduces fan power consumption, and improves indoor environmental quality. For ESCO projects, the ability to quantify and verify energy savings makes Aeroseal an ideal partner for achieving performance-based energy goals. As the demand for energy efficiency continues to grow, technologies like Aeroseal will play a critical role in helping commercial buildings reduce their energy footprints and improve their overall sustainability. ❁