



Guide to Air Sealing

Strategies for minimizing air leaks in building envelopes and ductwork

Section

1

Intro overview — costs and consequences

THE TANGIBLE COSTS OF HIDDEN AIR LEAKS

When you step into your home, office, or other commercial building, you may be under the impression that these indoor environments are airtight. Unfortunately, that's simply not the case. All buildings leak to some degree. Whether in commercial or residential sectors, new or old construction, air leakage in building envelopes and heating, ventilation, and air conditioning (HVAC) ductwork is inevitable. Often, these hidden air leaks continue to be undetected for many years and have far-reaching consequences to energy efficiency, comfort levels, and indoor air quality (IAQ).

Building envelope leakage refers to air leaks that commonly occur in areas such as gaps around windows and doors; joints in ceilings, floors and walls; and structural penetrations (from piping, wiring and ducts). Duct leakage refers to air leaks occurring throughout building's ductwork or ventilation system. Leakage is most common at junctures and joints but could occur anywhere throughout the system.

How common is air leakage?

Hidden air leaks are a prevalent issue within commercial and residential buildings, with aging facilities more likely to have increased leakage rates. U.S. Department of Energy (DOE) estimates speak to the scope of the problem:



90%

of all residential ductwork has hidden air leaks

20-30%

of ducted airflow is lost due to leaks

What are the impacts of air leakage?

Hidden air leaks are a prevalent issue within commercial and residential buildings, with aging facilities more likely to have increased leakage rates. U.S. Department of Energy (DOE) estimates speak to the scope of the problem:

Leaky envelopes account for approximately 4 percent of building energy use in the United States.

25–40 percent of home energy use can be attributed to leaky envelopes and ductwork.

30 percent duct leakage can reduce energy ratings by up to 50 percent.

Occupants are more likely to encounter drafts as well as warm and cold spots throughout a building.

Dust, allergens, pollutants and particulates can present risks to occupant health and/or well-being.

This Air Sealing Guide will help construction companies, building contractors and homeowners understand the importance of proper sealing of building envelopes and HVAC ductwork. You'll learn about the limitations of traditional air-sealing methods — contrasted with proven technologies, strategies and benefits of today's modern air-sealing technologies.

WHAT IS AIR SEALING, AND WHY IS IT IMPORTANT?

Air Sealing is the practice of minimizing or preventing unintended building airflows — of outdoor air into interior space or the escape of indoor conditioned air to the outside. This is done in two primary ways:

1

Sealing the gaps, cracks and openings within walls, ceilings, floors, windows, doors and other structural components — collectively known as the “building envelope”

2

Sealing leaks in HVAC ductwork and addressing leaks and inefficiencies in a ventilation system

Unfortunately, the importance of air sealing is often overlooked. But when done properly, it can provide a wide range of benefits to building occupants and owners, while lowering energy costs and helping to support more sustainable heating and cooling technologies.

Enhance indoor comfort levels

We've all experienced the comfort challenges that come from inadequate heating or cooling — that one room that is always too hot or too cold, or how uneven temperatures can be between the floors. Excessive air leakage can be a primary (and unseen) contributing factor. Air sealing can remove hot and/or cold spots by enabling conditioned air to be more evenly distributed among multiple rooms and floors. It also prevents dust and allergens from entering the building envelope or circulating throughout ductwork, resulting in cleaner air to breathe and overall enhancements to the indoor environment.

Improve occupant health and well-being



According to the U.S. Environmental Protection Agency (EPA), an average American spends approximately 90 percent of their time indoors, where the concentrations of some pollutants can be up to two to five times higher than outdoor concentrations. Insufficient air exchanges can also lead to the spread of airborne viruses and disease.



Air leakage in building envelopes and HVAC ductwork creates pathways for dust, pollutants, pathogens and other potential contaminants to enter a building. Hidden air leaks can also degrade an HVAC system's ability to regulate temperatures and humidity, which can result in additional health complications. Air sealing is essential for maximizing IAQ and ensuring proper air exchange rates needed to facilitate occupant health and well-being.

Increase energy efficiency and equipment performance

Proper air sealing is a force multiplier with respect to increasing the energy efficiency and effectiveness in new or existing buildings or HVAC systems. Sealing ductwork enables conditioned air to be distributed as designed, reducing fan runtime, lowering utility costs, and increasing the lifespan of HVAC equipment. Inadequate duct sealing can significantly lower the designed efficiency of heat pump systems. A 20 percent duct leakage rate (i.e., the lower range of industry averages) can lower a heat pump's seasonal energy efficiency rating (SEER) from 22 to 15 SEER — potentially reducing a heat pump's efficiency below that of a traditional gas furnace.



Comply with building codes and regulations

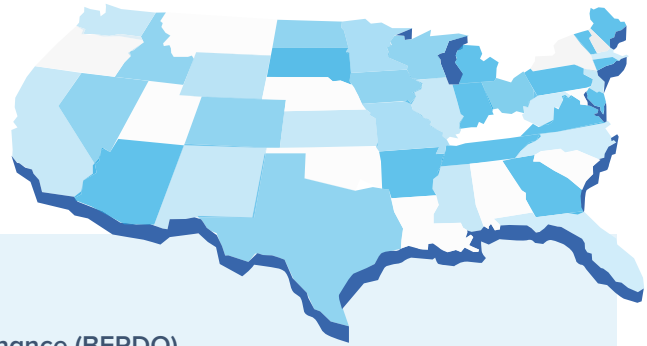
New building construction and deep retrofits are subject to building codes and regulatory standards that mandate air tightness in a building envelope or ventilation system. ASHRAE 62.1 and 62.2 standards outline acceptable ventilation and IAQ requirements in commercial and residential buildings. Buildings must also meet fire mitigation and moisture control codes as well as air changes per hour (ACH) requirements for the building envelope and HVAC ductwork. Compliance requires validation from blower door testing, HVAC system testing and balancing.

In addition, individual states, local municipalities, or authorities having jurisdiction (AHJ) may have energy efficiency standards as requirements for earning a certificate of occupancy (CO). Air sealing can help achieve compliance with these codes and standards.



Meet state energy requirements and building performance standards

Many U.S. states (e.g., California, Massachusetts, Texas, and Florida) and large cities (e.g., New York, Seattle, Boston, and Chicago) have strict requirements for HVAC and overall building energy consumption. In these regions, air sealing is all but essential for achieving compliance. In addition, building energy efficiency standards and eco-friendly construction initiatives are accelerating at a rapid pace:



New York City's Local Law 97 (LL97)

Boston's Building Energy Reporting and Disclosure Ordinance (BERDO)

International Energy Conservation Code (IECC) codes for building envelope

Leadership in Energy and Environmental Design (LEED) and ENERGY STAR® home requirements for certifications and rebates

Passive House initiatives

2030 District Network decarbonization pledges and initiatives

As these energy efficiency efforts become more commonplace, the importance of proper home weatherization cannot be overstated. Sealing ductwork has been identified as a key weatherization and energy conservation measure (ECM), and proper envelope sealing is essential to passive house and new ENERGY STAR standards.

Section 2

Solution definitions and comparison of traditional methods vs. AeroSeal

TRADITIONAL ENVELOPE AIR-SEALING METHODS & LIMITATIONS

Traditional envelope air-sealing methods are considered standard parts of the building construction process.

Methods of envelope sealing

Attic and wall insulation (i.e., traditional fiberglass and foam)

Caulking around windows, doors and floors

Weather stripping and tapes

Gaskets and flashing around joints

Vapor barriers for moisture control

Although these strategies provide a preliminary degree of air sealing, there are limits to their effectiveness. Implementation can increase construction costs and requirements — in terms of labor and materials needed — and put production schedules at risk. Ultimately, they may not provide the air tightness needed to meet building codes and standards in certain locations.

The limitations of traditional sealing methods include:

Finite durability - Continuous exposure to weather, ultraviolet (UV) radiation and other environmental factors will cause degradation over time.

Improper installation - Installation requires training, skill and attention to detail; improper installation can lead to gaps, leaks or reduced effectiveness.

Maintenance and upkeep - Regular inspections and maintenance are often required to identify and address issues like cracking, shrinking or wear.

Limited thermal performance - Some sealing methods may not be capable of providing sufficient insulation, leading to energy loss through the building envelope and an inability to comply with codes.

Material incompatibility issue - The use of different sealing and building materials may result in incompatibilities; careful consideration must be made to ensure long-term effectiveness.

LIMITATIONS OF MANUAL DUCT/ VENTILATION SEALING METHODS

The traditional process of sealing ductwork manually is labor-intensive and often ineffective. Whether a mastic sealant or tape is used, hand sealing often requires multiple applications to achieve the desired results — typically at the expense of construction budgets and completion schedules.

Mastic sealants come in two forms:

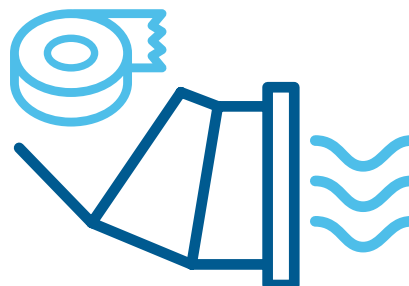
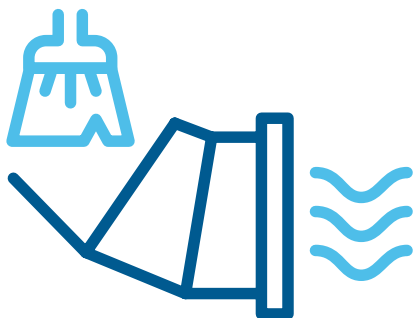
1

MASTIC — Thick, adhesive paste that is applied with a brush, roller or by hand to seal duct joints and seams

2

DUCT SEAL — Non-hardening, moldable compound that is pressed into joints and seams by hand

For a faster, lower-mess solution, duct or foil tapes are often applied onto ventilation joints and seams.



Manual duct sealing has many known limitations:

New or no installation - Because ductwork can't be easily accessed in existing buildings without the demolition of ceilings and walls, manual duct sealing can typically only be performed during new construction. On existing buildings, the effort is time-, labor- and cost-prohibitive, with significant disruptions to building occupants for extended periods of time.

Limited durability - Traditional sealing methods can deteriorate significantly over time from temperature fluctuations, UV exposure, and typical wear and tear. This continual degradation can result in a gradual increase of air leaks and decreased system efficiency.

Labor-intensive installation - Manual application of traditional sealants can be labor-intensive and require careful attention to detail for effective application. Improper application can lead to gaps and leaks, which may require multiple applications.

Declining performance in extreme conditions - Manual sealants may not perform well in extreme temperature conditions; their adhesive properties may be compromised (i.e., tape or mastic comes loose). sufficient insulation, leading to energy loss through the building envelope and an inability to comply with codes.

Inflexibility and/or rigidity - Traditional duct sealing methods may not be as effective in situations where ductwork experiences movement or vibration, as inflexibility may cause cracks for air to escape.

Uncleanliness - Sealants and adhesives can attract dust and debris, which over time may potentially impact indoor air quality.

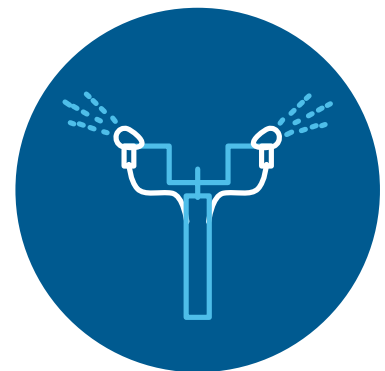
AEROSEAL TECHNOLOGIES STOP HIDDEN AIR LEAKS



Aeroseal's proprietary, non-invasive, air-sealing technologies are guaranteed to stop most hidden air leaks in building envelopes and ductwork. Suitable as part of a new construction process, building retrofits or renovations, Aero Envelope and Aeroseal Duct are considered true energy conservation measures (ECMs) that deliver far-reaching and long-term benefits to building performance, IAQ, occupant comfort and well-being.

Aeroseal Envelope: How it works

Our patented technology connects to your home or commercial building via a blower that's modified to pressurize and distribute a proprietary sealing formula. That pressure will carry our non-toxic, water-based formula throughout the facility and effectively follow airflow pathways to all existing leaks and seal them — whether they are visible or not.



The entire envelope sealing process can be completed in one day in four simple steps:

1

PREPARATION AND SETUP — Cover horizontal surfaces and openings not to be sealed; set up equipment.

2

PRESSURIZATION AND CALIBRATION — Pressurize building; input target ACH50 rating; begin controlled sealing process.

3

SEALING AND MONITORING — Seal and monitor progress every 60 seconds; verify achievement of ACH50 target.

4

CERTIFICATION AND CLEANUP — Software generates a certification of completion; remove protective coverings; resume construction work within 30 minutes.

Aeroseal Envelope advantages

Aeroseal Envelope offers many advantages compared to traditional building envelope sealing methods.



Precision and consistency - Our patented technology enables precise control over the sealing process, ensuring uniform coverage and a consistently airtight barrier. Traditional methods (e.g., caulking, taping, etc.) are prone to errors and inconsistencies, and may overlook some leaks completely.



Reduced time and labor costs - The automated sealing process takes only a few hours, potentially saving significant time during construction or renovation processes — unlike traditional methods, which require manual labor that can be time-consuming and labor-intensive.



Immediately measurable, certified results - AeroBarrier provides quantifiable results through post-application testing, such as blower door certification tests. Builders and contractors have immediate verification of the effectiveness of the sealing process and can achieve same-day blower door test certification. With AeroBarrier, air changes per hour (ACH) certification and other code requirements are met on the first application.

Aeroseal Duct: How it works

Aeroseal Duct is designed to be applied on the ventilation and ductwork used in both commercial and residential HVAC systems. The process starts by blocking all registers and intakes to pressurize the HVAC system. Then, our automated system distributes sealant into the interior ductwork, where particles remain suspended until they encounter an air gap. Then, particles bond around the edges of the leak and accumulate sealant until the entire hole is sealed shut. Airflow and leakage rates are measured throughout the entire three-step process.





**PRESSURIZATION
AND SETUP**



**SEALING AND
MONITORING**



**ACHIEVE IMMEDIATELY
MEASURABLE,
VERIFIABLE, AND
CERTIFIED RESULTS**

Aeroseal Duct advantages

Compared to mastic and duct tape, Aeroseal Duct offers a robust alternative with many advantages:



Seal hidden leaks - Reach all sources of leaks where traditional sealing methods cannot; receive computerized measurements that demonstrate leaks have been sealed.



Time savings - Seal an entire duct system in a matter of hours, reducing labor costs while minimizing disruption to occupants.



Cost savings - Eliminate costs related to demolition and construction; prolong the life of your existing HVAC system and optimize its performance for utility savings.



Verified results - Receive a computer-generated analysis and certificate of completion, showing the before-and-after results of the sealing process. The process provides immediate assurance to home or building owners that leaks have been effectively sealed and the building complies with codes/standards.

Aeroseal delivers proven results

Reduces up to
95%
of leaks

Lowers energy
costs up to
30%

Achieves
<1%
of duct leakage



Section 3

Applications, end uses, audiences and conclusion

AEROSEAL TECHNOLOGY: APPLICATIONS AND END USES



Aeroseal technologies are used widely in both the residential and commercial construction industries. Aeroseal Duct can be implemented on any project in any building that has a ducted heating and cooling system with little to no disruptions to the building, finishings or occupants.

Aeroseal Envelope can also be implemented in any new or existing building. From a logistical standpoint, implementation is recommended during the new construction process prior to the installation of floorings, countertops and other finishings — and in deep retrofit projects where the old floorings, walls and finishings have been removed.

How can Aeroseal help you?

The far-reaching benefits of Aeroseal technologies apply to a broad spectrum of residential and commercial building stakeholders, including new home builders, general contractors, design/build firms, architects, engineers and property owners.

Our Aeroseal Duct experts are experienced in helping the following practitioners:

- HVAC retrofit services (commercial and residential)
- HVAC new construction contractors
- Sheet metal/duct fabricators
- Duct cleaners
- Testing and balancing services



Aeroseal Envelope can be integrated into the following business disciplines:

- New residential and commercial construction companies
- Building performance consultants
- Energy efficiency and/or sustainability consultants
- Insulation contractors



EXPERIENCE THE BENEFITS OF AIRTIGHT SEALING

Proper air sealing in building envelopes and ductwork is crucial for enhancing occupant comfort, health and well-being — while boosting energy efficiency, complying with codes and regulations, meeting energy certifications, and building performance standards.

Traditional air-sealing methods are labor-intensive and ineffective in terms of robustness, reach, durability, precision and longevity. AeroSeal technologies overcome these limitations and offer proven air-sealing alternatives that are non-invasive and cost-effective, reducing implementation time and labor while delivering immediately measurable, certified results.

The versatility of AeroSeal Envelope and AeroSeal Duct solutions are suitable for new construction and deep retrofit projects, providing far-reaching benefits to IAQ and building performance. As the demand for energy-efficient and code-compliant buildings continues to grow, AeroSeal can deliver valuable and innovative tools for setting new standards in building and HVAC system performance.

