

HIGH-PERFORMANCE HVAC TODAY™

If You Don't Measure, You're Just Guessing!™

HVAC & Building Science



ALSO IN THIS ISSUE:

- Optimizing HVAC Performance Via the Building Side Duct System
- How Do I Know if I Need a Blower Door?
- The Power of Precision: Why Load Calcs Are Essential



A Condensate Solution
for Every Mini Split
Installation

Si-30

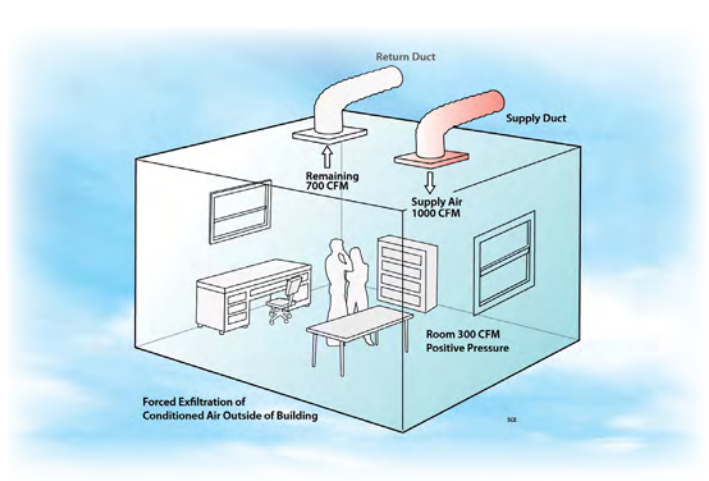
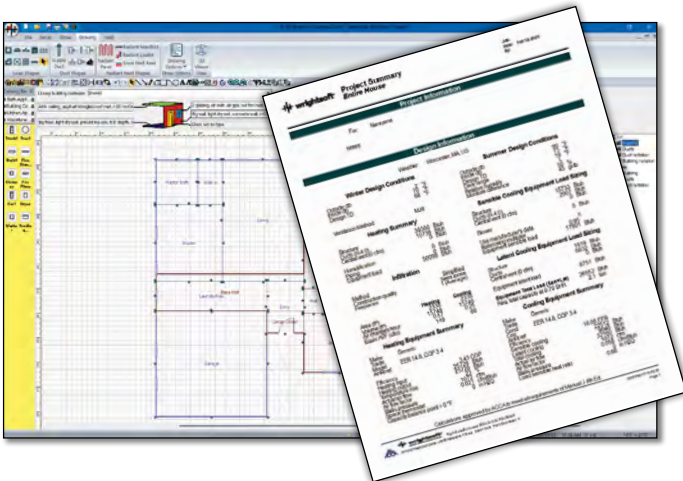
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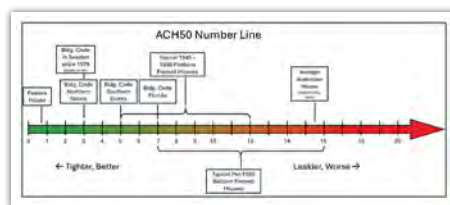


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Clean Energy: The State of the Decarbonize and Electrify HVAC Movement



Mike Weil is editor-in-chief and director of communications and publications at National Comfort Institute, Inc. Contact him at ncilink.com/ContactMe.

In my memory, concerns over energy have been in the forefront of everyone's collective mind stemming back to the days of the first Arab Oil Embargo of 1973.

What I didn't know is that two years earlier, the first U.S. president to ever address the nation's need for meeting the growing demand for economical clean energy was Richard Nixon. It was Nixon who established the Energy Policy Office in 1973 and that was the first step leading to the creation of the U.S. Department of Energy (DOE).

A lot has changed since those days more than half a century ago. From regulating the use of nuclear energy to the development of solar, geothermal, and wind energy projects, the DOE has been the instrument of every presidential administration since Nixon.

The Biden administration's **Inflation Reduction Act (IRA) of 2022** created the single largest investment in climate and energy in American history. The idea was to enable the country to tackle the climate crisis, advance "environmental justice," and secure America's position as a world leader in domestic clean energy manufacturing. IRA's goal was to put the U.S. on a path to achieve the Biden Administration's climate goals, including a net-zero economy by 2050.

This, along with other DOE and Biden initiatives led to a multi-state push to decarbonize and electrify energy-using appliances, including HVAC equipment.

The IRA started creating a demand that was beneficial to the HVAC Industry, especially in terms of [new heat pump technologies](#) that bring more efficiency and comfort, even in colder climates.

TRUMP'S SWEEPING CHANGES

After the Trump inauguration, he issued an executive order (EO) titled *Unleashing American*

Energy. It called for an "immediate pause" in the provision of funds under the Inflation Reduction Act and the Infrastructure Investment and Jobs Act. This pause could impact a broad swath of existing clean energy incentives.

The executive order's full impact remains to be seen. Here are a few points contractors should be aware of:

- The EO, for now, does not impact tax credits like Section 25C
- Contractors who have launched at least partial programs prior to the EO should have some confidence those programs will continue
- The EO **only pauses** the funding for grants, loans, and contracts under IRA to give Trump's administration time to reassess the process.

It's important to note that congressional action is needed to actually repeal the full IRA and its energy provisions. Chances are, based on the current political situation in Congress, there will NOT be a full repeal.

Read more about the impact of the Trump EO on the [Mercom Clean Energy Insights web-site](#). Suffice it to say, that despite some uncertainties, these moves by the Trump administration can still have a positive impact, especially for trained High-Performance HVAC™ contractors.

The fact is that consumers remain interested in energy savings and home comfort. By testing and measuring entire systems, you can show how your customers can save energy dollars — whether through duct renovation, Air Upgrades™, or equipment replacement.

From an NCI perspective, the key is to communicate to your customers, share the data, and let them know that the regulatory situation is fluid and that you will keep them informed.

This is the state of the electrification movement as of this writing. 

Written by HVAC Professionals for HVAC Professionals

TEC Minneapolis Blower Door

As an HVAC contractor, I care about making buildings work better. I want to discuss an important tool that I find very useful: **The Energy Conservatory (TEC) blower door**. This tool measures and locates home air leaks. Figuring this out is key to keeping homes comfortable, improving air quality, and saving money on energy bills.

Known as the **Minneapolis Blower Door**, this tool is easy to use and accurate. It comes with a unique gauge called the **DG-1000** that gives precise readings and is simple to operate. I like the automated testing feature, which makes everything quicker and more consistent.

The blower door has a lightweight

fan, and a frame makes setup a breeze, even for one person. I appreciate the cruise control, which maintains consistent building pressure and is ideal for extended testing. With this feature, I can focus on finding air leaks using tools like smoke pens or infrared cameras.



Many contractors might think the blower door is a bit pricey, though I found it pays for itself by allowing me to do better work and ultimately satisfy customers.

There is a bit of a learning curve to master all its features, though TEC has excellent training and support to help with that.

For High-Performance HVAC™ contractors, understanding building pressure is crucial. Air leak tests help us understand how a building's systems affect its ventilation and equipment. This holistic approach leads to more comfortable, efficient, and durable buildings.

TEC blower doors are essential for top-quality HVAC work. In my opinion, their accuracy, flexibility, and strong build make them the best choice for testing building performance.

To learn more, go to ncilink.com/TEC-BlowerDoor. **NCI**

— by Rob Minnick, National Comfort Institute Instructor

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Success by Focusing on Training, Culture, and a Local Business Approach

Baggett Heating and Cooling is a family-operated HVAC company with deep roots in Tennessee. It is located in Clarksville – a town with history dating back to the 1780s. It has survived and evolved through the Revolutionary and Civil Wars and became a center for the tobacco trade due to its prime location between the Cumberland and Red Rivers.

Baggett Heating was established in the late 1970s by Paul Baggett, and over its 40-year history has proven its resiliency and ability to adapt due to the owner's forward-thinking leadership.

Fast forward to the 1980s, when the company underwent a significant transformation when (current owner) Alana Ward's father, Allen Owen, assumed control.

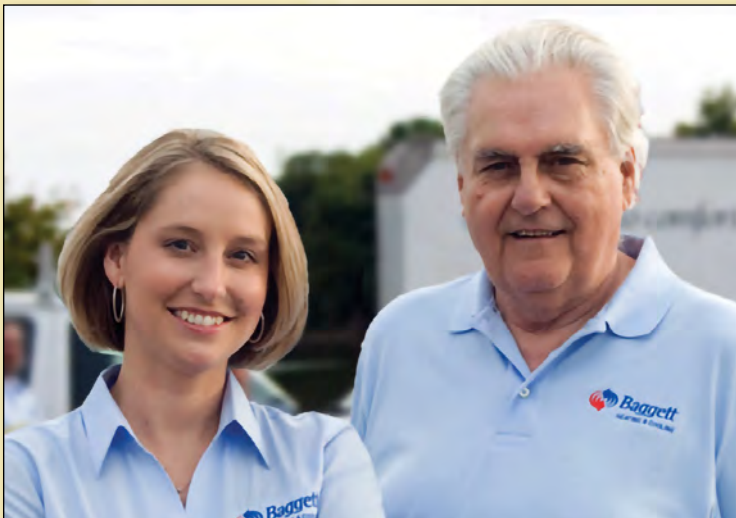
Over the years, it has grown from a small operation to a regional leader in HVAC services. Alana Ward, who now owns and operates the company, brings a distinct vision shaped by her unexpected entry into the family business and evolving into a respected industry leader.

LEAD BY DOING

Ward's path to running Baggett Heating and Cooling was not a straight line. Initially pursuing a degree in political science with thoughts of attend-

ing law school, she pivoted to join the family business temporarily after graduation.

That happened in 2001 when her father offered Alana a temporary role as the company's bookkeeper. Despite having no background in bookkeeping or HVAC, she accepted the challenge. In the end, this summer job evolved into a long-term career.



Alana Ward and her father, Allen Owen.

"Honestly, I didn't know what I wanted to do next," she recalled. After stepping into that bookkeeping role, Alana says she quickly realized the business's potential for personal and professional growth.

Her rise to leadership was swift. In 2006, she became the general manager, a role that allowed her to revamp operations and implement more structured systems. She incorporated

the company that same year, taking a 51% ownership stake. A year later, Alana Ward assumed full ownership.

OVERCOMING INDUSTRY CHALLENGES

Ward's tenure has not been without hurdles. Operating a heating and cooling business in Tennessee presents unique challenges, particularly during seasonal lulls. She describes the anxiety that comes with slower months when customers have less immediate need for HVAC services.

Ward also noted that many people enter the trade motivated solely by potential earnings rather than a genuine interest in the work. She says she believes such a mindset often leads to dissatisfaction and high turnover, especially when faced with the physically demanding aspects of the job, such as working in extreme temperatures.

With that in mind, she says that currently one of the most significant challenges during her tenure is maintaining a stable workforce. Unlike competitors who hire experienced technicians, Baggett Heating and Cooling often onboards individuals new to the trade. While this approach requires extensive training, it allows Ward to teach them about her company's high



standards from the ground up.

In fact, the [Baggett website](#) points out how this approach also helps them focus on being the best in Clarksville, not the biggest.

The website says, *“Our team lives and works alongside our customers in Clarksville every day. Our work is local, our efforts are local, and our proceeds are local.”*

“Our team of professional technicians will do what it takes to go above and beyond expectations for every service call, not only because we are professionals but because we see our customers in the grocery store or at the ballfield. Our customers and our community are our top priority.”

Ward also says that’s why the company focuses on hiring people who are new to the HVAC industry.

“It’s about more than just the paycheck. Our field service and installation team must love helping people and solving problems. That’s how they thrive in this business.”

This philosophy underscores the company’s emphasis on service quality. Ward believes attracting employees with promises of high pay is unsustainable in the long run.

“On a 98°F day in a Tennessee attic, money alone isn’t going to keep you there. As a service or installation technician, you need a deeper sense of purpose,” she remarks.

ADAPTING TO ECONOMIC AND MARKET SHIFTS

Navigating economic fluctuations has also been a defining aspect of Ward’s leadership. From dealing with seasonal lulls to surviving industry-wide disruptions caused by events like COVID-19, Baggett Heating and Cooling has consistently found ways to adapt.

The company embraced these changes by adopting new technologies and practices that enhance overall HVAC system performance and energy efficiency.

“Our commitment to staying ahead of industry trends means we do a lot of continuous learning and certification,” she adds.

This dedication enabled the company to offer cutting-edge solutions to meet the needs of its residential customers.

Ward recalls the initial uncertainty during the pandemic when operational norms were upended. By focusing on health and safety protocols and maintaining communication with clients, she says they were able to adopt new technologies and practices to enhance HVAC system performance and energy efficiency.

She highlights the company’s commitment to staying ahead of industry trends through continuous learning and certification, especially on the technical side of the business. Much



Alana Ward and her company have been recognized over the years for excellence and leadership in several of the national HVAC trade magazines, as well as by distributors, manufacturers, and local media.



Baggett Heating technician Jesse Waldrop explains static pressure test results to a customer.

of this training is done with [National Comfort Institute \(NCI\)](#).

Dedication to NCI's advanced level of training enables Baggett Heating to offer cutting-edge solutions that meet the needs of its customers.

She says, "Quite frankly the competition simply doesn't prioritize learning about these things."

Another key to the company's resilience has been its strategic decision-making regarding revenue goals and operational efficiency. In 2017, the company hit the \$1 million revenue mark, which took over a decade to achieve. Seven years later, in 2024, Baggett Heating surpassed \$2 million in revenue — a testament to Ward's leadership.

TRAINING AND PERFORMANCE STANDARDS

Speaking of training, in my mind, one of Alana Ward's standout contributions to the company has been her approach to employee development. She recognizes the importance of technical expertise and customer service and has implemented rigorous training programs to produce well-rounded technicians.

"Every service call is like a puzzle," Ward explains. "Technicians need to understand how all the pieces fit together to provide the best solution for the customer. Doing this has a positive impact on customers' lives. A problem-solving approach also keeps the work engaging and fosters a sense of accomplishment and pride among our team members."

Her emphasis on system performance testing and precise measurements has become a hallmark of the company's approach to HVAC services. By focusing on performance rather than just repairs, Baggett has differentiated itself from competitors and earned a reputation for thorough, high-quality work.

BUILDING A STRONG COMPANY CULTURE

Ward's leadership extends beyond operations and revenue growth — she places a high value on cultivating a positive and inclusive company culture. Despite the physical demands of the HVAC industry, she strives to create an environment where employees feel supported and motivated.

"You have to love the challenge of

the work and helping people," Ward emphasized. "If you don't have that, the physical part of the job will wear you down."

This culture-first approach has paid dividends regarding employee retention and customer satisfaction. Ward's emphasis on communication, problem-solving, and customer care has become a defining characteristic of Baggett Heating and Cooling.

Ward adds that this success goes back to the team's commitment to solving problems and providing exceptional service. She believes the company's reputation for excellence has been a key driver of its growth, as satisfied customers continue recommending Baggett Heating and Cooling to friends and family.

LOOKING AHEAD

As the HVAC industry continues to evolve, Ward remains optimistic about the future. She acknowledges



After static pressure and airflow testings, Jesse Waldrop tests refrigerant pressure to make sure the system performance is at its best.

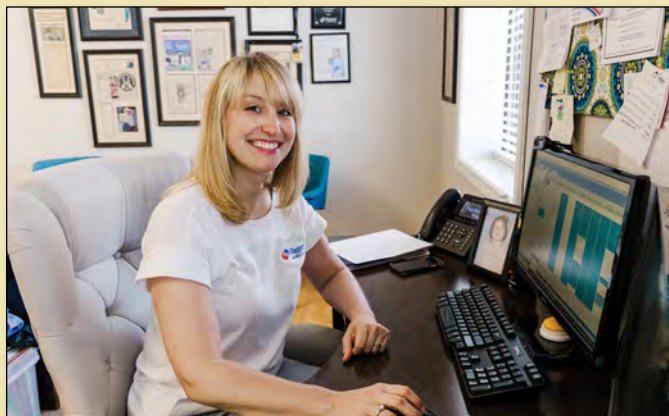
that technological advancements and changing customer expectations will require ongoing adaptation. However, she says the company's commitment to quality, innovation, and customer service will keep it ahead of the curve.

In addition to technological advancements, Ward sees opportunities for growth through community engagement and education.

By raising awareness about the importance of HVAC system performance and energy efficiency, she hopes to further position Baggett Heating and Cooling as a trusted resource for residential clients.

A STRONG FOUNDATION

The story of Baggett Heating and Cooling is one of perseverance, inno-



vation, and community-focused leadership. Under Alana Ward's guidance, the company has navigated industry challenges and set a standard for excellence in service and operations. Ward's journey from a reluctant bookkeeper to a dynamic business owner shows her focus and leadership.

As the company looks to the future, it does so with a strong foundation built on decades of experience, a commitment to quality, and a leader who understands that success is about more than just numbers — it's about mak-

ing a difference in the lives of employees, customers, and the community.

For these and many other reasons, the **High-Performance HVAC Today** editorial team has selected **Baggett Heating and Cooling** on which to shine its *March 2025 Contractor Spotlight*. Congratulations to Alana and her entire team. **NCI**

ONE GAUGE



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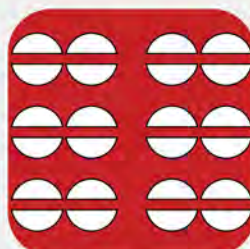
MULTIPLE APPLICATIONS



TEC Auto Test



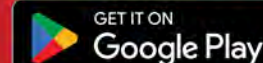
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The Power of Precision: Why Load Calculations Are Essential

As an HVAC contractor, we've encountered all sorts of approaches to system sizing. Some contractors still rely on rule-of-thumb estimates, while others swap out like-for-like units without considering the evolving needs of homes or buildings.

But over the years, at [Basnett Plumbing, Heating, AC & Electrical](#), we've learned that there's no substitute for precision. That's why we are passionate about load calculations — not just as a tool but as a philosophy that separates High-Performance HVAC™ contractors from the rest.

THE PROBLEM WITH RULE-OF-THUMB HVAC SIZING

Many HVAC contractors hate doing load calculations. Why? It often comes down to a lack of knowledge or concerns about time. It's easy to

assume that a 3,000-sq.-ft. home needs a four- or five-ton system based on experience, but assumptions like that can lead to costly mistakes.

Oversizing is one of the most common issues. We can't count how often we've walked into a home with a 120,000 Btu furnace that only needed 60,000 Btus.

Oversizing leads to short cycling, uneven heating and cooling, and higher energy costs. And let's not forget about premature equipment failure — cracked heat exchangers and other issues arise because the original system wasn't correctly matched to the home's needs.

Undersizing, though less common, is just as problematic — especially in an era where heat pumps are becoming the standard. If we don't know the home's heat load, how can we confidently select a system that will keep customers comfortable year-round without excessive reliance on backup heat?

WHY EVERY CONTRACTOR NEEDS TO DO LOAD CALCULATIONS

Load calculations are about more than compliance — they're about performance, efficiency, and long-term customer satisfaction.

At our company, we consider every factor: insulation levels, window types, building orientation, duct system design, and more. That level of detail makes a massive difference. We once worked on a 3,000-sq.-ft. home that, by traditional standards, would have required an 80,000 Btu furnace. However, because of modern insulation and high-performance windows, it only needed 35,000 Btus.

Windows alone can have a huge impact. A home with all south-facing windows will have significantly different cooling needs than one with

Project Summary
Entire House

For: Narragansett
Notes:

Design Information
Weather: Worcester, MA, US

Winter Design Conditions		Summer Design Conditions	
Outside db	2 °F	Outside db	90 °F
Inside db	70 °F	Inside db	75 °F
Design T1	68 °F	Design T1	75 °F
		Daily range	1 °F
		Relative humidity	50 %
		Mixture difference	25 g/b

Ventilation Method: M18

Heating Summary		Sensible Cooling Equipment Load Sizing	
Structure	39360 Btu/h	Structure	15733 Btu/h
Ducts (R-4.0)	10736 Btu/h	Ducts (R-4.0)	2907 Btu/h
Central vent (0 cfm)	0 Btu/h	Central vent (0 cfm)	0 Btu/h
Humidification	0 Btu/h	Finer	0 Btu/h
Piping	0 Btu/h	Use manufacturer's data	0 Btu/h
Equipment load	50066 Btu/h	Rate/sizing multiplier	0.95
		Equipment sensible load	17601 Btu/h

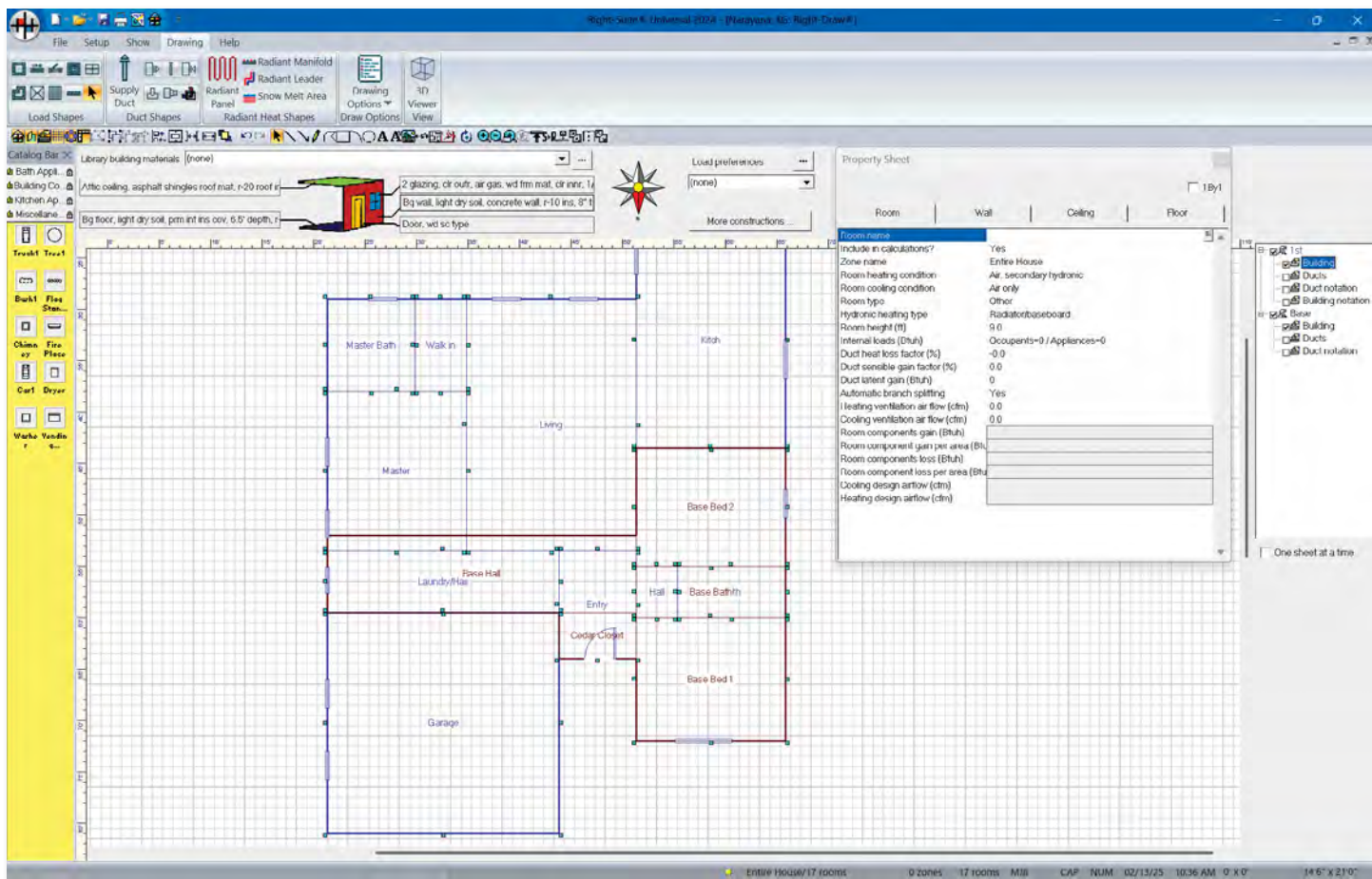
Infiltration
Method: Simplified
Construction quality: Semi-tight
Replacements: 1 (Average)

Heating		Cooling	
Area (ft²)	2338	Area (ft²)	2338
Volume (ft³)	15746	Volume (ft³)	15746
Air change/hour	0.57	Air change/hour	0.25
Equip. A/W (cfm)	149	Equip. A/W (cfm)	60

Heating Equipment Summary		Cooling Equipment Summary	
Make	Generic	Make	Generic
Trade	EER 14.8, COP 3.4	Trade	EER 14.8, COP 3.4
Model	AFH ref	Model	AFH ref
Efficiency	3.43 COP	Efficiency	18.08 EER
Heating input	20726 Btu/h	Sensible cooling	22512 Btu/h
Heating output	15746 Btu/h	Latent cooling	9448 Btu/h
Temperature rise	23 °F	Total cooling	32160 Btu/h
Actual air flow	1072 cfm	Actual air flow	1072 cfm
Air flow factor	0.021 cfm/Btu/h	Air flow factor	0.058 cfm/Btu/h
Static pressure	0 in H ₂ O	Static pressure	0 in H ₂ O
Space thermostat		Load sensible heat ratio	0.68
Capacity balance point = 6 °F			

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

Wrightsoft
RightSoft Universal 2024 24.03.04 R10/02/24
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shaded or north-facing exposures. These are the details that make or break system performance.

THE RIGHT TOOLS FOR THE JOB

At Basnett Plumbing and Heating, we currently use [Wrightsoft](#) for our load calculations, and while it has a bit of a learning curve, it's indispensable. However, we will eventually be moving toward using [Conduit Tech's](#) tools.

Let's face it, technology continues to improve and advances are making the load calc process even faster. We like how Conduit's **LIDAR-based tools** allow for faster and more highly accurate measurements.

Furthermore, Bluetooth-enabled devices can integrate airflow readings directly into our calculations. And the [measureQuick®](#) app helps us verify that the duct system is performing as expected.

Having said that, there are other

tools available, like [Cool Calc Manual J](#) or [Elite Software's RHVAC](#). No matter what you choose, the key is using a program that allows for detailed, room-by-room analysis.

Technology is making this process even easier.

TRAINING THE TEAM

At our company, we believe in hands-on training. New sales team members start by observing us doing load calculations, then gradually work up to performing their own.

We begin with whole-house load calculations before moving to a detailed room-by-room analysis.

Formal training is also essential. We've attended sessions with industry expert [Alex Meaney](#), who simplifies the process and teaches practical ways to improve efficiency.

Investing in training means fewer mistakes, faster calculations, and greater confidence when presenting

options to homeowners.

USING LOAD CALCULATIONS TO EDUCATE HOMEOWNERS

Speaking of homeowners, one of our biggest challenges is convincing them why they need a properly sized system. Many are conditioned to think that bigger is better. However, the customers begin to understand when we show them third-party data and real-world examples.

For example, we often sit down at the kitchen table and pull up an online search: "Why is a load calculation important?" Seeing independent sources confirm what we say builds trust.

Then, we explain how an oversized system will short cycle, create hot and cold spots in their home, and drive up energy bills. We walk them through why a modulating 60,000 Btu system is better than a single-stage 80,000 Btu system for their specific home.



After taking measurements, the Basnett salespeople sit down and perform load calculations in the customer's home.

Customers appreciate transparency. They feel confident in our recommendations when they see the data and understand that we're not just guessing.

THE SERVICE AND INSTALLATION CONNECTION

Load calculations don't just help with system selection — they're critical for proper installation and service. Once we size a system, we use cubic feet per minute (CFM) airflow measurements from our calculations to ensure each room gets the correct CFM.

Installers reference these numbers to size duct trunks and branches correctly. Our service team uses them for air balancing and duct sealing (we use the [Aeroseal](#) system), ensuring the system performs as designed.

Without these numbers, we'd be flying blind. We'd spend extra time going to callbacks and troubleshooting preventable comfort complaints.

HOW LOAD CALCULATIONS SAVED A PROJECT

On one job, for example, a homeowner wanted a large system to cool his entire home. He would have had poor airflow and uneven temperatures if we had gone with his request. But, by doing a proper load calculation, we determined that his ductwork couldn't support a single large system.

Instead, we recommended a combination of a central system with ductless splits for the upstairs bedrooms. The result? Perfect comfort and a happy customer.

Another time, we took over a project where a previous contractor had installed a heat pump without doing a proper load calculation.

The homeowner was freezing in the winter because the system couldn't maintain temperature on the coldest days. We redid the calculations, sized the right equipment, and solved the problem.

LOAD CALCULATIONS ARE NON-NEGOTIABLE

With the push for [electrification](#) and energy efficiency, accurate load calculations are more important than ever. In Massachusetts, where we do a lot of work, electric heat pumps are becoming the standard.

That means we need to know exactly when a system's capacity will drop and when backup heat will be required.

State requirements are also changing. More jurisdictions are demanding Manual J load calculations for permits. But here's the catch: not all contractors are doing them correctly.


Many are simply filling in numbers to check a box. We take pride in doing them right because we know that's

what ensures long-term success for both us and our customers.

FINAL THOUGHTS: STAND OUT BY DOING IT RIGHT

We understand that load calculations take time. But they're worth it. Here's why:

- They set us apart from competitors who take shortcuts
- They give us confidence in our recommendations
- And most importantly, load calculations ensure that our customers get the comfort and efficiency they're paying for.

If you're an HVAC contractor who wants to stand out in today's market, there's no better way than by embracing load calculations. Invest in the right tools, train your team, and educate your customers. It's not just about selling systems — it's about delivering actual performance. That's what makes us high-performance contractors, and that's why we do what we do. 



Jake Basnett is a comfort advisor at [Basnett Plumbing, Heating, AC & Electrical](#) in Littleton, MA. He's been with the company for six years and a comfort advisor for nearly four years. He started out

doing installation work, sealing ductwork, and performing ductwork modifications, eventually working his way into sales. He can be reached at ncilink.com/ContactMe.

Anthony Kent was exposed to the plumbing industry in 2004 with his father in a one-truck plumbing business. They did water heater and service repairs, plus boiler installations. Eventually, he got into new construction, remodeling, and service retrofit work. He saw an ad for a comfort advisor at Basnett, and the rest is history. Contact him at ncilink.com/ContactMe.





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UPCOMING NCI TRAINING: MARCH - MAY 2025

PUBLIC LIVE TRAINING

Duct System Optimization and Residential Air Balancing

March 18-20: Houston, TX
March 25-27: Hauppauge, NY
April 1-3: White Plains, NY
April 8-10: Valley View, OH
April 15-17: Grand Rapids, MI
April 15-17: Somerville, MA
April 22-24: Sacramento, CA
April 22-24: Morristown, TN
May 6-8: Centennial, CO
May 6-8: Fife, WA
May 13-15: Tampa, FL
May 13-15: Eagan, MN

Residential HVAC System Performance and Air Balancing

March 18-20: Salt Lake City, UT
March 25-27: Phoenix, AZ
March 25-27: Johnstown, CO
March 25-27: Livonia, MI
April 1-3: Roswell, GA
April 8-10: Kissimmee, FL
April 29 - May 1: Glen Burnie, MD
April 29 - May 1: Pittsburgh, PA
May 13-15: Hauppauge, NY
May 20-22: Dayton, OH

Commercial Air Balancing

April 15-17: Richmond, VA
April 29 - May 1: Lewisville, TX

PUBLIC LIVE TRAINING (cont.)

Airflow Testing & Diagnostics

May 13: Johnstown, CO

Refrigerant-Side Performance

May 14-15: Johnstown, CO

Combustion Performance and Carbon Monoxide Safety

May 20-22: Salt Lake City, UT

PUBLIC ONLINE LIVE TRAINING

Airflow Testing and Diagnostics - ONLINE LIVE

March 11-12

Commercial Air-side Recertification - ONLINE LIVE

May 6-7

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Optimizing HVAC Performance Via the Building Side Duct System

As an HVAC professional with over 25 years of experience, I have seen firsthand how the industry often focuses on equipment efficiency while overlooking the broader system dynamics. HVAC contractors frequently discuss a “system,” but many define it narrowly — focusing on the furnace, air handler, and condenser.

However, **true system performance** extends beyond the equipment; it includes ductwork, airflow, and the interaction between conditioned air and the building envelope. Understanding these relationships can dramatically improve comfort, efficiency, and indoor air quality (IAQ).

With that in mind, in this article we will take a look at the following:

- Identifying “the System”
- How Air Moves Through a Home
- Measuring Building/Room Pressures
- Temperature – Density Pressure Flow
- Review and Next Steps.

REDEFINING THE HVAC SYSTEM

One of the biggest challenges in the HVAC industry is shifting our perception of what constitutes a system. Traditionally, we think of the system as the mechanical components — fans, coils, and compressors.

However, real performance is dictated by how well air moves through ductwork, how pressures are managed, and how the home or building interacts with these forces.

HVAC professionals need to assess the system holistically — considering temperature control, pressure management,

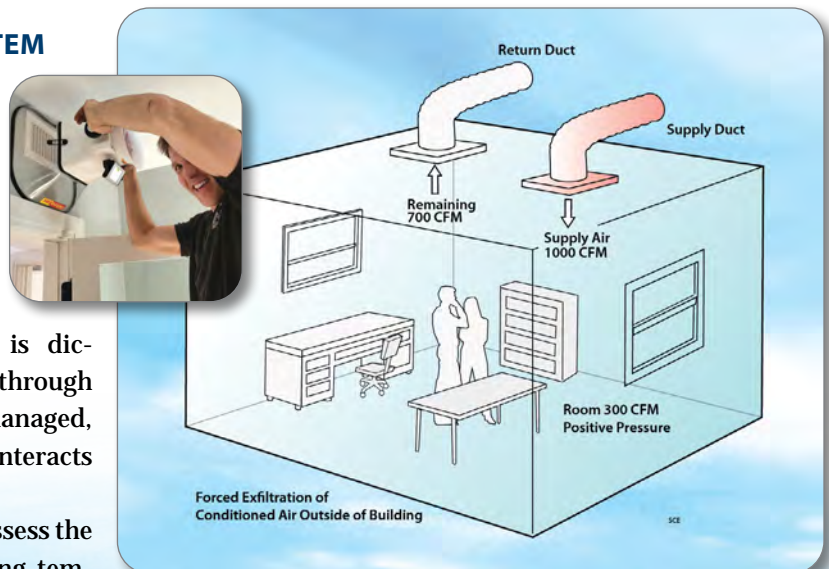
air distribution, and duct leakage. If the airflow is restricted due to improper duct design or pressure imbalances, even the most efficient equipment will fail to deliver optimal performance.

Understanding duct design principles and how each section of ductwork contributes to overall airflow is key to diagnosing inefficiencies.

Additionally, recognizing the impact of thermal losses through uninsulated duct runs helps design more effective solutions.

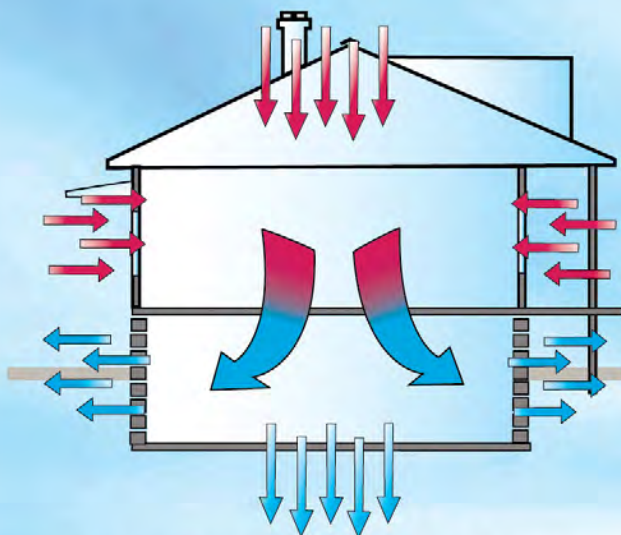
AIRFLOW AND PRESSURE: THE HIDDEN VARIABLES IN HVAC EFFICIENCY

Air moves from areas of high pressure to low pressure. This fundamental principle governs how HVAC systems distribute air. However, several factors influence this movement, including duct design, register placement, and the presence of leakage points. Understanding how air moves within a building requires an awareness of two key effects:



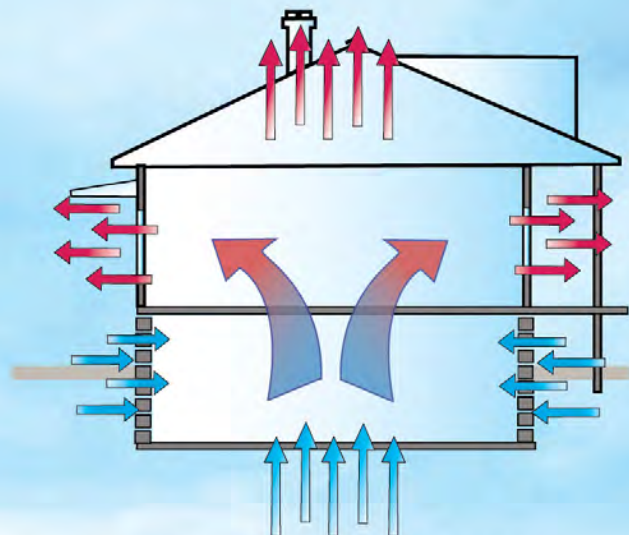
A room with inadequate airflow

Stack Effect in a Two Story House



Summer Time Stack Effect House

Stack Effect in a Two Story House



Winter Time Stack Effect House

● **The Stack Effect:** In winter, as the air is heated, it becomes less dense and rises to the top of the home. This action creates a positive pressure zone in the upper portions of the home. The pressure forces air out through leaks in the attic or upper walls while drawing in cold air from lower levels or basements. These pressure shifts can make some rooms feel significantly colder in winter, leading to excessive thermostat adjustments and higher energy costs.

● **The Reverse Stack Effect:** In summer, the process reverses. Cool air, being denser, settles at the lower portions of the home, increasing pressure in those areas and forcing conditioned air out through leaks. This results in unintentional infiltration of humid, unconditioned air from the upper portions of the structure, which can contribute to mold growth and excessive wear on cooling systems.

Both effects illustrate why sealing a building envelope is crucial. Without

proper control, the HVAC system is fighting against constant air leakage, reducing efficiency, and increasing energy costs.

Sealing leaks, improving insulation, and ensuring balanced airflow between supply and return vents are crucial to mitigating these issues.

MEASURING SYSTEM PERFORMANCE: ESSENTIAL TOOLS AND TECHNIQUES

HVAC contractors should embrace testing and measurement techniques to quantify performance and diagnose issues. Several tools can provide valuable insights:

1. Manometers for Conducting Pressure Diagnostics

- ❑ A micro-manometer instrument measures room pressures, identifying imbalances that may lead to inefficient operation.
- ❑ Testing involves placing a hose under a closed door and recording pressure differentials while the system runs.

- ❑ If pressures exceed three Pascals, pressure relief strategies may be needed, such as jumper ducts or transfer grilles. Adjusting duct layouts and balancing dampers can also help correct excessive room pressures.

2. Blower Door Testing for Infiltration Control

- ❑ This test quantifies how much air leaks through the home's envelope.



Blower-door instrument seals outside door for pressure testing the building and find leaks.



Measuring room static pressure with a "Roomulator" and a micromanometer.

- ❑ A blower door depressurizes the home, revealing unintended pathways where air enters or escapes
- ❑ Sealing leaks can significantly improve efficiency and IAQ, reducing the load on HVAC equipment and lowering energy bills.

3. Flow Hoods for Air Balancing

- ❑ An air-balancing hood measures how much air each register delivers
- ❑ Using flow hoods allows contractors to verify if supply and return airflows are correctly matched and balanced throughout the home
- ❑ Balancing air distribution ensures even heating and cooling, reducing hot and cold spots.

4. Duct Leakage Testing

- ❑ Using a duct leakage test, technicians can measure leakage rates in

the duct system

- ❑ Excessive duct leakage leads to significant energy losses and comfort issues
- ❑ Sealing ducts using mastic and proper insulation improves airflow efficiency and reduces system strain.

ADDRESSING COMMON AIRFLOW PROBLEMS

Room Pressure Imbalances:

When doors to bedrooms are closed, those rooms become pressurized if they lack return air pathways. This forces conditioned air out through unintended gaps, increasing system inefficiencies. Solutions include:

- Installing jumper ducts to provide a direct return air path
- You should add transfer grilles to equalize pressure between rooms and hallways
- Enlarging return pathways to improve airflow and balance indoor pressure.

Duct Design Issues: Many duct systems are undersized, kinked, or improperly routed, leading to static pressure problems. When static pressure is too high, the blower works harder, reducing efficiency and increasing wear on components.

- Always verify duct sizing using industry-standard calculations
- Seal ducts to minimize leakage and ensure efficient airflow
- Ensure adequate return pathways for unrestricted airflow to maintain system balance
- Avoid long, restrictive flex duct runs because they can significantly reduce airflow and efficiency.

Combustion Safety Risks: Pressure imbalances can backdraft com-

bustion appliances, leading to dangerous carbon monoxide buildup. Testing combustion appliance zones for depressurization is critical, especially when modifying duct systems.

- Always test for back drafting when adjusting pressure dynamics
- Ensure proper ventilation and fresh air intakes for safe combustion
- Monitor carbon monoxide levels in homes with natural draft appliances.

PRACTICAL STEPS TO IMPLEMENT TESTING & AIR BALANCING

For HVAC contractors looking to incorporate performance testing into their service offerings, the following steps will provide a solid foundation:

1. Invest in Proper Testing Equipment

- ❑ A micro-manometer and air-balancing hood are essential for diagnosing airflow problems
- ❑ A blower door is valuable for whole-house performance assessments



Measurements will continue become easier to take, especially with LiDAR technology for use in room sizing for load calculations.

- ❑ Tools like thermal imaging cameras can help visualize heat loss and air infiltration points.

2. Practice on Known Systems

- ❑ Before testing customer homes, practice airflow and pressure measurements on your own home, office, or shop
- ❑ Practicing on known systems will help refine techniques and interpretation of results, improving diagnostic accuracy.

3. Educate Homeowners on the Benefits

- ❑ Explain how measuring system performance can lead to greater comfort and efficiency
- ❑ Demonstrate how small changes —

like sealing duct leaks or balancing supply and return airflows — can significantly improve energy use and comfort.

THE FUTURE OF HVAC IS HIGH-PERFORMANCE

The HVAC industry is evolving. As equipment efficiencies plateau, actual gains will come from optimizing system performance through airflow management, pressure control, and whole-home diagnostics.

Contractors who adopt a high-performance approach will improve their customers' comfort and energy efficiency and set themselves apart as true industry experts.

By shifting our focus beyond equipment and embracing the principles of

airflow and pressure management, we can transform the way HVAC systems operate—ensuring every component works in harmony to deliver the best possible results. **NCI**



Adam Mufich serves the HVAC industry as a curriculum developer and instructor for National Comfort Institute, Inc. (NCI). NCI specializes in training that focuses on improving, measuring, and verifying HVAC and

building performance. If you're an HVAC contractor or technician interested in learning more about air sealing benefits, contact Adam at ncilink.com/ContactMe. NCI's website, www.nationalcomfortinstitute.com, is full of free information to help you improve your professionalism and strengthen your company.

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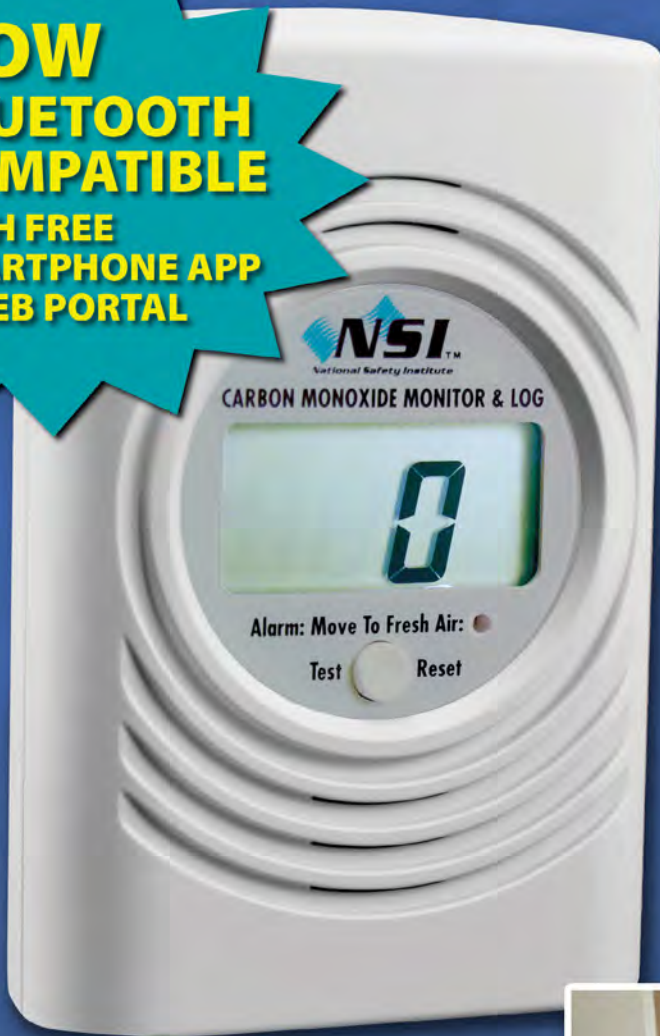
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How Do You Know if You Need a Blower Door?

One of my favorite HVAC Technicians, Chris Hughes, once told me a story about a difficult conversation he had with a homeowner about the expectations of a new HVAC system.

A similar conversation happened more than once. The homeowner made it clear that they had very high expectations of the new system. So, like a good Comfort Advisor, Chris directed the conversation to clarify expectations.

The conversation went something like this:

Chris: *OK, so you're telling me you want perfection out of this new system.*

Homeowner: *Yes, that's right. I want it to be perfection!*

Chris: *OK, I understand that. Unfortunately, you didn't buy that kind of house.*

Chris was being blunt, but he knows which customers it's OK to be blunt with. More importantly, he was being honest. Why is that honest? Shouldn't we expect the perfect new system install to deliver HVAC perfection?

In a word, no. We can't expect perfection from a new system install because the equipment is only part of the system. The house, the ducts, and HVAC equipment together are a system.

This is why the whole process begins with a load calculation – we must understand the heat loss, heat gain, and other aspects of the building itself if we want to deliver High-Performance HVAC™.

That's where a **blower door** can help an HVAC technician to understand the building itself. So, what does a blower door do, and how does it work?

A blower door primarily does two things. It measures the total air leakage from a house or other building, and it helps to locate the leaks within a building envelope.

WHAT A RESIDENTIAL BLOWER DOOR DOES

A blower door uses a variable-speed fan to depressurize or pressurize the entire volume of a house or other building. The fan can measure the air that flows through it as the test is performed.

A fabric panel and frame are temporarily fit into a residential exterior doorway so that air doesn't leak around the fan and the whole house can be maintained at the same pressure (see Figure 1).

With the most common test, the blower door fan is set up to depressurize the house to -50 Pa (-0.2 in. H₂O).

At that pressure we

know that all the air leaking into the house is being blown out through the fan, which is measuring the air flow. If there's 2000 CFM going out through the fan, then we know there's 2000 CFM leaking in through all the leaks. This is called the CFM@50Pa or CFM50.

TWO COMMON MEASUREMENTS

CFM50 isn't the only number we use to score

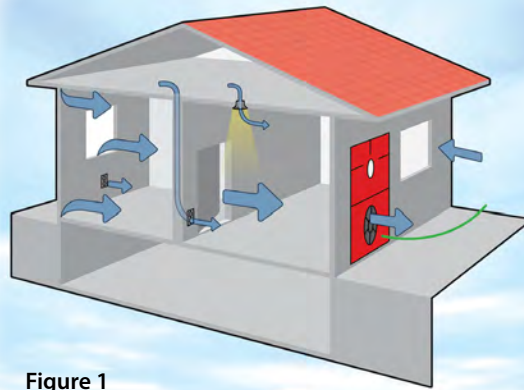


Figure 1

Floor Area (sq ft)	Average Ceiling Height (ft)	House Volume (cubic ft)	CFM50	ACH50
800	8	6,400	725	6.8
2200	8	17,600	1995	6.8
6000	11	66,000	7480	6.8

the leakage of the house. It's also common to normalize leakage by using the volume of the house since larger houses usually leak more than smaller houses. The resulting number is ACH50, or Air Changes per Hour at 50 Pa. It's the number of times all the air would get exchanged in the house if it leaked at the CFM50 rate for an hour.

This table compares a small, typical, and large house if they all had the same ACH50 score. ACH50 is important because that's what most states use for their building codes, but there are other ways to normalize leakage.

UNDERSTANDING ACH50 – A NUMBER LINE

Now let's see where that 6.8 ACH50 would fall on a number line of typical houses and against the building codes. **Figure 2** shows that 6.8 ACH50 would barely pass today's building code in Florida since it's just under 7 ACH50, the maximum allowed.

In general, a more airtight house is always better. In a tighter house, it's always easier to control the temperature, the humidity, and the air quality. This is simply because the air we condition doesn't leak out as fast and get replaced with unconditioned outdoor air.

When houses get extremely leaky, approximately eight ACH50, it becomes very difficult to keep the house conditioned so that it's consistently comfortable.

SO WHY SHOULD AN HVAC TECH HAVE A BLOWER DOOR?

One common answer to this question is because a blower door will help dial in your load calculations and make them more accurate. This is true, but the benefits are sometimes overstated.

If you don't know how leaky a house is, you'd make an air tightness guess somewhere in the middle of the scale, to keep the error to a minimum. You wouldn't assume it's really leaky or super tight; something approximately eight ACH50 would be a good guess.

If you do that, the uncertainty in your load calculation would rarely be more than $\pm 15\%$. That's a lot smaller than the capacity steps in the equipment you select.

You might see as high as 25%, but only for the heating load and only in very cold climates. Remember, properly sizing heating equipment isn't as critical as properly sizing cooling equipment.

Heating equipment usually comes

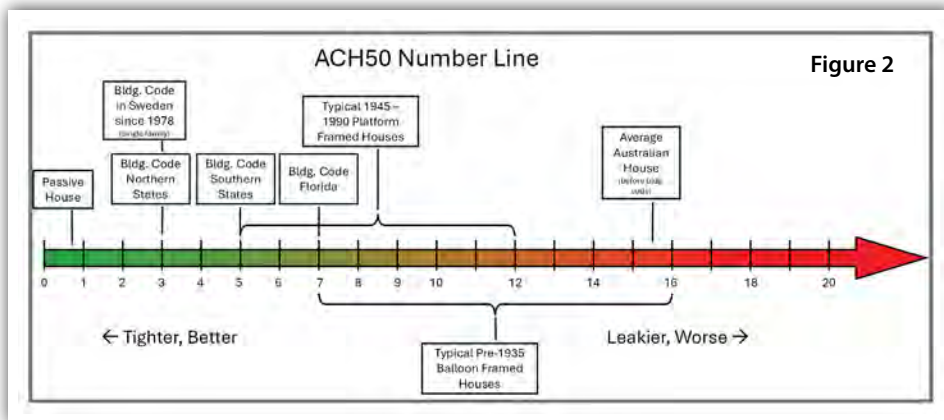
in increments of 20,000 Btuh, while cooling equipment comes in increments of 6000 Btuh (half a ton). So, the bottom line is that the lack of a blower door test will rarely change the size of the equipment you choose.

ANTICIPATE, FIND, AND SOLVE COMFORT PROBLEMS

If improving your load calculations isn't the main reason to have a blower door, what is? Diagnostics! The house, ducts, and equipment all work together as a system. A blower door can help you become the master of that system.

Combined with an infrared camera, a blower door can locate major and minor leaks in the house. Locating leaks can be very important because air leakage in real-world houses isn't like we assume it is in a load calculation. A load calculation assumes the insulation thickness is the same in all the walls and all air leaks are uniformly distributed in the exterior surfaces.

But we know from experience that



certain construction features are much leakier than others. The knee walls in the bonus room over a garage or in houses with an upstairs half-story are notoriously leaky.

Interior soffits over bathtubs or kitchen cabinets are also common leak spots. The chase that hides plumbing, a chimney, or duct work between

floors is often not sealed properly where it reaches into the attic or down into a crawl space.

In a scenario where a house kitchen sits over a crawl space, while the rest of the structure is over a conditioned basement might mean that kitchen is always too cold in the winter.

Another important way blower doors can help diagnose the house is by screening for leaky ducts. Whenever the ducts are in a vented attic or crawl space, a blower door can be used to screen for and even estimate the locations of large leaks by using what's called the pressure pan method.

Here is how that works: Once the blower door is installed and running, with the HVAC system off, a pressure pan is placed over each supply grille to measure a pressure for a few seconds. If the pressure measured is more than 1 or 2 pascals, that indicates a large duct leak connected to outside is near the supply grille being tested.

YOUR DEFENSE TEAM – A BLOWER DOOR

Sometimes it is important to know if the building envelope was built properly in the first place. This could especially be true in new construction. We all know that when the proud owner of a brand-new

home is uncomfortable, the HVAC contractor is much more likely to be blamed than the insulation and air sealing contractor.

Being able to run a blower door test and demonstrate that the house wasn't built according to the details used for the load calculation could help ensure you don't end up paying the bill for another contractor's mistake.

The same thing can be applied to system equipment swap outs. Some customers may have unrealistic expectations of new HVAC equipment. They may expect the new equipment to fix pre-existing problems in the duct work or in the building envelope.

The difficult conversation with an unhappy customer will usually go much more smoothly if the HVAC company offers to do some testing and diagnosis of the house and ducts. Do this even if the customer originally declined those services.

If the customer understood at the outset that you can't make any guarantees if you don't know how much the ducts and house leak, it will be much easier for them to accept that the problem was truly outside of your control.

Once you move past *that* conversation you will be in a better position to add a duct renovation or envelope improvements at a later date.

HOW TO FIX THE HOUSE

By now you may be wondering who's going to fix the problems that get diagnosed with a blower door. Do we expect HVAC companies to invest in training and equipment to start air sealing attics and blowing in new insulation? In most cases that doesn't make much business sense, although



larger companies might consider it.

However, it does make sense to find and build relationships with insulation and air sealing contractors in your area who know how to make the improvements and repairs that may be needed.

One easy way to screen an insulation contractor is to ask them if they own a blower door and how often they use it.

TAKE AWAYS

It's certainly not necessary for every HVAC contractor to have a blower door system on their truck, but it probably makes sense for mid-sized and larger companies to have one technician who focuses on building science and has the necessary test

equipment to help diagnose and solve problems in the building envelope and duct work.

For smaller companies, there is probably someone in your area that has equipment and expertise to do blower door tests and infrared camera scanning.

That person might work for an energy rater company or be part of a community weatherization program and be willing to work with you to help you solve the problems you face.

Thinking back to Chris Hughes and his uncomfortable conversation about expectations, we should all recognize the limits of new equipment. Expecting perfection from new equipment in an existing house with existing duct work is a little like putting the engine

from a new C8 Corvette into an old, well-worn, 1998 Ford Expedition with its original air intake and exhaust.

If you did that you would never expect the vehicle to perform like the Corvette does on a racetrack. The Corvette engine might fit in the Expedition's engine bay, but there's a lot more to track performance than that! Everything must work as a system. **NCI**



Steve Rogers owns **The Energy Conservatory** (TEC), a manufacturing company specializing in home performance. The firm produces the **MINNEAPOLIS** brand precision diagnostic blower door equipment and develops processes to solve building comfort, energy use, durability, and air quality problems. Steve can be reached at ncilink.com/ContactMe.

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NCI IN THE NEWS

February was a busy month for the team at National Comfort Institute (NCI).



First the team joined the [Sixth Annual HVAC/R Training Symposium](#), February 6-7, 2025 in Ocoee, FL. There, **Adam Mufich** helped attendees understand how to use math to choose HVAC system components and predict what the new system's airflow and static pressures will be.

Also, **David Richardson** discussed a step-by-step approach to High-Performance HVAC™ by adding testing, diagnostics, and system upgrades to your service offerings.

Then **Dominick Guarino** shared how to make High-Performance HVAC profitable. From pricing your work properly to integrating testing and diagnostics into your sales processes, he helped attendees understand how to create a win-win for their businesses, team, and customers.



Then, the NCI team headed to Orlando, FL for the [AHR Expo](#) from February 10-12. Besides presenting several important educational sessions, the team participated in panel discussions, podcasts, and greeting contractors at the NCI booth.

Ben Lipscomb, P.E. addressed the



AHR Expo 2025 scenes: **Top photo** shows Dominick Guarino (left) and Adam Mufich participating in a podcast. **Middle photo:** David Richardson in action during one of his AHR educational session. **Bottom photo:** Dominick Guarino (far left) facilitates a contractor panel discussion.

[electrification](#) issue in his educational session on whether heat pumps can perform efficiently in cold weather.

David Richardson focused his session on [Air Upgrades](#) and how they can help cure HVAC equipment failures. He also presented a session on "The Path to High-Performance HVAC™."

Then **Adam Mufich's** educational session covered "The Building Side of the Duct System: Where Building Science and HVAC Intersect."

Plus **Dominick Guarino** facilitated an industry panel discussion with HVAC Industry leaders on the State of the Industry in 2025. **NCI**

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The AHR Expo in Orlando this past February did not disappoint. In addition to an extensive trade show brimming with new products and services, this year's event featured hundreds of educational sessions, dozens of podcasts, and several great panel discussions.

I had the honor to participate once again in a State of the Industry panel, and was asked to moderate two other panels.

The first had four amazing HVAC contractors on recruiting, training, and retaining people. The second was with a group of around 100 students from a local trade school who were brought in to tour the show and participate in the panel discussion.

While the other panels were great, in all honesty, I enjoyed the student panel the most. Having a chance to get in front of tomorrow's promise for our industry was priceless! Their curiosity and thirst for information was very heartening.

CAREERS IN HVAC

The unified message from the panelists was also amazing. Each of us shared our stories of where we started, many in the same place those students are today. We talked about the careers that we built from those humble beginnings.

I personally was one of those trade school kids 50 years ago (sounds crazy out loud). With initiative and hard work I built careers in several industries, from consumer electronics, to medical equipment, to HVAC.

With almost 40 years in the HVAC industry, My background includes being a magazine editor and publisher, comfort advisor, installation manager, and finally co-founder of NCI in 1994.

The panel was united in advising the students to not let anyone tell them that being a service tech or installer is something to be ashamed of,

or to feel less than someone with a college degree or fancy letters after their name.

Several students asked about career paths they might expect in our industry. We unanimously shared how the possibilities are limitless, ranging from becoming a top tech earning six figures, to sales, management, working for a distributor or manufacturer, even starting their own business.

OUR FUTURE LEADERS


It was interesting to watch the group dynamic – with most of the kids in the first and second rows bright eyed and listening intently.

As I looked back beyond those rows I saw a mix of some students paying close attention, some looking at their phones – even a few nodding off. It was clear the first two rows were the future movers and shakers in our industry.

We covered a myriad of topics, too many to share in this editorial. A few really stood out, and should be a bellwether of what makes your future employees tick.

For example, there was a great deal of interest in what technologies they would work with as they entered the industry. The discussion ranged from state-of-the-art inverter systems, to controls, to the instruments and software that continue to evolve to provide them with the best diagnostic and design tools ever available.

Overall, it was an amazing experience. If you really want to know what your future team members will be like, I highly recommend you visit some of your local trade schools.

Maybe work with the school to do a Q&A hour with their students on what to expect once they graduate. If you do this be sure to look for the bright-eyed kids in the first two rows. These are the ones you'll want to recruit before they even graduate! 

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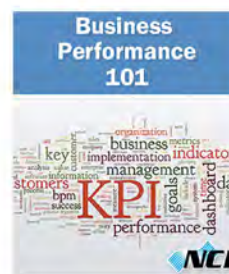
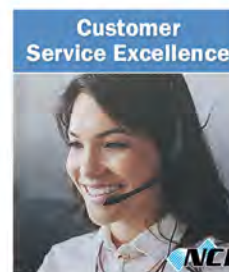
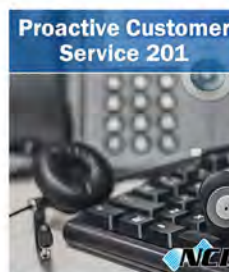
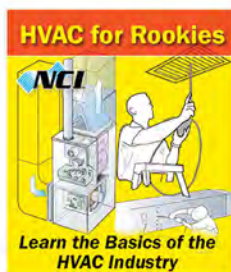
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