

# HIGH-PERFORMANCE HVAC TODAY™

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## Technology and the HVAC Industry: Don't Be Left Behind

### ALSO IN THIS ISSUE:

**Training Partnership: The Role of Distributors**  
**Are Combustion Efficiency Calculations Misleading?**  
**You Cannot Judge a Book by its Cover**





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# HIGH-PERFORMANCE HVAC TODAY™



### TRAINING SPOTLIGHT:

## Training Partnerships: The Role of Distributors

Four HVAC distributors discuss the importance of training partnerships with their contractor customers.



### THE LEADING EDGE:

## Technology's Impact on the HVAC Industry

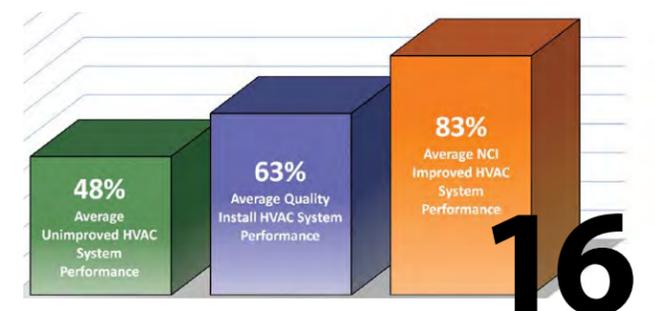
Austin Energy's Tom Turner foreshadows a future where Performance-Based Contracting is THE delivery method of choice. Those who don't embrace it may be left behind.



### TECHNICAL:

## Are Combustion Efficiency Calculations Misleading?

Jim Davis of NCI says Performance-Based Contractors shouldn't depend on the calculated efficiency of a combustion analyzer. Doing so can be misleading.



### INDUSTRY:

## You Cannot Judge A Book By Its Cover

Mel Johnson, NCI VP of Utility Programs, says now is the time for High-Performance HVAC contractors to shine. The opportunity to improve customer perceptions is now.

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## Training By the Rule of One Degree

**M**y friend and fellow NCI teammate, David Richardson, recently wrote a blog post ([nciblog.com/one-degree](http://nciblog.com/one-degree)) using a similar title to the one I have here. In his post he compares the act of boiling water by adding heat to it, one degree at a time, to moving forward with your life's goals.

He wrote, "All of us change as a direct result of the daily decisions we make and the habits they eventually become. Positive change doesn't take place overnight – it's the result of hard work and repetition.

"As you start, things might not happen as quickly as you want them to. Continuously adding one degree often takes us out of our comfort zone, but allows us to do things we normally wouldn't."

David pointed out that this applies to everything and everyone. But unlike that pot of water, people don't have thermometers to let them know when they've not only reached their boiling points, but when they are at the cusp of changing state. He wrote, "A major breakthrough could be just one step away and you'll miss it unless you continue to add one degree."

This really struck a chord with me, especially when it comes to training and education. So many people look for a silver bullet – a way to set them so far apart from the pack that they will rake in all the money and glory. The problem is, they want it fast. Instantaneously.

That is a fantasy. We all know it, but somehow everyone loses sight of that as they make decisions regarding the training of their people and their approach to their marketplaces.

If you set a goal to provide true High-Performance services to your customers, you must commit to training. It must be part of your company culture and the services you provide.

It's not a one-and-done event. That first de-

gree of change just starts the momentum. Each degree added continues building toward that change of state.

The good news is that contractors are not alone when it comes to turning up the heat on the professionalism of their teams and their companies. The HVAC Industry is blessed with many resources to help contractors add one degree everyday.

Your distributors are key to that. In fact, virtually all of your vendors (distributors, manufacturers, trade allies, and associations) provide opportunities to help you train your people and yourself.

### IN THIS ISSUE:

In fact, this month we spoke with four distributors on how important training contractors is to *their* strategies and goals. Their comments are further reason why you should look to them for technical and non-technical training. Read the interviews at [ncilink.com/DistRT](http://ncilink.com/DistRT).

Furthermore, Tom Turner of Austin Energy discusses the very important need for contractors to stay on top of changing methodologies for testing and diagnosing comfort systems at [ncilink.com/LeftBehind](http://ncilink.com/LeftBehind).

You can also learn why combustion efficiency can sometimes be misleading in the latest article from NCI's own Jim Davis at [ncilink.com/Calcs](http://ncilink.com/Calcs).

And finally, see how High-Performance contracting offers more depth in how you positively impact your marketplace AND the HVAC Industry ([ncilink.com/BookCvr](http://ncilink.com/BookCvr)).

All these articles play nicely with the One Degree rule. Remember, if implementing High-Performance into your company was easy, everyone would do it. If you start at one degree per day, the sky is the limit.

Have you added one degree today? 



*Mike Weil* is editor-in-chief and director of communications and publications at National Comfort Institute, Inc. He can be reached at [mikew@ncihvac.com](mailto:mikew@ncihvac.com).

## Written By HVAC Professionals for HVAC Professionals

### FIELDPIECE JL3KH6 WIRELESS CHARGE AND AIR TEST KIT

When it comes to refrigerant-side performance, the **JL3KH6 Wireless Charge and Air Test Kit** is where it's at. It helps to reduce refrigerant contamination and displays enthalpy change, so you know if adding charge is the proper course of action.

The kit needs to be on the cover of **Time** magazine. Not for its Bluetooth capability or its simple and easy setup procedures. Not for the small instrument profiles or durability. Not even because of its magnetized flexible single wand psychrometers. It should be on the cover because of the latest software update.

This has made it easier for technicians to data log a system. Space temperatures, register and grill temperatures, and the

refrigerant circuit can all be recorded. In data logging mode, you can set up time frames for days, hours, and minutes. The best part about the JL3KH6 is its very reasonable price point.

In true Fieldpiece fashion, this kit is built for rugged use. It can survive being dropped and will still provide the tech with an operational and accurate measurement.

One more thing: you can put the calculators down. The app performs all the necessary calculations. All instruments can switch from high and low-side measurements. It can take supply and return temperatures as well. This makes it very easy to distinguish where each instrument is located.

Fieldpiece has thought of everything. The refrigerant line temperature clamps



run a continuity test. This assures it will display the correct line temperatures and provide accurate measurements. It also includes a compact carrying case for all six instruments.

For more information or if you're interested in buying this product, go to [ncilink.com/FP-JL3KH6](http://ncilink.com/FP-JL3KH6).

— by Casey Contreras, National Comfort Institute Field Coach and Instructor

### DWYER 460 AIR METER AND DRAFT GAUGE

These Dwyer instruments are essential test instruments for anyone who diagnoses carbon monoxide (CO) and combustion problems on vented equipment.

This includes natural draft (drafthood) and induced draft (80%) equipment. Without it, you could easily misdiagnose a problem contributing to dangerous combustion readings.

With proper training, the draft gauge will tell you if adequate combustion air is available for the equipment and that no building pressure changes are interfering with equipment operation. In a few short steps, it can also tell you if a flue is restricted or undersized.

Contrary to popular belief, the draft gauge **cannot** verify proper equipment

venting. You'll need a combustion analyzer for that. The Dwyer 460 is an inexpensive and versatile solution for most draft pressure measurement applications. It comes with the following:

- Carrying case
- Dwyer 460 Air Meter / Draft Gauge
- 4" length of pressure tubing
- Various probes and accessories.

Draft pressure is measured in units called inches of water column (in. w.c.). The Dwyer 460 measures up to one-tenth of an inch of pressure (.10" w.c.) and is very sensitive to pressure changes. To get this feature in a digital manometer, you would have to pay hundreds of dollars.

Pressure tubing connects the draft gauge to a curved metal probe that is inserted into the flue for draft measurement. A small white ball inside the draft



gauge moves up and down freely to indicate the draft pressure reading on the gauge's black scale.

Occasionally, the inside of the gauge may get damp from flue gas and must be cleaned so the ball moves freely.

If you're interested in learning more about the Dwyer 460, go to the NCI Store at [ncilink.com/Dwyer460](http://ncilink.com/Dwyer460).

— by David Richardson, Curriculum Development and Instructor, NCI

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# Training Partnerships: The Role Of Distributors

The HVAC Industry is rich in training. From A to Z contractors have access to educational programs – both live and online – that address every aspect of running their companies. This includes teaching ways to improve business and sales, marketing, and staying abreast of new technologies.

Do contractors take full advantage of all the training available? Not really. And that is where the local distributor comes in. Distributors play a vital role in bringing training to their contractor customers in an organized and meaningful way.

This is especially important in the realm of Performance-Based Contracting™ where technical expertise goes well beyond just replacing equipment and upselling accessories.

In this light, *High-Performance HVAC Today* spoke with several distributors about their role in the training sector and how partnership with National Comfort Institute helps them in this mission.

## THE IMPORTANCE OF HVAC CONTRACTOR TRAINING

**Chad McAllister** of R.E. Michel Co. in Glen Burnie, MD says for his organization, training HVAC contractor customers is vital.

“Proper training is imperative to our customers success,” he



explains. “Our customers have a business to run, and as a value-added supplier, we must bring them training opportunities to help them grow their business, learn about new equipment, and new technologies.

**Ken Perotta** of Crescent Parts and Equipment in St. Louis, MO concurs. He says training is a centerpiece of the services they offer their contractor customers.

“We conduct more than 100 annual training days in our main office and an additional 50-plus classes in the rural branches each year. Our sales group also does hundreds of classes, one to two hours long in our contractors’ offices to help train on specific areas they need help in.”

All four of the distributors we spoke with say that their focus on training helps their customers do their jobs better and sell more equipment as a result. This creates a win-win-win scenario for contractors, consumers, and the distributors alike.

“We view contractor customers as an extension of our company,” adds **Jeremy Barnes** of Ferguson LLC., Tampa, FL branch. “Without quality contractors representing our product in our markets, we can’t accomplish our goals as an organization.”



## GETTING THE WORD OUT

One of the main factors to conducting successful training programs is “filling seats.” Distributors are in the drivers seat when it comes to making this happen.

According to **Tony Aspesi** of Baker Distributing Co. in Jacksonville, FL, you can have the best state-of-the-art training facility, but it is worthless unless you have a marketing strategy to get the word out to contractor customers.



“We certainly have our own marketing approach,” says Aspesi, “but what really pulls it together for us is the training partnerships we have with outfits like National Comfort Institute. Their approach is top notch and that makes it so much easier to promote training at our facilities.”

At R.E. Michel, they use their sales and marketing teams together to promote training. They spread the word via word-of-mouth, email, and website promotions, as well as social media campaigns, according to **McAllister**.

On the other hand, **Perotta** sees the success of Crescent Parts’ programs also based on bringing good national training organizations into the regions they serve to train their contractor customers.

“These organizations get our contractors in the door. They help us make them better and more efficient.

“This also attracts new contractors that we don’t normally do business with into our location so we can showcase our training room, our warehouse, and our people,” Perotta adds.

“They get to witness our relationship with our contractor customers and in many cases we start to earn more of their business.”

## TRAINING IMPACT ON BUSINESS

“When contractors are better at doing what they do, we have less warranty claims,” **Aspesi** comments. “Most warranty claims are due to improper installation practices. Proper training greatly reduces these claims.

“When jobs are done right, customers are more satisfied and when that happens good news travels fast. Bot-

tom line – good work equals good news which equals more sales.”

**Barnes** agrees and adds, “We have found, especially on the technical side, that working with companies like NCI has vastly improved the quality of work done by the contractors who have attended.

“One of the biggest areas we have noticed is on the airflow side of the residential business. While getting to a zero claim world is not attainable, we do see that contractors who attend the residential air balancing class now install systems that run like they are supposed to and require far less call-backs.”

## PARTNERSHIP IS KEY

All four of the distributors we spoke to agree that training partnerships are

really important to the success of keeping HVAC contractors on top of their game. Each says that from a technical perspective, the training partnership they have with NCI is key.

“NCI has shown us time and again that they take technical training to the next level. They help us arm contractors with the tools and knowledge they need to improve their skillset and their businesses,” **Barnes** concludes.

If you are an HVAC contractor working in the High-Performance sector, or planning on doing so, remember that your distributor is a key partner in helping you be successful.

Take advantage of the training opportunities they provide. It is in your customers’ and your company’s best interest to do so. NCI

# NCI’s Online Airflow Diagnostics Course



This six-module, **Airflow Testing and Diagnostics** interactive training is designed to help you learn the basics of static pressure and airflow testing. The course also addresses how to diagnose common air-related issues found on most HVAC systems, then provide the right solutions to make a significant impact on your customers’ homes and businesses.

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- Plotting Fan Airflow
- Completing an Air Upgrade



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# Technology's Impact on the HVAC Industry

The year was 2000. The “Y2K” bug ([nci-link.com/Y2KBug](http://nci-link.com/Y2KBug)) arrived with much fanfare and little bite. Some called it a hoax and others credit the \$300 billion spent to avoid a worldwide system crash of power plants, banks, and even automotive systems.

Interestingly, that same year two authors' —Tim LaHaye and Jerry B. Jenkins — first novel was released as a movie. “Left Behind” ([leftbehind.com](http://leftbehind.com)) was one of 16 books in a series and the first of three films. The movie was a view of global end times and the peril humans would face.

Today, we steal the title and apply it to a popular topic in the air conditioning and heating industry. In place of an “end-of-the-world-as-we-know-it” scenario, we set the stage for our industry and the companies within it that fail to embrace the concepts behind “Home Performance” and “Performance-Based Contracting™.”

Our industry, for the most part, continues down a path of plug-and-play without regard to consequences of underperforming equipment. A soon-to-come reckoning will end that journey for many in the HVAC contracting industry.

Equipment manufactured today is too sophisticated to not be installed properly. When today's high-end equipment becomes the basic standard, many in our industry will be “Left Behind.”

## LESSONS FROM HISTORY

As the current crop of baby boomers begins stepping off the contracting stage, significant les-

sons from industry events are being forgotten. Think about a child on a trip across the country who is too preoccupied with their gaming systems and computers to notice the landmarks and beauty they drive past.

They miss the opportunity to appreciate the significance of the moment. Today we are too busy selling, installing, and repairing equipment to see the landmarks and milestones of the industry.

In those days, we could simply drop new equipment in and experience little pushback from customers or manufacturers. Since we didn't measure performance, systems limped along with little indication of any problems outside of a high electric bill and marginal comfort.

## CURRENT EVENTS

Enter today's equipment. Many manufacturers include technology that will not allow equipment to run when installed incorrectly. Furnaces and air conditioning units use sensors that monitor airflow, refrigerant levels, and oil distribution, shutting the equipment down prior to damage occurring.

Furthermore, customers are becoming better educated with access to information via the internet and the growing interactive web presence of manufacturers. As a competent contractor, you must be critically aware of the right way to install. You also must be aware of how much information on the internet is not true or is misleading.

Finally, manufacturers won't sell equipment

to just anyone. The expense involved with warranty issues is becoming too great to simply take a hit and pass on the costs. Add these issues together and you can see how a plug-and-play installation approach is soon to be a thing of the past.

## IT'S NOT A GIMMICK

The number one cause of underperforming HVAC systems is inadequate airflow. The number two issue is equipment not matched to the conditions the system can handle. In other words, the capacity of the system is mismatched with the home's heat load.

While there are few in the industry who embrace Home Performance or Performance-based Contracting™ as their preferred delivery method, many will soon adopt the idea out of necessity. Some in the contracting community use the phrase as a gimmick, not understanding the commitment.

Contractors who make the commitment are shocked to see the incredible system performance improvements to their new installations and will tell you they wish they had embraced performance models earlier.

Why?

Each aspect of a Performance-Based job acts upon other components producing increasingly better results. When we follow an outline that addresses all aspects of the home with proven methodology, we continual-

**“PERFORMANCE-BASED CONTRACTING” ISN'T A CATCH-PHRASE THAT WILL FADE OVER TIME. IT'S THE PROTOCOL FOR THE FUTURE OF THE INDUSTRY.**

ly improve our jobs.

Here is an outline you can follow:

## ANALYZE PROJECTS CORRECTLY

**New Construction.** You are at the mercy of the information provided by the builder. Be sure all relevant information is included. This includes all plans that define wall, window, and door materials. The framing plans should give your company an idea whether or not you can install correctly sized duct.

When necessary you must push back on construction themes that limit your access to do the job correctly. It may be the prudent option to walk away on occasion when you know the job will not perform as it should.

Just because the architect wants a specific look or the owner wants specific floor space does not mean we acquiesce and install an inferior design.

**Retrofit.** These are the jobs we can impress customers with. Homes built in the 1950s, 1960s, and 1970s are homes we can influence greatly. Don't be afraid to trust a load calculation that tells you something other than what the old rules-of-thumb say.

When we follow the Energy Code with appropriate methods and material, we move performance well above

the 650 to 750 feet per 12,000 Btu performance range. This includes an efficiently functioning duct system.

**Set up a plan of attack.** After analyzing the structure, create a comprehensive plan to address each job with the same comprehensive scope customized to meet specific needs.

**Share with the team.** Too often we assume our team understands how a job should be installed. Clear instructions with an accurate material list will go a long way to improving job quality and profits.

In today's market, your workforce can change. You should begin the process of continuous training in-house or contracting it out.

## SYSTEMATICALLY APPLY PRINCIPLES

**Envelope efficiency** will influence your job beyond comprehension. The more efficiently the envelope is sealed, the more effective all other measures become compounding savings and comfort at every level.

**Aligning Insulation and thermal properties** will ensure all installed products will perform efficiently and improve comfort. Too often we overlook construction issues that impact the equipment performance.

Having a basic understanding of Building Science is necessary. Without knowledge, we will continually chase goals that are unachievable.

**FOLLOW PROTOCOL FOR INSTALLATION**

**Load Calculation.** This is a most important requirement. You must remember, no matter who performs the load calculation, you and your company are responsible for the end results.

**Equipment selection.** Taking the results of the Manual J and Manual S will help you select the correct equipment for the job. Avoid preconceived notions on tonnage for the job.

Pay attention to sensible and latent loads and match them with systems that perform at the correct capacity.

Whether in heating- or cooling-dominant climates, make sure the system has the capacity to handle the secondary load.

Pay special attention to high SEER heat pump capacity.

**Duct Layout.** Too often we send an installation crew out with little more than a truck full of duct materials. Why would we expect a quality installation with no guidance?

Take the time to survey and measure the job from inside the home. Make adjustments once you view the job from the attic. If we view the job from the attic only or initially, we will always include too much linear footage of duct as it is extremely difficult to judge distances or measure in the attic.

Make sure you follow the fundamen-

tals of ductwork outlined in National Comfort Institute's (NCI) training.

A quick reference guide is included on clipboards from NCI's sales and support page ([ncilink.com/Clipbds](http://ncilink.com/Clipbds)).

**Duct Install.** The efficient use of duct materials is the number one trait of a quality installation. Using the smallest amount of duct routed straight and turned on a slow radius will yield great airflow results.

Just because flex duct is flexible doesn't mean it should be. View every flex duct run as if it is rigid pipe. Where you don't have room, you must find a solution or quality will suffer.

**Transitions.** All too often we see filter housings butted up against a furnace, air handler, or a slab evaporator with a transition that exceeds 25 de-

grees. These close-up encounters with components in the air stream cause noise, excessive velocities, high in-duct pressures, and poor heat transfer.

Where evaporators are placed too close to the air outlet, the result is an appliance that will never achieve its potential for removing heat.

**Adequate return grille size.** Adequate return grille size is easy to calculate. Divide the required cfm of the appliance by 2 and you have the gross grille area required for proper airflow at a reasonable velocity.

An example is 2.5 tons requires 1000 cfm. Divide 1000 by 2. So, we need 500 square inches of gross grille area.

What we pay little attention to is the choke on performance the filter provides. That is our next point.

**Using the appropriate filters.** If performance is your goal, you understand that one-inch filters have little room in your inventory. Only the smallest air handler and furnaces will operate efficiently with one-inch filters, and those filters will not be above a MERV 7.

Where capacity exceeds three tons nominal, you will likely need two media filters to handle the job.

With evaporator fin count so dense it is imperative we protect the customer's investment with better filtering. Perhaps you include media filters as a standard with all your jobs.

The deep-pleated media will help prolong the life of the evaporator, even when time gets away from the customer. If we change the filter annually, the evaporator will most likely survive. These filters will not break the bank.

IF YOU CHOOSE TO KEEP USING OLD-SCHOOL METHODOLOGY YOU WILL BE **LEFT BEHIND.**



happier when a problem occurs, and it is resolved quickly vs. no issues to deal with at all.

You should take advantage of the information and include a visit post-installation at the nine to 12-month point.

**The refrigerant charge.** Please note that weighing in the charge at startup will save your company on return trips and warranty calls. Superheat and subcooling stats take you only so far.

To accurately charge a system with this method you must verify that airflow and air temperatures fall within seven to 10 degrees of desired laboratory settings. Anytime we charge a system when temperatures are low, we can overcharge it. When temperatures are high, we can undercharge the system.

On a final note, it is impossible to charge a heat pump correctly in the winter without weighing in the charge.

**TEST TO MAKE CERTAIN OF YOUR RESULTS**

Testing products after installation should be standard. How do we walk away without knowing how well our job is performing?

While the model for performance-based contracting will give you the template for successful jobs time after time, validation through testing allows you to adjust installations to maximize performance and quality.

**Back at the office.** Take the time two days after a job has closed out to handwrite a note of thanks to the customer. Surveys indicate customers are

**Supply your customer with a full set of documentation.** Think twice prior to furnishing your customer with a load calculation, equipment selection criteria, full duct layout, or job scope information.

Once the job is complete and you have payment in hand, THEN provide a complete set of documents that include an additional set of owner or operator manuals, a detailed load calculation, a summary sheet of work performed, and a clean copy of the paid invoice.

This package will provide value beyond what the customer paid in his or her mind.

**"Performance-Based Contracting"** is not a catchphrase that will fade over time. It is the protocol for the future of the HVAC industry.

Technology is driving our industry whether you choose to embrace it or not. Remember, if you choose to keep using old-school methodology you will be **Left Behind.** NCI



**Tom Turner** has 40 years experience in construction and the HVAC residential/commercial industry. He is an advocate for the Performance-Based Contracting business model. Currently, Tom works for Austin Energy as the Environmental Program Coordinator for the nationally recognized municipal utility.

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# Combustion Efficiency Calculations: Are They Misleading?

**T**oday, with all the new digital combustion analyzers available, more HVAC contractors are checking equipment efficiency. This efficiency is based on calculations built into the combustion analyzers using an O<sub>2</sub> and a flue temperature reading. These are the same calculations once used on the original [slide-rule](http://ncilink.com/SlideRule) ([ncilink.com/SlideRule](http://ncilink.com/SlideRule)) efficiency calculators.

However, unless someone was working on oil equipment, the old slide rule was rarely used. Even when it was, how often did contractors test-in and test-out?

## SOME BACKGROUND

In the 1970s and early 1980s, there was an energy crisis and a push to use less fuel. This was the same time the first digital combustion analyzers were introduced.

Testing-in and testing-out became necessary to meet government requirements for tax credits. It is also when people began questioning the ability of these analyzers to calculate actual efficiency.

During that time, servicing and/or upgrading equipment showed little or no efficiency calculation improvement, and in some cases a decline. Yet customers were saving a considerable amount of energy in all situations.

The question in both my mind and the customers' was Why? Unfortunately, no information on when or how these calculations were developed is available.

Currently these calculations remain an industry standard and are used to rate the efficiency of all HVAC equipment currently manufactured because that is the way it has always been!

## APPLYING THE LAWS

**Figure 1** lists five sets of combustion readings, on the same piece of natural gas equipment, adjusted with different gas pressures, that all have the same analyzer-calculated efficiency.

Before breaking down the calculations, here are three rules or laws of combustion and energy you need to know:

- The temperature of an object determines the amount of Btus it contains
- Air contains 21% Oxygen and 79% Nitrogen
- Natural gas has an adiabatic flame temperature of 3600° at 0% - O<sub>2</sub>.

Adiabatic simply means 100% of the energy is available and not lost to any other substance.

In the real world, the substance that absorbs or steals a good per-

	O <sub>2</sub>	Flue Temperature	Efficiency Calculation
1	12%	250°	82.2%
2	10%	290°	82.2%
3	8%	320°	82.2%
4	6%	350°	82.2%
5	4%	380°	82.2%

centage of combustion energy is Nitrogen. For every 1% Oxygen in the combustion air, there is 4% Nitrogen. Nitrogen absorbs the heat or cools the flame and makes the energy unavailable for transfer.

Now examine each of the readings, try to avoid being too scientific, and just use some simple math.

## FIVE EXAMPLES:

**1 12% Oxygen equals 48% Nitrogen.**

This cools the flame to 2000 degrees out of a possible 3600 degrees. That equates to 55.5% of the energy being available for transfer.

The flue temperature is 250 degrees; therefore 1750 degrees of heat was transferred.

Divide 1750 degrees by 3600 degrees and you get 48.5% efficiency or transfer. So where did the original 82.2% energy efficiency calculation shown above come from?

**2 10% Oxygen equals 40% Nitrogen.**

This cools the flame to 2250 degrees out of a possible 3600 degrees. This equals 62.5% of the energy being available for transfer.

The flue temperature is 290 degrees; therefore 1960 degrees of heat

was transferred.

Divide 1960 degrees by 3600 degrees and you get 54.4% efficiency or transfer. Again, where did that 82.2% come from?

**3 8% Oxygen equals 32% Nitrogen.**

This cools the flame to 2500 degrees out of a possible 3600 degrees. This equals 69.4% of the energy being available for transfer.

The flue temperature is 320 degrees; therefore 2180 degrees of heat was transferred.

Divide 2180 degrees by 3600 degrees and you get 60.5% efficiency or transfer. What's up with this 82.2% in the energy efficiency calculations above?

**4 6% Oxygen = 2800 degrees or 77.9% available energy.**

The flue temperature is 350 degrees; therefore 2450 degrees of heat was transferred.

Divide 2450 degrees by 3600 degrees and the result is 68.0% efficiency or transfer. Once again I ask where does this 82.2% comes from?

**5 4% Oxygen = 3100 degrees or 86.1% available energy.**

The flue temperature is 380 degrees therefore 2720 degrees of heat was transferred.

Divide 2720 degrees by 3600 de-

grees equals 75.5% efficiency or transfer. Getting closer!

The calculations in my five scenarios only consider sensible heat and yet there is another loss of latent heat that is not even being considered.

## ONE LAST NOTE

Older combustion analyzers could not calculate efficiency on condensing equipment because of Latent Heat. Today, new calculations have been added for Latent Heat recovery (based on theory) and the calculations are impressive!

*15% Oxygen – Flue temperature 90 degrees = 99% efficiency!!!*

The point I'm trying to make is that if you depend on the calculated efficiency of a combustion analyzer to determine the actual performance of a piece of equipment, you are being misled.

Maximizing efficiency means adjusting equipment to operate as close to its rated output as possible. Using the formula CFM x DeltaT x ADCF (Air Density Correction Factor) gives you the approximate output.

Keeping oxygen the lowest, flue temperature in a proper range, and carbon monoxide at a safe level will produce the best results. When this is accomplished, efficiency has been maximized. 




**Jim Davis** has a long and storied career in the HVAC Industry. That career began back in 1971. Today he serves the industry as the senior instructor for National Comfort Institute and continues researching into all things combustion related. He can be reached at [JimD@ncihvac.com](mailto:JimD@ncihvac.com).

# You Cannot Judge a Book by its Cover

There is a serious perception issue within the HVAC Industry that prevents many people from knowing who they really are, what they really do for their customers, and why they really matter to their community.

Most HVAC businesses believe they are only as good as the brands they carry, the volume of products they install, and the amount of service agreements they sell.

Unfortunately, most HVAC business owners will not do anything to change this perception until something unexpected happens.

It usually begins with a decline in their customer base, fewer jobs, lower profit margins, loss of key performing staff, a higher number of call backs, and

for streamlining a business and field automated technologies help with productivity, cost avoidance, and potential energy savings. The truth, however, is these streamlined processes and advanced technologies have only exasperated the problem by revealing a deeper knowledge gap that has existed for decades without detection.

Most people are unaware this knowledge gap consists of confounding variables from more than 144 known problems that impact the performance and energy use of HVAC systems. The attitude of technicians and their level of engagement is directly connected to an appreciation for how well they impact these problems to make a difference for the customer and how well they represent the mission of your company.

In an effort to identify and reduce the number of possible causes to comfort problems, technicians attempt to deploy refrigerant measurement and diagnostic technologies. Some of these are included as HVAC measures in utility energy programs across the nation. When using these technologies, techs receive multiple major and minor fault messages relating to refrigerant charge and airflow. What is wrong and what may be wrong are left to the technician's discretion to correct.

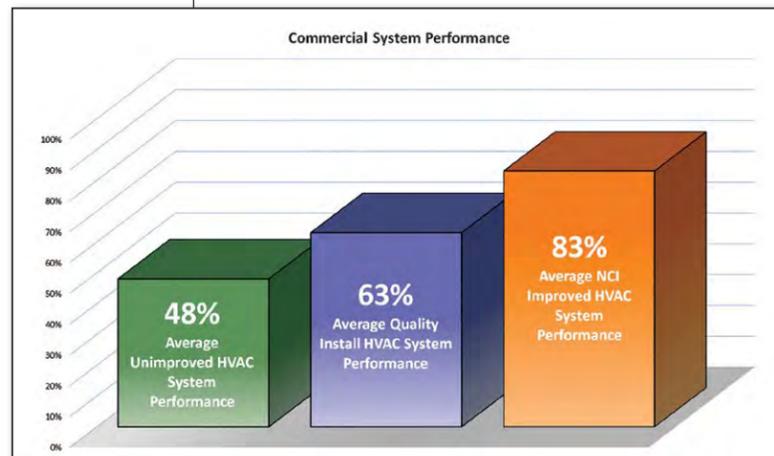
This attempt to increase field productivity, accuracy, and professionalism is well-intentioned, but does not reveal what is truly plaguing system performance. The reason is, these technologies are being built upon assumptions that exclude how well the entire HVAC system is performing.

## THE COST OF CHANGE

ASHRAE (American Society of Heating, Refrigeration, and Airconditioning Engineers) has gone on record and indirectly stated this truth – yet few know this. Even fewer have been willing to put these truths into practice.

Who can blame them?

Figure 1. Field measured system delivered capacity data collected by NCI-certified contractors from 2012-2018.



an increase in customer dissatisfaction. The work environment and morale begin to decline and quickly spiral into a race to the bottom.

## MORE THAN PERCEPTION

Let's start this conversation on the deck plates instead of the boardroom. Our industry not only faces a perception problem, it is also encumbered with a major labor shortage. This is a problem further compounded by a great gap in skills and conduct.

Yes, field service management platforms are great

HVAC Contractors already made enormous investments in service management software, automated field service technologies, as well as facility, utility, and third-party programs.

Right now, the current approaches with these technologies are stranding thousands of comfort systems that deliver less than 60% of what is promised by manufacturers in their capacity and efficiency ratings. What's worse is, these systems under-perform and under-deliver when they are needed the most.

As utilities adopt Time of Use Rates (TOU's), customers are being hit with new pricing signals. This signal shifts energy use from peak hours to off-peak hours which penalizes end-users for excessive HVAC energy use. In addition, in the Western U.S., there is a bold movement toward "building electrification," meaning changing reliance from gas to electricity in residential and commercial buildings.

What most regulators and utilities don't realize is the margin of error with heat pumps is even less tolerant than gas equipment to these confounding variables.

## TESTING AND MEASURING ARE KEY

What I find most alarming is technicians are not expected to measure and correct an HVAC system that is not performing to its designed capacity and efficiency ratings. No one in the value chain knows, expects, or requires this to happen.

If manufacturer equipment ratings are not measured in the field by the technicians who install, service, and repair them, then who are we expecting to perform this task?

Again, what **IS** wrong and what **May Be** wrong are left to the technician's discretion to correct.

Businesses are being built upon **assumptions** that exclude a customer **valuing** how well their entire HVAC system is performing. Unfortunately, by continuing to make these uninformed assumptions these issues will penalize your customers' safety, comfort, and efficiency, as well as your business' value proposition!

This also means technicians go unappreciated for their contributions. So the customer value proposition, contractor differentiation, along with increased selling prices and profit margin, are all hidden from sight until the business owner decides to require measured field performance.

If what ASHRAE states is true, shouldn't we be building workforce professionals who focus on HVAC system performance, who know their identity, and who have strong values,

practice work ethics, and exhibit craftsman-like behavior?

Our industry is positioned to change the consumer view of HVAC from a commodity to a well-performing asset that increases the value of homes and buildings. Performance-based HVAC contractors are the only ones capable of doing this and here is why: professionalism.

## MEASUREMENT IS A PATH TO PROFESSIONALISM

In the old days, a coat-of-arms distinguished "professionals." Professional people have taken the time to study and train to establish their individual identity. They then perceive themselves as professionals. They don't need a brand, association, or company to identify their worth. Yet, they recognize their individual value and know why they are important.

A person without a coat-of-arms associates their identity to things outside of themselves and experience more uncertainty in terms of their value. They question their problem-solving skills and struggle with adaptability.

Just looking at the outside does not distinguish a coat-

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of-arms professional. Any novice can provide a 15-point clean and check, a summer/winter visual inspection, use an industry/association consensus checklist approach, or even conduct a refrigerant circuit analysis.

These approaches won't distinguish a company, nor will they reveal what is plaguing system performance.

Measurements beyond the refrigerant must be taken to address electrical and mechanical issues. These range from supply/return air balance, control system problems, fan performance, compressor performance, to the delicate balance of refrigeration temperature and pressure, superheat, and subcooling.

The most overlooked is **airflow**, which is foundational to air conditioning performance. Yet, the published data for these performance factors differs between laboratory environments and real world in-field applications.

**BUILDING PROFESSIONALISM**

This coat-of-arms comes from building and mentoring each technician's professional identity in HVAC system performance. As an industry it is our job to help them become comfortable with their professional value, understand their specific job requirements, and develop the skills needed to meet the demands of a changing workforce.

Professionals must know how to use the right instruments and tools. Their confidence comes from hands-on training. All of this positively impacts HVAC system performance.

We have found that, on average, trained and certified technicians can improve a system's delivered capacity more than 50%. Not only will consumers receive what is promised in the

Fixed Orifice Metering Device	Superheat	Subcooling	Low Side Pressure	High Side Pressure
Overcharge	↓	↑	↑	↑
Undercharge	↑	↓	↓	↓
Low Airflow	↓	↓	↓	↓
Dirty Condenser	↓	↓	↑	↑
Bad Compressor	↑	↑	↑	↓
Restriction	↑	↑	↓	↓
Non-Condensables	↓	OK	↑	↑

TXV Metering Device	Superheat	Subcooling	Low Side Pressure	High Side Pressure
Overcharge	OK	↑	OK	↑
Undercharge	OK/↑	↓	OK/↓	↓
Low Airflow	OK	OK	↓	↓
Dirty Condenser	OK	OK	OK	↑
Bad Compressor	↑	↑	↑	↓
Restriction	↑	↑	↓	↓
Non-Condensables	OK	OK	OK	↑
Loose or Poorly Insulated TXV	↓	↓	↑	↑
TXV Bulb Charge	↑	↑	↓	↓

Commonly available refrigerant-side diagnostics charts and software imply that you can diagnose all issues based on refrigerant measurements. This is misleading and commonly leads to misdiagnosis and missed opportunities.

manufacturers' capacity and efficiency ratings, but performance can now be valued by customers.

This means the perception issue within the HVAC Industry can now be addressed head-on! People can know who they really are, what they really do for their customers, and why they really matter to their community. HVAC businesses can now be differentiated by professional people who believe in themselves, knowing they deliver all the potential of the brands they carry. The bonus value is that they can increase the margins and volume of the products they sell and install while expanding their service agreements.

Now is the time for HVAC contractors to grow their customer base, increase the number of jobs they do,

raise profit margins, and scale-up the performance of their staff.

At the same time these professionals will reduce performance call backs while increasing customer satisfaction. There has never been a more opportune moment to raise morale and create a performance-charged work environment. 



**Mel Johnson** is vice president of utility programs at NCI. His depth of knowledge is derived from nearly two decades of experience within the energy utility and HVAC Industry. He continues to interact with a broad array of stakeholders, associations, industry trade allies, and end-use customers. Mel has created, directed, supervised, and governed mass market Investor Owned Utility projects mandated by the State of California through the CEC and the CPUC.



*"It's a wonder you're still alive!"*

— Nate Copeland, Copeland & Son, Nashville, TN

This is a horizontal, 80% AFUE furnace with a single-wall vent side discharge and a plastic dryer vent cover outside. Someone used spray foam to seal the holes in the vent pipe. Epic fail!!

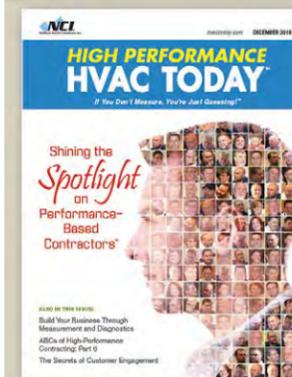
Nate Copeland, from Copeland and Son, is the November 2019 winner of our Photo-of-the-Month contest, in the "Bad" category, as voted on by the subscribers to the [High-Performance HVAC Today](#) magazine and visitors to the website. He will receive a \$50 gift card.

You can too – submissions are always welcome. If you'd like to submit a photo for consideration in our Photo-of-the-Month contest, go to [ncilink.com/POMSubmit](http://ncilink.com/POMSubmit) and fill out the information as requested.

**THE DECEMBER CONTEST OPENS ON NOVEMBER 8, 2019.**

That gives you plenty of time to submit something in any of our three categories: **The Good, The Bad, WTH (What the heck).**

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relationships, and explore new opportunities during the **National Comfort Institute High-Performance Summit**, from April 5-9, 2020.

This is the only event of its kind completely focused on marketing, selling, and delivering High-Performance HVAC systems.

This year the conference focuses on coaching your entire team to High Performance. From the opening session through every workshop, you will learn how to coach team members on specific topics as you integrate performance into your company.

In addition, a fifth, High-Performance Town workshop, consisting of three hands-on labs, will be held so you can experience advanced tests and calculations to diagnose and offer highly profitable system upgrades, just as your teams do in the field.

The sessions include:

- Coaching Your Entire Team: **What Is High-Performance Contracting and Why Are We Doing It?** – led by NCI's David Richardson.
- Coaching Your Managers: **How We Will Integrate High Performance into Our Business** – led by Dave DeRose
- Coaching Your Technical Team: **How**

**We Will Integrate Performance Testing into Service and Installation** – led by

NCI's Casey Contreras

- Coaching Your Sales Team: **How We Will Market and Sell High Performance**

– led by NCI's David Holt

- Special: **High-Performance Town 2020 - Hands-on Testing & Diagnostics Labs** – taught by

Rob Falke, Jeff Sturgeon, and Justin Bright.

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**NCI ROLLS OUT ITS LATEST ONLINE TRAINING CLASS**

National Comfort Institute just launched its newest Online University training course: **Airflow Testing and Diagnostics**.

This is a six-module, interactive course designed to help you, your technicians, and your sales team learn the basics of static pressure and airflow testing.

The course also addresses how to diagnose common air-related issues found on most residential HVAC systems in the U.S., then provide the right solutions to make a significant impact on your customers' homes and businesses.

**Airflow Testing and Diagnostics** consists of more than eight hours of online technical and sales instruction on how to measure and interpret static pressures, and then educate your customers about what this means to the safety,



health, comfort, and energy use of their homes.

The modules of this course include:

- The Air Upgrade Approach
- Introduction to Static Pressure
- Measure and Interpret Static Pressure
- Fundamentals of Fan Airflow
- Plotting Fan Airflow
- Completing an Air Upgrade.

This online training course costs \$299 per student. If you are an **NCI Member**, you can save \$100 off that price.

If you're an **NCI Learning Excellence Online** or **NCI Premium Level** member, the course is available for all your employees at no additional cost!

Just log into your account on [National-ComfortInstitute.com](http://National-ComfortInstitute.com), then click on this link: [ncilink.com/ATOnline](http://ncilink.com/ATOnline).

If you have any questions or experience any problems, be sure to contact your representative at 800-633-7058.

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## Communicate and Coach Your Way to Success



**Dominick Guarino** is publisher of *High-Performance HVAC Today* magazine and CEO of National Comfort Institute, Inc. He can be reached at [domg@ncihvac.com](mailto:domg@ncihvac.com)

**W**hen changing a company's culture or adding a new product or service, two key ingredients are especially important: Communications and Coaching.

Put simply, it's about how you communicate important changes and plans to your team. Unless these communications are clear and concise, and reinforced often, they will likely fall short.

Coaching is a great way to communicate with your team. In other words, rather than proclaiming edicts like, "This is the way we're doing things from now on," use a coaching process to help your team understand **why** you want to move your company in the direction you are sharing, **what** you plan to start doing differently, and **how** you plan to do it.

### THE WHY

Win the heart and the mind will follow. To win over your team on a new direction you must communicate your vision with all the passion and vivid detail you can muster. Talk about the benefits to your customers and your employees first, then follow with what it will do for the company.

For example, if your people understand why you decided to become a High-Performance contractor, and how you want them to be more than just tradesman — and grow into true craftsmen — you'll be more successful in winning their hearts and minds.

In Simon Sinek's podcast TED Talk, "[How Great Leaders Inspire Action](#)," and his book, "[Start With Why](#)," Sinek uses an illustration showing a Golden Circle which consists of three concentric circles, with the outer circle being **What** a company does. The next circle inward is **How** you do it, and the innermost circle is **Why** you do what you do.

When you decide to make a change, or to sell a new product or service, it's a good idea to start with the **Why**. Try to communicate your Why with one short sentence.

While this approach can work with virtually anything, let's continue with our example of becoming a High-Performance Contractor.

My "Why" for doing what I do is:

**"I believe everyone deserves to live and work in safe, healthy, comfortable, and energy efficient homes and buildings."**

What's your "Why?" Have you given it some thought? If the "Why" above resonates with you, feel free to make it yours.

Once you've determined your "Why," it's important to communicate it to your team. But before you do, make sure you have a good strategy to make it work, and what the end product will look like in your customers' eyes.

### THE HOW

Here you need to spend time communicating and coaching your team on how you plan to become more Performance-Based. This includes how you will train your technical team on testing, diagnosing, and providing solutions to often longstanding issues. It also involves determining the tools, methods, and processes you will need to put in place to support their efforts in the field.

### THE WHAT

Finally, you must focus on coaching your team on what your company's new products and services will look like to customers. This means giving your salespeople the training and tools they need to communicate your approach clearly and effortlessly.

Be careful. Just putting them through training and giving them new tools will not guarantee success. You have to start by winning their hearts and minds, and making them feel like they are genuinely part of the solution.

This editorial could continue in great detail for pages, but the great thing is this magazine is already laser-focused on supporting your quest.

You will find a treasure-trove of examples of Why, How, and What to do in many past and future issues of this publication. I am excited for you as you continue on your High-Performance journey, and wish you unlimited success! 



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Nov 5-7: Los Alamitos, CA\*  
Dec 3-5: Greensboro, NC

#### Residential HVAC System Performance Certification Program

Nov 12-13: Pompano Beach, FL  
Nov 14-15: Pompano Beach, FL

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Nov 19-21: Richmond, VA  
Nov 19-21: Sheffield Lake, OH  
Nov 19-21: Lenexa, KS  
Dec 10-12: Mobile, AL  
Dec 17-19: Los Alamitos, CA\*

#### Commercial Air Balancing Certification Program

Nov 5-7: Chantilly, VA  
Nov 5-7: New Orleans, LA  
Dec 3-5: Los Alamitos, CA\*

#### Commercial HVAC System Performance Certification Program

Nov 12-13: Tampa, FL  
Nov 12-13: Los Alamitos, CA\*  
Dec 3-4: Sheffield Lake, OH

#### Optimize Economizer Performance with Certification

Nov 14: Los Alamitos, CA\*

#### National Balancing Council Commercial Balancing with Certification

Dec 9-13: Sheffield Lake, OH

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