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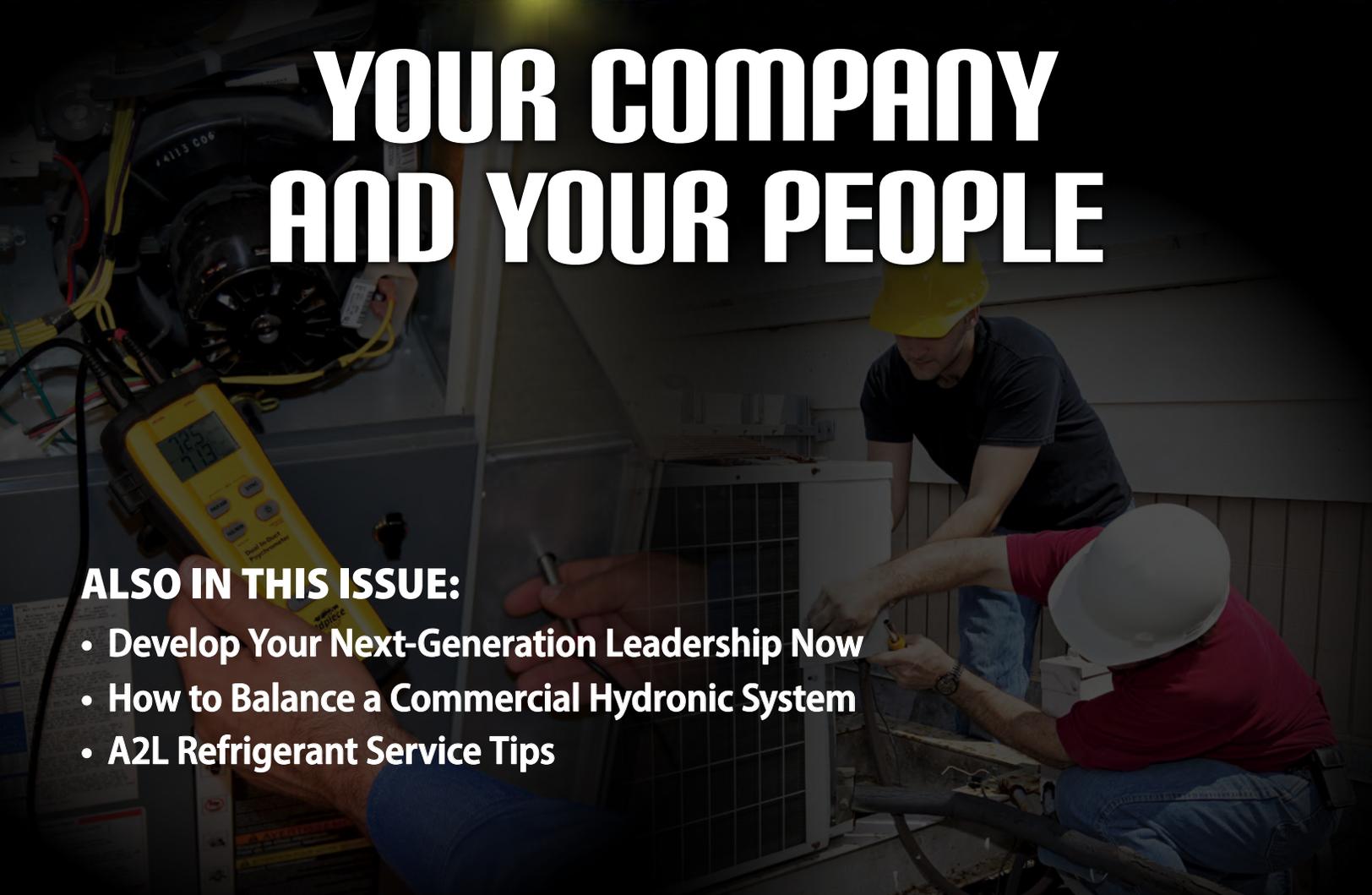
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- Develop Your Next-Generation Leadership Now
- How to Balance a Commercial Hydronic System
- A2L Refrigerant Service Tips



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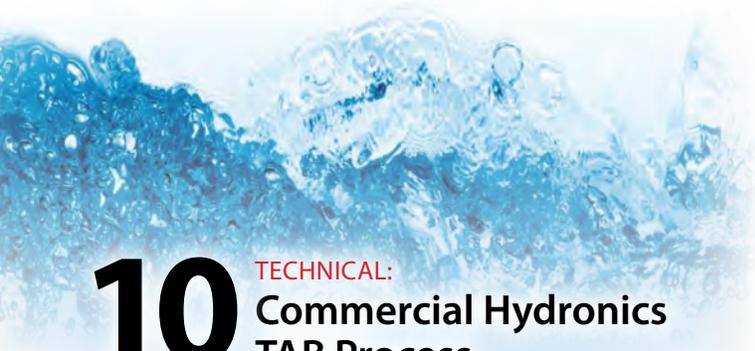
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COVER STORY:

Develop Your Next Generation Leadership Team Now!

None of us are getting younger. All High-Performance HVAC contractors should be looking at developing next-generation leadership in their firms.

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EPA Refrigerant Cylinder Ban is Banned:

What this Means to You



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

Back in 2020, Congress passed something called the AIM (American Innovation and Manufacturing) Act, which gave the EPA (Environmental Protection Agency) authority to phase down the use of HFC refrigerants in its effort to fight climate change.

The EPA then created a rule prohibiting using disposable refrigerant cylinders by 2025. They intended this rule to help battle illegal imports of HFC (usually transported in non-refillable cylinders). They also called for mandated use of QR codes to keep tabs on cylinders containing HFC refrigerants.

A coalition of HVAC Industry members that included ACCA, HARDI, PHCC, and others, along with a manufacturer of American-made refrigerant cylinders, filed suit in federal court to challenge this ruling as being harmful to the entire HVAC supply chain.

The good news is that the industry won. A U.S. Court of Appeals struck down the EPA ban because the majority of judges felt EPA overstepped its authority.

Why is this Good? If the EPA's rule had stood, HVAC contractors would have had to deal with heavier, refillable cylinders that could cause safety issues and increase costs, which would then pass on to consumers. Here's why: the HVAC Industry's standard 30-lb. refillable cylinder weighs around 21 lbs. while the most widely used non-refillable versions only weigh five pounds. Imagine carrying a 30-lb. refrigerant cylinder up ladders and around job sites.

The overturning of the ban also removes the potential need for contractors to retrofit service vehicles to accommodate the bigger, heavier cylinders.

Last but not least, there is currently only one U.S.-made cylinder manufacturer, and forcing the industry to use refillable models only would cause

significant financial hardships for that manufacturer and open the door for foreign manufacturers to dominate the American marketplace.

The HVAC organizations that sued EPA felt the agency never considered these issues. They never responded to offers by the manufacturer to redesign their non-refillable cylinders so they were wholly recyclable, prevent potential leaks, and use scannable QR codes or RFID chips to help ward off any black-market activities (which was a huge concern of the EPA).

Here's the Rub. By being non-responsive, the EPA ignored legitimate industry concerns and expertise. In my opinion, this is another example of a government entity ignoring facts and making more harmful rules than good.

The AIM Act is geared to phasing out the use of HFC refrigerants which this industry is diligently working to accommodate (see the [A2L Refrigerant Tips](#) story elsewhere in this issue).

But the EPA took it too far. Like so many actions by our federal government, rulings start with good intentions and then tend to spiral down the rabbit hole, becoming hurtful to the interests of American people and industries.

And It May Not be Over. The EPA's response to the District Court's over-turning of their ban is to say they are "reviewing the decision." They could request something called an [en banc hearing](#) at the D.C. Circuit Court or directly petition the U.S. Supreme Court to overturn the District Court's ruling.

My questions are: is this in the best interest of the HVAC Industry? Is it in the best interest of the American people?

I know our industry trade associations are and will continue to stay on top of this. So celebrate for now, but let's not take our collective eyes off the ball. 



Written by HVAC Contractors for HVAC Contractors

SAUERMANN SI-CA-130 COMBUSTION ANALYZER

I met a couple of the Sauermann representatives at a Goodman event in Texas a few years ago, and we spoke about their combustion analyzers. Though skeptical about their instrument, I figured I should try it out.

Since then, NCI trainers have taken the Si-CA 130 to combustion classes and used them in the field when time permits. The consensus is that the Si-CA 130 is an awesome addition to our tool bags.

The Si-CA 130 seems to be very robust. Its protective rubber cover protects it from those “oops” moments when the device decides to jump out of our hands. The screen is large for those who know our eyesight is degrading but refuse to get glasses. By the way, you also can

increase the display size. Did I mention it also has a color touchscreen?



The Si-CA 130 uses a rechargeable battery, so don't forget to plug it in to charge when it's not in use. Sauermann has created an app to connect via Bluetooth to the analyzer. In addition to the app, it comes with PC-based management

software. The app is excellent for measuring draft while making changes to pressure zones as it allows you to stay connected and keep an eye on those combustion and draft readings.

The analyzer probe and tubing are just as robust as the meter itself. The Si-CA 130 will display a lot of measurements, including CO, O2, and stack temperature.

Plus the custom NCI Si-CA 130 kit Sauermann built just for NCI Analysts has a built-in draft gauge and a separate draft probe so you can measure draft in the right location while simultaneously measuring CO and O2. This makes it the perfect all-in-one instrument that will be a great addition to your tool bag.

For more information, go to ncilink.com/si-CA130.

— by Casey Contreras, NCI Instructor

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Bridging the Gap Between Energy and HVAC

The early 1980s was a time of significant energy efficiency and technology change. There was an intense interest in finding renewable energy sources, including solar energy for heating.

Sure, there was nuclear power. But after the 1979 accident at Three Mile Island in the U.S., the public grew afraid of this as a source of energy. That fear solidified in the 1980s after the meltdown at the Chernobyl reactor in Russia.

Cutting down on fuel consumption became the battle cry, but no matter how efficiently manufacturers built their mechanical systems, energy costs in commercial and residential buildings continued inching upward.

THERE HAD TO BE A BETTER WAY

It was apparent there needed to be a way to better measure and manage energy use. The idea for [The Energy Conservatory \(TEC\)](#) was born in 1980 from conversations between two men interested in the latest discoveries in residential energy efficiencies.

The two men were Gary Anderson, then an auditor in St. Paul, and Gary Nelson, an engineer at the Minnesota Energy Agency. The blower door was one test instrument advance that captured their imaginations.

They wanted to design, build, and sell blower door test instruments to help builders, contractors, and researchers better understand and manage energy.

TEC started in a garage where the two partners strove to create a blower door design that would be more practical for mainstream contractors.

That meant it had to be less expensive, lighter, and easier to use. Anderson and Nelson worked to make blower door testing more friendly, accurate, and efficient. They helped develop protocols for weatherization programs to prioritize air sealing.

Their efforts paid off and helped propel advances in construction and air sealing techniques that have become mainstream elements in both new construction and retrofit applications.

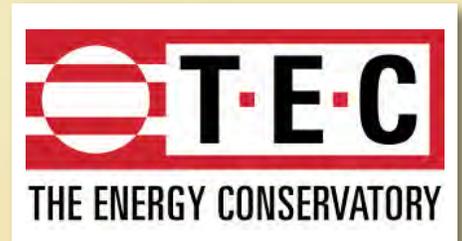
THE MOVE TO UNDERSTAND DUCT AIRFLOW LEAKAGE

Over the years, TEC developed many industry-leading products, including the first high-precision two-channel digital pressure gauge and the first automated blower door testing system.

In the late 1980s, TEC was at the forefront of research that led to the understanding that duct leakage is a big problem. The problem was not just energy waste but also pressure imbalances caused by the duct system that can result in back-drafting and indoor air quality problems. This realization led to the development of the [Minneapolis Duct Blaster®](#) system.

In the summer of 1999, the company moved into its current location in the Greenway Building in Minneapolis, MN. Here the tradition of innovation

continues with advances in performance testing equipment to measure air handler flows quickly and accurately, register and ventilation system flows, and air-tightness levels in large commercial buildings.



TEC TODAY



Steven Rogers

Today TEC employs 25 people in Minneapolis and several programmers in Madison, WI, and Houston, TX.

“The company mission set by Gary Nelson when he started was to help the industry deliver better built environments. This not only meant more energy efficiency, but also more comfortable, healthy, safe, and durable homes,” says Steve Rogers.

He adds, “Our primary customers in the U.S. are weatherization professionals and energy raters. However, we see serving the HVAC Industry as a big and growing market for us — consistent with our core mission.”

Rogers, who bought TEC from Gary Nelson in 2017, now serves as its



Gary Nelson

president. He and co-owner/business partner Bill Graber split the management between them. Steve's background is in instrumentation for process controls, and he runs the engineering side of the business. Graber is the sales and marketing leader.

"I'm fairly new to HVAC and building science," Rogers adds. "With my background, I already had cut my teeth measuring airflow and pressure. That knowledge became very useful when I came to The Energy Conservatory. I started working here in 2015 as the engineering and operations manager."

According to Rogers, the most significant change for TEC is the big push into HVAC. He attributes the beginning of that push to a conversation with TEC Marketing Director Frank Spevak a few weeks after coming to work for TEC.

"Spevak showed me all the products TEC offered, including the TrueFlow® Grid. He told me that if TEC could make this product less expensive and more intuitive, many more HVAC contractors would use them.

"I later learned what the TrueFlow was about and how many HVAC super nerds really liked the product."

TECHNOLOGY NERDS

The one thing Rogers emphasized during our conversations was the very deep knowledge of building science and blower testing that hails back to the company's beginning. He says that deep understanding came from founder Gary Nelson who, in

Roger's words, is "one of the foremost experts in measuring small pressures in the country."

He adds, "That's important because you must measure small pressures for a blower test. The company developed a product called the **TrueFlow® Grid** to do just that: measure small pressures.

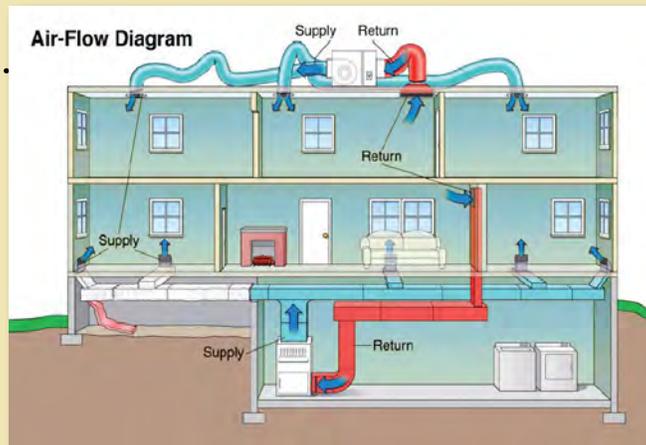
"That knowledge and knowing what instruments to use is a key part of our reputation. Technology nerds appreciate this about us. They also appreciate our reliable equipment and customer service when something doesn't go the way they want."

He also adds that in the early days, the propensity to be nerdy made TEC products intimidating to many energy raters and HVAC contractors. The company needed ways to simplify things to broaden its appeal.

TEC developed the new Digital TrueFlow grid to be easier to use – and at a lower price! They also released a free **mobile app** to work with the updated TrueFlow.

Now users can not only make better measurements, Rogers says that they also get insight into how the HVAC system is performing and potential actions that should be taken based on the measurements.

"Now, the app not only helps when you measure airflow, but it interprets the data and gives you visual ranges: green, yellow, or red flags that tell the contractor the airflow quality," he adds. "Is it too low or too high? Or is it red, and the contractor needs to fix something?"



Steve Rogers of TEC shares his desire to educate the industry. He recently teamed up with HVAC School to do a **podcast** on the importance of measuring total system airflow.

CONNECTING TO THE HVAC COMMUNITY

Rogers adds that the need to build reputation in the HVAC Industry came after product development. "We were known for being a bit too nerdy, too esoteric, and for not always focusing on the practical things," he explains.

"We need more street credibility among HVAC contractors and technicians," he says.

A key step in building a connection to the HVAC community was hiring Chris Hughes to the TEC Team, according to Rogers. Hughes began his career as an HVAC contractor, having started **Hughes Mechanical** in Louisiana many years ago. Rogers says Chris' interest eventually became focused on the building science side of things.

"Chris is passionate about learning more about how building science and HVAC work together to make the house the system. When he decided to leave the family business and join TEC, he brought the experience and knowledge we needed to truly understand the daily life of HVAC contractors and technicians.

"Chris has helped TEC connect with the HVAC community. Our goal is to help contractors do better business, win more jobs, and make it easier for them to justify the work that is needed. And that community is a key



part of delivering better built environments and to the future of TEC.”

TRAINING IS CRITICAL

In Roger’s opinion, testing and measuring are central to building science and HVAC. Teaching people how to test and measure and what tools are best for doing that is essential.

“Our product is not one where people know what they need and choose brand A or B. Our sales are largely driven by helping customers understand why they need to make these measurements. That’s where the training comes in.”

TEC has always used a ‘train-the-trainer’ approach to the marketplace. Rogers explains that the organization lacks direct contractor or energy rater training.

“We train educators,” he says. “In other words, we’ll train HVAC instructors. We will work with larger HVAC service organizations on their internal training. Sometimes, these companies may send their instructors to our train-the-trainer events, which we hold once a year.”

A PARTNERSHIP WITH PROMISE

“Our partnership with National Comfort Institute (NCI) is one of great promise,” Rogers continues. “NCI has excellent reach and recognition among HVAC companies. Again, this partnership helps TEC because we don’t have the resources to train the number of people NCI reaches.

“They have relationships with the High-Performance HVAC community, which is everything to us. We are mission-driven, but if we don’t have customers and the products to serve them best, that mission is null and void.”

He adds that TEC brings their deep knowledge of building science to the partnership table. “Let’s face it,” he adds. “It’s not a matter of ‘if,’ but of ‘when’ a contractor gets in over their head. Building science questions can get tricky and complicated. That’s when you need experts like Gary Nelson, Collin Olson, and Jake McAlpine with the deep expertise and experience to help contractors resolve building science issues.”

Rogers also says that his team has known for a long time that NCI is *the* expert group when it comes to testing, measuring, and diagnosing HVAC systems. “They are the experts on the air side of HVAC.

“Lots of organizations will train based around the refrigerant. Some may get into combustion and furnace troubleshooting. But NCI has a well-deserved reputation for really focusing on the air side, including combustion analysis,” Rogers continues.

“There’s a natural partnership between our two companies because we have the best tools for understanding the airside, and NCI has the best training. Let’s face it: Air side problems are hard to fix without measurements. Without measurements, you can’t get a complete picture of what’s happening.”

TOP ISSUES FACING THE HVAC INDUSTRY TODAY

When asked what two key issues HVAC contractors face today, Steve Rogers is emphatic.

“The biggest problems in HVAC involve duct leakage and airflow,” he says. “What’s interesting is both are understood, particularly the impact of duct leakage when it leaks outside of the building, based on research papers

written in the mid-1990s.

“But the knowledge of what that means and how that impacts the HVAC system has not spread. If you asked 100 HVAC contractors across the south, where ducts are not in conditioned space, to explain what goes wrong when ducts aren’t tight, less than half would have a good grasp. Maybe only 20 or 30% of them would.”

He also says total system airflow is a concept that is understood. The problem is that most contractors don’t know why they need to get airflow right. One reason for that, according to Rogers, is that proper measurement tools haven’t existed for very long.

“These two issues are challenges TEC has been working on for 30 years. With our NCI partnership, we can better tackle both challenges.”

FINAL THOUGHTS

Rogers says that in the end, whether you are an energy rater, home performance pro, or an HVAC contractor, the mission should focus on airflow.

“The AC part of HVAC is all about air conditioning, but so many energy raters and HVAC contractors don’t understand the air. Armed with the proper training and tools, however, they can set themselves apart from competitors by solving comfort and energy problems that nobody else can solve.

“When a consumer buys a new system with the same comfort problems as the old one, that is a huge problem. If you are a company that can solve those problems, you’ll develop a reputation, and consumers will turn to you.”

For these and other reasons, the **High-Performance HVAC Today** magazine’s team shines their spotlight on **The Energy Conservatory**. 

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A Commercial Hydronic System *TAB Process You Can Use*

When you find yourself in a position where you can't seem to achieve an air or water flow specification, that, in my opinion, is when the fun begins. You must ask yourself, "Why."

Our company excels at analytical testing to discover the reason why. Going the extra mile to find the reason for poor performance has greatly enhanced our reputation in the industry.

We follow this process at [Integrity Test & Balance, Inc.](#) As TAB (Testing, Adjusting, and Balancing) contractors, we come in after the mechanical contractor has completed his work and test the system to ensure it operates as designed.

Feel free to use this process in your business to help determine why commercial system performance isn't what it should be.

CHECKING THE SPECIFICATION REQUIREMENTS

After securing a project, we examine the specification requirements and compare them to our hydronic test and balance plans. We do this to ensure we can achieve the flow specifications.

The first step is to compose the required test and balance reports with the design documents. We gather all the design documents, including the project specification booklet, addendums, and any bulletins to date, along with a complete set of reviewed and approved equipment submittals.

The key here is to verify that the equipment submittals have the "**Reviewed and Approved**" stamp on it. This is very important. If you use equipment submittals that don't have the "Approved" stamp, you risk the possibility that the equipment was rejected, and the supplier had to "Re-Submit" per the engineer's correction notes. That means there may be changes to the equip-

ment that you need to know about.

I can't emphasize enough the need for an up-to-date set of mechanical plans. I've known of some construction management companies who will confiscate outdated project prints. If this happens, it will set you back because you must acquire the latest prints approved "FOR CONSTRUCTION." Don't ever let that happen.

PUMP TEST REPORTS

We start by composing Pump Test Reports by viewing both the hydronic equipment schedule pages and the approved pump and hydronic submittals. We list all the required design information on the pumps, including flow rate (GPM), operating head differential (DP), voltage, rated horsepower (HP), and brake horsepower (BHP). We also include design pump speed (RPM) and operating frequency (HZ) if the pump is controlled by a variable frequency drive (VFD).

We review both the hydronic equipment schedule and approved submittals to see if there are any significant discrepancies between the two. The design operating DP and the submitted operating DP should be the same. The design engineer calculates the DP, and the pump suppliers should base their pump selection on the same, along with the pump model number.

HYDRONIC LOAD TEST REPORT

Next, we review our TAB estimate and the mechanical schedule pages to determine the count for hydronic equipment and loads. We also check each hydronic load and the specified flow rate (GPM).

We then start to mark up our hydronic drawings and number each load starting with the first heating load from the supply heating main to the

last load on the system. We number each hydronic load in our Hydronic Test Report.

After tallying the entire hydronic system, we fill in each load's specified flow rate. It may get confusing with discrepancies between the flow rates listed on the mechanical schedule and those recorded in the approved equipment submittal.

If the two flow rates differ, we list the specified flow rate from the approved equipment submittals. We add a note to that hydronic load indicating which flow rate we used for clarification.

This is common when engineers specify mechanical equipment based on a particular manufacturer. When other manufacturers bid on the equipment, flow rates may differ based on providing the same required heating or cooling Btus.

Always review equipment submittals to verify the required flow rate (GPM). Now add up all the hydronic loads and the listed required flow rates to determine your "connected load."

A pump size is typically based on the required flow rate and calculated operating DP. The design pump flow rate and the "connected load" are usually nearly equal on most hydronic systems. If the pump design flow rate is less than the connected load, verify if this system is based on a diversity factor. If that is not the design intent, there is a good chance that the pump will still be able to provide the flow rate for the

connected load.

Another possibility is that the design team did not confirm the connected load before selecting the pumps. You may have to increase the pump size and flow rate.

You'll need balance valves for each hydronic load. The mechanical detail pages should illustrate such. Should you find any balance valves missing on a hydronic detail, say so in the TAB Submittal. More on that below.

TAB SUBMITTAL

Most TAB specifications require you to send a "TAB Plan" submittal to the design team for review and approval before commencing work. This submittal is your opportunity to flush out any questions or concerns.

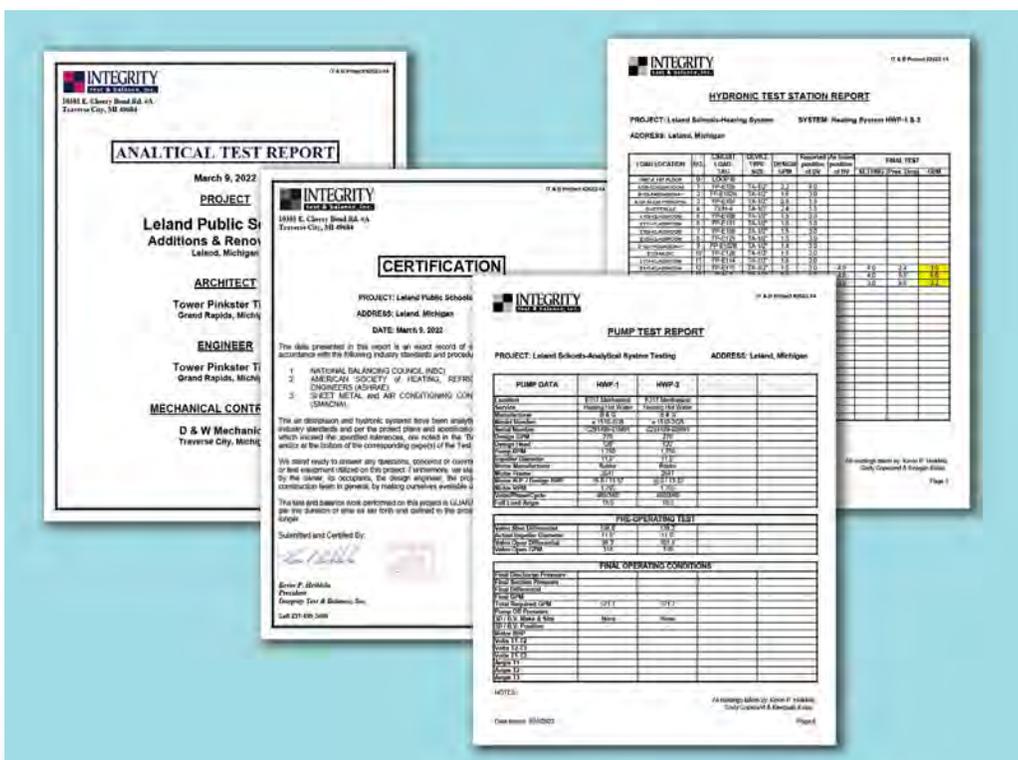
We start by being upfront with our understanding of the specified TAB work. Being upfront means listing all the systems and equipment to be

tested and balanced on the inside page of our TAB submittal. Should we be missing anything, the design team can note that correction when they review and return our submittal.

We also list in our TAB submittal any issues that would prevent us from properly testing and balancing the hydronic system. What am I talking about? Here is a list of some problems we commonly identify.

- No balance device is illustrated on the hydronic detail or the hydronic floor plan prints
- Balance valves listed on the mechanical prints may no longer be functional
- It is missing a balance device for the secondary pumped circuit that typically has two to three
- Incorrect piping layout
- Existing loads without a flow specification or a balance valve are illustrated

Sample analytical test report pages used by **Integrity Test and Balancing**. Courtesy of Kevin Heikkila



- Required “Loop Balance Valves” not illustrated on hydronic drawings for hydronic sub-loops. This is especially important for multi-level projects, major sub-loops, and phased completion schedules.

PRELIMINARY HYDRONIC TEST & BALANCE

After receiving the approved TAB Pre-Submittal, we can note any clarifications from the design team and proceed with pre-testing the main pumps.

First, we coordinate with the Temperature Control Contractor so they can make a “global command” on the DDC (direct digital control) network to toggle all the hydronic heating control valves to the fully open position.

This allows us to measure the pump’s operating DP with all valves open to determine the required flow rate (GPM). This process is commonly known as a “full call” for heating and cooling.

We record all the motor data and specifications on the pump rail tag in the field. Some of this information may vary slightly from the equipment submittals. We typically verify low-load amperage specifications for the motor in the field.

Note: Before beginning the pre-TAB



work on a hydronic system, verify the system piping is fully installed, that all mains and isolation valves are in the open position, that all control valves are toggled open, and that all the air is purged from the system.

If this is a multistory building, you must calculate a minimum primary pump suction pressure so that the upper levels do not operate with a negative suction pressure.

Operating a hydronic system in a negative pressure risks drawing in air. If automatic air bleed devices are installed in the system, they not only bleed unwanted air from the system but can also allow air into it. Ensure the system is filled properly to prevent operating at a negative suction pressure.

PRIMARY PUMP PRELIMINARY TESTING

When water balancing a hydronic system, start by testing the primary pumps. Begin by confirming whether one pump or two pumps are designed to operate.

Typically, dual pumps are for redundant backup. If a single gauge is installed to measure pump DP, we will use the bridge gauge installed at each pump. Should that gauge have too low of a pressure range and/or we think it is unreliable, we will temporarily install our own gauge to take the DP readings.

Note: Only install one gauge with ball valves to take all the pump measurements. Gauges are like snowflakes. No two are alike. For every one PSI of incorrect reading, that dictates 2.3-in. of incorrect head DP.

Also, note that bridge gauges must be installed at each pump flange on the supply and return connections. A common mistake is to find the suction

bridge gauge connection at the inlet of the suction strainer. This situation can add unwanted pressure drop and thus provide an unreliable reading.

Another common error is that we find a bridge gauge was either not specified and/or not installed. When we run into that situation, we shut the pump off, then isolate it from the system by closing the shut-off valves on the suction and discharge sides of the pump.

We then remove the plugs at the flanges and install a **Pete’s Plug** fitting at each side of the pump. We can test the pump with our digital hydronic manometer by inserting the test needles into the Pete’s Plug fittings.

Next, we perform a “Deadhead no-flow” test on each pump. We start by measuring the pump differential at “NO FLOW” by closing off the pump’s discharge valve. Doing this lets us verify the pump impeller size on the manufacturer’s pump curve.

Should the deadhead reading be slightly different than what the manufacturer’s pump curve indicates at no flow, we plot a new pump curve next to the original one and use that curve to verify the total pump flow. **NCI**

Read the rest of this article on our website at

ncilink.com/KHeikkila4

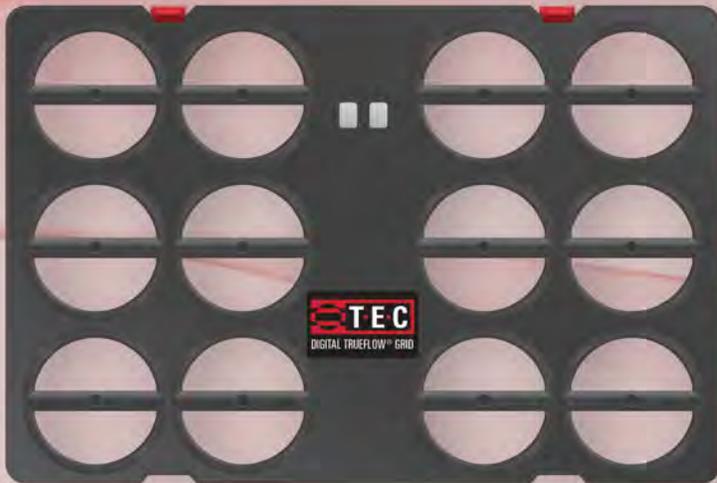


Kevin Heikkila owns Integrity Test and Balance, Inc., of Traverse City, MI. His 21-year-old company specializes in commercial system testing, adjusting, balancing, and commissioning. They conduct air and hydronic measure-

ments on HVAC systems, then adjust flows to achieve optimum performance. You can reach Kevin with any questions about this article at ncilink.com/ContactMe.



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A2L Refrigerants: *Contractor Knowledge is Power*

As of January 1, 2022, the United States officially entered the world of A2L refrigerants for residential HVAC applications with the first installation of a Daikin [ATMOSPHERA](#) ductless system, with R-32 refrigerant. I installed that new system into a home in the Orlando, Florida area.

The introduction of A2Ls will soon be the new refrigerant standard in the United States. Why? Because A2L refrigerants have an improved ozone depletion rating – Global Warming Protection (GWP) – and a better ability to offset the dangerous greenhouse effects of currently used HFC-based refrigerants.

For several years, discussions focused on A2L refrigerant's slight flammability characteristics. The key word here is "slight." The bottom line is, yes, A2Ls can ignite, but it takes a lot of effort to make them ignite. With proper training, HVAC technicians who follow existing OSHA regulations and manufacturer guidelines, can install and service A2L HVAC systems without concern.

I was a mechanical contractor in the state of Florida for seven years and recently returned to that market after working for Daikin Comfort Technologies. I was fortunate to have the



opportunity to install the very first R-32 mini-split in the United States in January 2022. I want to share what I've learned from the experience so that other HVAC professionals can know what to expect.

I'll focus primarily on R-32 because it's the current leading A2L (over 160 million systems already installed worldwide), and I have the most experience with that refrigerant. However, the service and installation procedures outlined here will apply to most A2Ls.

A2L-CERTIFIED VACUUM PUMPS

Based on my first R-32 experience, installations only require minor changes. Among those, first and foremost, you must purge refrigerant lines with nitrogen when doing retrofits.

In fact, it makes a lot of sense to flush out the system and install a new line set with any R-32 mini-split installation. If you are servicing an R-32 system, be sure any vacuum pump you use is rated for A2Ls. Most newer vacuum pumps from [Fieldpiece](#), [Appion](#), and other manufacturers are A2L certified.

This certification is no different than considering exhaust fans in combustible areas. They, too, must be certified combustion-proof, meaning they can have no motor windings or anything electrical exposed to the atmosphere.

That's the same type of rating given to vacuum pumps that are A2L certified. There is nothing in the compression or recovery machine process that would create a spark within that machine that could ignite A2L refrigerant.

A2L refrigerants aren't new – there are more than 160 million HVAC systems installed worldwide that use the A2L refrigerant R-32.

KNOWLEDGE IS POWER

LIABILITY ISSUES?

From a service standpoint, there are many questions about liability. The fact is if your technicians are trained in proper refrigerant handling and proper system charging protocols, your liabilities are no different.

As high-performance professionals, you always want to check for correct system operation. When it comes to charging systems, you always want to verify proper airflow on the return or supply side of the system. Superheat is still superheat; subcooling is still subcooling.

Every piece of A2L-charged equipment has a label highlighting the refrigerant's flammability so that consumers will know this immediately. If they have concerns, it might make sense to point out that any automobile manufactured and sold in the U.S. today uses A2L refrigerant for the air conditioning system, which is installed next to a combustion engine.

These slightly flammable refrigerants are already here. And not just in cars. A2Ls are in some residential kitchen refrigerators, so they are already in people's homes.

The stigma or fear of causing damage or harm is no different for HVAC equipment than for an appliance service professional who works on your refrigerator that uses propane. It's no different than the mechanic

who works on your vehicle equipped with A2L-based air conditioners.

The liability aspect is very low if you follow OSHA regulations when doing installations. It's very low if you follow the manufacturer-recommended guidelines. Do those things, and you limit your liability.

Different A2L refrigerants have different properties, so pay attention to the charge on the data tag and your temperature and pressure readings to be sure you charge the system correctly.

DIFFERENCES BETWEEN R-410A AND R-32

Before we talk about the differences between R-410A and the A2Ls that are slated to replace it, we need to establish that not all A2Ls are the same. Even though the A2Ls are all similar from a flammability standpoint, they're made up of different chemicals.

A2L R-32, is a non-blend refrigerant. R-410a, on the other hand, is a 50-50 blend of R-125 and R-32. In a way, technicians have already been using R-32 since the adoption of R-410A as the standard.

Other refrigerants, like R-454B, are HFO (hydrofluoroolefin) blends. R-454B is what we call a "low-glide" blend, just like R-410A. Like R-410A, you will need to charge blends like R-454B in the liquid state.

When charging A2L-based equipment with R-32, one of the significant differences will be using different enthalpy and saturation charts than those used for R-410A. But in essence, you'll be looking for the same numbers.

Other A2Ls, like R-454B, also have pretty similar discharge pressures to R-410A despite having different charts. Still, you'll want to make sure you're using the right charts and resources for the refrigerant you're working with. Don't rely on an R-410A or R-454B chart for an R-32 system because there are differences.

Another difference is due to the chemical properties where A2L-based mini-split systems will use much less R-32 than their R-410A counterparts.

For example, in an R-410a-based system, the full refrigerant charge may be four pounds, while an R-32-based system, designed to deliver the same capacity, will only use around 2.8 pounds. In other words, A2L-based systems require less refrigerant.

Furthermore, R-32 performs better than R-410A in low ambient conditions, providing better heat pump performance with greater capacity in

low ambient temperatures.

Again, different A2L refrigerants have different properties, so pay attention to the charge on the data tag as well as your temperature and pressure readings to be sure you charge the system correctly.

SERVICE CONSIDERATIONS

Other questions in the industry revolve around servicing equipment charged with A2L refrigerant. For example, I'm often asked how to check this equipment for leaks. What precautions are necessary?

If a leak exists in a room, there is little difference between most A2Ls and R-410A besides the A2Ls being slightly more flammable. The key is properly ventilating the space, which you're supposed to do, no matter what refrigerant you're working with. By following existing service protocols and procedures, you should have no problems.

Most HVAC equipment manufacturers have safety procedures they provide when it comes to charging their equipment.

What about when installers do changeouts? Again, standard procedures already exist. When changing out a compressor on an A2L unit, technicians should ensure they flush the system with nitrogen. Then they must cut the copper connections on compressors instead of un-sweating them.

The old mentality was to remove a filter dryer or a reversing valve. You'd un-sweat it and then re-sweat it back in. When a technician services the components of an A2L-based mini-split system, removing them using copper or tubing cutters is safer than using a torch to un-sweat it.

Many R-32 based mini-splits have

flared connections. There is no reason for a technician to use torches on mini-splits with these connections. The problem is that many technicians fear flaring due to minimal experience and practice.

I recommend [watching this video](#) to learn about the best practices for making ductless flares.

Many technicians get scared when they think about A2Ls, and that's because they have yet to acquire the proper knowledge and experience.

When brazing lines that may have had an A2L refrigerant in them, the technician must ensure they're brazing with nitrogen. This process is something everyone should be doing anyway, no matter what refrigerant may have been in the line.

Nitrogen helps reduce the oxide contamination that builds up inside the copper line. Nitrogen brazing has been around for a very long time. The safety aspects have always been there.

KNOWLEDGE IS POWER

Regarding A2Ls, the objective is not to scare technicians and consumers away because of its light flammability. The aim is to give them knowledge.

They need to know whether the A2L they're working with is a drop-in or replacement refrigerant. What does it mix with? What oil is compatible and not compatible with it? What service

practices are we supposed to be doing?

Again, many things have not changed: pressure testing with nitrogen, pulling a proper vacuum, and so on. Technicians should isolate with the vacuum to ensure the equipment passes decay tests without leaks. Then, they charge the system. Outside of that, everything is the same. The refrigerant hose connections are the same, and there are no counter-thread connections – these are just false rumors.

And finally, the most common question I hear is about how to carry and handle A2L refrigerants. The EPA, OSHA, and other government entities have a lot of material about how you carry and store A2L-based refrigerants, which is different from how you may have done so previously. These refrigerants require that technicians and contractors need to change their mindset.

Previously, you could leave tanks of R-410A in your trucks all day, no matter the temperature outside. However, if you do that with a tank full of A2L refrigerant, there would be severe repercussions. A2L tanks must be stored in cooler areas – like a truck's cab, a storage compartment, or a shaded area. You can't expose tanks to any elements where they will get overheated.

The Department of Transportation (DOT) has regulations about transporting A2L refrigerants. And yes, those regulations are a bit more stringent than those for R-410A. But the rules are no different than those DOT has for transporting oxygen acetylene torches, which most contractors have carried on their service trucks for decades.

Acetylene oxygen is 10 times more flammable than A2L refrigerants. Most good contractors and technicians

don't hang their torches loosely in the back of the truck. They also don't allow acetylene nor oxygen bottles to roll around.

Many technicians get scared when they think about A2Ls, and that's because they have yet to acquire the proper knowledge and experience. Proper education with a good understanding of these refrigerants' properties and how to work with them will provide technicians with the same comfort level they have today.

EDUCATION IS EVERYTHING

Anytime there is a change, fear always follows. The key to alleviating anxiety is education and certification. That's why most HVAC equipment manufacturers provide training and

certifications for people who work on their products. ESCO's eLearning network has several free and paid courses (some of which provide NATE credits) about A2L refrigerants.

Some manufacturers also have webinars and courses available through ESCO's eLearning network. You can find a list of resources below.

The secret is understanding what you're working on and knowing what limitations and safety precautions to take. The fact is, A2Ls, including R-32, will be the prominent refrigerants used in HVAC equipment in the United States by 2026, so the HVAC service industry really can't shy away from it.

RESOURCES

- The facts about R-32 and R-454B

ncilink.com/A2L-Facts

- Daikin Atmosphaera R-32 Single Zone Heating and Cooling System ncilink.com/Atmosphaera
- 32 Reasons For R-32 Website ncilink.com/32Reasons
- Daikin Training Center ncilink.com/DaikinTraining. 



Roman Baugh is a Director of Commercial HVAC for **Kalos Services**. He spent 17 years working in central Florida's mechanical and industrial trades as a senior technical support manager, HVAC service manager, project foreman, and service technician. Before his time at Daikin in 2021, he was the first technician in the U.S. to install a complete R-32-based mini-split system. He can be reached at ncilink.com/ContactMe.



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Develop Your Next-Generation Leadership Team Now

Let's face it – none of us are getting any younger. At least in the HVAC Industry, many owners and managers are either at or beyond retirement age and must prepare the next generation of leadership for their HVAC companies.

By the way – it's not just that HVAC contractors are retiring or want to. We can partially blame the leadership gap on the pandemic creating a work-from-home ideology where people leave their companies to start home-based businesses. This "movement" is called [The Great Resignation](#), where older millennials and younger Gen X people in prime positions to step into leadership roles – are leaving the HVAC workforce.

So what should you do?

We contacted several HVAC company owners to discuss how they are working to develop the next generation of leaders, where they are in that process, and why they think it's so important.

THE IDEA OF SHARED VISION

Having a shared vision is something that many consultants say is vital for a family business to continue from one generation to the next. According to Steven P. Miller of Family Enterprise Center, UNC Kenan-Flagler Business School, Chapel Hill, NC, "Lack of a shared vision for the family enterprise and weak next-generation leadership are often cited as two of the leading reasons for the failure of family firms to successfully transition from one generation of family ownership to the next."

In an article posted on the [Frontiers in Psychology](#) website, Miller says that developing next-generation leadership in a family business also requires having the right family climate (open communication and shared values).



Jim Brown, of the Jim Brown Company in Mountain Home, AR, is a second-generation owner who has set the stage for his son to take over the business.

"For me," he says, "our customer base best describes the shared vision. If we are meeting their needs and are servicing their homes well with sound financial practices, the business has a strong chance of moving forward with the next generation.

"This means everyone has to be strong listeners and open communicators."

Brown adds that leadership starts with loyalty. He says that if a person doesn't want to be involved in the long haul, they aren't a qualified candidate for leadership. In his opinion, leaders need to understand the tasks necessary for success, need to perform those tasks, and need to have a desire to go beyond them.

"I am talking about work ethic here," he adds. "If they don't have that, they won't have anything else. Oh, and by the way – none of these attributes are academically teachable. They can be learned by example. The saying that *there is no external solution for an internal problem* is true in all segments of life. You foster leadership by having a friendly environment with people willing to help one another."



Rob Basnett, the owner of Basnett Plumbing and Heating, Littleton, MA, says he is just starting to prepare for the next generation of leaders in his company.

"We have succession meetings to discuss each other's goals,



plans, and vision. It is a work in progress that we tweak yearly. We're working on a vision for the next 5-10 years," Basnett says.

"For me, I want our leaders to treat people with respect. I want them to foster encouragement, always to be positive and confident, and to know how to make decisions no matter the situation."

He says he tries to teach this by leading by example and being present and available.

"Not everyone is built to be a leader," he continues. "There are leaders and followers. For those I see with potential, I'll guide them, encourage them, and point out ways to improve their leadership."

"For those who don't have leadership potential, I try to help them see other attributes to strive for. Everyone has strengths; they just may be in a different area. It is our job to figure that out and encourage, guide, and coach."

TRANSFORMATIONAL LEADERSHIP

In an article posted on the [HRCO Learning Center](#) website, author David Meginley writes about how

tomorrow's leaders need to learn to navigate challenges and keep their companies moving forward. He defines this forward momentum as "transformational leadership" and says such people help members of their teams, company, and communities reimagine a better future.



At **GV's Heating and Cooling, Inc. of Glenview, IL, owner Greg Vickers** is a strong proponent of re-imagining the future. Though they do not

have a formalized leadership model, he says he has some younger team members, including his daughter, who are forward thinkers with solid work ethics and positive attitudes, and want to be his company's next-generation leadership team.

"From the beginning, when my wife and I started our company in 1990, we focused on creating a culture of honesty, accountability, and putting other team members first," he says. "We developed an onboarding process to show prospective team members and staff what the company's culture is, our expectations, and how we must

focus on exceeding all of our customer's expectations."

Then he says by leading by example and practicing servant leadership; he hopes to get potential leader candidates to think outside the box and to visualize a better future.

"We are and have been nurturing future leaders with our vision and their vision for the company and their role in moving the company and themselves forward. Leadership development is an ever-evolving process. We also have conversations about how nothing is guaranteed, but positive things happen through hard work, dedication, and giving 100% every day," he adds.

Vickers' comment ties in with what Meginley says about transitional leadership. Meginley writes, "To transform your workforce, the next generation of leaders should be authentic, open, compassionate, curious, and inclusive."

THE IMPORTANCE OF A SERVANT LEADER MINDSET

Meginley's transitional leadership segues nicely with what is known as a servant-leader mindset. When Jim Ball owned his own HVAC company,



he focused on putting the needs and desires of others ahead of his own. In an article, he wrote for this publication, [How Servant Leadership Made My Company Better](#), Ball said that servant leadership is not about hoping to become a better leader whose reward is meeting all their financial needs.

“A true servant would never perform their acts of service with the end motivation of leading others,” Ball says.

For Rob Basnett, this approach is, by nature, who he is. “I’ve never really looked at myself as a leader. I treat people like we are all equal teammates. My inclination is to give our employees the option to be part of something and contribute their thoughts and ideas. This approach invigorates them and me, especially when their ideas get implemented.”

According to Greg Vickers, GV’s entire approach to High-Performance HVAC contracting is through servant leadership.

“Servant Leadership is on top of

our whiteboard at every meeting. We stress that not only are we in the service industry and serving others is a privilege, but this is the only way to become the best leaders possible. Again putting others before self.”

TRAINING TOMORROW’S LEADERS

When training the next generation of leaders for your business, Meginley writes that current company leaders need to foster active learning, which he defines as providing education that doesn’t only depend on passive listening. He says, “Active learning experiences help learners arrive at the conclusion themselves.”

For Jim Brown, this is how his father taught him and how he taught his son.

“My father taught me the basics of running a successful HVAC business and allowed me to learn the rest independently. My successor is my son, and I used the same approach with him. From my perspective, the

ingredient that must be common between teacher and student is the ability to understand that the mission is to service the needs of others in the most economical way possible.

“The method for doing that is never the same for any two people. And by the way, the generation gap is real, and something that worked 10 years ago may not work today. So the transition from the existing to the next generation of leadership is a moving target. You have to adapt and be open to new ideas. Isn’t that what any leader should do?”

Brown adds that some training does have to come from the outside. Basnett agrees and says he has used leadership training offered by [BDR](#). He also says that you must be available to coach, guide, and encourage those team members you want to consider for future leadership roles.

Greg Vickers, on the other hand, has not developed or used formalized leadership training yet. He does recommend books for candidates to read,

Ted Talks, and other Internet-based resources. “We have been working on this for a year and are still in the infant stage. But we have seen solid growth from the employees we groom as tomorrow’s leaders.”

IT DOESN'T HAPPEN QUICKLY

Creating the next generation of leaders for your company takes time. A lot of it. That is why many consultants and family business gurus strongly urge business owners to begin looking for their replacements sooner rather than later.

Jim Brown says that developing future leaders is a two-part transaction: an offer and an acceptance.

“If my son didn’t accept my offer (at first, he didn’t and left the company

to become a state trooper), then I had only two choices: to continue in my capacity or try to find another candidate and start over.

“Luckily, in my case, my son returned to the business and committed his energy to help us grow. The rest, as they say, is history.”

Then the transition from parent to child has to take place, which can be very tricky. In Brown’s case, that transition is now complete.

“My son runs the company’s affairs, and I am the bookkeeper and CFO. He often asks for my opinion, and I am happy to provide it.

“But two people cannot steer one vehicle, and I had to learn to let go. I had to back away and let my son solve his own problems. That was a great

learning process for me.”

Greg Vickers adds that the smart thing to do is to identify future leaders as early as the hiring process and nurture them with experience.

“Then lead by example. Watch to see who drinks the Kool-aid. If they have leadership potential, send them to leadership training. Ask them who they admire as a leader and research that person or persons and how they got to where they are.”

“Don’t forget to ask questions,” Rob Basnett concludes. “Find out their interests and desires. See if they are passionate about them. There must be some passion. Then help them set personal goals. You now have the basis for planning for your business’ next generation of leaders.” 

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For those of you who missed Summit 2023 in Branson, MO, you can watch session recordings along with your entire team. Just go to ncilink.com/Summit23Vids and get yourself set up to watch these highly educational sessions. Be sure to check out

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Four Tips to Keep Your Business on Track



Dominick Guarino is publisher of *High-Performance HVAC Today* magazine and President & CEO of National Comfort Institute, Inc. He can be reached at ncilink.com/ContactMe

According to the U.S. Department of Energy (DOE), 20% of HVAC contracting businesses fail every year, and only 30% of startups reportedly make it past the first year.

There are several common business killers that are relatively easy to remedy. You could fix most of them within 30 days. Focus on the following four key areas and your odds of success will increase exponentially:

1. CREATE A BUSINESS PLAN, AND UPDATE IT REGULARLY

Whether it's your first or 20th year in business, a business plan is a must for so many reasons, including the ability to borrow money when needed. A business plan however, is more than projections on a spreadsheet. While numbers are important, your plan must be a map to where you want your business to go, as opposed to just "winging it."

One of the most important elements of a good plan is your strategy. In other words, what is your unique proposition in a sea of sameness among your competition? A high-performance approach is one such strategy. Figure yours out and let other goals and priorities follow.

2. IMPLEMENT GOOD FINANCIAL AND BANKING PRACTICES

One of the biggest mistakes I've seen contractors make over the years is not setting up bank accounts for different functions. For example, it's critical you set up a separate payroll account.

Many companies fail because they don't set aside payroll taxes, and when they're due, they don't have the money to pay them. Don't fall into this trap – it's a business killer!

Even if your payroll provider automatically withdraws your weekly payroll, it's important to

set up automatic transfers from your operating account to a separate account from which payroll withdrawals are made.

3. PRICE YOUR WORK PROFITABLY

One of the biggest issues plaguing our industry for decades is not understanding the difference between markup and margin. This subject is covered in many great articles and books. The bottom line is that markup is misleading, and it's not a good way to achieve the profits you expect.

Another common mistake is using the same margin when estimating labor versus materials cost. Your labor should be calculated at higher gross margins than materials.

You can always buy more product to meet demand, but labor is your most precious asset, and it's not very easy to get more of quickly. It requires an investment in hiring and training people. As a high-performance contractor who sells more labor-intensive system renovations, those jobs should be priced at 70% gross profit margins.

4. BUILD A STRONG MAINTENANCE AGREEMENT BASE

Maintenance agreements are the life blood of a profitable HVAC business. They create recurring revenues, and the work can be done during your low-demand seasons. These agreements also provide leads year after year. When a customer's equipment is ready for replacement, you will likely get that work.

In addition, companies with thousands of maintenance agreements are worth many more multiples of net profit, and will sell for top dollar.

If you are not already doing all of the above, I hope you start implementing these things within the next 30 days – it will mean a big difference for your company in 2023 and beyond! 



Cutting-Edge Training

From The Industry Leader In High-Performance Contracting™

Think you know airflow? Think you know carbon monoxide safety? Think you know how to solve your customer's comfort issues? Be sure. Don't guess. Find the training and expertise you need from the National Comfort Institute (NCI). Only at NCI will you find certification courses like Duct System Optimization and Combustion and Carbon Monoxide Safety, taught by leaders and innovators in the HVAC industry. Find out why NCI says, "If You Don't Measure, You're Just Guessing!"™ Visit the link below or call **800-633-7058** to find classes near you.

UPCOMING NCI TRAINING SCHEDULE

PUBLIC LIVE TRAINING

Airflow Testing and Diagnostics

August 29: West Allis, WI
August 30: Kimberly, WI

Combustion Performance and Carbon Monoxide Safety Certification Program

August 29-31: Glen Burnie, MD
September 6-8: Sheffield Lake, OH
September 6-8: Lansing, MI
September 6-8: Centennial, CO
September 12-14: Kimberly, WI

Residential HVAC System Performance and Air Balancing Certification Bundle

September 6-8: Fenton, MO

Commercial Air Balancing Certification Program

September 12-14: Sacramento, CA

Duct System Optimization and Air Balancing Certification Program

September 12-14: Portland, OR

*NCI training sponsored/subsidized by Southern California Edison (SCE) for qualified local contractors.

**NCI training sponsored by TECH Clean California for qualified local contractors.

PUBLIC ONLINE LIVE TRAINING

Residential Air-Side Recertification - ONLINE LIVE

July 11-12

Combustion Performance and Carbon Monoxide Safety Recertification Program

August 15-16

Test and Certify Ventilation Systems and Economizers Certification Program - ONLINE LIVE

August 23-24: *Part 1*

August 30-31: *Part 2*

Airflow Testing and Diagnostics - ONLINE LIVE

September 6-7

*SCE SPONSORED LIVE TRAINING

Commercial System Performance Certification Program

July 11- 12: Anaheim, CA

Test and Certify Ventilation Systems and Economizers Certification Program

July 25-26: Anaheim, CA

Residential HVAC System Performance and Air Balancing Certification Bundle

August 15-17: Anaheim, CA

*SCE SPONSORED LIVE TRAINING (cont.)

High-Performance HVAC Design and Redesign

August 22-24: Anaheim, CA

Hydronic Testing, Adjusting, and Balancing

September 6-7: Anaheim, CA

Airflow Testing and Diagnostics

September 12: Anaheim, CA

Airflow Testing and Diagnostics Implementation Workshop

September 13-14: Anaheim, CA

**TECH CLEAN

CALIFORNIA TRAINING ncilink.com/TECHCleanCA

Airflow Testing and Diagnostics

July 27: Anaheim, CA

August 29: Fresno, CA

August 31: Sacramento, CA



Visit NCIlink.com/ClassSchedule to view the latest schedule.

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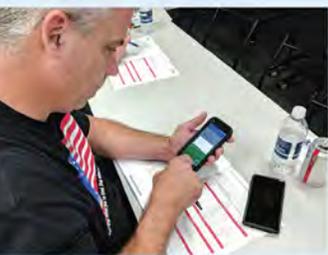
For Onsites Between June 1st and August 15th



Book your training today for any time between June 1st and August 15th, and save thousands off our regular rates (Members save even more!)

Here are just a few reasons onsite training is an incredible value:

- The schedule and content can be customized to meet your specific training needs
- One affordable price to train, certify, and/or recertify your entire team
- Your team gets more one-on-one time with the instructor
- Bonus evening sessions with our instructors at no additional cost!
- We can train all areas of your company, so everyone is on the same page
- You have **NO TRAVEL EXPENSES** because we come to you. We train in your facilities. This means so much less downtime for your team.
- You can earn NATE, BPI, and even State CEUs (where applicable)
- You can recover your investment in weeks by implementing what you learn right away.



SO WHY WAIT?

Onsite training slots fill up fast – especially with this special summer offer. Bring NCI certification training to your technicians and keep your company on the cutting edge of High-Performance HVAC. Lock in your discounted summer training dates today. The NCI Summer Onsite schedule is filling up fast!



Contact Nick Guarino at 800 633-7058 or email NickG@ncihvac.com to lock in your dates!