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See [pg. BSE1](#)



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**FEATURES:**

**14 VRF, DOAS Give Boost to High-Performance Buildings**

Heightened awareness of IEQ is driving demand for better-performing ventilation systems. Market incentives, a sustainability mindset, and government regulation also are steering building owners to more energy-efficient HVAC solutions.

*By Kevin Miskewicz*

**20 Specifying Protective Coil Coatings for HVAC Equipment**

Not just for residential work, time-saving, do-it-yourself coatings today have been re-packaged to let contractors on light commercial and industrial projects coat coils in their shop or onsite before installation.

*By Bob Martinelli*

**BOILER SYSTEMS ENGINEERING:**

**BSE1 ABMA Focuses on Educating Boiler End-Users**

Emphasizing outreach, group launches new podcast series, installation guide for members.

*By Scott Lynch*

**BSE5 Endless Learning Potential**

County school system finds hybrid water heaters can ensure a reliable supply of hot water, reduce operating costs and provide long-lasting dependability.

*By Rinnai America Corp., a Case Study*

**BSE14 Remembering Lochinvar's William Vallett Sr.**

The energy efficiency pioneer left us in May, but his legacy lives on for the water-heating industry..

*By Kelly Faloan*

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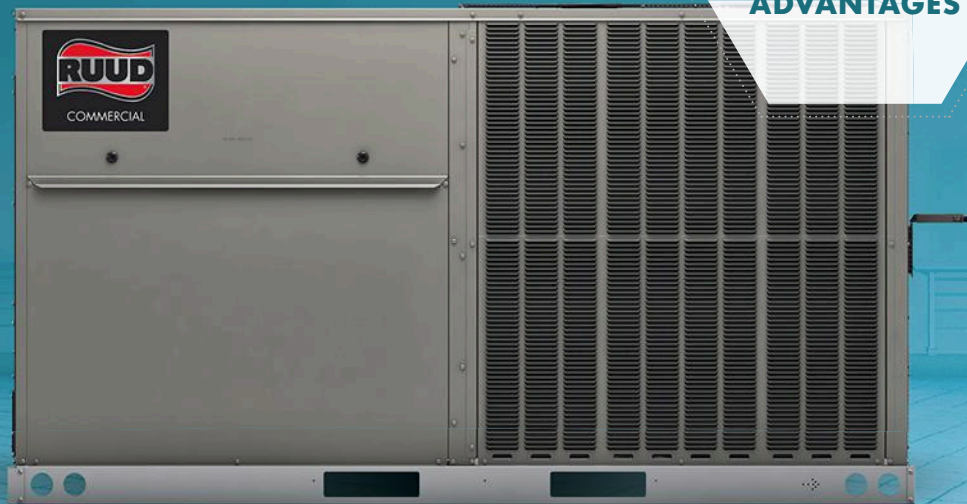
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## Inventing a New Golden Age

Some of us may believe that history's best inventions are all behind us. After all, in the 20th Century, alone, humans created the automobile, airplane, computer, and cell phones. We cured myriad diseases, and even mastered interior climate control.

But one need not look far to see that this century is already gaining creative momentum, even if we don't always appreciate how ubiquitous the constant advances are. A year ago, for instance, I remember noticing on my morning commute that 22 out of the 25 passengers on my train car were using iPhones. Now, a sizable portion each day are using those same devices to show the conductors their mobile ticket apps.

In my office, a motion detector turns on the light when I enter in the morning, and my work laptop calls my cell phone to make sure that it is me when I log on to start the day. Pretty incredible, when you think about it. But most of us don't, most of the time.

Which is why we really should take a moment to thank our industry's true movers and shakers, the innovators who for whatever reason have seen opportunity in changing the status quo.

One such pioneer is the late **Bill Vallett Sr.**, who responded to the Middle East oil crises of the 1970s by leading Lochinvar Corp. to develop our industry's first energy-efficient commercial water heater. Having passed away earlier this year, Vallett is remembered fondly in this issue for both inspiring and mentoring his employees to separate themselves from the competition. (See p. BSE 14.)

Toward that end, this issue also features another family driving change, the Goswamis of San Francisco. Derived simply from

a father's desire to help his asthmatic son breathe more easily, their patented 'Molekule' PECO air purifier uses filter media with a nanoparticle coating that acts to destroy airborne pollutants when light-activated. Traditional indoor air filters strain and collect the pollutants, so the Molekule aims to improve on that status quo.

So far, the residential market has responded eagerly. According to our sustainability columnist **Larry Clark**, the Goswamis cannot keep their product in stock. Even so, the family still has plans to develop a commercial version of its filter as soon as they can catch their breath. (See p. 6)

Last month, Clark also showcased more of that entrepreneurial spirit when he told us about the EcoSnap-AC Heat Pump System, developed by the National Renewable Energy Laboratory (NREL). Aiming to eliminate the familiar "window-rattler" air conditioning units, its concept is simple: to be able to easily and economically install a high-

efficiency mini-split heat pump without cutting a large opening in a wall. It, too, will likely spawn commercial applications, so stay tuned. (To read the article, visit our website and search: **Clark's Remarks**.)

In 2016, Eco-Snap made *R&D Magazine's* list of the 100 best research and development innovations of the year, a list that publication has been compiling for more than 50 years.

Think about that.

That means that this century alone has seen nearly 2,000 inventions, culled from who knows how many candidates, gathered by just one media source. So, the golden age of creativity never really ended. We just have to lift our heads from our phones long enough to appreciate the changes all around.

*Let's take a moment to thank our industry's true movers and shakers, the innovators who are never satisfied with the status quo.*





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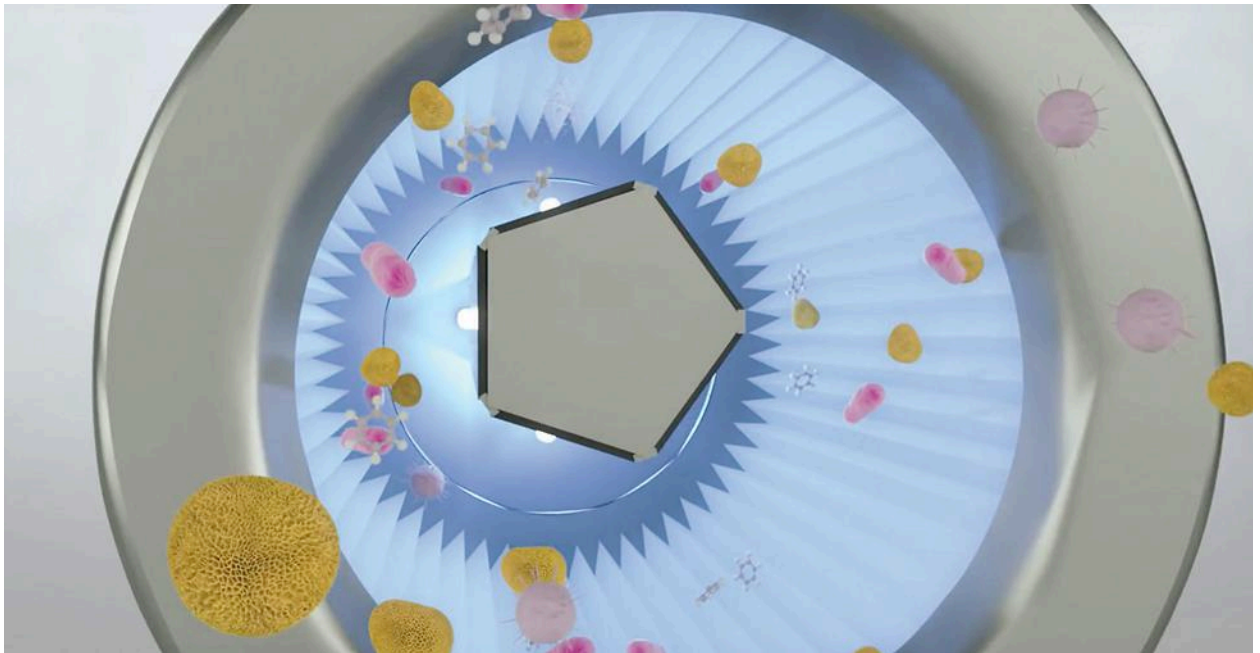
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## Breathing Easier: New Air Purifier Turning Heads

*Claiming to surpass HEPA filters, the 'Molekule' PECO purifier uses filter media with a nanoparticle coating that, when light-activated, reacts to destroy all airborne pollutants.*



*The PECO purifier uses filter media with a nanoparticle coating that, when light activated, reacts to break down airborne pollutants.*

One of the first things I learned after starting to write this column in 2013 was that the research took significantly more time than did the putting of pencil to paper (or, more accurately, typing keystrokes on the computer). It's also, for me, more fun, since I always learn something new. Unfortunately, that research does not often involve direct conversation with leaders in our industry. Such was not the case this month.

Following up on a lead from HPAC's **Rob McManamy**, who had heard a radio promo for Molekule Inc., I had the opportunity two weeks ago to speak with firm CEO **Dilip Goswami**. Based in San Francisco, the manufacturer of indoor air purifiers — with a research and development component in Tampa, FL — was started by Dilip, his sis-

The idea sprung from an acclaimed researcher's desire to help his asthmatic son to breathe better, and his dissatisfaction with existing air purifiers.

ter **Jaya**, and their father, **Yogi Goswami**, PhD. The elder Dr. Goswami, a leader in solar technology research (he's currently Distinguished Professor and Director of the Clean Energy Research Center at the University of South

Florida) began researching indoor air purification solutions when Dilip, then a child, suffered from serious allergies and asthma and Dr. Goswami was not satisfied with the air purifiers then commercially available.

Fast forward to 2016, when Molekule launched their "molecular" air purifier, utilizing the photo electrochemical oxidation (PECO) technology that Dr. Goswami had been using in the development of solar water purification. The PECO purifier, unlike conventional HEPA filters, uses filter media with a nanoparticle coating that, when light activated, reacts to break down airborne pollutants.

*A regular contributor to HPAC Engineering and a member of its editorial advisory board, the author is a principal at Sustainable Performance Solutions LLC, a south Florida-based engineering firm focusing on energy and sustainability.*

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## CLARK'S REMARKS



*Even as residential demand repeatedly sells out, the company is planning commercial applications.*



*CEO Dilip Goswami*

According to Dilip, their air purifier will destroy particles as small as  $0.00001\mu\text{m}$  vs. the typical  $0.3\mu\text{m}$  capability of HEPA filters or  $0.12\mu\text{m}$  of ULPA filters. Although their current product offering is limited to a residential unit, which has a pre-filter for larger particles and is both quiet and energy efficient (they can be purchased online at their website), much of our discussion was on their

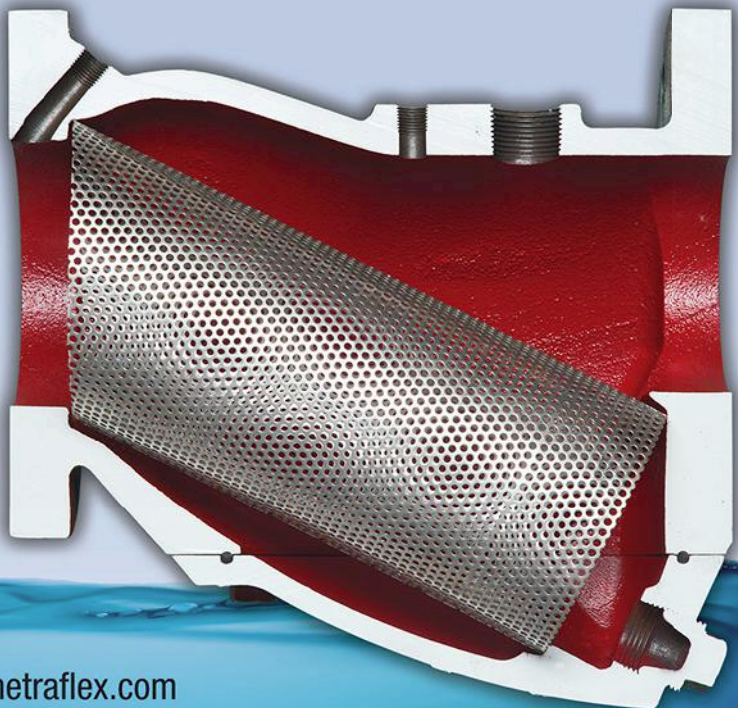
future ability to scale-up for commercial applications. Incidentally, according to Dilip, they have sold out their residential air purifier production seven times since they began shipping product in early 2017!

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Because their patented PECO technology is relatively simple in concept, they do not anticipate any major hurdles to developing filters for commercial applications. A filter wall in an AHU could, for example, be coated with their light-activated catalyst. Or, for smaller systems, an inline filter could be duct-mounted. Since indoor air quality is one of my primary professional interests, particularly in critical environments such as clean rooms and hospital operating rooms, we specifically discussed the potential for PECO filtration in those applications, and he agreed to let me know when they start doing Beta testing for those end uses. It might make for a good follow-up article.

It doesn't seem to get any newer than this! [HPAC](#)



The On-Off switch in the center of the top of the tower provides a readout of room climate conditions.

## Water filter optimizes heat transfer efficiency

### PROBLEM:

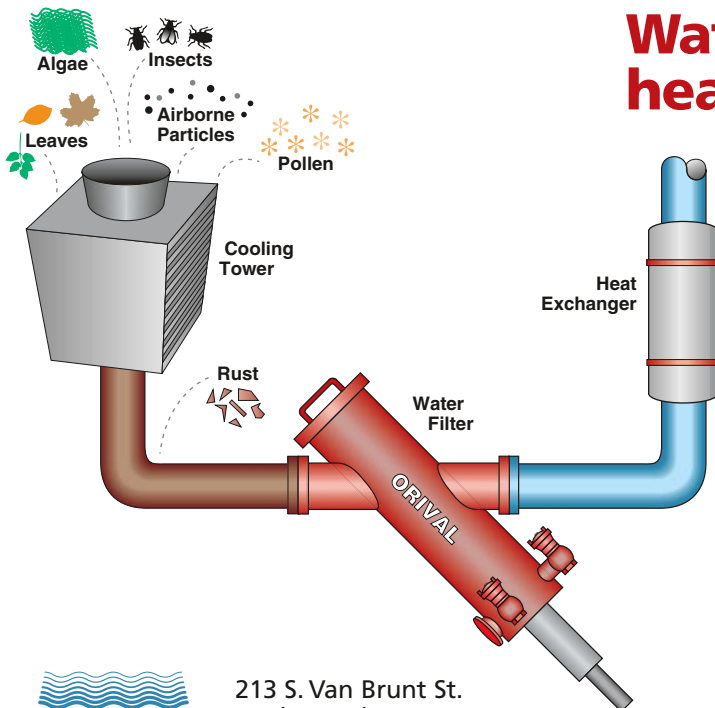
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BY LARRY FELKER, BELIMO AMERICAS, RENO, NV

## What Is So Dangerous About Smoke in Building Fires?

*Everyone knows smoke inhalation can cause death, but the long-term effects on survivors can also be devastating and physically irreversible.*

Smoke kills—that is well-known. Far less understood is the reason why. We know we cannot inhale smoke because of its noxious effects. We know it smells bad, but that is about it.

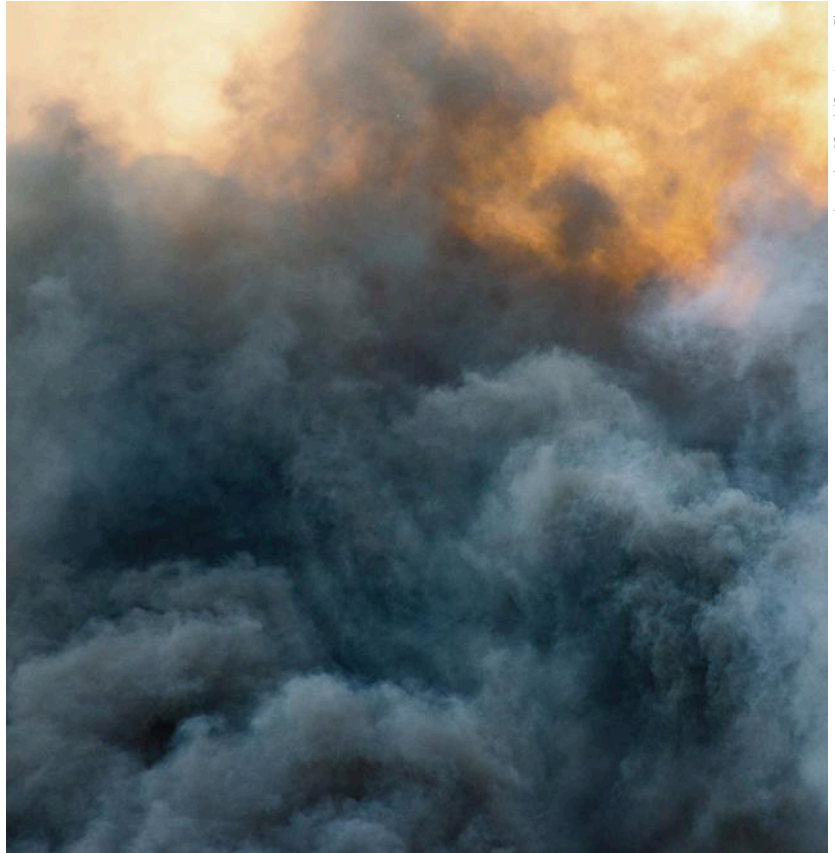
In addition to being chemically toxic, hot smoke can be damaging to the skin, eyes, and lungs and lead to disablement. Further, it can obscure vision, hindering escape. Explosion or flashover can occur if the concentration of smoke particles is sufficient and the particles have been heated to their ignition temperature.

### Composition of Smoke

When a building and its contents start to combust—smolder or flame—smoke is generated. Typically, this smoke is composed of a large number of various molecules and particles that form an aerosol. All common fuel sources from building structure to furnishings contain carbon and hydrogen, while most modern materials (plastics and polymers) also contain sulfur and nitrogen. Recycled materials can contain other potentially harmful compounds. The nitrogen and sulfur compounds produced in a fire are highly toxic. Among the products of combustion are hydro-

gen sulfide, sulfur dioxide, hydrogen chloride, ammonia, and various organic products. Black

soot forms from incompletely burned carbon. More than a hundred known toxins are generated.<sup>1,2</sup>



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*Mixed with toxic burning chemicals, hot smoke can be damaging to the skin, eyes, and lungs and lead to disablement.*

### CO and HCN

In a typical non-hazardous-occupancy fire, carbon monoxide (CO) and hydrogen cyanide (HCN) are the two most dangerous compounds.<sup>3,4,5</sup>

The mechanisms of action of CO and HCN are different. CO attaches very tightly to the hemoglobin in blood and prevents oxygen from being delivered and carbon dioxide (CO<sub>2</sub>) from being removed. The result is asphyxiation. HCN acts on the mitochondria of cells, particularly in the nervous system.<sup>6</sup> Its mechanism of action is more complex, but essentially stops the

production of adenosine triphosphate (ATP), the biochemical that drives functioning of almost all of the processes in a cell. With the recycling of ATP 10 times a second, HCN is more destructive than CO because it acts almost immediately and shuts down cell functions.

At high temperatures, CO<sub>2</sub> commonly is produced. At low temperatures, incomplete combustion occurs, and CO is produced instead. HCN is produced at higher rates at lower temperatures.

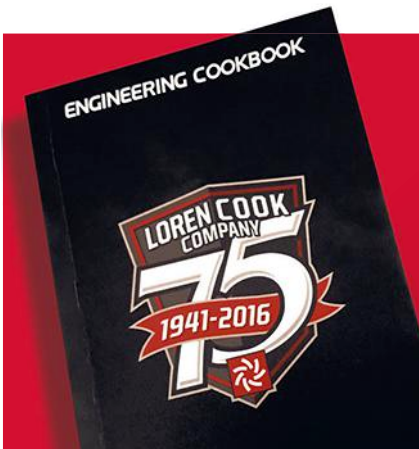
During the early stages of combustion, as fire spreads, CO and





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HCN production begins. Oxidation of HCN leads to formation of other toxic compounds and more CO. Where present, sprinklers limit 88 percent of fires until firefighters arrive.<sup>7</sup> When water cools a fire, formation of HCN is promoted. In a like manner, restricting oxygen promotes formation of CO instead of CO<sub>2</sub>. The best practice is to completely extinguish a fire and douse the embers,<sup>8</sup> but this takes time.

## Long-Term Effects of Smoke Inhalation

Less well-known than the immediate dangers of smoke are the effects of long-term exposure. CO attaches to other molecules, particularly myoglobin and mitochondrial cytochrome oxidase. This leads to significant damage to the heart and nervous system. Cyanide kills brain cells by reducing their energy-production capability.<sup>9,10</sup> The heart attacks of many firefighters are suspected to be caused by cyanide poisoning.<sup>11</sup> The higher the concentration of cyanide, the quicker the death.

Among the mid- to long-term symptoms of smoke inhalation are hoarseness (vocal-cord damage), coughing, breathlessness, worsening of asthma symptoms, and impairment of pulmonary function.<sup>12,13,14,15</sup> The most exhaustive reference on the subject is a study on health impacts on 9/11 responders.<sup>16</sup> Smoke can cause or contribute to the formation of cancer, autoimmune diseases, sleep apnea, and sarcoidosis.

## Summary

Smoke from building and furnishing fires contains more than 100 toxins, with CO and HCN the most dangerous in general. While the immediate effects of smoke inhalation can be death or permanent damage, the long-term effects also are serious. Efforts to control

smoke protect the long-term health of occupants and firefighters alike.

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*A specialist in fire and smoke dampers and actuators, Larry Felker is manager of fire and smoke products for Belimo Americas and vice chair of Air Movement and Control Association International's Fire and Smoke Damper Task Force. He is a member of the International Code Council, the National Fire Protection Association, and the Society of Fire Protection Engineers and a life member of ASHRAE. He is co-author of the book "Dampers and Airflow Control," published by ASHRAE Special Publications in 2010.*



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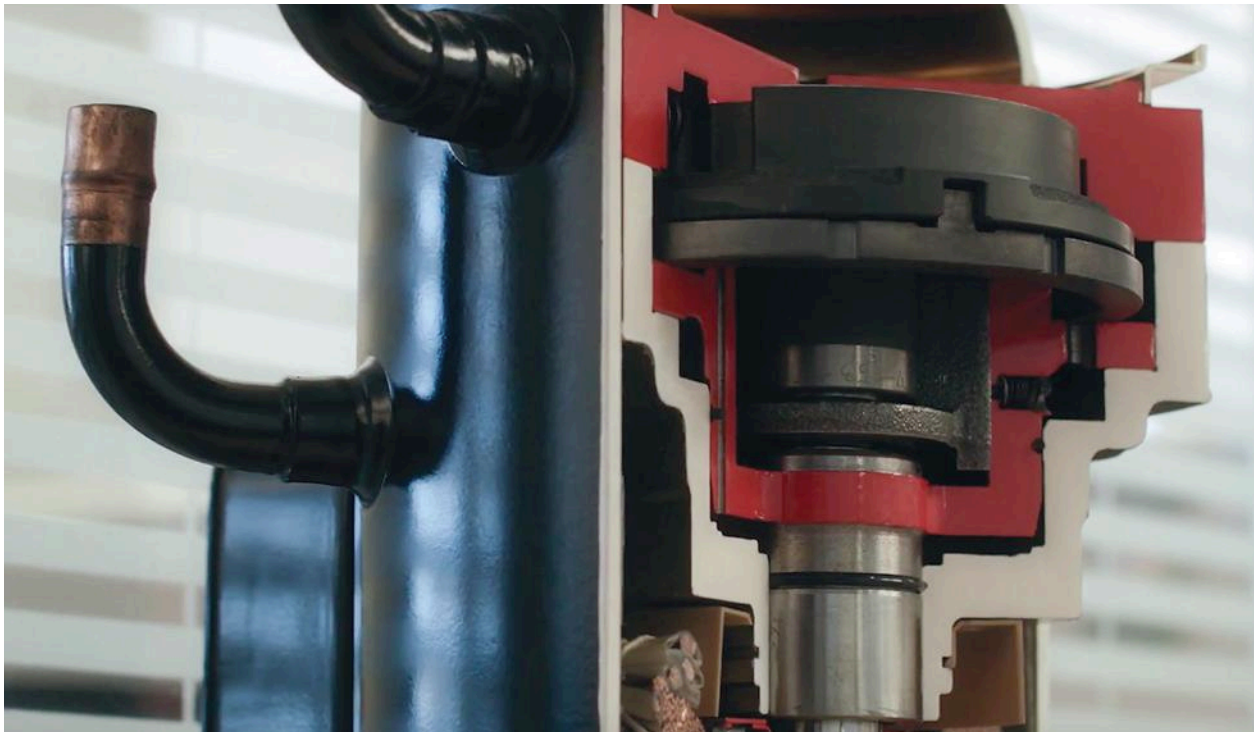
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# VRF, DOAS Give Boost to High-Performance Buildings

*Heightened awareness of IEQ is driving demand for better-performing ventilation systems. Market incentives, a sustainability mindset, and government regulation also are steering building owners to more energy-efficient HVAC solutions.*



*The INVERTER-driven design uses only one refrigeration circuit regardless of tonnage, but can deliver room neutral air to a wide range of conditions.*

By KEVIN MISKEWICZ  
Mitsubishi Electric Trane HVAC US LLC  
Atlanta GA

**T**oday's tech-savvy building owners — and occupants — are demanding more from their HVAC systems. Interest in more sophisticated ventilation systems is driven by some of the same

trends that motivate the AEC community to adopt Variable Refrigerant Flow (VRF) technology for a more efficient, intelligent approach to cooling and heating.

An increased awareness of indoor environmental quality (IEQ) is one of several trends driving demand for better-performing ventilation systems. Building occupants have a greater awareness of the importance

of IEQ and how it can be affected by climate and population density.

Energy efficiency is also more relevant than ever. Market-based incentives, a sustainability mindset and government regulation are leading building owners to look for energy-efficient HVAC solutions.

Additionally, more efficient and sophisticated cooling, heating and ventilation systems are needed as ar-

*Based in Atlanta, the author joined Mitsubishi Electric in 2014, and has led its U.S. marketing efforts for cooling and heating in the commercial segment since 2016.*

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chitects design high-performance buildings to satisfy the requirements associated with LEED, Green Globes, Passive House, zero-net energy, deep-energy retrofits and other sustainability programs. High-performance buildings also require tighter envelopes, making sophisticated mechanical ventilation even more critical for occupant well-being. Furthermore, regulatory requirements like AHRI Standard 920 are forcing efficiency into the ventilation market segment of HVAC.

**Where does VRF come in?**

VRF technology addresses many of these needs. Designed to provide energy-efficient comfort control for a building’s occupants according to the conditioning needs of a building’s zones, a VRF system moves conditioned refrigerant directly to each indoor unit instead of moving conditioned air through ductwork (or conditioned fluid through hydronic piping). The outdoor unit works in tandem with integrated controls and sensors that measure cooling and heating loads for each zone, and its compressor seamlessly adjusts speed to maintain the zone’s set point. VRF systems minimize the energy-intensive



**DOAS and VRF:**

Applying Systems for High-Performance Buildings

White Paper  
June 2018



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process of turning a compressor on and off to meet loads, which are subject to change throughout the day.

A complete, high-performance HVAC solution will also offer greater design flexibility. As a function of its sophisticated design, VRF systems are relatively compact, giving architects and building owners a range of installation options that maximize usable space within a building. Because the equipment is more compact than traditional HVAC systems, architects and building owners may design around an aesthetic vision without impacting the designs of engineers responsible for ensuring optimal performance of mechanical systems. Design freedom is also supported by whisper-quiet operation. VRF indoor units run at sound levels between 19 and 34 decibels, and outdoor units operate quieter than a typical conversation.

Finally, consumers are accustomed to interacting with smart technologies that provide near-instant access to information, and have developed expectations for personalized comfort control. Building occupants are looking for personalized control within their space, while building owners and facility managers want better centralized control of equipment through building management systems. These allow for more efficient management, greater insight and reporting and tighter control of utility costs.

VRF systems address this by using one (or more) out-

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**Zone control:** In 2015, the Bank of San Antonio built a new, 56,000-sq-ft branch and office facility downtown. Needing to find an energy-efficient HVAC system, the owner chose a rooftop VRF unit (inset) that has provided quality comfort with flexible control.

door units to support a network of zoned indoor units. Personalized comfort is achieved through individual controllers in each zone. Additionally, VRF units are more electronics-based than traditional HVAC systems, with built-in controls logic to support centralized and local control.

### Complementing VRF with DOAS

Building owners and facility managers know what they need from HVAC systems, and a growing number are familiar with the benefits of VRF technology. It is important to understand how Dedicated Outdoor Air Systems (DOAS) complement VRF systems to meet building comfort demands and provide a complete, high-performance HVAC solution.

IEQ, for example, improves with the use of a DOAS. VRF systems are not purpose-built for ventilation, and as a system's compressors run slower during partial load conditions, its coils handle less refrigerant and are less active. While this is great for energy efficiency, a warm evaporator coil in cooling mode does not dehumidify effectively. Consulting engineers who have adopted VRF for energy efficiency often also use a DOAS to handle ventilation and moisture removal.

At its most basic, mechanical ventilation introduces fresh, outside air into a space. While cooling and heating systems are regulated by energy codes concerned with efficiency and occupant comfort, ventilation systems are regulated under mechanical codes, which concern occupant

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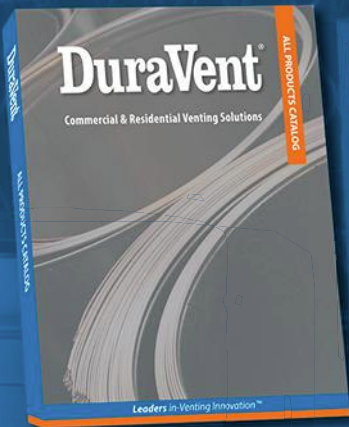


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safety. In the U.S., ventilation systems for commercial buildings must comply with state and local codes, based upon ASHRAE 62.1 or International Mechanical Code, which use similar calculations to determine a building's ventilation requirements.

### Digging deeper into DOAS

DOAS are dedicated ventilation systems designed to condition outdoor air. They are available as packaged equipment or as a split system to support decoupled designs. There are pros and cons to both options – packaged equipment is commonly more cost effective at startup and simpler to install, but split-system DOAS offers more design freedom inside and outside the building, allowing architects and building owners to separate and strategically arrange VRF outdoor units and DOAS equipment.

The use of DOAS also saves on the required cooling and heating tonnage, which manufacturers recognize is of growing importance to facility managers. In response to the growing demand for energy-efficient ventilation, some manufacturers, such as Mitsubishi Electric Trane HVAC, now offer split-system and packaged DOAS equipment with INVERTER-driven compressors like those found in VRF systems.

Room neutral conditions — the range of temperatures where humans experience comfort without needing to shiver to produce heat or sweat to cool off — can be more easily achieved using DOAS with INVERTER-driven compressors. Because reheat is typically only available on the lead refrigeration circuit, conventional DOAS produces room neutral air in a limited range of outside air operating conditions. With an INVERTER-driven design, there is only one refrigeration circuit regardless of tonnage. The result is a proportional amount of hot gas reheat to the cooling load, and the abil-

ity to deliver room neutral air to a wide range of conditions.

### What can we expect for the future of ventilation?

Newly introduced efficiency metrics for ventilation will soon impact how equipment is manufactured. Ventilation is historically governed by mechanical codes, but AHRI Standard 920 introduced two new efficiency metrics for DOAS. Moisture Removal Efficiency (MRE) is a full load efficiency metric while Integrated Seasonal Moisture Removal Efficiency (ISMRE) is a part load efficiency metric. Think of these metrics as similar to Energy Efficiency Ratio (EER) and Integrated Energy Efficiency Ratio (IEER) for cooling. In the near future, architects, engineers and building owners will be able to find information at AHRI directory.org to compare products. The trend toward the regulation of efficiency is likely to drive more manufacturers toward including INVERTER-driven compressors in ventilation equipment. This is a great alternative to the option of increasing efficiency by making coils larger, which would take up more space and could become cost prohibitive and unattractive in terms of design.

The ability to assess and deliver the appropriate amount of ventilation in real time benefits occupant comfort, improves IEQ and saves energy. Motivated by new codes and standards, market-based incentives, a sustainability mindset and a global movement toward better building design, VRF manufacturers will continue to develop DOAS systems to meet building occupant needs. As adoption of VRF becomes more widespread, specialized ventilation systems are expected to become more widely recognized as a necessary component for comfort and a complete, high-performance HVAC solution. **HPAC**



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# Specifying Protective Coil Coatings for HVAC Equipment

*Not just for residential work, time-saving, do-it-yourself coatings today have been re-packaged to let contractors on light commercial and industrial projects coat coils in their shop or onsite before installation.*



Contractors can now coat coils in their shop or onsite before installation with coatings packaged in convenient aerosol cans.

By BOB MARTINELLI  
RectorSeal LLC  
Houston TX

Applying aftermarket protective coil coatings is critical to sustaining the full lifecycle of newly-installed HVAC equipment destined for corrosive environments, but many engineers

and contractors don't specify this important step.

Coastal areas are the most likely target markets for coil coatings. Salt spray from oceans can prematurely corrode outdoor HVAC coils in as little time as a year if not coated before use. Salt spray can travel as far inland as 10 miles, which creates a huge area of vulnerable equipment on North America's seaboard.

Protecting HVAC equipment with coil coatings isn't a new concept. For many years, HVAC manufacturers have shipped newly-made coils directly to coating specialists as per the specification of engineers and contractors. Sensitive parts, such as electrical components, are masked-off, then coils are sprayed or electro-coated before the unit is shipped and installed in their corrosive environment destination.

*Based in Houston, the author is Director of Corporate Development at RectorSeal. Modine Coatings recently named RectorSeal the master distributor for GulfCoat™, a new coil coating packaged in aerosol cans for contractors to apply to extend the lifecycle of coils and HVAC equipment exposed to coastal area salt, urban air pollution and corrosive chemicals. Contact: bob.martinelli@rectorseal.com.*





*DIY: Contractors can spray the coil coatings, themselves, saving the time and money involved in outsourcing the work to a factory.*

What is new today are coatings that have been packaged in game-changing, convenient easy-to-use aerosol cans. Contractors can now coat coils in their shop or onsite before installation. This skips past the time and effort required to send a coil or the entire unit out for factory-applied coatings. Furthermore, contractors can create an entire do-it-yourself (DIY) coating niche that requires minimal experience or training.

**What is new today are coatings that have been packaged in game-changing, convenient aerosol cans.**

When selecting a coil coating it is important to make sure that the product has passed ASTM B117 test standards for salt spray. It also should have multiple marine and industrial ASTM test standard listings for resisting ultraviolet (UV)

rays, acid rain, high concentrations of urban vehicle emission air pollutants and other outdoor contaminants. It's also important to choose a brand that with a long history and reputation for provid-

ing OEM-approved, factory-applied coil coatings.

### When To Use A DIY Coating

Deciding when to use a coating specialist versus a contractor with field-applied DIY aerosol applications, usually depends on the project scope. For example, it's more economical to request the manufacturer ship 200 new split system condensers to a factory-coating specialist if the units are destined for a beachfront condo complex. However, a contractor using DIY aerosol protective coatings for a beachfront home's condenser(s) can be very economical and reduce the installation time versus shipping the product(s) to and from a coating specialist. As for unit size, typically any HVAC coil in a system 10 tons or smaller is perfect DIY coating application.

While coastal areas play a large part in coil corrosion, other potential areas where premature coil corrosion can occur include:

- Urban areas, and particularly



*Some coatings are blue so the applicator can visibly track even coverage of the sprayed area.*



*Coil corrosion can create formicary and pitting processes that ultimately lead to leaks.*

airports, which have heavy concentrations of airborne vehicle emissions;

- Buildings near or located inside properties of waste water treatment plants;
- Any heavy industrial area that emits airborne chemicals;
- Restaurants where cooking grease particulates are exhausted in close proximity to the HVAC rooftop system.

### Heat Transfer and Static Pressure Considerations

Many engineers and contractors have questions about how the coatings will effect a coil's heat transfer performance. While some coating formulas might be borrowed from other industries, only coatings designed specifically for HVAC coils should be used, because they're formulated for negligible heat transfer loss. These specialty coil coatings are typically only 1.4-ml thick or less, versus other thicker industrial coatings that can negatively affect heat transfer.

Static pressure is also a consideration, but coatings designed specifically for HVAC coils don't increase the pressure drop through the coil. Instead, they may even lower the

pressure drop versus an uncoated coil, because less static pressure-increasing contaminants will reside or adhere to the coil surfaces.

Of course, there's more to consider about corrosion than its effect on static pressure. Corrosion, especially from salt, can create formicary and pitting processes that ultimately lead to leaks.

**As for unit size, typically any HVAC coil in a system 10 tons or smaller is perfect DIY coating application.**

### How DIY Coatings Are Applied

Contractors can apply DIY coil coatings in the field, or in their shop. Obviously, shop-applied coatings are preferred, because of the controlled environment for temperature, humidity with no challenges from wind.

"Clean" and "dry" are key to a good coating adhesion. The first step mandates cleaning the coil with a foaming, non-acid, non-caustic coil cleaner and then thoroughly rinsing the coil. Many contractors believe

that new coils are clean. However, most new coils have machining oil residue from the manufacturing process that must be fully removed for successful coating adhesion.

While contractor-applied coatings are designed for new units, if an older unit that has already been exposed to corrosion is being coated, it should be treated first with a purposely-formulated salt and oil removing coil cleaner.

Once the coil has been cleaned and is completely dry, the electrical contacts, moving parts, valves, compressors and other parts not to be coated, are masked off with blue painter's tape, which doesn't leave a residue and is easily removed. It might also be beneficial to coat the unit's compressors and accumulator to minimize the corrosive environment's effect on these key components.

The coating stream is sprayed approximately four inches away from the coil in similar movements to spray painting. Some coatings are clear, which allow the coil to appear aesthetically uncoated (See image on p. 20.) Other coatings are blue, for when the applicator prefers to visibly track even coverage of the sprayed area. Drying times for touching is 10 minutes; handling is 20 minutes; re-coating is 30 minutes; and a full cure typically requires 48 hours.

During use, the corrosive elements in the air will attack the coil's coating instead of the copper and aluminum surfaces. For this reason, coatings may need a re-application every five to 10 years depending on the environment's corrosiveness.

Coatings are essential for coastal areas. However, engineers and contractors should also consider the prospect of coating coils in high air pollution areas such as urban centers and airports. In any corrosive situation, coatings will help improve the efficiency of the unit and maximize the unit's useful life. **HPAC**

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# ABMA Focuses on Educating Boiler End-Users

*Emphasizing outreach, group launches new podcast series, installation guide for members.*



**On the Air:** CEO Lynch launched the new 'Inside the Boiler Room' educational podcast series in June.

The American Boiler Manufacturers Association (ABMA) has tapped into a need for the boiler industry with the launch of its new podcast and release of the *Boiler Installation Guide*. These new products are focused on educating boiler end-users to ensure boilers are safely operated and optimized to perform at the most efficient levels.

By Scott Lynch  
American Boiler  
Manufacturers  
Association

ABMA's podcast, *Inside the Boiler Room*, was launched in June and, by late August, its first four episodes already had been downloaded more than 600 times. The monthly podcast features interviews with experts on a wide range of topics impacting the global boiler industry.

Our goal is to talk directly to the end-user community

*Based in Vienna VA, the author was appointed President & CEO of the American Boiler Manufacturers Association in June 2014. He oversees the day-to-day operations of ABMA and partners with its Board of Directors to map out the strategic direction for the group.*



Best practices for installation, operations and maintenance, and repair and training make up just some of the podcasts' subject matter.

and offer education and insights on today's boiler room. The podcast will also share boiler innovations, industry trends and help end-users avoid issues in their facilities.

ABMA recently released Episode #5 featuring **Connor Lokar**, an economist and in-demand speaker from ITR Economics. The interview included insights on short and long-term economic outlook, the impact of tariffs on manufacturing and realities of coal, gas and renewables.


ABMA is a long-time partner with ITR Economics and our members receive quarterly economic reports on trends impacting the boiler industry to stay ahead of the curve and make informed business decisions.



Previous podcast episodes have focused on boiler maintenance and training and the importance of proper boiler installation that included an overview of ABMA's recently released *Boiler Installation Guide*.

The episode on boiler maintenance and training featured **Steve Taylor** from WARE. This conversation addressed the need for a comprehensive maintenance schedule, how to head off issues before they become big problems and the importance of partnering with expert field technicians. In addition, the podcast addressed importance of training for boiler installers, operators and anyone working with boilers and Steve shared some details on WARE's Boiler University.

For the topic of boiler installation, ABMA was joined by




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The new guide can be downloaded at [ABMA.com](http://ABMA.com).

Installers can find all the resources they need in the new guide.

**Gene Tompkins**, ABMA's Technical Consultant and **Jim Kolbus**, product manager at Clark-Reliance, who authored the recently released *Boiler Installation Guide*.

The Guide is set up to assist installers with ensuring proper installation

by addressing common issues in the combustion air supply & tuning, safety controls, stacks & duct work and much more. In addition, the appendix shares many of the codes and regulation groups that have an influence over boiler installations.

During the podcast episode, Gene and Jim highlighted the most common missteps of the boiler installation, the importance of incorporating the proper codes and standards and what can happen if the boiler is not properly installed by a trained technician.

To subscribe and download episodes of ABMA's *Inside the Boiler Room* podcast, visit iTunes, Stitcher, Google Play or other podcast platforms.

In the coming months, ABMA will be releasing new publications focusing on Deaeration that will be followed by a future episode of *Inside the Boiler Room*, where we will share an overview of the publications and discuss the importance of this critical boiler room component.

In addition, ABMA will be launching *Boiler Weekly*, an e-newsletter focused on news from our industry. If you are interested in subscribing to the e-newsletter, send us an email to [info@abma.com](mailto:info@abma.com).

For more details on ABMA, the podcasts, or to download the *Boiler Installation Guide*, visit [ABMA.com](http://ABMA.com). [HPAC](#)

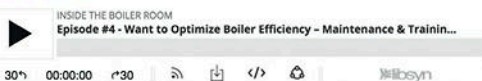
### Inside the Boiler Room



ABMA has launched our podcast - **Inside The Boiler Room**. If you are working with boilers, this podcast is for you. The podcast has been established to raise awareness of today's boiler industry and share important issues impacting our sector.

You can listen to our podcasts below or download them using the following links.

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Steve Taylor from WARE joins ABMA for Episode #4 of the podcast to discuss the importance of boiler maintenance and training. Our conversation addressed the need for a comprehensive maintenance schedule, how to head off issues before they become big problems and the importance of partnering with expert field technicians.

In addition, we discussed the importance of training for boiler installers, operators and anyone working with boilers and Steve shared some details on WARE's Boiler University.

Visit the growing library of podcasts at the [ABMA website](http://ABMA website).

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#### Upcoming Events

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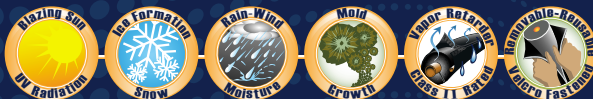
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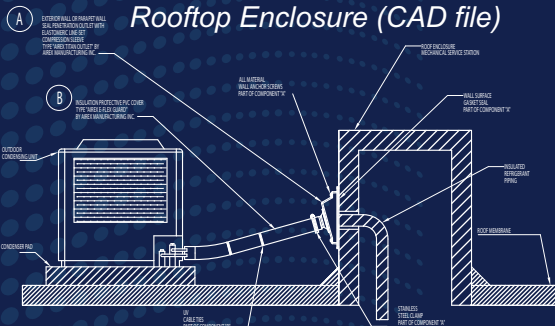
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# Endless Learning Potential

*County school system finds hybrid water heaters can ensure a reliable supply of hot water, reduce operating costs and provide long-lasting dependability.*



*Countryside High School replaced two commercial tank-style water heaters (left) with three Demand Duo 119-gal. Hybrid Tank Systems.*

Like any other public school system, Pinellas County Schools in Florida operate on a tight budget and answer to a lot of vested parties, including a school board, parents and taxpayers. So, it's no surprise that they're always looking for ways to function more efficiently and effectively, to better serve students, save money and reduce time spent on equipment upkeep.

When water heating units started failing in Countryside High School, the county began searching for a dependable, efficient and serviceable solution for the school and its students and staff. What the county needed was a hot water source that didn't have the same fallibility and short service life as the units they currently used. Moreover, they needed a system

that offered redundancy, to avoid a complete loss of hot water during the school day.

## Smarter Hot Water, Quick and Easy

For years, the Pinellas County School System, located in the Tampa Bay area of Florida, relied on traditional tank-style water heaters. However, over time, those responsible for maintaining and servicing these units realized their lifespan was shorter than they had expected — typically only six to eight years, at the most.

With the heat exchanger located on the inside of the unit, acidic condensate was consuming the tanks from the inside out, eventually causing the tanks to rupture. "With such a short life span, I knew there had to be a better

By Rinnai  
America Corporation  
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# The Voice of the Boiler Industry

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***Want to Optimize Boiler Efficiency — Maintenance & Training is a Necessity*** with Steve Taylor — Director of Sales, Rental Equipment and Special Projects at WARE

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alternative,” said **Ty Crawford**, in charge of maintenance for the school system. “We’ve been running Rinnai tankless products in other schools for about 10 years now, so we trust (them).”

**“We’ve had zero problems — and not a single complaint from our schools — in the first year of use.”**

— Ty Crawford, Journeyman Boiler Mechanic, Pinellas School District, Tampa FL

“I’d heard about the Demand Duo,” Crawford continued, “and I thought it sounded like it might be the ideal solution for us. So I started looking into it.” It wasn’t long afterwards that Tempaco, an Orlando-based distributor of natural gas and propane products, installed three Rinnai Demand Duo hybrid units at Countryside High School. These direct replacement solutions were a fast, straightforward upgrade from the school’s tank-style units. And the successful installation has since led to more installations at other schools throughout the Pinellas County School System.



*The ‘Demand Duo’ combines a tankless unit with a tank-style water heater.*

## INSTALLATION HIGHLIGHTS Countryside High School



**19%** MONTHLY SAVINGS



**1,930**  
STUDENTS



**153**  
STAFF MEMBERS

Replaced two commercial tank-style, 130-gallon, 500,000 BTU water heaters, along with three 119-gallon storage tanks.

### How It All Came Together

When it came to heating water, Pinellas County Schools were concerned with increasing equipment life and cutting costs – not only for the new water heater install, but also for the long-haul on energy usage.

It was Crawford who suggested Rinnai again to Tempaco, but this time he was interested in what the Demand Duo had to offer.

“The ease of installation was the first big factor for Pinellas County,” said Tempaco’s **Lewis Johnson**. Rinnai’s Demand Duo Hybrid Water Heaters feature connections similar to most tanks. So customers quickly can replace a standard tank and be operational again, with a minimum of disruption.

“They also liked the combination of tank-style and tankless technology, because that meant the heat source – the heat exchanger – was located outside the tank,” said John-

# ADVENTURES OF **JOHNNY TUNDRA** COLD-WEATHER ENGINEER

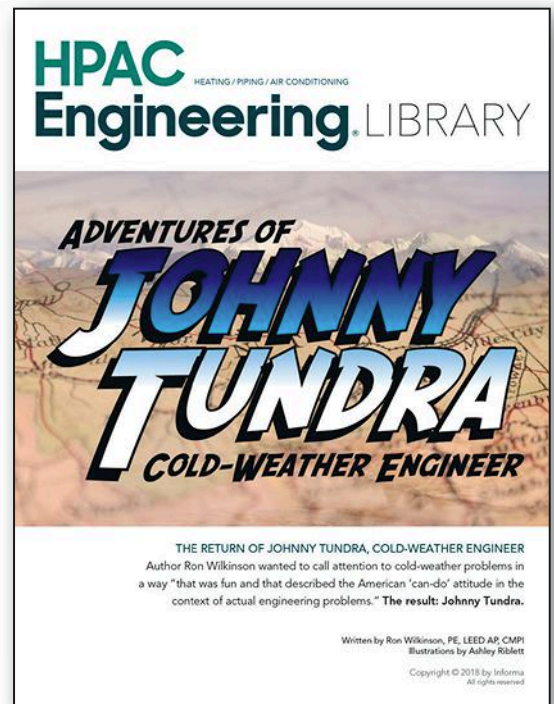
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## THE ADVENTURES OF JOHNNY TUNDRA: COLD-WEATHER ENGINEER

Follow our intrepid hero and his faithful dog Montana through this complete collection of his adventures. This engaging, 13-part series would run for more than two and a half years, before concluding in December 2017 with a generational handoff to a younger, tech-savvy troubleshooter representative of a new era for engineers.

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son. “And given the issues with their previous units, that was a huge factor.”

### Savings From Day 1

According to Crawford, installed costs on the new units were about half the cost of sticking with the same units the school had previously used.

“The up-front price difference was huge,” said Crawford, “but what has really surprised us since then is how much we’re saving on gas every month.”

On average, Countryside High School saves close to 20% on their monthly utility bills since switching to the Demand Duo units. The commercial ENERGY STAR® certified tankless units offer 96% thermal efficiency, yet deliver more stable temperatures and more hot water than the previous system.

**“They also liked the combination of tank-style and tankless technology, because that meant the heat source – the heat exchanger – was located outside the tank. And given the issues with their previous units, that was a huge factor.”**

— Lewis Johnson, Tempaco

Crawford expects to reap more savings over the long run, thanks to the Demand Duo’s dependability and serviceability.

“They’re worth their weight in gold, because they’re so reliable and easy to maintain,” said Crawford. “I don’t have to babysit them all the time, like we did the old water heaters. I was spending a ton of money keeping the old units up and running.

“Rinnai even taught a free, on-site class for my shop people on maintaining and servicing the Demand Duo,” Crawford continued. “So, if the heat exchanger ever does fail, I can swap it out for a fraction of the cost of new water heaters. And with

the redundancy of the units, we never lose hot water, even during servicing.”

### More Schools, More Demand Duo Units

Since October of 2016, when the Countryside High School installation took place, the Pinellas County School System has replaced tank-style units in another seven schools with Rinnai’s Demand Duo Hybrid Water Heating Systems. Tempaco’s Johnson said that more Demand Duo installations are likely in the future for Pinellas Schools, as more old water heating systems fail in other schools.

“We’ve seen the track record with these units now,” said Crawford. “We simply don’t have issues with them. We’ve had zero problems — and not a single complaint from our schools — in the first year of use.” [HPAC](#)

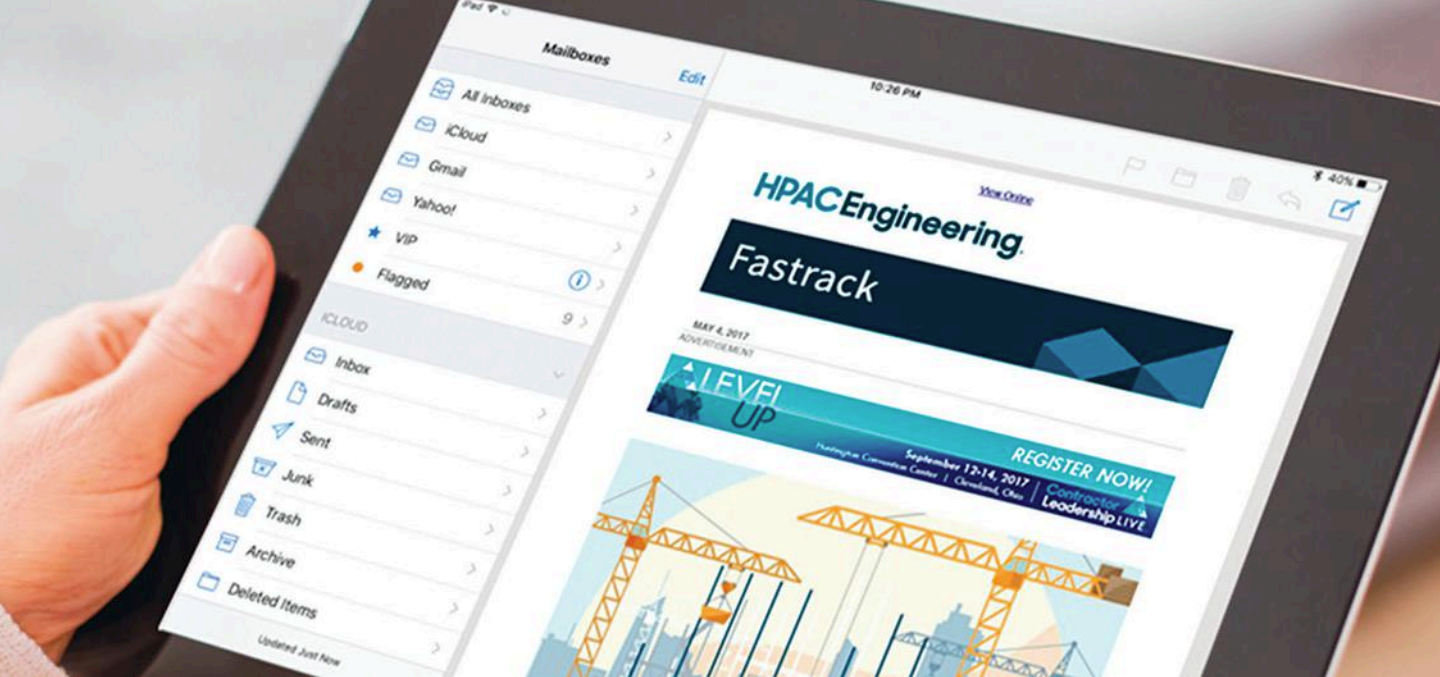
## NEW UNIT ATTRIBUTES

- Endless supply of hot water
- Built-in redundancy – never experience downtime during the school day
- Ability to service without system shutdowns
- Save money – cut installation, maintenance and operational costs
- Commercial ENERGY STAR® certified
- 96% thermal efficiency
- Ultra low NOx compliant

## ADVANTAGES OF ‘DEMAND DUO’ 119-GAL. SYSTEM

- Quick and easy upgrade from standard tank-style systems
- Combines best of both a tankless unit and a tank-style water heater
- Route venting through existing B vent or terminate vent vertically or horizontally
- Rinnai C199 Commercial Tankless Water Heater eliminates thermal stress on the tank, lengthening life and maximizing performance of the unit
- System weight up to 250 lbs. lighter than competitive units

*For more information on commercial water heating solutions, maintenance services and a free sizing consultation by Rinnai Applications Engineers, call 866-383-0707 or visit [rinnai.us/commercial](http://rinnai.us/commercial).*



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### MagnaClean Commercial Magnetic Dirt Filter

Adey introduces the MagnaClean Commercial Magnetic Dirt Filter for light commercial to heavy industrial applications. The patented magnetic filtration system starts to work immediately upon installation, removing virtually all of the suspended iron oxide that collects in hydronic heating systems. The magnet array has been redesigned to allow the magnetic rods to be lifted individually. This easy release sequence allows the magnetite from each rod to fall into the base of the filter body so it can be flushed out via the 1 1/4-in. NPT drain at the base of the filter. Commercial filters are available in five inlet and outlet flange size options including 2 in., 3 in., 4 in., 6 in. and 8 in.

*Adey Innovation*  
www.adey.com

### Evergreen Commercial High-Efficiency Boiler

The Evergreen commercial high-efficiency boiler from Weil-McLain features 96.5 percent combustion efficiency, a 10-to-1 turndown ratio, Smart Sequencing that balances the energy load across all system boilers, low NOx, a propane conversion kit, direct vent 100 ft. for intake and 100 ft. for vent a commercial-grade heat exchanger and non-metallic condensate base. Available in floor or wall-mount models. ZoneStacking controls allow up to 24 programmable zones without need for an additional panel. Ability to control multiple boilers with lead-lag capability without an external device. Available in models providing 220, 299 and 399 mbh.

*Weil-McLain*  
www.weil-mclain.com



### Upgraded Crest Commercial Condensing Boiler

Lochinvar's Crest condensing boiler family upgrade provides up to 96 percent thermal efficiency in six models ranging from 2.5 million to 6 million Btu/hr. for large commercial applications. The new models are manufactured with an upgraded combustion system and 316L stainless-steel heat exchanger. The fire-tube design transfers heat to surrounding water even more efficiently than before. The boilers feature an enhanced modulating burner that delivers a turndown ratio up to 20:1 and flexible flow rates up to 600 gal. per minute. The SMART TOUCH control system includes a built-in cascading component that enables communication and seamless sequencing of up to eight units.

*Lochinvar Corp.*  
www.lochinvar.com

## Commercial Wall-Hung Fire-Tube Boiler

Navien's NFB condensing, wall-hung, fire-tube boiler comes in two sizes — the NFB-175 and NFB-200 — both with an AFUE of 95 percent. The gas flow control system provides a 10-to-1 turndown ratio. Every boiler comes with a field conversion kit to switch from natural gas to propane gas. The Energy Star-rated boilers feature advanced controls with built-in hardware for connection to a boiler pump, three zone pumps or three zone valves. An optional SmartZone pump controller provides control for up to six additional zones. They have multiple venting options and materials along with exceptionally long vent lines, up to 150 ft. They also can be common-vented for up to eight units and cascaded up to 16 units.

Navien

[www.navieninc.com](http://www.navieninc.com)



## Commercial Steam Boilers

Triad's line of steam boilers is designed with a small footprint for tight mechanical rooms. They feature pressures of up to 150 psi, longer-lasting firetube design that heats very quickly, a water-backed combustion chamber for very quick heat transfer, and Low-High-Low, modulating and dual fuel are available. When sequenced with a control panel, a highly efficient system is created that assures the fewest number of boilers will fire for the minimum required time.

Triad Boiler Systems

[www.triadboiler.com](http://www.triadboiler.com)

## Commercial Wood-Fired Boiler

WoodMaster Commercial Series boilers give commercial heating systems the advantages of biomass heat. Features include automatic fuel feeding, ash extraction and sootblowing; boilers achieve 92 percent LHV efficiency using digital modulating-output control; ASME-certified pressure vessels, burns CO<sub>2</sub>-neutral wood fuel (such as wood pellet or chips). Models are available from 80 kW to 2,000 kW (up to 6.8 million Btu./hr.)

WoodMaster

[www.woodmaster.com](http://www.woodmaster.com)





### PureFire Condensing Commercial Boilers

The Peerless PureFire commercial product line from PB Heat features gas-fired, stainless-steel condensing boilers with inputs of 399 to 1,500 MBH and thermal efficiencies of up to 96.6 percent. These cascade-ready boilers have a condensate system with built-in neutralizer and 120V convenience outlet. The larger sizes allow for common vent capability. The PFC-850 to PFC-1500 models are essentially two boilers in one cabinet, making them the perfect choice for jobs requiring cascading and redundancy. They offer a one-year parts-and-labor warranty and a 10-year limited warranty on the heat exchanger.

*PB Heat*

[www.peerlessboilers.com](http://www.peerlessboilers.com)

### Compact Sanineutral Kit

The Sanineutral neutralizer kit from Saniflo incorporates neutralizing granules to increase the pH of acidic condensate water produced in residential or commercial applications before it reaches the sewer line. Condensate produced by boilers, water heaters, air conditioners and other appliances moves through the compact unit, which neutralizes it to prevent the corroding of drains and sewer systems. It can be used without a pump, where the acidic condensate simply needs to drain through gravity or in conjunction with a condensate pump. The unit can rest on the floor, base or be wall-mounted. For appliances with higher Btu inputs that may require even more neutralization, it can be installed in series for increased performance.

*SFA Saniflo*

[www.saniflo.com](http://www.saniflo.com)



### G615 Cast-Iron Commercial Boilers

The G615 Cast-Iron Commercial Boilers from Buderus are designed to operate at any return water temperature. The Thermostream design increases efficiency and system reliability with no thermal shock. The full three-pass boiler design increases the heat transfer and efficiency of the boilers. Thermal insulation at 3 1/2 in. and 4-in.-thick decreases standby loss. The burner doors are field adjustable to swing fully open from either side to enable the boilers to fit in any location. They feature cast-iron breaching for long life and no refractory parts for reduced maintenance.

*Buderus*

[www.buderus.us](http://www.buderus.us)

### Combination Boiler Feed, Backflow Preventer Valve

Taco's brass boiler feed and dual check backflow preventer with atmospheric vent is designed for use in hydronic heating systems. It prevents heating system water from flowing back into the supply water piping if supply pressure falls below heating system pressure. It also offers simple pressure setting adjustment between 10 and 25 psi which is separate from the exclusive, lockable fast-fill lever. The valve is available in 1.2-in. cast-iron union sweat or union NPT feed valve with a brass backflow, as well as 1/2-in. and 3/4-in. brass union sweat or union NPT feed valve with a brass backflow.

*Taco Comfort Solutions*

[www.tacomfort.com](http://www.tacomfort.com)





# Remembering Lochinvar's William Vallett Sr.

*The energy efficiency pioneer left us in May,  
but his legacy lives on for the water-heating industry.*



Photo courtesy of Lochinvar Corp.

**Grand plans:** Bill Vallett Sr. (center) passed on his wisdom and foresight to sons (from left) Bill Jr., Tom and Jeff.

**W**illiam Vallett Sr. of Lochinvar Corp. pioneered the concept of energy-efficient water heaters during the height of the 1970s energy crisis. His drive to differentiate his company led to the first energy-efficient commercial water heater.

Since then, the water heater and boiler manufacturer has spent considerable resources on research and development to marry energy-efficient technologies with the performance its customers rely on.

By Kelly Faloon  
Special to  
HPAC Engineering

In 1992, after 42 years with Lochinvar, Vallett Sr. retired and left the company in the hands of his three sons, **Bill Jr.**, **Tom** and **Jeff**. He died on May 4, leaving behind his wife, four children, 20 grandchildren, 18 great-grandchildren and a rich legacy of innovation that is still benefiting our industry.

Before Lochinvar was Lochinvar, it was the Walter Vallett Co. in Detroit. That was back in 1939, when **Walter Vallett Sr.** started the business to market residential, commercial and



*William "Bill" Vallett Sr. grew up in the water heating business. During his tenure heading up Lochinvar, he positioned the company as an energy-efficiency leader.*

industrial water heaters. The company changed its name to Lochinvar Water Heater Corp. in 1957 after acquiring Michigan Tank and Furnace and the Lochinvar brand in 1954.

Walter's sons, Walter Jr. and William "Bill" (Sr.), were working with him at the time of the name change and helped grow the company. Bill Vallett served in the U.S. Navy during World War II, after which he attended Michigan State University before joining the family business in 1950.

"They were marketing and selling a unique value proposition to the design engineers, consulting engineers and creating a brand," notes **Mike Lahti**, vice president of sales, marketing and business development at Lochinvar. "We were creating the pull in the market — creating demand by having these products specified by consulting engineers through differentiation strategy."

The brothers separated the business in 1979. By then, Lochinvar had

relocated to Nashville, TN, and was engaged in pool heating as well as residential and commercial water heaters. Walter Jr. developed a passion for the pool heating side of the business while his brother was much more interested in water heaters.

Bill Sr. built a new manufacturing facility in Nashville — the start of what we know as Lochinvar today.

### Energy crisis = energy efficiency

This restructuring was during the time of the second energy crisis of the 1970s. The Middle East oil crisis caused panic and drove up the price of crude oil. People waited in long lines to put gas in their cars. Turmoil made the situation much worse as oil production in the Middle East came close to a standstill. An economic recession hit the U.S. and other countries. It wasn't until the mid-1980s that oil prices began to subside.

Bill Sr. saw the energy crisis as an opportunity to not only differentiate

his company but to be an energy-efficiency leader in the industry, Lahti says. He hired Chief Engineer **Jim Smelcer** and encouraged him to develop energy-efficient technologies. Taking that direction, Smelcer designed the Lochinvar Power-Fin commercial water heater in 1986.

"At the time, the Power-Fin was a one-of-a-kind product," Lahti says. "The product redefined efficiency and performance standards, taking efficiency up to 88 percent. It had a small footprint, making it very appealing to get it in and out of tight mechanical rooms. It had diagnostic controls. It had direct-vent sealed combustion. It had things that few others had marketed in the United States before in this kind of technology and Bill brought it to market. It changed the industry, the country and this company. It put us on a growth trajectory that has been incredible — sales increases 37 out of 38 years in a row — all dating back to the start of Bill Vallett's vision for high-efficiency products."

Of course, new technology is expensive. Smelcer designed the Power-Fin to take up less space, so consulting engineers, mechanical engineers and contractors liked it because it solved the problems they had. Building owners liked it because it would save on installation costs.

"We had to do a good job of marketing the benefits of energy efficiency and the intrinsic benefits of a better-designed product," Lahti adds. "Due to the energy savings the Power-Fin offered, it quickly became a highly sought-after product and the subsequent revenue stream enabled Bill to reinvest that money to create a pipeline of new products."

Product development included adding boilers to the mix. Bill Sr. ensured that Lochinvar continued research and development efforts to push efficiency levels higher for all its products — a priority the manufacturer still has today.

## Industry mentor

Bill Sr. was a mentor to many people in his company, as well as a fierce competitor in the water heating industry and respected by his peers.

"In our industry, there are a lot of hard-working worthy competitors," says **Dan Sheko**, Lochinvar's national sales manager. "I have heard many compliments over the years about this great company that Bill Vallett was so instrumental in building. I believe those who know our history would say he did a great deal to promote energy efficiency in our industry and that he thought outside the box."

**Tim O'Mara Jr.** agrees: "Bill was known by everyone in the industry because he was always coming up with new products, new ideas. There were many out there who looked up to Bill. He was much admired and highly respected."

Smelcer describes Bill Sr. as "admired and respected as a man of personal integrity, an innovator and relationship builder to his customer base." Doing what's right for the customer was an ideal he strived for. The concept is still part of Lochinvar's corporate philosophy.

As a leader, he put his faith in the people who worked for him, never micro-managing a situation. "Bill always asked questions," Lahti explains. "He never would come in and say you're doing something wrong. He had an inquisitive approach. 'Are there other alternatives we should consider?' It helped us to look at things a different way."

He was genuinely interested in his employees and helping them excel in their careers. Bill Sr. saw the potential in them that they may not have realized themselves.

"Back in the old days, when Lochinvar was in Detroit, they decided to move all the department heads to Nashville," O'Mara recalls. "I was the service/parts manager. I didn't want to move, so I handed in my resignation. No one said anything to object. On my 'last' day, the secretaries had cake and some little gifts. At 4:30, Bill called me into the office and proceeded to say he had listened to



*Bill Sr. (kneeling) with some of Lochinvar's staff and the Power-Fin, mid-1980s.*

me sell Lochinvar to service people all these years. He said, 'I think you would make a good salesman.' **Larry Keelan**, the regional manager, agreed to make me a salesman and here I am, 42 years later, still a salesman."

Bill Sr. also helped Lahti early in his career. "I'd only been at the company for four years and was at a sales meeting in Nashville," Lahti notes.

**He was a great innovator and motivator; he had the vision to see beyond what the American water heating industry was doing at the time.**

"Bill said, 'Hey Mike. Why don't you ride with me in the car?' I rode with him and he asked, 'How are things going?' I said they were good. He asked, 'Anything you like or dislike?' 'No, sir,' I said. Then he said, 'Would you like more opportunity?' And I thought, well, I'm a young 26-year-old kid, so why not? I said, 'Well, sure.' Never heard anything else about it until two months

later, when my boss promoted me to regional manager."

Smelcer notes that Bill Sr. was a great innovator and motivator; he had the vision to see beyond what the American water heating industry was doing at the time and set goals to achieve the objectives he set for the company. "I emulated some of his management characteristics later on in my career as a manager," Smelcer adds. "Bill was complimentary when you did well, a disciplinarian when you messed up. But he never held a grudge as long as you were found to be trying your best."

Sheko, who has been with the manufacturer for nearly 35 years, was 16 years old when he started a part-time position at Lochinvar. "At the time, Bill Vallett seemed larger than life to me," he says. "In my part-time position, I was often given the responsibility to drive the company station wagon to Detroit Metro Airport to pick up Bill, as well as others who had flown in. I can still recall many of the conversations, the direction and the feedback that Bill gave me during those airport drives and while interacting at our Detroit facility. I had great respect and gratitude for Bill, so I took every comment to heart and used his advice to do the best job possible." **HPAC**

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## LF Series

Air-cooled condenser chiller with capacities from 4-55 tons. The LF Series is available with an integrated variable flow pumping package within a double wall polyurethane foam insulated service compartment. Auxiliary electric heat can be provided in the insulated waterside compartment for freeze protection. Variable capacity scroll compressors provide unmatched part load performance and save operation costs.

## LZ Series

Air-cooled condenser chiller with capacities from 45-200 tons. Evaporative-cooled condenser chiller with capacities from 53-540 tons. The LZ Series is available with an integrated variable flow pumping package within a temperature controlled double wall polyurethane foam insulated cabinet for freeze protection. VFD controlled scroll compressors and variable capacity oil-free magnetic bearing TurboCor centrifugal compressors are available to save operating costs.

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