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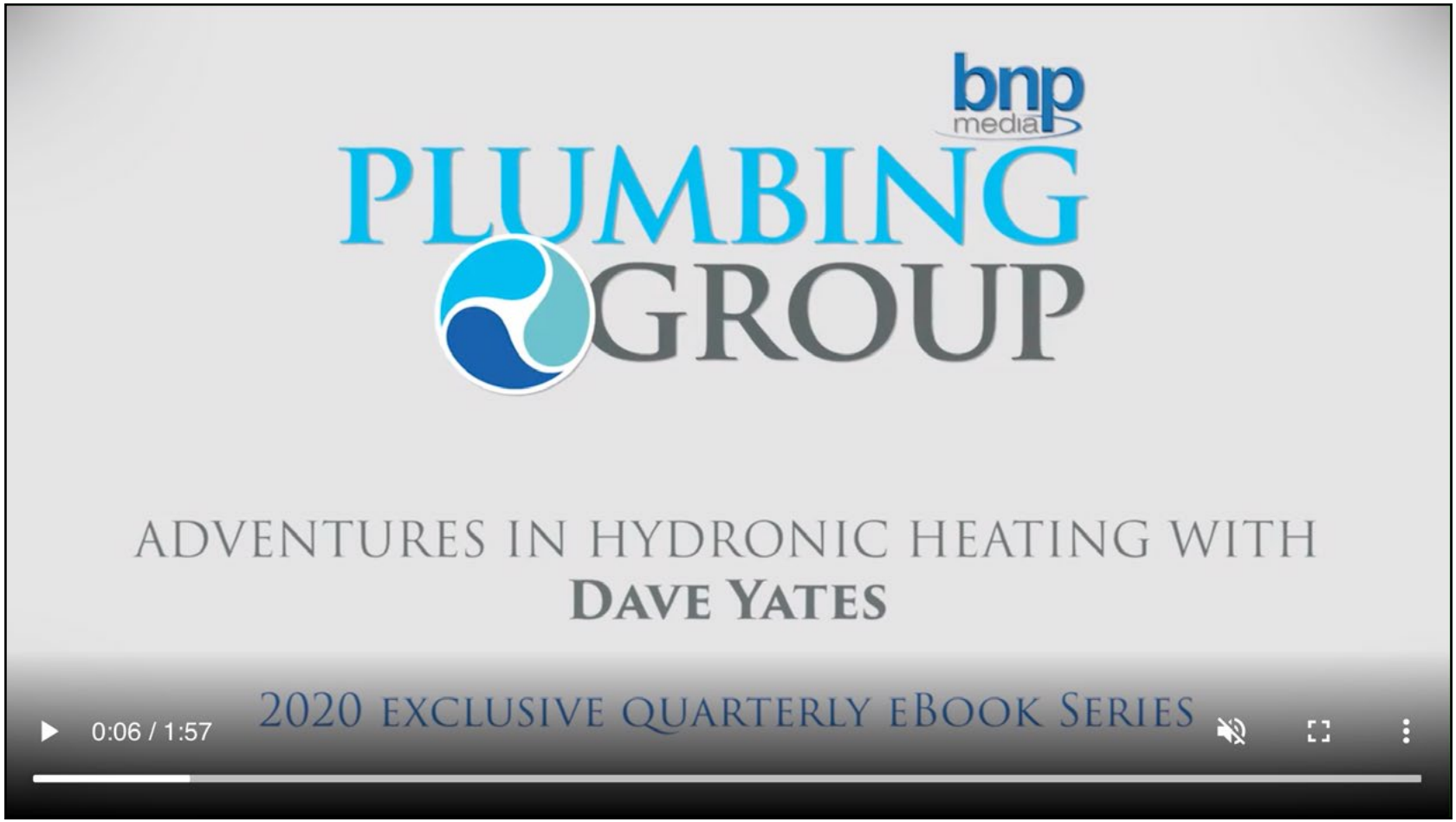
ADVENTURES IN **HYDRONICS HEATING**

With Dave Yates

VOLUME 4

A SPECIAL MESSAGE
FROM DAVID YATES



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Dave Yates began his career in the PHCP-PVF trades in 1972 with F. W. Behler, a third-generation plumbing/ HVAC firm he purchased in 1985. Yates also is an experienced teacher in the hydronics industry, serving as an adjunct professor and on the Technical Advisory Board for the Thaddeus Stevens College of Technology. He is also very active in writing articles for industry trade publications including BNP Media's Plumbing Group, attending trade shows and speaking at events. He can be reached at dyates@fwbehler.com.

EDITORIAL
COLUMNS

Honesty

The essential foundation for your business.

"Honesty is such a lonely word," (from the song, "Honesty" by Billy Joel). It never ceases to amaze me when folks we deal with are not honest.

As a new apprentice in 1972, **Paul Strayer** and I were doing demolition work in preparation for remodeling a customer's bathroom. An old steel-walled shower with a terrazzo floor stood in the corner. There was a drywall gap above the top ledges of the corner shower. The rest of the walls were covered. The "lady" of the house gave us marching orders, saying she had lost her high school ring when she placed it on the metal ledge and accidentally bumped it, causing it to fall into the wall cavity: "I want that ring found! You'll find it behind the left wall of the shower."

When we removed the left sidewall of the metal shower, there was a thick layer of dust/debris accumulated on top of the base 2x4 of the wall. There did not appear to be any markings in the dust/dirt indicating a ring, so I called the lady to inspect the undisturbed areas between studs. After dragging her fingers through the dust/debris, she exclaimed, "You stole my ring!"

No amount of explaining how that wasn't possible because it was obvious the layer of junk had not been disturbed satisfied her, and she stormed off like a dark storm cloud. We took the verbal lashing and got back to work.

When we removed the right wall panel and looked at the debris accumulation, there was an obvious bump revealing the shape of a ring. It was obvious her memory was wrong, and the ring had been on the other ledge. We called her back into the bathroom so she could plainly see the undisturbed layer of dust/debris to retrieve the cherished ring. Grateful? Nay, my friends, she accused us of having stolen the ring from the left wall and placing it in the right wall's debris field to get out of trouble.

Honest facts

The son-in-law of an acquaintance, who was in hospice care, called to have his steam boiler inspected. It had dry fired, and the fire department responded because the hard-wired smoke detectors went off and had turned off the gas. Sure enough, each section was cracked across the bottom. Price given and contract signed. The son-in-law turned in a claim to the homeowner's insurance company. They, in turn, wanted to know if it was due to normal wear-and-tear or a mechanical failure.

Sure enough, the mechanical low water cut-off was full of mud because of a lack of maintenance, which was why the boiler dry fired, causing its failure. You already know what he suggested I do: Lie to the insurance company so his mother-in-law would be covered. The fastest way I know for you to trash your hard-earned reputation is to be caught lying and be charged with insurance fraud. I explained that we simply could not do what he wanted, and told him if the insurance company contacted me, they would be given the honest facts. They, of course, did and, as you can guess, he called me every name in the book. Honest folks must develop thick skin!

Integrity pays off

A large commercial customer's operations manager asked me to join him for lunch in the cafeteria. During lunch, he told me he needed a new boiler, and dictated I was to bill his company for all the work. "I'll tell you which job it's for in the plant and issue a purchase order."

I told him I could not do that, but I'd be happy to lend him a hand on my own time and we set up an appointment after-hours. We scheduled a weekend to install the boiler he said he would obtain, but karma paid him a visit a few days later and he was fired — for extorting deals with other vendors while having the bills charged to the owner's business.

The best part? They were onto him and had been closely monitoring his dealings. Somehow, they overheard our conversation and knew I had refused to do as he instructed. As a result, we were one of just a few outside vendors who they continued to do business with.

In the courtroom

Picture this scene: I'm in court and the judge asks me to describe the events.

"Your Honor, it was late on a Sunday evening. These folks called with no heat. The husband told me he had just brought his wife home from the hospital and said he was willing to pay overtime to have the heat restored. It was well below freezing outdoors, and they lived in a three-story row home. His wife still had her hospital bracelet on her wrist and their teenage son was quite surly."

"Can you describe the home?" the judge asks.

"Yes, the front door opened into the living room and they were watching TV. He was drinking a can of Yuengling Lager, and they were sharing a large bowl of popcorn. They had a Honeywell T87 thermostat, and a quick check revealed a spark when the mercury broke away from the contacts, which I showed the husband and explained that it indicated the system transformer was on and working. The basement was a mess with clothes strewn about. The cellar steps were wobbly and in need of repairs. The boiler was an antique American Standard with standing pilot, which was not lit. It would not stay lit. I installed a new thermocouple, lit the pilot and their heat was restored."

The judge now turned to the husband and asked for their side of the story.

"He was never at our home."

Say what? I'll freely confess I was at a loss for words. How in the world was I going to defend against that blatant lie? The judge then asked him if my description was correct. "Sure is, your Honor."

It was all I could do to keep from laughing. The judge said he ordinarily takes 10- to 30-days to render judgment, but in this case did not need any time to weigh the facts. Judgment is in Mr. Yates behalf!

Kind of like the schoolteacher who said he'd never called us to clean and tune his oil boiler. The judge turned to me and asked if it was our policy to break into people's homes to do work? We all shared a good belly-laugh over that one, and "we don't break in to do work," became our internal company motto! Judgment in our favor.

We were on another job where we replaced a tub and shower faucet. There was no access panel, so we installed one. The young lady decided she wasn't going to pay the bill, so we ended up in court. When the judge asked her why, she replied that our secretary gave her a quote over the phone for 1/4-hour labor, saying that's all these jobs take. The judge turns to me, and I asked permission to have our secretary come to the courtroom. He then asked our secretary if she gave a quote telling the young lady it only takes 15 minutes to replace a tub/shower faucet?

Mary then told the judge our standard fee, along with labor hours, for replacing a tub/shower faucet. Bang went the gavel!

Honesty and integrity are an essential foundation for your business if you value your reputation. So is thick skin. Fortunately, these types of bamboozlers are few and far between, but theirs is a slippery slope guaranteed to cause you injury.

Time is money

Don't be put off by upfront costs of new technologies.

In 2003, while attending ISH in Frankfurt, Germany, I saw numerous innovative products that impressed me with their potential to save installation time. Cutting your labor hours gives you a distinct advantage over your competition, lowers your job cost and wins more bids. A number of companies, including Ridgid Tool Co., had press tools for copper potable water (and other) systems from 1/2-inch up to 4-inches.

Upon returning to the U.S., I sought out pricing for a Ridgid press-tool, and as you might expect, sticker-shock set in. While putting together a bid for a Cheeseburgers in Paradise restaurant, I tallied up the total number of copper solder joints for all of the 1/2-inch to 2-inch copper fittings, and the time required for each solder-joint. When compared to the time for pressing the same fittings and including the higher cost for press-fittings, it was blatantly obvious the cost to purchase the press tool was more than justified. Like any innovative product, as time goes by, you realize the gains in jobs won far outweighs the upfront cost.

For example, downtime for hotels and other commercial applications when changing out large water heaters that have no isolation valves is dramatically reduced because you can press a valve onto the cut pipe while water is still draining.

ISH 2003 also opened my eyes to new and exciting technology that offered breakthroughs in energy conservation: Modulating-condensing boilers and ECM circulators. We had to wait a few years before those types of products became available on this side of the pond.

ISH Germany attendees discuss products on display with PAW employees.

Gasketed PP (polypropylene) combustion venting, widely utilized in European countries, is gaining traction here in the states. PVC for combustion venting has been outlawed in Canada — can the U.S. be far behind a similar measure? Plumbing drainage systems on display were also lightweight gasketed plastic. In downtown Frankfurt, a look inside a mechanical contractors van revealed they were utilizing these same timesaving gasketed tubing and fittings.

A decade later

ISH 2015 did not disappoint where innovative, timesaving products were seemingly at every twist and turn while wandering miles

Victor (foreground) and Joe Waskiewicz, USA PAW reps, explain several of the PAW pump/control packages while educating Dave Yates on the features, benefits and ease of programming.

of aisles. Manufacturers are fine-tuning products to make them easier to install and programming more intuitive — all of which is designed to allow installers to save time and make more money. What's not to like?

The PAW innovative system technology for hydronic heating, solar thermal systems and domestic hot water technology grabbed my attention — it neatly captures exceptional quality and ahead-of-the-curve technology while enabling our jobs as installers to be completed if far less time.

Victor Waskiewicz and **Joe Waskiewicz** head up the U.S. division of PAW, and together, we toured the booth to go over each of the available panels, manifold assemblies and piping strategies that all fit together in modular components. What often takes days for the average installer who cobbles hydronic systems together can be accomplished in just a few hours using the PAW line. Time literally equals money, but contractors are sometimes put off by the upfront cost. Let's take a look at a PAW 3-zone panel with hydraulic separator.

After collecting the components, you have $1,562.48 invested. The PAW panel system cost is $1,559.82. We still need to install both, and PAW suggests six hours for our cobbled-together components versus 90-minutes for their component system installation.

Personally, I think they are being generous allotting only six hours to the cobbled together system. The time spent obtaining all those components, the fuel wasted driving to several supply houses, and if that were a solder-together system, with wiring thrown in, you could easily suggest 18-hours versus 90-minutes. And that assumes there are no leaks!

"When compared to the time for pressing the same fittings and including the higher cost for press-fittings, it was blatantly obvious the cost to purchase the press tool was more than justified. Like any innovative product, as time goes by, you realize the gains in jobs won far outweighs the upfront cost."

Let's say you charge $100 per hour. The PAW system for this application saves your customer $450 to $1,650, and you win more competitive bids. Given the fact that profits are based on markup of materials while labor carries your overhead, you complete more jobs in the same time while giving a tasty boost to your profits!

As an added bonus, your work utilizes less real estate with friendly appliance-looking cabinets instead of looking like the mission-control room at NASA, which is less intimidating to your customers. What's not to like?

Victor and Joe introduced me to PAW GmbH & Co. Owner **Marc Pommerening** who, after swearing me to secrecy, gave me a tour of their secured private area where products not yet available were on display. Select customers of PAW were provided access for advance orders. A security guard stood sentry each night to ensure no unauthorized entry would take place. Suffice it to say, these new products will be game-changers for the hydronics industry.

After meeting the assembled PAW team and sitting through a team-briefing, it became obvious why PAW holds a majority share of the European market for these types of products. With Victor and Joe at the helm of the U.S. PAW division, I know we are in good hands for inventoried product and service. For information on PAW visit: [www.paw.eu/us/products/heatingengineering/produkte_heizungstechnik.php.](www.paw.eu/us/products/heatingengineering/produkte_heizungstechnik.php)

Perfect Together

Brute FT® Wall Hung + PowerStor Series® Indirect Water Heater.

The Brute FT®'s modulating technology automatically adjusts fuel usage to match heat demand – saving up to 20% on heating utility bills compared to standard "on-off" boilers! It's available as a combi boiler/water heater or heat-only boiler, which you can pair with a PowerStor Series® indirect water heater for a perfect hydronic solution.

Find out more at our website dedicated to the professional:

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BRADFORD WHITE®
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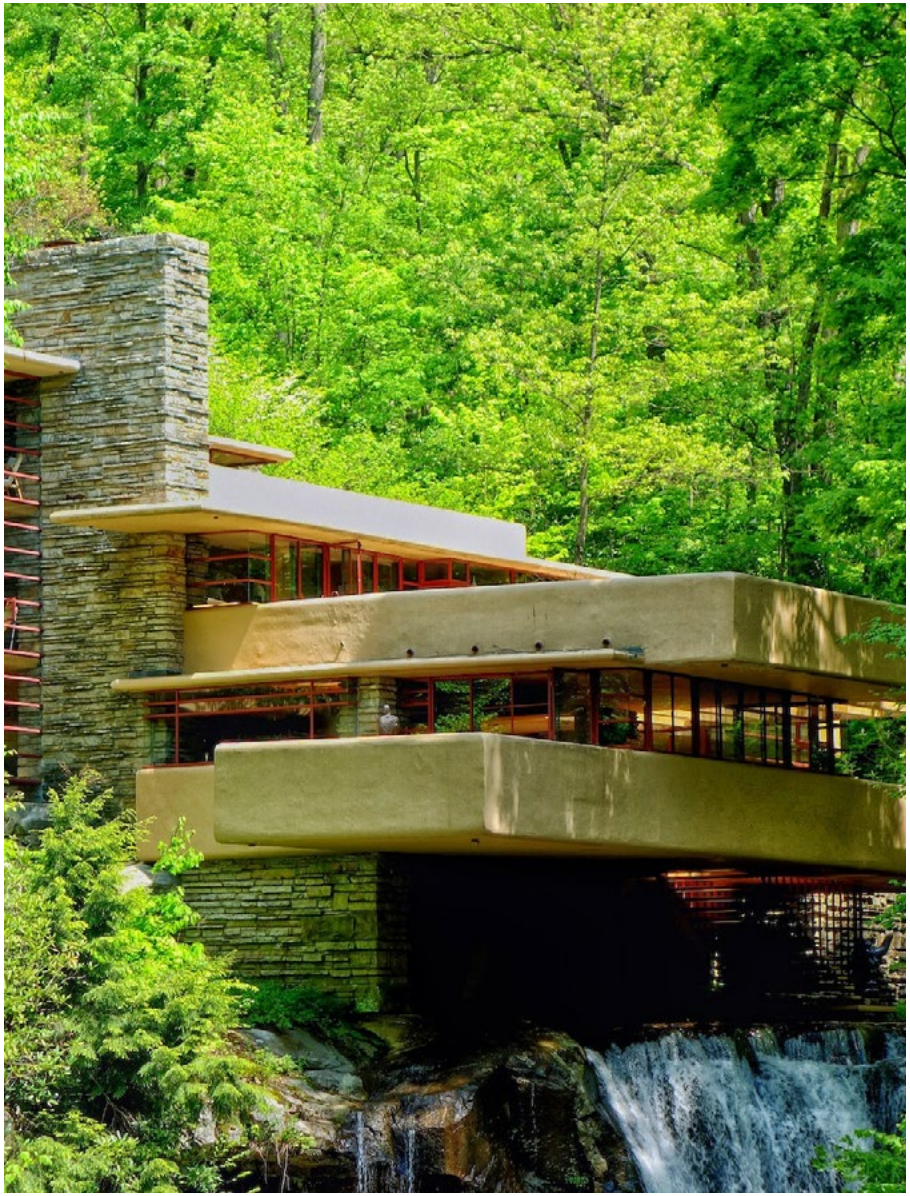
Remodel of the century

Architect Frank Lloyd Wright's genius extends to mechanical systems as well.



Constructed in 1936, Fallingwater embodied the culmination of Frank Lloyd Wright's nearly four decades as an architect. Wright designed Fallingwater for Edgar Kaufmann Sr., of Kaufmann's Pittsburgh Department Store fame, to be utilized as the family's weekend retreat. These two remarkable men formed an immediate bond that would be stretched to the breaking point on a number of occasions during the design and construction of Fallingwater.

Wright's design placed the home's location directly over the falls in the Bear Run stream that Kaufmann had hoped to see from the home, but Wright convinced him otherwise. Prior to its construction, Kaufmann had a number of engineering studies performed, culminating in that stated the site chosen by Wright was unsuitable because its foundation rested on the stream bed, which could be eroded over time. Wright replied that Kaufmann should return the home's drawings because they obviously did not deserve a home of his design! Other engineering reports to follow also received a frigid reception from Wright. Edgar Kaufmann acquiesced to Wright's iron will and determination. He buried the engineering reports behind one of the stones in the dining room wall.

Wright was irascible, cantankerous, ambitious and did not take kindly to being countermanded, but he was also a genius who was passionate, devoted and unafraid to boldly stretch the boundaries of architecture.

Fallingwater would eventually be handed down to Edgar Kaufmann Jr., who donated the home and its 1,543 acres to The Western Pennsylvania Conservancy in October of 1963. During the

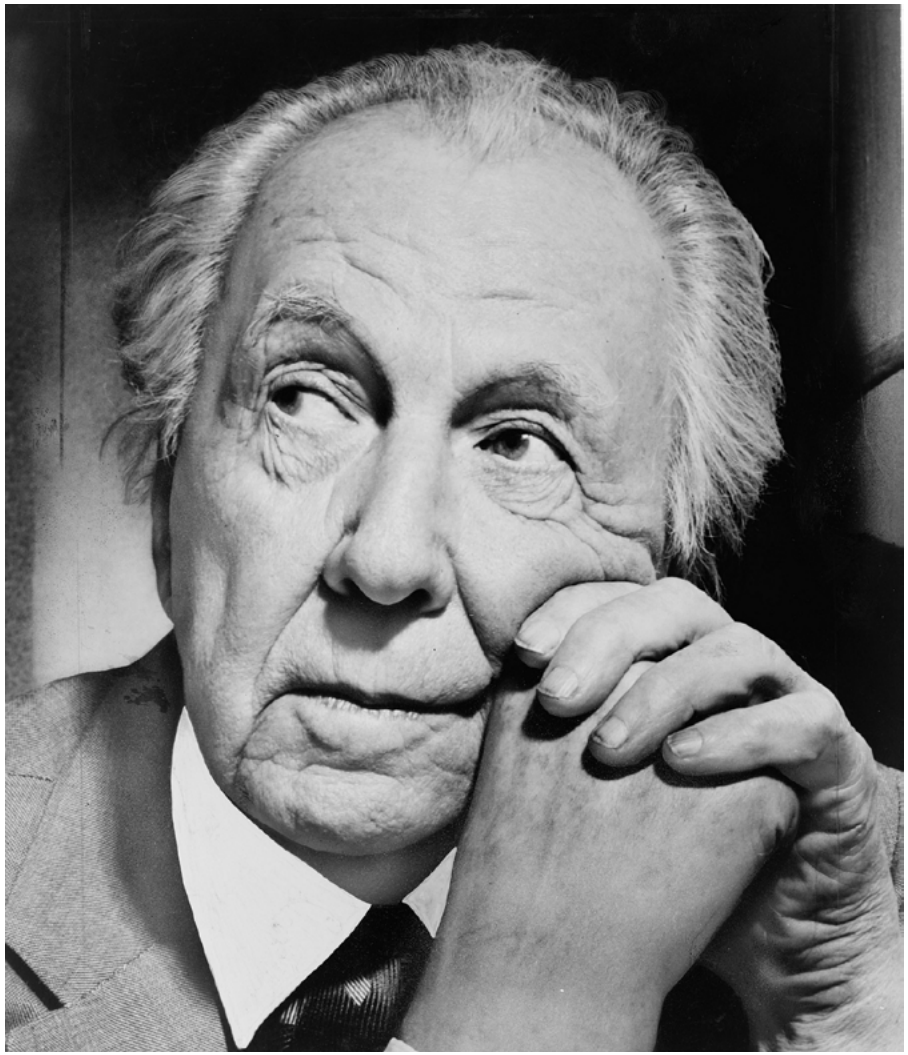
ceremony, he stated, "Its beauty remains fresh like that of the nature into which it fits. It has served well as a home, yet has always been more than that: A work of art, beyond any ordinary measures of excellence…. house and site together form the very image of man's desire to be at one with nature, equal and wedded to nature…. such a place cannot be possessed. It is a work by man for man, not by a man for a man…. by its very intensity, it is a public resource, not a private indulgence." The home was opened to tours shortly thereafter and remains one of the most interesting living museums available to the public.

On July 20, 2000, the American Institute of Architects named Fallingwater as the Building of the Century. However, time and gravity had taken their toll on Fallingwater, and the home was imperiled. To prevent a potential collapse, steel supports were gently erected to carry the cantilevered construction's weight until a permanent structural cure could be found that would not adversely impact Wright's original design. A design was found that involves installing steel cables to counter-balance stresses placed on the cantilevered concrete beams in much the same way suspension bridges are built. In order to incorporate this design into the home, the stone floors had to be removed. When completed, every stone was returned to its original position and the home restored.

The mechanical systems

The original blueprints do not contain any specific plumbing or heating designs. The discovery that Wright had not included radiant heating into the home's original design was a mystery, given the fact that the concrete construction would have lent itself so readily to incorporation of in-floor tubing below the stone pavers.

Adding to this mystery was the fact that the servants' small sitting area behind the kitchen has in-floor radiant heating. On previous tours, tantalizing glimpses of cast iron hydronic convectors could be glimpsed through the wooden slats behind the built-in furniture.



With the flooring and built-in furniture removed for this huge remodeling/renovation project, the hydronic piping and convectors would be exposed. A return to Fallingwater was like a siren's call that could not be ignored!

"The 66-year-old work of the mechanical contractors was exposed and had obviously been installed with great care."

Conversations with Jeff Gaul, the head of buildings and grounds maintenance for The Western Pennsylvania Conservancy, led to the discovery that this project involved a great deal more than just removing the flooring to strengthen the cantilevered construction. They had embarked on an ambitious project involving all of Fallingwater's mechanical systems.

With as many as 1,000 visitors per day, you might imagine the sewage and water systems would be taxed to their limits, and they were. The zero-flush odiferous composting system serving the public restrooms is itself being flushed in favor of an on-site zero-discharge sewage treatment system. Thousands of feet of underground piping have already been laid, along with sewage lift stations; no small feat in given the unforgiving rock and terrain. All components are concealed from public view.

Drainage systems at Fallingwater, both public and private, will be collected and pumped to a hilltop treatment plant where it will be filtered, treated and its liquid recycled for flushing water closets and urinals. Remaining liquid will be utilized for drip irrigation.

The existing open-air reservoir cannot be labeled as potable water because of its small volume size and being subject to potential contamination from animals or debris. A closed system either consisting of wells or connection to a proposed municipal line was in the works. One of the concerns with a well water system involves the acid and mineral content of the local aquifer. The necessary treatment equipment would add to the zero-discharge septic system load as a result of back-washing the filter and media beds.

Fallingwater's electrical system components have either been replaced or upgraded in accessible areas. Although the living room area incorporates natural cooling by way of an open stairway to the stream below, the home gains a lot of radiant heat from the glass and concrete mass. Fans were tucked into the many fireplace chimneys to ventilate the warmer air during tours.

Site inspection

Clinton Piper, assistant director of Fallingwater, accompanied us during our inspection of the renovation construction, hydronic and plumbing systems. The absence of furniture and flooring revealed much of the piping and convectors, likw a wonderful gift were just unwrapped at Christmas.

The 66-year-old work of the mechanical contractors was exposed and had obviously been installed with great care. The only insulation in the home's flooring cavity is the burlap/horsehair material that resembles a very dense moving/storage blanket. Long strips are wrapped around the side-by-side copper supply and return lines. There are 8-inch by 8-inch boxed openings through the concrete poured-in-place floor joists and additional cored openings through the massive concrete cantilever support beams for the 1-inch and 3/4-inch copper tubing.

Rising through the flooring sandwich, the piping is reduced to 1/2-inch and valved as it joins up to the Arco cast iron convectors manufactured by the Pittsburgh-based American Radiator and Standard Sanitary Corp. The walls and furniture form each convector cabinet to conceal the convectors. A layer of asbestos was applied to the wall and backs of furniture at the time of original construction, but was subsequently removed during an abatement project many years ago.

It is, however, somewhat surprising that with exposure to freezing temperatures, the loosely wrapped insulated piping in the floor

cavity has survived more than 60 years without damage. Fallingwater is not insulated and contains massive amounts of stone, concrete and single-paned glass encased in steel sash, which creates a huge heat loss. Together with Wright's shortfall of adequate radiation during design conditions, the heat loss result requires almost constant circulation, thereby averting potential freeze damage!

A trip to the mechanical room revealed the original oil-fired boiler was replaced with a Weil McClain 78 series; model 578; 4.45 gph cast iron sectional boiler. You can be assured this was a knock-down model, given the narrow steps and corridors leading to this small room that's filled with mechanical equipment.

Two B&G series 100 pumps were return mounted, and no air eliminator was visible. An older style steel expansion tank resided against the ceiling, and its boiler drain, located at forehead height, was covered with impact deadening ArmaFlex. Duplicate safeties existed along with isolation valves on the supply and return lines for compliance with the Pennsylvania boiler laws.

The inspection certificate and boiler tag were in plain view. Fuel oil for Fallingwater is maintained in underground storage tanks. The home's 2-inch brass potable water feed enters here and quickly branches off into a variety of sizes with valves both old and new; all are clearly labeled. An electric water heater was located just outside the mechanical room, and there is a half bath off to the side. Even here, architectural features as mundane as a toilet paper holder were distinctively influenced by Wright's design.

Other design features

The sitting area behind the kitchen had originally been another open-air porch, but was closed in several years after Wright had completed Fallingwater. In the interim, he had completed a number of his Usonian house designs and used radiant heating extensively in them. When the Kaufmanns had him return in 1939 to change this porch to an enclosed sitting area, he added radiant to the new concrete floor pour. The servant staff had the most comfortably heated room in the house!

"Architectural features as mundane as a toilet paper holder were distinctively influenced by Wright's design."

Another unusual feature of Fallingwater was every bedroom had its own bathroom. The plumbing fixtures are Kohler, and Mrs. Kaufmann had the water closets recessed into the floor to provide a 10-inch height to the bowl's rim. The Kaufmanns evidently felt that this was in keeping with the character of the home's design and the belief that this particular height placed the user in a "proper" position for using the fixture.

Imagine how interesting a service call would have been to change out the closet gasket! That won't ever be a problem in the main house because they have turned off the water to all of the upper floor bathrooms, which are not used. However, the Fallingwater maintenance staff was faced with just that problem in the office area bathroom, which is located above the guest house garage in what was once the servants' quarters. The guest house is also heated hydronically with its own oil-fired boiler.

The exposed hydronic piping was slated to be replaced — with copper tubing of course — and once covered over, will not be seen for another very long period of time, if ever. New waterproof roofing materials were being installed with 2-inch thick insulation included over heated areas. The tensioning cables were installed and tightened to remove the nearly catastrophic stresses placed on Wright's cantilevered design, but will not be tightened to a point that would counter the deformation that time, stress and gravity has wrought.

Wright's genius lives!

Pay it forward — "Less is more"

Be a friend to all of your customers.

Without hesitating, define outstanding customer service (OCS). Can it be relayed to your customers in writing, or is it simply the actions behind OCS speak louder than words? Is it inherent in your company, automatic per your employees' behavior, or is it taught and practiced by you? Personally, I've found it's a combination of the two — and in need of constant tweaking.

What about the flip side of the OCS coin? One thing for certain, you certainly know OCS when you're on the receiving end!

OCS builds brand loyalty. Don't buy into the notion there's no customer loyalty these days. From the initial phone contact to the sales force to the folks who go out the door to deliver service, all have the power to eviscerate customer loyalty and drive customers to the competition. How many times have you overheard or been told about lousy customer service (LCS)? Fortunes are being made by owners of websites built specifically to allow customers to spout off about their LCS or OCS. Some of it is legitimate, and some is not.

Mom and dad were fond of telling me (repeatedly) that if you give a customer OCS, they might tell three others, but give them LCS and they'll spend their lifetime telling anyone who will listen. Mom would always add friends come and go, but enemies accumulate — be a friend to all of your customers — especially the complainers. She also noted on very rare occasions you will have to fire a customer.

OCS to the rescue

We were awarded the installation of a large commercial-sized cast iron steam boiler for a very large home built back when coal was king. Converted to oil (I'll have 4 gph, thank you), then natural gas a few

We were awarded the installation of a large commercial-sized cast iron steam boiler for a very large home built back when coal was king.

The existing boiler was grossly oversized.

PAY IT FORWARD — "LESS IS MORE"

Les Scrivens of Thomas Somerville goes above and beyond while helping move the Weil McClain steam boiler into the mechanical room.

The F.W. Behler crew load a cast iron section to be recycled.

The F.W. Behler crew load a cast iron section to be recycled.

decades ago and condemned by the gas company for lack of combustion air. The existing steam boiler was, to put it kindly, grossly oversized.

There was no guesswork because the connected load survey revealed the actual size required to adequately meet the system's needs. Demolition revealed its front-end section weighed more than the new boiler! Hat's off to our crew for the OCS in protecting the owner's property and the cleaning that followed. The new boiler's size and its more than half-ton weight were a concern due to the steps to be negotiated and the boiler's shallow-recessed pit.

I'm breaking the tell-three rule by pointing out the OCS delivered. The brand specified, and subsequent requests for quotes, dictated which supplier was to be used: Thomas Somerville. As is the case with several of the local supply houses, they have a power-lift hand-truck available for deliveries. Our contacts there, as is true for almost all local suppliers, go the extra mile, which has built loyalty.

However, the sheer size and weight of this boiler caused concerns for everyone's safety. So much so that we were visited at the home's jobsite by several representatives who had serious doubts about attempting to move the boiler as a single block of factory-assembled cast iron. The

PAY IT FORWARD — "LESS IS MORE"

The new steam header and piping joins to the old system piping.

boiler's end sections have long thin cast iron legs and this was causing much concern for turning the block onto its end for transport-clearance through the home's doorway.

Scott Barnett with F. W. Behler works with the welder building the new steam piping on-site.

Full disclosure: As someone who began his career in the trades in 1972, this was hardly my first rodeo, or largest tussle, with a steam boiler! It wasn't unusual for steam boiler sections we wrestled with to be larger and taller than we were. A lot younger and physically stronger, but dumber in those days, as sheer muscle power and non-motorized, solid-rubber-tire hand trucks were available. Had it not been for the power-lift hand truck, we would have simply dismantled the boiler block into more manageable chunks. As for those apparently too-thin cast iron legs? Lay the boiler on its substantial back and then lift it to rest on its end. No stress on the legs, "No worries mon," as they would say in Jamaica!

That's when I got the call from **Bob Kuhn**, our sales guy at TS. "**Les Scrivens** has volunteered to handle the delivery and will assist with the move-in."

If you ask me, the backbone of this industry — any industry — rests on the shoulders of those who have direct contact with customers. The first time we experienced OCS at Les's hands, was the delivery of two

large modcon boilers, their hydronic rack and dozens of large flat-panel radiators for this job. Les insisted on helping us move each item to its final point of installation. Unexpected OCS! This time was no exception, and Les cheerfully pitched in from start to finish until the new boiler was resting safe and snug in its new home.

With all the whining and complaining that surround us each day, OCS is so unusual it often passes us by without our bothering to tell the owner or boss. Take a minute to let others know when someone provides OCS. Maybe it's the folks at Panera Bread or the cashier at the grocery store or someone from a vendor. Pay it forward and speak up!

The new steam header and piping joins to the old system piping.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CASE HISTORIES

Helipad snow melt

Fourteen miles of 3/4-inch Watts Radiant RadiantPEX+ with a 50% glycol mix were installed once the project was completed.

For many people, when asked to name the earliest example of airborne medevac, the TV show "M*A*S*H," set in the time of the Korean War, comes to mind.

If you're among them, you may be surprised to learn the early 1950s timeframe is nearly a century too late. The earliest recorded use of air transport to get trauma victims to medical treatment occurred in 1870, by means of hot air balloons, during the siege of Paris in the Franco-Prussian War.

We've come a long way. Today, medevac helicopters have twin jet engines, terrain awareness systems, on-board weather radar, night vision technology and a plethora of life saving, high-tech medical equipment.

For the birds

WellSpan York Hospital, located in South-Central Pennsylvania, is one of the only Level 1 regional resource trauma centers in the surrounding counties.

The hospital built a new, cutting-edge helipad as part of an ongoing $50 million modernization of its emergency department, improving the hospital's ability to administer advanced, life-saving specialty care to the region's sickest and most seriously injured patients.

The new helipad adds yet another measure of sophisticated technology to combat one of the last remaining obstacles to safe air transport of patients for medical care: Winter weather. Ice and snow accumulations on flat helicopter pads can pose great risk to airborne patients and those flying the craft as well.

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Fourteen miles of 3/4-inch Watts Radiant RadiantPEX+ with a 50% glycol mix were installed once the project was completed.

HELIPAD SNOW MELT

There's an art to maintaining just the right degree of heat within a concrete helicopter pad to ensure that it's free of ice and snow, which can temporarily blind pilots at a time when they're most vulnerable.

The hospital's elevated helicopter pad is 34 feet off the ground and measures 7,200-square feet — more than 3,000 square feet larger than the hospital's old helipad. The early pad required larger "birds" to land at an alternate location, over a half-mile away, where ambulances would meet them to complete the patient's transport to the hospital.

"In trauma care, every second counts, and this helipad will enable us to provide care even sooner to our most seriously injured patients," said Keith Noll, president of WellSpan York Hospital and senior vice president of WellSpan Health.

Three primary aeromedical systems provide helicopter transport to York Hospital. The hospital received 190 trauma patients by helicopter last year.

Winters in Pennsylvania are a force to be reckoned with. Raw, wet and cold conditions, with wind chills that can drop temps into the double-digit negatives, make the perfect recipe for piles of snow and treacherous ice.

Maintaining York Hospital's new helipad in the winter months is now simple, thanks to its automatic snow melt system with more than three miles of snow melt tubing installed beneath the surface to keep snow and ice from accumulating.

One of the oldest mechanical contracting firms in the area, James Craft & Son, founded in 1900, was the lead mechanical contracting firm for the ongoing HVAC and plumbing renovations at York Hospital. The company installed the steam, condensate, heat exchangers, pumps and distribution piping to all manifolds.

Jeff Ream, the project manager, chose to subcontract the helipad project to our firm. When I asked how they chose us, Ream said, "In all my research, your name and your firm kept popping up and you're well-recognized for hydronic, radiant heat and snow melt expertise.

F. W. Behler is the other oldest mechanical contracting firm in the

Jeff Ream, the project manager, chose to subcontract the helipad project to our firm.

The hospital received 190 trauma patients by helicopter last year.

area (also founded in 1900), and the firm has undertaken hundreds of radiant heat and snow melt jobs through the years.

Was the overall snow melt project a concern for us? After all, we had never tackled a project this large before. No, and here's why: My training via the Radiant Professionals Alliance ensured we could tackle this, or any other radiant snow melt project, with full confidence in its outcome. Before the project would be completed, that RPA training paid off by my being able to make changes on-the-fly and, most importantly, provide advice to the project supervisors that avoided costly mistakes as the project moved forward.

At the hospital, the project called for radiant snow melt not only under the helipad, but also for an access road that was built after the old helipad was demolished, an emergency room entrance, ambulance bays, sidewalks, employees private entrance and roadways that included a bridge.

Operation helipad

"Operation Helipad" required our crews to get the new launch pad up and running in the coldest of winter months. In fact, the winter of 2014/2015 — when they needed to carefully monitor post-install surface temperatures for the first time — was a record-breaking winter for low temps and snowfall.

We'll never forget some of those high-stress days when no matter what we did, we couldn't stay warm. Big jugs of coffee, thermal socks, long underwear, down jackets and multi-layering were no match for those winter conditions.

We knew from the outset, with work beginning in the fall, the first and most important part was to have a safe place for the helicopters to land as winter approached.

More than 16,000 lineal feet of 3/4-inch Watts Radiant RadiantPEX+ tubing was installed before the helipad's cement surface was poured. A glycol mix solution runs through the radiant tubing to provide hydronic snow melting.

More than 16,000 lineal feet of 3/4-inch Watts Radiant RadiantPEX+ tubing was installed before the helipad's cement surface was poured.

"Operation Helipad" required our crews to get the new launch pad up and running in the coldest of winter months.

HELIPAD SNOW MELT

The pad's design included several areas that would not have any tubing — as they were left open to the space below. This would ensure that in case of a crash landing or ruptured fuel tank, the fuel could drain away, avoiding an explosion and providing safe exit for personnel and the patient in the event fuel caught fire.

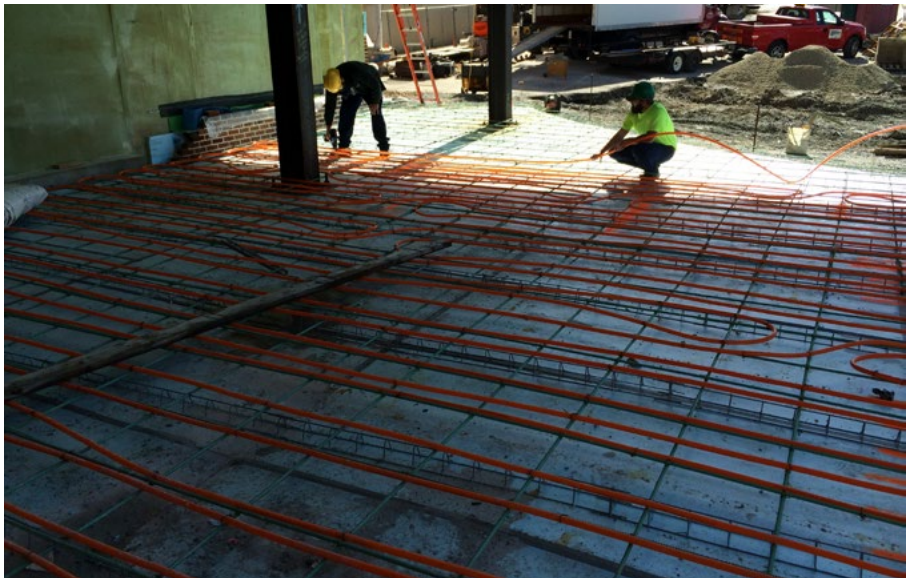
The helipad juts out from the side of the hospital. Its nearly 40-foot elevation means it is exposed to the wind and weather, which meant that snow and ice were sure to collect there if not for the warmth within the pad.

The biggest challenge was wrestling with 3/4-inch RadiantPEX+ in subzero weather. In addition, the helipad offered no shelter from weather and windy conditions.

The formula for getting the job done quickly was to wire the tubing to rebar. This required three people — one person to lay the tubing out, one to wire it to the rebar and one to stand on the cold-hardened tubing. We used motorized wire tie tools to save time, which performed triple wrap twists and cutoffs in less than a second.

One of the fun parts of installing the snow melt was the audience we had. The Watts tubing is bright orange. We were installing it right outside of the hospital with airborne snow swirling all around us. We could glance up at any time and see lots of people from different windows and floors watching what we were doing. Some had binoculars, others took pictures. Given that the helipad was substantially behind schedule, we also had a group of project managers watching over us on-site. They gave us eight days to complete the snow melt tubing installation, but having three crews set up a bit of competitive spirit, we finished in less than a week with pressure testing on all manifolds so we could obtain their sign-off. That was our trial by fire in frigid weather, and we were officially off the hook and had gained their respect.

Another design challenge was created by the manifolds for the helipad, which needed to be installed inside of the loop area. Ordinarily, manifolds are off to the side in snow melting systems and termination points come straight out to a vault. IMG_3764



In all, 14 miles of 3/4-inch Watts Radiant RadiantPEX+ with a 50% glycol mix were installed once the project was completed.

Because of the bump-out areas for sidewalks around the pad and certain areas not getting snow melt for emergency fuel drainage, the tubing had to be installed, and terminated, in different angles. At times, we only had five inches of space to work with.

Where the hospital's old helipad used to be, a new entrance and access road were being built, and completely heated with snow melt. The access road would be completed later, because the emergency room needed to be accessible at all times — it was built in two phases. Phase one of the new access road was complete, along with the completion of a new 12-rig ambulance bay, completely heated with snow melt.

In all, 14 miles of 3/4-inch Watts Radiant RadiantPEX+ with a 50% glycol mix were installed once the project was completed. That's

HELIPAD SNOW MELT

The hospital's new helipad, and other radiant snow melt areas, have been in operation for more than five years.

"This past year we were asked to return to install more snow melt for the entrance and sidewalks for the new imaging center on the other side of the hospital."

a lot of work, PEX and glycol solution. But our teams were equally tough — tough enough to battle the worst that Mother Nature could pitch at them in a wintry tantrum.

In most other areas, large subterranean concrete vaults were installed to house our radiant manifolds. These required OSHA's latest certification for confined space entry. Fortunately, every one of us had been through the training, and we already had all the required safety gear, equipment and a four-gas meter. The hospital's safety director was quite happy to discover we had a written confined space entry plan with the necessary protocols.

The hospital's new helipad, and other radiant snow melt areas, have been in operation for more than five years. As we were installing the last, remaining few miles of PEX, we got satisfaction when we would see a bird coming in for landing, knowing that the new helipad will provide a safe and swift landing, and the patient on board was about to receive the best care possible.

The 'birds' come in swift and safe in all types of weather. With each, another patient has a much better chance of living a longer, healthier life. You can't ask for much more than that.

Well, actually you can! This past year we were asked to return to install more snow melt for the entrance and sidewalks for the new imaging center on the other side of the hospital.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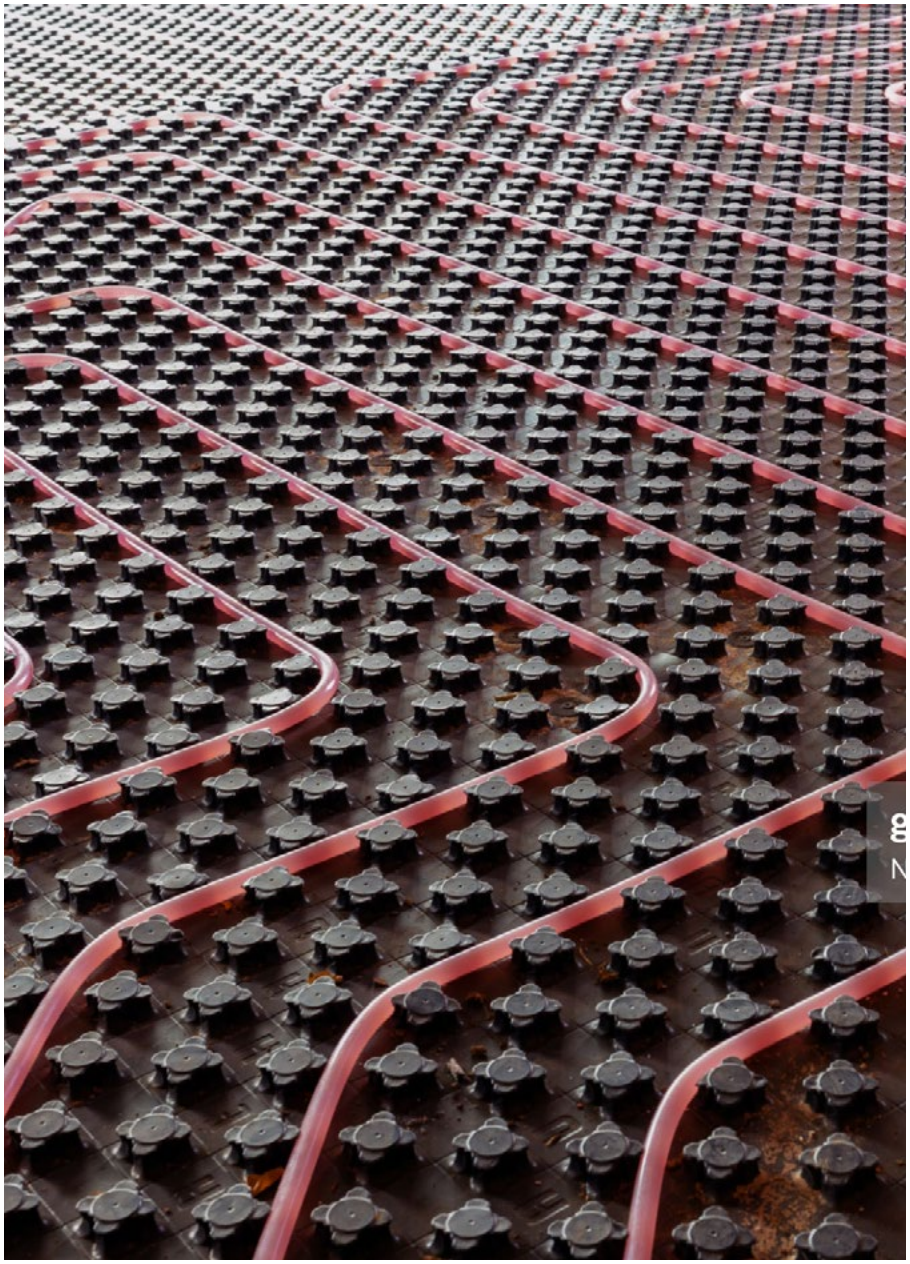
A long loop

"Our radiant heating doesn't heat beyond 60° F and the room over the garage is under 50°," the homeowner said.

The real salt-in-the-wound was the radiant heating had been added to the scope after I had suggested it to the architect while extolling the virtues of radiant heating.

Here was my chance to see what had been done — or should I say not done? I arrived to the home first and parked across from the garage doors to allow the owner access to the garage for his expensive Mercedes-Mayback. As he pulled into the driveway, the garage doors opened, and I spied two 80-gallon electric water heaters, a single Taco 011 circulator and just two 1/2-inch PEX tubes rising from the concrete. My design had included a gas-fired, high efficiency boiler with seven 250-foot loops of 1/2-inch PEX. Their design, as it turned out, had only 1,000-foot loop! The second-floor room that was so frigid? It was open to the lower radiant-floor along its width via a balcony railing.

"We were told the radiant heat would find its way up there and no loops were placed under that floor," said the homeowner.



The fix was more cost than they could bear, so the addition's central A/C system was swapped out for a heat pump. I'd call that a double inside the park hit.

Happy customer

Visiting another homeowner with a comfort problem, I arrived for a new boiler estimate, and asked why they wanted the fairly new Burnham, which was in good shape, replaced.

"We had another contractor work on it and he said it needs to be replaced," said the customer. "Ever since he was here, it stopped heating very well."

It turned out he turned the four-way mix for the radiant slab to 100% hot water (no mix), which was sucking up Btu like an energy vacuum. He also turned the high limit down to 130°! The lower water temperature prevented the convectors and baseboard elements from heating the home (could not heat above 60°) while the radiant addition was experiencing a fairly wide flywheel affect with temperatures rising well above the thermostat setting.

I had him turn up the thermostats for both zones and due to the four-way mix, the boiler could not rise above 125°. The manual four-way valve was reset to an approximate 50/50 mix, and the temperature gauge began a fairly rapid rise, but cut off at 130°.

"He [other contractor] said it had been heating to an unsafe temperature and that this was much safer, and that we need a new boiler," said the new customer.

I reset the upper limit to 180°, and made sure that's when the burner cut off. His wife hollered down from the first-floor asking what we had done to restore comfort. The estimate turned into an adjustable fix. No boiler sale, but a very happy couple and new customer.

Given that this was just before Christmas, I did not charge the new customer — grand slam!

And you know what? They decided to go for the Full Monty a year later and had us install a modern high efficiency mod con boiler and indirect water heater.

Commercial customer

This customer had two hydro-coil air handlers with two A/C systems. They ended up with two 84% efficiency boilers, not the 95% models we had bid. The two new down-flow hydro-air units had the A/C coils below the air handlers, and they failed to retain the prior duct clearance above the floor that previously provided sufficient clearance for the old condensate pumps.

The fix — they whacked a hole in the plywood deck and suspended a condensate pump on thermostat wire while wrapping the ends around drywall screws. There were no condensate traps on the A/C coils and there was evidence that this had caused condensate to be held back due to the negative air pressure caused by the Venturi Effect of air rushing by the drain outlet, which had stained the sheet metal ductwork.

The safety disable switch on the lone condensate pump (receiving condensate from three A/C coils) had been ignored with the two wires terminating in air. All low voltage and high voltage wiring was installed through the air handler cabinets without protection (box connectors or rubber grommets) and stretched tightly over the cabinets sharp edges.

Adding insult to injury, the old filter racks were gone. No air filtration, but the property manager had figured that out and required the installers to correct that. Their solution? Cut the return plenum ells and install sheet metal ledges on three sides to hold filters while adding poorly fitting rectangles of sheet metal over the holes attached with self-tapping screws.

Pricing was submitted to correct all defects and was accepted. Home run!

Dealing with acidic condensate

Combustion-produced condensate is more acidic than battery acid.

The 1980s brought forth the first condensing gas-fired appliances we dealt with: 92% efficiency furnaces. Those first-generation condensing furnaces had more than their share of glitches, which gave us a few more gray hairs while customers chewed us a new behind on more than a few occasions!

In the early 1980s, condensing and modulating-condensing boilers followed and those first generation boilers had their fair share of unforeseen issues, too. I know first-hand because we lived with a nightmarish Glowcore boiler until its heat exchanger failed early in its third year. Having not dealt with combustion-produced condensate previously, we either piped it to a nearby floor drain or to the outdoors using a condensate pump. That first winter, we learned — the hard way — that an ice plug in the pump's termination line led to either a no-heat call when the safety float interlock broke the power to the furnace, or condensate overflow that often soaked items stored nearby. Oops.

All about acidity

Today, it is unusual for us to install boilers and furnaces that do not condense and 95% is the normal efficiency. On average, we were told in classes, it is possible to produce a gallon of condensate for every 100,000 Btu combusted per hour. No one gave any thought to the fact that the condensate was "mildly acidic." Before long, we noticed the concrete where condensate was allowed to drain onto its surface was becoming etched. In addition, cast iron floor drain covers would be eaten through.

Acid condensate neutralizer is visible on the lower right. A black magnetic filter is on the lower left side of boiler.

DEALING WITH ACIDIC CONDENSATE

The pH scale runs from 0 to 14, with seven being neutral. Any number below seven is acidic while numbers above seven are alkaline. Mildly acidic would be six or above. If you have a pH test kit or meter, you can clearly determine the actual pH of combustion-produced condensate ranges from two to five on the pH-scale! That's more acidic than battery acid.

Natural gas or propane combust using airborne oxygen and will form water vapor that, prior to high-efficiency appliances, was kept in vapor form up through and out of the chimney to the great outdoors. Providing the hot gasses remained above approximately 350° F, condensing would only briefly occur on start-ups, unless you had an unlined brick chimney with multiple feet exposed above the roofline where severe damage to the cement and soft bricks could plainly be witnessed.

Once we dropped the outgoing exhaust gasses below 350° in order to extract more useful indoor comfort-energy, masonry chimneys could no longer be used and indirect venting (exhaust to exterior while combustion air is drawn from inside the home) or direct venting (both exhaust and combustion intake are piped to the exterior).

You might ask: Why is the condensate so acidic? Great question! Nitrogen, the largest component of the combustion air (70% by volume), is taken along for the combustion process ride and forms NO (nitrous oxide) and NO_2 (nitrogen dioxide), both of which readily dissolve into the condensate being produced to become nitric acid. You have probably heard about NOX combustion byproducts, which refer to NO and NO_2.

Neutralization

As plumbers, you have no doubt seen the damage to cast iron drainage lines downstream of commercial kitchens and/or grease traps. A ribbon of cast iron no longer present running along the bottom of the piping. The exact same thing occurs in cast iron piping that has been exposed to long-term exposure to acidic combustion-produced condensate.

"National and local codes often mandate combustion-produced acidic condensate be treated at the source to affectively raise the pH to above five with seven being the ideal target."

In the past, we have made up our own acid neutralizers using 3-inch PVC with a solvent-weld cap on the bottom and cleanout plug on the top to add neutralizer. Drilling/tapping the sides for the bottom inlet and top outlet with C-clamps installed on unistrut for wall-mounting. The same neutralizer used for aggressive well-water can be utilized, but make sure it's the blend used for the most aggressive low-pH water.

There is no need to waste the time making your own acidic condensate neutralizer these days, as virtually every manufacturer now sells products designed to last for 12 to 18 months that can be recharged with media during your annual maintenance service calls.

You might have a newer home with all-PVC drainage lines that may well discharge to SDR-35 PVC sewer mains, but sewage treatment plants are seeing a spike in acidity in the waste stream that's causing degradation of metallic components. National and local codes often mandate combustion-produced acidic condensate be treated at the source to affectively raise the pH to above five with seven being the ideal target.

Septic systems can see the necessary bacteria cultures compromised if sufficient quantities of low-pH acidic condensate are introduced. Here again, a wee bit of education for Mr. and Mrs. Homeowner can go a long way in helping you to sell this inexpensive upgrade to your high-efficiency systems.

Handling the disposal of both the acidic condensate and air conditioning coil condensate (which can also be adversely affected by airborne indoor air contaminates) can be relatively simple by

"Where boilers are concerned, we now are more aware of water quality issues with many manufacturers tightening up issues for warranty claims. If you aren't treating your hydronic water, you should be and ignoring that issue may result in denial of warranty!"

discharging treated condensate to a floor drain or pumped to a safe-waste like the clothes washer stand-pipe. Drilling a hole in the basement concrete floor and directly discharging condensate into the Earth is a short-cut that should be avoided by professionals.

Aside from the snot-pool deposited under the floor, radon can easily be drawn in by the air-handler if the evaporator coil cabinet trap dries out during winter or, as is too often seen, no trap was installed. As air passes by the condensate collection gutter under the AC coil, negative pressure is created (Venturi effect), which will draw in air through the condensate drain.

Where boilers are concerned, we now are more aware of water quality issues with many manufacturers tightening up issues for warranty claims. If you aren't treating your hydronic water, you should be and ignoring that issue may result in denial of warranty! You'll have some 'splainin to do with your customer and most likely be on the hook for all costs.

Installing a magnetic filter to capture metals floating around in your hydronic water is rapidly becoming popular. It is amazing to see the crud these magnetic filters capture! Yet one more reason why you should be selling service agreements that include a water quality check and magnetic filter cleaning. Along with a combustion analysis and scheduled heat exchanger cleaning (per manufacturer's guidelines) and, of course, testing safeties.

Got that in writing?

Searching through five years of text, emails, notes, proposals, letters and other correspondence is a huge PITA.

Remember the Polar Vortex back in January and February 2019? No doubt, you busted your butt working crazy hours, striving to keep up with your customers' demands. Seems like every time we have a Polar Vortex or Siberian Express weather event, there's at least one boiler or furnace that becomes its own nightmare event. Like you need more stress in your life!

This time it was a boiler — a single boiler serving a large public space. The first hard lockout occurred on the third day of the extreme cold, which coincides with all you-know-what breaking out after three solid days of sub-arctic freezing weather days. Pipes break, flooding occurs and heating systems go on the fritz or give up the ghost. Hang the phone up; it rings. There were no fault codes, so the boiler was reset, and it fired right off and cycled on/off repeatedly. Showing no signs of another tantrum, we left to move on to the next crisis. Two hours later, it was off again, and once more the same results. Wash, rinse, repeat. The carbide ignitor checked out, the safeties all checked out and the control board passed with flying colors, so ring-ring — hello tech service.

This single boiler should have, at a bare minimum, been two boilers for a commercial public space that serves as a wedding venue and restaurant. We had provided the prior owner with a proposal to install four modulating/condensing boilers in place of the failed behemoth low efficiency chimney-vented boiler. They obviously chose the lower priced chimney-vented low efficiency single boiler bidder, which we discovered when the new owner began using our services.

An added twist

One wing of the restaurant has glass walls and 12 ancient hydronic fan/coil units. We discovered six out of the twelve were not working shortly after the new owner hired us to service the heating system in 2015. As it turned out, they were obsolete with no parts available. Each passing year another one or more units gave up the ghost.

By 2017, the new owner was complaining the glass-walled wing was not heating properly. In spite of repeated warnings — as more and more of the hydronic fan/coil units failed, the comfort of their guests would suffer and the potential for freeze damage loomed larger with each expired unit — the owner told us he had more pressing matters and we should move on to other tasks. I wrote the owner and his management team a letter outlining the issues and the fact that they were down to just one functional hydronic fan/coil unit in that area.

GOT THAT IN WRITING?

Back to the boiler

After several days of hard lockout calls, the control board gave a fault code indicating the carbide ignitor was faulty. We always keep an extra on site because no one locally stocks parts for this brand of boiler, and a new ignitor is needed roughly every six months. Did they agree to scheduled routine maintenance on this boiler, or the other mechanical systems? No.

Tech service — on speakerphone — explicitly stated (with one member of the management team present) that cleaning the gas-fired boiler was now mandatory. To say the heat exchanger was fouled would be a gross understatement. However, after a thorough cleaning, the hard lockouts continued sporadically with no fault codes. By then, all involved parties were frustrated with frayed nerves on our part.

Control board

Another fault code appeared for another carbide ignitor, which we had just received the day prior. We installed the replacement only to obtain another fault code — this time for the control board itself. Same tech service and same test as before, only this time, it was the control board that proved to be defective. We ordered the control board through our wholesaler only to be told the boiler manufacturer is out of stock and it will be weeks before they will have a control board to ship, which was not acceptable!

So we scoured the country! Our wholesaler located a control board half way across the country, and we ordered it next day air — $170 shipping cost. The new control board arrived, and we hot footed it to the job site, installed the new control board only to discover it is defective — right out of the box! Another control board is shipped next day air, we rush back to the job, install the control board and all's well that ends well. Not!

Remember the glass walled wing of the restaurant? Three of the inoperable convectors and a sprinkler line froze, split and created water damage. We capped off the convectors and, once again, warned the owner/management team — in writing — that they need to replace the defective units. This time they asked for a proposal.

The letter

A short time later, we received a letter from the lawyer who represents the insurance company who insures the boiler. After accusing us of every heinous crime he could list, and stating we pretty much took our sweet time responding to the client's distress calls and refusal to provide the correct parts in a timely fashion, their intent was to sue us for recovery of damages! Good grief. I get it that he's a hired gun, but nothing could be further from the truth.

That spurred a records search. The first thing I did was contact our insurance company, who contacted their lawyer, who I knew would ask for anything we had in writing because if it was only he said/she said, we would be toast. Ever search through five years of texts, emails, notes, proposals, letters written and any other correspondence? What a huge PITA.

But, I found the letter from 2017 detailing the glass wall wing's heating issues and a 2015 text exchange regarding the cost to add a second boiler for redundancy or two high efficiency modulating/condensing boilers. The owner and his management team never wanted to follow through on our recommendations, and then there was the long letter regarding the lack of maintenance and their refusal to consider starting routine scheduled maintenance with those issues detailed in writing. As our insurance company's lawyer said, "I was praying you had something in writing. What you have provided is perfect!"

If it's not in writing, it doesn't exist. CYA! Who knows, maybe the owner's insurance company will turn back on them and refuse to pay for the property damages? Or, if they've already paid the owner for the damages, seek to recover all monies paid.

Yesterday, today and tomorrow

Assembling prior columns, updating older information, along with some new content for the four eBooks has been an interesting review of my 48-years as a mechanical contractor. It also reveals my progression from black hair to mostly gray — marking the passage of time!

Looking back, it seems heating was in my future from very early on, and starting at the advanced age of six, I was allowed to tag along with my Pop-Pop who owned a Westinghouse appliance store. Not only did **Roy H. Gorman** service the appliances, TVs and radios sold in his store, he also installed new electrical services and boilers. Saint Claire, Pennsylvania, was in the heart of the anthracite coal region, and their home, as well as his customers' homes, were heated with coal-fired boilers.

When I turned 8, Pop-Pop would let me help with hands-on experience. Customers would bring in tubes from their appliances, and he had a huge tube tester with ports for every size, shape and matching voltage, which I became adept at using. But the thing I enjoyed most was helping him on heating service and repair calls. Cleaning out the ash pits became a way for me to earn some pocket money. Looking back, the boilers were simplistic, low efficiency and easy to repair and maintain.

Fast forward to 1972 when I began my trades career. Boilers and furnaces were low efficiency, and 56% to 70% AFUE was considered to be moderate to high efficiency. In reality, we did not yet know the term AFUE because it wasn't until 1975 when ASHRAE (American Society of Heating, Refrigeration, and Air-conditioning Engineers) developed the standards for SEER, EER, HSPF and AFUE, which were detailed in President Gerald Ford's Energy Policy and Conservation act in 1975. As Captain Barbosa said in "The Pirates of the Caribbean," "The Code is more what you'd call guidelines than actual rules." So these new

guidelines for energy efficiency were just that: Voluntary guidelines! No teeth meant no changes in AFUE.

A little history on efficiency standards

In 1979, I struck out on my own to pursue the American Dream. Ironically, that included a return to my roots because a friend who sold Eshland coal boilers hired me to do the installations. Some of the larger models held more than 120 pounds of coal and held full output at stated ratings for three days — or longer in milder weather. Dang things weighed as much as an army tank and were often installed on farms, so the farmers often assisted with tractors to handle the weight as we lowered them down exterior stairwells. To this day I can recall that pure coal, which doesn't exist in nature, holds 1,440

Btu per pound. I had to learn all about coal because I ended up testifying as an expert witness a few years later in a case where a coal boiler manufacturer's literature was, to put it mildly, completely false regarding operating efficiency and Btu output over a stated range of hours. Our client was awarded full judgment.

At one of our plumbing association meetings in 1977, the guest speaker brought along his invention for upgrading the operating efficiency of any furnace, be it oil or gas. Essentially a scrubber, it consisted of a hot water coil to be installed in the return plenum, a tee to install on the flue gas outlet (before the draft diverter), a box that contained a water chamber with pump to circulate water to/from the hot water coil, and an opening where the flue was to be connected. Inside the flue riser, there was an injector for water to be pumped through an oil burner nozzle. The expanding cone of water spray created a Venturi effect that would draw all or a portion of the flue exhaust, which scrubbed the heat energy. The resulting hot water was circulated to the coil and the now cooled exhaust was to be piped to the exterior using plastic piping. My calculation revealed we were now operating at 94% AFUE!

Its main drawbacks were cost, and it was very noisy. I would see this incorporated into an experimental boiler I beta tested for a boiler manufacturer in the early 2000s. When I saw it in their R&D lab, I remarked how similar it was to my 1970s scrubber. Turned out it was the same inventor who persuaded the boiler manufacturer to incorporate it into an experimental model.

On Oct. 1, 1977, President Jimmy Carter enacted the Department of Energy Organization Act, which birthed the U.S. Department of Energy. However, the DOE failed to come up with minimum standards and, as a result, mass confusion reigned with individual states mandating efficiency standards (no longer mere guidelines).

Imagine being a manufacturer of HVAC equipment and dealing with operating efficiencies being different from one state to another! Manufacturers had to resort to suing the DOE for its failure to enact efficiency standards as was mandated in the 1975 Energy Policy and Conservation Act. Their suit was successful, which led to the first mandated efficiencies in 1978. It wasn't until 1987 that Congress passed the NAECA (National Appliance Energy Conservation Act). The minimum AFUE for furnaces was 78%, which seems laughable looking back in time compared to today's furnace and hot water boiler EFUE ratings that both can achieve 99%.

In the mid-1980s we saw AFUE reach into the low 80% range, and suddenly we were confronted with a new phenomenon — flue gas condensation. Although not common, it wasn't unusual during cold weather to see a wet or frosted chimney outline on exterior walls of row homes as condensation from flue gasses seeped into the unlined brick chimneys. One that still stands out in my memory was a three-apartment row home where the landlord, as was becoming increasingly popular, had installed a separate boiler for each apartment. The end result was occasional low stack temperatures as boilers cycled on/off rather than one larger boiler maintaining an elevated stack temperature. All of the 28-gauge flue pipes were rotted through, and the occupants were in danger from CO poisoning.

In many cases, retrofit power flue gas exhaust systems had to be installed to sidewall vent the boilers or furnaces. That rendered the chimney vastly oversized for the water heater(s), and they too had to be outfitted with powered exhaust or replaced with direct-vent models.

We older folks can recall Jimmy Carter's push for installing programmable thermostats, and his 10/10/10 suggestion that setting back the heating 10° for 10 hours would save 10% in operating costs. He suggested thermostats should be set no higher than 65° F, to wear a sweater while setting the heat back to 55° when sleeping or away from home and cooling set no lower than 78° with a corresponding 88° set up. Bear in mind, this was during the oil crisis time period, and Carter was striving to reduce oil consumption. Many followed his suggestion and we were installing lots of programmable thermostats. Commercial buildings had

mandated limits on heating and cooling temperatures while residential was voluntary. The end result was oil consumption dropped by 300,000 barrels a day. President Ronald Reagan nixed Carter's mandate for energy conservation.

In the 1980s, 92% high efficiency condensing furnaces became available, and our foray into selling energy conservation began in earnest. The first models often had "complications" that bit us pretty hard in our wallets as business owners. Some had premature end of lifespan, which cost us some customers, but we stayed the course and condensing furnaces became very reliable.

Then came ISH, the major trade show held in Frankfurt, Germany, every two years. Modulating condensing boilers and ECM circulators that I saw opened my eyes to energy conservation issues on both the fuel and electrical energy consumption. Viessmann arrived in the USA and Heat Transfer Products developed the Munchkin with a much lower price-point. Many of our customers opted for the Munchkin, as you'll see in my eBook stories and pictures. Unfortunately, few of the Munchkins survived beyond 10 years. Today, virtually every boiler, furnace and tankless water heater manufacturer has modulating condensing models. Although still available, the price-point between 92% and 95% efficiency condensing furnaces has narrowed to a point where I can't remember the last time we installed a 92% furnace, or, for that matter, an 84% efficiency model. For us, 95% became the norm long ago. The same thing can be said with regard to modulating condensing hot water boilers with 95% efficiency being the majority of our installations.

Looking ahead

Which brings me to consider what's going to become the norm in future years. Here are my predictions:

• Wi-Fi connectivity with PHVAC equipment will be standard. That's already underway;

• On-board diagnostics will alert you and the property owner before an issue causes a breakdown. No more blinking light-codes because the appliance will talk to you in whatever language you prefer or send you a text or an email;

• You will no longer need a combustion analyzer, as equipment will automatically adjust for optimum combustion. This too is on its way sooner rather than later;

• Safety will be enhanced because a CO leak will result in a hard lockout;

• Chimneys will no longer be needed;

• Flame rods and igniters will be obsolete and replaced by light beams that can be hot enough to cause ignition and read flame conductivity;

• Technology will advance to a point where no heat-energy remains in combustion gasses and will cool flue gas below surrounding ambient air temperature rendering 99% AFUE as yesterday's technology;

• PVC will be outlawed for venting combustion byproducts (short-term) and newer plastics will join polypropylene for venting combustion byproducts;

• Infrared sensors will make the thermostat obsolete;

• Circulators will become obsolete with hydronic flow electrically induced to any flow required;

• Fossil fuels will be replaced by alternate fuel sources that cost less to operate and no venting to atmosphere will be required. We've already seen this with high-efficiency VRF (variable refrigerant flow) mini-split heat pumps, although their lifespan leaves much to be desired at this time. I'm referring to furnaces, boilers and water heaters;

• The DOE, if they still exist, will grow a pair and raise the bar regarding minimum operating efficiencies;

• Water-based heating products will include onboard water conditioning and filtration. Steam boilers will no longer rot out at the water line due to changes in manufacturing; and

• Plumbers and HVAC workers will be held in reverence and handsomely paid for the societal benefits their essential work provides.

THANK YOU

A special thanks to Dave Yates and our eBook team for compiling all the useful and entertaining content regarding advice on radiant and hydronic systems.
And thanks to the sponsors who helped make this eBook series happen!

Stay tuned for more great eBook content from Dave in 2021 covering his three plus decades in the plumbing/heating/cooling field.

In the meantime, please bookmark the below link to access this series anytime — and pass it on to your friends and colleagues in the business. They will appreciate it!

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