ELECTRICAL WIRE PROCESSING TECHNOLOGY EXPO

APPLIANCE & HVAC REPORT

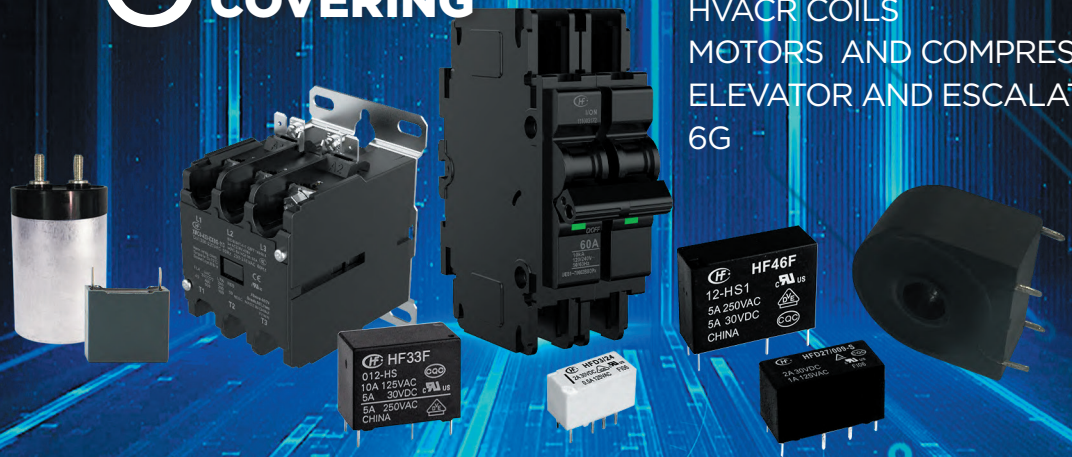
Reaching Design Engineers at the OEM Level

April 2024 www.appliancehvacreport.com VOLUME 6 ➢ NUMBER 2



6 FEATURES COVERING

- COOLING TOWER WATER
- HFOS
- HVACR COILS
- MOTORS AND COMPRESSORS
- ELEVATOR AND ESCALATOR DESIGNS
- 6G



TECHFLEX
Braided Sleeving Products

ELECTRICAL WIRE PROCESSING TECHNOLOGY EXPO 2024

CONFERENCE: MAY 14-16 | EXHIBITION: MAY 15-16

BAIRD CENTER | MILWAUKEE, WI

HARNESS THE FUTURE

Catch a Rising Star's Keynote at EWPTE



KEYNOTE SPEAKER:

Christina Rutherford

Advanced Materials & Process Engineer,
Honeywell Aerospace Technologies

Christina Rutherford is an IPC Rising Star and Honeywell Aerospace Outstanding Engineer Award winner. Rutherford was the inaugural Hillman-Lambert Committee Member of the Year awardee for her work as co-chair on the IPC/WHMA-A-620 Space Standard Committee. She will feature the standard in real-world examples to show why it's important to develop and successfully implement process controls throughout the supply chain.

Don't Miss Out!
WEDNESDAY, MAY 15

PRESENTATION:
Process Controls and Their Impact on Supply Chains

Connect with more industry leaders, suppliers, and experts.

Register today!

Produced by:

WHMA Wiring Harness Manufacturer's Association | IPC BUILD ELECTRONICS BETTER | BAIRD CENTER

LEAD | EDUCATE | CONNECT

ELECTRICALWIRESHOW.COM | #EWPTE2024

We beat THE NEW YORK TIMES…



The Sunday, March 10 NEW YORK TIMES had an article entitled ''Maine Warms Quickly to Electric Heat Pumps''. Great stuff, but we beat them too it, in our first quarter issue: Appliance & HVAC Report Vol. 6, No. 1 (appliancehvacreport.com) . See pages 26-27. Score one for the business-to-business industry!

Welcome to our Second Quarter issue. It's our pleasure to note we continue to generate great readership numbers from our editorial product. How do we know? Our best barometer is our bi-weekly newsletter, which is generating ''open'' rates greater than 30%. So our readers, OEM design engineers, want it conveyed to them, primarily in digital form. But for longer articles and stories we still rely on our magazine, digital (with print for tradeshows).

Regarding print for tradeshows, this issue will be distributed at the Electrical Wire Processing Technology Expo (EWPTE for short). It's in Milwaukee, Wisconsin May 14-16. Stop by and say hello. We are at booth #1448.

I want to give a ''shout-out'' to our friends at CSA Group and Intertek. As our still young brand continues to grow we develop new marketing options for suppliers. These organizations both have engaged THE APPLIANCE & HVAC REPORT to host webinars for them, to educate our audience further.

They are the first (and not the last I am sure) to do so. By the time you have this issue in your hands or on your computer screen CSA's webinar is complete. If you need the link we can send it…just let me know. Intertek's is coming later this year.

As usual we have a fair number of tech articles for your consumption. Thanks to Chemours, Hongfa America, Littelfuse, Molex and a newbie working with us, NeoTEch Aqua Solutions/ChemRid. These companies and others willingly supply their materials to us, via a barter arrangement, so they can get them in the hands of our 24,000 audience. Quite simply, without this kind of cooperation we could not exist.

Have a great spring and we will see you with our third quarter issue, deployed in early July.

Regards,
Brad Glazer
Editor/Publisher
brad@appliancehvacreport.com
216 233-6943

APPLIANCE & HVAC REPORT
Reaching Design Engineers at the OEM Level

Reaching
Design Engineers
at the
OEM Level

Brad Glazer
Founder & Publisher
brad@appliancehvacreport.com
(216) 233-6943

Stefanie Mirman
Art director
stefaniemirman@gmail.com

JABS Media, LLC

Contents copyright (2022) by JABS Media, LLC, Executive Offices: Brad Glazer, 3793 Meadowbrook Blvd., Cleveland, OH 44118 • Tel: 216-233-6943. **Postmaster:** Send address change to Appliance & HVAC Report, 3793 Meadowbrook Blvd., Cleveland, OH 44118.

Information presented in Appliance & HVAC Report is supplied by manufacturers and/or advertisers and is, to the best of our knowledge, accurate. JABS Media, LLC makes no representation, warranty or guarantee, expressed or implied, as to the quality, marketability, fitness for a particular purpose or use, or other characteristics of any product or material referred to in its publications. Publication does not constitute endorsement.

Follow us on

LinkedIn
https://www.linkedin.com/company/appliance-hvac-report

https://twitter.com/AppHVACReport



Cover Photo courtesy of HONGFA AMERICA

April

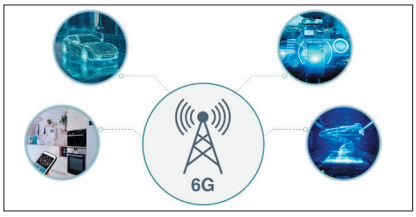
FEATURES

5 

An Alternative Method for Treating Cooling Tower Water Without Chemicals
By George Diefenthal, CEO of NeoTech Aqua Solutions, and Epifanio Zamudio, President of ChemRid

7 

The World Needs HFOs: How We Got Here and Why We're Staying
By Andrew Pansulla, Technical Service Engineer, Chemours

10 

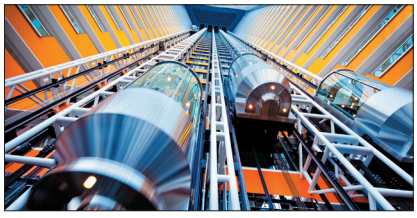
Will 6G Trigger a Manufacturing Revolution?
By Roger Kauffman, Sr. Director, Product Management & Marketing, Molex

12 

Dispelling Misinformation about Corrosion of HVACR Coils
By Marcus Elmer, Director of Tube and Fittings with the Copper Development Association

18 

The 5 Things You Should Know to Specify Relays for Motor and Compressor Protection
By Rich Hall, North American Marketing Manager for Hongfa America

22 

Take Your Elevator and Escalator Designs to the Next Level
By Ryan Sheahen, Global Strategic Marketing Manager for the Electronics Business Unit.





DEPARTMENTS

26 News Beat

38 Advertisers Index

An Alternative Method for Treating Cooling Tower Water Without Chemicals



Cooling Tower Conditioning System

Introduction

Providing cool air for comfort or to keep process water chilled is a vital part of today's industrialized world. Removing heat from these processes is accomplished by passing air over cooling fins or through the evaporation of water. Due to concerns from the need for chemicals there has been a trend in the industry to move away from water towers in favor of air-cooled systems, however, size, efficiency, and other factors prevent the industry-wide discontinuation of water-based evaporative cooling systems. Increased regulatory requirements and costs associated with water cooling towers, including the cost of chemicals, issues with the chemical content of blowdown water, chemical storage, maintenance costs, operator training, excess water usage, and the life of the equipment make a case for the implementation of chemical free water treatment equipment for cooling tower systems. We will explore the use of existing technologies that can address these issues.

Chemical Treatment

The most common method currently used to treat cooling towers sumps is through chemical treatment. The chemicals come in many formulations, but they all are designed to provide the three basic functions of disinfection, corrosion control, and anti-scaling. As is often the case when introducing chemicals into the water treatment industry, regulation often follows after they have been put into use. As a result, some of these chemicals have been banned due to their carcinogenic potential. Another long-standing issue is the concern over the chemical load associated with blowdown water and the impacts on wastewater treatment systems.

The disinfection aspect of the chemicals focuses primarily on the prevention of biofilm. Accumulation of biofilm is associated with reduced efficiency of the cooling tower, increased maintenance costs, and a reduction in the life of the equipment due to overuse and microbiologically influenced corrosion (MIC) underlying biofilms. In addition, antimicrobial chemicals tend to be acidic and can attack the cooling tower materials, which is where the addition of anti-corrosion chemicals comes in to play.

An additional concern with cooling towers is the potential for spreading legionella spores. According to the CDC, nearly 10,000 cases of legionella were reported in 2018, and it is suspected that the number is significantly under reported. Furthermore, a CDC-sponsored study of cooling towers across the country found that 84% contained legionella bacteria. While the spores can enter the system via the atmosphere, it is generally recognized that the major source of the bacteria is the makeup water. The presence of legionella bacteria in drinking water is generally harmless. The legionellosis illness occurs from inhaling the spores, not ingesting them. While

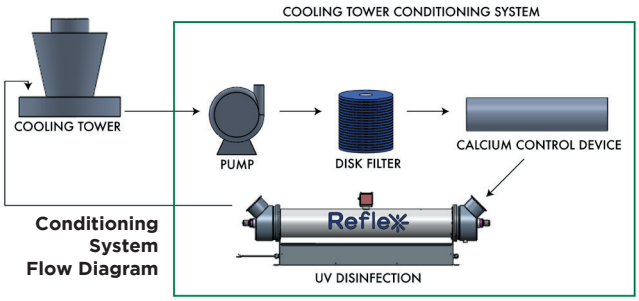


legionella is not common in cooler months, the bacteria can hide in biofilm and then be released during the warmer months.

Scale is the second build up of concern in cooling towers. The biggest concern here is build up on the cooling fins. Scale formations reduce cooling efficiencies and can lead to a shortened life of the equipment. Once they have formed on the fins, an acid bath is generally used to clean the screens, also affecting their long-term life.

Finally, corrosion often occurs under a build up of biofilm or scale (MIC), which can lead to equipment failure rapidly.

A Chemical Free Design



Conditioning System Flow Diagram

So, due to the challenges faced by chemical treatment of cooling tower water and the need to address biofilm and scale buildup, we decided to identify other technologies that could be used. The result is a skid that combines filtration, UV, scale treatment, and eductors, see Figs. 1 and 2.

Filtration. A filter is used to remove the debris that is brought into the sump from the fans, make up water, and scale particles. The filter will dump about 10 gal. every hour, so there is some blow down, but it is chemical-free.

UV. Ultraviolet disinfection has been in use for many years and provides a replacement for the biofilm chemicals. The water circulates past the UV system several times an hour, which does not give bacteria any time to settle and start the biofilm process.

A bi-metal device with a sacrificial anode is used to convert the calcium carbonate to aragonite, instead of calcite. While this conversion is temporary, it is long enough for the particles to flock and be captured by the filter. There will still be a need for anti-corrosion chemicals to treat pipes that lead to and from the facility, so depending on the design, some chemical usage may still be required.

Eductors. The water in a sump is often not well mixed or circulated. Therefore, eductors are used to assure that the entire volume of the sump is treated and that there are no dead zones present.

Does it Work?

So, having assembled the required technologies, the question is does such a solution provide the desired results, and the answer is yes. Early versions of the technology have been in use for four to five years. These cooling towers have been in chemical-free use the entire time(except as noted above) and have remained biofilm-free and exhibit no scale build up since the skids went on-line. In a more recent installation, Nov.'22, the sump water is tested weekly. This was a new installation, so the tower was started in a chemical-free state since installation. The weekly test results show a bacteria count of only 1 – 3 CFUs, significantly better than typical city water.

Cost

The final question then becomes, is this a cost-effective solution? The result from the early prototypes showed that the ROI for the skid is generally in the 9 to 12-month range. These savings are based on the cost reduction of the chemicals and water usage. Additional cost reductions, not included in the ROI calculations include:

- Chemical storage costs
- Maintenance personnel training costs
- Handling costs
- Reduction in electricity used
- Extended equipment life

Summary

With this technology it is possible to reduce or eliminate the use of chemicals in most applications, resulting in significant cost savings and a benefit to the environment. With the use of this device the decision to use the more efficient water cooling versus air cooling system becomes an easier decision. Results to date have borne out the benefits of this technology. ■



Epifanio Alberto Zamudio, is a graduate of the Technology Institute in Hermosillo, Mexico. Where he received a B.S. in Electrical and Industrial Engineering and Computer Science
Alberto has over 35 years of experience in computer and industrial equipment automation and for the past 10 years, focused on water quality and reduction of chemical waste.
As head of Chemrid, he continues to search for solutions with innovative technology to address several of today's water problems.



George Diefenthal is the CEO of NeoTech Aqua Solutions, and has been involved in the UV water treatment industry for over 20 years. He has an BS in Electrical Engineering (1981) and an MBA (1991) from San Diego State University. During his career he has held positions and managed groups in engineering, manufacturing, operations, and sales.

The World Needs HFOs:
How We Got Here and Why We're Staying



Refrigerants. They are something the average consumer doesn't think twice about. In fact, most don't even realize just how many applications refrigerants have in their daily lives. Consumers trust that their HVAC contractor, auto mechanic, local grocery store manager, and so forth are equipping all the places refrigerants impact their lives with the most reliable, safest product. Moreover, consumers expect these products to support a healthier planet.

For OEMs, contractors, suppliers, and facility managers, refrigerants require a great deal of thought, education, and strategic planning because of the refrigerant transition happening in and beyond the HVACR industry. The transition is driving reduced use of hydrofluorocarbons (HFCs) in favor of hydrofluoroolefin (HFO) refrigerants, HFO blends and—at the head of the line—the newest generation of HFOs, classified as A2Ls. As for what is driving the transition, we have an integration of regulatory policies happening at local, regional, and national levels, with a worldwide movement toward decarbonization.

The regulations in place have been structured to ensure a smooth and feasible transition. However, what the industry is going through remains fairly complex. Although different evolutions have occurred to replace refrigerants with better ones, we see many refrigerants along the timeline still in use. In a single week, an HVAC shop may service a family restaurant with a Freon™-charged walk-in, retrofit a local supermarket's cooler for an HFO, and install a new A2L HVAC system for a large office building. In addition, scientists like those at Chemours continue to push the envelope in refining current refrigerants to offer even lower global warming potential (GWP), while achieving the optimal balance of performance, safety, and other sustainability properties.

The history of refrigerants can illustrate why and how the industry is where it is today, and why it's important to prepare for a world that will increasingly rely on A2Ls. This journey can also help you better appreciate the role certain refrigerants play today and start or continue a refrigerant plan that supports your company's growth goals and sustainability commitments.

Opteon™

- ☑ Non-ozone-depleting
- ☑ Non-carbon-emitting
- ☑ Low GWP (Global Warming Potential)
- ☑ Low flammability
- ☑ Non toxic
- ☑ Safe operation
- ☑ Available supply
- ☑ Easy installation
- ☑ Versatile usability

Traveling the Refrigerant Timeline—Origin, 1000 B.C.

Around 1000 B.C., industrious individuals in Asia first harvested snow and ice from local rivers as their "refrigerant." They kept food cool by packing it with snow or ice into pits and domed structures made from mud. Fast-forward to the late 1800s and icemen delivering blocks of ice to residences and businesses for their iceboxes. To this day, ice remains a refrigeration material used for everything from beverage coolers to "icing" iced lattes. For our industry, although ice is not the literal refrigerant anymore, producing it plays a significant role.

Our modern understanding of refrigerants as gases starts in the mid-1870s, when ammonia was first used in compression refrigeration machines. This was followed by carbon dioxide (CO2) refrigerants in the early 1900s, and the commercialization of propane refrigerants in the 1930s. Today, these so-called "naturals" continue to have some skin in the refrigerant game.

While "natural" refrigerants served their purpose early on, the common use of ammonia, sulfur dioxide, and CO2 raised concerns over toxicity, safety, and efficiency. In the 1930s, DuPont—the company from which Chemours spun off—invented Freon™. For generations, these chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) refrigerants addressed safety concerns and solved several performance issues of their predecessors. However, a growing hole in the ozone layer put CFCs and HCFCs on the hot seat. Chemists developed a better solution, focusing the industry on HFCs, which offered excellent performance properties and zero ozone depletion potential (ODP). The 1987 Montreal Protocol accelerated adoption of HFCs by implementing a global phasedown of HCFC production and consumption. While HFCs helped fix the ozone layer, they were later found to contribute to a rise in global warming.

Scientists then turned to innovating HFO refrigerants, which have zero ODP and offer stellar performance properties and significantly lower GWP. HFO and HFO blends have been in use for several years in new equipment and retrofits. The solutions under this umbrella include products such as R-449A and R-513A. The Jan. 1, 2022, launch of the EPA's HFC phasedown—implemented under the American Innovation and Manufacturing (AIM) Act—spurred more HFO adoption. On Jan. 1, 2024, the AIM Act implemented an additional 30% reduction in HFC manufacture and consumption. HFO-based refrigerants are on a fast track to becoming the dominant solution across the board for the HVACR industry.

Today, we're at the early stages of the A2L era of our timeline. Chemists developed A2Ls to further lower GWP and maximize the performance, operating efficiency, and energy savings of HFOs. These HFOs carry the ASHRAE and ISO Safety classification of A2L, due to their low flammability. New-generation A2L refrigerants—found in the Chemours Opteon™ XL line—deliver very low GWP solutions. A2Ls also support increased system efficiency, lower energy consumption, low toxicity, and improved safety for use in a broad range of applications, and they can lower operating costs throughout the life cycle of the refrigeration equipment.

The World Needs HFOs

Refrigerant history shows why HFOs sit atop the evolutionary scale. The bottom line is, HFOs support critical applications that allow our homes, communities, societies—and world—to function, evolve, and thrive. Moreover, they do so in ways that enable energy efficiency and advance global climate targets by helping industries reduce dependence on fossil fuels and achieve emissions reductions. A significant way HFOs support decarbonization is through the electrification of heating, cooling, and transportation. Consider just a few applications in which HFOs make our lives and society possible:

- Climate control in offices, hospitals, and public and private buildings
- Heating and cooling for homes
- Comfort cooling for internal combustion engine vehicles
- Thermal management for EVs
- Ensuring a robust cold chain for food quality and safe pharmaceutical transport and storage
- Medical devices and pharmaceutical processing
- Enabling digitalization, high-speed computing, and more through thermal control of data centers
- Improving energy recovery for various industries, through waste heat and electricity production

And because HFOs can be recovered, reclaimed, and reused, they minimize resource waste and support circularity.

The Future Calls for A2Ls—as Easy as A-B-C.

A2Ls represent the ultimate "hero" of the HFO transition, as do OEMs and contractors who are already embracing and moving forward with this technology. It's important to note that, due to their low flammability, A2Ls are used in new equipment only. With their lower GWP and ability to decrease costs and emissions of running systems, A2Ls are being adopted more and more in refrigeration systems around the world, chosen for their ability to support regulatory compliance as well as their performance attributes.

At Chemours, we stand by the concept that ''together, the future can be as easy as A-B-C.''

- R-454A (Opteon™ XL40) for supermarkets and industrial. In one recent installation—a world-first switch from R-744 to R-454A in a supermarket application—the use of Opteon™ XL40 resulted in 34.5% reduction in annual energy consumption, 29% lower total system emissions, and refrigerant leakage reduced to 3%. (For additional information explore the case study, ''ASDA and A2Ls: How HFOs are Helping Retailers Get More for Less'' at opteon.com.)
- R-454B (Opteon™ XL41) for air conditioners and heat pumps. Offering a 78% reduction in GWP compared with R-410A, Opteon™ XL41 is a leading lower-GWP alterative to R-410A. (For additional data see the Opteon™ XL41 product sheet for properties, uses, storage and handling at opteon.com.)
- R-454C (Opteon™ XL20) for supermarkets and industrial applications, with a GWP of less than 150. The adoption of Opteon™ XL20 by Hensley Beverage for their cold-storage warehouse is paving the way for A2Ls in commercial refrigeration.

As regulations and ''megatrends''—ranging from heat pumps emerging as the superstar of decarbonization to the criticality of circularity to the emergence of immersion cooling and more—continue to shape refrigerant use, HFOs and especially A2Ls provide what our world needs to drive future environmental and societal progress.

For more information on HFOs and A2Ls, visit opteon.com.■

ABOUT THE AUTHOR

Andrew Pansulla, *Technical Service Engineer, Chemours*

Andrew has been immersed in the chemical industry for over a decade. His first assignment as an Associate Investigator with DuPont entailed researching next-generation refrigerant solutions to support new-product launches. This is where Andrew first tapped into the passion that distinguishes him in the industry today as technical service engineer with Chemours. His ability to strike the right balance between understanding the science and technology with understanding the realities and needs of businesses has made him well respected, sought out, and ''a winner'' internally at Chemours and among the many communities it serves. Andrew's technical support is critical in helping contractors, engineers, and end users across the HVACR industry transition to more sustainable refrigerants while minimizing business disruption. Andrew is known for inspiring others through his steadfast drive to help customers tackle their challenges and achieve successful outcomes.



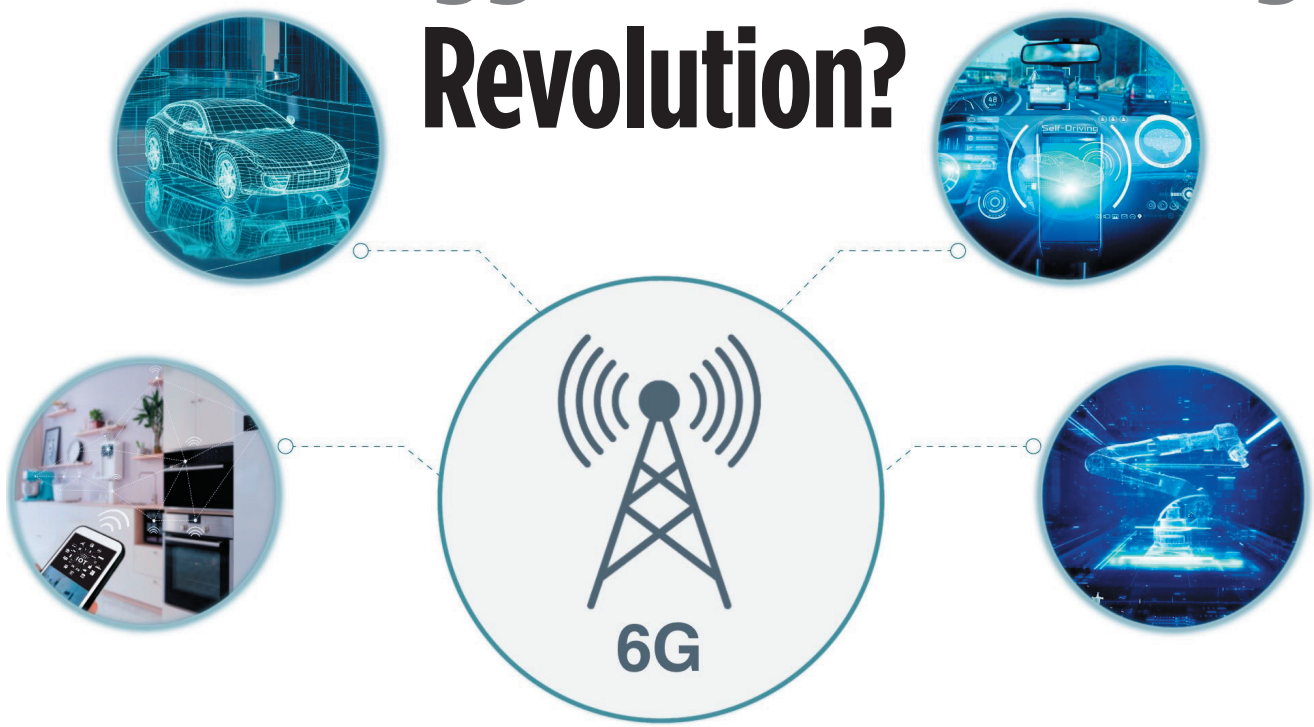


Myths About So-Called "Natural" Refrigerants

''Naturals''—industrial gases including hydrocarbons, sulfur dioxide, ammonia, and CO2—once were broadly used, but their purpose and practicality in our world have diminished considerably due to HFO innovations. Still, ''naturals'' get a lot of attention, which makes informed decision-making critical. Here are some top myths and truths about ''naturals.''

- Myth: ''Naturals'' are natural. All refrigerants are synthetic. Moreover, the production of some ''naturals,'' such as ammonia, consumes a significant amount of energy and results in an enormous carbon footprint (accounting for an estimated 2% of fossil fuel use worldwide and the release of 400 million tons of CO2 , representing approximately 1% of the world's total global annual CO2 emissions, according to Proceedings of the National Academy of Sciences.)
- Myth: ''Naturals'' offer the best option for all applications. The HVACR industry is highly complex and consists of an untold number of applications. ''Naturals'' can meet some of the demand. But HFOs—born in chemistry and its adaptability—offer a greater capability to meet changing needs driven by evolutions in HVACR equipment and global sustainability requirements.
- Myth: ''Naturals'' are futureproof. ''Natural'' refrigerants were first adopted more than 100 years ago, then broadly abandoned due to industry innovations well as concerns over safety, energy consumption, and toxicity.
- Myth: ''Naturals'' support circularity. CO2 refrigerants, for example, are not reclaimed. Instead, they are vented into the atmosphere as greenhouse gas emissions. HFOs are recovered, recycled, and reclaimed.
- Myth: There's an endless supply of ''naturals.'' More readily available than ''naturals,'' HFO refrigerants offer a secure and reliable supply chain for today's numerous HVACR applications.

Will 6G Trigger a Manufacturing Revolution?



The next evolution in mobile networks is on the horizon with 6G. Set to surpass 5G with enhanced speed, reduced latency and expanded capacity, countless applications will benefit. Manufacturing is anticipated to be one of the greatest beneficiaries. While the technology is still years away, manufacturers planning for the future should start thinking about the possibilities of 6G and how to ensure readiness.

The 5G to 6G Transition: A Major Overhaul

Today's consumers demand faster and more dependable experiences across devices — from smartphones and wearable devices to in-vehicle infotainment systems. In response, network providers are enhancing and expanding 5G infrastructure, the current leading-edge wireless technology. But is it enough? Industrial applications in factories and warehouses are already pushing 5G to its limits, demanding more data at faster speeds. For manufacturing, 6G can't come fast enough.

With testing expected to begin in 2030, 6G will mark a new era in connectivity — but it won't be a flip of the switch. Similar to the transition from 4G to 5G, the switch from 5G to 6G will require significant infrastructure investment. The enhanced coverage and greater bandwidth necessary to support 6G applications will require construction of new transmission towers. To handle the unprecedented data traffic 6G is expected to support, fiber-optic cable deployments will be essential. In addition to these hardware considerations, sophisticated new software must be deployed to efficiently orchestrate the intricate web of 6G-connected devices.

True 6G Relies on Millimeter Wave Frequencies

Millimeter wave frequencies (mmWave) are radio frequencies with a wavelength between 1 and 10 millimeters. They offer notable benefits compared to other frequency bands, primarily substantial bandwidth capacity to handle large amounts of data. mmWave frequencies also provide low latency, ensuring rapid data transmission. These characteristics render mmWave frequencies particularly suitable for high-demand applications that prioritize speed and dependability — like those driving the need for 6G.

Nonetheless, mmWave frequencies come with certain limitations. Transmission range is relatively short. Buildings, walls and trees pose other challenges, as these signals are easily blocked by common physical objects found in the environment. To counteract these limitations and ensure comprehensive coverage, networks using mmWave frequencies will require densely packed base stations. To combat signal attenuation—a more pronounced issue for mmWave than lower frequency bands—technologies like massive MIMO (multiple-input multiple-output) antennas

and high-precision, high-frequency connectors are essential to enhance performance.

How 6G will Benefit Manufacturing

To upgrade the communications infrastructure of an entire manufacturing operation to 6G, the benefits must outweigh the steep financial investment. For a factory that is running at high efficiency over Wi-Fi, a transition to 6G would have to represent a can't-miss manufacturing paradigm shift. What could move the needle for widescale 6G adoption?

Real-Time Digital Twins

6G is set to be a cornerstone of the ongoing advancement of Industry 4.0, leveraging capabilities of artificial intelligence (AI), machine learning (ML) and digital twin technology — areas that rely on the immediate processing, analysis and response to vast amounts of data. This technological infrastructure will facilitate the real-time monitoring, control and automation of industrial processes to boost efficiency and productivity. Rather than reacting to issues after they occur, digital twins will raise awareness of impending problems and prompt preemptive action.

A More Intelligent Supply Chain

Where are those parts we ordered? Enabled by 6G, each container on a cargo ship could have an embedded sensor to allow real-time tracking from anywhere in the world. Additionally, by applying digital twin technology to the global supply chain, manufacturers can anticipate future delays and identify inefficiencies.

Autonomous Vehicle Assembly

Imagine an electric vehicle (EV) assembly plant with no conveyor system. Instead, the vehicles drive themselves around the factory floor from station to station, making stops at the bumper installation robot, windshield station and final quality inspection. Eventually, the completed car rolls out to the street, heads to the dealership or the buyer's driveway. Yes, this would require vast amounts of data collected by multiple systems simultaneously and in real time — but this is exactly the type of application enabled by 6G.

Autonomous Robots

While the previous example imagines vehicles driving through the factory floor and visiting stationary assembly stations, the opposite could be true in other manufacturing processes. 6G could enable mobile autonomous robots to move around the factory floor, free from physical safety barriers, enabling them to complete tasks from pick-and-place to mechanical assembly.

Protecting Critical Data in the Cloud

While enhanced data security protocols are anticipated with 6G, no system can be expected to be completely invulnerable. Every IoT device poses a potential security risk, and the integrity of the entire network is contingent upon the security of the software it runs on. Recent high-profile incidents of data breaches, losses and privacy concerns have underscored the vulnerabilities of cloud-stored data. This is particularly concerning in manufacturing processes where sensitive, proprietary information — including a digital twin of the factory floor — could end up in the wrong hands.

Despite these concerns, 6G is expected to take several steps forward in the arena of data security, including:

Enhanced Encryption

6G is projected to utilize advanced encryption standards, enhancing security against unauthorized access and decryption of data as it moves across the network. This enhanced security is intended to safeguard data both during its transmission and in cloud storage.

More Robust Authentication and Authorization

6G is expected to integrate multi-factor authentication, biometric recognition and AI-powered behavioral analytics to verify user identities, thereby restricting access to sensitive data in the cloud solely to authorized individuals.

Real-Time Communication via Ultra-Low Latency

The anticipated ultra-low latency and instantaneous communication capabilities of 6G could facilitate swift identification and neutralization of security threats, allowing security protocols to rapidly address and prevent potential breaches from expanding.

Expect 6G to be Limited at First

Since the advent of 1G in 1979, wireless technology has progressed through a new generation every 10 years. As the impending sixth-generation standard, 6G won't achieve full functionality immediately upon release. Infrastructure development will be a gradual process, with broadband providers competing to offer the most expansive and reliable network. This evolution will mirror that of 5G, which is still being refined to unlock its full capabilities. Similar to how 4G LTE paved the way for 5G, 6G will require several years of development and may be iterative. Wireless technology historically has seen cumulative improvements with each new generation and 6G is poised to follow suit.

While consumers will race to buy 6G-enabled devices, manufacturers must take a more measured approach to adoption. This will require careful analysis of existing factory infrastructure, local 6G availability and a thorough understanding of the costs involved in the transition.

For more information, please visit www.molex.com. ■

Roger Kauffman, Sr. Director, Product Management & Marketing, Molex



Dispelling Misinformation about Corrosion of HVACR Coils

Round Copper Tubes Prove Superior to Round Aluminum Tubes in Nearly All Applications

Round copper tubes are the preferred material for heat exchanger coils in nearly all applications. They are the tried-and-true, de facto industry standard. Round copper tubes have a proven record of performance, durability, and corrosion resistance in nearly all environments. They are superior also with respect to manufacturing as well as repair costs if needed.

Copper tubes, including condensers and evaporators, remain the first choice for air-conditioning, refrigeration, and heat-pumping applications. Tube diameters for round tube plate fin (RTPF) heat exchangers range from conventional three-eighth inch (9.52 mm) tubes down to the current 5 mm technology and smaller, including smooth and inner-grooved tubes.

Round copper tubes are highly competitive against brazed aluminum microchannel coils. Microchannel coils showed promise as an alternative to RTPF coil but failed to live up to expectations in the field. The small "microchannels" in the ribbon-like extruded tubes increase the local (inside the tube) heat transfer coefficients (HTCs), allowing for compact heat exchangers; however, microchannel coils have been plagued by maldistribution of refrigerant, large header volumes, difficulty with defrosting and poor drainage. Cleaning serpentine-style fins squeezed between the ribbon-like multichannel tubes is difficult; hence, fouling and clogging are problematic. Fouling also aggravates issues with corrosion.

A better way to increase the heat transfer coefficient of HVACR tubes is to use smaller-diameter copper tubes. Smaller diameter copper tubes debuted in the high-volume production of room air conditioners and are now well-accepted in a wide range of applications.

Small-diameter copper tubes benefit from inside-the-tube enhancements. These inner grooves, also known as "microfins," improve the local heat transfer coefficients. The result is more efficient condensers and evaporators and more efficient HVACR systems. Smaller diameter tubes with internal enhancements deliver efficiency, materials savings, and refrigerant reduction without the disadvantages of brazed aluminum microchannel.

The Truth about Corrosion

As the HVACR industry transitioned to smaller diameter copper tubes, a few industry stakeholders raised concerns that the smaller copper tubes might be more susceptible to pitting and formicary corrosion. They argued that the thinner walls of the 5 mm tubes made the tubes more susceptible. As tube diameter decreases, the burst pressure of tubes increases, allowing reduced thicknesses of tube walls and hence savings on material costs.

These claims of susceptibility to corrosion were baseless. "Class action" lawsuits were eventually dismissed. Courts ruled that corrosion affected only a small percentage of heat exchangers regardless of tube diameter. Any corrosion of copper tubes is quite rare, and formicary corrosion is even rarer. False claims were roundly

dismissed upon closer examination of the evidence [1].

The truth is that pitting and formicary corrosion occurs in response to a narrow class of chemical contaminants in the environment. Pitting and general corrosion are more common in aluminum heat exchangers, including brazed microchannel and round aluminum tubes.

Furthermore, corrosion has little or nothing to do with the diameters of round tubes. It occurs because of chemical contaminants, mainly in the environment, and is relatively rare compared to the total number of RTPF heat exchangers.

Formicary corrosion has been known about for decades. While tens of millions of copper round tube heat exchangers have never experienced formicary corrosion, a few thousand may be subject to this corrosion when exposed to certain chemicals. Less than one heat exchangers per hundred may be affected by formicary corrosion. Where this type of corrosion occurs, the remedy is to replace the heat exchanger with one that has a suitable coating to protect it from corrosive chemicals in the environment.

Service failures and leaks typically occur rapidly if pitting and formicary corrosion are initiated in aggressive environments. It is difficult to imagine how tube diameter or tube wall thickness are factors. While anecdotal evidence exists, such corrosion affects only a minute percentage of the total number of units produced using the new technology. In other words, such corrosion mechanisms do not offer a valid case against using smaller-diameter copper tubes, and such cases have been rightfully dismissed [1].

An honest discussion of corrosion must consider that the service lifetimes of heat exchangers in real-world environments are typically limited to about 10 to 15 years, as suggested by the warranties offered by OEMs and for coils in the aftermarket.

The Case Against Aluminum

Well-maintained copper tube coils could last considerably longer, but 15 years is considered an acceptable service life. Coatings and maintenance can extend the service life for both aluminum and copper coils. Coatings are typically mandatory for aluminum coils since they are affected by humidity and temperature. That adds costs to the manufacture of aluminum coils.

For copper coils, coatings are typically applied only when it is anticipated that the coils will be used in chemically aggressive environments. Any good coil maker or service technician is well-versed in the gamut of coatings available for copper and aluminum evaporators and condensers. The Copper Development Association provides extensive information about various types of coatings for copper [2].

Aluminum heat exchangers have finite service lives and eventually corrode. Copper's durability and corrosion resistance is superior to aluminum. The thermal conductivity metals is typically higher for purer alloys. Just as nature abhors a vacuum, it is not fond of pure metals. When metals are exposed to atmospheric conditions, they react with moisture and chemicals in the environment to form undesirable compounds. This process is called "corrosion." It can be slowed, but corrosion is in one direction only, that is, towards further deterioration of the metals. At best, it can only be



slowed down.

Copper and aluminum naturally form a protective passivation layer that slows corrosion. A green patina forms naturally on copper and bronze. Also called "verdigris," the patina on copper usually consists of a mixture of copper chlorides, sulfides, sulfates, and carbonates.

Similarly, a very thin layer of aluminum oxides quickly forms on aluminum upon exposure to oxygen. Aluminum metal is highly reactive. Without this protective layer, it would quickly "burn away" upon exposure to oxygen. The thickness of this "aluminum passivation" is self-limiting since it blocks further diffusion of oxygen to the aluminum metal beneath it. Certain chemicals can attack these ultra-thin layers in the environment. Their protection is far from absolute, and corrosion of aluminum fins and tubes is quite common.

The aluminum industry has attempted to introduce aluminum heat exchangers into the HVACR industry for decades, going back at least fifty years to the 1980s. These attempts typically fail because aluminum deteriorates rapidly in humid environments, especially in salt air and salt water. A chalky, white coating of aluminum oxide and unpleasant pitting is very common with aluminum in heat exchanger applications. Brazed aluminum microchannel enjoyed success in the auto industry, where it is used for car radiators with glycol antifreeze as a coolant; however, the brazed aluminum has met mixed success in the HVACR industry, where higher pressures and stress corrosion cracking are factors.

Microchannel heat exchangers also proved incompatible with India's hot, humid climates and other tropical and subtropical regions. These heat exchangers enjoyed a few years of popularity in India until it was learned that they are incompatible with hot, humid climates [3].

Corrosion of Copper Tubes

In the case of round copper tubes, coatings are the exception rather than the rule. One reason is that bare copper is a better heat conductor than coated copper tubes. Another reason is cost. Coatings can add costs to manufacturing. In the lion's share of cases, copper round tubes with aluminum fins do not need coatings. They provide extended service lives and are unaffected by pitting or formicary corrosion.

The causes of formicary corrosion nowadays are almost always due to environmental factors. Most distributors and HVACR contractors will never encounter formicary corrosion. Nevertheless, they should know the basics of formicary corrosion and recognize it when and if it occurs in the field.

Pitting, Pinholes, and ANC

Formicary corrosion is well-studied academically. A fascinating technical literature has developed around this topic because it is easy to reproduce formicary corrosion in a laboratory. The first step is exposing the copper surface with a 1000 ppm acetic acid solution. Under certain conditions of acidity, temperature, and exposure to carboxyl acids, pits can form on the surface of the copper and subsequently generate the networks of tunnels characteristic of ant nest corrosion (ANC).

The pitted area of contaminated copper and copper compounds behaves like a local anode (positive electrode), while the nearly pure copper acts as a cathode (negative electrode). Consequently, the pits can spread and grow, resulting in formicary corrosion, pinholes, and, ultimately, leaks in the copper tubing.

Pitting also occurs in aluminum tubes, so round aluminum tubes are almost always coated in HVACR applications, especially in indoor evaporator coils, where aluminum round tubes are occasionally used in AC systems today. Coatings always add to the total cost of coil manufacturing, reducing the tubes' thermal conductivity. Coatings on aluminum round tubes are much thicker than the thin aluminum oxide layer that naturally forms when aluminum is exposed to the atmosphere.

Formic Acid and Formicary Corrosion

The name "formic" comes from formica, the Latin word for "ant," and the name of the genus many ants belong to. Believe it or not, formic acid was first obtained from the distillation of ants, hence its name. Although ants and other insects produce significant amounts of formic acid, the chemical is now made industrially. The word "formicary" is also related to ants, but in a different way. The use of the word "formicary" to mean "ant nest" is attested in the English language since at least 1816. It is derived from Medieval Latin formicarium and ultimately from Latin formica "ant." So, the phrase "formicary corrosion" is synonymous with ant nest corrosion (ANC), although the derivation of "formicary" is distinct from the derivation of the "formic" acid. Perhaps to avoid this confusion, the technical literature refers to this type of corrosion as "ANC."

ANC begins in the presence of carboxyl acids. Chemistry students may recognize these acids by the COOH group attached to an R-group. The carboxyl (COOH) group is so named because it is composed of a carbonyl group (C=O) and a hydroxyl (OH) group.

The simplest carboxyl acid is

commonly known as formic acid and is officially known as methanoic acid. Formic acid has a hydrogen atom for the R-Group attached to the COOH group. Next up is acetic acid, officially known as ethanoic acid. It has a CH3 group attached to the COOH group. In short, acetic acid has two carbon atoms, and formic acid has only one carbon atom.

Acetic acid is the most common acid involved in the initiation of ANC. Vinegar is about 4-6 percent acetic acid in water. The Latin word for vinegar is acetum, from which ''acid'' is also derived. Ethanol fermentation occurs in the absence of oxygen, whereby sugars (such as glucose, fructose, and sucrose) in the presence of yeast are converted into ethanol and carbon dioxide. Further fermentation in the presence of oxygen and yeast results in acetic acid that is, vinegar, a fact known by winemakers for many thousands of years.

Precursors to ANC

Organic acids such as acetic acid, citric acid, and oxalic acid are useful for cleaning metals by creating a lift-off effect between particles and surfaces. They also have carboxylic functional groups and so could initiate ANC. Also, alcohols can be converted into carboxyl acids under certain conditions, such as when ethanol undergoes a second fermentation phase in the presence of oxygen and changes to acetic acid.

Coil manufacturers may use various solvents, lubricants, and cleaners to produce tubes and coils. If carboxyl acids or their precursors are left inside the tubes, then ANC could begin inside the tube under certain conditions. These phenomena are well understood today by manufacturers at every step of the supply chain. Most, if not all, formicary corrosion today will occur from contaminants introduced from outside the tube. Manufacturing processes include thorough cleaning and rinsing steps that safeguard against corrosion events.

That said, what environments are unsuitable for copper tubes? What applications require coatings on copper tubes? One extreme example includes fruit processing plants, which use ethylene gas generators to ripen fruits like bananas. Alan H. Brothers writes about fruit processing plants in an informative article titled ''Detecting and Eliminating Causes of Coil Corrosion'' [4]. Brothers and Sole also review the main types of coatings available to protect against corrosion in aggressive environments [5].

Brothers states that the combustion byproducts combined with the moisture prevalent in humid, equatorial regions form a weak acid that eats pinhole leaks into the coil tubing in a year or less. The mixture of ethylene gas, high humidity, and a myriad of cleaning chemicals used to ensure sanitation at the facility inevitably results in ANC on uncoated copper tubes. According to Brothers, most problems with ANC occur when environmental acids corrode coils from the outside in. That is even more true today, as copper tube suppliers and coil makers are extremely vigilant about eliminating sources of ANC from their manufacturing processes.

Other harsh environments that could trigger ANC from the ''outside-in'' are as follows

- Fermenting yeast (lactic acid from milk) in a bakery walk-in cooler
- Chlorine from an indoor swimming pool or aquatic process.
- Urine (ammonia) from dead animals in meat processing plant coolers
- Sulfur from well water used in cleaning coils or rooms with coils.
- ertilizer (ammonia) in agricultural building evaporative coolers



Bastidas et al. 2006 estimated that ten percent of all premature failures of copper tubes used in the heating, ventilation, and air-conditioning (HVAC) industry result from ant-nest corrosion. They review the various pathways and environmental chemicals that could initiate ANC and provide an extensive list of earlier references [6].

Pits and Tunnels

Corrosion resembles a mining operation with its pits and tunnels. In both cases, copper metal atoms corrode and are carried away, but there is a difference between pitting and ANC. In the case of pitting, negative ions such as fluorine or chlorine attack the thin film that normally protects the underlying metal, and local corrosion ensues around a tiny electrochemical battery. This pitting progresses linearly through the thickness of the tube, forming a pinhole. On the other hand, ANC might begin with pitting, but it soon branches out to create a network of microscopically corroded tunnels within the tubing wall. These tunnel networks are substantially more extensive than the surface pitting above them. The result is the same in any case. Papadopoulou et al. call this tunneling "tortuous" pit propagation [7]— Eventually, the pits or tunnels breakthrough on the other side.

A Deeper Dive into ANC

Electrochemistry and surface science are fascinating topics. Through laboratory research, much progress has been made in understanding the basic mechanisms underlying pitting and formicary corrosion. Though relatively rare, formicary corrosion has been known to affect heat exchanger coils since the 1970s. Today, OEMs and coil manufacturers are keenly aware of this type of corrosion and do everything possible to eliminate the causes from the manufacturing processes.

The tunnels resemble ant nest-type structures, and hence, this is called Ant Nest Corrosion [ANC]. This type of corrosion is readily produced in the laboratory and has been the subject of many academic and scientific studies in peer-reviewed literature. The interested reader could explore this topic deeply by following the references in some recent papers.

Baba and Kodama reproduced ANC in copper tube samples exposed to a wet atmosphere containing formic and acetic acid vapor. They proposed a mechanism for generating this type of corrosion in 1995 [8]. More recently, Lachowicz conducted a metallographic study and observed that the orientation of the formed tunnels can be related to their movement along the grain boundaries [9].

Such research is invaluable as it helps to identify the factors affecting the development of ANC. Research could also help OEMs, coil makers, and end-users take precautions to reduce the occurrence of ANC.

Examining samples in the field can also be useful in minimizing occurrences of ANC. From a practical point of view, Brothers and Sole identify the usual suspects as acetic acids and acetates (formed by combining acetic acid with a base) [5]. These chemicals are found in adhesives, paneling, particle board, silicone caulking, cleaning solvents, vinegar, foam insulation, and other products. Formic acid can be found in cosmetics, disinfectants, tobacco and wood smoke, latex paints, plywood, and other materials.

When these chemicals are deposited on an HVACR coil along with moisture and oxygen, they could be a primary cause of ANC. Either remove the chemicals from the environment or replace the coil with a suitably coated coil. When a contractor finds a coil with ANC or pitting, the first step is determining what in the environment contributes to the corrosion. Swapping out the coil for an identical coil would be unwise unless the environmental conditions are identified and remedied. It will be better to replace the coil with an OEM coil or an aftermarket coil with a corrosion-resistant coating.

Coatings to the Rescue

Hundreds of useful, clear coating products are on the market, formulated from numerous polymers, solvents, and additives. The user selects a coating based on economics, intended life, desired transparency, and expected service conditions from these.

Many coating manufacturers prefer to custom blend coatings and work closely with users to solve their specific problems. There are numerous standard compositions, which can be ordered by trade names and will satisfy many needs.

For heat exchangers, coatings can generally be divided into polymer coatings and silanes [5].

Polymer coatings are typically thick epoxy or phenolic coatings, which are generally inexpensive and easy to apply. They are thicker than silanes, so they decrease heat transfer more. Many polymer coatings are also sensitive to ultraviolet (UV) degradation and can crack off the coil surfaces over time.

Silanes are organofunctional silicones. They are hybrid compounds of silica and resin-like organic materials. They improve the bonding between metals to organic resins. Silane-based coatings are composed of alcohol and water

and are applied in a thinner coat compared to polymer coatings. They are usually applied only by a licensed applicator. They are typically harder and more abrasion-resistant than polymers.

Coil makers and HVACR OEMs have extensive experience with coatings for residential, commercial, and industrial applications. There are excellent coatings available specifically in the supply chain for HVACR applications. In designing coils for HVACR applications, selecting an appropriate coating is an essential part of the design process.

The Bottom Line

In nearly all cases with copper tubes, coatings are not necessary. Nonetheless, a suitable coating is appropriate when the heat exchanger coil will be used in a chemically aggressive, corrosive environment.

Most, if not all, OEMs and aftermarket suppliers offer off-the-shelf coating options. Some OEMs provide coatings on all their coils as a precautionary measure, as with aluminum tubes. Typically, however, a coating is not required, and the coating will needlessly reduce the heat transfer efficiency of the coil. Coatings add to the initial cost as well as the operating cost.

In the final analysis, copper tubes are the superior choice for heat exchanger coils and will remain for the foreseeable future. Compared to copper, the aluminum round tubes and aluminum microchannel tubes are much more susceptible to corrosion. Aluminum can corrode in environments that are quite benign to copper.

Copper has the ideal combination of physical properties for HVACR equipment. Round copper tubes offer long service life and high efficiency with few disadvantages in nearly all HVACR applications.

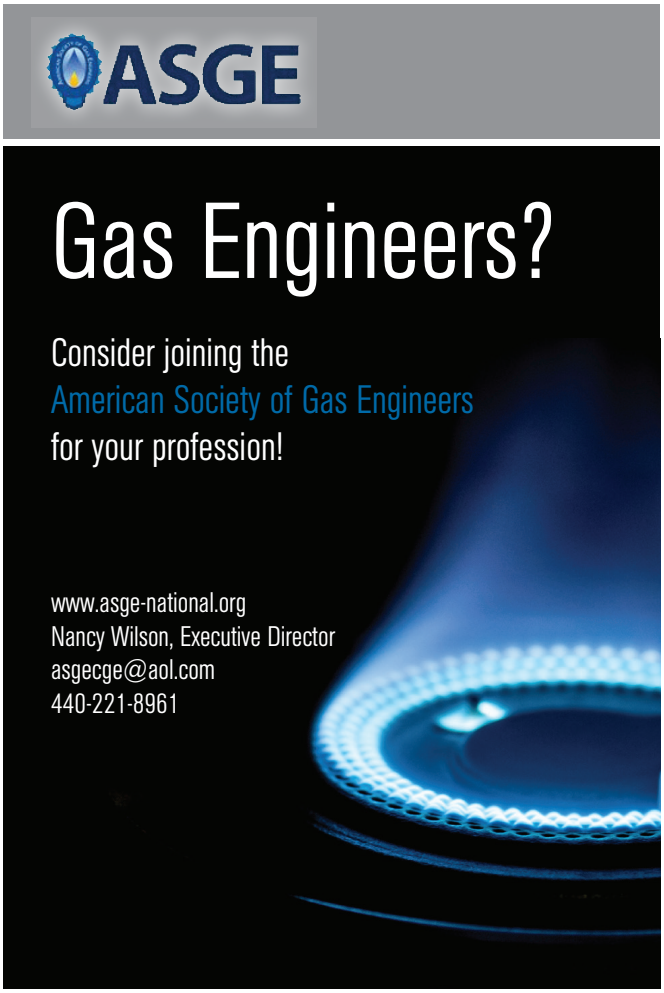
Get in touch with the Copper Development Association to partner on the research and development of air-conditioning, heat pump and refrigeration systems and components; in particular, design, analysis, and optimization of tube-fin, small-diameter copper tubes, and brazed plate heat exchangers. ■



Marcus Elmer, Director of Tube and Fittings with the Copper Development Association, is a seasoned professional with over 15 years of experience in the plumbing and mechanical industries. He leverages his expertise to identify and influence market trends for copper tube and fittings products, driving strategic programs that encompass technical research, codes and standards, advocacy, and education. With a unique perspective gained from his time as a project manager with commercial plumbing, mechanical, and refrigeration contractors, Elmer has a deep understanding of the industry. He holds a Master of Business Administration from Union University in Tennessee and a Bachelor of Science in Construction from the University of Wisconsin - Stout.

References

1. Ty Armstrong, "Goodman Amana HVC Cases Dismissed: What Happened?", classaction.org, June 15, 2017. https://www.classaction.org/blog/goodman-amana-hvac-cases-dismissed-what happened
2. Copper Development Association, "Corrosion Protection & Resistance," https://copper.org/resources/properties/protection/
3. ACRO News Show Daily, Day 2, "Indian OEMs Discover the Advantages of Smaller-Diameter Copper Tubes," ACREX India 2019, 1 March 2019, Page 7. https://acrex.in/uploads/ACRO NEWS_DAY2.pdf
4. Alan H. Brothers, "Detecting and Eliminating Causes of Coil Corrosion," (June 2009) in EPATest.com by Mainstream Engineering, Educational Articles, https://ww2.epatest.com/edarticles. Article: https://ww2.epatest.com/wp content/uploads/2019/01/Detect-Elimin-CoilCor.pdf
5. Alan H. Brothers and Joshua D. Sole, "A discussion on HVAC coil coatings and corrosion," Reliable Plant, Web Article, https://www.reliableplant.com/Read/24392/HVAC-coil-coatings-corrosion.
6. D. M. Bastidas, I. Cayuela and J. M. Bastidas, "Ant-nest corrosion of copper tubing in air conditioning units," Revista de Metalurgia, 42 (5) September-October, 367-381, (2006). https://digital.csic.es/bitstream/10261/2120/1/33.pdf
7. S. Papadopoulou et al., ICEAF V (2018), 5th International Conference of Engineering Against Failure, 20-22 June 2018, Chios Island, Greece. Open Source Paper available online. MATEC Web of Conferences 188, 03005 (2018). https://www.matec conferences.org/articles/matecconf/pdf/2018/47/matecconf_iceaf-v2018_03005.pdf.
8. Haruo Baba and Toshiaki Kodama, "Localized Corrosion of Copper in Wet Organic Acid Vapor," Zairyo-to-Kankyo, 44, 233-239 (1995).
9. Marzena Małgorzata Lachowicz, "A metallographic case study of formicary corrosion in heat exchanger copper tubes," Engineering Failure Analysis, Volume 111, 2020, 1

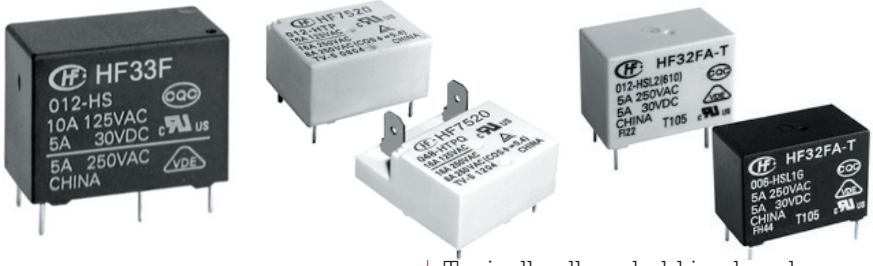


The 5 Things You Should Know

to Specify Relays for Motor and Compressor Protection

In this article, you will learn:

1. **What is a relay?**
2. **Why are relays critical for controlling and protecting motors and compressors?**
3. **Why and where is quality important?**
4. **Relay applications in appliances, HVAC, refrigeration, and air dampers.**
5. **Selecting the best relay.**



What is a relay?

A relay is an electrically operated switch. Most relays use an electromagnet to mechanically operate, but others employ other technology, such as solid-state circuitry. Relays are used when it is necessary to control a circuit using a low-power signal (with complete electrical isolation between control and contact circuits), or where several circuits must be controlled by one signal.

A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core, an iron yoke provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts. An armature is hinged to the yoke and mechanically linked to one or more sets of contacts.

Typically, all are held in place by a spring so that when the relay is de-energized, there is an air gap in the magnetic circuit. In this condition, contacts in the relay are closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function and configuration.

Since relays are switches, the terminology applied to switches is also applied to relays; a relay switches one or more poles, each of whose contacts can be thrown by energizing the coil in one of two positions:

Normally open (NO): contacts connect the load circuit to the common contact when the relay is activated; the circuit is disconnected (open) when the relay is inactive. It is also called Form A contact or ''make'' contact.



Normally closed (NC) contacts disconnect the load circuit from the common contact when the relay is activated; the circuit is connected (closed) when the relay is inactive. It is also called Form B contact or ''break'' contact.

Why is Relay Choice Critical?

A high-quality relay can play a critical role for controlling and protecting a motor or compressor. For example, appliance loads with a high-inrush current or an inductive reverse voltage kick-back on start-up or shut down that can cause contact bonding and may aggravate the contacts of the arc, shortening relay life. The type of relay chosen for a particular application is extremely important. For example, since the compressors of refrigerators and air conditioners need to operate for many cycles over the life of the appliance, it is critical to match the contact load handling capability to the reliability expected that can exceed the design expectations.

To alleviate some of the issues above, some relays are designed for

a specific motor horsepower, and their proper pairing (just like fine wine) will help guarantee safe and effective operation. For example, one major manufacturer lists relays in their online and printed catalog for air conditioners, refrigerator compressors, fans, and small home appliance motors in a chart with part photos and links to their data sheets. This is very helpful to a specifying engineer. The horsepower offerings include, but are not limited to: 1/6, ½, 2, and 3 HP. For more recommendations and to see photos of the relays, please visit: https://www.hongfa.com/en/Solution/Item/for-motors-and-compressors

How Important is Quality in Relay Choices?

While relays may look alike in appearance, there is a great deal of difference in the materials used to make them, how they are manufactured, and how they perform. Ultimately, your company's reputation rests on the quality and the performance of motors, compressors, and other components in your products. While most companies are under cost pressure to reduce the cost of goods sold and the cost of components, often the difference is a matter of cents per unit to have a top-quality product. Hopefully you know if your component suppliers have automated in-line testing. If not, what percentage of their output is QA tested? Does the manufacturer employ quality assurance personnel and R&D staff? What are their TQM standards? What is their quality reputation in the industry? Do they perform regular in-house reliability testing? These are good questions to get answers to.

Where is Quality Important?

Fault Tolerance: High-quality components are designed to be more fault tolerant, meaning they are less prone to failures or malfunctions.

Durability: Appliance motors and compressors may undergo frequent start-stop cycles and variations in load conditions (consider a washing machine, for example). Quality relays are built to withstand the mechanical stress and electrical demands associated with these operations, ensuring a longer lifespan and reduced likelihood of failure.

Consistent Performance: Reliable relay performance is essential for maintaining consistent and stable power delivery to motors and compressors. Inconsistent or unreliable relays can lead to voltage spikes. Improper current regulation or other electrical issues that may negatively impact the operation of motors and compressors.

Temperature Stability: Relays operating in motor control systems may be exposed to varying temperature conditions. Quality relays are designed to maintain stable performance across a range of temperatures, ensuring reliable operation in different environments.

Consistent Switching Characteristics: The switching characteristics of relays, such as contact resistance and response time, are critical for proper motor control. High-quality relays maintain consistent switching characteristics over time, contributing to the overall reliability of a motor control system.

Compliance with Standards: Reliable relays and contactors are often designed and manufactured in compliance with industry standards and regulations, such as Underwriter's Laboratories (UL). This ensures that they meet specific performance and safety criteria, providing confidence in their use for protecting motors and compressors in various applications.

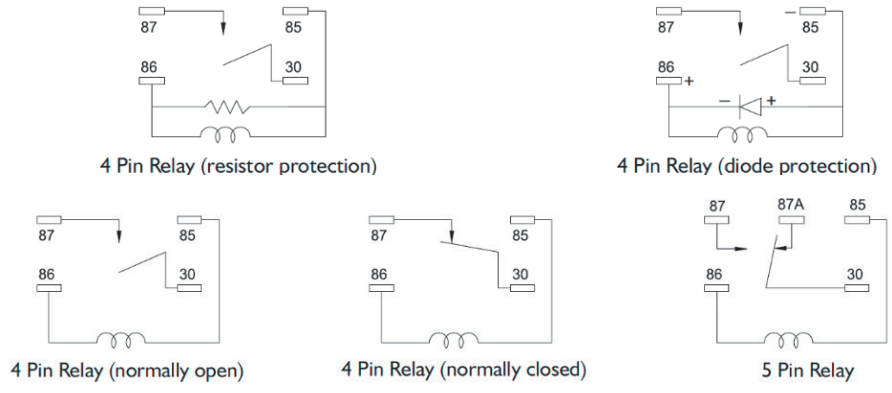
Applications in Appliances, HVAC and Refrigeration Equipment and Air Dampers:

In general, relays are indispensable components in HVAC equipment, refrigeration systems, air dampers and appliances, playing critical roles in control, safety, and efficiency. Here are some specific applications:

Compressor Control: In refrigeration equipment such as refrigerators, freezers, and air conditioners, relays are used to control the operation of the compressor. Relays can be employed to start and stop the compressor motor based on readings from sensors within the system.

Fan Control: Relays are utilized to control the operation of fans in HVAC systems and refrigeration equipment. They can switch the fans

Sample Wiring Diagrams for a 4 Pin Normally Open Relay



on and off, based on temperature, humidity, or other environmental conditions to maintain optimal operating conditions and energy efficiency.

Defrost Control: In refrigeration systems, relays are used to control the defrost cycle of evaporator coils. They can initiate the defrost cycle based on sensors detecting frost buildup on the coils, ensuring efficient operation, and preventing ice accumulation.

Thermostat Control: Relays play a crucial role in thermostat systems, which regulate temperature in HVAC equipment and appliances. They act as switches to control the heating or cooling components based on the temperature set by the user or programmed settings.

Air Damper Control: In HVAC systems, relays are employed to control the opening and closing of air dampers to regulate air flow within ducts. They can be used to modulate the airflow to different zones or areas of a building, optimizing comfort and energy efficiency.

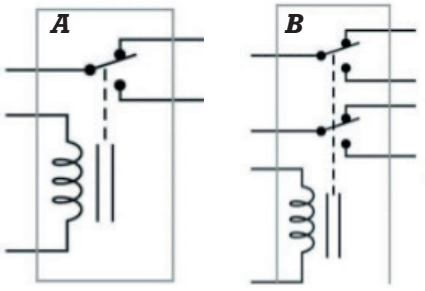
Sequence Control: Relays are often used in HVAC systems to sequence the operation of various components, such as compressors, fans, and heating elements, to ensure smooth and efficient operation while preventing issues such as power surges or excessive energy consumption.

Timer Control: timer relays can be utilized for time-based control in HVAC systems and appliances. For instance, they can control the timing of defrost cycles, periodic fan operation, or other scheduled tasks to optimize performance and energy usage.

Selecting the Best Relay:

Selecting the best relay or contactor for your application is critical! Most component manufacturers have Application Engineers who will help you specify the correct part, based on the specific needs of your application as well as parameters such as voltage, amperage, size, construction, sealing, certifications, contact arrangement, material, resistance, and many other variables. Application Engineers typically have degrees in engineering and many years of experience with various situations requiring judgement on many technical levels to recommend the most reliable and cost-effective components for your needs.

A. *SPDT RELAY – FORM C CONTACT*



B. *DPDT – TWO SETS OF FORM C CONTACTS **

** Published under the terms and conditions of the Creative Commons Attribution 4.0 International Public License*

It is wise to explore the breadth of a component manufacturer's product line so that you can minimize the number of vendors that you require, have the choices you need, and to cut component acquisition costs. Hongfa, the world's largest relay manufacturer offers Safety Relays, Latching Relays, Smart Miniature/ Standard Circuit Breakers, Power Relays, HVDC Relays, Snap-Action Switches, Smart Home Relays and High-Frequency Relays, to name a few, all of the highest quality, and with UL certification.

Choosing the best relay or contactor for an application involves considering several factors to ensure compatibility, reliability, and efficiency. Here's a 9-step guide to help you make the right choice:

1. Understand the Application Requirements: Gain a clear understanding of the application's electrical requirements, including voltage, current, frequency, and load type (AC or DC) and the electrical endurance required for the loads. Identify whether the relay will be used for switching, control, protection, or isolation purposes.

1. Define Operating Conditions: Determine the environmental conditions in which the relay will operate, such as temperature range, humidity, altitude, and vibration levels. Ensure the selected relay can withstand these conditions without degradation in performance.

2. Select Relay Type: Choose the appropriate relay type based on the application requirements. Common types include electromechanical relays (EMRs), solid-state relays (SSRs), reed relays, and hybrid relays. Consider factors such as switching speed, contact life, and compatibility with the load.

3. Evaluate Contact Material: Evaluate the contact material based on the load characteristics and switching frequency. Common contact materials include silver alloy, gold-plated contacts, and tungsten contacts. Choose a material that offers low contact resistance, high-conductivity, and resistance to arcing and corrosion.

4. Consider Coil Voltage and Power Consumption: Select the coil voltage compatible with the control circuitry and power supply. Ensure that the relay's power consumption aligns with the available power budget and efficiency requirements, especially

for battery-powered or energy-efficient applications.

5. Access Contact Rating: Determine the relay's contact rating, including maximum voltage and current ratings, to ensure it can handle the load without exceeding its specified limits. Consider factors such as inrush currents, overloads, and short-circuit conditions during selection.

6. Review Mechanical and Electrical Life: Evaluate the relay's mechanical and electrical life expectancy, which indicates the number of operations or switching cycles it can withstand before failure. Choose a relay with a sufficient lifespan for the application's expected usage scenario.

7. Check Response Time and Switching Speed: Consider the relay's response time and switching speed, especially for applications requiring rapid switching or precise timing. Choose relays with low latency and fast operation to minimize signal delay and improve system performance.

8. Ensure Safety and Reliability: Prioritize safety and reliability by selecting relays from reputable manufacturers with a proven track record of quality and compliance within industry standards (e.g., UL, CE). Consider additional features such as built-in diode protection, arc suppression, and thermal overload protection for enhanced reliability and safety.

9. Cost Analysis: Conduct a cost analysis considering initial purchase cost, installation, maintenance, and operational expenses over the relay's lifecycle. Balance the cost with the desired performance, reliability, and longevity to ensure the best overall value for the application and the end-product performance and reputation. Remember, your company will be judged on the performance of your whole product, which is a sum of how all of its components perform!

By systematically evaluating these factors, an engineer can confidently select the best relay for the specific requirements of the application, balancing performance, reliability, cost, and compatibility. Additionally, consulting with experienced colleagues, supplier engineers or industry experts can provide valuable insights and guidance during the selection process.■

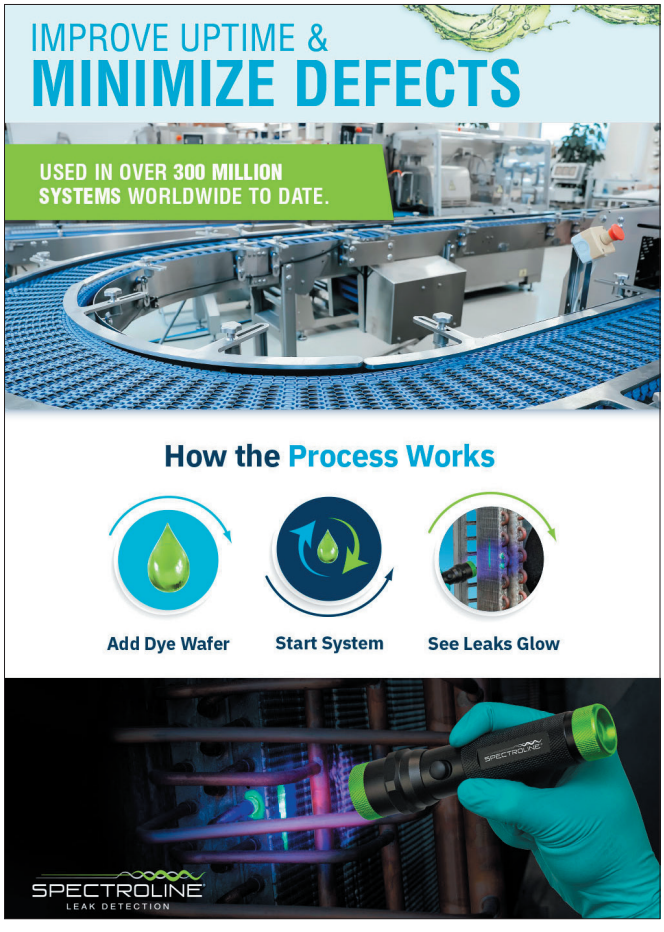
About the Author:
Rich Hall is the North American Marketing Manager for Hongfa America, the distribution and sales subsidiary for award-winning Xiamen Hongfa Electroacoustic Co., Ltd. Parent-company Hongfa is the largest manufacturer of relays in the world, producing electromechanical components for most of the world's top manufacturers who use electronics. Rich earned his MBA from the University of Southern California; a Bachelor of Science Degree from California State University Long Beach and he has worked in the high-technology and electronics industry for over 30 years.

References:
1. Rjpereire, Jonathan, Circuits Electronics, Introduction: All You Need to Know About a Relay. The Electronic Specifier. https://www.electronicspecifier.com/industries/alternative-energy/new-regulations-and-electronic-components-bring-safer-ways-to-save-the-planet
2. Chow, Michael, PE, CXA, LEED APBD+C (2020, November) Consulting – Specifying Engineer. Fundamentals of Motor Circuit Protection. www.csemag.com
3. Shepard, Jeff, (2022, September) Power Electronic Tips – An EE World Online Resource. What's a Protective Relay and What Does it Protect? https://www.powerelectronictips.com/whats-a-protective-relay-and-what-does-it-protect-faq/#:~:text=Protection%20relays%20are%20used%20to,and%20turning%20the%20power%20off
4. Edwards, D. (2023, August) Robotics and Automation News. The Importance of Motor Protection Relays in Industrial Settings. The Importance of Motor Protection Relays in Industrial Settings – Robotics & Automation News (roboticsandautomationnews.com)
5. (2024) c3controls.com. Overload Relays: Types & Tripping & What is Overload Protection? Overload Relay | What is Overload Protection? - c3controls
6. (2024) - Industry Educational Organization. Electricity-Magnetism.org, Understanding Motor Protection Relays, Operation Principles of Motor Protection Relays, Types of Motor Protection Relays. Motor Protection Relays | How it works, Application & Advantages (electricity-magnetism.org)
7. (2024) Multiple contributors: Eng-Tips.com, Necessity of Lockout Relays for Motor Protection. https://www.eng-tips.com/viewthread.cfm?qid=437505
8. (2024) Wikipedia – The Free Encyclopedia. Protective Relay. Operations Principles, Types According to Construction.
   Protective relay - Wikipedia
9. (2024) Swe-Check.com. Understanding Relays & Wiring Diagrams https://www.swe-check.com.au/editorials/understanding_relays.php
10. (2024) Hongfa.com, Solutions, Products for motors and compressors https://www.hongfa.com/en/Solution/Item/for-motors-and-compressors

References Footnote and Disclaimer:

This technical article is being offered to its readers for purely educational purposes. To that end, all sources of information for this article were consulted solely to provide accurate industry and solution options for engineers.

The content provided in this white paper is intended solely for general information purposes and is provided with the understanding that the authors and publishers are not herein engaged in rendering engineering or other professional advice or services. The practice of engineering is driven by site-specific circumstances unique to each project. Consequently, any use of this information should be made only in consultation with a qualified and licensed professional who can consider all relevant factors and desired outcomes. The information in this white paper was posted with reasonable care and attention. However, it is possible that some information in these white papers is incomplete, incorrect, or inapplicable to circumstances or conditions. We do not accept liability for direct or indirect losses resulting from using, relying, or acting upon information in this white paper.





Take Your Elevator and Escalator Designs to the Next Level

New technology is showing up everywhere, including in the elevators and escalators that all of us use to reach the floors of commercial buildings, shopping malls, apartment complexes, and condominiums. Nearly 20 million elevators and escalators are operating worldwide, and the number of installations is growing substantially. In 2021, new installations exceeded a quantity of one million units. Market drivers include the growth in cities' population, which requires more apartment buildings and office buildings. Other drivers include adding intelligent sensing and wireless connectivity to reduce unplanned downtime and increase user convenience.

The need to reduce power consumption compels innovation. New, improved motor drives and electronics can significantly reduce energy consumption and costs. For example, LED lighting reduces the power required for elevator illumination, and occupancy sensors shut down power when the elevator is idle. Most importantly, regenerative motor drives can reduce energy consumption by up to 35%, capturing energy when the elevator travels down and transferring the power to other building systems.

In addition to ensuring high reliability for a product that must be operational 24 hours a day, seven days a week, the additional electronics challenge designers to protect sensitive circuitry from external environmental threats. In addition, designers have the challenge of reducing energy consumption compared with older elevator designs.

This article focuses on safe and efficient elevator design, providing design engineers with solutions to protect against overcurrent conditions, overvoltage transients, overtemperature conditions, and electrostatic discharge (ESD). Furthermore, the article recommends components that can improve the efficiency of the design and reduce energy costs. These recommendations will enable designers to develop robust, reliable, safe, and energy-efficient elevators.

Designers must ensure reliability for the elevator power control panel and the elevator cabin. The following paragraphs will address making these two elevator elements robust to electrical hazards and energy efficiency.

Recommendations for a robust, energy-efficient elevator power control panel

Let's start with the design of the elevator power control panel. The example in Figure 1 shows an elevator power control panel. The blocks around the control panel highlight the recommended components that provide circuit protection, sensing, and efficient control. The control components can contribute to reduced energy consumption and energy savings.

Figure 2 provides more detail and illustrates a block diagram of the

elevator power control panel. The adjacent table lists the components required by the circuit blocks for protection and energy efficiency.

Since ensuring a reliable elevator design is essential, the initial discussion will focus on protecting the control panel from potential failure due to electrical hazards. These hazards include overcurrent, overvoltage, overtemperature conditions, and ESD.

Protecting the control panel circuitry from overcurrent and overvoltage conditions

Input Protection block

The Input Protection block connects to the AC mains. The AC mains have the capacity to supply high current to a load, such as an elevator control panel, if an overcurrent condition occurs. In addition, high-power voltage transients induced on the AC power line by lightning and large motors energizing and de-energizing can strike the Input Protection block of the control panel.

For maximum safety, protect the control panel from the high current capacity of the AC power line with a fast-acting fuse. To ensure the fuse can operate properly, select a fuse with a voltage rating exceeding the maximum possible voltage of the AC power line. Also, choose a fuse with a high current interrupting rating so the fuse will extend and not allow arcing during an overcurrent condition. Support the fuse in a fuse holder with similar ratings as the fuse so as not to degrade fuse performance.

Consider a MOV for safely absorbing a voltage transient propagating on the AC power line. Investigate a MOV that can withstand at least a 6000 A transient pulse and at least 400 J of transient energy. Designers can ensure the MOV is functioning properly by selecting a MOV with an internal thermal element that will open the component if the transient duration causes an overheating condition.

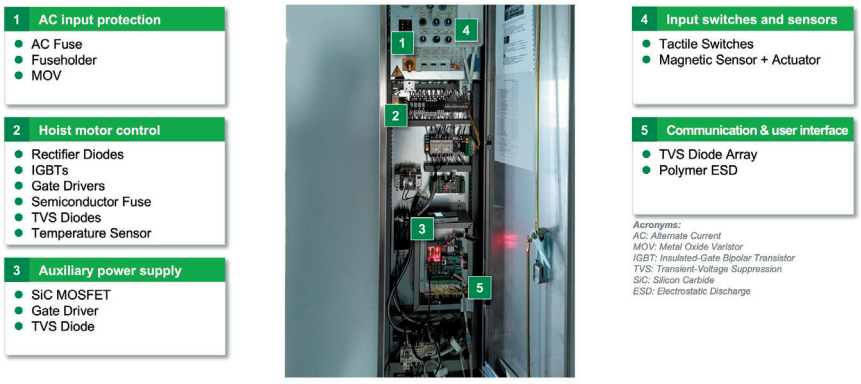


Figure 1. Elevator power control panel

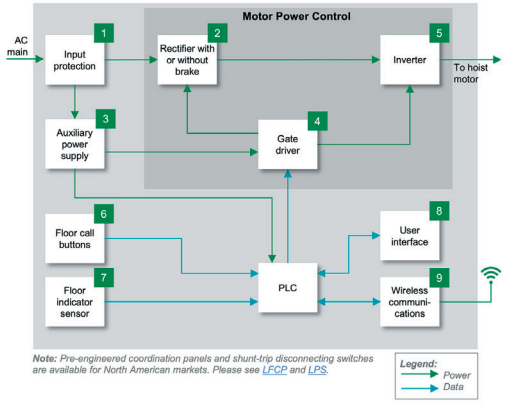


Figure 2. Elevator power control panel block diagram

	Technology	Product Series
1	Fuse	JLS, JLLS, LDC, L70QS 606, 504, 505, 607
	Fuseholder	LFT, LFJ
	MOV	TMOV, UltraMOV
2	Rectifier Diode without Brake	Module Offerings, Discrete Devices,
	Rectifier Diode with Brake	VUB, MDMAxxxUB
3	SiC MOSFET	LSIC1MO170E1000
	Gate Driver	IX4351NE
	TVS Diode	SMF, 1.5SMC
4	Gate Driver	IXD_6xx
5	Semiconductor Fuse	QS, PSR
	IGBT	IXYN, IXXN
	NTC	USUR1000, SM
	TVS Diode	SMBJ, SMF4L, 1.5SMC
6	Tactile Switch	KSC, TLS
7	Magnetic Sensor	59140, 57140
8	TVS Diode Array	SP1012, SP1003
9	TVS Diode Array	SP3213, SP3401
	Polymer ESD	XGD

Auxiliary Power Supply block

The Auxiliary Power Supply converts the AC line voltage to DC for powering the Programmable Logic Controller (PLC) and the other DC-powered blocks. Designers can protect this circuit from any portion of the voltage transient that passes through the Input Protection block with a transient voltage suppressor (TVS) diode. TVS diodes protect the semiconductors in the Auxiliary Power Supply and the downstream current blocks. TVS diodes have response times under a nanosecond. Look for TVS diodes that can safely absorb at least 200 W of transient power.

Inverter block

The Inverter provides the power to drive the AC hoist motor. Consider using a high-speed fuse and a TVS diode to protect the power semiconductor components from motor-induced transients. Select a fuse with a low I2t characteristic to minimize heat energy from impinging on the components. Add a TVS diode to clamp the voltage transients to safe levels. Ensure the TVS diode can safely absorb as much as 600 W of peak pulse power.

Providing overtemperature protection

In the Inverter circuit block, monitor the temperature of the high-power semiconductors to prevent a thermal runaway condition. Look for NTC thermistors with a fast thermal response. Ensure high reliability with thermistors that are hermetically sealed and can operate up to 220° C.

Ensuring ESD protection

The circuit blocks that interface with the external environment, such as the User Interface and the Wireless Communications interface, are susceptible to ESD. TVS diodes, with their ultra-fast response times, are excellent choices for the suppression of ESD from either a user or the external environment. For the User Interface, consider a TVS diode array, as shown in Figure 3, to protect up to five data lines

with a single, small component. Use a TVS diode with IEC 61000-4-2 compliance to allow adequate ESD absorption.

In the Wireless Communication block, which transmits elevator status information, options for ESD protection include a TVS diode or a polymer ESD suppressor. Figure 4 shows a bidirectional TVS diode for protecting against ESD of either polarity. If using a TVS diode, select based on the diode capacitance to minimize distortion to the transmitted signal. TVS diodes with capacitances under 1.0 pF are available. The alternative, the polymer ESD suppressor, can withstand a higher ESD strike, up to 30 kV, and can have capacitance under 0.1 pF. Figure 5 shows an example schematic of a polymer ESD suppressor.

Incorporating reliable performance

Use long-life, tactile switches in the Floor Call buttons circuit. The switches should have sufficient haptic feedback, so users can feel the button has been activated. Select switches with a rated life of at least 200,000 operations and be aware that switches are available with rated lifetimes of up to 10 million operations. Investigate switches with hermetic sealing and corrosion resistance properties to further enhance reliability.

The Floor Indicator Sensor block detects when the elevator reaches the level of a floor. A magnetically operated proximity sensor can serve the requirement. Choose a hermetically sealed sensor for long life and maximum reliability.

Maximizing energy savings

Elevators consume a significant quantity of energy, and energy-efficient elevators can save a building owner a substantial amount of utility costs. The more energy efficient the elevator, the greater the competitive advantage it can have in the market. Designers have the challenge of maximizing energy efficiency.

The Rectifier Block is a circuit that offers the opportunity to reduce power consumption. Rectifier diode packages are available that have both low forward voltage drop and low leakage current. Packages are also available with a control circuit that can permit returning energy to the power grid utilizing energy recovered from the braking action of the hoist motor.

The Auxiliary Power Supply is another circuit that can become more energy efficient. Using a switch-mode topology with SiC MOSFETs, the designer can achieve a high-efficiency AC-DC converter. Use a SiC MOSFET with low RDS(ON), low gate charge, and low output capacitance to minimize power loss in the MOSFET and allow high-frequency switching.

Optimize the efficiency of the MOSFET with a gate driver chip, which provides the following:

- Quick turn-on and turn-off signals to control the MOSFET,
- A negative gate bias circuit enables fast turn-off of the MOSFET, and
- More energy savings and simplified circuit complexity with a single package.

The Gate Driver circuit block controls the power inverter semiconductors. Use a high-power gate driver. Dual gate driver chipsets can source as much as 30 A peak current and operate on voltages from 5 V to 35 V. Also, look for gate drives that consume the least power with supply currents of around 10 µA.

The fourth circuit where designers can save energy is the Inverter circuit. In this circuit, designers can employ IGBT power transistors for power delivery to the motor. Ensure maximum drive efficiency by considering IGBTs with low VCE(SAT) and low gate charge.

Recommendations for a robust, energy-efficient elevator cabin system

With the power control panel optimized for robust protection and energy efficiency, the designer needs to complete the elevator design work by applying the same development considerations to the elevator cabin. Figure 6 shows an example elevator cabin, and the surrounding text blocks indicate where protection and energy-saving technology can apply. Figure 7 shows a block diagram of the cabin system. The adjacent table lists the recommended components that provide the cabin system circuitry protection, safety, and energy efficiency.

Protecting the elevator cabin

To protect the cabin control system from AC power line-induced overcurrent and overvoltage conditions, use a fuse and a MOV in the Input Protection circuit. Unlike the control panel, consider a time-lag fuse in the Input Protection circuit of the cabin control system. A time-lag fuse will avoid nuisance shutdowns resulting from inrush currents.

Ensure the door motor is protected from overheating. Use an NTC thermistor to monitor the temperature of the door motor.

The Wired Communications and

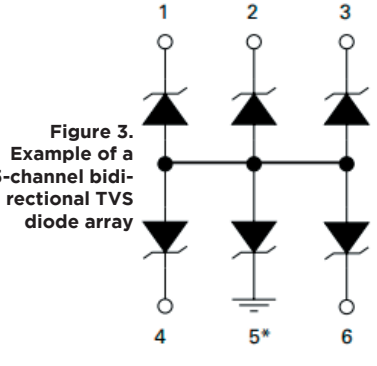


Figure 3. Example of a 5-channel bidirectional TVS diode array

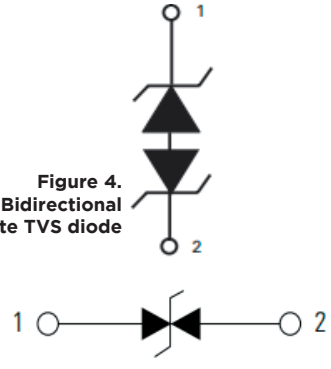


Figure 4. Bidirectional discrete TVS diode

Figure 5. Polymer ESD suppressor

Wireless Communication circuits should use TVS diode arrays to protect the semiconductor components from ESD strikes. Like the power control panel Wireless Communications circuit, designers can choose a polymer ESD suppressor rather than a TVS diode.

Incorporating reliability and safety

In the Lighting, Audio, and Other Outputs circuit block, consider optically isolated, solid-state relays to protect users and service personnel from high voltage circuits. Look for relays with active current limit and thermal shutdown protection.

Consider using a magnetic sensor to detect the position of the door in the Door Open and Close Sensor circuit. Hermetically sealed sensors offer extended life for greater reliability.

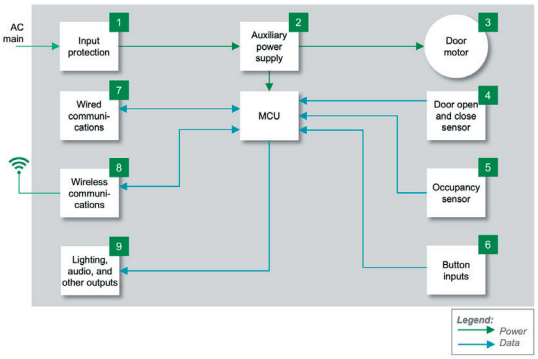
In the Button Inputs circuit, use a long-life switch identical to the switch recommended for the Floor Call circuit in the power control circuit. Long-life tactile switches can have ratings as high as 10 million operations. Also, consider switches that have options for illumination and are sealed from water and dust ingress.

Designing in energy efficiency

There are opportunities for improving energy efficiency in the elevator cabin system. Maximize efficiency in the Auxiliary Power circuit by using power MOSFETs which allow a switch-mode supply to have a high switching speed. High-speed switching enables the use of smaller inductive components, which can save circuit board space and cost.

A motion detector circuit in the Occupancy Sensor circuit allows detection and notification that people are in the elevator. Designers can use compact motion detectors with integrated microcontrollers to simplify detecting motion and to process the data. Data from the circuit informs the cabin system microcontroller when the elevator's power circuits can shut down.





	Technology	Product Series
1	Fuse	215, 835
	MOV	TMOV, UltraMOV
2	MOSFET	X2 Class
3	NTC	SM
4	Magnetic Sensor	59145, 57145
5	PIR Sensor + MCU	ZMOTION
6	Tactile Switch	KSC, TLS
7	TVS Diode Array	SRV05-4HTG, SP0504SHTG
8	TVS Diode Array	SP3213-01UTG
	Polymer ESD	PESD
9	Solid State Relay	CPC1510, CPC1511

Achieving a robust, reliable elevator with energy efficiency

A reliable, robust, safe, and energy-efficient elevator project poses many challenges for the design engineer. This article offers suggestions for components that can help the designer achieve these objectives.

Fortunately, designers can get assistance from the component manufacturer's application engineers to save development time and costs. They have the expertise to offer technical services, including:

- Cost-effective component selection
- Guidance on applicable safety standards
- Pre-compliance testing (provided by some component manufacturers) to help identify issues before submitting a design for formal compliance testing.

Using the recommended protection, control, and sensing components will ensure a reliable, safe, and energy-efficient elevator.

Download the Building and Home Automation Application Guide, courtesy of Littelfuse, Inc. ■



Ryan Sheahen is the Global Strategic Marketing Manager for the Electronics Business Unit. Ryan joined Littelfuse in 2011 as an inside sales specialist. He was previously the Global Product Manager for the magnetic sensing product portfolio. His current responsibilities include the development of marketing collateral, management of marketing activities for new product launches, and performing marketing studies and feasibility analysis for new product ideas. Ryan earned his BS in Mechanical Engineering Technology from Purdue University.

What's Happening

NVision's 3D Scanning Helps HVAC Makers Keep Their Cool

Air conditioning is hotter than ever. Hot as in demand, a must-have, a comfort most of us want, and, with higher trending temperatures generating heat-related health issues, one that many can no longer live without. NVision, Inc., a leader in 3D non-contact optical scanning and engineering, has worked extensively with the HVAC (Heating/Ventilation/Air Conditioning) industry for more than 30 years and recently helped major HVAC manufacturers successfully:

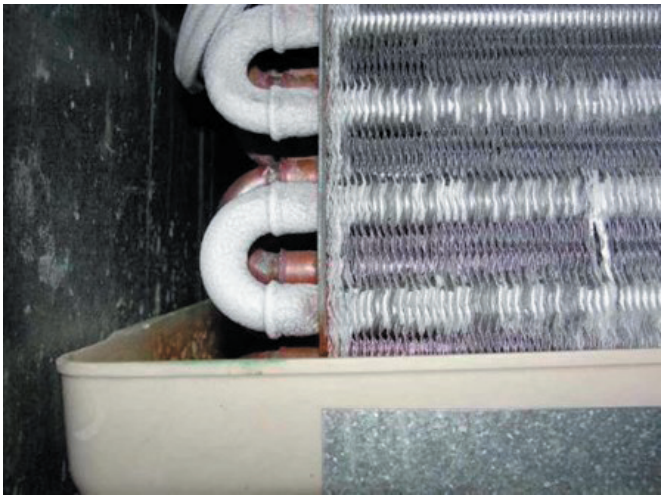
- Evaluate and confirm the viability of converting copper system components to aluminum.
- Reverse-engineer and improve the design of air conditioning (A/C) drip pans.

More than a century after Willis H. Carrier built the first modern electrical air conditioning unit, A/C systems are a fixture in most U.S. homes. According to the U.S. Energy Information Administration (EIA), as of 2020 nearly 90 percent of U.S. households were using air conditioning. Internationally, the use of A/C is expected to rise over the next 30 years, with the world's hottest regions producing much of the demand.

The near-essential nature of A/C makes HVAC a highly competitive industry. Improving efficiency, dependability, and affordability is essential to staying alive in the A/C market. To address these challenges, some A/C manufacturers are following the example of the automotive industry and converting their copper system components to aluminum.

When it comes to A/C components, aluminum offers several advantages over copper. Aluminum is the more abundant metal and thus is less expensive. It is also lighter, providing more options for system designers and engineers. But perhaps more significantly, it is impervious to formicary corrosion, which attacks copper and copper alloy tube walls, creating a network of microscopic tunnels culminating in pinholes and leaks in coils and piping. Formicary corrosion can cause premature equipment failure and reduce the longevity of system components.

One of the principal U.S. HVAC manufacturers wanted to test the viability of converting its copper A/C components to aluminum. ''The primary impetus for the proposed conversion was to avoid formicary corrosion of pipes,'' says Steve Kersen, President of



A/C parts scanned by NVision engineers included the system's coils, casings, and soldering joints. (Note: Image is not from this project)

NVision. ''Before greenlighting the conversion, the manufacturer wanted to assess the results of converting to aluminum to ensure that all the parts would meet manufacturing specifications. To accomplish this, the new aluminum parts needed to be precision-measured to a degree that was impossible with traditional measurement tools, such as calipers.

''The HVAC company had done extensive research and understood the high level of accuracy that non-contact scanning brings to part measurement and inspection,'' says Kersen. ''They asked NVision to conduct first-article inspections, spot-checking parts from the first production run to confirm that they matched all the manufacturing tolerances.''

NVision engineers began scanning the converted A/C components, which required multiple non-contact scanners, including HandHeld laser and CT scanners. The NVision team measured the system's U-shaped coils, as well as its casings, soldering joints, and more.

A/C parts scanned by NVision engineers included the system's coils, casings, and soldering joints. (Note: Image is not from this project)

''Our HandHeld scanner has an accuracy of +\- 0.025 mm or 25 microns, which is one-thousandth (0.001) of an inch. As its laser light sweeps across an object's surface, it rapidly—at a speed of 60,000 or more separate measurements per second—collects massive amounts of individual location points on the surface, each with its own x,y,z coordinates and i,j,k vectors,'' says Kersen. ''The full dataset, or 'point cloud,' collected by the scanner comprises literally millions

of these measurement points. With this vast amount of dimensional data, we inspected the components against all the aluminum parts in the A/C system, down to the most minute detail.''

A CT scanner uses X-rays to produce 3D representations of external, as well as internal, components. As its accuracy depends on material density, aluminum is ideal for CT inspection, allowing for an accuracy of 0.0004 inches.

''The scanning results confirmed that the new aluminum parts met all of the manufacturer's specifications, so the company proceeded to convert its A/C parts from copper to aluminum,'' says Kersen.

NVision also worked with a second HVAC manufacturer, one that has built much of its reputation on making some of the most energy-efficient A/C units on the market. It also manufactures heat pumps, furnaces, boilers, garage heaters, air handlers, thermostats, and indoor air quality systems.

The company was going to modify the drip pans on five of its A/C units but needed accurate CAD (computer-aided design) models of the current pans to serve as the starting point for the redesign. Drip pans play a vital role in the A/C process as they collect the condensate produced as evaporator coils come into contact with the surrounding warmer air of a home.

To create nominal CAD models, NVision needed to scan three drip pans of each style, as three would provide an average of each pan style's dimensions. Thus a total of 15 different drip pans were scanned. Made of commodity plastics, such as polyurethane, the pans were all rectangular and roughly measured about 3 feet x 3 feet x 3 inches.

After scanning the pans with a HandHeld laser scanner, NVision engineers used the point clouds to create STL (STereoLithography) models of each pan's average dimensions, followed by the creation of 3D models. These were then converted to CREO, which is, along with SolidWorks, one of the five major 3D CAD platforms. The manufacturer used these models to make the desired modifications to its A/C drip pans.

''I'm proud that our 3D scanning and engineering services played a role in extending the lifespan and improving the design of these A/C systems. Neither of these projects would have been as successful without the accuracy of 3D non-contact scanning,'' says Kersen. ''You could say that NVision is helping to improve home comfort from A to C.''

Copeland Announces North American CO2 Compressor Manufacturing



Company aims to meet additional market demand through its Sidney, Ohio, and Rushville, Ind., locations

Copeland, a global provider of sustainable solutions, today announced regional investment in manufacturing its compression products qualified for use with the natural refrigerant, CO2 (R-744). Copeland CO2 semi-hermetic and scroll compressors currently being manufactured in Mikulov, Czech Republic, and Cookstown, Ireland, will expand production to two of the company's North American locations.

Last week, manufacturing began on the Copeland 4MTLS transcritical and 4MSLS subcritical CO2 semi-hermetic product lines in Rushville, Indiana; simultaneously, Copeland ZO(D) CO2 scroll and digital scroll compressors commenced in Sidney, Ohio.

This change comes as the industry anticipates accelerated adoption of CO2 refrigeration technology

S&P bmax™
SIMPLY AT THE TOP
Radial Motorized DC Backward Wheel Series

Quiet. Efficient. Versatile.
CONTACT US TODAY!
(973) 257-8900 | oemsales.jax@solerpalau.com
www.soler-palauinc.com

being driven by food retail businesses pledging sustainability targets and needing to comply with environmental regulations. There has also been additional growth in cold storage infrastructure. Bringing CO2 compressor manufacturing to North America will help Copeland's original equipment manufacturer (OEM) and end-user customers more quickly achieve their sustainability and regulatory compliance goals and build out their cold storage infrastructure as product lead times shorten and CO2 compression is implemented within new store builds and remodels.

"The investments we are making in our facilities, supply chain and people in North America will allow Copeland to increase production capacity and flexibility," said Dave Bersaglini, vice president and general manager of refrigeration, at Copeland. "Positioning operations closer to customers and improving delivery times will allow us to be more responsive, providing customers with local support to help ensure their success."

To learn more about how Copeland is meeting sustainable, lower global warming potential market needs, or to learn about other Copeland HVACR technologies, please visit Copeland.com.

Sensience Earns Additional UL Certification for A2L Gas Sensing

Detecting R-454B is pivotal to helping OEMs ensure safety, protect the environment and comply with regulations

Sensience, a sensor manufacturer that enables enhanced safety and sustainability for leading manufacturers, announced today the attainment of UL certification for adherence to UL 60335-2-40, 4th edition as it relates to detecting the refrigerant R-454B. This milestone is in addition to their previous certification of R-32 refrigerants.

The certification comes as Sensience continues to focus on helping the HVACR industry prepare for the January 2025 transition deadline to A2L refrigerants. Due to their mild flammability, A2L gas sensing is critical for ensuring safety, compliance with regulations, protecting the environment, and maintaining the integrity of equipment in applications where these refrigerants are used.

Sensience is proud to be at the forefront of innovation within the sensing market, setting a new standard for gas sensing technologies. This certification represents a pivotal step in the company's ongoing commitment to development of products that enable a sustainable future.

For more information about Sensience's sustainability initiatives and UL-certified products, please visit https://www.sensience.com/products/30g-refrigerant-sensor/



Jeffrey F. Koehl Appointed Chairman of SPIROL International Holding Corporation

SPIROL International Holding Corporation Board of Directors announces the unanimous decision to appoint Jeffrey F. Koehl as Chairman of SPIROL International Holding Corporation. Jeff joined the company in 1997, and has been serving as Chairman and Chief Executive Officer of SPIROL International Corporation since his appointment in 2010.

Jeff succeeds his father, Hans H. Koehl, who passed away on November 30, 2023. Serving as Chairman of SPIROL International Holding Corporation since his appointment in 1969, Hans retired from active management of the company in 2004 after 45 of dedicated service. Hans' vision, dedication, and passion led to the transformation of SPIROL from being a small, family-owned business in Northeast Connecticut into a world-renowned manufacturing company with locations on 4 continents and in 13 countries. It is impossible to put into words the unparralled contributions that Hans made to SPIROL over the last 64 years – most importantly the education, coaching and mentoring of his son, Jeff, in preparation for him to be his successor.

SPIROL was co-founded in 1948 (then called Connecticut Engineering and Manufacturing Company) by Hans' father and Jeff's grandfather, Herman J. Koehl, Hans A. Prym, and Walther G. von Conta. After 75 years, the families of the 3 founding members are all still intimately involved with the company, with two serving as Directors on the Board.

While succeeding his father as Chairman is no insignificant task, Jeff is uniquely qualified for the position. As stated by Peter von Conta, Non-Executive Director of SPIROL and grandson of co-founder Walther G. von Conta, "As both a Shareholder and Director, I feel we are extremely fortunate to have planned for this natural succession and seamless transition to the Chairmanship. With Jeff, we undoubtedly have the leadership in place that will continue the unwavering

commitment to our vision and values needed to ensure SPIROL's continued success for generations to come."

Jeff earned his bachelor's degree in biomedical engineering from Brown University, and his MBA from Boston College. He has over 26 years of experience at SPIROL and has held a number of leadership positions prior to being appointed Chairman and CEO of SPIROL International Corp. Under Jeff's direction, SPIROL has achieved profound success and growth including the establishment of numerous wholly-owned subsidiaries as well as the recent acquisition of Ford Aerospace in South Shields, England.

Given his proven accomplishments and his demonstrated capacity to skillfully lead the company through numerous unprecedented and extraordinary challenges, Jeff has the complete faith of the shareholders and support of the Board of Directors. Peter von Conta avowed, "As we embark on an increasingly complex period of industry transformation, Jeff is uniquely equipped to lead us through this pivotal era. We are excited about the future of SPIROL and look forward to the Company's next chapter under Jeff's strategic leadership as Chairman of the Board."

ECI Recognized for Supplier Quality Excellence by Mabe



Electrical Components International, Inc. , a leading global supplier of electrical distribution systems, control box assemblies, and other critical engineered components for diversified markets, is delighted to announce its recent participation in Mabe's Best Suppliers event at his Tequisquiapan location, where ECI was recognized for its active involvement in the quality campaign, earning the "Mabe seal".

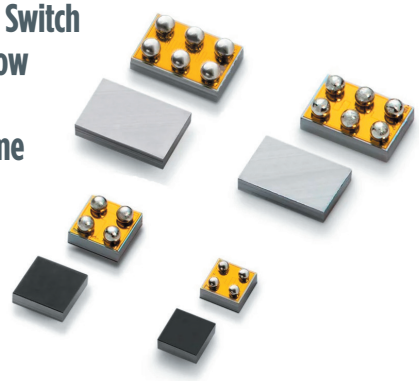
This recognition not only underscores our commitment to being acknowledged as highly qualified suppliers but also solidifies our position at the forefront of the industry. Our paramount objective is to uphold the trust of our consumers and users by consistently delivering top-notch quality across all aspects of our operations.

Carlos Meneses, Quality Manager, expressed his gratitude towards the team, saying, "Our deepest gratitude extends to the entire staff. Whether in Production, Maintenance, Manufacturing, or HR, each team member has played an integral role in our success. The unwavering support and dedication to maintaining a sharp focus on quality have been instrumental in achieving this remarkable milestone. This celebration is a collective triumph, a testament to the dedication and teamwork of every individual."

While our achievement is notable within the context of our collaboration with Mabe, we want to emphasize that our commitment to quality extends far beyond any single partnership. Tequis Plant 1 remains steadfast in upholding the highest standards for all our customers. Trust and reliability form the bedrock of our operations, and we are resolute in our determination to continue delivering excellence.

As we express our gratitude, we eagerly anticipate further accomplishments. This recognition marks not the endpoint but a stepping stone towards even greater heights. At ECI, we have a culture of continuous improvement, with a keen focus on enhancing our delivery and quality performance. We see this acknowledgment as both a validation of our past efforts and motivation for the future.

Littelfuse Unveils Load Switch ICs Series with Ultra-Low Power Consumption Extends Battery Lifetime



Small form factor and best-in-class efficiency make them ideal for IoT, mobile, wearable electronics.

Littelfuse, Inc., an industrial technology manufacturing company empowering a sustainable, connected, and safer world, announced the latest release of five versatile load switch devices in the Protection ICs product line.

These new Load Switch ICs are ultra-efficient, 2 and 4 A-rated load switches with integrated true reverse current blocking (TRCB) and slew rate control. Their best-in-class efficiency makes them ideal for mobile and wearable consumer electronics. They support the industry's lowest quiescent current (IQ), low RON, and shutdown current (ISD), helping designers reduce parasitic leakage current, improve system efficiency, and increase overall battery lifetime. View the video.

The latest Load Switch ICs are ideal for use in a wide range of electronics designs, including:

- Handheld devices,
- Wearables,
- Internet of Things (IoT),
- SSD storage,
- Building automation, and
- Consumer electronics.

"The new Load Switch IC Series supports an extended battery lifetime for mobile and wearable products by providing low power consumption and power savings with easy-to-power on/off control," said Bernie Hsieh, Assistant Product Manager of the Protection Semiconductor Business team at Littelfuse. "Their package's chip-scale form factor provides space savings while integrating multiple functions, such as slew rate control, true reverse current blocking, and quick output discharging."

The Load Switch ICs offer the following key benefits over previous solutions:

- Power saving results in a significantly longer battery lifetime.
- The lower power consumption (lower RON, IQ, ISD) provides high-efficiency operation.
- They use a chip-scale package (with WLCSP) to replace discrete circuits with multiple functional integrations such as power MOSFET, reverse diode, discharge MOSFET, passive components, etc.
- The chip-scale-size form factor also significantly reduces PCB space requirement.

The Load Switch ICs are available in the following series:

- LQ05021QCS4 - 5V, 2A Ultra-Low Consumption with Slew Rate Control
- LQ05021RCS4 - 5V, 2A Ultra-Low Consumption with True Reverse Current Blocking
- LQ05022QCS4 - 5V, 2A Ultra-Low Consumption with Slew Rate Control
- LQ05041QCS6 - 5V, 4A, Ultra-Low Consumption with Slew Rate Control
- LQ05041RCS6 - 5V, 4A Ultra-Low Consumption with True Reverse Current Blocking

The load switch devices utilize a small, chip-scale package with:

- Four (4) bumps in a 0.77 mm x 0.77 mm x 0.46 mm package size on a 0.4 mm pitch,
- Four (4) bumps in a 0.97 mm x 0.97 mm x 0.55 mm die size on a 0.4 mm pitch, or
- Six (6) bumps in a 0.97 mm x 1.47 mm x 0.55 mm package size on a 0.5 mm pitch.

Availability

The Load Switch ICs are available in tape and reel format in quantities of 4,000 (LQ05021QCS4, LQ05021RCS4, LQ05022QCS4) or 3,000 (LQ05041QCS6, LQ05041RCS6). Place sample requests through authorized Littelfuse distributors worldwide. For a listing of Littelfuse distributors, please visit Littelfuse.com.

Illinois, United States, Littelfuse was founded in 1927. Learn more at Littelfuse.com.

Carrier Announces Agreement to Sell Global Access Solutions Business to Honeywell for $4.95 Billion

Carrier Global Corporation (NYSE: CARR), global leader in intelligent climate and energy solutions, entered into a definitive agreement today to sell its security business, Global Access Solutions, which includes the industry-leading brands of LenelS2, Supra and Onity, to Honeywell (NASDAQ: HON) for an enterprise value of $4.95 billion, which represents approximately 17x 2023 expected EBITDA. The sale agreement is a successful first step in Carrier's portfolio transformation.

With approximately 1,200 employees operating in 33 countries, Carrier's Global Access Solutions business is an innovative global leader in advanced access and security solutions, electronic locking systems, and contactless mobile key solutions. This pending sale will allow the business to build on the strength of its leading brands, innovative solutions, strong partner relationships and high growth potential.

"Global Access Solutions is a great business with dedicated, customer-focused teams, and we look forward to watching its continued growth under the ownership of Honeywell," said Carrier Chairman & CEO David Gitlin. "The transaction, together with the planned exits of our Industrial Fire, Residential and Commercial Fire, and Commercial Refrigeration cabinet businesses, will accelerate our growth strategy and focus, positioning Carrier to deliver higher growth and superior shareholder value and further reinforcing our track record of performing while transforming."

Carrier expects net proceeds from the transaction to be approximately $4 billion and intends to use the proceeds to pay down debt. The company anticipates resuming share repurchases as soon as its net leverage returns to approximately 2x EBITDA.

Beginning in the fourth quarter of 2023, Carrier expects to classify the Global Access Solutions business as "held for sale" on the balance sheet, but the results will remain in continuing operations until the sale closes.

The proposed sale is subject to regulatory approvals and customary closing conditions. It is expected to close before the end of Q3 2024.

Goldman Sachs & Co. LLC and J.P. Morgan Securities LLC are serving as financial advisor to Carrier. Paul, Weiss, Rifkind, Wharton & Garrison LLP and Linklaters LLP are providing external legal counsel.

AHR EXPO CHICAGO
JAN 22-24 / 2024

AHR Expo Announces 2024 Innovation Awards Winners

The AHR Expo (International Air-Conditioning, Heating, Refrigerating Exposition) announced the winners of the 2024 AHR Expo Innovation Awards. Winners are chosen annually in 10 industry categories, representing the most innovative products and technologies in the market.

"There's no shortage of innovation in HVACR right now," said Show Manager, Mark Stevens. "To be recognized as an award winner is a true honor and an indication that we as an industry are responding to real problems with creative solutions. The Innovation Awards aim to highlight this innovation trajectory and celebrate those that are pushing the bar."

The program draws hundreds of manufacturers to enter breakthrough designs for new and never before seen solutions or improvements upon existing products and technologies. All entries are reviewed and selected by a panel of third-party judges made up of distinguished ASHRAE members. Evaluations are based on overall innovative design, creativity of the product or service offered, product or technology real-world application, as well as overall potential market impact.

"It's encouraging to see so many entries and the growth the awards program brings year to year," continued Stevens. "Manufacturers across the industry are responding with solutions for cost savings, energy savings, production efficiency and are filling performance gaps in product and technology. Congratulations to our 2024 winners, we look forward to supporting your journey of innovation in Chicago and beyond!"

In addition to celebrating innovation in HVACR, the Innovation Awards provide a means to strengthen the industry by allowing for the AHR Expo Workforce Development program, which aims to grow the industry through programming geared to inspire future members of the HVACR community.

Funds collected from the entry fees are donated to programming at the student level, including show field trips, curated introductions to professionals and manufacturers, laboratory equipment and monetary donation to student programs in the hosting city. Learn more about workforce development on ahrexpo.com.

Winners for the 2024 AHR Expo Innovations Awards include:

BUILDING AUTOMATION



Winner: 75F
Innovation: 75F HyperStat Split
AHR Booth: #S6374; S6277 75F

The 75F HyperStat Split enables contractors to upgrade RTUs with advanced rooftop control with unprecedented ease. Using only two existing wires from the RTU to the thermostat, HyperStat Split provides dual enthalpy economizer, demand-control ventilation, and VFD control. What's more, an onboard PIR occupancy sensor enhances energy savings with auto away. Devices like the HyperStat Split encourage the building controls industry to make two design considerations the norm.

First, HyperStat Split's ability to work with the existing two wires provided for a standard temperature sensor while still delivering advanced control sequences demonstrates that hardware can work with existing infrastructure without excessive complexity.

Second, the device's eight onboard sensors and native cloud connectivity for real-time analytics prove that rising demand for excellent indoor air quality management can be met in a straightforward, modern, and user-centric manner.

Finalists: Carrier, i-Vu Express Connected Building Automation Appliance (Booth #S7510); Copeland, Copeland CC200 case controller (Booth #S7110).



COOLING

Winner: Danfoss
Innovation: DSG Compressor
AHR Booth: #N2510
Danfoss

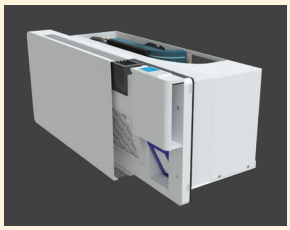
The DSG compressor has been specifically designed for low pressure refrigerants such as R1234ze with low global warming potential. Applications include chiller systems, with a wide range of compressor capacities available to support unit design requirements. The DSG has been specifically designed for low pressure low global warming potential refrigerants such as R1234ze. These refrigerants would usually require a much larger compressor size to have the same capacity as high pressure (R410A, etc.) refrigerants.

As chiller manufacturers will need to transition to lower global warming potential refrigerants <700 GWP they will need to move to medium and low-density refrigerants. The DSG with its same size will enable

a smooth transition without a significant increase in physical compressor size. It is qualified for R1234ze which is an excellent replacement for the market that has been dominated by R134a for many years, but will be phased down due to its impact on the environment.

The DSG can also be used with other refrigerants with similar properties, so it offers a great deal of flexibility for manufacturers to choose without requiring a new compressor design. This will also support future refrigerant changes and regulations without requiring significant modifications.

Finalists: Daikin Applied Americas Inc., WMT (Booth #S7549) ; Innovair, DuoTec (Booth #N3060).



HEATING

Winner: Ephoca
Innovation: Nextac - The next generation of PTAC AHR
Booth: #S9914
Ephoca

Nextac transforms the PTAC into a tour-de-force of total comfort control. R32, twin rotary inverter compressor, heat pump performance to -10°F, integrated ERV, MERV13, zero air leakage, self-cleaning coils, 27 dB(A) operations, STC of 40, sleek, all-metal, paintable cabinet. No drain is required for cooling or heating. For many years, PTACs have seen minimal advancement.

Often considered a "cheap, low-end" product, installers have favored them for their affordability and ease of installation. However, those living with PTACs in their homes have endured poor performance with no better options to fit existing sleeves.

Nextac aims to disrupt this status quo with this new high-efficiency and quality PTAC by compelling manufacturers to enhance their PTAC lineup, making them more efficient, aesthetically pleasing and adding more insulation for quieter operation and a better seal.

Finalists: Caleffi Hydronic Solutions, Caleffi XF (Booth #S7981); Intellihot Inc., Electron iE1 (Booth #S10323).

INDOOR AIR QUALITY

Winner: WellStat
Innovation: WellStat
AHR Booth: #N3417
WellStat



WellStat® is an indoor Air Quality + Energy Management Software platform used by property and facility management teams to responsibly assure healthy air quality conditions, lower operating costs, and increase operating revenue. It is our goal to optimize an asset's performance while promoting a safer and healthier work environment. WellStat is FCC tested and UL listed. It provides data beneficial for achieving various sustainability certifications (LEED, WELL, RESET certified, US Energy Policy Acts).

WellStat is completely integrated, customizable and provides a single, unified enterprise hardware, software, and mobile platform experience. With WellStat, customers can optimize their asset's performance while promoting a safer and healthier work environment. Additionally, WellStat uses the highest caliber sensors available and maintains systemic accuracy through persistent, over-the-air calibration that never requires maintenance.

Monitoring systems are tested, calibrated and always accurate, all the time including 14+ IAQ sensors monitoring: temperature, relative humidity, particulate matter, carbon dioxide, ozone, total volatile organic compounds, formaldehyde, reset TVOC, dew point, wet bulb, light level, carbon monoxide, occupancy, pressure, sound DB, duct flow.

Finalists: ECM PCB Stator Technology, Ultra-light, Premium Efficiency 6hp PCB Stator Air Blower Motor (Booth #S10334); Sensirion, Inc., SEN6x (Booth #S6156)



PLUMBING

Winner: Rheem Water Heating
Innovation: Triton® Light Duty (50- and 75-gallon)
AHR Booth: #S7569
Rheem Water Heating

A smart, robust solution for small businesses, Triton Light Duty is the most intelligent high efficiency commercial gas water heater on the market. Boasting built-in smart monitoring and precise leak detection, the unit prevents downtime, manages water heater issues, and keeps businesses running smoothly. Perfect for retrofit or new construction.

With changing regulations, Rheem designs with sustainability in mind. Triton Light Duty (LD) is designed to promote energy efficiency and environmental responsibility and holds the potential to drive transformative changes in the way water heaters are conceptualized and manufactured.

With a capacity ranging from 50 to 75 gallons, Triton Light Duty's patented combustion system and helical coil heat exchanger provide maximum thermal efficiency and durability. The latest Triton offers up to 97% thermal efficiency and eliminates downtime with

the ability to detect and prevent water heater problems before they occur thanks to LeakGuard™ — an all-inclusive leak detection and prevention system capable of limiting water leakage outside the tank. The helical coil heat exchanger offers maximum thermal efficiency and energy savings. With porcelain/ glass-coated steel, corrosion is minimized, extending the life of the tank while the unique minimum weld joint construction increases durability.

Most importantly, the unit features a built-in condensate neutralizer, which eliminates the need for a separate device to raise the pH of the condensate for safe draining.

Triton LD is part of a decarbonization portfolio to transition away from less efficient water heaters, thereby reducing carbon emissions and environmental impacts. This signals a strong direction for the future, where new product development is likely to be influenced by an increasing emphasis on sustainability. Energy efficiency will take center stage as manufacturers strive to align with evolving regulations and meet strict carbon emissions reduction targets set by state and local governments.

Finalists: Bonomi North America, Inc., LOCPOWER Energy Harvesting Control Valves (Booth #N2560); ECM PCB Stator Technology, Ultra-light, Premium Efficiency 3HP PCB Stator Pump Solutions (Booth #S10334).

REFRIGERATION

Winner: AirGreen
Innovation: AirGreen-BMIL Brine-based DX Cold Room Heat Pump
AHR Booth: #S9377



AirGreen

The innovative AirGreen-BMIL brine-based DX refrigerant system essentially creates a low dewpoint "heat pump" for cold room applications – providing <26F dewpoint supply air in a single process step. Because of its simplicity and efficiency, this packaged unit design provides up to 50% energy savings while also significantly reducing capital costs.

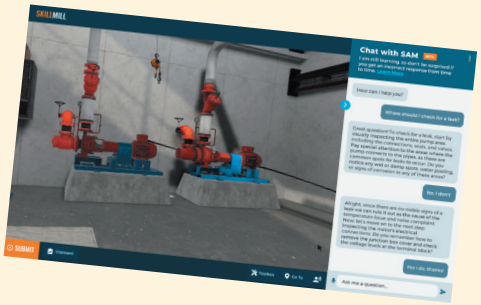
Solid desiccant products can only achieve supply air at 55F with a 40-45F dew point, and to lower the dry bulb temperature to as low as 33F it requires three or more pieces of equipment at considerable capital and energy penalty. The unique low temperature brine solution achieves this performance because it simultaneously cools and dehumidifies.

For customers, it also eliminates the downtime related to multiple defrost cycles, or worse, downtime for cleaning if condensation forms. Further, the AirGreen product only needs low regeneration temperatures (~110F), compared to solid desiccants requiring 180F or more. This low temperature hybrid brine system is uniquely suited for cold storage applications and addresses a $5.1B market. Customers will benefit both from precise supply air temperatures and the demonstrated energy savings of this design approach.

Finalists: Honeywell, Honeywell Solstice N71 (R-471A) (Booth #N2137); Mitsubishi Electric Trane HVAC US, Mitsubishi Electric Variable-Speed Scroll Compressors (Booth #S7177).

SOFTWARE

Winner:
Interplay Learning
Innovation:
SAM (Skill Advisor and Mentor)
AHR Booth:
#S10537



SAM (Skill Advisor and Mentor) is the first AI-powered advisor for the skilled trades. SAM gives teams instant and personalized guidance so they can gain skills faster and more efficiently. Technicians can ask SAM questions and get immediate assistance while they're learning, helping enhance comprehension and sharpen critical thinking. SAM is the first of its kind. Interplay's unique approach to on-demand mentorship and training provides considerable value, such as:

- Fast Tracks Learning: SAM meets technicians where they are, providing assistance to suit their specific needs. It's like an approachable study buddy who understands them perfectly and helps them learn faster;
- Sharpens Critical Thinking: SAM doesn't shortchange learning with easy answers. It guides them towards "aha" moments and helps develop problem-solving skills;
- Saves Time and Boosts Productivity: When newer techs ask SAM for help first, it can free senior techs and managers from answering basic questions and give them more time to grow the business;
- Taps Into Expert Knowledge: SAM uses data from SkillMill, which has been carefully crafted by seasoned subject matter experts, to ensure techs learn skills right the first time.

Finalists: Conduit Tech, Conduit Tech Software (Booth #S10064); IES Ltd., IESVE Software (Booth #N3452).

SUSTAINABLE SOLUTIONS



Winner: Midea Residential Air Conditioning
Innovation: Midea PWHP
AHR Booth: #S10371

Midea's Packaged Window Heat Pump is a window-mounted cold climate air source heat pump, designed for DIY installation and high-performing, energy-efficient heating and cooling. Developed to support multi-family buildings' transition towards electrification, the Midea PWHP provides a cost-effective solution for buildings looking to quickly meet future sustainability requirements.

Midea's PWHP stands out in innovation and uniqueness as a window-mounted unit. Unit performance is 9,000 BTU/hr heating and cooling, with the category's highest CEER of 16.0, as of the application date, a 2.35 COP @ 17F, up to SEER2 21.8 and HSPF2 11.6. This is done without the use of auxiliary heat.

While high-efficiency heat-pumps typically require professional installation including new electrical circuits, the Midea PWHP operates on a 120V/15A circuit mounting to hung-type windows, allowing for DIY installation. The innovative saddle design allows window view and functionality while simultaneously reducing indoor noise levels.

A distinguishing feature of the Midea PWHP is a telescoping center section that adjusts to various wall depths and a hinged outdoor section allowing for rotation during installation. This along with ~50% footprint reduction from the industry first integrated inverter compressor offers the ability to quickly install into windows while maintaining optimal performance.

Finalists: Blue Frontier, Blue Frontier, Liquid Desiccant DOAS (Booth #N1440); Mitsubishi Electric Trane HVAC US, Mitsubishi Electric, Hybrid VRF® (Booth #S7177).



TOOLS & INSTRUMENTS

Winner: INFICON
Innovation: FLUE-Mate ™Combustion Analyzer
AHR Booth: #N2934

FLUE-Mate Combustion Analyzer is designed to improve combustion efficiency and safety. This tool is equipped with an integrated manometer, thermometer, CO test, cracked heat exchanger test and provides draft analysis. FLUE-Mate can even generate a QR code that can be scanned with your smart device for a quick analysis report.

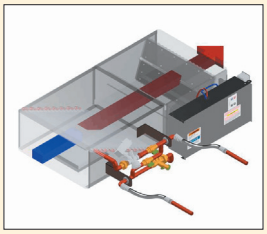
The Combustion Analyzer provides a host of useful features for user convenience and safety, like the easily visible water trap and filter, easy operation, cracked heat exchanger test, automatic pump shut-off, and ambient CO monitoring. The free mobile app is a major advantage that allows the user to do even more with their combustion analyzer.

FLUE-Mate generates a QR code that can be scanned using the app for a quick analysis report without the need for a Bluetooth® connection. All important readings and information are on your smart device with just a quick scan of the code. The app also allows the user to save and share reports.

Unlike many other combustion analyzers, FLUE-Mate displays efficiency, O2, CO2, CO and flue gas temperature readings all on one screen. This makes FLUE-Mate more user-friendly and helps techs get the job done quicker. FLUE-Mate's water trap and filter assembly is designed to always be upright and easy to see, so you always know when to change the filter or empty the trap and keep your FLUE-Mate protected. The automatic pump shut-off feature stops flow when a high level of CO is detected, saving the CO sensor from being poisoned and saving customers an expensive repair bill.

Finalists: MSA Safety, Legend Series HFC (Booth #S6536); Snap Drill AS, Snapdrill (N3165).

VENTILATION



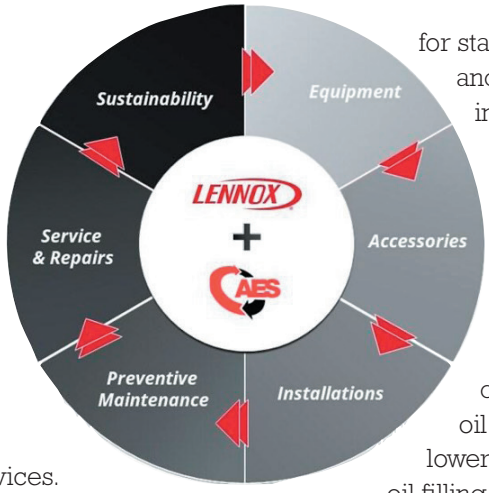
Winner: HVAC Manufacturing and Technology Inc.
Innovation: SAV® Smart Air Valve
AHR Booth: #S9220

The SAV-Smart Air Valve is an economical self-commissioning air control solution. Featuring a 100-1 turndown and precision airflow accuracy to within a few CFM operating as low .03"W.G. It matches the ventilation rate to the risk of hazard featuring advanced Demand Control Ventilation & low EUI with a single unit size. The SAV® adds value and mitigates risk by creating a new simplified and economical value chain leading to a paradigm shift by obsoleting fixed orifice plate technology. The Variable Orifice Plate Technology solves a complex fluid dynamic problem of measuring a fluid accurately over a wide dynamic range, obsoleting current fixed orifice single venae contracta fluid measurement/fluid control air terminals. Offers a variable dimensional aspect ratio footprint. It solves current issues for end users, Architects/engineers, contractors, and TAB entities.

This innovation allows the controls companies/system integrators to supply and warranty the zone level devices as part of their scope of work, optimize their software/network architecture with self-balancing flexibility, Eliminate GIGO (garbage in garbage out) data and mitigate risk for the life cycle of the building. SAV-Smart Air Valve transforms an infrastructure into a user centric healthy flexible space without mechanical infrastructure upgrades.

Finalists: ECM PCB Stator Technology, High-Performance, Lightweight 12hp PCB Stator Blower Motor (Booth #S10334); LG Electronics U.S.A. Inc., LG Split Compact M3 DOAS with Multi V S® (Booth #S8345).

Lennox Acquires AES to Expand Commercial HVAC Services



Lennox (NYSE: LII), a leader in energy-efficient climate-control solutions, today announced it has completed the acquisition of AES, a company dedicated to service and sustainability in the light commercial market.

Across North America, AES provides installations services, adapter curbs, and reclaim services. AES will become part of the Lennox Commercial Business Segment and enable the delivery of ''front-to-back'' life-cycle integrated services to AES and Lennox customers.

Lennox Commercial Business Segment HVAC Lifecycle Capabilities with AES Acquisition.

''AES represents a strong strategic and cultural fit for the Lennox Commercial segment and is consistent with our growth strategy,'' Lennox EVP and President of the Commercial Heating and Cooling Business Joe Nassab stated. ''By adding AES's services to our already strong portfolio, we have positioned our business to grow through providing our customers with more capabilities. In addition, we are thrilled that AES and Lennox share many of the same core values and we look forward to growing together.''

AES President Jason Benton will join the Lennox Commercial business segment in a leadership role and will continue to lead the AES business and team of approximately 280 associates.

''This is an excellent fit for us,'' said Jason Benton, President of AES. ''Our customers trust us to respond quickly and personally. We are excited for the opportunity to reach new customers and expand with Lennox resources.''

A New Design For Piston Compressors

Continuous innovation for a modern, quiet and efficient design

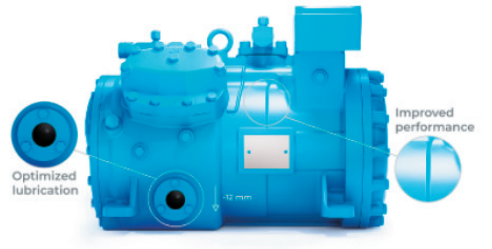
A modern design, quiet operation and ease of installation and maintenance are the key features of the new and exclusive design for reciprocating compressors D and Q.

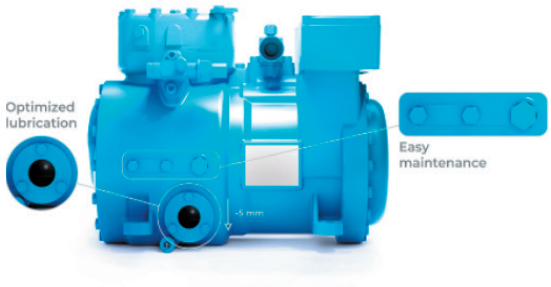
Frascold brings together innovation and attention to detail to create increasingly high-performance and modern compressors featuring a comprehensive study of each element, synonymous with quality. The company's Technical Team has designed a new body for standard and ATEX piston compressors D and Q, driven by their passion for constant innovation.

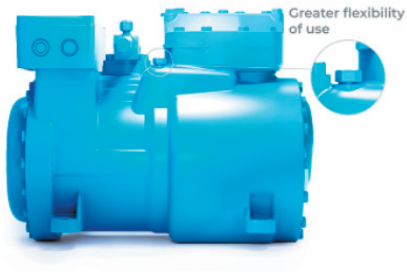
Improvements made to D and Q piston compressors

The new features offer important advantages in terms of design, flexibility of use and quiet operation. In particular, for both the D and Q sizes, a modern design has been developed featuring an oil sight glass respectively 5 mm and 12 mm lower than previous models to allow reduced oil filling in favor of optimized lubrication and improved overall efficiency.

The focus was also on ensuring easy maintenance for standard and ATEX D size piston compressors, aligning the pressure ports on the same side to ensure simpler and faster maintenance. Moreover, the new design features greater flexibility of use thanks to the liquid injection port that can be ordered upon request and as an option in the compressor delivery, located next to the intake valve. A new geometry has been specially designed for the inner part of the compressor, ensuring greatly reduced vibration.







The new Q size reciprocating compressors in the Standard and ATEX range feature a similarly cutting-edge design, in addition to superior volumetric displacements of 36 and 39 m³/h, making them perfect for use in commercial and industrial contexts, and in heat pumps.



Thomas Nowak to step down as secretary general of the European Heat Pump Association

After 17 years leading the European Heat Pump Association (EHPA), the voice of the European heat pump sector in Brussels, secretary general Thomas Nowak has announced that he will step down in the coming months.

Over time, he has developed the association from a ''one man band'' to a vibrant and energetic team of nearly 25 staff members. Membership has grown from a few dozen to more than 200 organisations. EHPA connects the heat pump sector to policy-makers and politicians on the European and international levels via its advocacy, communications, projects, events and work on certification.

Since 2006 the heat pump industry has grown from sales of 500,000 units in Europe, to 3 million last year. Heat pumps are now providing clean heating and cooling to nearly 16% of Europe's buildings, as well as to industry and district heating networks. A real success from a truly collaborative effort.

Thomas Nowak commented:

''The sector has gone from a minnow to a big fish on my watch. Heat pumps are now recognised at all levels of society as critical to decarbonising buildings and industry and helping secure Europe's energy independence.

''I am so glad to have contributed to this, and I'm proud of the thriving association – with an excellent secretariat team, a strong board and a growing membership and network – that I set up and nurtured.

''While I am moving on from EHPA, I will remain part of this vibrant and vital sector, convinced as I am of the benefits of heat pump technology. Handing EHPA over to new leadership will also be good for the association, as we are clearly seeing a sea change in the challenges the sector is facing. Fortunately, the association is in perfect shape to seize the opportunities offered by this dynamic market.''

''We still need all hands on deck to accelerate the deployment of heat pumps and ensure the technology's full contribution towards a sustainable and resilient heating and cooling supply to all Europeans.''

''A big thank you to all the colleagues and friends that contributed, collaborated, and co-created the success we are seeing. Thank you also to all of you who claimed heat pumps could not work: you helped me focus our efforts and I am very pleased that we were able to find answers to overcome all your doubts.''

EHPA president Martin Forsén said:

''What Thomas has done for the heat pump sector is exceptional. With his genuine passion and dedication, he has brought us from a niche, somewhat geeky technology to where we are today – a major European industry playing a lead role in the race to net zero.

I have had the honour and privilege of being part of the journey alongside Thomas and am proud to call him a close colleague and friend. The entire heat pump industry cannot express its gratitude for all Thomas ''Mr Heat Pump'' Nowak has done.''

Thomas Nowak will join Sweden's Qvantum Industries as their VP public affairs and government relations in the first half of 2024, after coordinating the handover to his successor. Qvantum Industries is a member of EHPA.



Honeywell Aerospace Engineer Christina Rutherford to Deliver Keynote at Electrical Wire Processing Technology Expo (EWPTE)

BANNOCKBURN, Ill., USA, February 8, 2024 — Christina Rutherford, Advanced Materials & Process Engineer at Honeywell Aerospace Technologies, is set to take center stage at this year's Electrical Wire Processing Technology Expo (EWPTE) May 14-16 at Baird Center in Milwaukee, Wis. as the keynote speaker. Rutherford will address industry professionals and enthusiasts in a keynote titled ''Process Controls and their Impact to Supply Chains'' on Wednesday, May 15. In her keynote speech, Rutherford will provide a deep dive into the critical role of process controls in shaping and enhancing supply chain dynamics, with a focus on the development and successful implementation of these controls.

As an award-winning engineer and a key contributor to IPC/WHMA-A-620 content development, Rutherford brings a unique perspective to the discussion. Her

insights into the intricacies of cables and harnesses design, coupled with her expertise in technical supply chain management, make her the perfect guide to navigate the complexities of process controls.

Attendees can anticipate an engaging presentation that goes beyond theoretical concepts, as Rutherford will share practical examples and case studies that showcase the successful application of process controls in real-world scenarios. Through her keynote, Rutherford aims to empower professionals across industries with actionable insights that can be implemented to drive positive change in their respective supply chains.

Rutherford's commitment to innovation and excellence, as demonstrated by her role in leading the adoption of new process development techniques at Honeywell Aerospace Technologies, sets the stage for a keynote address that promises to be both enlightening and impactful.

EWPTE provides a unique opportunity for industry professionals, enthusiasts, and aspiring engineers to connect with one of the industry's brightest minds. Christina Rutherford's keynote speech is expected to leave a lasting impression, inspiring attendees to explore new avenues for improving supply chain processes within their organizations.

More information about EWPTE, including details on educational opportunities networking, schedule, travel and more is available at electricalwireshow.com.

ETCO announces its product brochure

ETCO manufactures precision stampings along with rubber and plastic molded products used by manufacturers in multiple industries including automotive, appliance, consumer electronics and more. ETCO has major customers in these and other industries within the USA and in over thirty countries throughout the world. ETCO has factories and a research complex in Bradenton, Florida and a factory and engineering center in Warwick, Rhode Island.



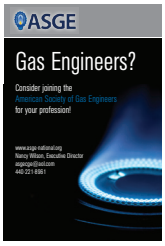
Intellihot announces its 2024 Product Guide

Intellihot's mission is to use leading-edge clean technology to do more while consuming less for the built environment, setting the benchmark for superior performance and efficiency to advance a waste-free future.



Ad Index

PRINT ADS



ASGE
www.asge-national.org
17



Continental Fan
www.continentalfan.com
13



EWPTE
www.ahrexpo.com
Inside Front Cover



Soler & Palau
www.solerpalau-usa.com
27



Spectronics
www.spectroline.com
21



Surface Igniter
www.surfaceigniter.com
Back Cover



Techflex
www.techflex.com
5



E-BLASTS

Continental Fan
www.continentalfan.com

Hernon Mfg
www.hernon.com

Littelfuse
www.littelfuse.com

Parker/Sporlan
www.parker.com

Soler & Palau
www.solerpalau-usa.com

Vitrek
www.vitrek.com

ENEWSLETTER

BlockMaster
www.blockmaster.com

Surface Igniter
www.surfaceigniter.com

WEBINAR

CSA Group
www.csa.org

HOW TO GET LEADS FROM

APPLIANCE & HVAC REPORT

Reaching Design Engineers at the OEM Level

IT'S AS SIMPLE AS 3-2-1

3 SELECT — The companies you want to reach from those who open us digitally

2 REVIEW — The list of companies who opened our digital edition

1 BUY — Advertising that appears in our print and digital editions and link to your site

FOR MORE INFORMATION CONTACT:

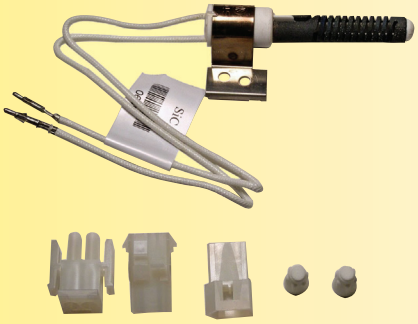
Brad Glazer, Founder and Publisher

(216) 233-6943 / brad@appliancehvacreport.com

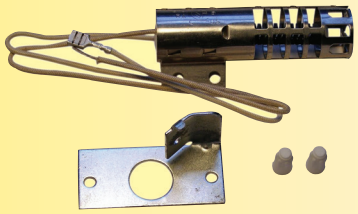
JABS Media, LLC

Surfaceigniter LLC

THE PIONEER IN HOT SURFACE IGNITERS



Surface Igniter has been pioneering the development of silicon carbide igniters since 1969. We are the premier manufacturer of hot surface ignition products for BBQ grills, clothes dryers, gas ranges, HVAC systems, boilers, and more.



Check Out These Catagories:

- 12 Volt / 24 Volt
- 2.5 ~ 3.0 Range Igniter
- 3.2 ~ 3.6 Range Igniter
- Boiler Igniter
- Dryer Igniter
- Flame Rods
- HVAC Igniter





info@surfaceigniter.com
customerservice@surfaceigniter.com
865-268-2846

Surfaceigniter LLC