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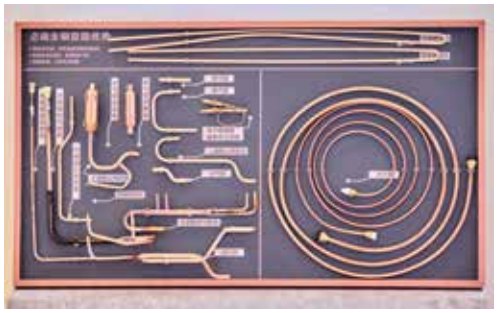
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Mastering High Voltage: The Importance of Accurate Test Equipment

Introduction

Accurate measurement of electrical performance parameters is crucial for the reliability and safety of high-voltage equipment and cabling.

For applications involving tens of thousands of volts, safety risks and demands on test equipment are high. Proper calibration of test instruments is essential to meet strict performance needs and standards, often conducted by certified laboratories with traceability to national standards like NIST.

This article is a synopsis of the full whitepaper available online at Vitrek.com and discusses the importance of high-voltage test equipment calibration and considerations for ensuring measurement accuracy.

HV Measurement Techniques

Various high-voltage measurement techniques have unique advantages and calibration needs:

- Step-Down Transformers: Reduce high voltage to manageable levels.
- Capacitive and Resistive Voltage Dividers: Divide voltage proportionally.
- Series Resistance (Microampere Measurement): Measure current through high resistance in series with voltage source.
- Analog Style Measurement Devices:
  - Sphere Gaps: Measure breakdown voltage between two spheres.
  - Electrostatic Measurement: Quantify electrostatic force between two plates

Why Measure High Voltage?

Measuring high voltage is increasingly important as technology advances. High-voltage systems reduce current carrying requirements and minimize energy loss. Also, in many cases, voltage values determine system performance. This means the voltage sources must be accurate and reliable in order to meet systems specifications. Also, monitoring systems need to be in place to ensure that the systems perform reliably from end-to-end and year-to-year.



Many types of equipment are used for high-voltage measurement.

High-Voltage Applications by Industry

High voltage is used in various fields including:

- Defense/Aerospace
- Manufacturing
- Research
- Power Products
- Inspection
- Medical
- Semiconductor
- And More

Conclusion

As technology advances, the importance of accurate high-voltage measurements will only grow, making it essential for industries to invest in proper calibration practices. Ultimately, mastering high-voltage measurement is about safeguarding both the equipment and the people who rely on it, ensuring a safer and more efficient future for all.

This article is a synopsis of a free whitepaper that provides additional materials including Calibration of High-Voltage Test Equipment and Choosing the right HV Test Equipment for the Application.

View the full article at: https://bit.ly/41XVNSi

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GEORGE FOREMAN AND ICE SCOOPERS

Here we are approaching the summer months. And now you have our 3rd quarter issue. You might be thinking why is George Foreman doing on our front cover? As a publisher, we strive to get your attention and hope that cover has done so.

Foreman, the Olympic gold medal winner and later heavyweight champion of the world passed away earlier this year. But his fame did not just extend to boxing. No, he achieved notoriety and wealth from The George Foreman Grill. Supposedly more than 100 million of them have been sold worldwide since being introduced in 1994. Because our brand reaches design engineers, here is some info on that subject:

The product has a clamshell design that simultaneously heats the top and bottom surfaces of the food, eliminating the need to flip it. Each heating surface is grooved to reduce contact area, and covered in a non-stick coating. The lower heating surface is angled to allow hot, liquid fat and other fluids to drain through the grooves into a removable drip tray, which shows the amount removed from the food. This arrangement has been marketed as a way to ''knock out the fat'', suggesting a healthier way to cook. (source Wikipedia).

The other cover picture is of an ice scooper. For those who have traveled often most of their lives they know all too well what happens in hotels. The water in the bathroom faucet is not cold. So you go find the closest ice machine, hopefully on your floor and scoop some into a plastic container. Take it back to the room and voila, you feel a lot better. And we have an article related to those ice machines this issue, courtesy of Littelfuse.

On another subject, remember CONSUMER REPORTS? Yes, it's still around. I received a promotion for it, contained in our local newspaper, The (Cleveland) Plain Dealer. Here are some of their comments regarding certain appliances:

They do recommend the Ninja Professional Plus Kitchen System BN801 blender over its Cusinart Hurricane Compact CPB-380 counterpart. It also recommends the LG LSDF6336f range as compared to the Viking 5 Series model VGR5304855 unit, which it calls ''The $5750 Mistake Some Homeowners Make. And regarding vacuum cleaners, it recommends a Kenmore model, which, it says, will do the job of Oreck, but at $130 less.

My dad was a furniture and appliance retailer from the day he graduated college until he retired. No wonder he didn't like that publication.

Last but not least, we exhibited again at EWPTE, our 4th year there. A 2 day show in Milwaukee every May, it seems to get busier every year. Glad to part of it.

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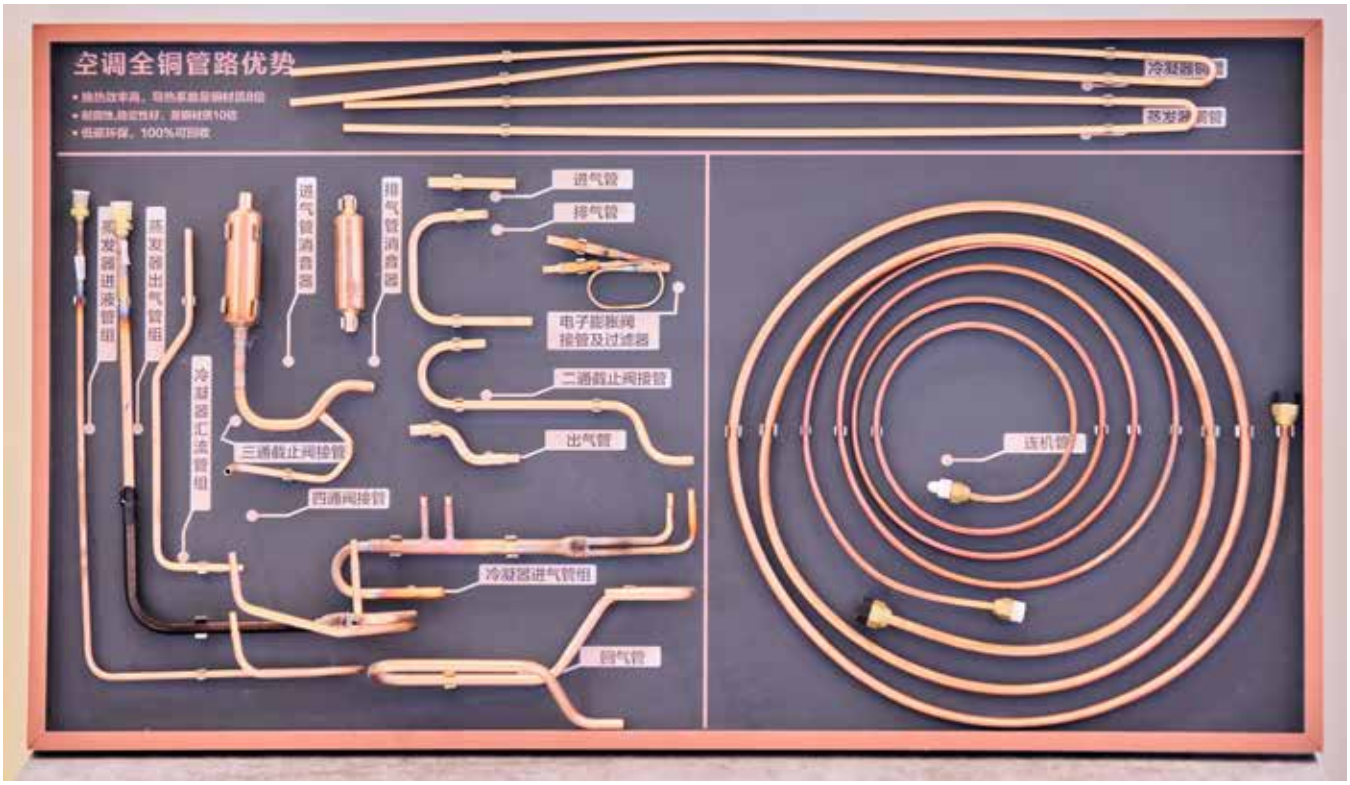
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Beyond Performance



Copper Shines at AWE2025: How Copper Is Driving the Low-Carbon Transformation in the Global Appliance Industry

The Appliances & Electronics World Expo, also known as AWE, (https://en.awe.com.cn/) is an awesome platform for global dialogue on low-carbon technology.

AWE2025 is the largest such industry event in Asia. As the global home appliance and consumer electronics industries strives for transformation under carbon-neutral goals, its 2025 theme ''AI Technology, AI Life'' reflects on the growing presence of artificial intelligence in appliances and consumer electronics.

Focusing on low-carbon technologies and sustainable development, more than 800 multinational enterprises and leading local companies assembled their exhibits within the Shanghai New International Expo Center for what could best be described as a symphony of technology and environmental sustainability.

One awe-inspiring instrument in this symphony orchestra was the ''Copper Inside'' exhibition, which was organized by the International Copper Association China Office. The top of mind question for more than 200,000 visiting professionals at AWE2025 was How to balance consumer upgrades and environmental constraints in the face of growing demand for more sustainable living practices?

Naturally, the ''Copper Inside'' exhibition garnered a great deal of attention with its theme of ''Copper Builds a Green Low-Carbon Life.'' The critical importance of copper materials in appliance design was exemplified by two products: (1) the Casarte 100% full copper refrigerant tube air conditioner and (2) Midea's R290 refrigerant small-diameter copper tube heat exchanger technology.

These products were on display at the ''Copper Inside'' exhibit revealing an often overlooked but critically important reality: Although traditional copper materials have been used for decades in appliances and consumer electronics, copper now plays a central role in the low-carbon revolution of the home appliance industry. The new role of copper is due to its outstanding physical properties and environmental advantages as outlined in this article.

Copper materials are key to driving the home appliance sector's low-carbon, energy-efficient and sustainable development. The new role of copper is a victory for materials science and an admirable example of industry-wide collaboration and innovation. As copper steps out from backstage, taking center stage in the limelight, it is transformed into the ''green metal.''

An Air Conditioner with 100 Percent Full Copper Refrigerant Tubes

The Casarte AC on display at the ''Copper Inside'' exhibit demonstrates how a material revolution is reshaping industry standards. This AC shows how the copper inside provides

(1) corrosion resistance,
(2) superior thermal conductivity,
(3) health and environmental protection

These advantages follow from using 100 percent copper in the refrigerant carrying tubes of the Casarte air-conditioner.

1. *Corrosion Resistance: The ''Copper Wall'' Defines Lifespan*

At the center of the ''Copper Inside'' booth, the Casarte air conditioner proudly displayed the trademark ''Industry's Only 'Copper Inside' Authorized 100% Full Copper Refrigerant Tube,'' underscoring how the inherent physical properties of copper are actively reshaping industry standards.

Data reveals that copper's corrosion resistance is more than ten times that of steel, significantly extending the life of air conditioners while preventing refrigerant leakage. This property becomes even more critical in hot and humid climates or coastal environments with high salt content. Traditional steel tubes typically corrode and result in refrigerant leaks after just five to eight years, whereas copper tubes can last 15 to 20 years, thus reducing both the cost of repairs and the environmental risks associated with leakage.

This performance advantage is rooted in copper's natural passivation property: copper reacts with oxygen in the air to form a dense copper oxide film, effectively preventing moisture and metal ions from penetrating into the bulk metal. Comparative experiments for tubes



in the same acidic environment show that the annual corrosion rate is only 0.001 mm for copper tubes in contrast to 0.01 mm for steel tubes, affirming the immense durability of copper.

2. Thermal Conductivity: Redefining the Technology Benchmark for ''Instant Comfort''

Copper boasts an extraordinary thermal conductivity of 401 W/m·K. That's eight times greater than steel and twice that of aluminum, making copper the ideal material for constructing high-efficiency heat exchange systems.

The Casarte air conditioner uses copper tubing with internal threads, which increases the internal surface area by 30% compared to ordinary smooth tubes, significantly boosting heat transfer efficiency. The improvement in heat transfer efficiency enhances the user experience by reaching the set temperature faster after startup and directly reduces energy consumption. Copper tubes transfer heat more quickly and efficiently, improving the air conditioner's cooling and heating performance. During both the cooling and heating processes, copper tubes can rapidly transfer heat from the refrigerant into the air or absorb heat from the air, thereby improving the air conditioner's efficiency in delivering both cooling and heating.

3. Health and Environmental Protection: Dual Closed Loops from Maternal and Infant Care to Circular Economy

In response to consumer demands for health-conscious home appliances, Casarte allows for healthy living solutions in households with infants. The natural antimicrobial properties of copper have become a key selling point. Research shows that copper surfaces can kill 99.9% of Escherichia coli and Staphylococcus aureus within two hours, an internationally certified feature by SGS testing and certification company. https://www.sgs.com/en/

our-company/about-sgs

For families with young children, the antimicrobial property of copper tubes effectively prevents bacteria growth in enclosed spaces, making it an essential feature for upgrading home appliances to meet the heightened focus on health and hygiene in a post-pandemic world.

On the environmental front, copper's 100 percent recyclability helps form a perfect circular economy cycle. Even after many years of use, copper can be regenerated through pyrometallurgical or hydrometallurgical refining processes without losing its quality. By recycling waste copper, the need for new copper mining is significantly reduced, valuable natural resources are conserved, the lifespan of copper mines is extended, and the long-term, stable supply of copper resources is ensured.

Regarding energy savings, recycling copper uses far less energy than mining and refining new copper. Copper recycling can save as much as 85 percent of the energy needed compared to primary production. Direct utilization and electrorefining save over 80 percent and around 50 percent, respectively, reducing production costs and minimizing reliance on fossil fuels, thus contributing to a low-carbon economy.

Copper recycling also plays a crucial role in significantly reducing waste generation and environmental pollution. It helps to mitigate the negative impact of discarded copper on soil and water resources. Compared to mining new copper, copper recycling produces much fewer greenhouse gases. Recycling one ton of copper can reduce carbon dioxide emissions by approximately 2.1 tons, contributing to the global effort to combat climate change.

Midea's R290 Refrigerant Technology: The Synergistic Evolution of Copper and New Refrigerants

1. R290 Refrigerant: The "Natural Choice" for the Low-Carbon Era

On the other side of the "Copper Inside" booth, Midea's Grade 1 Energy Efficiency split inverter wall-mounted air conditioner with R290 refrigerant vividly showcased the synergistic innovation between copper technology and new eco-friendly refrigerants, underscoring copper's vital role in supporting the use of R290 refrigerant in air conditioning systems.

The system's small-diameter copper tube heat exchanger is crucial in this breakthrough green technology. As a natural hydrocarbon refrigerant, R290 (propane) offers revolutionary environmental benefits: it has an Ozone Depletion Potential (ODP) of zero and a Global Warming Potential (GWP) of just 3. Traditional refrigerants have much higher GWPs: R410A has a GWP of 2088 and R32 has a GWP of 675. Air conditioners using R290 refrigerants have an almost negligible impact on global warming, which aligns perfectly with the goals outlined in the Montreal Protocol's Kigali Amendment for eliminating Hydrofluorocarbons (HFCs) and China's "dual carbon" targets.

In the global context of advocating for low-carbon, sustainable living, these advantages of R290 refrigerant are pivotal in reducing the environmental footprint of air conditioning products. However, to fully leverage the potential of R290 refrigerant, stable operation is essential, and this is where copper's role becomes critical.

The use of R290 faces two significant challenges: first, its flammability, as propane has an explosion limit of 2.1%-9.5% in air, requiring strict control over the refrigerant charge; second, the compatibility of materials with the refrigerant, as hydrocarbons can chemically react with certain metals, creating potential safety risks. Here again, copper demonstrates its advantages. Copper offers exceptional chemical stability with R290. Furthermore, small-diameter copper tube technology reduces the refrigerant charge, overcoming safety and efficiency bottlenecks.

2. Small-Diameter Copper Tube Heat Exchanger Technology: The



"Key" to Solving the Paradox of Safety and Efficiency

Midea's research and development in small-diameter copper tube (SDCT) heat exchangers features high-efficiency inner-grooved copper tubes with an outer diameter of just 5 mm. Although this design change may seem insignificant initially, it embodies profound innovations in materials science and fluid dynamics. SDCT heat exchanger technology uses high-efficiency inner-grooved copper tubes with 5 mm outer-diameter. Combined with meticulously optimized fins and flow path designs, SDCT designs ensure that heat exchange efficiency is not compromised while significantly reducing refrigerant usage.

Midea has balanced technological advancement and environmental value by integrating this SDCT heat exchanger technology with R290 (propane) refrigerant. The design of the small-diameter copper tube reduces the use of copper material, leading to reduced costs and lighter equipment while simultaneously decreasing the overall system volume. This innovation allows the refrigerant charge to be controlled within 300 grams, significantly improving the safety of this flammable refrigerant and meeting the stringent international standards on refrigerant charge limits. The smaller diameter also leads to higher refrigerant flow speeds, enhancing the turbulence effect and improving the heat transfer coefficient by up to 15 percent.

Given R290's outstanding thermodynamic properties (its evaporation latent heat is 20 pecent higher than that of R410A), this technology can reduce compressor power consumption, improve energy efficiency, and lower electricity consumption while reducing indirect carbon emissions. The overall energy efficiency ratio (APF) can reach as high as 5.2, exceeding the national level Grade 1 energy efficiency standard (5.0).

With such efficiency of energy utilization, air conditioning energy consumption is naturally reduced, lowering operational costs for users. More significantly, on a global scale, the widespread adoption of such highly efficient and energy-saving air conditioners will contribute immensely to society's low-carbon objectives, helping address global challenges such as climate change and other pressing environmental issues.

3. From Technological Innovation to Industrial Ecology: The "Hidden Value" of Copper

Midea is one of the pioneers in researching and applying R290 refrigerant in air conditioners. Since 2008, Midea has been strategically investing in developing R290-related technologies. In 2011, with financial support from the United Nations Multilateral Fund, Midea completed the first-ever industry transformation of a production line for R290 compressors and developed the first R290 fixed-speed air conditioning unit. In 2013, Midea's R290 air conditioning compressor became the first of its kind to be mass-produced in the industry, and the R290 air conditioners developed by Midea received the first-ever 3C certification in the industry. In 2015, Midea's R290 mobile air conditioners successfully entered the European market, marking a significant step forward in global expansion. In 2016, Midea



established the world's first R290 application demonstration base, further solidifying its leadership in this field. In 2017, Midea received the prestigious "Outstanding Contribution Award for 30 Years of the Montreal Protocol" from the United Nations.

In 2018, Midea's R290 products earned the global first "German Blue Angel Certification" in the air conditioning industry, with R290's key technologies recognized as internationally advanced. In 2019, Midea was awarded the "Low Carbon Environmental Protection Leadership Award" by the United Nations Environment Programme and other prominent organizations. In 2020, the United Nations Industrial Development Organization presented Midea with the "Outstanding Contribution Award for Energy Saving and Environmental Protection." In 2021, Midea received the "German Blue Angel Certification" once again.

Over the past 14 years, Midea has steadily moved from fixed-speed air conditioners to variable-frequency air conditioners, and from split air conditioners to integrated air conditioners. It has expanded its presence from the domestic market to the global stage. Midea's journey demonstrates its unwavering commitment to establishing a strong industry position and voice in R290 technology.

Midea's experience has shown that the value of copper lies not just in the material itself but also in its optimal synergy with the overall system. The low GWP (Global Warming Potential) characteristics of R290 refrigerant demand compatible hardware, and copper's natural resistance to corrosion, excellent thermal conductivity, and adaptability to processing make it the perfect material to support this innovative technology. This combination of "material-technology standards" has fostered a shift in the air conditioning industry, moving from upgrades in individual components to system-level innovations.

The SDCT heat exchanger design has made it possible to reduce the size of heat exchangers, facilitating the development of smaller and lighter air conditioners and reducing the refrigerant charge of R290, decreasing the flammability and improving the system's safety. This, in turn, has resulted in a significant reduction in carbon emissions associated with transportation and installation.

Empowering the Industry with Copper: From Individual Products to Full Industrial Chain Transformation

In other areas of the AWE2025 exhibition, the role of copper is evident across various applications: oxygen-free copper liners in water heaters, copper evaporators in refrigerators and copper coil motors



in washing machines are just a few examples, which reinforce a widely shared understanding: Copper is rapidly becoming the "universal language" for decarbonization in the home appliance industry. Statistics show that global copper usage in the home appliance sector has grown from 1.5 million tons in 2010 to 2.3 million tons by 2024, with an average annual growth rate of 4.5 percent. This growth rate far outpaces that of steel (1.2%) and aluminum (2.8%).

This rapid growth is driven by the irreplaceable role of copper in several key areas: In heat pump technology, copper tube heat exchangers are 30 pecent more efficient than their steel counterparts, significantly boosting the performance of air-source water heaters with a 300 percent energy efficiency ratio. In variable-frequency motors, copper windings have a 60 percent higher electrical conductivity than aluminum, reducing electromagnetic losses and improving motor efficiency by more than 5 percent. In the realm of 5G smart appliances, copper's exceptional electromagnetic shielding properties ensure stable signal transmission and prevent interference that could arise from plastic casings, ensuring uninterrupted performance.

Envisioning the Future: How Copper Continues Its "Green Metal" Legacy

The "Copper Inside" booth at AWE 2025 is not only a showcase of technological achievements but also a rethinking of the "value of materials," fostering a deep dialogue on sustainable development. As AI and the Internet of Things continue to reshape the home appliance industry, copper's "ancient yet ever-new" properties exemplify how foundational materials can drive industrial transformation. When the high-quality products such as Casarte's 100 percent Full Copper Refrigerant Tube air conditioners safeguard performance and Midea's R290 refrigerant-based variable-frequency split air conditioners lower carbon footprints, copper has evolved beyond being just a material: It is becoming a key connector between technological breakthroughs, consumer upgrades, and environmental protection.

As the "Copper Inside" coalition grows and deeper collaboration within the industrial chain unfolds, copper materials are poised to write a low-carbon success story across even broader sectors. Achieving this vision will require more than just technological investments from companies. It will require active participation from policymakers, industry organizations, and consumers. When every full-copper appliance becomes a "green living" micro-unit, and every meter of copper tubing serves as a neuron in a low-carbon network, we will be witnessing an industry-wide ecological reconstruction powered by a materials revolution—one in which copper, in its "green metal" form, leads the way.

As the countdown to carbon neutrality continues, the story of copper is far from over. It serves as a reminder that a genuinely low-carbon revolution starts with meticulous attention to every detail and exploration of every potential. When technology and nature find harmony in copper materials, we will witness more efficient home appliances and pave the way for a sustainable future.

Copper will continue to create a more comfortable and sustainable lifestyle for global users, and the International Copper Association will continue to play an essential role in certification, promotion, and guiding the development direction of the industry in this process.



By Harry Schmitz, The Kellen Company, Washington, D.C.

Harry Schmitz is a director of strategic communications at the Kellen Company. He was graduated Stony Brook University with a doctorate in materials science and engineering based on research completed at several national laboratories. Marketing campaigns have focused on small diameter copper tube heat exchanger technology for AC, refrigeration, and heat pumping.



Designing Appliances for the New Refrigerants

How a Switch for a Bulldozer Saved a Commercial Ice Maker

Sometimes you get lucky. A product designed for one application unexpectedly solves a problem in an entirely different industry. That's exactly what happened when a switch originally built for off-road vehicles operating in harsh environments became the perfect solution for a new generation of environmentally friendly commercial ice makers.

The refrigeration industry is undergoing a significant transformation. Environmental regulations have mandated a shift away from hydrofluorocarbons (HFCs), which contribute to global warming by trapping heat in the atmosphere when they leak or escape during use, servicing, or disposal. This regulatory push has led manufacturers toward alternatives like propane (R-290), which offers superior efficiency and minimal environmental impact.

Propane's advantages as a refrigerant include:

- **High latent heat of vaporization,** allowing more cooling per unit of refrigerant,
- **Low molecular weight,** which provides high volumetric cooling capacity and allows for smaller compressors and heat exchangers,
- **Operating pressures similar to Chlorodifluoromethane (R-22),** making retrofitting or redesigning systems less mechanically complex,
- **Low global warming potential (GWP) of 3**, a measure of the quantity of greenhouse gas a chemical can trap in the atmosphere. HFCs like R-22 have GWPs of approximately 1810 and higher values.
- **Higher energy efficiency** ranging from 5 to 12 % or even higher, depending on the refrigerant, compared with propane.

While propane is an excellent refrigerant, it has the disadvantage of flammability, which introduces new design challenges. Propane-based refrigerant systems require leak detection, ventilation, and ignition-proof components. The transition to propane requires familiarity with previously unencountered safety standards and component specifications for engineers accustomed to working with non-flammable refrigerants.

The Challenge: New Territory for Refrigeration Engineers

A manufacturer of commercial ice makers found itself in precisely this position. Their engineering team, skilled in designing efficient cooling systems with traditional refrigerants, needed to develop a new propane-based product line. Among their many challenges was finding a toggle switch that would be safe in an environment where refrigerant leaks could potentially create explosive conditions.

The engineering team recognized the need for components that wouldn't create a spark in the presence of propane. However, this was new territory for them. They weren't even sure which standards applied or how to verify compliance.

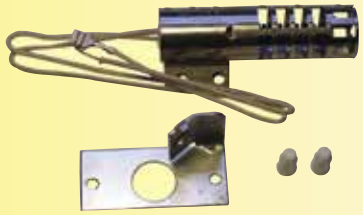
The team began searching for explosion-proof switches but quickly realized they lacked the expertise to evaluate whether the components they found would meet the necessary requirements. What started as a simple component selection turned into a crash course in explosion-proof design standards.

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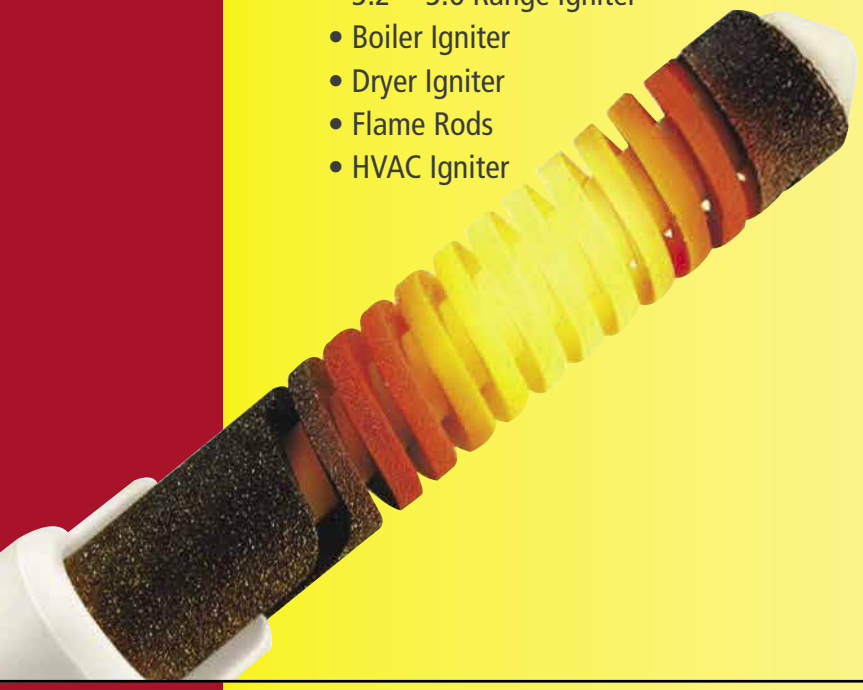
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The Unfamiliar Territory of Safety Standards

Before selecting components, the team needed to understand the regulatory landscape governing propane-based refrigeration systems. This led them to investigate several safety standards for refrigeration systems and electrical components. The applicable standards are:

- **UL/IEC 60335-2-89:** Corrigendum 3 - Household and Similar Electrical Appliances – Safety – Part 2-89: Particular Requirements for Commercial Refrigerating Appliances and Ice-Makers with an Incorporated or Remote Refrigerant Unit or Compressor. In addition to governing commercial refrigerating appliances, the standard covers their incorporated electrical components.
- **UL 60079-15:** Explosive Atmospheres – Part 15: Equipment protection by type of protection. This standard describes the evaluation of security and life safety signaling system components.
- **UL NCKL2/8:** This standard defines the certification process for components used in refrigeration and air conditioning equipment to prevent ignition in the presence of flammable refrigerants.
- **ATEX Directive 2014/34/EU:** This European Union standard applies to equipment and protective systems intended for use in potentially explosive atmospheres.

These standards established the framework for the design requirements, but translating them into specific component selections proved challenging.

Arriving at a solution

The ice maker manufacturer's design team contacted their electrical components distributor for guidance. This led to a consultation with Carling Technologies, a Littelfuse company known for its switching solutions. During the meeting, an unexpected possibility emerged. Carling representatives suggested considering a switch they had developed, not for refrigeration applications, but for off-road vehicles such as construction equipment operating in wet and dirty outdoor environments. Initially, the team was skeptical about how a switch designed for bulldozers and excavators could meet their requirements for a food-service refrigeration product. As they discussed the specifications with Carling, they realized it might be exactly what they needed.

The recommended switch was an environmentally sealed toggle switch with an IP68 rating, designed to withstand the extreme conditions faced by construction equipment. It also met the rigorous MIL-DTL-3950G requirements for an environmentally sealed toggle switch.

Figure 1 illustrates the mechanical design of the IP67-rated, environmentally sealed toggle switch, the ST Series from Carling. The switch construction contains multiple seals. An internal silicone seal bonds to the metal cover, holding the switch assembly together. Terminal seals prevent the ingress of moisture and dust where the internal switch contacts connect to the external terminals.

The only feature the switch lacked was explosion-proof certification. Carling engaged Underwriters Laboratories (UL) to test the switch for compliance with the UL 60079-15 standard.

The testing confirmed that the switch, designed to be impervious to dust, water, and vibration, provided the seal integrity necessary to prevent ignition in a potentially explosive atmosphere. The robust construction that sealed out dirt and water also effectively kept propane from potential ignition sources.

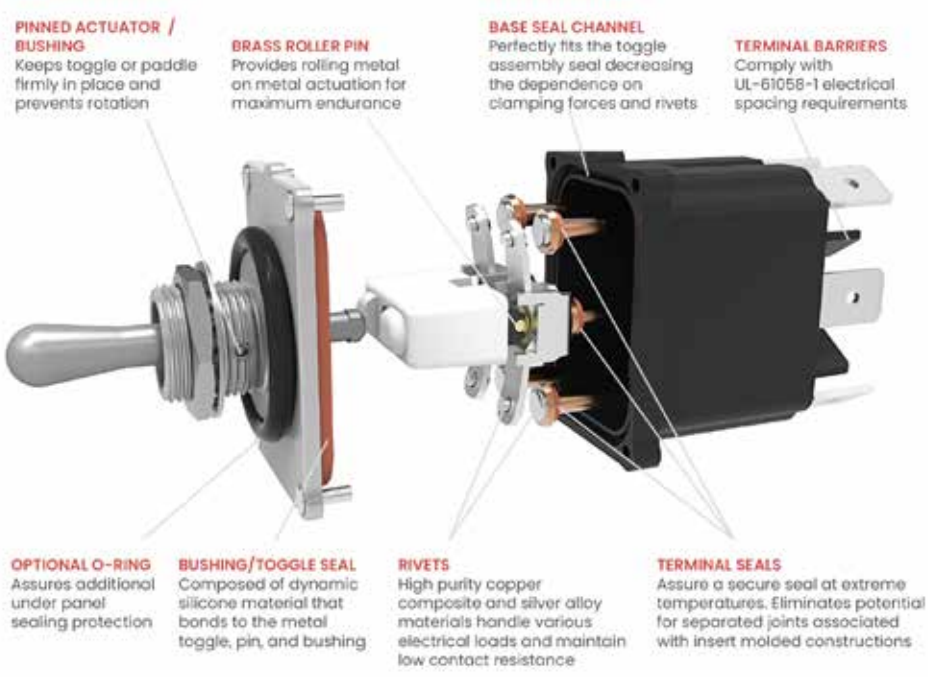


Figure 1. Environmentally sealed, explosion-proof switch (Courtesy of Carling Technologies).

A Surprising Solution with Additional Features

The new switch not only solved the safety compliance issue but also brought several additional advantages to the ice maker design:

- **Versatility:** The switch can operate in 120 VAC, 250 VAC, 12 VDC or 24 VDC circuits.
- **High current capacity:** With contact ratings of 10 A @ 250 VAC, 15 A @ 125 VAC and 16 A @ 12, or 24 VDC, the switch can exceed the current requirements for a wide range of ice maker designs.
- **Configuration options:** Available in single- or double-pole configurations with maintained or momentary contacts.
- **Low power loss:** Initial contact resistance of 10 mΩ minimizes the power the switch dissipates.
- **Reliability:** Designed for a lifetime of 100,000 cycles.
- **Durability:** Compliant with MIL-STD-2026 for vibration and shock tolerance and operates over a temperature range of -40 to +85 °C.

Ultimately, the switch, originally designed for off-road vehicles, proved to be an excellent fit for an entirely different environment: hotels and commercial kitchens. It met the flammability requirements, electrical ratings, and sealing standards needed for a propane-based refrigeration appliance and did so without the lead time or cost of developing a new component from scratch.

The use of flammable refrigerants such as propane significantly changes the design requirements for refrigeration equipment. Design engineers may not be familiar with the safety standards that apply to these systems, creating a knowledge gap that can delay product development.

To address these challenges, manufacturers should:

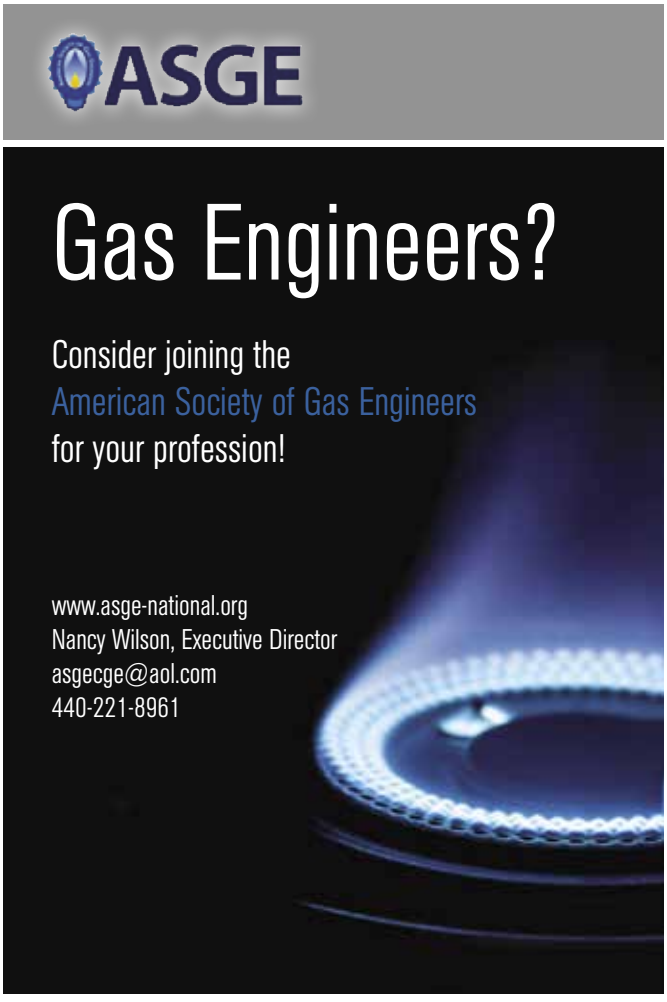
- Invest in understanding the applicable safety standards.
- Consider components from adjacent industries that may already meet the design requirements.
- Work closely with component suppliers to identify suitable options.

For component manufacturers, the transition to flammable refrigerants represents an opportunity to certify existing products to specific safety standards, potentially opening new markets for products originally designed for other applications.

In this case, a switch used in bulldozers found a new home in commercial refrigeration, highlighting how communication with component manufacturers can solve challenging regulatory and engineering problems. As the refrigeration industry continues its environmental transformation, the expertise of component manufacturers can prove increasingly valuable.



Paul Kramarz is an applications engineer at Carling Technologies https://www.carlingtech.com/switches, a Littelfuse Brand. Over nearly three decades, he has developed deep expertise in electromechanical switches, evolving from his early role in inside sales to his current position. Paul provides product support and technical guidance to customers, ensuring that solutions are tailored to meet their specific needs.



EC Fan Technology:
The Future of Efficiency

As the demand for energy efficiency, cost savings, and environmental responsibility continues to shape the HVAC and refrigeration industries, high-performance technologies are stepping into the spotlight. One of the most transformative among them is Electronically Commutated (EC) fan technology. Engineered to outperform traditional AC fans in both efficiency and control, EC fans are rapidly becoming the go-to solution for professionals who prioritize performance, sustainability, and long-term value.

But what exactly sets EC fan technology apart—and why is it redefining the future of ventilation and cooling?



ebm-papst AxiBlade fan
Courtesy: ebm-papst Inc.

The Science Behind EC Motor Technology

EC technology traces its roots back to the 1960s, when ebm-papst pioneered the first EC/DC compact fan. Since then, continuous advancements in motor design and electronic commutation have positioned EC fans as a fundamental component in energy-efficient system design. Today, they are used extensively in HVAC units, refrigeration systems, and other applications where energy performance and reliability are a necessity.

At the core of EC fan innovation lies an intelligent motor that combines the benefits of both alternating current (AC) and direct current (DC) voltages. Unlike conventional AC motors that rely on carbon brushes for commutation, EC motors use sophisticated electronics to precisely control motor function. Here's how it works:

- **Brushless Operation:** By eliminating carbon brushes, EC motors significantly reduce wear and tear, extend operational lifespan, and minimize maintenance.
- **Magnetic Efficiency:** The rotor, embedded with permanent magnets, interacts with stator windings through electronically controlled magnetic fields. This results in optimal rotation with minimal energy loss.
- **Smart Electronics:** Integrated controls automatically adjust motor speed in response to real-time system demands, optimizing energy use and reducing unnecessary heat generation.

Why EC Fans Outperform Traditional AC Fans

Industry professionals are making the switch to EC technology—and with good reason. EC fans offer a broad range of benefits that make them an attractive alternative to their AC counterparts:

- **Energy Efficiency:** EC fans can use up to 50% less power than traditional AC fans, dramatically reducing energy consumption in high-demand systems.
- **Low Maintenance:** The brushless design eliminates one of the most common mechanical failure points, resulting in longer service intervals and reduced downtime.
- **Quiet Operation:** EC fans operate smoothly and quietly, even at variable speeds, making them ideal for environments where noise control is essential.
- **Precision Speed Control:** Variable speed capability allows EC fans to respond dynamically to changing airflow needs, improving system responsiveness and efficiency.
- **Compact Footprint:** Smaller and lighter than their AC counterparts, EC fans simplify design and integration without sacrificing performance.
- **Lower Heat Emissions:** With



reduced energy loss, EC motors generate less heat, increasing system efficiency and extending component life.

EC vs. AC Fans: A Smart Investment

Upgrading to EC technology is like replacing incandescent bulbs with LEDs—both deliver dramatic efficiency improvements and long-term savings. The advantages of EC fans over AC fans include:

- **Adaptive Performance:** Traditional AC fans operate at fixed speeds, limiting flexibility. EC fans adjust dynamically to airflow needs, achieving significant energy savings.
- **Seamless Integration:** Designed as plug-and-play replacements, EC fans can easily be retrofitted into existing systems without complex modifications.
- **Cost-Effectiveness:** While EC fans may have a slightly higher initial cost, the long-term energy savings and lower maintenance requirements ensure a rapid return on investment.

A Solution for Every Industry

The versatility of EC fans makes them valuable across a range of industries and applications:

- **HVAC Systems:** High-efficiency operation and precision control are essential for maintaining comfort and minimizing energy use.



EC motor with built in electronics Courtesy: ebm-papst Inc.

- **Refrigeration:** EC fans enhance system performance through quieter operation, smaller footprints, and better temperature control.
- **Healthcare:** EC fans provide reliable and low-maintenance performance, supporting the sensitive demands of medical environments.
- **Data Centers:** With a focus on low noise and high energy efficiency, EC fans help maintain the stable conditions critical to IT equipment.

Looking Ahead: EC Fans in Data Center Cooling

Let's focus on that last industry: data centers. With their intense cooling requirements, data centers are increasingly turning toward EC fan technology for optimized thermal management. Whether used in air-to-air, liquid-to-air, or advanced liquid-to-liquid cooling systems, energy-efficient fans are central to heat exchange and airflow control. While the basic principle involves replacing hot air with cooler air, the execution varies widely. Modern cooling strategies are constantly evolving to support colocation and hyperscale data center designs while maximizing energy efficiency.

At ebm-papst, we offer a broad range of EC cooling solutions tailored to specific infrastructure needs. From targeted server-row cooling and modular systems to integration with dry coolers and cooling towers, our fan technologies meet the demands of modern facilities. For example:

- **Axial Fans:** Especially useful in environments near residential or industrial zones due to noise regulations. Our AxiBlade series offers high power density with low noise output, while the AxiEco line is ideal for applications requiring higher static pressure.
- **Centrifugal Fans:** These are particularly effective in data center fan arrays. The RadiPac series features optimized airflow for reduced energy use and is designed for broad speed ranges to maximize flexibility and savings.

Embracing a Sustainable Future

As businesses and industries continue to prioritize sustainability, EC fan technology stands out as a critical enabler of progress. Combining high efficiency, reliability, and ease of integration, EC fans help organizations meet their energy goals while improving operational performance.

For forward-thinking professionals ready to modernize their systems, EC fans offer more than just a technological upgrade; they offer a path to a more efficient and sustainable future. Much like the shift to LED lighting revolutionized energy use in buildings, the transition to EC fans is setting a new standard in HVAC and refrigeration systems.

The future of fan technology is here. Invest in EC today—and lead the way in performance, efficiency, and environmental responsibility.



Company Description
Representing North and South America, ebm-papst Inc. is a key subsidiary of the globally renowned ebm-papst Group—the world's leading manufacturer of fans and motors. ebm-papst Inc. can provide air movement solutions for the data center market with an array of highly efficient products.

John Palomba Director VAC, ebm-papst Inc. Courtesy: ebm-papst Inc.

Navigating A2L Refrigerants: Leak Detection, Recovery, and Charging



The HVACR industry is now well into the transition to A2L refrigerants like R-32 and R-454B. While these mildly flammable refrigerants introduce new safety considerations, the core service practices that technicians have relied on for years remain largely intact. If you've worked with A1 refrigerants, you're already ahead of the curve.

This article breaks down what stays the same—and what changes—when servicing A2L systems, focusing on leak detection, recovery, and charging.

Leak Detection: Proven Methods, Heightened Awareness

The biggest change when working with A2Ls is their mild flammability. That's why leak detection is more than just good practice, it's essential for safety. Certain A2L systems may include integrated leak detection sensors and automatic shutdowns to mitigate hazards. But for the technician, the leak detection process itself doesn't change. You'll still trace the refrigerant line set, evaporator coil, and connections using your A2L-compatible leak detector to pinpoint the leak.

One misconception is that infrared and heated diode leak detectors are unsuitable for A2L detection because they introduce heat in the combustion equation. The truth is, neither technology reaches the ignition temperature of A2L refrigerants. Leak detectors that utilize heated diode and infrared sensors are not only compatible with A2Ls but are also preferred for their fast response and accuracy.

For systems using 50 pounds or more of refrigerant—whether A1 or A2L—routine leak inspections are a legal requirement. If the annual leak rate exceeds allowable thresholds, you're required to repair the leak within 30 days or develop a documented plan. Confirming the repair with follow-up testing is also mandatory.

Recovery: Familiar Steps with a Flammability Twist

When recovering A2L refrigerants, you must use tanks rated specifically for A2L use. These cylinders look similar to A1 tanks—gray body with a yellow top—but they include red markings or stripes for identification. A1 cylinders use rupture discs that release the entire contents if pressure limits are exceeded. A2L cylinders, on the other hand, feature spring-loaded pressure relief valves that vent only enough gas to bring pressure back to a safe level.

Another key safety feature: A2L recovery tanks have left-handed (reverse) threads on the cylinder port to prevent cross-contamination with A1 refrigerants and ensure safe handling. Against common misconception, left-handed threading is found only on the cylinder port, not on the system service ports. Left-handed threads are typically indicated by notches or grooves on the fittings. The recommended approach is to use a hose extension with a left-handed adapter and ball valve. The ball

valve will provide further isolation and control, and the extension will reduce the likelihood of leaving the adapter on the cylinder when exchanging tanks with your gas supplier.

Another important consideration: Avoid pulling a vacuum during recovery of high-pressure appliances with a refrigerant charge of less than 200 pounds. For A2Ls, drawing even a slight vacuum—especially with a known leak—can allow oxygen into the cylinder, creating a combustion hazard. Use recovery machines with an auto-stop feature at 0 in Hg to stay compliant and safe. Refer to EPA Section 608, Required Level of Evacuation of Appliances, for different high, medium, and low-pressure standards.

Charging: Similar Steps, Stricter Protocols

Charging an A2L system should feel familiar to any seasoned technician, but A2Ls bring additional required steps that go beyond what was considered "best practice" with A1s. It is now required to purge with nitrogen before conducting repairs and to conduct a pressure test after repairs are complete.

If the system is undercharged and a leak is suspected, you'll need to:

1. Recover refrigerant per regulations.
2. Purge the lines with nitrogen to remove residual flammable vapor.
3. Perform leak repairs.
4. Pressure test for at least 60 minutes.
5. Evacuate the system.
6. Charge per manufacturer specifications.

These steps ensure you're not exposing yourself to unnecessary ignition risks, particularly when cutting lines or brazing near residual A2L vapors.

Documentation: The Key to Compliance and Protection

Whether you're servicing an A1 or A2L system, accurate documentation is now more important than ever. Keeping track of refrigerant type, quantity recovered, and service steps completed is not just best practice—it's required. For A2Ls, documentation proves you followed safety protocols and regulatory procedures. It also helps prevent callbacks and provides evidence of proper service should any post-installation issues arise.



One of the easiest ways to document processes on the job is to pair A2L-compatible wireless diagnostic tools with a reporting app. Tools and apps like the Job Link® System not only provide diagnostic assistance and help run a temperature-compensated pressure test, but they also allow you to complete checklists and generate reports seamlessly.

Final Takeaways: Smart, Safe, and Ready for A2Ls

Working with A2Ls isn't about reinventing your service routine, it's about refining it. Leak detection, recovery, and charging all follow familiar patterns. But with A2Ls, attention to safety is more critical than ever.

By following the standards established by ASHRAE and the EPA, technicians can deliver safe, compliant, and efficient service in this new regulatory landscape. A2L-compatibility is a must for every electrical tool that will be in contact with A2L refrigerants, including recovery and evacuation machines, leak detectors, manifolds and wireless probes. The message is clear: Use the same best practices—but take A2Ls seriously.

With the right equipment, proper training, and a strong focus on safety, HVACR technicians are well-positioned to lead the transition to A2Ls while continuing to deliver high-quality, compliant service.



About the Author
Tony Gonzalez, CSME
Fieldpiece Instruments
Tony Gonzalez has more than 20 years of HVAC experience with Fieldpiece Instruments and has led national training since 2020. A recognized educator and how-to video creator, Tony works closely with leading industry organizations to help HVAC professionals adopt best practices that make their jobs easier, safer, and more efficient.

What's Happening

Powerhouse Dynamics Demonstrates the Power of Connected Equipment at The NAFEM Show



Equipment Data Empowers Restaurants to Improve Efficiency and Reduce Waste

Powerhouse Dynamics, the leading Internet of Things (IoT) solutions provider for the foodservice and retail industries, recently demonstrated the latest ways that connected equipment—from HVAC to refrigerators and fryers—is helping major restaurant brands to strengthen their competitive advantage and their overall financial performance.

Powerhouse Dynamics, a Middleby company known for its OEMagnostic Open Kitchen® platform for foodservice companies, showcased its innovations at The North American Association of Food Equipment Manufacturers (NAFEM) Show in Atlanta February 26-28.

"We're seeing an accelerating level of interest in the benefits of a connected equipment strategy, including reduced food and energy waste, lower costs, greater operational efficiency, and improved food safety," said Powerhouse Dynamics President Jay Fiske.

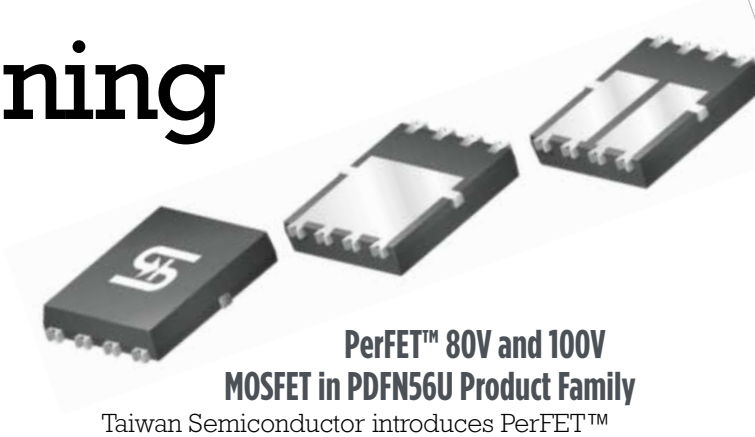
Participants got an up-close look at how the detailed performance data and analytics from connected equipment, along with real-time alerts to potential problems, give facility managers a new level of visibility, control, and automation from the cloud.

For example, the Powerhouse Dynamics team showed how data from connected fryers helps restaurants ensure high oil quality while controlling costs by preventing premature disposal of cooking oil, an expensive resource for foodservice operators.

The team also highlighted connected equipment applications, including:

- Flagging sources of energy waste such as rooftop unit malfunctions
- Identifying maintenance needs in time to prevent equipment breakdowns
- Distributing limited-time-only menus to thousands of ovens within minutes
- Freeing short-staffed teams from routine tasks like temperature checks
- Recording hazard analysis critical control point (HACCP) data

For more information, contact Jay Fiske at jay@powerhousedynamics.com.



PerFET™ 80V and 100V MOSFET in PDFN56U Product Family

Taiwan Semiconductor introduces PerFET™ 80V and 100V technology in the PDFN56U (5mm x 6mm) single and dual packages for high power, high switching frequency and high-performance requirement automotive applications. A portfolio of 18 items, including both normal-level (10V) and logic-level (5V) gate drive types, enables customers to select the best-fit product for their design. All of this enables the best-in-class FOM (RDS(on) * Qg) and Performance in the market.

The PDFN56U wettable flank package offers improved solder joint quality and enhanced AOI accuracy. Additionally, it is highly footprint-compatible with the majority of 5mm x 6mm packages on the market.

Key Features

AEC-Q101 qualified
Best-in-class FOM (RDS(ON) * Qg)
Optimized RDS(ON) for low conduction losses
Low gate charge for reduced switching losses
175°C junction temperature (TJ)
Wettable flank enhances AOI accuracy

Applications

48V Automotive applications
SMPS, Server and Telecom power supplies
DC/DC converter
BLDC motor driver
E-fuse

Axalta Appoints Tim Bowes as President, Global Industrial Coatings

Axalta Coating Systems Ltd., a leading global coatings company, today announced that Tim Bowes has been appointed President, Global Industrial Coatings, effective January 27, 2025. Mr. Bowes will succeed Shelley Bausch who will be stepping down from her role.

Most recently, Mr. Bowes served as Axalta's Senior Vice President and Chief Transformation Officer. Prior to joining Axalta, he served as Senior Vice President and President of Electrification, Industrial, Aftermarket, Purchasing & Supply Chain for Meritor. Mr. Bowes has also served as Senior Vice President and President of the Casting business unit for American Axle & Manufacturing and CEO and President of Transtar

Industries, an Industrial and Automotive Aftermarket company. He also held executive leadership roles at ITT Automotive and Intermet. Mr. Bowes has lived and worked in Asia and Europe and holds a Master of Business Administration from Wayne State University in Detroit, Michigan and a bachelor's degree from Lawrence Technological University in Southfield, Michigan.

"Tim brings a wealth of experience to this role with his extensive background in managing industrial businesses across a number of industries and regions. He has played an important role in Axalta's transformation over the past two years, driving significant advancements in strategy and operational excellence," said Chris Villavarayan, Chief Executive Officer and President of Axalta. "As we look forward to Axalta's exciting future, I am pleased that Tim has accepted the opportunity to lead our global Industrial Coatings business at such an important time."

Mr. Villavarayan added, "On behalf of our Board of Directors and our executive committee, I want to thank Shelley for her many contributions to Axalta. We wish her all the best in the future as she explores her many personal and professional interests."

AkzoNobel Reports Organic Sales Growth and Adjusted EBITDA Increase



AkzoNobel has reported a 1% increase in organic sales and a 3% rise in adjusted EBITDA for the fourth quarter of 2024. The company also saw a 4% increase in revenue for the quarter.

For the full year, AkzoNobel's organic sales grew by 2%, driven by higher volumes and an increase in price/mix. The company's adjusted EBITDA for the year was up 3% to €1,478 million, with an adjusted EBITDA margin of 13.8%.

Despite the growth in organic sales and adjusted EBITDA, AkzoNobel's operating income for both the fourth quarter and full year was impacted by restructuring costs. The company's operating income for Q4 2024 was €127 million, down from €214 million in Q4 2023. For the full year, operating income was €917 million, compared to €1,029 million in 2023.

AkzoNobel's CEO, Greg Poux-Guillaume, highlighted the company's ability to grow in mixed market conditions and its focus on self-help measures.

"2024 was a year where we grew organically while increasing our adjusted EBITDA, demonstrating our ability to grow in mixed market conditions. In Q4, we increased adjusted EBITDA by 3%, with costs at constant currencies now in line with the previous year. We continued to make progress while accelerating our self-help measures," said Poux-Guillaume.

Looking ahead, AkzoNobel does not expect a significant market rebound in 2025. The company is targeting an adjusted EBITDA of above €1.55 billion for the year.

The report for this quarter can be viewed and downloaded here: https://akzo.no/Q4-2024-results.

ASC Announces New Board Officers, Re-Elected Directors

The Adhesive and Sealant Council (ASC) announced new officers to its Board of Directors as well as directors reelected to the Board for another three-year term beginning January 1, 2025.

ASC's new Board officers are:

Board Chairman – Tom Stewart, Business Director, Durable Goods, North America Building Components, Bostik

Treasurer – Corbett Wallace, Corporate Vice President, Packaging & Consumer Goods Adhesives, Henkel Corporation

Re-elected to the Board serving three-year terms are:

Scott Buss, Business Development Director, Industrial Adhesives & Tapes Division, 3M

Bob Butera, Vice President, R&D and Innovation, DAP Products

Peter Carbutt, Technical Services Director, ITW Performance Polymers

Bob Ddamulira, Vice President of Technology, Meridian Adhesives Group

Shamsi Gravel, Vice President, Regional Development North America, Evonik Corporation

Marco Kubitza, Chief Officer, Jowat Corporation

Corbett Wallace, Corporate Vice President, Packaging & Consumer Goods Adhesives, Henkel Corporation

"The newly elected ASC Board officers and directors begin their terms during a solid period of growth for the Council," said ASC President William Allmond. "As President, I am excited to work alongside our new officers and Board to create and deliver to the

membership a new three-year strategic plan this year that aligns with their current needs and address emerging trends.''



Congratulations to Phillips Tube Group, Inc., CEO Angela Phillips for being named to Ohio Business Magazine's 3rd annual list of Ohio's 500 Most Influential Leaders

For the third consecutive year, Ms. Phillips was selected in the category of Manufacturing

This research initiative by the editors of Ohio Business produced a personal, engaging look at the state's leaders across all major industries. The 500 executives were selected based on extensive contacts in regional business circles, and interviews, culminating in a highly selective biographical guide to the people who really run Ohio.

Monique Buch appointed as new Chief Commercial Officer of Covestro



Covestro, a world-leading supplier of high-tech polymer materials, announced Monique Buch (50) as the company's new Chief Commercial Officer (CCO). The Supervisory Board of Covestro has unanimously appointed Monique Buch who is taking over from Sucheta Govil by 1st June 2025. Sucheta Govil has been Covestro's CCO since 2019. Her two consecutive terms with Covestro come to an end by 31st July 2025.

As the Chief Commercial Officer, Buch will be responsible for the segment of Solutions & Specialties. With this, she will be leading six business entities including the supply chain centers in the three major regions.

Dr. Richard Pott, Chairman of the Supervisory Board of Covestro said: ''Monique Buch is an experienced B2B commercial executive with a strong international footprint. With her background in building sustainable, market-leading businesses she will be an ideal successor to Sucheta Govil in the Board of Management and will continue to shape the future of Covestro. Already now, we want to express our deep gratitude to Sucheta Govil who has laid the solid foundation for a successful development in commercial excellence and innovation. With her strong background in commercial operations, sales, marketing, and innovation, she has been and will be steering the transformation journey of Covestro.''

''I am very much looking forward to join the transformation journey by driving profitable growth, along with the whole Covestro team and my new colleagues on the Managing Board,'' said Monique Buch.

Dedicated to sustainable growth

Monique Buch was born in the Netherlands and studied industrial engineering and management. In her last position, Buch was Executive Vice President Nonwoven at Lenzing AG. Before, she held various executive positions in international B2B companies, among them Freudenberg Performance Materials and Owens Corning.

Indoor Air Innovation Leader Madison Air Acquires AcoustiFLO, Pioneering Fan and Acoustic Technology Company

AcoustiFLO Joins Madison Air's Air Handling Group (AHG), Creating Efficiencies Across Portfolio That Includes Nortek Air Solutions, UV Resources and Specified Air

Indoor air quality leader Madison Air, today announced the successful acquisition of AcoustiFLO, LTD., a pioneering company in aerodynamic efficiency and acoustic performance for the air handling industry.

AcoustiFLO has provided technologically advanced fan assemblies for the semiconductor industry and other advanced manufacturing, hospitals, high-rise office buildings and educational facilities worldwide for over 25 years. AcoustiFLO products are AMCA certified for efficiency and acoustics and are used extensively on projects requiring LEED certification.

''This acquisition was developed to strengthen our customer value proposition and reinforce our commitment to delivering custom air handling solutions that lead the industry in sound and performance,'' said Jill Wyant, Madison Air CEO. ''AcoustiFLO's track record of breakthrough innovation, engineering excellence and the ability to adapt to changing market opportunities and evolving customer needs is very much aligned with Madison Air and our companies.''

AcoustiFLO's performance-engineered plenum fan was created to be the quietest and most energy-efficient fan on the market. The company's groundbreaking fan and acoustic technology was designed for integration into air handling platforms. The acquisition will enable improved sound and energy performance and other design advantages to be scaled across the Madison Air portfolio.

AcoustiFLO will report to Madison Air's Air Handling Group (AHG), which also includes Nortek Air Solutions (NAS), UV Resources and Specified Air. AcoustiFLO's groundbreaking fan and acoustic technology will be

integrated into the portfolio's air handling platforms, including its FANWALL TECHNOLOGY® offerings, to optimize sound and energy efficiency performance.

SEE AIR DIFFERENTLY madisonair.com



Vitrek Honored as Top Semiconductor Solution Provider of 2024

Semiconductor Review Magazine Recognizes Vitrek's Industry-Leading Products are at the Forefront of Innovation in the Semiconductor Solutions Market.

Vitrek, a leader in high-performance test and measurement equipment, is proud to announce that it has been recognized as one of the Top Ten Semiconductor Solutions Providers of 2024 by Semiconductor Review Magazine. This award underscores Vitrek's reputation and trust among customers and industry peers, as well as its innovative contributions to the semiconductor industry.

The award was granted after evaluation by an expert panel of C-level executives, industry thought leaders, and the editorial board of Semiconductor Review. Vitrek's comprehensive range of high-precision solutions, including products from its MTI Instruments and GaGe brands, played a significant role in earning this accolade.

Vitrek's Achievements Recognize the Collective Impact of Its Three Brands:

MTI Instruments: Known for high-precision, non-contact capacitive measurement tools, the MTI line includes the semi-automatic Proforma 300iSA, which offers full wafer scanning and thickness accuracy of +/- 0.25 µm.

GaGe: Specializing in high-resolution, high-speed digitizer cards capable of streaming vast amounts of data at high speeds, the GaGe products are integral to various applications, including measuring ion density, ultrasonically imaging chiplet bonds and identifying defective MOSFETs via high speed switching analysis.

Vitrek: Renowned for precise high-voltage measurement, the Vitrek line of products are used in larger equipment such as ion implanters and automated test systems, among other applications.

"We are honored to receive this recognition from Semiconductor Review," said Ken Ameika, Vitrek VP of Global Sales. "This award is a testament to our commitment to innovation, quality, and customer satisfaction. We will continue to push the boundaries of technology to meet the evolving needs of the semiconductor industry."

Vitrek's products are trusted by globally recognized compliance and standards organizations, including the National Institute of Standards and Technology (NIST) and Underwriters Laboratories (UL). Manufactured in the U.S. and supporting the CHIPS Act, Vitrek's portfolio combines American ingenuity with a global reach, supported by a robust distribution network and U.S.-based servicing.

AHR Expo Announces 2025 Innovation Awards Winners

The AHR Expo (International Air-Conditioning, Heating, Refrigerating Exposition) today announced the winners of the 2025 AHR Expo Innovation Awards. Winners are chosen annually in ten industry categories, representing the most innovative products and technologies in the market.

"To be recognized as an award winner is a true honor within our industry," said Show Manager, Mark Stevens. "We are thrilled to highlight the dedication of manufacturers and team members as they work to create real solutions. The Innovation Awards aim to highlight these companies, professionals and their innovation trajectory and to celebrate those that are pushing the bar."

The Innovation Awards draw 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.

"The continued growth of the awards program is an encouraging indication that manufacturers are responding to problems with creative solutions," continued Stevens. "Moreover, the winning innovations must satisfy a range of factors, such as affordability, energy consumption, compliance, and production efficiency, while also addressing performance gaps in products and technology. Congratulations to all our 2025 winners!"

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 2025 AHR Expo Innovations Awards include:

BUILDING AUTOMATION

Winner: Distech Controls

Innovation: Eclypse Facilities

Eclypse Facilities is a game-changer for system integrators, equipment manufacturers and leading digital partners who can leverage unparalleled openness and interoperability with Eclypse controllers to deliver advanced digital services. Buildings implementing Eclypse ensure the highest occupant satisfaction, equipment performance and minimal operational costs to maintain the highest asset value.

COOLING

Winner: Climate Control Group

Innovation: EnviroKIT™

The EnviroKIT™ is a quick, simple, and budget-friendly solution for restoring vertical stack fan coil unit performance. Sustainably replace aging components in just a few hours per room without drywall demolition. Ideal for the hospitality industry, this kitted solution improves cooling performance of fan coils with minimal room downtime.

HEATING

Winner: AERCO, A Watts Water Company

Innovation: AERCO CFR

CFR is the world's first stainless steel condensing boiler that can be installed in a Category I vent, making it an ideal solution for the commercial retrofit market. It delivers energy savings, reliable performance, and cost-saving installation flexibility in a compact footprint to cost-effectively comply with local energy mandates.

INDOOR AIR QUALITY

Winner: Senva Inc.

Innovation: TotalSense Indoor Air Quality Sensor

The TotalSense Air Quality sensor is the most configurable air quality sensor available with any combination of ten sensors including Carbon Dioxide (CO2), Carbon Monoxide (CO), relative humidity (RH), temperature, occupancy detection (PIR), total volatile organic compounds (TVOC), Ozone (O3), particulate matter (PM), barometric pressure and ambient light.

PLUMBING

Winner: Grundfos

Innovation: Grundfos ALPHA HWR

The Grundfos HWR is the first high-efficiency, digitally connected circulator for domestic hot water recirculation systems. It is the most efficient circulator available, with a best-in-class energy rating of 215 from the Hydraulic Institute. The fully digital solution achieves advanced comfort with maximum water and energy savings.

REFRIGERATION

Winner: Danfoss

Innovation: Danfoss BOCK HGX56 CO2 T

Danfoss BOCK HGX56 CO2 T is a transcritical 6-cylinder CO2 compressor with expanded range to enable larger refrigeration and heat pump applications with a smaller footprint, and strong energy efficient performance.

SOFTWARE

Winner: Radiant Professionals Alliance

Innovation: Building Efficiency System Tool™ 6.2 (BEST 6.2)

The Radiant Professionals Alliance's (RPA) free interactive Building Efficiency System Tool™ 6.2 (BEST 6.2), revolutionizes HVAC system efficiency comparison. BEST Software is held by Taco (which has control over the content and function thereof). The Software is copyrighted and protected by United States copyright laws and international treaty provisions.

SUSTAINABLE SOLUTIONS

Winner: LG Electronics U.S.A. Inc.

Innovation: LG Residential Cold Climate Heat Pump

Conventional heat pumps suffer significant degradation in performance when confronted with temperatures below 0°F (-17.8°C), making them less reliable and efficient in cold climate regions. New heat pump products such as this innovation from LG have been developed to combat cold climate challenges, operating down to -31°F (-35°C).

TOOLS & INSTRUMENTS

Winner: PassiveLogic

Innovation: PassiveLogic Sense Nano

The Sense Nano is the first truly wireless sensor — communicating via Bluetooth mesh, while extracting its operating energy from the surrounding environment. Goodbye, battery replacements. Installing in 15 seconds, it fits in the palm of your hand. And it packs a punch with seven sensors inside a 45mm diameter ring.

VENTILATION

Winner: Rosenburg USA, Inc.

Innovation: Rosenberg I-Series Backward Curved Fans

Rosenberg has developed 23 models of I-Series fans, ranging from 355MM to 630MM. The high-efficiency, high-volume I-impeller features five backward-curved, hollow-profiled, airfoil section aluminum blades, with efficiency-optimized circumferential diffusers. The new impeller can increase efficiencies up to 11%, while reducing noise levels by more than half compared to older impellers.

In addition to category winners, one overall 2025 Product of the Year winner will be announced and awarded in Orlando. This prestigious honor is awarded based on exceptional leadership in HVACR innovation.

"Innovation in our industry will continue to increase in urgency as we battle workforce shortages, increased demands, changing regulations and the call for fast, reliable training," said Kim Pires, AHR Expo. "Participating in the Innovation Awards, along with the honor of being named a winner, is an indication to the industry that you are at the forefront of where HVACR is heading in the future."

"What's more, fees from the Innovation Awards program support workforce development through donation to HVACR high school programming in the cities where the show is hosted," continued Pires. "It is a means to inspire, connect and secure innovation for the future of the industry."

For more information about the awards, AHR Expo, and to register for free, please visit ahrexpo.com.

Carrier Completes Strategic Portfolio Transformation with Closing of $3B Sale of its Commercial and Residential Fire Business

Carrier Global Corporation, global leader in intelligent climate and energy solutions, announced it has completed the sale of its Commercial and Residential Fire business to an affiliate of Lone Star Funds for an enterprise value of $3 billion.

"The sale of our Commercial and Residential Fire business is the final step in our strategic portfolio transformation, further simplifying and focusing our company, and strengthening our global leadership position in intelligent climate and energy solutions," said Carrier Chairman & CEO David Gitlin. "As we enter 2025, we are laser-focused on our customers, growth, innovation and execution. We are deeply committed to delivering unparalleled value for our customers, shareowners and employees as a higher-growth, pure-play company dedicated to improving lives and creating a more sustainable world for generations to come."

Today's closing marks the culmination of Carrier's strategic portfolio transformation, which also included the acquisition of Viessmann Climate Solutions and the divestitures of its Industrial Fire, Access Solutions and Commercial Refrigeration businesses.

Carrier intends to use the estimated $2.2 billion net proceeds from the sale of the Commercial and Residential Fire business to fund share repurchases, with at least $1 billion under an accelerated share repurchase program.

GE Appliances "Elf-Gingers" Adapt and Donate More Than 100 Toys For Kids With Disabilities



Employee Volunteers Spread Holiday Cheer and Foster Inclusivity

During the 2024 holiday season, a team of passionate and innovative employees from GE Appliances, a Haier company, known as the "GE Appliances Elf-gineers," dedicated their time and engineering expertise to adapt more than 100 toys for local children with disabilities. The goal: to help ensure every child can experience the magic of play, regardless of their abilities.

For many children with disabilities, toys with buttons that light up, move, or play sounds can be difficult or impossible to use without assistance. Adapted toys—outfitted with special switches and features tailored to various abilities—give these children a chance to play independently. However, these customized toys are often expensive, making them out of reach for many families already facing other costs.

Upon discovering these challenges, the Elf-gineers—a team of mechanical and electrical engineers from GE Appliances—came together and transformed their air conditioning lab at the company's Kentucky-based headquarters into a whimsical elf workshop, using their engineering expertise to reconfigure more than 100 toys to meet the unique needs of local kids.

"Our employees have the freedom to explore their passions at work and the "Elf-gineers" choice to use their skills to make a difference for kids in our community is just one way our culture comes to life," said Rocki Rockingham, chief human resources officer at GE Appliances. "This initiative is a powerful example of how our core values of inclusion, innovation, and commitment to our community are lived daily. The same people designing and building innovative household appliances that simplify life are using their expertise and consumer-focused mindset to help create inclusive play experiences to make a difference for kids during the holiday season."

The adapted toys are being distributed this month to several non-profits and schools in Louisville, including Jefferson County Public Schools, the Visually Impaired Preschool Services, and Kids Center for Pediatric Therapies.

This is the latest example of GE Appliances' employees using their skills and passion to help others and join projects like the Access Kit, an inclusive tactile offering for blind and low vision appliance owners, and a collaboration with Mothers' Milk Bank Northeast that revolutionized milk donation tracking and measurement.

Mary Marcus Appointed CEO of NewAge Industries™, Inc.



NewAge Industries™, Inc., parent company of AdvantaPure™ and NewAge Performance Products, a global leader in fluid transfer systems solutions for the biopharma and industrial markets, is pleased to announce the appointment of Mary Marcus to the position of CEO.

"Since her arrival in 2008, Mary has been a vital part of NewAge Industries, Inc. In her most recent role as Interim CEO & General Manager, Mary has successfully led the organization while strategically positioning it as a global leader with tremendous growth opportunity within the industry," said Andreas Georghiou, Lead Director of the Board.

"I enthusiastically support Mary's appointment to CEO. I have been impressed by her commitment and dedication to the Company, its team members and to our many global partners," said Ken Baker, previous CEO and current member of the NewAge Industries, Inc. Board of Directors.

Mary joined NewAge in 2008, in supply chain operations. She subsequently held numerous leadership roles in operational functions which have enabled the Company to successfully navigate the incredible growth and challenges that come with servicing the BioPharma industry, including the establishment and development of single-use sterilization programs, the build-out of several cleanroom production suites, the creation of a quality management system and the expansion of the Company's global footprint, with the launch of a new manufacturing site in Europe earlier this year.

Mary graduated from Penn State University with a Bachelor's Degree in Business Administration and attained her Master's of Science in Organizational Development from St. Joseph's University.

"Ken has done an amazing job setting the company up for success and created such a strong foundation upon which to build. I am honored and humbled to be able to lead the organization into the next chapter," said Ms. Marcus.

AUX Expands Global Footprint With Entrance Into U.S. Market



AUX, a $10 billion global leader and innovator of residential HVAC solutions, announced its entry into the U.S. market with AUX AIR USA—a significant milestone in the company's nearly 40-year journey of delivering cutting-edge technology backed by unmatched service.

This announcement coincides with AUX's participation in the HARDI Annual Conference, taking place December 7-10, 2024, in Atlanta, where the company will be exhibiting (Booth #907) and engaging with industry leaders to discuss its plans for introducing innovative solutions to the U.S. HVAC market.

As a subsidiary of AUX, with a robust presence in Europe and Asia, AUX AIR USA's entrance into the U.S. is a strategic expansion into a market ripe with opportunity.

"This expansion is a natural next step in AUX's strategy to bring advanced HVAC solutions to markets that demand high performance and quality at a competitive price point," said Matt Lacey, AUX's Vice President of U.S. Sales. "Early reception has been positive, indicating a strong need in the U.S. for the next level of cooling innovation with superior technology and simple installation."

Transforming the U.S. HVAC Landscape

With its U.S. headquarters and corporate team in South Plainfield, N.J., AUX is growing its presence across the country. The company plans to continue adding to its headcount throughout 2025 to support growth, with future plans to establish a factory in North America.

AUX's solutions offer distinct advantages, including:

- Ease of Installation: AUX's mini-split systems are designed for single-person installation, reducing labor costs against the backdrop of ongoing labor shortage in the HVAC industry.
- Superior Technology: AUX brings innovative Japanese engineering to its standard features, including an interactive, locally based, voice control interface.
- Exceptional Support: With a dedicated local technical support team, AUX is committed to providing exceptional service to contractors and distributors.

- Innovative Roadmap: AUX is bringing new, cutting-edge technology to the market with new releases in 2025, including central air systems and an innovative air-to-water system.

AUX will debut its expanded product lineup at the 2025 AHR Expo in Orlando, Florida in February, at booth 4370. The product lineup will showcase AUX as the new standard in efficiency and sustainability by combining advanced refrigerants and hydronic technology.

For more information, visit auxair.com/us.

Nidec/U.S. Motors Announces Two Senior Staff Promotions

Cory Knipp



Nidec's U.S. Motors division recently promoted two long-time staffers to senior roles. Cory Knipp is now director, strategic planning and marketing operations, and Patrick Hogg is senior marketing director, industrial OEMs and distribution. The U.S. Motors brand offers electric motors featuring advanced technology, from variable speed electronically commutated motors to NEMA Premium efficient motors.

In his new role, Knipp will support growth initiatives, collaborating with senior management in shaping business strategy and conducting data analysis to ensure continued alignment with goals. He was previously director, marketing operations. Knipp joined Nidec in 2017 as a market manager. He holds a bachelor's degree in general engineering from the University of Illinois and an MBA from Southern Illinois University-Edwardsville.

Patrick Hogg



Hogg will continue to lead the company's industrial pumping, distribution, and general industry markets, along with a stronger focus on business development for these and other growing markets in the industrial segment. He has been with Nidec for over 16 years (including when U.S. Motors was part of Emerson). In that time, he has moved up from engineering co-op through customer design marketing and product management. For the past three years, Hogg has been director of marketing for the industrial markets. He holds a bachelor's degree in mechanical engineering from Southern Illinois University-Edwardsville and an MBA from University of Missouri-St. Louis.



Prima Power Unveils Competitive and Productive Platino Linear® 2D Laser Machine for Commercial Appliances Ideal investment for efficient, sustainable, and advanced production

Prima Power, the sheet metal machine tool brand of Prima Industrie, a leader in sheet metal working manufacturing solutions, introduced the latest addition to their 2D laser technology portfolio: the Platino Linear®. This reliable and productive 2D laser machine sets a new standard in compactness, efficiency, and affordability, catering specifically to small to medium-sized businesses and dynamic production operations.

The Platino Linear offers significant advantages for manufacturers of household and commercial appliances, particularly in terms of cost-effectiveness and material versatility. Its cost-effective operation and maintenance-free linear drive system minimize downtime and associated costs, contributing to competitive pricing in the appliance market. The machine's versatile material processing capabilities allow for seamless handling of various materials commonly used in appliance manufacturing. Additionally, the Platino Linear's compact design, occupying 22% less space than others in its category, optimizes production areas without compromising on performance. The innovative cantilever architecture and open-design cabin provide complete access to the work area, while the synthetic granite frame delivers exceptional vibration absorption and thermal stability, guaranteeing reliable performance.

An aluminum carriage minimizes the weight of moving components without sacrificing rigidity, ensuring high accuracy. Features like Smart Cut and Gas Mixer Cut optimize operations, reducing cycle times by up to 30% and enhancing cutting quality. ECO-TOUCH Cut reduces gas consumption by up to 40%, contributing to sustainability. Adaptive Cut adjusts focus and beam diameter for different materials automatically. The Safe Impact Protection System prevents damages from collisions, ensuring reliability. With these features, Platino Linear offers efficient, sustainable, and advanced production at a competitive price, ideal for any business seeking quality and cost-effectiveness.

Prima Power offers tailored automated solutions, all available for the Platino Linear, enhancing efficiency and productivity by minimizing manual intervention and optimizing space. The Compact Server features dual storage units and consolidates components onto an automatic pallet changer, maximizing space utilization. The Combo Tower Laser automates material flow with shelving groups and customizable loading units. The PSR 2D System ensures precise stacking and uninterrupted operation. The Night Train FMS® Storage System serves as material storage and buffer, with intelligent cassette management for real-time monitoring. Prima Power's commitment to personalized solutions evolves alongside customer needs, emphasizing modular and expandable automation to meet dynamic requirements effectively, encapsulated in our brand promise "Evolve by integration."

For more information, please visit www.primapower.com, or contact Prima Power North America Sales at 1 (800) 334-7143 or info@primapower.com.



Case Study:

Compact, Sealed Tactile Switch Solves Battery Indicator Challenges in European Power Tool Design

Helping engineering teams overcome integration, durability, and safety hurdles in harsh environments

Designing compact, durable, and user-friendly interfaces for handheld power tools presents a unique set of engineering challenges—especially regarding reliable switch performance in harsh environments. This success story explores how one European appliance manufacturer overcame issues related to size constraints, environmental sealing, user ergonomics, and lifecycle durability by integrating the Littelfuse KSC222J tactile switch into their battery-level indication system. This article, presented in a problem-cause-solution format, highlights key technical considerations and real-world performance benefits to help engineering teams facing similar design requirements.

The Challenge: Compact Reliability for Harsh, Demanding Environments

A leading European appliance manufacturer developing battery-powered handheld power tools—primarily drills and rotary devices—faced a critical challenge in the design of their latest generation cordless product line. The engineering team needed to implement a compact, rugged, and highly reliable tactile switch that would activate the battery level indicator on the tool's interface.

While this may sound like a relatively simple component to specify, the application presented a range of demanding design requirements. The switch had to operate consistently in tough jobsite environments, where exposure to dust, moisture, vibration, and frequent mechanical impact is routine. It needed to fit into an already space-constrained PCB layout, provide excellent tactile feedback for ergonomic operation, and meet stringent safety standards without increasing manufacturing complexity or cost.

The battery level indicator is a key user interface element that gives real-time feedback on battery capacity. For professional users, especially those in construction, carpentry, and renovation, this feature must work reliably under all conditions and over the full life of the tool—often several years of intensive use.

The Root Cause: Standard Push Buttons Aren't Built for This

Initially, the team explored standard push-button switches that were already used in other appliance and consumer electronics projects. However, these switches quickly revealed limitations during prototyping and early field testing.

Durability was a major issue. Standard push buttons were typically rated for 100,000 actuations—sufficient for light-duty devices, but inadequate for professional-grade tools used multiple times daily. The switches began showing

signs of degradation well before the expected lifespan of the tool, prompting concerns about warranty returns and customer dissatisfaction.

Environmental sealing was another pain point. During extended testing, fine drilling dust began penetrating the switch housing, leading to mechanical sticking and electrical failure. Water splashes and high-humidity environments also caused corrosion and leakage, especially in unsealed or semi-sealed models.

Form factor and integration also presented recurring issues. The switches were too large to fit comfortably within the compact layout of the tool's handle without design compromises. Misalignment during assembly sometimes caused inconsistent actuation, requiring rework or triggering customer complaints.

Ergonomics and safety added further complexity. The team needed a switch that could be activated easily—even while wearing gloves—yet not so sensitive that it caused false triggers during normal tool operation or accidental contact. Moreover, the switch had to safely interface with the battery management system (BMS) and any associated circuit protection devices, such as fuses or transistors, to prevent short circuits and meet EU safety regulations.

At this point, the engineers began asking more targeted discovery questions:

- What safety certifications and ingress protection levels are needed to ensure field reliability?
- Can we find a tactile switch that is already tested and rated for dust-tight and water-resistant applications?
- How will the switch interact with the power control circuitry and BMS logic?
- Is it possible to reduce the component footprint without sacrificing functionality?

The Solution: Littelfuse KSC222J Tactile Switch Delivers Precision, Protection, and Longevity

After extensive testing and consultation, the team selected the KSC222J LFS Tactile Switch from the KSC2 Series as the ideal solution. This sealed surface-mount tactile switch delivered the right combination of ruggedness, compactness, and electrical performance to meet all application requirements.

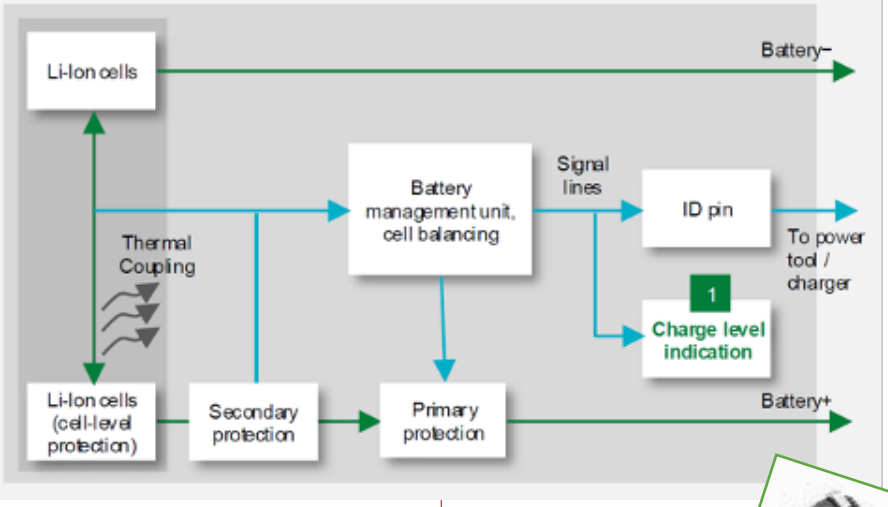


Figure 1. Tactile switch charge level indicator

Here's how the KSC222J met or exceeded every design challenge:

Compact & Space-Efficient

Measuring just 6.2 x 6.2 x 3.5 mm, the KSC222J occupies 20% less PCB space than the previous design, making it easier to integrate into the already-dense layout of the drill's control board. The tight ±0.2 mm dimensional tolerance also reduced alignment issues by 50%, improving both placement accuracy and overall assembly yields.

Electrical Travel (Te) and Electrical Height (He)

When integrating tactile switches into applications where precise actuation is essential, such as in human-machine interfaces (HMIs), design engineers must consider two critical dimensional characteristics: Electrical Travel (Te) and Electrical Height (He). Electrical Travel refers to the vertical movement of the actuator's top required to activate the switch. At the same time, Electrical Height denotes the fixed height from the PCB to the point where the switch electrically actuates. Traditionally, designers relied on Electrical Travel and a stack-up analysis to determine the switching point location. However, this method accumulates tolerances across multiple components, often resulting in a wide variation of ±0.4 mm; this can lead to overtravel, inconsistent tactile response, and potential long-term reliability issues.



To address these concerns, C&K—now part of Littelfuse—has refined the specification approach by prioritizing Electrical Height. By specifying the switching point directly relative to the PCB with tighter process controls and manufacturing precision, Electrical Height provides a more consistent and predictable integration point with a tighter standard tolerance of

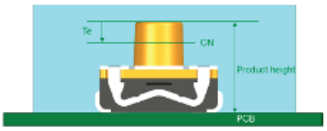


Figure 2: Electrical Travel Version

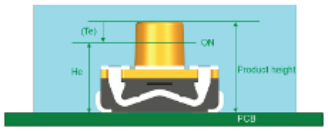


Figure 3: Electrical Height Version

±0.2 mm. In some cases, tolerances as precise as ±0.1 mm or even ±0.08 mm can be achieved. This shift simplifies design validation, reduces cumulative error, and ensures a more uniform tactile experience across units. For electromechanical designs requiring precise actuation, whether finger- or lever-operated, relying on Electrical Height over Electrical Travel improves integration accuracy and product performance.

Extreme Mechanical and Electrical Durability

The switch is rated for up to 1 million cycles—a 10x improvement over typical push-button alternatives. This extended life rating ensures that even under frequent daily use, the switch will remain operational for the full-service life of the power tool, reducing field failures and support costs.

The small switch has maximum contact current ratings of 50 mA at a maximum voltage of 32 VDC. That is more than sufficient capacity to interface with a BMS circuit and ensures long-life electrical performance.

IP67 Sealing for Dust and Water Resistance

The KSC222J's IP67 rating means it is completely sealed against fine dust particles and can withstand immersion in up to 1 meter of water for up to 30 minutes. For a jobsite environment, this provides critical protection from:

- Drilling debris and drywall dust
- Rain, water splashes, and humidity
- Grease and chemical exposure

This level of sealing significantly extends product longevity and simplifies compliance with EU appliance safety standards.

Improved Ergonomics and Activation Control

The KSC222J features a tactile feedback mechanism optimized for glove-friendly actuation. The force and travel profiles are tuned to reduce finger strain, while helping to prevent accidental or unintended activation—a common issue with overly sensitive designs.

This improvement not only enhances the user experience, but also improves operational safety, especially when tools are used in elevated positions or awkward angles.

Seamless Circuit Integration

The momentary electrical connection provided by the KSC222J easily interfaces with the tool's battery management system (BMS). This helps the BMS interpret the button press as a trigger to wake up and display battery capacity—without impacting power regulation or interfering with the main control loop.

The sealed switch also complements circuit protection strategies, since its robust housing helps isolate the control circuit from moisture or conductive particles that could cause shorts or component failure.

The Result: A Rugged, User-Friendly Battery Indicator Activation System

The implementation of the KSC222J tactile switch enabled the engineering team to meet all critical product objectives:

- Reduced PCB space requirements, enabling a sleeker and more balanced tool design
- Improved assembly tolerances and reduced rework caused by switch misalignment
- Longer switch lifecycle, minimizing warranty claims and increasing customer satisfaction
- Robust performance in tough environments, aligning with IP67 and regional safety standards
- Enhanced user interface, contributing to the premium feel and usability of the tool.

Ultimately, this design change helped the OEM differentiate its cordless power tools in a competitive market, while also ensuring compliance, reliability, and long-term durability.

Take the Next Step

If your application demands sealed, space-efficient, long-life tactile switches, explore the KSC2 series. Whether for power tools, industrial equipment, or other sealed appliance controls, the KSC222J offers a proven path to solving mechanical and electrical design constraints.

KSC2 Series Sealed Tact Switch for SMT

Tactile Switch Electrical Height Versus Electrical Travel Application Note

Download the Datasheet

View the Cordless Power Tools Spotlight Presentation

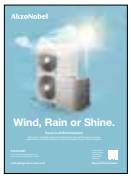


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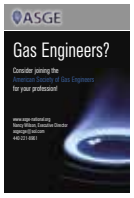
Paulius Juskevicius is a Strategic Marketing Manager for the Electronics Business Unit at Littelfuse. Paulius Joined Littelfuse in 2016 as field applicaion engineer for the EMEA region. His current responsibilities include the management of marketing activities for new product launches and performing marketing studies and feasibility analysis for new product ideas. Paulius earned his master's in electrical engineering from Kaunas University of technology.

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