ELECTRICAL WIRE PROCESSING TECHNOLOGY EXPO

APPLIANCE & HVAC REPORT

Reaching Design Engineers at the OEM Level

April 2022 VOLUME 4 ➢ NUMBER 2



9 FEATURES COVERING

COLOR
CONTRACTORS
CONTROLS
DIFFUSERS
ELECTRICAL TESTING
GREASE
ioT
OUTLETS
OZONE

microgroove™
SEE OUR AD ON THE BACK COVER

ETCO Is Turning 75



ETCO

Visit us at the
Electrical Wire Processing Technology Expo
in Milwaukee, WI, USA
Booth # 727 May 11 & 12, 2022

ETCO.COM
ISO 9001:2015
IATF 16949:2016

MADE IN THE USA

Our Product Line Is Our Spokesperson

Superior quality across a broad range of standard and custom products, reliable delivery and extremely responsive customer service are the three main reasons why our customers are so loyal. For 75 years we have been focused on these goals. If your supplier is not responsive to your needs contact **ETCO** at **1-800-689-3826** or **info@etco.com**

Welcome to our April issue, our second of 2022



January, which was distributed at AHR, marked a milestone for us, our tenth since our founding in autumn 2019. Happy to say we've come a long way in the past 2 ½ years.

We have increased our starting database of 18,000 by 25%. We have been profitable since day one. And we continue to provide technical articles and whitepapers to our OEM, design engineering audience.

We also have established a social media presence via linkedin and twitter. Pls follow us there!

Speaking of the AHR show, we were happy to exhibit. I was very impressed by the attendance in terms of exhibitors and attendees. People were bullish on the future and wanted, with caution, to put Covid behind them. The show was in the North and Central halls of the Las Vegas Convention Center. Masks were required and people did wear them. Of course, things were quite different in the hotels and casinos.

We also are making a concerted effort to be found at tradeshows now that they are back. We were at AHR and will be at APEC, the combined Foam Expo/The Adhesives and Bonding Expo and The Electrical Wire Processing Technology Expo. There are probably other events we should exhibit at too. As for now we haven't ventured outside the US much in terms of distribution but that may be in our future.

Let me also take this opportunity to announce our new relationship with the American Society of Gas Engineers (asge-national.org). They will be advertising with us on a regular basis, starting in this issue, to recruit new members. In return THE APPLIANCE & HVAC REPORT has been named a Platinum Sponsor of this organization. Thank you Ian Brown of Surface Igniter and William Taylor of ASGE who helped make this happen.

While we have become more of a digital world, as is our brand, and we now take many meetings online, it's still great to meet others in person. Whether its shaking hands, fist bumps, etc. we all enjoy getting out and meeting others. That goes for meeting colleagues who we hadn't seen in several years due to the pandemic.

Now we are going from the proverbial "frying pan into the fire". While it looks like the worst of Covid is over, we have the Russian invasion of Ukraine to worry about, and its effect on the rest of the world. Economics plays a part in it too…the family that has to spend more on food and gas will have less disposable income to purchase appliances, air conditioners, furnaces, power tools and the other products made by the companies who subscribe to our brand.

Editorially, here are the companies that contributed feature articles in this issue: Apple Rubber, BYK-Gardner USA, Bosch Thermotechnology (our cover story), EffectiV HVAC, Fenwal, Fieldpiece Instruments, Jabil, Littelfuse and Nye Lubricants. Regarding Fenwal, the shart-eyed reader may notice they have seen this piece before….they have, in our January issue. But due to several production errors for which I take full responsibility we omitted several sections erroneously. So we have included again in this issue, in full. Thank you one and all.

Feel free to contact me at brad@appliancehvacreport.com if we can ever be of assistance. See you with our next issue, July.

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

APPLIANCE & HVAC REPORT
Reaching Design Engineers at the OEM Level

Reaching Design Engineers at the OEM Level

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

Jeff Greene
Art director
jeff.greene1116@gmail.com

JABS Media, LLC

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

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

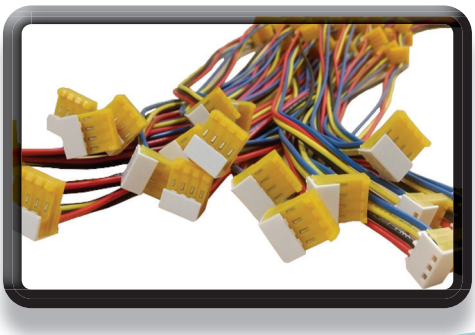
Ad Index

ASGE asge-national.org	7
Cesar-Scott cesar-scott.com	4
Continental Fan continentalfan.com	11
Etco etco.com	IFC
EWPTE '22 Electricalwireshow.com	IBC
Fenwal kidde-fenwal.com	eBlast
Hernon Mfg. hernon.com	eBlast
Littelfuse littelfuse.com	eBlast
Microgroove microgroove.net	BC
New Age newageindustries.com	eBlast
Pivot Point pivotpins.com	eBlast
Soler & Palau Soler-Palauinc.com	21
SurfaceIgniter surfaceigniter.com	19
Vitrek vitrek.com	6, eBlast

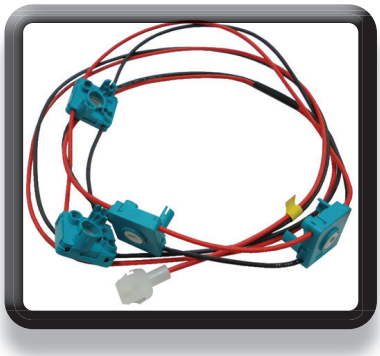
CESAR SCOTT®

WIRE HARNESS & CABLE ASSEMBLY

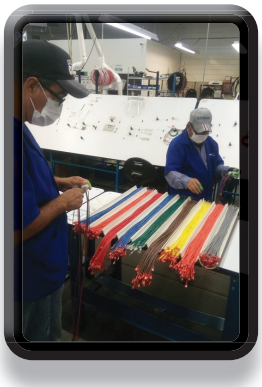
FOR APPLIANCE



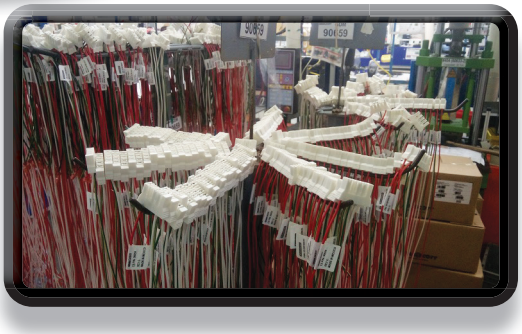












A low cost footprint for manufacturers
that want to manufacture in Mexico

Cesar-Scott, Inc.

1-800-880-3212 (915) 543-3212 www.cesar-scott.com www.electronicgasignitor.com

April

CONTENTS

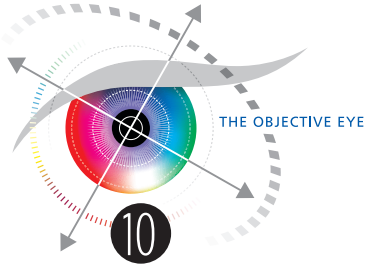
FEATURES



7

Get Smart: Innovations in Smart Appliances and HVAC Design
by Andrew Glickman

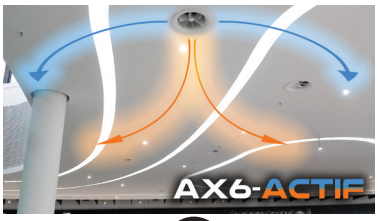
IoT-connected appliances are transforming the vision of tomorrow's smart homes into houses with higher IQs.



10

Maintaining Color and Appearance Sandards
by John Kowalski

A standardized color and appearance program plays a critical role in this process.



12

Thermodynamic Diffusers
by Frank Godbout

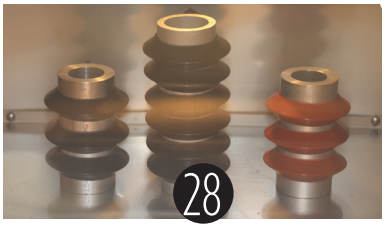
Thermodynamic diffusers help improve thermal comfort and indoor air quality.



26

The Contractor is the Beating Heart of HVAC Innovation
by Goncalo Costa

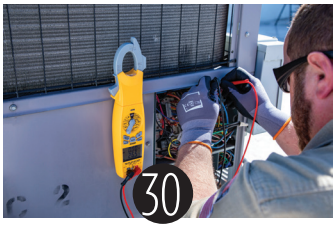
To ensure HVAC technology grows it's important to have input from the front lines - the contractors.



28

Understanding the Link Between Ozone and Rubber Deterioration
by John Tranquilli

How much exposure should rubber have, and what is the expected life of the rubber product?



30

Let's Make HVACR Electrical Testing Safer and Smarter
by Tony Gonzalez

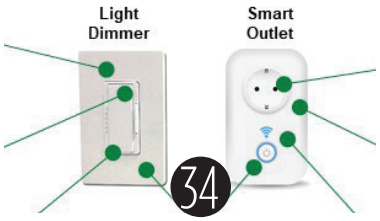
Three rules to follow: safety, using the right meter and follow best practices.



32

Collaboratively Created Appliance Controls, No Matter the Industry
by Marc Silverstein

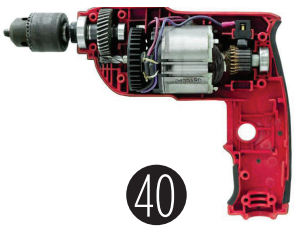
Choosing a trusted appliance controls company can help your product succeed.



34

Designing Intelligent Outlet Solutions For Smart Home & Building Automation
by Ryan Sheahen

Innovation in wireless and internet technology is converting common, non-intelligent devices into smart ones.



40

Top 4 Considerations When Selecting a Gearbox Grease
by Brian Kinkade

Gearboxes and gear motors drive the performance of products and are significant to size, weight, vibration, and noise.

DEPARTMENTS

3 **Advertisers Index**

20 **News Beat**

23 **New Products**



ACCREDITED
CERT #3678.01

VITREK

MADE IN USA

info@vitrek.com

High Voltage Test & Measurement

Providing Innovative Solutions for High Voltage Test & Measurement for 25+ Years

- *Manufacturing*
- *System Integrators*
- *R & D Departments*
- *Testing Labs*
- *Military & Defense*
- *Lighting*

V7X & 95X Hipot & Ground Bond Testers



- Wide range of AC/DC Outputs up to 30 KV AC & 15 KV DC
- Optional 64 test point Switching System and Automated Software available

4700 Precision High Voltage Meter



- Measures up to 10 KV directly, up to 140 KV with Smart Probes
- Up to 0.03% DC and 0.12% AC accuracies
- Chart Mode provides graphic documentation of HV drive ramp time, overshoot and sag

2000 Series Portable Calibration Instrument



- Laboratory accuracy in a compact, portable unit
- DC voltage & current capability - +/- 22 volt, 10ppm accuracy, +/-22mA, 40 ppm accuracy
- Temperature simulation with 0.01° resolution, 0.015°-0.12° accuracy (90 day)
- DC resolution down to 10nV or 10pA
- Battery powered portability for flight line use

XiTRON Brand Products

XiTRON By VITREK



- Power Analyzers
- DC Calibrators
- Ballast Testers
- LED Spectral Analyzers
- DC Electric Loads
- Phase-Angle Volt Meters
- Digital Milli-Ohmmeters

PA920 Series

Ultra-High Accuracy (0.024%) Harmonic Power Analyzers

Vitrek Introduces the New PA920 Series, the Most Powerful, Accurate & Flexible Power Analyzer Available!

- Ultra-high 0.024% power accuracy for all channels, 0.015% voltage and 0.018% current base accuracies
- Up to 4 channels of power measurement of accuracy, input & resolution
- Color touchscreen displays Harmonics, Power Data, Scope View, Cycle View, Vector Standby Power & History
- Improved Voltage & Current self-heating adders
- Faster sampling rates & bandwidth performance
- Greater harmonic frequencies



DL Series

Electronic DC Load

Vitrek Introduces the New DL Series Electronic DC Load, The Industry's Easiest-To-Use DC Load!

- High accuracy measurements (0.05%) of voltage and current within pulses or sweep steps as short as 20µs
- Easy-to-use touchscreen for quick setup and configuration with graphical measurement readouts
- Generates kW, mW or µW loading >20:1 higher and >1000:1 lower loading capability range than most presently available benchtop DC loads
- Performs any combination of CC, CW, CV, CR in static or non-linear loading modes
- Rack mount option available.



Check out Vitrek's New Product Training Videos & Webinars at www.Vitrek.com!

Visit www.Vitrek.com/ahvac or call (858) 689-2755 to schedule a free product demonstration!



Get Smart: Innovations in Smart Appliances and HVAC Design

BY ANDREW GLICKMAN

The continuing surge in IoT-connected appliances is rapidly transforming the vision of tomorrow's smart homes into houses with higher IQs today. Smart security systems continue to be a top purchase driver for many households. However, other connected devices, like smart speakers, smart lighting and voice assistants, are not far behind. Also, the importance of them all being able to interact seamlessly is gaining ground quickly.

Aside from the much-ballyhooed time savings associated with using smart appliances, there's the added benefits from elevating comfort, convenience, safety and security. Clearly, the opportunity to save energy and money also are big motivating factors, which explains the uptick in demand for smart power strips, smart thermostats, smart light fixtures, a wide range of smart appliances, home energy monitoring systems, the list goes on and on.

Additionally, the lasting impact of the pandemic on the smart home market can be felt in the rise in home-based air filtration and purification systems. At the same time, ultraviolet (UV) disinfection solutions have graduated from being just a curiosity. Portable lights and lamps that use UV-C technology to purify the air of bacteria and viruses, including SARS-CoV-2, the virus that causes COVID-19, are likely to keep showing up in more and more homes.



Also experiencing market momentum are smart and efficient control systems that better manage heating, ventilation and air conditioning (HVAC). Besides lowering energy costs, these smart systems offer a boost in energy efficiency and comfort by adjusting temperatures automatically based on the preferences and behaviors of the home's occupants.

Technology is increasingly becoming table-stakes in this fast-growing market segment. That's why it is so critical for product designers and developers to navigate an evolving ecosystem of potential partners to ensure a simple, seamless and interconnected consumer experience.

Holistic Human-Machine Interfaces Rule

The importance of integrated, intuitive human-machine interfaces (HMIs) cannot be overstated or underappreciated. What's at stake? Product differentiation and market leadership will be determined by which companies' products deliver the ultimate customer experiences. Major innovations encompassing developments in holographic, capacitive touch and haptics technologies are poised to leapfrog current engagement with smart devices and appliances.

For instance, the trend for touchless faucets, which intensified exponentially during the pandemic, is shaping the future of kitchen and bathroom appliance designs. A Consumer Electronics Show (CES) 2022 Innovation Awards Honoree, Moen's Smart Faucet with Motion Control lets users control both temperature and waterflow with simple hand motions. In fact, the gesture-recognition technology is so advanced, Moen designed a version of the faucet without a handle.

Holographic HMI technology also was on display at CES, along with other advances in hands-free and voice-activation technologies. On the smart appliance front, advancements in haptic technology are evolving at a steady pace aligned with increasing use of touchscreen displays. Tactile feedback is considered the fastest-growing segment of this market slice, mostly because of its accepted prominence in smartphones, tablets and other consumer devices, which enables greater development for smart appliances.

Still, strong expertise is required to enable intuitive feedback to touch commands using ultrasonic vibrations, electroactive polymers or microfluidics. For product developers, it comes down to evaluating and optimizing customer-centric functionality while then devising the most effective, efficient and economical path to commercialization.

For premium appliance brand Fisher & Paykel, putting the customer first in product development and HMI decisions is based on a customer-value barometer that guides both its product-design philosophy and go-to-market approach. The company equips its smart kitchen appliances with embedded sensors, capacitive technologies and streamlined human-machine interfaces that are proven to be durable under extreme heat and cooling conditions.

The addition of guided cooking functionality with touchscreen interfaces offers Fisher & Paykel appliance owners real-time access to recipes and step-by-step cooking instructions. The development of Thin-Film Transistor (TFT) displays, which use transparent semiconductors and electrodes, are ideal for creating detailed images with rich colors and sophisticated graphics.

Connectivity also represents another major focus for Fisher & Paykel to ensure integrated communications and functionality across appliances, as well as throughout connected smart homes. To that end, the company is also investigating camera solutions. For example, the ability to use a camera that could automatically recognize types of food and then activate the oven to cook to a particular temperature for a desired outcome is a major step forward in home automation.

Adding Intelligence Drives Differentiation

At the 2022 Kitchen & Bath Industry Show in February, leading kitchen and bath brands joined innovative startups in showcasing data-driven solutions designed to take customer experiences to the next level. LG Electronics' luxury brand, Signature Kitchen Suite introduced "ThinQ Care," a customer support program that uses artificial intelligence (AI) to help homeowners monitor and maintain their Signature Kitchen Suite appliances. The program collects and analyzes appliance usage patterns and performance data while proactively notifying homeowners if a potential service issue is detected or could be on the horizon.

As a leader in the smart home category, LG has gained significant momentum creating a smart home ecosystem that encompasses advanced solutions for kitchen, laundry, HVAC, water heater and energy storage. Soon, full energy management and distributed energy resource management solutions will be added to LG's suite of solutions to provide consumers with greater control and intelligence over their home environments.

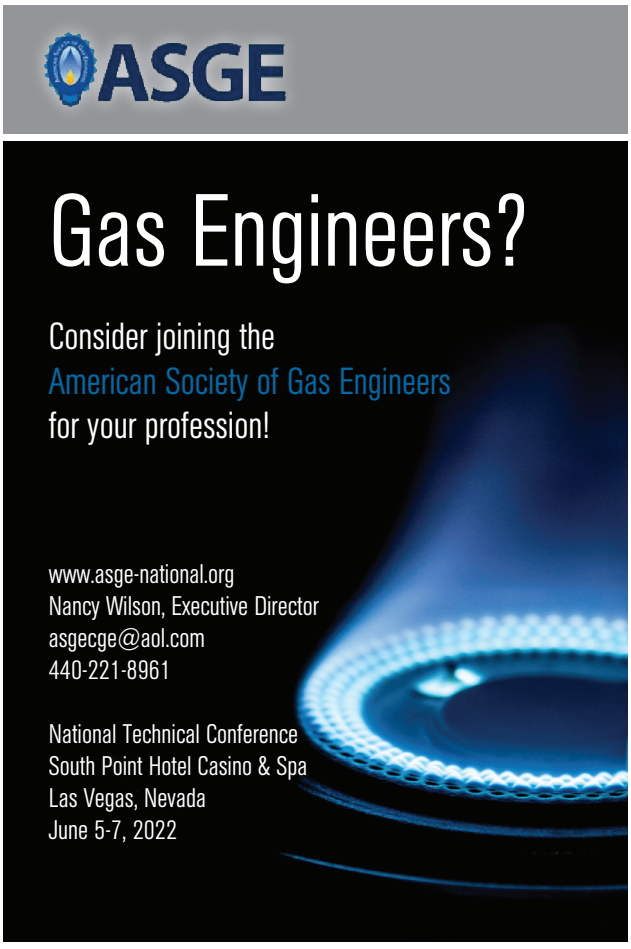
To accomplish this, however, users must feel comfortable with their appliances taking a deep dive into their daily lives and then aggregating data on usage. According to a study by the Columbia Business School, 75 percent of people are more willing to share various types of personal data with a brand they trust, and 80 percent will do so with non-required data for reward points and product recommendations. While this elevated level of trust in revealing personal information presents businesses with an opportunity to display targeted messaging to enhance customer loyalty, they must approach this scenario carefully or risk eroding trust if consumers feel their personal data has been misused.

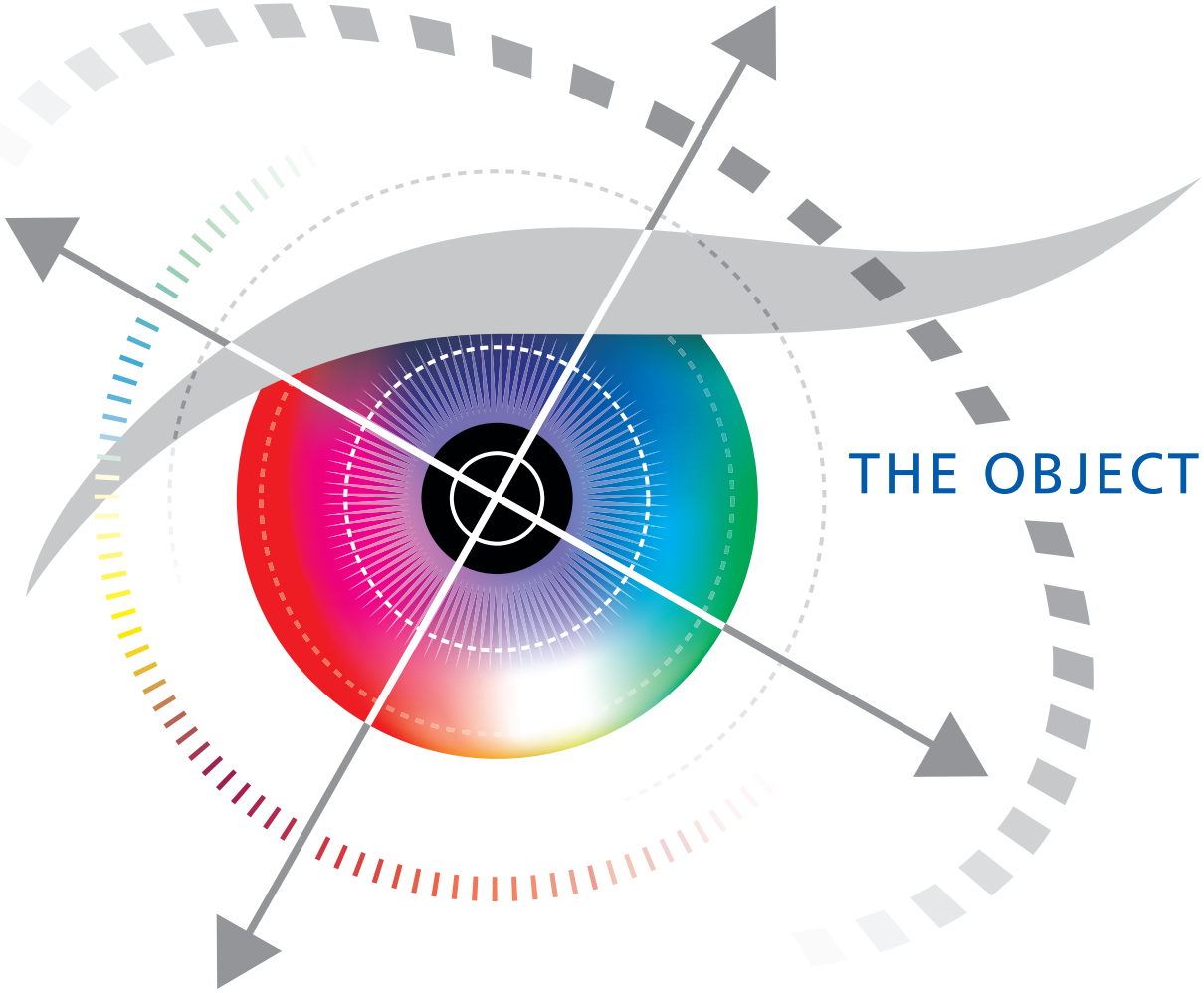
Task automation, remote monitoring, waste reduction and personalized experiences are all hallmarks of an IoT-connected home. In the race to develop the latest and smartest appliances and HVAC systems, product designers must continue to make tough decisions about how best to unify product interfaces, operations and data sharing.

The challenge is determining which blend of leading-edge technologies and data-driven insights produces the ideal mix of performance, ease of use and interoperability. For that reason, many leading appliance and HVAC brands are turning to experts in connectivity, sensors, HMI product design, integrated electronics, software, global supply chain management and manufacturing automation to establish a firm market foothold. In doing so, they not only can leapfrog their competition but can set the pace for ongoing innovations and advancements that will define tomorrow's smart homes.



Andrew Glickman *is the Director of Global Strategic Development for Jabil, a manufacturing solutions provider with over 260,000 employees across 100 locations in 30 countries. He has been with Jabil over the past 10 years across many functions and roles, including business development, business units, strategy and engineering. He holds an Executive MBA from Wharton School of Business and Undergraduate and MBA degrees from the University of South Florida.*





Struggling to Maintain Color & Appearance Standards

BY JOHN KOWALSKI

Appliance manufacturers are under pressure to maintain color and appearance standards throughout the supply chain, from incoming materials to the finished product. By managing these standards at every stage of production, you can ensure that your products look their best and meet customer expectations.

A standardized color and appearance program plays a critical role in this process by verifying color and appearance consistency (and harmony) across all stages of production. By using the latest color measurement and appearance analysis technologies and workflow, you can maintain a high standard while still meeting deadlines and budgetary constraints.

One of the most common challenges to appliance manufacturers is the ability to maintain consistent color and appearance standards. By managing your standards throughout the entire process – supply chain, incoming materials and lab formulation to production and final QC – it ensures consistency, harmony, and optimized efficiencies.

Key Elements for Optimal Success

- Instrumentation
- Standards & Organized Workflow
- Software
- Data Share
- Data Analysis

Instrumentation

The first step is to have the right instrumentation and a standard

operating procedure for its use. In doing so, this will save time, remove the guesswork, and ensure the color, gloss, texture and appearance is within your tolerances. In addition, the data can be analyzed immediately and reviewed over time to determine any long-term color and appearance trends.

Standards & Organized Workflow

By creating digital standards and an organized workflow, it allows you to manage and offer consistent organization using schematics to ensure an "apples to apples" comparison no matter where the part or materials are coming from. Digital standards eliminate the need for distributing physical standards to plants and suppliers. Since physical standards inevitably differ from the true target color, this in effect eliminates a significant source of measurement error across the supply chain. Implementing standardized measurement location, instrument orientation and labeling, ensures harmonization of the product by producing "precision to standard" tolerances. Digital standard result: Color on target!

Software

Your color and appearance software is the true workhorse of any color and appearance program. By collecting measurement data in correlation to your standard, the reporting and processing power is endless.

Data Share

Your software application should communicate the color and appearance data proactively from the SQL database in any number of formats. This allows measurements to be compared across numerous suppliers and production plants to ensure true harmony, even before the final product is assembled.

Data Analysis

By analyzing the color and appearance data not only will green light or pass/fail reporting be verified but also any trending of color and appearance data over time, facility, or supplier.

Digital color and appearance data can be mined from production for multiple uses to demonstrate

- Repeatability over time
- Integrity from a sample of production runs
- Multiple time frames to show robustness of process

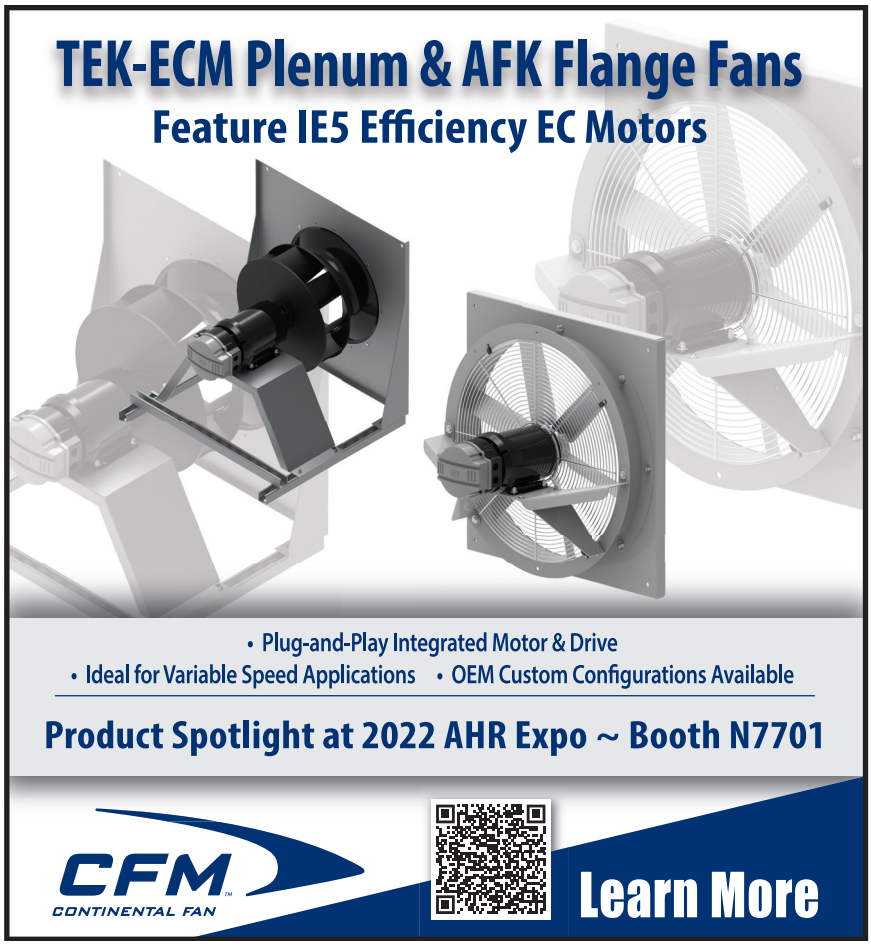
Large amounts of data can be mined from multiple databases or points in time to be reviewed in color space and reference against visual comments and acceptance.

In reviewing and optimizing your color and appearance program you will achieve product harmonization along with:

- Better color, appearance, and physical test measurements
- Better manufacturing efficiency
- Reduced product scrap
- Data analysis for data-driven decisions



John Kowalski *Is the Technical Marketing Manager at BYK-Gardner USA. He has over 25 years of marketing, branding and strategy experience with more than 12 in color technology. Visit http://byk-instruments.com for more information.*



Thermodynamic Diffusers

BY FRANK GODBOUT

A CFD simulation of a restaurant with high ceilings concluded that thermodynamic diffusers helped improve thermal comfort and indoor air quality while saving 43% energy in heating. They were profitable as early as in the first year.

Introduction

When supplying air in the room for both heating and air conditioning, diffusers installed in ceilings higher than twelve feet are normally setup to supply a horizontal air jet in order to avoid reaching the occupied space with high velocity air drafts. High velocity jets combined with cold air temperature would create serious thermal discomfort for building occupants.

Although we might achieve a good balance of air mixing, temperature control, energy efficiency and thermal comfort in air conditioning, it is rarely the case when heating the space from the same diffusers.

The impact of buoyancy effect causing hot air to rise due to a difference in density increases with the height of the ceiling. The heated air jet coming out of the diffuser tends to rise and stick to the ceiling, creating stratification. Multiple factors influence the intensity of air stratification, such as ceiling height and diffusers' installation height, angle of the air jet, temperature difference between supplied air and room air, and sources of heat loss such as doors, windows and walls.

Drawbacks of air stratification are a waste of energy, the inability to achieve occupants' thermal comfort, and a lack of proper air mixing in the occupied space.

A common approach is to use ceiling fans (also called destratification fans) to push hot air near the ceiling downwards, towards the occupied space. Although the use of fans often makes it possible to reach the desired temperature at the thermostat or in the occupied space, extra air velocity caused by the fans is often a concern. Occupants can feel direct air drafts and variations in air temperature, two factors causing serious discomfort, mostly when sitting at the same location for a while.

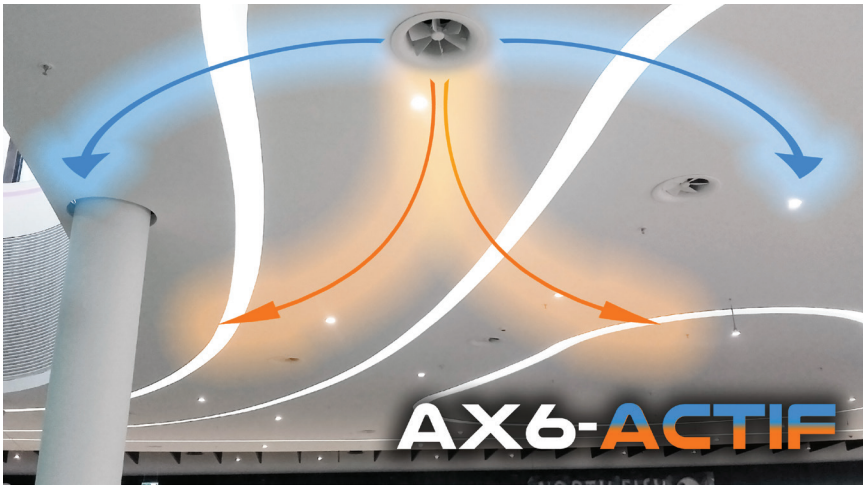


Figure 1: AX6-ACTIF thermodynamic diffusers with heating and cooling modes.

Thermodynamic Diffusers

EffectiV HVAC's thermodynamic diffusers have been on the market for many years now, successfully improving thermal comfort and energy efficiency in larger spaces with high ceilings. In addition to the positive feedback from engineers and building managers who have used the products, EffectiV's engineering team wanted to quantify how much energy could be saved in heating.

Thermodynamic diffusers use thermo-reactive materials in order to adjust the direction of the air jet based on the supplied air temperature. A thermal spring or thermal wax piston actuator is exposed to the air coming from the ventilation system and passing through the diffuser. The actuator expands or contracts, adjusting the diffuser's airflow according to the supplied air temperature. The concept behind this mechanism is to diffuse cold air horizontally or upward, and hot air downward to compensate for the buoyancy effect causing hot air to elevate and saturate near the ceiling.

Three models of thermodynamic diffusers are available. DCG-ACTIF aluminum 3 cone round diffuser and AX6-ACTIF round swirl diffuser are both designed to be installed in high ceilings, while KAM-ACTIF nozzle jet diffuser is meant to be installed in the sidewall of larger rooms.

Thermodynamic diffusers are "plug-and-play" solutions which do not require electricity to operate, nor any special configuration or maintenance.

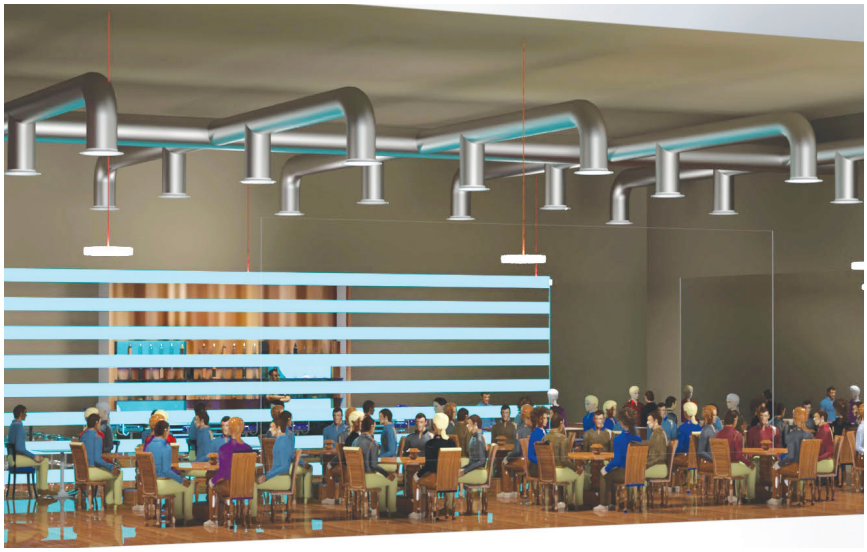


Figure 2: A restaurant with 90 people seating capacity and 22 ft. high ceilings was used for the CFD simulation.

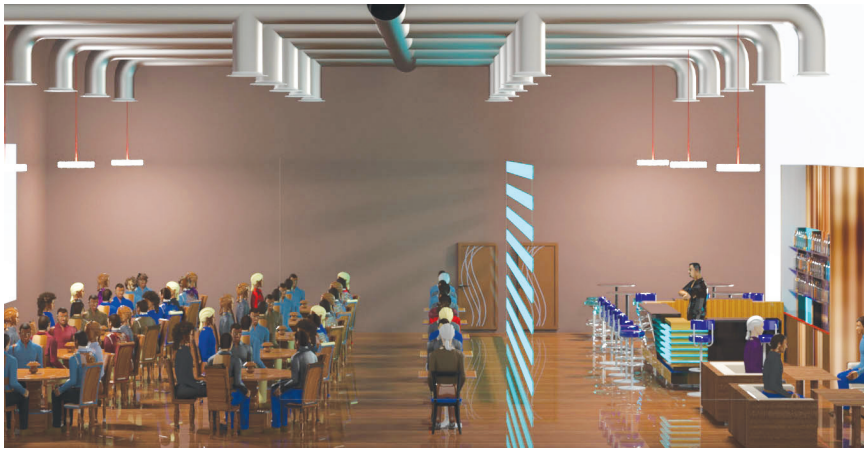


Figure 3: A total of 20 diffusers supply 21,180 cfm of heated air.

They are installed like standard diffusers and operate autonomously.

The thermodynamic diffusers used in the current case study were AX6-ACTIF.

Space Configuration and Conditions

The modelized space is an open concept restaurant with a 90 people seating capacity. The dimension of the room is 100 feet x 60 feet (40 m x 18 m), with 22 ft (6.7 m) ceilings. The open concept ceiling has visible ducts, and the diffusers are installed 6 feet (1.82 m) below the ceiling, 16 feet (4.88 m) above the floor.

A total of 20 diffusers are supplying 21,180 cfm of air in the entire restaurant, 1059 cfm per diffuser. The diffusers are installed on 16'' ducts.

Because standard diffusers and thermodynamic diffusers both supply cold air horizontally along the ceiling, a similar performance without efficiency gain were assumed in air conditioning mode. AX6's swirl air diffusion pattern can improve air mixing compared to non-swirl diffusers, however this feature was disregarded in the current case study by using swirl diffusers in both scenarios.

The CFD simulation considers winter conditions in the northern half of North America, with an outside temperature of 14°F (-10°C). The supplied air temperature of the heating system is 90°F (32°C). Natural body heat gain from seated occupants (91.4°F or 33°C) and heat loss from the walls and single-glass windows were considered.

The Simulations

In order to limit the necessary computing resources and to accelerate the simulations, the room was divided into four sections. Simplified simulations were executed in each section and the results were compared. The bar section (top left, colored in red in Figure 4) has no significant source of heat loss and was the warmest. The smaller blue section, near the door and between the two large windows, was the coldest section. The green section with six tables and one window was the most representative and very close to the restaurant's average, therefore that section was retained for in-depth simulations.

A total of three simulations were executed and analyzed, comparing three different solutions.

1. The first simulation used only swirl diffusers supplying hot air horizontally;

2. The second simulation combined the same diffusers with eight (8)

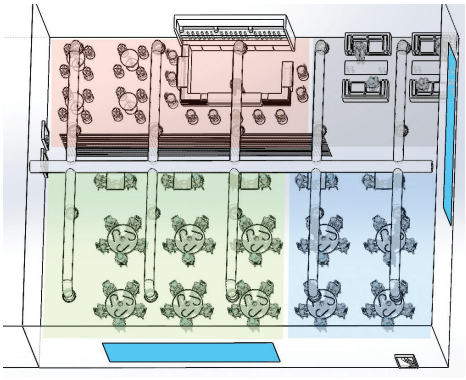


Figure 4: The restaurant was divided into four sections to simplfy the simulation.

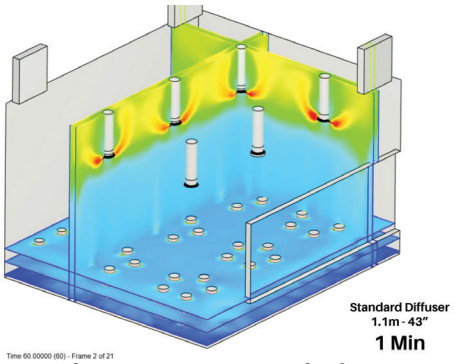


Figure 5: Temperature in the room after the first minute of heating with standard diffusers.

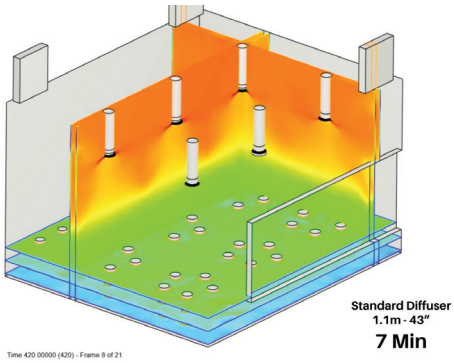


Figure 6: It took 7 minutes to reach a comfortable temperature at the thermostat height with standard diffusers.

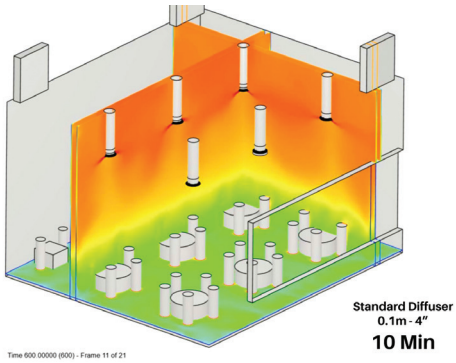


Figure 7: Seated occupant' thermal comfort was achieved in 10 minutes with standard diffusers.

ceiling fans. A common fan model specifications were used for the simulation;

3. The third simulation used AX6-ACTIF thermodynamic diffusers configured in heating mode.

Simulation Results - Temperature

In the current case study, two important heights were retained for temperature measurements. The first height is the seated occupants' head level, 1.1 m or 43'', a very important temperature for thermal comfort. The same height was used for the thermostat readings, which commands the system and has a direct impact on energy consumption.

The second height considered was seated occupants' ankle height, 0.1m or 4''. These measurements were considered strictly for thermal comfort. In order to follow ASHRAE's requirement for seated occupants' comfort, the temperature difference between 1.1m and 0.1m must be 3 degrees Celsius or less.

The simulation results show temperature colors on two vertical planes below the diffusers, as well as on three horizontal planes at respective heights of 0.1m, 0.6m and 1.1m.

In each simulation, initial room temperature is below 55°F or 12.8°C. The temperature is measured after each minute of running the HVAC system with a supplied air temperature of 90°F. A temperature bracket considered ideal in this scenario is between 68°F and 74°F – between 20°C and 23.4°C –, represented in green in the CFD results.

• **Standard Diffusers.** Standard diffusers supply hot air horizontally, therefore hot air quickly rises towards the ceiling when exiting the diffusers in a cold room, as shown in Figure 5 after the first minute of simulation.

It took a total 7 minutes before a stable state between 68°F and 74°F at the thermostat level was reached, as shown in Figure 6. This is the value retained for the energy consumption comparison.

Also, after 7 minutes, strong air stratification is noticeable with an air temperature of 87°F or 31.6°C near the ceiling. Simultaneously, the temperature at occupant's ankle height is still too cold for thermal comfort requirements.

It took a total of 10 minutes to reach an acceptable level of thermal comfort with standard diffusers, with a

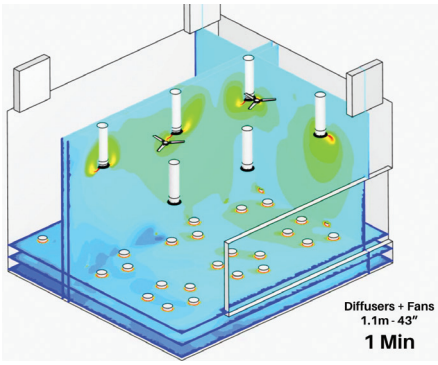


Figure 8: Ceiling fans help push hot air down into the occupied space as soon as the simulation starts.

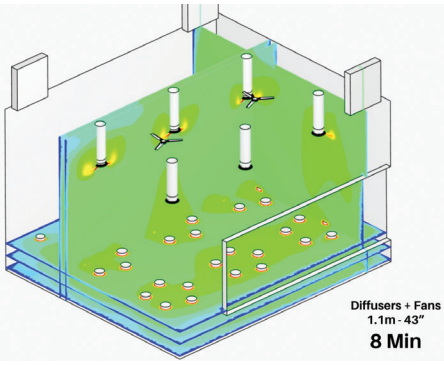


Figure 9: It took 8 minutes to reach a stable temperature at the thermostat level with ceiling fans.

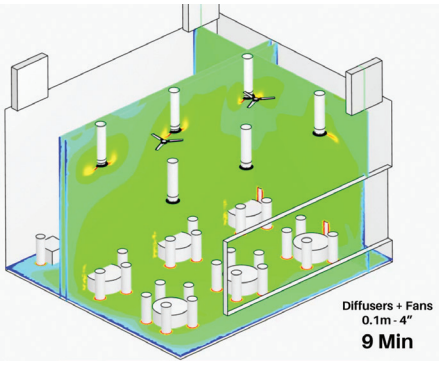


Figure 10: Occupants' thermol comfort was reached in 9 minutes with the combination of standard diffusers and ceiling fans.

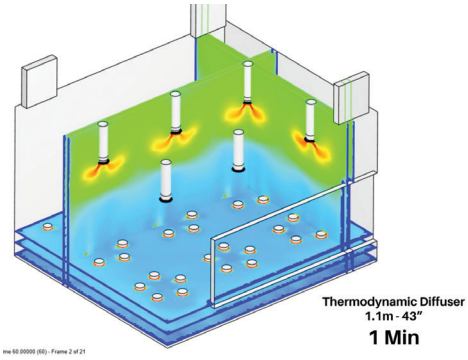


Figure 11: Hot air tend to rise when first coming out of thermodynamic diffusers, because of the difference in air density.

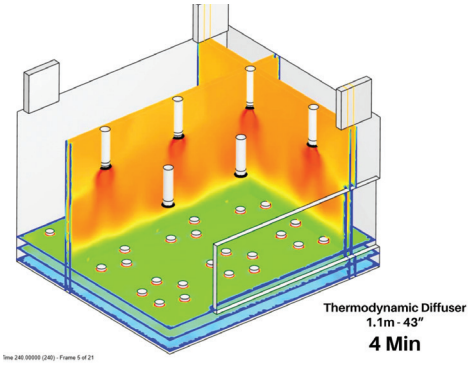


Figure 12: A stable temperature at the thermostat was reached afteronly 4 minutes with thermodynamic diffusers.

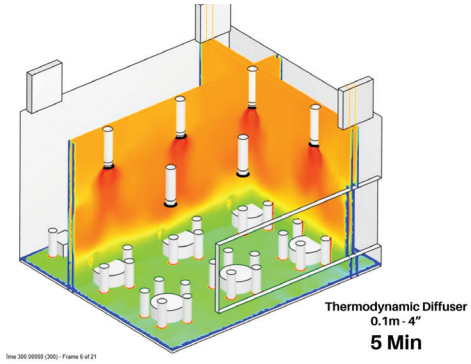


Figure 13: Occupants' thermol comfort was reached after 5 minutes with thermodynamic diffusers.

temperature difference of exactly 3°C as show in Figure 7.

• **Standard Diffusers with Ceiling Fans.** When adding ceiling – or destratification – fans to standard diffusers, hot air is forced downwards into the occupied space. Warmer spots near 68°F are noticeable in the first minute of simulation, as illustrated in Figure 8. This translates into a faster temperature improvement in the occupied space.

However, because of the intensified air movement in the room, it took longer (8 minutes instead of 7) to reach a stable comfortable temperature at the thermostat level with fans than without fans.

However, a comfortable temperature at ankle level was reached in only 9 minutes, with a delta temperature of 2.5°C between 1.1m and 0.1m height.

• **Thermodynamic Diffusers.** Although thermodynamic diffusers supply heated air with a downward jet, the difference in air density causes hot air to rise in the first minute after starting the system.

However, as the difference in air density diminishes, the supplied heated air maintains its downwards direction. It took only 4 minutes to reach a stable comfortable temperature at the thermostat level with thermodynamic diffusers.

Occupants would feel thermal comfort with a temperature difference of 2.35°C between their head and their ankles after only 5 minutes.

Simulation Results - Air Velocity

During the same simulations, air velocity was also measured in order to analyse its impact on occupants' thermal comfort and also on indoor air quality. The perfect balance is sometimes difficult to obtain. In a restaurant setting, an ideal air velocity in the occupied space would range between 20 and 60 feet per minute in heating. A higher air velocity would cause air draft related discomfort, while an air velocity less than 20 fpm would be insufficient in order to properly ventilate the occupied zone. Ensuring proper ventilation in a restaurant is very important for customers' safety. It helps reduce the risk of airborne diseases transmission and evacuate other harmful particles. Another benefit is ensuring a more pleasant customer experience by removing odors within the space.

• **Standard Diffusers.** With standard diffusers, most of the air movement happens between the diffusers and the ceiling. As shown in Figure 14, after 7 minutes and when we have reached a stable temperature at the thermostat level, the air velocity varies between 0 and 10 fpm at the 1.1m height corresponding to people's head. This is great for thermal comfort because occupants won't feel any air draft, however, air mixing is almost inexistent and does not provide proper indoor air quality.

At occupants' ankle level or 0.1m, the air mixing is slightly better but still insufficient, varying between 0 and 20 fpm.

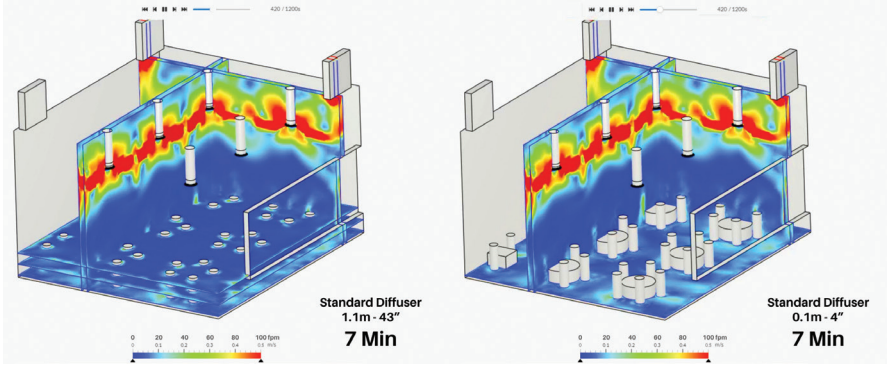


Figure 14: Air velocity in the occupied space with standard diffusers is good for thermol comfort, but not for indoor air quality.

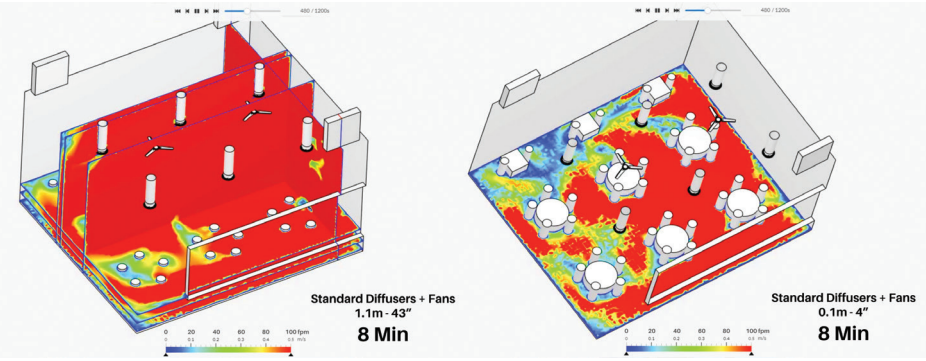


Figure 15: With ceiling fans, air velocity is at 100 fpm or above in the most occupied space, which is good for IAQ but high velocity air drafts will create thermal discomfort.

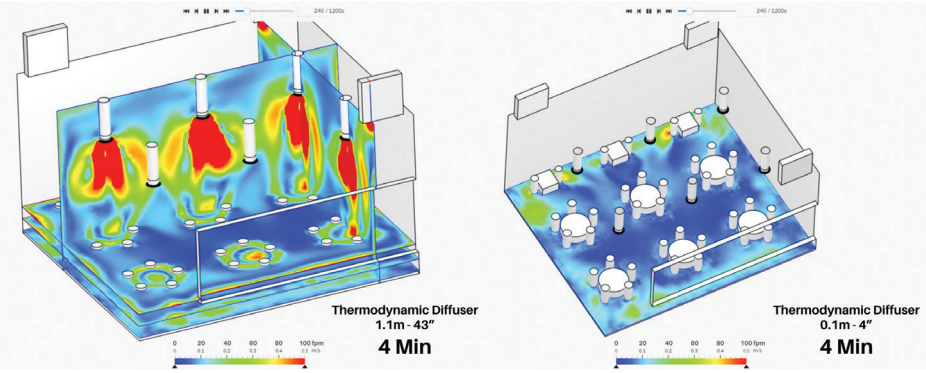


Figure 16: Air velocity is between 20 and 60 fpm in most of the space with thermodynamic diffusers, ensuring a good balance between thermal comfort and IAQ.

• **Standard Diffusers with Ceiling Fans.** With ceiling fans, the air velocity is at 100 fpm or above in most of the occupied space, either at 0.1m or 1.1m. Such air mixing will ensure good ventilation and indoor air quality, however, high velocity air drafts above 100 feet per minute will cause serious thermal discomfort.

• **Thermodynamic Diffusers.** After 4 minutes of system runtime – once a stable thermal comfort temperature has been reached at the thermostat level – the air velocity in most of the occupied space is between 20 and 60 feet per minute. Although there are some lower air velocity zones between the tables and higher velocity spots below the diffusers, the overall balance between thermal comfort and indoor air quality is much better than in the two previous simulations.

Energy Consumption Analysis

Considering that the thermostat reading controls the HVAC system, it can be assumed that energy consumption is proportional to how long it takes to reach the desired temperature at the thermostat height. Table 1 shows the running time required to reach a stable comfortable temperature, as well as the relative energy consumption compared to standard diffusers.

Although ceiling fans helped heating the occupied state faster compared to ceiling diffusers only, the impact of added air movement on thermostat readings resulted in a 14% extra energy consumption with ceiling fans. Furthermore, this number only considers the HVAC system's energy consumption. The relative energy consumption percentage will increase once ceiling fans' electric consumption is added to the HVAC system's consumption.

Thermodynamic diffusers showed a significant energy efficiency improvement, reducing the load on the HVAC system by 43% compared to standard diffusers when heating from high ceilings.

Thermal Comfort Analysis

In order to analyse thermal comfort, we must consider two parameters: temperature and air velocity. In this simulation, it was possible to reach a stable thermal comfort state with standard diffusers only, however it took longer to achieve than with ceiling fans or thermodynamic diffusers. Also, with higher ceilings or an increased number of heat loss sources (i.e. larger windows and/or more windows), it might have been

TABLE 1: ENERGY CONSUMPTION
Comparing Solutions

	Standard Diffusers	Standard Diffusers + Ceiling Fans	Thermodynamic Diffusers
Running Time	7	8	4
Relative Energy Consumption	-	+14%	-43%

TABLE 2: THERMAL COMFORT
Comparing Solutions

	Standard Diffusers	Standard Diffusers + Ceiling Fans	Thermodynamic Diffusers
Time to Thermal Comfort Temperature (minutes)	10	9	5
Relative Time to Reach Thermal Comfort	-	-10%	-50%
Average Delta T Between Head and Ankle	3°C	2.5°C	2.35°C
Air Velocity - Majority Bracket	0-20 fpm	100+ fpm	20-60 fpm

TABLE 3: MONTHLY ENERGY CONSUMPTION
For Each Solutions

	Standard Diffusers	Standard Diffusers + Ceiling Fans	Thermodynamic Diffusers
kW per Month (8 hours/day, 7 days/week)	7975	9114 + 134 = 9248	4557
kW per month (24/7 using x2.5 multiplier)	19938	23120	11393
$/Month (US electricity cost average 0.1319 $/kWh)	$2,630	$3,050	$1,503

impossible to reach the desired temperature only with standard diffusers.

Adding ceiling fans helped reach the occupied space with heated air right away, and also reduced by 10% the amount of time required to reach a stable state of thermal comfort. A smaller temperature difference between their head and ankles will also result in the improvement of occupant's thermal comfort. However, the high velocity air drafts resulting from the combination of the diffusers and ceiling fans will create serious thermal discomfort which might offset the previous benefits.

Lastly, the simulation using thermodynamic diffusers reached a stable thermal comfort state in only 5 minutes, 50% less time than it took to reach the same state with standard diffusers. The temperature difference between occupants' head and ankles is also lower at 2.35°C and the majority of the occupied space has air velocity ranging between 20 and 60 feet per minute.

Indoor Air Quality Analysis

The combination of standard diffusers with ceiling fans created high velocity air drafts of 100 feet per minute or more in most of the occupied space, which is problematic in terms of thermal comfort.

However, the resulting air mixing will ensure optimal air changes per hour and faster removal of odors, gases, airborne microbes, and other contaminants. Indoor air quality in the occupied zone is the best with ceiling fans.

Thermodynamic diffusers offered overall acceptable air mixing with an air velocity ranging between 20 and 60 feet per minute in the majority of the occupied space.

Air mixing in the occupied space was insufficient when heating with standard diffusers. In ASHRAE Standard 62.1, Table 6-4: Zone Air Distribution Effectiveness, an Ez correction factor of 0.8 is recommended for applications with ***ceiling supply of warm air 15°F (8°C) or more above space temperature and ceiling return.*** When applying the Ez factor of 0.8, the minimum ventilation rate for the room is increased to compensate for the inefficiency caused by air stratification. However, in a case like this with very high ceilings, such a correction factor does not reflect the reality and the increased Air Changes Per Hour is mostly happening near the ceiling and not in the occupied space.

The main objective of this case study was to analyze and compare the energy consumption of the three systems. However, the indoor air quality concern in a case where there's a high level of stratification should be considered as important as energy consumption, mostly in a post COVID-19 pandemic world.

Economical Analysis

To compare the return on investment of each solution, both the energy cost and installed cost of each system had to be considered.

- **Energy Cost.** When calculating the energy cost of standard diffusers with ceiling fans, the fans' energy consumption (134 kW) had to be added to the HVAC System's energy consumption (9114 kW). When calculating the 24-hours consumption, a 2.5 multiplier was used assuming that the thermostat would be set to a lower temperature outside of business hours.
- **Installed Cost.** The total installed cost includes materials cost and installation costs for the diffusers and fans. In the case of ceiling fans, an electrician's cost to run power to the fans was also taken into account.

TABLE 4: TOTAL
Installed Cost

Standard Diffusers	Standard Diffusers + Ceiling Fans	Thermodynamic Diffusers
$3,400	$6,600	$10,500

• **Thermodynamic Diffusers vs. Standard Diffusers.** The total installed cost difference between thermodynamic and standard diffusers is $7,100.

The cost savings using thermodynamic diffusers versus standard diffusers is $1,127 per winter month.

Therefore, in this scenario, it would take ***6.3 winter months*** (approximately two years) to recover the extra investment when comparing thermodynamic versus standard diffusers, based on energy consumption only.

The return on investment of thermodynamic diffusers versus standard diffusers after 10 years is $26,710 or 376%.

• **Thermodynamic Diffusers vs. Standard Diffusers and Ceiling Fans.**

The total installed cost difference between thermodynamic and standard diffusers with ceiling fans is $3,900.

The cost savings using thermodynamic diffusers versus standard diffusers with fans is $1,547 per winter month.

Therefore, in this scenario, it would take 2.5 winter months (less than one year) to recover the extra investment when comparing thermodynamic versus standard diffusers with fans, based on energy consumption only.

The return on investment of thermodynamic diffusers versus standard diffusers with fans after 10 years is $42,510 or 1090%.

Interpreting the Results

The current simulation was made in heating only, assuming that the energy consumption would be similar for all systems when cooling or ventilating the space. It is important to note that the outside temperature in these simulations was 14°F (-10°C). The calculated energy savings may be lower in states with warmer outside temperatures when heating in the winter.

Numerous other factors can also affect these numbers, for instance the dimension of the room, the ceiling height, the installation height of the diffusers, the insulation grade of the walls and windows, the number of windows and their dimensions, the number of occupants in the room, and the intensity and direction of sunlight.

Conclusion

In this case study, CFD simulations were used to compare the performance of standard diffusers vs standard diffusers with ceiling fans vs thermodynamic diffusers, when heating a restaurant with high ceilings.

Thermodynamic diffusers showed significant energy savings compared to standard diffusers only (43%) and standard diffusers with ceiling fans (50%).

When comparing thermodynamic diffusers to standard diffusers, the time to recover the extra investment is 6.3 winter months, or approximately two years based on 3 months of winter per year. The ROI after 10 years is $26,710 or 376%.

When comparing thermodynamic diffusers to standard diffusers combined with ceiling fans, the time to recover the extra investment is 2.5 winter months, or less than one year based on 3 months of winter per year. The ROI after 10 years is $42,510 or 1090%.

Thermodynamic diffusers also showed significant gains in terms of thermal comfort, reaching a stable comfort temperature in half the time required by standard diffusers and reducing the temperature difference between seated occupants' head and ankles by 22%. The combination of standard diffusers and ceiling fans created high velocity air drafts in the occupied space, exposing customers to feeling serious thermal discomfort.

When analyzing air change effectiveness for indoor air quality, standard diffusers failed to properly mix the air in the occupied zone. The system failed to achieve the minimum ventilation requirement for occupants' safety. While the high velocity drafts caused by the addition of ceiling fans and standard diffusers created serious thermal comfort problems, air mixing is more than optimal for proper indoor air quality.

Thermodynamic diffusers provided the best balance between thermal comfort, IAQ and energy consumption. ●

TABLE 5: RETURN ON INVESTMENT
And Other Benefits

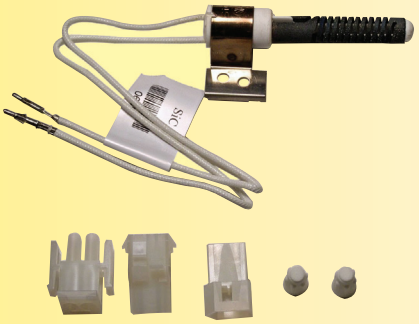
	Thermodynamic vs Standard Diffusers	Thermodynamic vs Standard Diffusers + Fans
Investment Recovery Time (Heating Months)	6.3	2.5
Investment Recovery Time (Years)	2	1
10 Years ROI	$23,710 (376%)	$42,510 (1090%)
Benefits	Energy Saving Improved IAQ Improved Thermal Comfort	Energy Saving Improved Thermal Comfort



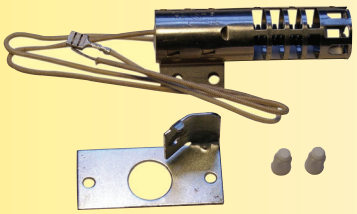
Frank Godbout *is President of EffectiV HVAC. EffectiV HVAC designs and manufactures high performance architectural diffusers and other HVAC solutions. EffectiV 's unique ceiling air diffusers allow architects and mechanical engineers to answer specific architectural and performance needs. EffectiV diffusers help improve thermal comfort, energy efficiency and indoor air quality.*

Surfaceigniter LLC

THE PIONEER IN HOT SURFACE IGNITERS



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



Check Out These Catagories:

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





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

Surfaceigniter LLC

What's Happening



Enforcement of new standards for certain imported/exported electrical appliances from Saudi Arabia will begin February 21, 2022. The **Saudi Product Safety Program** (SPSP) for Saudi Arabia and the **Saudi Standards, Metrology and Quality Organisation** (SASO) have issued a circular to all Certification Bodies (CBs) providing clarification on the new standards listed below for certain electrical appliances.

- SASO IEC 60335-2-21:2021 Electric Storage Water Heaters
- SASO IEC 60335-2-30:2021 Electric Room Heaters
- SASO 2815:2021 Electric Cord Extension Sets

Intertek's experts can provide guidance to customers to ensure they fully understand the requirements of these new electrical safety standards.

Intertek is a SASO approved Conformity Assessment Body for operating the Saudi Product Safety Programme (SPSP).



Brian Green promoted to EVP of Marketing & National Sales of **Spectroline.**

As EVP of Marketing & National Sales of Spectroline, Brian is responsible for the global marketing strategy and programs for the company, and overseeing the Domestic Sales divisions' sales strategy development, forecasting, resource planning, and budgeting. As Spectroline has refined its strategic focus on leak detection markets, the new combined role of Marketing & National Sales will help align sales and marketing initiatives to grow as Spectroline brands in the industry.



Reliance Worldwide Corporation announced that it has completed its acquisition of **EZ-FLO International**, a leading manufacturer of plumbing supplies and specialty plumbing products. During its more than 70 years of operation, RWC has made strategic advancements to optimize its product portfolio, deepen its distribution network and continue to strengthen its customer service capabilities. That legacy continues with this acquisition, augmenting RWC's capabilities across product, distribution and manufacturing to better serve customers.

Established in 1980, EZ-FLO has grown rapidly by continuously expanding its product range. In 2000, EZ-FLO acquired Eastman, which is a leading brand in appliance connectors, supply lines, stop valves and gas connectors. The Eastman brand immediately positions RWC as a leader in appliance connectors, including plumbed appliances, gas, hot water and dryer venting.

RWC's family of brands includes SharkBite™ push-to-connect plumbing solutions, HoldRite™ engineered plumbing and mechanical solutions, Cash Acme™ control valves and John Guest™ fittings and fluid dispense products. Now with the addition of the EZ-FLO and Eastman brands, customers will benefit from more top-quality products, along with the combined supply chain capabilities that will help ensure products are available where and when customers need them, strengthening customer service across every channel.



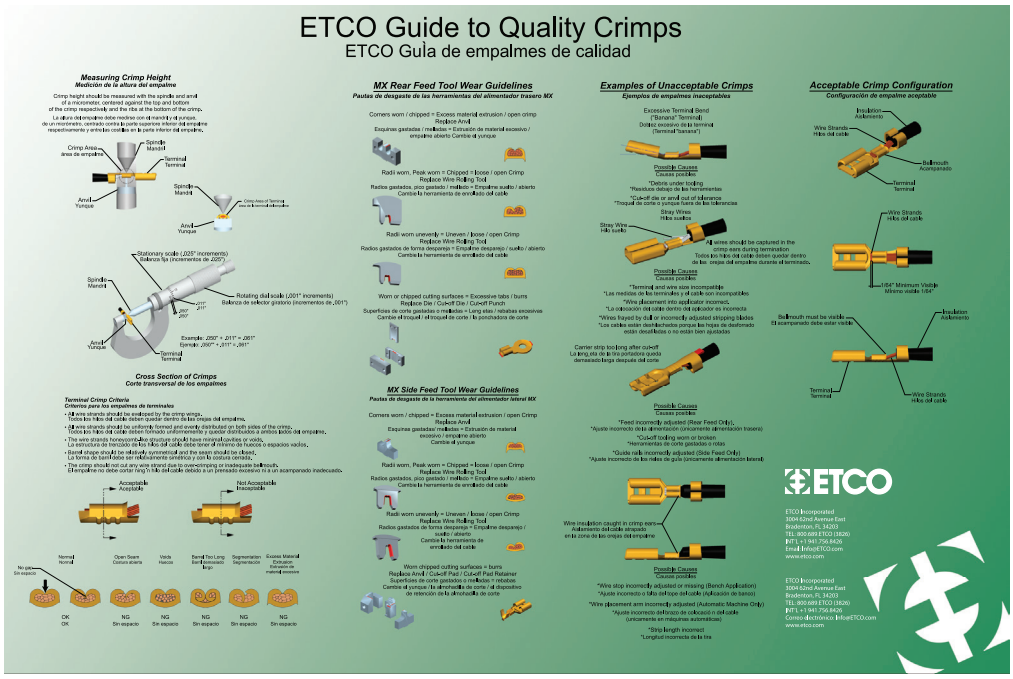
With mobile and consumer products becoming ever-smaller and thinner, OEMs feel greater pressure to simplify communications within the device itself while enhancing data-transfer speeds. To that end, **Molex** has acquired core technology and intellectual property (IP) from **Keyssa Inc.**, a pioneer in high-speed contactless connectors. Keyssa's wireless chip-to-chip technology, which comes to Molex with over 350 filed patent applications, will complement the company's push to expand and diversify its micro-connector portfolio with highly flexible, cable-free connectors for near-field, device-to-device applications.

In addition to eliminating the need for physical cables or connectors, the technology acquired by Molex also alleviates concerns over pairing and reliability. Design for manufacturability is also enhanced with fully encased, dust- and water-proof packaging with wide alignment tolerances.

The Keyssa technology operates at data rates up to 6 Gb/s on the 60-GHz band with no Wi-Fi or Bluetooth interference. The tiny, low-power, low-latency, solid-state contactless connectors can solve critical data-transmission needs with minimal overhead. Molex plans to advance these current capabilities by supporting exponentially higher data rates and full-duplex communications. Additionally, Molex will leverage its signal-integrity expertise and mmWave antenna capabilities to speed the commercialization of new contactless connectors.



Terry Curtis has been a sales representative of **ETCO** incorporated for 40 plus years. Terry has a vast knowledge of processing applications through his experience in stamping of strip form contacts and also wire cutting, stripping and terminal crimping. In addition, Terry has many years of experience in associated wire processing methods such as crimp quality validation and in process crimp testing, ultrasonic welding and laser processing.



The ETCO Guide to Quality Crimps Poster explains the relationship between a wire, connector and tooling to assure the production of high quality ''F'' and ''B'' crimp. Fully illustrated and published in English and Spanish, this poster shows steps in the crimping process that can create problems such as loose strands and the tooling issues that cause them.

Providing photo-illustrations of the anatomy of a crimp, featuring acceptable and unacceptable crimps, the ETCO Guide to Quality Crimps helps engineers troubleshoot the possible causes for faulty crimps. Guidelines are included regarding tooling ETCO crimps wear and the impact of tooling wear issues on the resulting crimps.



After launching in 2020 and succeeding despite global economic challenges, **Sequel** is continuing to deliver on their dedication to exceeding customer expectations by hiring a new sales manager, additional employees, and expanding facility capabilities.

Todd Eagan was sought out by Sequel and selected as Sales Manager due to his depth of knowledge and experience of more than 30 years in nearly every aspect of the wire and cable supply chain and major components. His diverse background covers the process from start to finish, including cast copper rod, compounds, and commercial uninsulated and insulated wire. He understands the interrelation of purchasing, manufacturing and selling the raw materials necessary to make insulated wire.

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



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



CoorsTek Engineer JW Shin, EHS Technician Steve (JH) Lee, and Engineer Se-Im Kim display the Gumi plant's award for Best Practices in Chemical Accident Prevention and Management.

The **CoorsTek** plant in Gumi, South Korea was recently presented with an award from the **National Institute of Chemical Safety** (NICS) in recognition of the facility's exceptional safety protocols and best-in class chemical accident prevention plan.

CoorsTek, a leading manufacturer of technical ceramics, operates more than 30 manufacturing facilities across three continents. At its Gumi, South Korea plant, which provides a variety of high-performance ceramics engineered specifically for semiconductor processing applications (including PureSiC silicon carbides and PlasmaPure aluminas), a wide range of hazardous materials are used. Due to the extensive use of these materials, the plant is subject to regular inspections to review safety procedures and chemical spill prevention plans.

Gumi employees passed last summer's chemical safety inspection with marks so high that representatives from the NICS asked them to share best practices at a conference in November. CoorsTek team members accepted the offer and used the opportunity to showcase the plant's comprehensive accident prevention program. The Gumi facility has grown in serving partners since 2000, including a recent expansion to support semiconductor and electronics industry growth as well as many additional customers in the region.

CoorsTek was among 12 organizations that were highlighted at the event, but one of only five to receive the Director's Award for Chemical Safety. CoorsTek was in excellent company; the other four winning organizations were Sam-Yang, SK Materials, Hyundai Motor, and Samsung.


Andy Blandford


Jürgen Vinkenflügel


Hubertus Mühlhäuser

Kelvion, a leading global manufacturer of industrial heat exchangers, announced today a portfolio and leadership transition in which the company will spin-off its Thermal Engineered Solutions ("TES") Business Unit and **Andy Blandford** will succeed **Jürgen Vinkenflügel** as Chief Executive Officer of the remaining Kelvion business.

The legal carve-out of the TES Business Unit was expected to be completed by January (subject to final clarifications on tax and legal matters). Immediately upon such completion, each entity in the reorganized TES Business Unit will remain a subsidiary of Mangrove LuxCo IV S.à r.l.a.

"My passion for Kelvion, with its 100-year history, our employees and our customers have been my main drivers throughout the years. Together, we have achieved a lot, building a solid momentum and two strong growth platforms around Kelvion´s Product and Project businesses. I believe that now is the right time for me to hand over the baton for the Kelvion Group and focus on the Spin-Off of the TES Business Unit", said Jürgen Vinkenflügel.

Jürgen Vinkenflügel has played an instrumental role in developing a compelling strategy, fostering the "Kelvion Spirit", and improving both financial performance and operational processes. **Hubertus Mühlhäuser**, Chairman of the Board at Kelvion, underlines this: "Under Jürgen's strong leadership, the company has been successfully transformed and returned to profitable growth. We are very grateful to him for all his achievements and that he will continue as Chairman of the to be spunoff TES Business Unit".

Andy Blandford, the incoming CEO, is an experienced executive with a highly relevant industrial background and a consistent track record of delivering strong results as well as building great teams. Andy is an exceptional fit as CEO for the next phase of Kelvion's corporate development with an emphasis on profitable growth, innovation, and operational excellence.

Andy joins Kelvion from DEMATIC, the world's leading provider of supply chain solutions, where he served as SVP/Managing Director for Northern Europe and later as SVP Execution/Operations for EMEA. His previous experience includes roles at CNH Industrial, where he was VP, Construction Equipment, EMEA, and at AGCO Corporation (a leading agricultural machinery manufacturer), where he was VP Manufacturing, USA and later VP Sales and Marketing covering Europe and APAC. Andy has also served at JCB Excavators as Director/GM of both JCB Compact Products and JCB Cab Systems. Andy graduated from the University of Hertfordshire, UK with an honors degree in Manufacturing Systems Engineering and has studied global leadership at the INSEAD Business School, France.

D.L.S Electronic Systems, Inc. received three Quality Service Awards from the Washington, DC based **American Council of Independent Laboratories** (ACIL):

- Nationwide ACIL 2021 Customer Quality Service Award
- Special Recognition Award for Timeliness
- Special Recognition Award for Overall Customer Satisfaction

ACIL was developed in 1996 to address the industry's quality issues and recognize those laboratories with exemplary quality performance. The Program provides laboratory data users with a mechanism to evaluate testing laboratories. Participants commit to ensuring data integrity, meeting customers' quality needs and setting performance standards for the testing laboratory industry. No other evaluation program ranks customer satisfaction with laboratory services and requires laboratory management to commit to a data integrity program.

To become a participant, testing laboratories must distribute satisfaction surveys to customers, commit to an ethics program and submit a signed code of ethics.





Nidec Corporation announced today that the Nidec Group received a **Bosch Global Supplier Award** from Germany's Robert Bosch , a global supplier of technology and services, in the "Purchasing of direct materials – Consumer Goods" category. This is the second time for our Group to receive this Award since 2017, when they were selected for the Award in the "Electronics and Electromechanics" category

The Bosch Global Supplier Award is given every two years to suppliers that demonstrated excellent performance especially in relation to quality, cost, innovation, and logistics in the areas of raw materials, products, and services. In the 17th Award in 2021, presented for the performance in 2019 and 2020, 46 out of approximately 23,000 suppliers were selected.

This Award is a recognition of our group-wide systematic support as "One Nidec," including the supply of products for home appliances by our Small Precision Motor & Solutions Business Unit, Nidec Sankyo Corporation, Nidec Global Appliance Compressor, and other organizations to BSH (Bosch und Siemens Hausgeräte GmbH), a Bosch Group company.



THERMALLY CONDUCTIVE, ELECTRICALLY NON-CONDUCTIVE, LOW OUTGASSING EPOXY

Master Bond EP40TC is a two part epoxy system, designed for bonding, sealing and encapsulating applications where thermal conductivity and electrical insulation are required. With a high thermal conductivity value of 8-11 BTU•in/(ft2 •hr•°F) [1.16-1.60 W/(m•K)], it is formulated with a small particle size filler making it ideal for filling small cavities and applying the product in thin sections. Its volume resistivity is greater than 1015 ohm-cm.

"EP40TC's key distinguishing factor is that there is no compromise on the bond strength while providing excellent elongation and toughness. It has a high strength profile with a tensile lap shear strength of 2,300-2,500 psi, an elongation of 60-70%, and a tensile modulus of 5,000-15,000 psi," says Rohit Ramnath, Senior Product Engineer. "Also, it meets NASA low outgassing specifications which is a prerequisite for many aerospace, electronic, and optical applications."

Serviceable from -100°F to +300°F, this toughened system resists thermal cycling, vibration and shock. EP40TC exhibits a high peel strength of 40-60 pli and Shore D hardness of 70-80 at 75°F. It features a convenient 1:1 mix ratio, and cures in 2-3 days at room temperature or faster with the addition of heat. This compound adheres well to a variety of substrates such as metals, composites, glass, and many plastics. EP40TC is available in standard packaging, as well as premixed and frozen syringes.

Airzone's Integration and Zoning Solutions for VRF and Inverter Equipment



Airzone presented its range of products at AHR Expo 2022. Among the products presented is Aidoo Pro, a Wi-Fi integration device that controls Inverter equipment which is also compatible with 3rd party smart thermostats such as Nest, Ecobee and Honeywell, while maintaining the original manufacturer functions of the Inverter system intact. This is thanks to the direct manufacturer protocols used in the development of Aidoo Pro. In addition, Airzone also exhibited solutions for zoning VRF units, which provide comfort in all rooms and reduce energy consumption significantly. The Airzone Sales Managers will be providing further information on the opportunities the company is currently offering in North America to the professionals. Visit company website at: www.airzonecontrol.com

SOLUVA® UVC (UVGI) AIR DISINFECTION

Heraeus Noblelight, a specialist for industrial light source solutions, announces its Soluva® UVC (UVGI) air disinfection product line debuted at the 2022 AHR Expo in Las Vegas, NV from January 31 to February 2. Now in addition to social distancing, hand washing and mask wearing safety measures, the UV-C (UVGI) devices make the working environment even safer and help avoid business disruptions due to employee infections. Facility managers and building owners can retrofit the Soluva devices into ventilation systems and install them in rooms to enhance indoor air quality and provide another layer of protection for occupants. HVAC contractors and service companies can expand their offerings to clients by installing and retrofitting Soluva devices into existing buildings.

Jim McMahon, Managing Director for Heraeus Noblelight America, LLC (Gaithersburg, MD) explained, "As we've seen the vaccines are not 100% effective and of course mutations are an ongoing risk. In addition to usual hygiene practices, the Soluva UVGI disinfection devices are an engineering control measure that provides a consistent and reliable way to mitigate the impact of COVID-19 as well as future viruses and seasonal colds and flu. The Soluva products first successfully introduced into the European market last year are now becoming available in the North American market. We are excited to show AHR Expo visitors the products as well as the scientific studies verifying their efficacy."





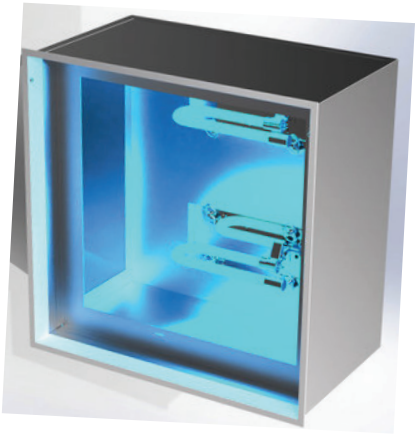
Bluon Completes Series B with $37M in Financing

Bluon. a rapidly growing company in the HVAC-R space, with a wildly popular support app for HVAC technicians, today announced the closing of its Series B round with $27.6 million in equity financing. This adds to its recently completed $9 million in venture debt. The new capital will be primarily used in developing Bluon's e-commerce platform (BluonLive) and in particular for software development and rapid growth in its sales teams and technician support teams.

The round was led by Bluon's existing primary capital partner, Ecosystem Integrity Fund (EIF), and included significant participation from MacKinnon, Bennett & Company (MKB), a Canadian growth equity firm investing in innovative companies shaping the future of energy and transportation sectors.

Notably, the round also included participation from two significant HVAC industry players – Ferguson and Reece through their venture arms – Ferguson Ventures and Superseed Ventures, respectively. The participation from Ferguson and Reece clearly shows their support for Bluon's vision to transform its super sticky support platform into the first brand-agnostic, demand-focused e-commerce platform serving the HVAC-R industry.

EffectiV HVAC Releases a New Version of its UV Diffusers With Proven Efficiency Against SARS-CoV-2



EffectiV HVAC reinforced its position as a new leader in IAQ innovation as the company announces their 3-in-1 solution has been verified by industry-recognized expert Innovative Bioanalysis as an effective solution in containing the spread of COVID-19 after being tested against the virus.

Typically installed in the ceiling and designed to treat air before it enters the room, EffectiV HVAC's UV diffusers use the latest cutting-edge technology by combining low pressure drop MERV-9 filtration, UV-C Germicidal Irradiation and high induction diffusers improving air mixing.

The PLAY-UV diffuser was finalist of the 2021 AHR Expo Innovation Awards in the 'Indoor Air Quality' category. EffectiV HVAC designed a new version of its UV diffusers to further increase their efficiency, and were one of the firsts to test their product with the actual SARS-CoV-2 virus.

"We're thrilled that our UV diffusers have been recognized by third party experts as an effective solution in preventing the spread of COVID-19 through ventilation systems," said Frank Godbout, President of EffectiV HVAC. "It confirms the data that was previously provided by the experts in UV-C irradiation who analyzed our product."

Public health experts throughout the course of the COVID-19 pandemic have consistently stressed the importance of ventilation, filtration and air cleaning indoors as a tool to prevent virus transmission. In most commercial buildings, up to 90% of air is recirculated, oftentimes without being treated. EffectiV HVAC's UV diffusers neutralize the virus at the entrance of each room to prevent between-room transmission, while better air diffusion can help reducing in-room transmission.

"Indeed, the last year and a half have been exceptionally difficult for us all. With today's announcement, we are looking forward to making our proven technology available in order to play our part in keeping our communities safe, while ensuring businesses and institutions are able to operate in the safest manner possible," said Godbout.

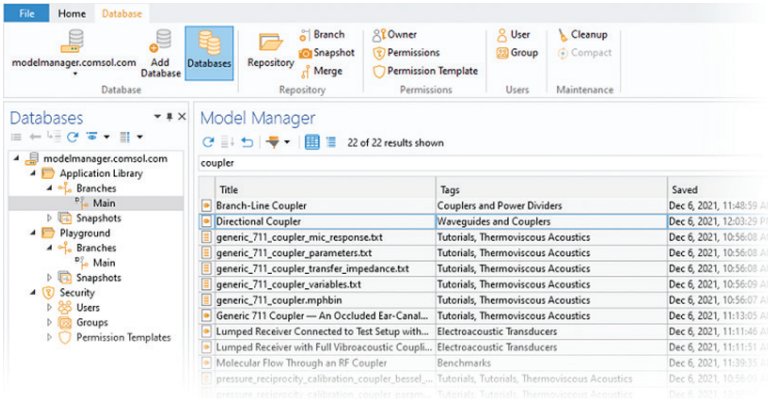
The effectivity tests were conducted by Innovative Bioanalysis in their laboratory in California. Using a live sample of SARS-CoV-2 in a triple redundancy test with control points, the results showed EffectiV HVAC's UV diffusers have a 99.949% single pass virus neutralization rate while supplying 458 cfm of air. UV diffusers are also effective against other airborne viruses and bacteria, like Tuberculosis, Legionella and Influenza.

The product only uses safe and proven technologies. UV rays are contained within the diffuser for occupants' safety. High-quality UV lamps made of quartz do not emit any ozone. Only a subtle blue glow is visible through the filter. Employees and customers can see that the system is functional and that the air they are breathing is being treated.

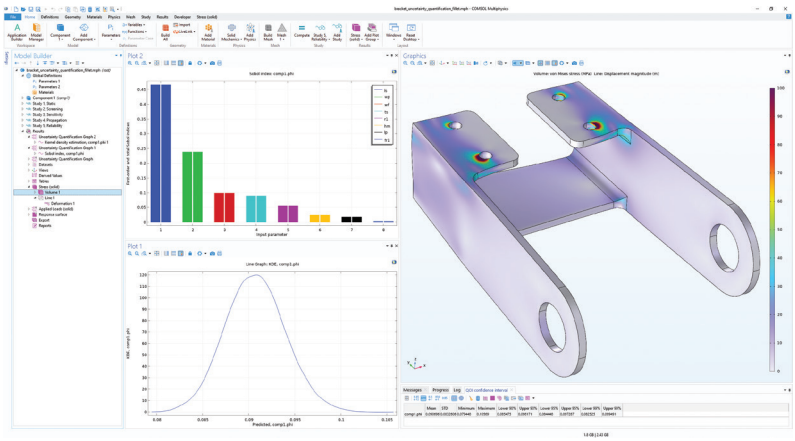
UV diffusers are a simple-to-use and reliable solution. The air disinfection performance is already pre-calculated based on the volume of air passing through the diffuser, and the data is available in a table. Their performance is also reliable and won't be affected by installation factors.

COMSOL Releases Version 6.0 and Introduces Model Manager and Uncertainty Quantification Module

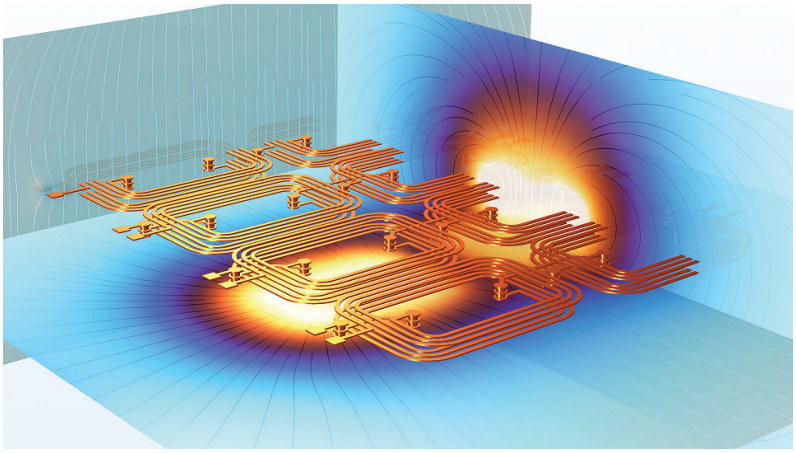
COMSOL, the leading provider of software solutions for multiphysics modeling has released version 6.0 of the COMSOL Multiphysics® software. The release introduces the **Model Manager**, a new workspace in COMSOL Multiphysics that enables efficient simulation data management and collaboration. Also introduced with version 6.0 is the **Uncertainty Quantification Module**. This is a new add-on product to COMSOL Multiphysics that uses probabilistic design methods to quantify uncertainty in analyses and predetermined safety margins. Version 6.0 further brings major improvements to the solvers with performance speedup by a factor of 10 in engineering areas such as heat radiation and models subjected to nonlinear structural material behavior. With version 6.0, COMSOL promises to boost the productivity of engineers, their teams, and their enterprises in the areas of product design, process development, and manufacturing.



The Model Manager provides version control and common storage for efficient collaboration in simulation projects.



The Uncertainty Quantification Module reveals how variability of input parameters affects the simulation results.



Version 6.0 delivers performance improvements and simplifies simulation of many important applications, such as printed circuit board (PCB) design (pictured).



The Contractor is the Beating Heart of HVAC Innovation

BY GONÇALO COSTA

The HVAC industry is a critical part of our economy. It is responsible for keeping people comfortable in their homes and businesses. In order to ensure that HVAC technology continues to grow and improve, it is important to have input from the people who are on the front lines - the contractors. They are the ones who are installing and servicing HVAC equipment. They have as intimate and long-term relationships with the products as the manufacturers' own engineers do. Smart manufacturers understand this importance and are focusing their efforts on a number of ways to ensure that new and future products reflect the ever-evolving needs and wants of contractors.

In recent years, the industry has seen several changes and transitions that have moved the industry forward while helping contractors be more efficient and successful in their jobs.

When do the benefits outweigh the hassles?

An example of this has been highlighted with the rapid evolution and adoption of inverter technology. Inverters allow a heating and cooling system to vary its output and regulate the refrigerant flow. Being a relative newcomer to the mainstream industry in only the last five or ten years, not all contractors have experience with this type of technology; however, they soon will. They have outpaced the traditional single-stage, all-or-nothing functionality that has been the staple for decades in American homes in almost every way. HVAC systems with multi-stage, variable-speed or fully modulating inverters are far more energy efficient, provide a consistent level of exacting comfort and are much, much quieter.

There are, however, two areas where inverters have stumbled. The first is price. However, although they currently come with a premium up-front cost, the efficiency compensates for that in the long run. Also, as inverters become more popular, the pricing will become more competitive with competing technologies. That said, the biggest challenge hasn't been with how, when or why inverters work better—consumers love them—it has been with contractors. Installation has been a headache. It has required complex wiring, the use of cumbersome, proprietary thermostats and a complicated communication vehicle between the inside and outside equipment.

As the benefits of these systems began to rise to the top, so did the negative feedback and complaints regarding the installation and maintenance by contractors. The engineers took that feedback and got to work. Thanks to recent breakthroughs, there is no longer a need for the inside/outside communication set up. Contractors can throw out the proprietary thermostats and the systems with inverter technology are as simple and straightforward to install as a traditional single-stage unit.

Internet of Things is Changing Everything

While new innovations have cut out the need for inside/outside communication in inverter systems, technology has broken open wide the way everything else communicates. The Internet of Things (IoT) is changing the day-to-day lives of contractors in ways that would have shocked the even the most forward-thinking HVAC professionals as little as 20 years ago.

Contractors' wants and needs are top of mind for most manufacturers and most product design teams ask two fundamental questions when developing new features or solutions. Do contractors actually want this? And will this make contractors' jobs easier and faster? Once IoT applications started to hit the market, the answer was a resounding yes and yes!

Let's look at one of the most time consuming and frustrating aspects of any contractor's job, troubleshooting. In times past, a good ear and decades of experience were the best tools for troubleshooting. Today since a fault code can't be seen, felt or heard, even the most experienced are stymied without digital assistance.

IoT puts live data at contractors' fingertips and enables them to communicate with HVAC equipment whether they are on site or on the other side of the world. For an on-site, active issue repair, for example, a contractor can connect to Bluetooth within 20 feet of the unit and then the unit itself will walk them through step-by-step troubleshooting. They can see checkpoint values, thermostat calls, compressor loads, how much refrigerant is needed, outdoor temperature variability and much more. In practical terms, all this data and access means that the days of leafing through a huge manual to find the fault code and next steps are firmly in the past where they belong.

This level of smart troubleshooting helps contractors figure out which steps are next and which ones can be skipped. The systems learn and can adapt the troubleshooting as they go, while collecting the data along the way. A major benefit of IoT is knowing what the most common fault codes in a specific region are, for example. This can help manufacturing and product development learn, fix and prevent issues months or even years faster than previous generations. Further, companies can better prepare their customer support teams to answer certain questions regarding common faults, all in an effort to help contractors work smarter. In fact, today's systems can feed the contractor what the issue is before they even get on site. That way they can show up with the exact tools and parts needed to get the job done and get on with their day.

Labor Shortages and an Aging Workforce

The labor shortage is an issue that is increasing in scope across the nation. On top of this is the fact that the HVAC industry is aging, and many are knocking on retirement's door. The people with the most experience, who are at the top of their game, are starting to leave the workforce and taking their knowledge with them. They are being replaced by a much younger population with vastly less experience. At the same time, products are getting more sophisticated and certainly more technical. … but that's not necessarily a bad thing.

Because of the labor shortage, these younger people are being put into positions and situations that don't match their experience. The amazing thing is, as digital natives, they are naturally tech savvy and find navigating online troubleshooting, live streams and accessing info as easy as breathing in and out. Technology engineered with and for contractors is helping level the playing field in the best possible ways while enabling contractors of all levels of experience to know they are not alone. By the end of an installation, the contractor—or their boss in another state—can see in detail how great the installation went.

As the beating heart of HVAC innovation, contractors are the lifeblood of this industry and smart manufacturers are making them a critical part of the equation when it comes to developing new technology. The latest innovations leverage IoT technology to help contractors communicate with HVAC equipment like never before and make it easier than ever for them to be more efficient, accurate and successful in their profession. ●



***Gonçalo Costa** is director of AC Regional Business Unit, North America for Bosch Thermotechnology. With 20 years of experience in product development at Bosch Thermotechnology, Costa develops and executes AC product strategy for the North American market and leads the AC regional business unit product management, engineering and project management teams. For more, please visit https://www.bosch-thermotechnology.us.*

Understanding the Link Between Ozone and Rubber Deterioration

BY JOHN TRANQUILLI

One of the first design consideration that engineers should take into account when working with rubber are the effects of ozone. The question must be asked — how much exposure should rubber have, and what is the expected life of the rubber product?

What can ozone do to rubber? A common effect includes cracking along the exposed, stretched, or stressed face — this is sometimes referred as dry rotting.

Ozone can be found everywhere. Even "normal" air can have up to 0.01 ppm of ozone. The addition of electrical equipment or lighting can increase the ppm level even greater.

Different rubber polymers will have greater or less resistance to ozone — the less saturated rubber polymer, for example, will experience greater ozone effects. Unsaturations are the amount of double and triple chemical bonds in the polymer structure, which become susceptible to the free radicals created by ozone and break the bonds.

The resistancy of a material will determine which applications it should be used for, such as car door seals and weather stripping. These are typically made of EPDM rubber, which is very stable in ozone and will last a long time.

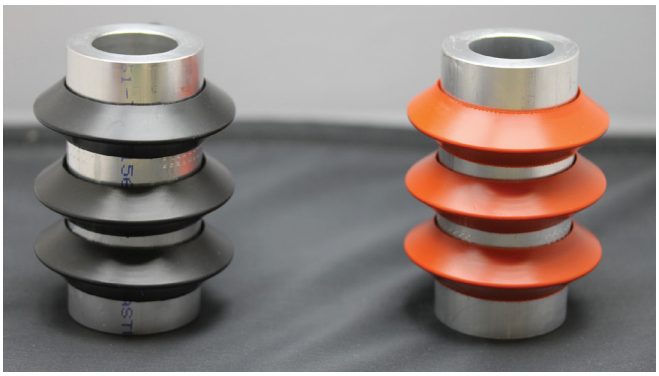
In a small way, even seals that are used in an oil- or fuel-related application need to have some resistance to ozone to prevent deterioration in the warehouse storage after production.

Fortunately there are a few different standard test methods that help classify how a particular rubber behaves when exposed to ozone, such as ASTM D1171. Specifically, ASTM D1171 is the standard test method for rubber deterioration – surface ozone cracking outdoors or chamber (triangular specimens). The advantage of this method is that it can be tested against a predetermined rating, creating a pass/fail condition. The method can also be used to track the growth rate of cracks in a material to see how quickly it deteriorates.

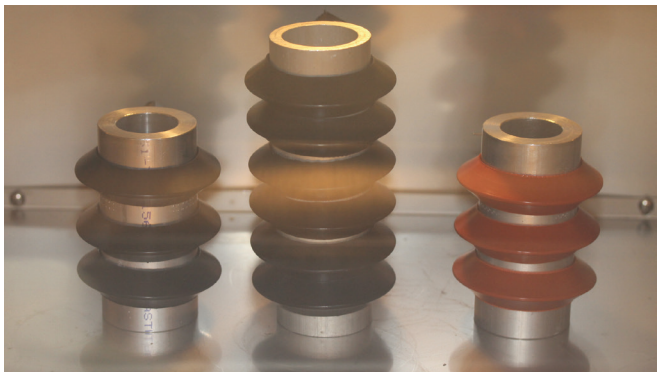
This post is based on the chamber method. Apple Rubber utilizes a Mast/Keystone 700-10LTA ozone test chamber. This is simply a sealed chamber with an attached ozone generator that is regulated by an ozone meter. This test uses a specimen molded from the desired material in a triangular shape that has a base of .75 inches with a radius of .065 inches located .5 inches from the base of the triangle. The overall length of the specimen is 10 inches long. These pieces are then set in a strained position by securing them with wire and looping them over a two-inch mandrel.

Test preparation allows the mounted specimens 70-72 hours to condition at room temperature in the laboratory environment before moving them to the ozone chamber for another 70-72 hours at 40°C with no ozone generation. The preconditioning allows waxes to bloom to the surface, which protects the rubber if part of the rubber formula.

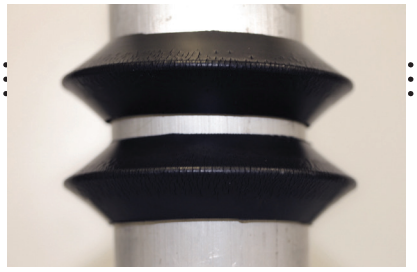
The standard test exposure then proceeds at an ozone concentration of 50±5 pphm for 72 hours. After this period, the specimens are removed and given a rating based on a.) the amount of cracking under 2x magnification, and b.) their comparison to the given figure in the specification. It is also very common



Mounted test specimens before testing



Specimens in chamber expose to ozone



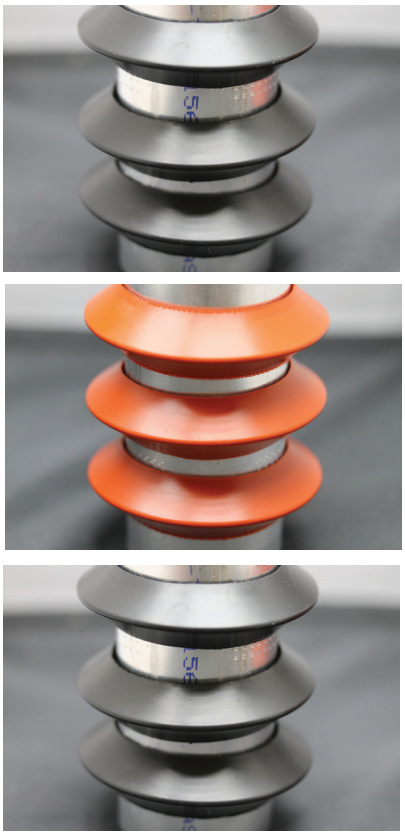
Nitrile (Buna-N) rubber

for the specimens to be removed at the 24-hour and 48-hour marks and be given ratings for those time periods, as well.

Below are three examples of these materials after the 72 hour period. The materials are an Eehylene propylene (EPDM) rubber, silicone, and an HNBR material. These materials tend to do very well and have a good rating of 0 when compared to the specification in terms of ozone degradation.

The final test specimen is a nitrile, which is not very ozone-resistant as evidenced by the growing cracks throughout the strained section of the test specimen. This sample would have the comparative rating of three, which is the worst rating that the specification can give. One can quickly understand that even if nitrile (buna-N) rubber is readily available, it might not be the best choice.

One example where we commonly see failure of design is in medical devices. During initial testing, the parts may work fine. In field testing, however, there may be failures because the O-ring is exposed to ozone, which causes a degree of deterioration that leads to failure. At times, design engineers can even see this process act out even if they simply let the medical device sit on their office desk for an extended time.



From top: EPDM rubber, silicone rubber, and HNBR rubber

Sometimes, with materials that are known to be very resistant to ozone (such as ethylene propylene), some product developers also choose to increase the exposure time to follow the latter part of the test method. In this case, the exposure time within the ozone chamber is increased to six weeks, with the test specimens pulled out every two weeks to be examined for signs of cracking.

Another extended exposure application is performed by Underwriters Laboratory (UL). This application uses the test method known as UL 157 for compounds to be listed for atmospheric ozone and generated ozone. The mounted specimens are to be subjected to an ozone partial pressure of 90-110 MPa for 70 hours and a temperature of 40 ±2°C (104 ±3.6°F) for applications covering atmospheric ozone; and an ozone partial pressure of 10,000 – 15,000 mPa for 70 hours and a temperature of 40 ±2°C (104 ±3.6°F) for applications covering generated ozone. Apple Rubber has two compounds, 14SL7ML and 35SL5ML, that UL lists for this end use. Both compounds are silicone polymers.

The final method that some developers use within this test method is an outdoor exposure rather than a controlled chamber. With this method, the parts are mounted so that they are exposed facing south at a 45° angle from the ground. The advantage to this method is that real-time exposure to weathering can be accomplished.

However, that same real-time exposure can also be a drawback. It is not always feasible to wait for such an extended period of time when designing a part to see when it starts to deteriorate, especially when using a weathering / ozone-resistant material.

When rubber polymers are attacked by ozone, a compounder will use waxes and antiozondiants (chemicals added to the formulation that scavenge up the free radicals created by the ozone before they attack the polymer backbone) to protect the rubber. Waxes bloom to the surface and protect the rubber by slowing the ozone penetration. This is commonly seen when purchasing new tires — a consumer can see the wax on the surface of the new tire. This is also why people who buy new bicycle or motorcycle tires are advised to ride slowly to remove the wax and create proper road friction before normal use.

EPDM, Silicone, HNBR, Neoprene, FKM, and Fluorosilicone rubber have greater resistance to ozone. Nitrile (Buna-N), natural rubber, and SBR will are more susceptible to ozone attack. Designs should always consider whether the rubber part will be exposed to ozone — even in storage. How long, once exposed, do you want the part to last? Will there be electrical motors or devices close to the rubber part? These are critical design questions that need to be considered first before selecting a rubber. ●



John Tranquilli *Is the Materials Manager with twenty-six years of experience working alongside the executive team at Apple Rubber. John has a BS in Chemical Engineering from the University of Buffalo.*



Let's Make HVACR Electrical Testing Safer and Smarter

BY TONY GONZALEZ

When you're troubleshooting and testing the electrical components of an HVACR system, there are three things to keep in mind. ***First is safety***. Working with electricity is dangerous, and even deadly, if you aren't careful at all times. ***Second is to use the right meter.*** If you're testing an HVACR system, make sure to use the right meter for the job. ***Third is to follow best practices.***

The following tips are industry best practices for a reason – they work!

Always Put Your Safety First

Like we said, safety is important for you, your co-workers and your customers. Before you take electrical measurements, make sure you're working safely. How do you do that? By following the right procedures, wearing the appropriate PPE and by ensuring that you're always using the correct equipment. Rules to live by:

- **Turn it off.** After troubleshooting a system you may determine there's an electrical issue that needs to be repaired. Before conducting the repair, turn off the power at the breaker box. Don't just hit the power button on the unit.
- **Lock the circuit.** When you're working with the electrical components of a system, lockout and tag the breaker. This ensures that a co-worker or the homeowner won't accidentally energize the system when you're working on it.
- **Check it twice.** Even if the power is off, use a multimeter to test the system to confirm it is, in fact, de-energized. Also, make sure that your meter is rated for the voltages on the equipment you're testing.
- **Dress correctly.** Wearing personal protective equipment is typically the last line of defense against accidental electrocution. By conducting a safety assessment, you'll be able to determine the level of PPE you need. This could include insulated blankets, hoods, gloves and a helmet in some conditions. In general, you should avoid wearing any metal jewelry or other things that conduct electricity — this includes some synthetic fibers. Also, always wear a face shield or safety glasses.
- **Use safe meters.** If you're working with electricity, make sure your meter is designed with safety in mind. Many meters include specific safety features. For instance, if you only

need to determine if a circuit is energized, use a meter with a non-contact voltage sensor that beeps and lights up when near energized equipment.

In addition, make sure your test leads have finger barriers that provide visual and tactile cues to keep fingers away from live components. If you're using a clamp meter, pick one with a built-in test lead holder. This will keep your hands even further away from power sources and energized components.

Is it The Right Meter For The Job?

• **Safety ratings.** Meters should be rated for use in your working environment. CAT III – 600V is a typical rating. Meters with these ratings should be independently tested and listed to UL 61010.

• **More and more VFDs.** As HVACR system technology continues to advance, it's important to select a meter designed to keep up. For example, more and more HVACR systems come equipped with variable frequency drives (VFD) to enable greater efficiency. A VFD takes the supplied AC power and converts it to a PWM (Pulse Width Modulated) non-sinusoidal voltage to accurately control the speed of an AC motor. Traditional "True RMS" meters will show readings that are 20% to 30% higher than the actual output when used to check these voltages. It is important to choose a meter with low pass filtering technology to ensure you get accurate voltage measurements.

• **Mini-splits carry big volts.** If you're working on mini-splits equipped with VFDs, keep in mind that they can operate with high voltage signals. Look for a meter that can measure up to 1000VDC and 750VAC. Also, for mini-splits, it's important to use a meter that can measure resistance into the Megaohm (MW) ranges as higher resistance values are commonly found in more advanced equipment.

HVACR Electrical Troubleshooting Best Practices

When we're troubleshooting an HVACR system, there are three main areas that we want to check. These are the electrical system, airflow and refrigerant charge. They're all dependent on each other, but based on the symptoms you're hearing from the customer, you'll get a clue where you should start. Here are a couple of examples of customer complaints that are likely caused by an electrical issue and how to effectively troubleshoot them:

• **"The system doesn't turn on."** If the system isn't even turning on, start by checking the electrical components. First, check the incoming voltage to make sure the unit is getting power from the utility. Then, check that the appropriate inputs and outputs are present at the control board. Also, a quick check at the thermostat for a 24-volt communication signal lets you know quickly if the signal from every thermostat is reaching the indoor and outdoor units of the system. These steps can help you quickly diagnose why it isn't starting.

• **"My energy bill keeps getting higher even though I'm not using my AC more."** Some meters on the market measure real-time kilowatt power. That gives them the ability to measure how much power in kW the system is consuming. The benefit here is you can measure the system power consumption before and after a service call to show your customer that it's using less power after changing filters and giving it a tune-up. This could lead to a drop in their energy bill. Plus, some electrical meters that work with powerful field service mobile applications can measure system efficiency in SEER and EER. This will help you roughly compare the system with the equipment manufacturer's energy specifications.

Let's Be Safe Out There

Working with electricity is part of the HVACR business. The tips in this article are great to keep in mind as you're working on a system: Be safe, use the right equipment and follow best practices. If all of us work with these ideas in mind, we'll all work smarter and safer.

Call outs – life-hacks:

• **The skinny on test leads.** When testing, you might come across mini-splits and other modern systems that include Molex plugs. Your typical test lead's tips will not fit in these plugs for measurement. Get a meter that comes with thinner test lead tips to help you take measurements through these thinner plugs.

• **Magnets work.** Companies put magnets on their tools to make your life easier. If your meter has a magnet, stick it to a nearby panel. You'll be free to use both your hands to safely take your measurements. Also, you'll never need to set your meter on the ground.



Tony Gonzalez *is the Technical Training Manager for Fieldpiece Instruments. He has more than 20 years of industry experience with Fieldpiece developing new products. Most recently, he led the Job Link® App development team and developed Fieldpiece's wireless power clamp meters. He is committed to training on best practices to help the HVACR professional do their job easier, faster and better. Tony enjoys road cycling and rooting for his hometown LA Dodgers.*

Editors Note: This article ran in our January issue, but due to some production complications we omitted a section of it. So we are re-publishing it in full here.

Cascade of boilers allowing for more efficiency in large buildings



Collaboratively Created Appliance Controls, No Matter the Industry

BY MARC SILVERSTEIN

Every industry relies on specific controls to manage their appliances. Whether you're controlling fryers or commercial laundry equipment, finding the right controls product for your appliance can be challenging because, while you are the expert in your industry, developing controls can be an unnecessary burden. Choosing a trusted appliance controls company can help your product succeed and allows manufacturers to stay focused on their daily demands. Fenwal Controls has a record of expertise in developing components for appliance controls. Partnering with Fenwal helps everyone win, no matter the industry. Here are some case studies of successful partnerships with key OEM customers.

Commercial Boilers and PIM®

A commercial boiler company was looking for a new approach to control their entire line of boilers. The manufacturer needed a flexible, adaptive solution that would not require programming in the factory. Their goal was to have a single control in their factory that could be easily configured to every different model and size of boiler they offered, both modulating and conventional. They also needed the flexibility to cascade multiple boilers to support larger buildings and operate boilers with multiple stages and gas valves, all from a single control. Using a collaborative approach based on extensive industry research across North America, Fenwal Controls engineers designed a new type of control that could support many different configurations with a single SKU. The Fenwal Controls PIM, or Platform Ignition Module, was developed to specifically address the needs of OEM boiler manufacturers. One unique feature developed specifically to reduce control module SKU's and shop floor programming is the Fenwal PIM ID card. By plugging in a different ID card for each boiler or size of boiler, a single PIM will run the correct program to control that boiler. Today, most of this customer's boilers are controlled with a single PIM SKU. The PIM was the result of fruitful collaboration, and this project continues to evolve as new boilers are developed and integrated into the family.

Commercial Laundry Equipment and UART

A commercial laundry manufacturer wanted to design a dryer that could be easily sold globally and increase serviceability and support at the same time. Instead of following traditional 24VAC low voltage or European 230VAC mains voltage practices, the manufacturer wanted to adopt a universal power supply design. Using low voltage DC, a universal power supply, like what is typically sold with laptop computers, can accept input voltages from 80VAC to 230VAC and output a clean DC voltage. By switching their entire design to DC, a single model of dryer could be sold globally. The company's additional goal, improving serviceability, meant improving information from the gas ignition control to the dryer's motherboard. Working together with the commercial laundry manufacturer, Fenwal Controls developed its first DC voltage direct spark ignition control with a universal asynchronous receiver-transmitter (UART) interface. The UART sends a customized digital message to the dryer's main control providing operational status and performance data. The new control was designed tested and approved for North America, Europe and Australia. Now in production for several years, Fenwal Controls has seen an increase in demand of both DC controls and UART communications and has continued to make steps to improve both



Communicating commercial laundry equipment able to transmit fault conditions



High efficiency fryers improve performance with fewer components and simplified design

technologies in the controls industry.

"There were a lot of firsts in this project, an innovative concept for a communicating DC powered direct spark ignition control. Meeting weekly with our customer ensured the product met all their goals."
– Paul Finn, Compliance Engineer, Fenwal Controls

Streamlining Commercial Cooking Equipment

A commercial cooking company needed to improve the design of their high efficiency gas fryer. Their existing design used multiple components including a gas ignition control, a pulse width modulation board, multiple time delay relays and a very complex wiring schematic. They needed to reduce the number of components and vendors, cabling cost and to clean up the design. After a long search, the commercial cooking company realized that no vendor had a control that met their specific needs. They met with Fenwal Controls and collaborated on a redesign of an existing Fenwal Controls product. In under a year, the slimmed-down product went from kick-off to production, including agency approval. A year after that, Fenwal sold almost a thousand units to the company. The design proved so successful that the new control was incorporated into additional fryer models. As the customer considers future design improvements, their engineering team continues to work with Fenwal Controls engineers to add additional functionality and meet other design needs.

Alignment Provides More to Customers

Fenwal Controls and UTEC are now working together under Carrier and use a combined 226 years of experience to deliver quality products more efficiently and to support a wider range of appliance manufacturers. From agricultural equipment to elevator solutions, from heat pump & geothermal to food equipment controls and so much more, Fenwal and UTEC are so much more than HVAC.

"With Fenwal Controls and UTEC working together we are able to provide our customers a broad range of controls, user interfaces and sensors for a variety of applications. Coupled with connectivity, these solutions enable access to commissioning, monitoring and maintenance." – Suresh Ram, Managing Director, Carrier Global Controls

The alignment of Fenwal Controls and UTEC under the Carrier brand has allowed our two companies to increase our manufacturing capabilities and provide more products to more industries. And with more locations around North America and Asia, you can trust us to be better supplied to meet challenging global demands that stress businesses. Getting help when you need it is essential, so providing fast, local support and knowledge has been a major alignment priority. We're ready to support global customer needs with experts located around the world. ●



Marc Silverstein *is the Product Manager for Fenwal Controls (fenwalcontrols.com) in Ashland, MA, U.S., a part of Carrier Global Corporation, a leading global provider of healthy, safe, sustainable, and intelligent building and cold chain solutions. He has more than 15 years of experience in Product and Program Management for software and hardware technologies. He brings his experience and knowledge from other industries to Fenwal Controls. He received his BSEET from the University of Hartford's Ward College of Technology.*

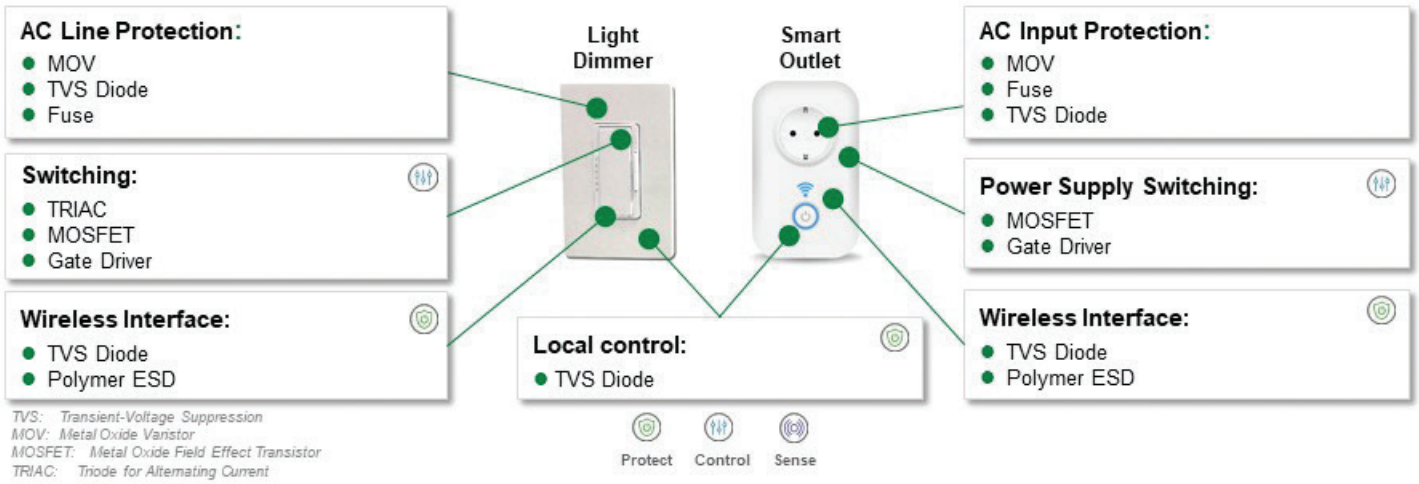


Figure 1: Recommended protection and control components for smart light dimmers and smart power outlets.

Designing Intelligent Outlet Solutions For Smart Home & Building Automation

BY RYAN SHEAHEN

Innovation in wireless and internet technology is converting common, non-intelligent devices into smart devices that help users leverage the Internet of Things (IoT). This trend is occurring in our homes, workplaces, and buildings. IoT technology has entered the home, creating the smart home with convenience, security, lighting control, entertainment, and environmental control products.

To enable these technological advances in the latest home and building designs, traditionally non-intelligent devices such as light dimmers and power outlets must become ''intelligent.'' The smart power outlet market is growing at a compound annual growth rate of around 25%1, and the market is estimated to reach 45M units/year in 2024. The smart light dimmer market is forecasted to be growing at over 15%2 and is estimated to reach 15M units/year by 2024.

Other devices such as ground-fault circuit interrupters (GFCIs), arc-fault circuit interrupters (AFCIs), and USB outlets are becoming more intelligent. The market for GFCI/AFCI devices is roughly estimated to have a growth rate of around 5%, while the USB market is estimated to be growing at a rate of 10%. Protecting these devices from potential overvoltage and overcurrent damage is essential for long-term reliability and safety.

What Makes a Device Intelligent?

An intelligent device has electronic circuitry that enables control, system coordination, and status feedback. The smart device can be programmed by audio (voice), manual, or electronic control. An IoT intelligent device can be accessed and programmed remotely through a wireless communication protocol such as cellular, WIFI, or Bluetooth. Your personal computer, tablet, smartphone, or virtual assistant can easily communicate with these intelligent devices.

Designing For Safety and Reliability

Designers need to ensure that these new smart devices are safe and reliable as consumers expect high reliability without risk of service interruption. Environmental hazards such as lightning surges, induced power surges, electrostatic discharge, and electrical transients can negatively impact these intelligent devices. Thus, the devices require overvoltage

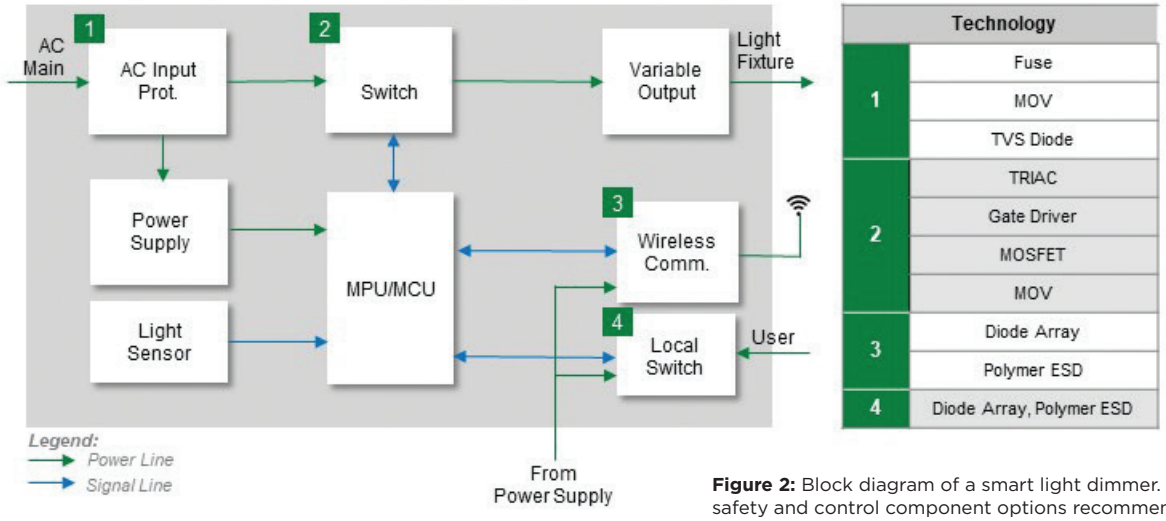


Figure 2: Block diagram of a smart light dimmer. The safety and control component options recommended for the circuit blocks are shown in the list adjacent to the block diagram.

and overcurrent protection to maintain operation. This article informs designers about the types of components to use and the circuit architecture they should consider.

Design Considerations For Smart Devices Connected to the Power Lines

Intelligent outlets are connected to incoming AC power lines and need to meet agency standards and reliability expectations. Typically, a fuse is used for overcurrent protection, and the fuse will interrupt if a current exceeding its rating occurs over a defined period. When selecting a fuse, consider normal operating current, application voltage, ambient temperature, overload current conditions, maximum fault current, resistance, and agency approval.

A lightning strike can create an induced power surge on the power line creating an overvoltage transient which can cause failure. The designer typically selects metal oxide varistors (MOVs) and/or transient voltage suppression diodes (TVS) for protection. MOVs and TVS are both designed to absorb transient current surges. TVS diodes have a faster response time of under a picosecond, and MOVs can absorb more energy depending on the specific component selected. The right component choice depends on the exact system layout and other components in the system. The designer must consider operating voltage, clamping voltage, surge requirements, and component costs.

Primary fuse parameters:

- Current rating
- Maximum operating voltage
- Interrupting current rating
- Series resistance

Primary MOV parameters:

- Maximum transient energy absorbed
- Maximum peak surge current
- Maximum continuous operating voltage
- Clamp voltage
- Operating temperature range

Primary TVS Diode parameters

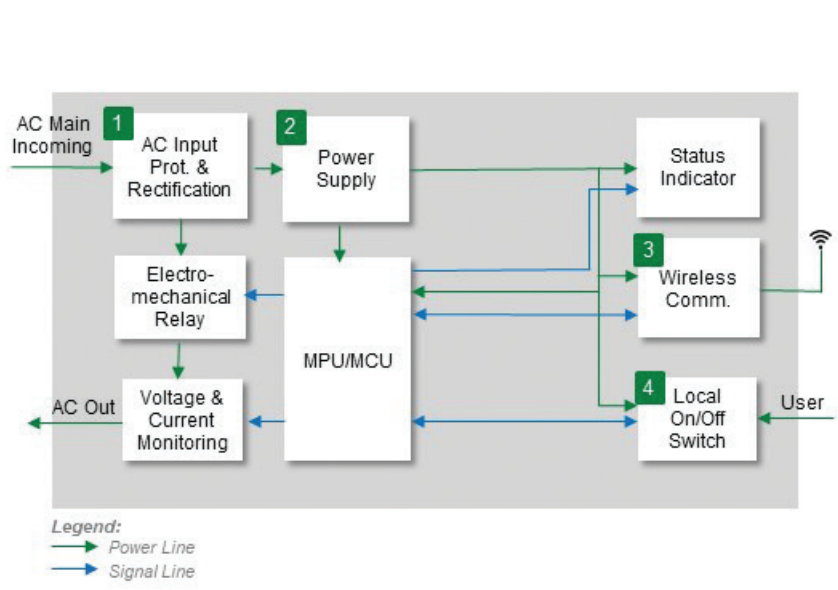
- Reverse standoff voltage
- Peak pulse power dissipation
  Breakdown voltage

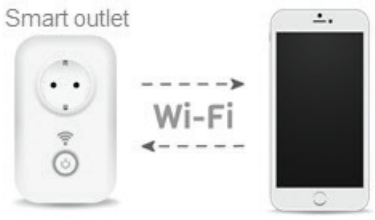
Protecting the Wireless Communication Microprocessor From Electrostatic Discharge (ESD)

The wireless communication circuitry for intelligent outlets is exposed to the external environment, including human touch, and should primarily be protected from ESD. Choosing the best suppression technology depends on the threat level, system architecture, and form factor.

ESD suppression components protect the wireless chipsets and the digital circuitry behind the wireless interface. TVS diode arrays and polymer ESD suppressors are two solutions. TVS diode arrays have the advantages of the lowest possible clamping voltage and minimum package size. Both components have low leakage current and low capacitance of under 1 pF. A typical TVS diode used for this application will withstand +/- 12 kV ESD following the IEC 61000-4-2 standard.

Both TVS diode arrays and polymer ESD suppressors have small footprints and consume a small amount of valuable pc board space. Of most importance, depending on the





	Technology
1	Fuse
	MOV
	TVS Diode
2	Schottky Rectifier
3	TVS Array
	Polymer ESD
4	TVS Array, Polymer ESD

Notes:

- *Some smart outlets have USB power outlet requiring additional protection.*
- *Some designers choose to use large caps and transformers which reduces protection requirements*

Figure 3: Smart outlet block diagram showing where protection and control components are required. The table lists the recommended component options.

component selected, these devices can withstand 30 kV from direct contact and 30 kV transmission through the air in compliance with IEC61000-4-2. The polymer ESD devices respond to ESD voltages in under a nanosecond while the TVS diodes respond in under a picosecond. If the size is a significant concern, the polymer ESD devices have a maximum footprint (length of pads) of 3 mm, while the TVS diodes can have a maximum footprint of 9 mm.

Primary polymer ESD parameters

- Standoff Voltage
- Clamp voltage
- Trigger voltage
- Capacitance
- Leakage current

Protection and Control For Smart Light Dimmers and Smart Power Outlets

Both smart light dimmers and smart power outlets obtain power from the power line; thus, they require power line protection. Both devices have wireless communication interfaces as well which require protection from ESD. ESD protection is also needed to protect circuitry from a manually-controlled switch and other contact points during production and installation. The typical options for overcurrent protection, overvoltage protection, and power control are shown in Figure 1.

Figure 2 shows a block diagram for the smart light dimmer, and Figure 3 shows the block diagram for a smart outlet. The recommended protection and control component options are shown in the list adjacent to the block diagrams.

Power Control For Smart Light Dimmer and Power Outlets

Smart outlets employ Schottky rectifiers for rectification in the switching power supply that powers the DC circuitry. Schottky rectifiers have a low forward voltage, which improves the power conversion efficiency. Furthermore, Schottky diodes have fast switching speeds that enable switching power supplies to operate at high frequencies for additional improved efficiency.

In dimmers, the TRIAC is used to control the percentage of the AC waveform that is output to the light. For low load current, light sources such as LEDs, TRIACs can have a holding current as low as 6 mA. Another option to control the light source is a MOSFET. MOSFETS have fast switching times and low on-resistance to minimize power loss and improve power transfer efficiency from input to output. A gate driver controls the MOSFET and ensures efficient MOSFET turn-on and turn-off.

Primary Schottky diode parameters

- Forward voltage
- Forward current
- Reverse voltage
- Reverse Recovery Time

Primary TRIAC parameters

- On-state current
- Voltage rating
- Holding current
- On-state current rate of rise

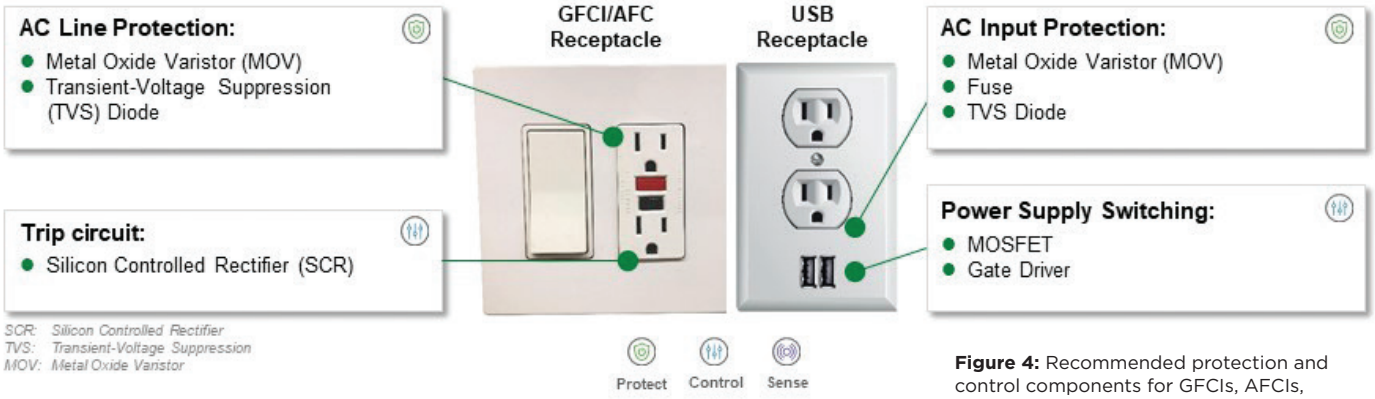


Figure 4: Recommended protection and control components for GFCIs, AFCIs, and USB charging outlets.

Primary MOSFET parameters

- Drain-Source current
- On resistance
- Switching time

Primary MOSFET gate driver parameters

- Input voltage
- Output current

Ensure Protection and Control For GFCIs, AFCIs, and USB Outlets

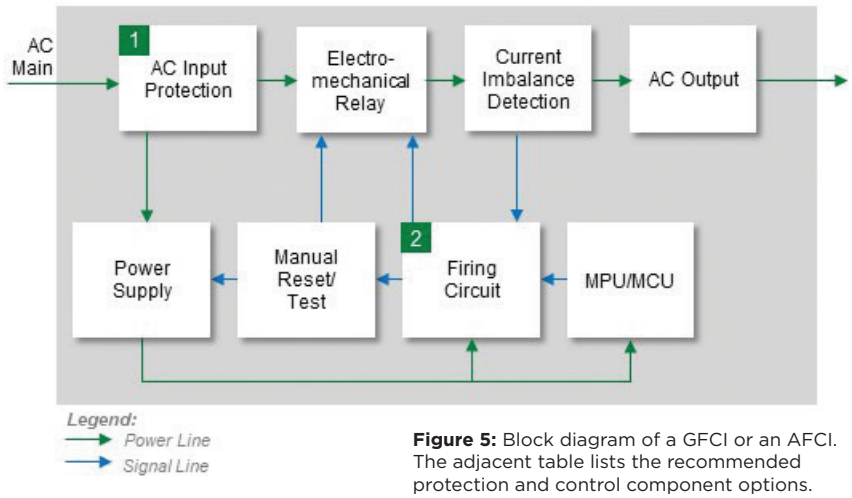
The original, intelligent devices for the home are the GFCI and AFCI. The GFCI senses when the load current delivered on the hot line does not return on the neutral line. If the current imbalance exceeds a pre-determined trip level, the GFCI removes power from the outlet to prevent an electric shock hazard. The AFCI detects an arc condition and removes power from the outlet to avoid a fire.

Power outlets with USB charging have become more common in residential and public locations. These outlets may have USB charging combined with historical power outlets or multiple USB chargers in a single device. GFCI, AFCI and USB chargers need protection from transients. Figure 4 shows the recommended protection and control components needed for GFCIs, AFCIs, and USB charging outlets.

The block diagram for the GFCI and AFCI are shown in Figure 5. The protection components are similar for smart light dimmers and smart outlets. The recommended power control component is an SCR. The SCR activates the relay that disconnects the AC main incoming power to the output when a current imbalance is detected. Also, SCRs are available in various through-hole and surface mount packages. They also will come with isolation voltages as high as 2500 Vrms.

Primary SCR parameters

- On-state current
- Blocking voltage
- Forward drop
- Gate current trigger level

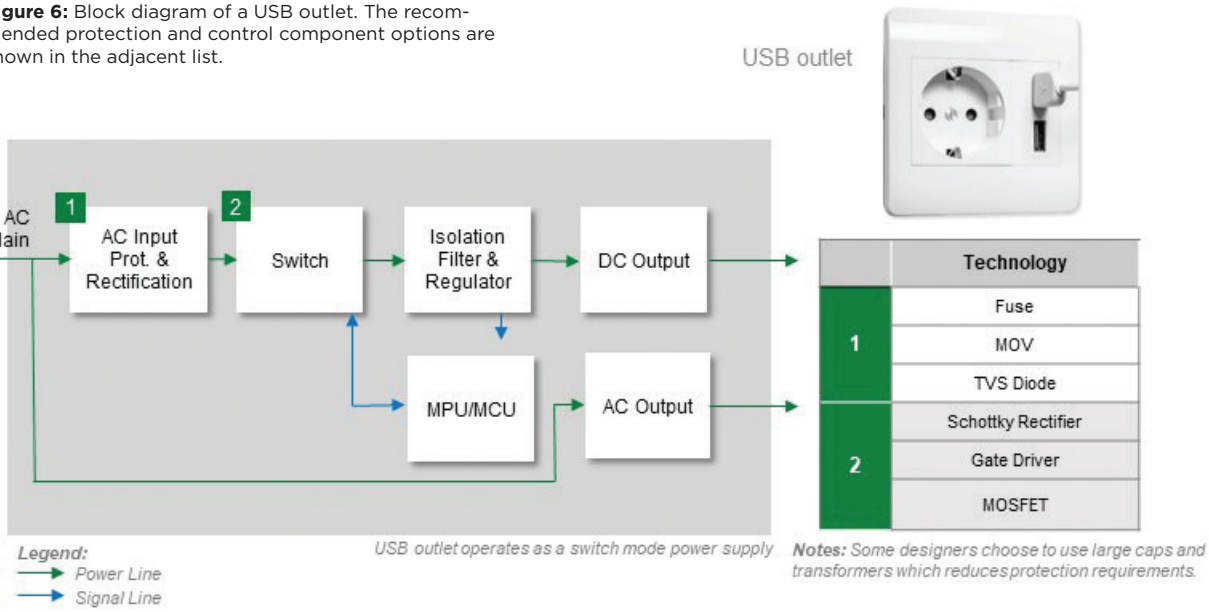


	Technology
1	Fuse
	MOV
	TVS Diode
2	SCR



Figure 5: Block diagram of a GFCI or an AFCI. The adjacent table lists the recommended protection and control component options.

Figure 6: Block diagram of a USB outlet. The recommended protection and control component options are shown in the adjacent list.



	Lighting Dimmer	GFCI/AFCI	Smart Outlet	USB Receptacle
Safety	▪ UL 1472 ▪ IEC 63036	▪ UL 943 – GFCI ▪ IEC 61008 Series - RCD ▪ UL 1699 – AFCI ▪ IEC 62606 - AFDD	▪ UL 231	▪ UL 498
ESD	Electrostatic Discharges – IEC 61000-4-2 Electrical Fast Transient – IEC 61000-4-4 Surge Immunity – IEC 61000-4-5			

Save Development Time With Knowledge of the Applicable Industry Safety Standards

Meeting UL standards or IEC standards is required for these intelligent devices since all of them operate on line power. The applicable specific standard depends on the global location where the device will be used. Missing a standard requirement can result in extended product development time and added project costs if a certifying body fails to approve your product. Table 1 contains a list of the applicable national and international standards for these products.

Summary

The growth in IoT technology and intelligent products makes the home a more connected and enjoyable place to live. With the new intelligent devices, consumers are gaining more convenience, security, environmental control, and entertainment. Smart outlets are part of this trend and are largely available today. Designers need to consider overvoltage, overcurrent, and ESD protection to increase device reliability and enhance safety. Designers can make their work more manageable if they know the safety requirements for the device they are developing. Understanding the components that protect and efficiently control the device will ensure a safe and robust design. The components need UL- or IEC-certification to provide proper overcurrent protection, overvoltage protection, and ESD suppression. Using components that comply with these standards will reduce the review time for intelligent device standards certification. ●

References:
[1] Global Smart Outlet Report 2019. Industry Research. March 2019.
[2] Report on Global Dimmers Market. Market Research Future. Jan 2020.

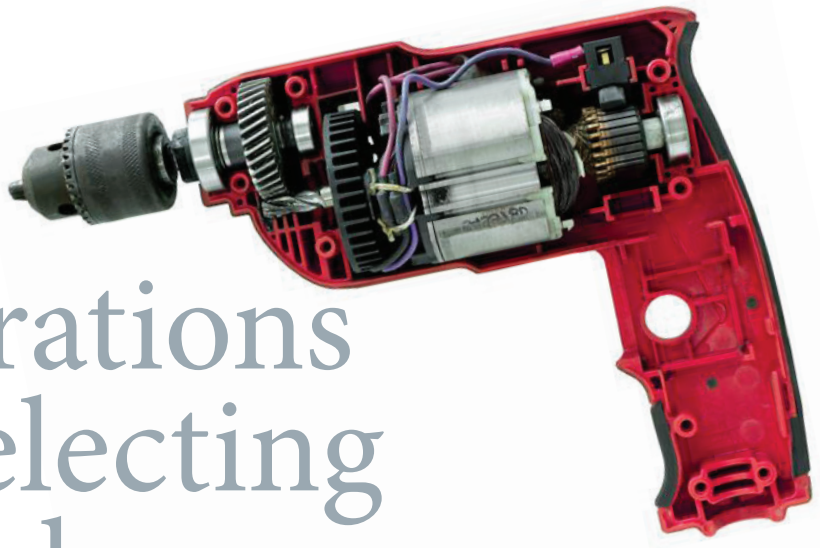
Table 1: . List of Applicable National and International Standards and Compliances.

Standard	Title	General Scope	Region
UL 1472	Solid State Dimming Control	Covers dimmer (non-touch) rated <600 vs touch rated <120 volts ac and electric s/ws minimum power rating of 300 watts incandescent or 300 volt-amp	North America
IEC 63036	Standard for Automatic Electric Controls for household	Specifies the electric interface and test procedures for the control by mains voltage phase-cut dimming	Global
UL 943	Standard for Safety for GFCI	Class A, single and three-phase GFCI intended for personnel protection	North America
IEC 61008	RCCB without integral overcurrent protection for household	Protection against safety hazard (RCCB rated <440V, 125A)	Global
UL 1699	Standard for safety for Arc-Fault Circuit-Interrupters	Covers AFCIs maximum rating of 20A and are intended for use in 120-Vac, 60-HZ circuits; cord AFCIs are rated up to 30A	North America
IEC 62606	General reqirements for arc fault detection devices	Applies to arc fault detection devices (AFDD) for household and similar uses in AC circuits	Global
UL 231	Standard for Power Outlets	Cover power outlets, with or without integral mounting post or pedestals	North America
UL 498	Standard for Attachment Plugs and Receptacles	Covers attachment plugs, receptacles, cord connectors, inlets, current taps provided with wiring terminals	North America
UL 1310	Standard for Class II Power Units	Safety requirements covering indoor and outdoor use of Class II power supplies and battery chargers	North America
UL 916	Standard for Energy Management Equipment	Covers energy management equipment and associated sensing devices rated 600V	North America
IEC 61000-4-2	Testing-Electronic Discharge (ESD)	Checks capability of equipment to survive repetitive electrical fast transients and bursts	Global
IEC 61000-4-4	Electrical fast transient/ burst immunity test	Evaluating the immunity of equipment when subjected to electrical fast transient/ bursts on supply, signal, control, and earth ports	Global
IEC 61000-4-5	Fast Transient Surge Test	Evaluate the immunity of equipment when subjected to surges	Global

For additional information, download the ***Building & Home Automation Application Guide***, courtesy of Littelfuse, Inc.



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



Top 4 Considerations When Selecting a Gearbox Grease

BY BRIAN KINKADE

Appliance and Power Tool OEMs remain concerned with brand loyalty and customer satisfaction as the profit drivers for their business. Gearboxes and gear motors typically drive the performance of these products and are often significant contributors to their size, weight, vibration, and noise. When selecting power tools and appliances, consumers often prefer small, quiet, and lightweight designs.

When properly selected, grease can help achieve these goals by reducing noise and vibration, starting and running torque, gearbox temperatures, and gearbox weight by enabling the use of plastic components. Selecting the right grease during the design phase can be crucial to product performance, customer satisfaction and brand loyalty. But how does grease impacts performance and reduce wear? Here are the top technical considerations an OEM should keep in mind when selecting a grease for their application.

Operating Temperature Range

Lubricants can help improve gearbox operation at high and low temperatures, but careful consideration must be taken to ensure the lubricant can provide protection across the entire operating temperature range.

Applications that operate at low temperatures must start and perform reliably. Common applications with low temperature operating conditions include, power tools stored in sheds and vehicles, icemakers, exterior door-openers, outdoor pan-and-tilt security cameras, motor-controlled awnings and gates, remote-controlled window shades and other chilled or outdoor equipment.

A grease that is too viscous at low temperatures cannot adequately move around the gearbox to lubricate the gear teeth. This means that more energy and torque is required to move the gears. When tasked with overcoming starting torque, OEMs could turn to larger motors, power circuitry and batteries to get the job done but this often increases the cost, size, and weight of the application.

Reducing an application's starting torque requirements can be done by looking at the following lubricant properties:

- NLGI grade (representing grease consistency or thickness)
- Base oil viscosity (describing the consistency or thinness of the oil)
- VI or viscosity index (how much the base oil viscosity changes over temperature)

Evaluating the results of low

Material Compatibility

with Synthetic Oils & Greases* (At Room Temperature)

Plastics	Synthetic Hydrocarbons*	Esters & Polyglycols	Silicones (All Types)	Fluorinated Ethers*	Mineral Oils
Acetals	●	●	●	●	●
ABS Resins	●	▲	●	●	●
Phenolics	●	●	●	●	●
Polyamides	●	●	●	●	●
Polycarbonates	●	▲	●	●	▲
Polyethylenes	■	■	●	●	●
Polyphenlene Oxide	●	▲	●	●	●
Polysulfones	●	▲	●	●	●
Terephthalates	●	●	●	●	●

Elastomers	Synthetic Hydrocarbons*	Esters & Polyglycols	Silicones (All Types)	Fluorinated Ethers*	Mineral Oils
Buna S	▲	▲	●	●	▲
Butyl	▲	▲	●	●	▲
Ethylene Propylene	▲	■	●	●	▲
Fluoroelastomers	●	▲	●	●	●
Natural Rubbers	▲	▲	●	●	N/A
Neoprene	●	▲	●	●	●
Nitrile (Buna N)	●	■	●	●	●
Silicone	■	■	▲	●	●

Legend: ● Good ■ Fair ▲ Poor

*Synthetic Hydrocarbons include PAO. *Fluorinated Ethers include PFPE and PPE.





*Caution: These compatibility ratings are intended to be guidelines for design engineers when selecting lubricants. Under high mechanical stress, high-temperature, poor plastic/elastomer quality, or any combination of these conditions, compatibility can be compromised. Any synthetic lubricant used with a plastic or elastomeric component should be tested to ensure compatibility in a specific application.

The chart above highlights the material compatibility of different plastics and elastomers with common grease and oil chemistries.

temperature torque test (ASTM D1478) is also a good way to compare grease performance. This test is typically run at -40 °C but can be specified to be run at any temperature. When a grease is used to lower starting torque, it might allow the engineer to use lighter weight materials in their design.

A grease with a base oil that maintains its viscosity at the maximum operating temperatures should also be considered. While cooking appliances are the obvious place to consider high operating temperatures, tools stored inside a car during the summer can experience temperatures as high as 120 to 140 °F. Temperatures also rise in gearboxes that perform at high speeds and/or high loads. The right grease can help engineers reduce gearbox temperatures by reducing the amount of frictional heat generated.

A lubricant that cannot withstand high temperatures may do more harm than good. In open gearbox applications, the oil that separates from the grease will migrate away from the gear surface, which reduces its lubricating benefits. A grease with low oil separation at high temperatures is recommended. Additionally, a grease with poor high temperature performance will oxidize and leave behind byproducts, like acids. These acids attack the metal surface and lead to increased wear and corrosion of the gear.

Material Compatibility

Gears can be made from different materials including stainless steel, yellow metals (i.e., brass, and bronze), sintered and powdered metals, and many kinds of plastics. Gaskets, bushings, and seals can also be made from different elastomers. To ensure optimal performance, it is important to consider how a grease or oil will react with the materials in a design.

Certain base oils and additives will absorb into plastic components and cause them to swell. Conversely, there are also oils and additives that extract soluble materials from some plastic components, causing them to shrink. Chemical interactions between certain base oils, additives, and plastics can affect the components' molecular structure and may lead to embrittlement and other losses in mechanical performance. Lubricants with an ester base oil should be approached with caution as they have been known to negatively affect many plastics and elastomers.

Base oil compatibility should be considered for powdered/sintered metal gears that are impregnated with oil. It's also important to consider the additives in a grease formulation. Extreme Pressure (EP) additives with active sulfur can soften, etch, or corrode yellow metals. EP additives with inactive sulfur, however, prevent the corrosive attack and forms a soft slippery chemical layer on the metal surface that protects against wear.

Material compatibility issues will ultimately impact the performance lifetime of the design. With so many different variations of metals, plastics

and elastomers, compatibility testing is always recommended to ensure a grease or oil will work properly in a specific application.

Noise Reduction

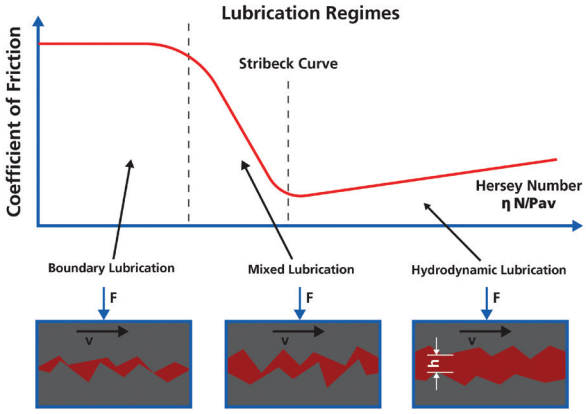
Quiet designs are becoming more important to consumers. A noisy application, even one that is working properly, can concern end users. Reducing noise, therefore, plays an important role in improving product quality and customer satisfaction. Noise reduction is a combination of proper lubrication and the noise damping properties of a grease.

Often the vibration noise from a gearbox presents itself as a whine associated with the gear mesh frequency (the number of teeth on the gear multiplied by the rotating speed of the gear). Alternatively, an unloaded gearbox may generate a rattle sound. This noise is often transmitted through the gear shaft and bearings to the housing where the noise and vibration can be felt and heard by the end user.

The vibration or noise generated from a gearbox comes primarily from Transmission Error (the difference between the actual position of the gear and the position it would occupy in an ideal design). Transmission errors often occur when the spacing between the gear teeth is less than ideal from conditions such as:

- Gear teeth flexing under the application's speeds or loads
- Excessive wear or surface damage
- Tooth damage

Lubricant acts as a barrier between gear teeth to prevent wear and surface damage that causes noise while also damping the noise generated when the surfaces contact each other due to transmission errors. Many designers complete noise and vibration testing at the various temperatures, speeds, and loads to validate a grease for their design. When a noise or vibration problem occurs, revisiting the grease requirements (NLGI grade, viscosity, VI, and additives) can often mitigate the problem.



Lubrication regimes describe the type of lubrication film that is created under specific operating conditions and is dependent on the degree of contact between surfaces. There are three lubrication regimes as indicated on the Stribeck curve. The curve was initially intended for bearing applications but are applicable to describing lubrication regimes for gears. The Stribeck curve shows the relationship between the coefficient of friction and the Hersey number. The Hersey number is a dimensionless number obtained from the velocity (m/s) times the dynamic viscosity (Pa·s = N·s/m2), divided by the load per unit length of bearing (N/m).

Load Demand

Without a sufficient film of lubrication separating metal-on-metal surfaces, high-load gears risk adhesive wear. Boundary lubrication describes the conditions under which opposing surfaces meet with little-to-no oil film separation and wear is accelerated. Boundary lubrication is more likely to happen when gears mesh in heavily loaded applications.

To avoid the effects of boundary lubrication, a lubricant with excellent film strength should be selected. When added to a grease, EP additives have a greater film strength and promote sliding rather than welding of surface asperities to protect gears against wear. For metal gears, ester oils provide excellent surface friction reduction to support both high-load and high-speed gearbox operation.

The Importance of the Right Grease

The right gear motor grease can reduce operating temperatures and generated noise, enable the use of plastic gears or lighter weight components, and improve component reliability. All these aspects contribute to brand loyalty and customer satisfaction. ●



Brian Kinkade *is the Market Development Manager at Nye Lubricants where he ensures engineers are equipped with the tools to select the best lubricant for their application. Kinkade holds a Bachelor of Science in Electrical Engineering from Rensselaer Polytechnic Institute and a Masters in Business Administration from Clark University. He can be reached at brian.kinkade@fuchs.com. For more information visit: https://www.nyelubricants.com/appliance*

ELECTRICAL WIRE PROCESSING TECHNOLOGY EXPO 2022

WISCONSIN CENTER
MILWAUKEE, WI

MAY 10–12:
CONFERENCE

MAY 11-12:
EXHIBITION

Featuring
IPC SummerCom

Standards Development Committee Meetings
May 7-12

WIRED & INSPIRED



Presenting A New Expo Experience

Your industry advocate — the Wiring Harness Manufacturer's Association — is leading the development of a new Expo experience driven by the needs of electrical wire and cable processing manufacturers and suppliers. It's your industry — now it's your show. Get wired in and inspired — mark your calendars today!

REIMAGINED TRAINING & EDUCATION

EXPANDED NETWORKING

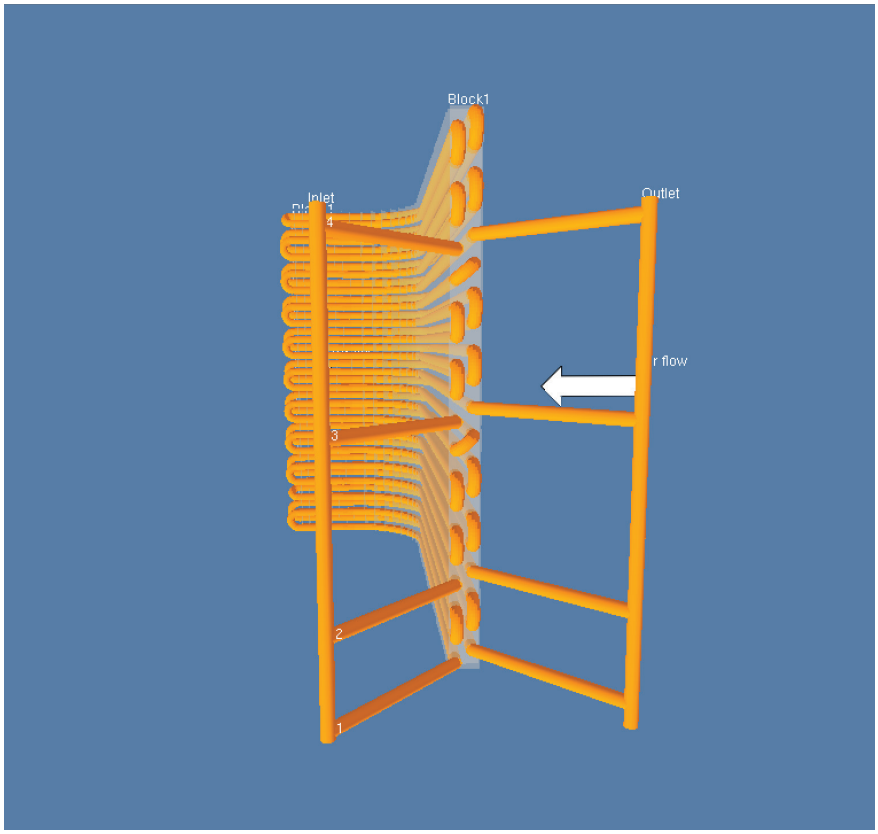
INCREASED ACCESS TO INDUSTRY SOLUTIONS

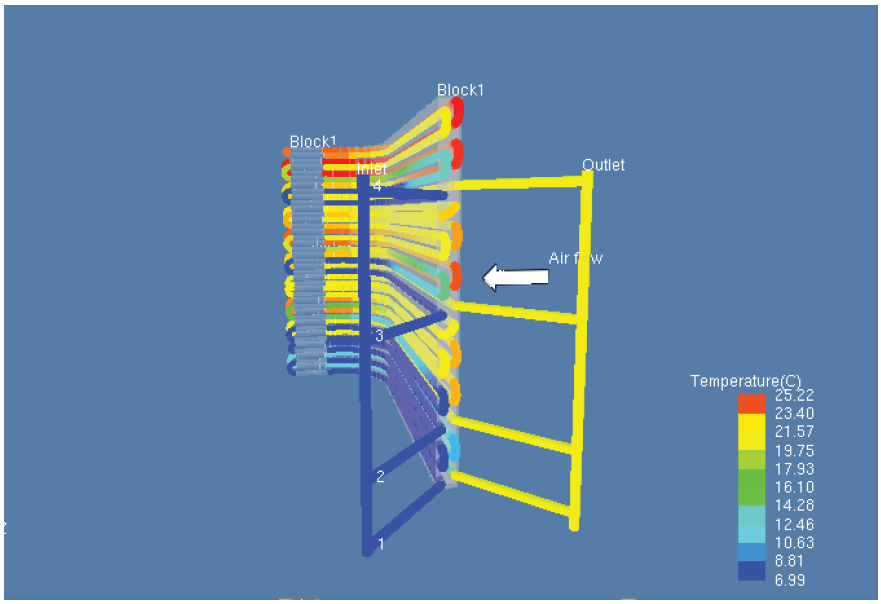
electricalwireshow.com

Produced by:

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

the microgroove™ advantage





POWERFUL HEAT EXCHANGER SIMULATION AND DESIGN SOFTWARE

The International Copper Association (ICA) is pleased to offer HXSim to interested and qualified heat exchanger designers FREE OF CHARGE. The sophisticated graphical user interface simplifies the input of heat exchanger design parameters. HXSim calculates heat exchanger performance and outputs the results in graphical and tabular formats, including three dimensional visualizations. ICA staff is available to answer questions about the software and will assist in the use of MicroGroove technology in heat exchanger design.

To download the HXSim software program and guide, visit **www.microgroove.net/HXSim**

www.microgroove.net

Cu International Copper Association
Copper Alliance



Available from a range of suppliers.
For more information visit:
www.microgroove.net