

electroindustry

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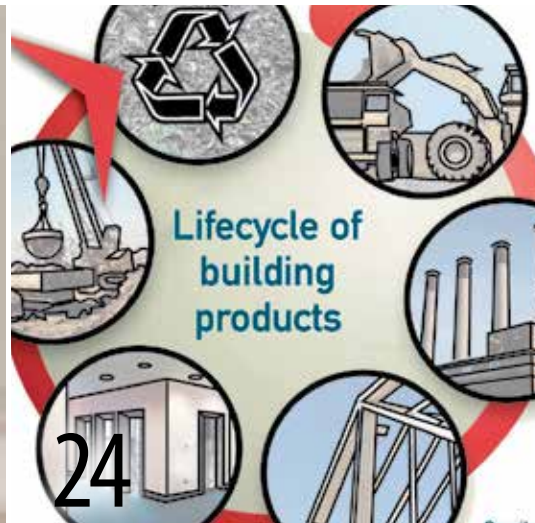
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Software may get all the attention these days, but the world runs on physical products. No matter how smart we make our buildings, how integrated we make our systems, or how interconnected we make our electrical grid, we still need quality infrastructure—things like conduit, fuses, breakers, and wiring devices.

Ultimately, the Internet of Things exists because of these physical “things.” Take, for example, a data center. Comprising thousands of computers and backup servers, it epitomizes the idea of individual physical products working in unison to enable a virtual technology so pervasive as to be commonplace. Without those physical aspects, there would be no email, no smart phones, and no Netflix!

Even larger than that, think about the U.S. electric grid (Congress is; see this month’s “View from Capitol Hill” for more). With all its thousands of miles of high-voltage lines and millions of miles of lower-voltage lines, this expansive machine enables no less than modern civilization. Yet it is only as strong as its weakest physical component.

As silly as it may sound, the first rule of troubleshooting is to make sure the unit is plugged in. End users often overlook such obvious physical requirements in their pursuit of more intelligent operations. Ironically, as our world increasingly grapples with intangibles, the prosaic physical aspects are just as important as they have always been. Operating largely in the background, they form the backbone of our electrical world.

Our Member companies make these products and offer services that enable our virtual environment. In doing so, they employ innovative technologies. In this issue of *electroindustry*, even as we celebrate the things without which the most sophisticated supercomputer would cease to function, we are leaning into the future. I invite you to read how our industry has championed efficient manufacturing processes, such as lean manufacturing, as well as new technologies, such as 3D printing. Standing at the forefront of electrical safety, reliability, and efficiency, NEMA Members are also moving into the virtual world in important areas such as industrial automation.

As a vital and rapidly changing industry, we are excited about the Internet of Things and all it promises. We expect to be leaders in realizing those promises, but we remain grounded in making and marketing the essential components of the electrical world.

Many predict a more digital future for our industry. Yet even as we anticipate the changes ahead, we remain committed to—and appreciative of—the humble things, the essential components that form the foundation of modern society. ☺

Kevin Cosgriff
President & CEO

Fostering Organization-Wide Leadership

As a manufacturer of electrical raceway and mechanical products, Atkore International knows it is crucial to be on the frontline in the development of installation codes and product standards. We must remain highly aware of and engaged in a wide range of industry issues. These include codes, standards, and regulatory requirements, as well as the effects that technical developments have on products, customers, and markets.



NEMA members work side by side with NEMA staff, standards development organizations, and other manufacturers to address industry concerns, provide input to codes and standards, and educate the electrical industry on our product attributes and installation. As is the case with other members, we have representatives on leadership and section committees. We actively participate in working groups, technical forums, and councils such as the High Performance Building Council.

Although involvement in all of these areas is a great starting point, ensuring that the knowledge and information acquired from this involvement is carried throughout the organization is crucial. In the past, we siloed the responsibilities of industry affairs members within their specific business units. This led to inconsistent communication between the units, which in turn resulted in business leaders not being as well versed in key issues as they could have been. Having responsibilities nested in each business unit also led to competition between business units on some issues. Unintentionally, we may have diluted our voice.

Recently, Atkore modified its approach to encompass an organization-wide reporting structure that ensures that the knowledge gained from participation in industry affairs is carried throughout the organization.

This improvement has led to

- an increased understanding across our organization of industry issues, decisions made, and positions that have been taken;
- a proactive process for informing key members of our strategic development teams about changes in codes, standards, and trends; and
- an increased understanding of the time, money, and resources we spend across a broad range of industry interfaces, the efforts of which bring a positive return on investment.

This greater connectivity is accomplished through a variety of meetings, which include monthly business unit meetings, Industry Affairs Council meetings, and quarterly Executive Industry Association meetings. Business unit meetings consider changes in standards, codes, and environmental regulations that could have an impact on a specific product group.

Monthly council meetings are now a forum for various business units to share issues. Information from this meeting is then forwarded to appropriate personnel (e.g., product managers and product engineers) as needed. The CEO, business unit presidents, and other members of the leadership team attend quarterly industry association meetings, which incorporate what we learned from association meetings and activities during the last quarter and what is coming up in the next quarter. The leadership team is aware of regulatory changes, concerns, and industry issues that could impact our products.

It is important to note that while we have implemented an organization-wide approach, the leadership team is sensitive to the fact that some of our products may compete in the marketplace and information shared may be proprietary to that product group. To ensure that confidentiality is kept, we designated experts for specific product groups to handle the association work and proprietary information.

In our highly regulated industry, which is impacted by ongoing technological changes, this approach has provided a path for staying current on leading industry issues and communicating the impact across our businesses. It is a key component of our strategic planning process. ☺

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Atkore's full range of electrical raceway products and accessories provide a variety of solutions for every application, reducing costs and moving everyone faster from blueprint to final inspection and approval.



Building a Made-in-America Economy

In order for us to create an economy built to last, we need to make strong federal investments in a 21st-century American infrastructure network that puts people to work and allows businesses to move their goods to market.



Senator Baldwin serves on the Senate Budget Committee; Senate Appropriations Committee; Senate Committee on Health, Education, Labor and Pensions (HELP); and Homeland Security and Governmental Affairs Committee.

President Trump has pledged to put forward a \$1 trillion infrastructure investment plan. In January, I joined with Senate Democrats to outline our priorities for that historic investment. Our Blueprint to Rebuild America's Infrastructure would provide billions for strengthening our electric system, modernizing Veterans Administration hospitals, rebuilding public schools, expanding transit infrastructure, repairing critical rail systems, funding essential road and

bridge improvement projects, rehabilitating water and sewer structures, and much more.

America's electric grid consists of an antiquated patchwork of interconnected power generation, transmission, and distribution facilities, some of which date back to the early 1900s. Not surprisingly, the grid suffers from hundreds of avoidable power failures each year, costing our economy between \$25 billion and \$70 billion, annually. Our grid simply is not up to 21st-century challenges such as extreme weather events and cyberattacks. Incredibly, the World Economic Forum ranks our electric grid 24th in the world in terms of reliability, just behind Barbados.

Notably, we would also invest \$100 billion in much-needed power transmission and distribution upgrades, upgrade our failing power

grid through new funding for next-generation energy infrastructure, and add certainty in the tax code with permanent incentives for electricity generation, fuel transportation, and energy-efficiency improvements. In the end, this would bring down consumer costs for energy.

In addition, our blueprint would provide billions for expanding broadband in rural communities. With a \$20 billion investment, we can expand broadband access to millions of Americans and create 260,000 new jobs. This will fund the buildout of high-speed broadband in unserved and underserved areas.

In his inaugural address, President Trump made clear that "buy American and hire American" would be a key element of his administration. For years, I have supported and fought for strong "Buy America" requirements because I believe that tax dollars for public projects should support jobs and businesses in America. Buy America reforms must be a guiding principle in any infrastructure plan. Our American manufacturers and workers deserve a solid commitment from us because they cannot afford to spend taxpayer dollars on foreign products. We must rebuild our country's infrastructure with American labor and American products.

The bottom line is this: we need a major investment in our nation's infrastructure—and we need it now.

Incredibly, the World Economic Forum ranks our electric grid 24th in the world in terms of reliability, just behind Barbados.

It's time that we work across party lines to make strong federal investments to put people to work rebuilding America's infrastructure. Real infrastructure investment is critical to sustaining our positive economic growth, creating millions of jobs, and building a modern economy. Investments in America's future must be made today. ☪

Court Upholds Copyright of Referenced Standards

A federal judge in Washington, D.C., has ruled in favor of standards development organizations (SDOs) who sought an injunction against PublicResource.Org, an entity that copies entire standards developed by SDOs and makes them available at no cost on the internet.

The court held that PublicResource.Org had infringed each of the SDO's copyrights and issued an injunction against PublicResource.Org and its principal, Carl Malamud, directing that the copyrighted standards be removed from their website within five days. Mr. Malamud has championed the idea that standards incorporated by law lose their copyright protection the minute they are referenced in federal regulations and law.

Several federal agencies, including the Office of Federal Register (OFR) and the Office of Management and Budget, have looked at this issue several times in recent decades and each time concluded that the copyright was not lost by reference in federal law as long the standard was reasonably available. Reasonable availability did not mean that the standards had to be made available for free. The court noted that each SDO had online reading rooms where the standards could be read at no cost in read-only mode.

NEMA, ANSI, UL, IEEE, ASSE, IAPMO, and NAESB—all SDOs—filed a joint amicus brief with the court last year in support of the request for an injunction. The court's opinion relied on portions of the amicus brief:

"... [T]his suit is not about access to the law in a broad sense, but instead about the validity of copyrights for these standards under current federal law. Copyright protection is a creature of

statute, and as such is the result of careful policy considerations by Congress. In the view of this court, Congress has already passed on the question of revoking copyright protection for standards that have been incorporated by reference into regulations, and any further consideration of the issue must be left to Congress for amendment."



Under regulations issued by the OFR in 1982, a privately authored work may be incorporated by reference into an agency's regulation if it is "reasonably available," including availability in hard copy at the OFR or from the incorporating agency.

The National Technology Transfer and Advancement Act of 1995 directed federal agencies to incorporate privately developed technical voluntary consensus standards, and Congress excluded incorporated works from Section 105 of the Copyright Act. Furthermore, Congress has remained silent on the question of whether privately authored standards would lose copyright protection upon incorporation by reference, choosing instead to maintain the scheme it created in 1966 that such standards must simply be made reasonably available. ☪

NEMA members can access Washington Watch, which provides up-to-date information about policy issues, as well as biographies and key information on select cabinet members, through the NEMA portal at www.nema.org/washingtonwatch.



CASE STUDY

Lean Manufacturing Creates Culture of Improvement

John Williamson,
President &
CEO, Atkore
International

Mr. Williamson is
a member of the
NEMA Board of
Governors

North American manufacturers have been part of the lean movement since 1990, when James P. Womack, Daniel T. Jones, and Daniel Roos published *The Machine that Changed the World*, documenting the advantages of Japanese manufacturing methods over the mass production model pioneered by Henry Ford.

During the past 25 years, we have learned that lean manufacturing cannot be a directive from the top down and that in order to successfully create and sustain a continuous-improvement mindset it must be built into the culture of the company. For this reason, Atkore has spent the last six years focusing on the development of a continuous-improvement culture.

Corporate culture is defined as the shared values, traditions, customs, philosophy, and policies of a corporation. In order to create that culture, our executive leadership team had to determine our corporate aspirations and how we manage the business to achieve those results.

The answers to these questions formulated a central mission, which is to be customers' first choice for electrical raceway and related mechanical products and solutions. They also shaped the company values of accountability, teamwork, integrity, respect, and excellence.

These values and their associated behaviors create a culture and a work environment in which all parties

- take responsibility for modeling the appropriate behaviors;
- win as a team and make the team better through their own actions;
- use best practices to drive personal and organizational achievements;
- challenge the status quo;
- aim for breakthrough results;
- create transparency, keeping lines of communication open; and
- celebrate wins.

Aligning Team Efforts

Every employee is expected to be a leader in the company, pointing out opportunities for improvement and challenging current processes to remove activities that fail to add value.

To support all of this, Atkore established the Atkore Business System (ABS), which is the foundation for how the company operates as a business. Specifically, it is based on excellence in strategy, people, and processes. It is tied together with lean daily management (LDM).

Over time, each department determines key performance indicators (KPIs), such as 5S (sort, set in order, shine, standardize, and sustain), delivery, quality, and cost. KPIs are measured during *gemba* walks, which Mr. Womack defines as going to where the action is. It affords company leaders, managers, and supervisors a means of supporting overall continuous improvement and process standardization while insuring alignment of the efforts of all teams.

Employees are responsible for indicating whether they have met or missed their KPIs. If metrics have been missed, an analysis known as “5-why” is performed. This technique, which explores the cause-and-effect relationships underlying a particular problem, is used to create a Pareto distribution diagram of root causes and countermeasures. A Pareto chart clearly illustrates what needs to be resolved by arranging variables in a bar graph that places the longest bars on the left and the shortest on the right. Regular report outs help create a culture of accountability and continuous improvement.

Strategic initiatives are also identified as part of the annual planning process and are deployed through the strategic deployment process (SDP), which is based on the Japanese concept of *hoshin kanri*. SDP ensures that the strategic goals of a company drive progress and action at every level. To become a strategic initiative, a proposal must be cross-functional, build capability, require the involvement of senior leadership, and drive breakthrough results. These initiatives, which now reside on an x-matrix with assigned black-dot owners, are then vigorously worked with the use of action plans and countermeasures to drive to completion. While some initiatives may remain on the x-matrix for a year, others may take multiple years, given the complexity of the breakthrough.

Delivering Improvement

A great example of the ABS at work is Atkore’s manufacturing kaizen funneling process, which is based on the Japanese concept of *kaizen*. A kaizen event is a specific continuous improvement project. Each manufacturing facility has a process by which salaried and hourly employees can submit ideas for a kaizen event to remove non-value-added activities from the manufacturing process. These ideas are then reviewed by leadership teams and prioritized in order of which will have the greatest impact on the business. Plans are created for each kaizen event to define the scope and help increase the odds of success.

Hundreds of kaizen events are held per year. After each, 30-, 60-, and 90-day reports ensure that the progress made during the event is sustained. The goal

of each kaizen event is the continued reinforcement of lean process thinking within the organization, until actual events are not necessary for continuous improvement to occur. Improvement becomes part of the company’s cultural DNA.

Another example is how Atkore decided to address problems with delivery, which is a key component to the success of the company’s mission statement to be the customer’s first choice. Upon identifying this performance gap, delivery became a strategic initiative and was added to the company’s x-matrix.

A cross-functional team was formed with subject matter experts from each business unit and operations area sponsored by an executive leader. This took collaboration and commitment between demand planning, customer service, and operations to develop the crucial elements of planning and working the order.

Standard work was developed along with an audit process to ensure sustainability, and metrics were created to measure performance based on customers’ expectations. It took a couple of years, but now with sustained performance, this initiative became a part of the LDM. Every day begins by reviewing sales, inventory, operations, and planning, along with customer service and planning KPI gemba boards. Failures are placed into Pareto charts to identify countermeasures. Weekly cadence calls are held with all business units, including demand planning, customer service, operations and distribution facilities. These ensure engagement and alignment across the organization and accountability by all team members.

Embracing Improvement

The ABS and the use of lean processes are applicable not only to manufacturing facilities; it can be applied to any aspect of a business.

Atkore’s finance team realized the benefits of embracing this mindset. It looked at each transactional area of responsibility (e.g., accounts receivable, accounts payable, and financial reporting) and created standard work for each team to follow. They removed non-valued-adding processes, set key metrics for measuring improvement, and assigned ownership for the results. All of this led to improvements within the business and has allowed their teams to focus more on value-added opportunities, serving the customer, and enriching their work experiences.

Atkore’s transformation with continuous improvement has been a journey, not an event. It has become a part of the company’s culture, driven by the company’s focus on the business system. ☺



CASE STUDY

Implementing Lean Processes: How Vendor-Managed Inventory Drives Efficiency



Bruna Oliveira,
Global Product
Manager, Pentair
Hoffman

Ms. Oliveira leads
global product
growth strategy
and key initiatives
for Hoffman's
commercial
enclosure and
wireway products.

In the commercial market, local product availability is vital to a business's success.

In order to fulfill product needs, businesses enhance productivity, eliminate waste, and reduce lead times by enforcing lean practices. Vendor-managed inventory (VMI) is a lean supply chain solution that enables companies to be more efficient by increasing visibility through electronic communication.

Transcending the Traditional

As a manufacturer and supplier of electrical equipment protection products, Hoffman supports a strong distribution network of thousands of local offices across the United States. Hoffman found that anticipating distributors' product needs through

supply orders caused unreliable guesswork on both ends. There was a lack of communication between the two parties, leading to the supplier trying to predict distributor needs and distributors attempting to estimate lead times. Essentially, both the supplier and the distributor have different sets of information, spending time and money trying to predict what the other will do.

For customers, keeping a project within budget and on schedule is key. It is unacceptable for a contractor to keep installers in the field waiting because they do not have their commercial products ready from the distributor. It's also common for contractors to have emergencies and last-minute product needs, which is why consistently having products locally available gains business.

When the traditional replenishment process is not able to keep up with the commercial market need, companies must develop new methods or techniques in order to succeed.

“We recognized that this process was no longer effective and failed to keep up to our standard,” said Kevin DeRung, VMI manager at Pentair Technical Products. “Our company is always on the lookout for ways to implement lean enterprise practices, so we sought out the ways in which we could best improve our methods—ultimately leading us to VMI.”

VMI in the Commercial Market

VMI is an automated process that uses historical data at the distributor level to generate ideal inventory levels. Hoffman partnered with a VMI service provider to assist with inventory planning and replenishment. The distributor inputs its sales activity to reflect inventory at the end of the day. The system then uses that information and the distributor’s historical activity to calculate forecasted demand, generating a suggested order for the supplier.

Along with this new process, Hoffman established two internal VMI analysts to review the daily suggestions, manage orders, and provide the distributor with an order acknowledgment. The system has innumerable settings, such as minimum and maximum order quantities, order frequency, and freight/dollar thresholds, which can be adjusted by both the distributor and supplier, enhancing collaboration and increasing the visibility for product demand.

“Before, our process was guesswork,” said Mr. DeRung. “Incomplete information leads to mistakes, which can be expensive for both organizations. VMI allows us to communicate better with our distributors and satisfy our customers.”

Replenishments to the distributor are based on the buying patterns of the end customers. VMI reflects customer demand, eliminating guesswork and giving end customers access to more of the right products when they need them. Because VMI creates a smoother, more predictable demand pattern, suppliers see a reduction in the total amount of order transactions and product returns, along with a decrease in freight cost. The higher efficiency increases brand loyalty by providing a quality product with quality service.

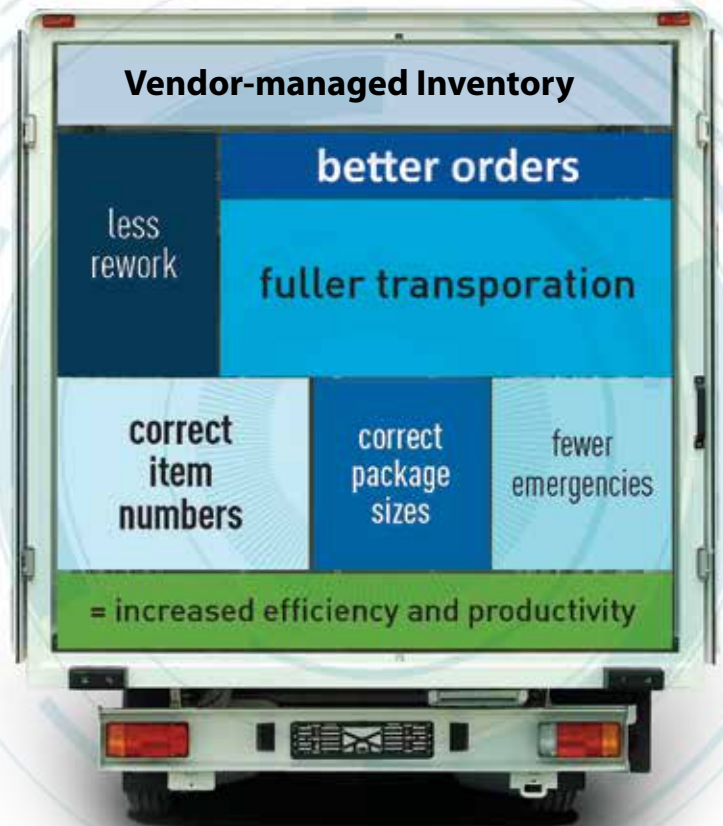
While the suppliers benefit by providing products in line with the demand for them, distributors also profit from using VMI. When the distributor relays product

demand information, in return it receives reduced transaction cost, a more accurate product mix, and stock suggestions for recently launched products that are a good fit for its market position. The reduced lead times and focus on product availability improve the relationship between the distributor and supplier, as well as with the end customer.

VMI Spells Success

For Hoffman, using VMI has changed the focus of the supply process, turning the supply chain into a revenue driver. Affecting the company in other areas outside of supply, using VMI has enabled better customer service and freed the salesforce’s time for selling. Since 2008, Hoffman has significantly increased its number of participating distribution locations to more than 350, with VMI responsible for 40 percent of all standard through-stock sales.

Continued on page 12



Continued from page 11

With an increased product mix at distributors and a better understanding of product demand, Hoffman has seen a 40 percent decrease in out-of-stock inventory and an increase in sales.

Border States Electric (BSE), a VMI partner with Hoffman, has been closely involved with the VMI

process since joining the program. Collaboration and communication were instrumental in the development of their VMI agreement. The partnership has resulted in greater efficiencies, annual cost savings, and improved processes.

The growth and success of the commercial product business relies heavily on products being on the shelves when the customer needs them.

“The Hoffman VMI team provides excellent service daily and acts as a single point of contact with nearly all procurement related activities,” said Jim Long, Vendor Performance Analyst at BSE. “The core values of this team are a great fit with our culture at BSE, and as a result of this work and relationship, Hoffman has achieved one of the highest scores in our Vendor

Performance Management program. They consistently achieve goals set forth and are maintaining a Platinum Vendor Performance status.”

Together, the companies have found success in using VMI by accommodating the system to their needs and the needs of the end customers.

Looking Forward

VMI has helped Hoffman and its key distributors run more efficiently and save money by eliminating wasteful practices. This lean process will continue to have a future with the company—Hoffman is looking to continue the success and expand its VMI participation with distributors and stock orders and its third-party stocking locations. VMI improves local product availability and delivery, supplying distributors with the correct inventory and giving customers the products they need.

The growth and success of the commercial product business relies heavily on products being on the shelves when the customer needs them, which is why VMI is clearly one of the main reasons for Hoffman’s success. ☺

Calling NEMA Member Companies: Share Your Stories

Does your company have a story to tell?

NEMA welcomes case studies and other analyses that demonstrate innovation, efficiency, and other aspects of manufacturing.

Submit your story for publication in *electroindustry* magazine to ei@nema.org.

Case study:

Power Outlets, Ports, and Enclosures Go Back to School



Two of the biggest trends in K–12 education are the adoption of mobile technology and the implementation of outdoor space. Regional School District No. 7 in Winsted, Connecticut, is on the cutting edge in both. It allows students to use smartphones for educational and social reasons during the day. The schools have courtyards that are used for outdoor learning opportunities and for students to take breaks.

The district's cell phone policy is unusual. Not only do students use mobile devices in class for web-based assignments, but they may also use their phones for personal reasons during breaks.

“We were early adopters of allowing students to use their phones,” said Judy Palmer, PhD, district superintendent. “Initially, some staff members were a bit apprehensive, but that was short-lived, and I think that speaks volumes about our culture. Our students are very respectful.”

THE CHALLENGE

If students are encouraged to use their personal devices, they need to have a way to charge them. District officials realized that adding charging infrastructure to the courtyards could meet that need and promote greater use of the outdoor spaces.

“We do have some areas to charge devices inside the building, but there was nothing outside, and we wanted that option for students,” Dr. Palmer said. “If their devices aren't charged, then they are unable to use them for classroom activities.”

THE SOLUTION

After hearing about Legrand's outdoor charging station, the school board and administrators believed they found a solution.

“I didn't have any concerns while implementing our plan,” Dr. Palmer said. “We had to bring electricity to the courtyards, but that was a simple process. The



Photo courtesy of Legrand, North America

charging stations have a sleek design and do not take up a lot of space. They are in use daily, and we haven't had any significant increase in our utility bills.”

The pedestal-shaped stations include a combination of standard power outlets and USB ports. They have a NEMA 3R rating for use in all weather conditions and feature light-emitting diodes (LEDs) for lighting.

Some educators may question the value of allowing students to use their phones during the school day and in advocating for them to take breaks outside. Dr. Palmer, an educator for more than 30 years and a superintendent for 17, is not one of them.

“One of the things that I like the most is when I look out my window and I see students sitting in the Adirondack chairs relaxing, listening to music, talking with one another, charging their phones,” she said. “The more I see of students in this particular environment, the more I see the value in it. I am a firm believer in encouraging students to take a break and relax with their friends when they can.”

The superintendent has seen the evolution of technology in schools during her career, from a single computer lab serving an entire school to laptop carts pushed around to classrooms. Now, computers in the form of smartphones and tablets fit in hand, are mobile, and access the internet wirelessly. Nearly all students have their own devices.

“The internet is right at the fingertips of our students, allowing learning to take place anywhere, anytime,” Palmer said. “It's been great to have power out there with the outdoor charging stations. The students are using them every day.”

Submitted by
Legrand, North
America



3D Printing Manufactures More than Hype

Kevin Connelly,
Senior Program
Manager, NEMA

Mr. Connelly admits to the thrill of witnessing force and speed on the manufacturing floor.

In 1928, Henry Ford completed construction of one of the greatest monuments to industrial manufacturing. The River Rouge plant was built on the model of receiving raw materials on one end and rolling a finished car off the other. I would love to have seen raw steel melted, formed, molded, stamped, and bent into parts, and then to see those parts assembled, painted, coated, and finally brought together to form a ready-to-drive vehicle.

The 600-acre River Rouge factory is now home to Ford's Rouge Center, an industrial park that includes six Ford factories. Imagine, if you can, the reduced footprint that could be achieved if the promises of 3D printing were to be realized. Also known as additive manufacturing, 3D printing offers a wide range of

benefits, including reduced inventories, improved performance, less tooling, and faster time to market.

In 2013, the research firm McKinsey Global Institute published "Disruptive technologies: Advances that will transform life, business, and the global economy," which suggested that 3D printing could have an impact of up to \$550 billion a year by 2025. This stands in contrast to the publicity focused on the residential market. 3D printing applied to the manufacturing supply chain has the potential to not only incrementally improve the bottom line of manufacturers but also disrupt the manufacturing process and supply chain.

Reducing the cost and complexity of manufacturing enables parts to be manufactured in house. Parts can be designed for a specific use instead of designed for general use and adapted for the specific. This results in greatly reduced manufacturing equipment: fewer parts in storage means less capital tied up in parts inventory.

Hype and Hyperbole

It is generally believed that any advance in technology is rarely, if ever, a panacea. Hyperbole and hype should be assessed to decide how, or even whether, to best take advantage of the technology.

For example, the internal combustion engine ushered in a significant era in our modern lifestyle but is responsible for a great deal of air pollution. In the early 1950s, nuclear power was seen as an unending source of energy, but the Three Mile Island accident in 1979 triggered a 33-year ban on new licenses. Almost every new communication technology introduced in the twentieth century, from radios and TVs to computers and smartphones, improved our ability to communicate, but many people feared they were responsible for destroying young minds.

As we implement 3D technologies, it may be prudent to look critically at the ability to produce a multitude of parts, assemblies, and products with only the interchange of a digital file. In some respects, this will eliminate the need for parts, as they are currently known. Today, many parts are produced as interchangeable devices for the purpose of accommodating the manufacturing process.

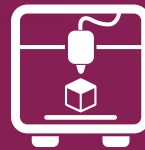
Interchangeable parts, however, may not be necessary in the 3D model. Furthermore, as manufacturers produce more products in house, on demand, and without specialized molds, the need to have sufficient inventory is greatly reduced.

Manufacturing Efficiency

Leaving the hype and hyperbole behind, here are a few undisputed advantages:

- **Quicker to market:** The ability to quickly, and with relative ease, produce customized parts and assemblies will offer manufacturers the ability to rapidly accelerate the time to market. As organizations refine or perfect the product innovation cycle, prototyping and test marketing will become quicker, wider in scope, and more flexible.

On the other hand, nimble organizations may be enabled to quickly and continuously get innovative products to market, potentially establishing market dominance. This has its own consequences: getting products to market without a quality system that adapts to the new speed of product development could expose manufacturers to liability. As the product development cycle shrinks, product development will likely evolve to incorporate greater emphasis on client feedback and customer centered design.



How 3D Printing Works

Direct metal laser sintering (DMLS) and selective laser sintering (SLS) are additive manufacturing techniques that sinter—that is, use pressure and heat below the melting point—to bond and partly fuse masses of metal particles.

They differ in how the layers are deposited. DMLS fires the laser into a bed of powdered metal, aiming the beam at points in space defined by a 3D computer-assisted design (CAD) model, thus bonding the material together to create a solid structure. SLM, a newer technique, achieves a full melt.

Similar techniques include selective laser sintering, fused deposition modeling, and fused filament fabrication. Others cure liquid materials using sophisticated technologies, such as stereolithography. In laminated object manufacturing, thin layers are cut to shape and joined together. [enr.com](#)

- **Increased customization:** Eliminating the expense and complexity of setting up molds allows manufacturers not only to produce and deploy prototypes quickly, but also to market smaller batches and more highly customized products. Want something with specialized features, but are only in limited amounts for a small but important client? No problem. Want something with a specific form factor? No problem. In the past these scenarios would have been too expensive to even consider, but with the advanced customization made possible with 3D printing, specialized products in small quantities will be much more reasonable.
- **Zero inventory:** The ability to print on demand will reduce the inventory of parts and could, if managed correctly, reach zero inventory with all parts being printed out on site, just in time.

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Continued from page 15

- **Eliminate the middle man:** It is not too hard to imagine that the 3D model could completely disrupt the supply chain as it currently exists. If manufacturers determine that it is more cost effective to produce parts in house and on demand, they may begin to decrease or eliminate the need to have an outside firm supply parts.
- **Easier entry:** The advent of 3D printing is likely to see new manufacturers emerge. Already in the consumer market are local 3D printers that will print replacement parts or specific designs for consumers. Consumers may also buy and use 3D printers themselves. There are also one-off job shoppers that will produce a part for a small fee. Home consumer with appropriate digital files can make replacement parts or their own designs without the time and expense of having molds developed. Reducing the barrier to entry will likely increase innovation and influence the existing players in the market.

On the other hand, there are risks and concerns:

- **Shifting landscape on quality:** Even as some quality issues are eliminated in the early stages of 3D printing, challenges remain with new entrants, smaller quantities, and how quality itself is addressed. Quality procedures may need to be adapted to the details of each product. Also, new production methods may allow for different specifications (e.g., smaller wall thicknesses), which does not necessarily mean that the product quality will be sufficient at that wall thickness, only that the production method allows for it. Some manufacturers might learn that lesson too late.
- **Material integrity:** As the technology evolves, concerns may shift from confirming the integrity of a mold or a large capital-intensive process to concerns of correct material mixture and application and file integrity.

Bullish on 3D Printing

John Lefavour,
Engineering
Manager,
Application
Tooling Products,
Burndy

Additive manufacturing, or 3D printing, is a boon for manufacturers that strive to get product to market quickly and cost effectively.

Printing metal parts by direct metal laser sintering (DMLS) or selective laser sintering (SLS) is on the rise. Advanced market sectors are taking advantage of this technology to reduce the number of components in an assembly and to make lighter products at lower cost. Through 3D printing, it has become easy to produce parts of complex geometries that could not otherwise be produced from conventional machining.



Photo courtesy of Burndy


Printing plastic parts is now widely embraced by the consumer market. Consumer 3D printers start at about \$300. Larger, more expensive units are readily available and well suited for business.

The application need and available budget are likely to heavily influence the buying decision. For example, if the application requires printing acrylonitrile butadiene styrene (ABS) plastic, which is a common thermoplastic polymer, a fused deposition modeling (FDM) printer may be a good choice.

Burndy, LLC, a manufacturer of electrical connectors and installation crimp tools, is benefiting from 3D printing capabilities. The process starts with a computer-aided design (CAD) model of a part. The CAD file (i.e., the part model) is processed in accordance with requirements for the 3D printer. The FDM printer is able to build the part with printing material such as ABS thermoplastic one layer at a time. Almost any geometry or shape can be printed. In some instances, additive manufacturing technology enables engineers to consolidate conventional machined parts into a single 3D-printed part, lowering the cost of the assembly.

Coming in April:

MITA to Fill in the Gaps in Medical 3D Printing

The Medical Imaging & Technology Alliance (MITA), a division of NEMA, will report on its efforts to enable hospital-based additive manufacturing (3D printing) across the clinical landscape through the use of the DICOM (Digital Imaging and Communications in Medicine) standard for the creation, storage, and management of additive manufacturing models in a healthcare setting. 

- **Greater potential for counterfeit:** The technology doesn't introduce anything new, other than tremendous manufacturing flexibility. Certainly counterfeit products are available today, but the ease of manufacturing does make it much easier to counterfeit a product. The best analogy is the music industry. Prior to Napster's appearance, it was possible to re-record music. Napster facilitated pirated music. 3D printers may introduce inherently dangerous materials into environments where the

Burdny engineers are bullish on 3D printing because it reduces the time to market for new products, since 3D printed parts enable quick design verification (fit, form, and, in some cases, function). Design verification and optimization are most beneficial early in the product development cycle but prior to the commitment of more expensive production tooling, such as investment cast molds, forging dies, plastic injection molds, and stamping dies.


3D-printed parts can be used to confirm that a particular design meets the customer's requirement. This enables the customer to provide feedback on a particular design early in the new product development cycle.

In preparation for new products, manufacturing engineers can use the 3D-printed parts for reference while developing production tooling, machine fixtures, casting tooling, and injection mold tooling. For example, the 3D-printed ABS parts can be installed in the machining fixture in lieu of more costly conventional metal parts. The plastic parts can sometimes be machined in place of metal parts to prove-out computer numeric control programs and tooling.

3D printing technology is rapidly changing, with many


operators may not have the appropriate safeguards in place. For example, a manufacturer that stamps out a piece of metal may begin to print that piece. If that manufacturer is not aware of the hazards and how to ensure safe operation of the equipment, there could be substantial risk. There are no 3D-specific safety standards available.

Predictions, of course, are never accurate, at least not *in toto*. Dystopian and utopian visions of the future rarely pan out, but they do spotlight possibilities. The movie *Minority Report* depicted drones and micro-focused marketing, concepts that have in some way come true. Precognition, the ability to view the future and anticipate crimes, has not materialized—yet.

The items discussed in this article are not intended to predict how 3D technology will play out. Instead, it is an opportunity for decision makers to analyze as many sides as possible in order to take advantage of this evolving technology and avoid any missteps. 


Fit, Form, Function in Minutes

Legrand, North America uses fused deposition modeling (FDM), a rapid additive prototyping process that allows the manufacturer to expedite new product development. In-house FDM capabilities make it possible to reduce prototyping time from several weeks to as little as a few hours.

FDM prototypes allow the company to quickly review and validate product ideas because they can be used for fit, form, and limited functional testing, as well as effectively gathering customer feedback. 

—Steve Rood, Director, Codes & Standards, Electrical Wiring Systems, Legrand America

types of printers available. Selecting a printer that is right sized for particular applications and budgetary needs can be a challenge. There is also post-processing equipment, which needs to be considered.


Finally, 3D printers can be office friendly and are an attractive showpiece for customer tours. Printed samples are inexpensive and make great customer takeaways. 



GE Invests in 3D

Additive manufacturing (AM), also known as 3D printing, is changing the way companies create and produce products. For many years, companies have used 3D printing to make rapid prototypes and accelerate new product design. In recent years, as the technology has advanced, we've seen manufacturers shift towards production applications, and General Electric (GE) is no exception. GE invested heavily in AM in 2016 and moved into the equipment space to support advanced manufacturing and production.

GE opened its Center for Additive Technology Advancement in Pittsburgh, Pennsylvania, to drive the industrialization of additive technology and accelerate the development production of new products in each of its industrial businesses. The center leverages expertise in AM to take new ideas or existing parts, reimagine them, and redesign them in a way that adds significant value by optimizing performance, weight, or total product cost. Designers find the best process to engineer complex pathways and optimize flow and thermal cooling.

This new way of thinking saves customers money by improving the overall efficiency of their products, reducing the need for energy consumption, and increasing throughput. At one German power plant, heat shields can cool air with 15 percent less cooling air with AM. Using 3D printing, CFM International's LEAP fuel nozzle is 25 percent lighter. GE's new advanced turboprop engine for Cessna will leverage AM to eliminate more than 800 conventionally manufactured parts. 

—Jennifer Cipolla, Center for Additive Technology Advancement Leader, GE

3D Printing Comes Home

While 3D printers for home use have been available for about five years, it is only recently that price and performance have come to a point that they can be called affordable. In January, I bought one.




Alex Boesenberg envisioned, designed, and delivered NEMA keyrings with his home 3D printer. Photo by Alex Boesenberg

Any hobbyist or DIYer is familiar with subtractive manufacturing. You start with a chunk of material and carve away everything that doesn't look like the finished product. 3D printing is the opposite: it is additive manufacturing. A melted filament of material (usually some form of thermoplastic) is extruded by a microcomputer-controlled setup. Additive manufacturing uses just enough material to make the form in question, with very little wasted material.

One opportunity that is already playing out in small-scale manufacturing is the ability to create devices or toys in relatively small numbers. Many of the fittings and braces for my

3D printer are, in fact, printed themselves. I can even download part files from the printer manufacturer and reprint versions for things that have been improved since my printer was made.

What fascinates me about 3D printing at home is that it removes the historic requirement of having the backing and expertise necessary to develop, build, and operate injection molding equipment. There are a rapidly growing number of online forums where hobbyists make, share, improve, and re-share almost any item you can imagine. Celebrity gearhead Jay Leno added a 3D printer to his garage a few years ago to prototype and test the fit and function of modeled replacement parts for his one-of-a-kind antique vehicles before having the parts made from appropriate metals.

Perhaps the most interesting aspect of 3D printing is the relatively quick turnaround from rendering to tangible item. The ability to envision, design, and deliver complex objects at home is now at a scale that until recently was only possible in professional prototyping facilities. 

Alex Boesenberg, Manager, Government Relations, NEMA



Standards, Testing, and Certification in a 3D Printing Era

Complex shapes made of lighter and stronger materials, intricate designs, and opportunities for mass customization—these are the benefits delivered by additive manufacturing, also known as 3D printing. Traditional manufacturing techniques such as casting and machining fall short of such results and can make them cost prohibitive.

The manufacturing of a 3D product starts with a digital design and involves solidifying thin layers of material, a process that offers unprecedented opportunities to industries such as automotive, aerospace, and healthcare, as well as in consumer products such as jewelry and packaging. This technology can be used throughout a product's lifecycle, from rapid prototyping to design, manufacturing, and maintenance, when spare parts can be printed on demand.

While additive manufacturing is currently too slow to support mass manufacturing, these key industries show no sign of slowing down with their 3D printing applications. As they continue to evolve their manufacturing technologies, it is only a matter of time before a commercially viable solution is identified.

The component parts and complex materials involved in 3D printing technologies add a layer of complexity—and safety challenges—that can be mitigated through reliable testing and certification.

Path to Commercialization

One need only look at the global manufacturing landscape to see 3D printing as a successful manufacturing technique that supports aggressive growth strategies. Among the leaders is Renishaw, a global company that designs and builds advanced additive manufacturing systems. Another is EOS, which turns innovative ideas from prototype to serial manufacturing.

These companies are among many that clearly demonstrate the use of 3D printing technology as a viable alternative to current manufacturing processes, particularly when customization at the design stage is required. When systems and finished products are tested and certified for safety and reliability, 3D printing can transform industries focused on delivering unique products on a mass scale.

Materials compatible with 3D printing range from plastics to metals, and their number is increasing. Each application will dictate the performance properties of the finished product, as users will expect a certain look and feel. Therefore, materials will need to meet mechanical, chemical, and tensile requirements. The testing and certification of such materials require most standards development organizations (SDOs) to extend their current capabilities and acquire relevant expertise.

Not only do machines require the correct material, but they also need to behave in such a way as to ensure that their end products meet minimum quality and safety standards. The answer is in the testing and certification of the entire system, using safety criteria that are suitable for the level of complexity introduced by the additive manufacturing methods.

The concept of functional safety is very much a part of the testing and certification services of many SDOs, such as CSA Group and Underwriters Laboratory (UL). Functional safety principles are applied to products or systems whose failure to operate reliably could harm people, property, or the environment. Companies can demonstrate functional safety by showing that the systems' functionality is dependable enough for the level of risk it controls.

Evolving technologies reshape the manufacturing landscape and accelerate change, but one thing remains constant: manufacturers need a reliable, technically competent, global testing and certification partner to gain and keep a competitive edge. ☞

Stephen Brown,
Director of
Innovation, CSA
Group

Mr. Brown is responsible for standards development, product planning and management, regulatory affairs, international business development, and strategic planning at CSA.



CORROSION:

Eating Away at Electrical Components

Photo courtesy of PPG

Maria Lamorey, Business Development Manager, Electrical Transmission & Distribution Equipment, PPG Industrial Coatings

Ms. Lamorey is has been recognized for her leadership and continued growth in the electrical equipment industry by the University of Pittsburgh Institute for Entrepreneurial Excellence.

According to NACE International, the corrosion of metal on infrastructure, buildings, equipment, and vehicles costs the world's consumers, businesses, and governments more than \$1 trillion each year. Electrical component manufacturers and their customers bear a significant portion of that expense, yet the best strategies for designing and coating electrical enclosures, transformers, switchgear, and lighting fixtures to protect against this nemesis are often an afterthought.

This is problematic for several reasons. For one, electrical equipment may be required to withstand decades of service in harsh environments. That makes metal coatings a critical first line of defense for sensitive instrumentation and controls. There also are hidden costs for corrosion-related maintenance and repairs, as well as the damage done to the manufacturer's brand image by having their name affixed to unsightly equipment.

It's no wonder that buyers consider metal equipment design and coatings in light of total lifecycle costs—including maintenance and repair requirements—rather than initial purchase and installation price only.

Causes of Corrosion

Metal components corrode for any number of reasons, including the intersection of two metals with different corrosion thresholds, or factors such as continuous or repeated exposure to high temperatures and humidity, acid levels, electrolytes, chemicals, ultraviolet (UV), and sunlight.

The most effective way to select the right coatings for metal electrical equipment is a total system approach that considers and accounts for the following variables:

- Composition of the metal substrate
- Types of lubes and coolants used to fabricate the equipment
- Materials selected to pretreat the metal
- Type of finish coat, including film build and cure requirements

Beauty's Not Skin Deep

A common misconception is that coatings are painted on metal. In most corrosion protection systems, coatings are applied to the pretreatment layer on top of the metal substrate, which serves as the first line of defense against corrosion.

In addition to reducing surface corrosion, pretreatment products enhance the ability of coatings to adhere to coated metal parts, thereby preventing delamination. There are multiple pretreatment chemistries available—from iron-phosphates and zirconium-based products to zinc-phosphates and cleaner-coaters. The best chemistry for a particular application depends on substrate type, fabrication method and materials, and the desired performance requirements of the full coatings system, including the primer and topcoat.

Three major coating technologies can be deployed individually or in combination with one another. They include liquid, powder, and electrocoating.

Liquid coatings use solvents or water. They are applied to pretreated metal with electrostatic spray, dipping, and other conventional methods, then air-dried or force-cured. When used as part of an integrated primer, pretreatment, and topcoat system, liquid coatings offer exceptional corrosion and chemical resistance, excellent sag resistance, and strong adhesion.

Powder coatings are formulated for applications that require the ultimate combination of corrosion resistance, weathering performance, and operational attributes. Powder coatings are typically formulated with polyester resins and are favored for their excellent corrosion resistance, chemical resistance, and all-around application versatility. Because they are made without solvents, they generate virtually no volatile

organic compound emissions, which can help achieve environmental compliance.

During the electrocoating process, pretreated metal substrates are immersed in an electrically charged paint bath. Charged coating particles form a tightly packed, insulating layer that reaches every recessed area of the coated part. At the end of the coating line, the metal part is baked, creating a tough finish that offers more thorough protection than spray-applied coatings.

Another important criterion for selecting the right coating chemistry is the design of the finished part. Components with sharp corners, recessed areas, or intricate shapes can be finished with coatings that are formulated with high-transfer efficiencies.

Coatings manufacturers offer a variety of resin chemistries to improve resistance to corrosion and UV exposure, including epoxies, polyesters, urethanes and acrylics, as well as hybrid coatings, which incorporate a combination of resin chemistries. Each has its strengths and weaknesses. For instance, epoxies are ideal for chemical resistance and mechanical properties but lack in UV resistance and weatherability. Polyesters, urethanes, and acrylics have exceptional weathering characteristics, but each offers a different benefit, such as great physical properties for polyesters; chip, scuff, and mar resistance for urethanes; and superior surface appearance for acrylics.

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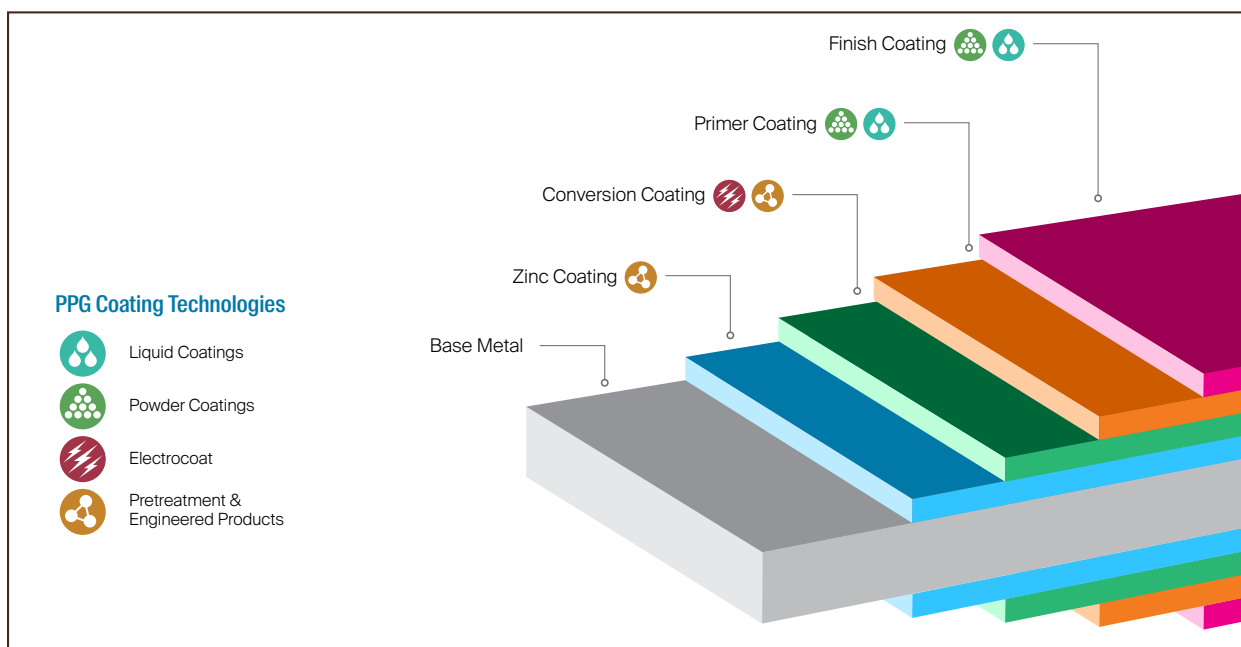


Illustration courtesy of PPG



Continued from page 21

Typical solutions include two-coat systems featuring a primer coat for corrosion protection and topcoat for color, appearance, and UV resistance. Other popular options include one-coat hybrid systems that combine a mixture of resin chemistries to provide an optimal balance of corrosion protection and UV resistance.

Troubleshooting

When coatings fail, determining the cause begins with basic questions:

- Is the corrosion visible on all parts or does it appear randomly?
- Is the corrosion confined to parts used in a specific geographic region, or do coatings fail in multiple climates and environments?
- Are failures widespread or sporadic? Is there a discernable pattern?

One parameter to analyze is phosphate coating weight. A phosphate coating weight that is too low will not provide enough corrosion protection, while one that is too high can compromise the structure of the coated part and cause it to crack or become brittle.

It is also important to look at crystal size in zinc-phosphate pretreatments and coating uniformity in iron-phosphate treatments. It is evaluated by viewing the failed coating under a microscope. This is the only way to determine whether a coating has the proper coverage and molecular structure to resist corrosion. The presence of bacteria also can negatively impact the conductivity of the paint (i.e., its ability to adhere to the metal substrate).

Another parameter is film build (or paint thickness). If the film build on a coated part is too thick, it can lead to problems with adhesion, peeling, and sagging. If the film build is not thick enough, the result is less protection from the environment and greater vulnerability to corrosion.

Paint cure is a variable that should be monitored carefully by running data packs through cure ovens to ensure that operating temperatures and other variables meet system specifications. Low cures can result in poor adhesion and insufficient mar and abrasion resistance. High cures produce peeling and cracks in the paint film.

A final consideration is laboratory-based performance tests that are designed to mimic real-world performance environments. While many coatings

systems are robust enough to pass industry-accepted performance tests, they can fail in the field because the real-world conditions are more difficult to survive.

Matching Coatings to Performance

When evaluating a coating system for electrical equipment, it is important to understand all of the product requirements and the possibility that multiple chemistries may be required to optimize service life and corrosion performance.

For example, the exterior coating on a transformer may require corrosion, weather and chemical resistance, while the interior coating may need to be compatible with certain oils, lubes, and chemicals.

Coatings for switchgear and electrical enclosures may need to meet additional demands, such as insulative properties that allow them to trap heat or permeability that enables them to dissipate it. Humidity and heat oxidation also can affect a coating's ability to protect against corrosion, and equipment with sharp edges or complex shapes require a coating that is capable of fully covering such areas, which are common pathways for moisture penetration and corrosion.

Last, whether you are considering a coating system for a transformer or electrical enclosure, or to enhance the design of a lighting fixture, it is important to specify a coating that is both mar-resistant and abrasion-resistant, as these units are commonly exposed to contact with people, tools, or other pieces of equipment that can further increase susceptibility to damage and potential for corrosion.

When beginning the design of a new product or the next-generation of an existing product, evaluate the best paint system early in the design process. This will help ensure not only that the product can perform well in its service environment but also that it will require less maintenance throughout its lifespan.

It also helps to involve paint and pretreatment suppliers as early as possible in the product design process. Proven paint suppliers typically have a deep understanding of the coatings process from start to finish, along with a wide range of products and resin chemistries that have been tested according to industry-standard criteria. They also act as a partner in identifying potential vulnerabilities to corrosion and in helping their customers to select the right products to prevent it.

Understanding the causes of corrosion and variables help manufacturers develop a comprehensive coating specification. Ⓢ



We protect and
beautify the world™

Putting You in Charge



General Electrical Finishes for Transformers, Switchgear, Enclosures and Lighting

From durable products that protect transformers, switchgear and enclosures to the bright whites and colorful coatings that illuminate the latest trends in lighting fixture design, PPG has been a trusted and reliable coatings supplier to the electrical equipment industry for decades.

Yet, there's more to our heritage than longevity. As one of the world's largest coatings companies, PPG produces an exceptional range of corrosion-, chemical- and UV-resistant products, including one of the most comprehensive selections of UL-1332 DTOV2-listed coatings in the industry.

We're also one of the few global coatings companies with expertise in every major coatings technology, from liquid and powder to electrocoat and pretreatment products. That means we can deliver fully integrated, single-source solutions for every stage of your coatings process, along with products tailored to your specific substrate, end-use application, production line and customer requirements.

To learn more, visit ppgindustrialcoatings.com or call 1.888.774.2001.



Environmental and Health Product Declarations: Threat or Opportunity?

Everyone on all sides of manufacturing knows that environment and health concerns are growing in relevance. Scientific research raises new facets of these concerns not only to the business community but increasingly to the greater public as well. How important they will be in the future is anyone's guess, but one thing is clear: the trend is upward.

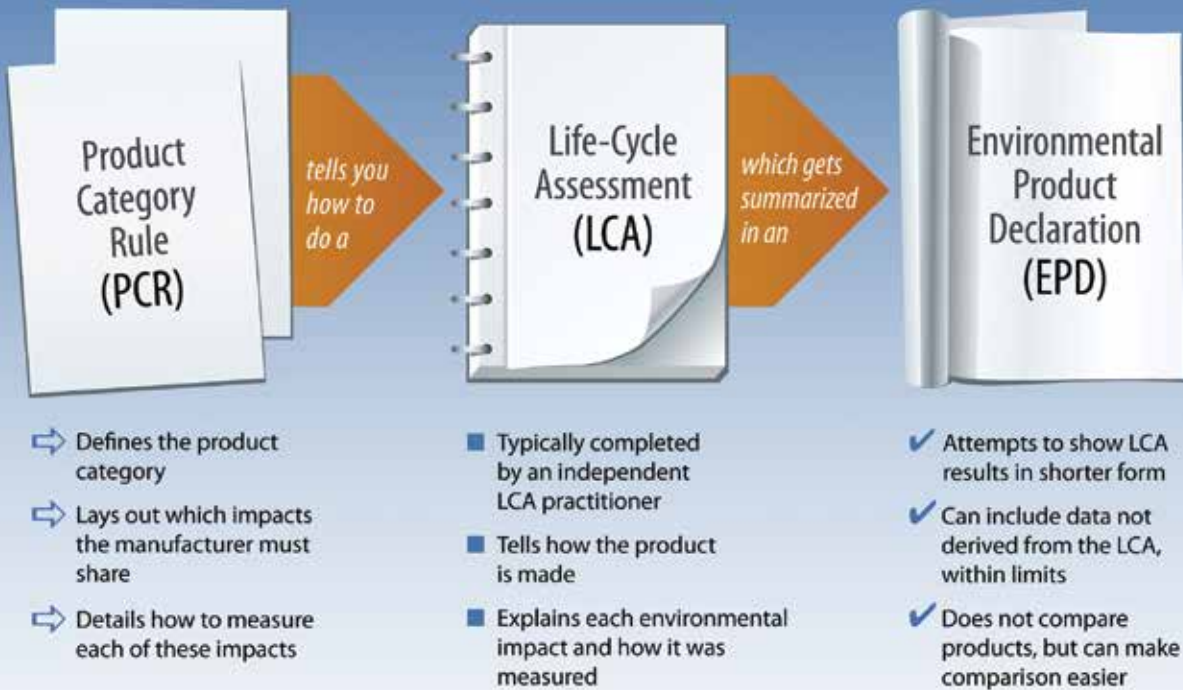
Electrical products are not immune to this movement. In various NEMA product sections, discussions on environmental and health product declarations started years ago. Their frequency increased as new trends emerged. For example, the International Green Construction Code (IGCC) has mandated environmental product declarations (EPD) for compliance. While electrical products are excluded for the moment, there is guarantee

that this situation will last. Health product declaration (HPD) requirements were also noted for some products.

Through the NEMA Strategic Initiatives program, and with guidance from members of the High-Performance Buildings Council, a program was established to research environmental and health product declarations. While the process is heavily dependent on the type of product being evaluated, there are a few high-level findings that are worth sharing.

One important finding is that the EPD and HPD processes have intrinsic value for companies engaged in them regardless of the market drivers. Furthermore, having done a HPD provides a head start on the EPD, since the company knows the product contents for both.

A clearly defined process leads to a good EPD.



CAUTION: Early adopters are deeply involved in setting up the rules.

CAUTION: Not every LCA comes from a PCR or leads to an EPD.

CAUTION: EPDs can appear more comprehensive than they are.

Deep analysis of all the components, materials, and processes involved in making the final product helps identify potential supply chain risks and liabilities that otherwise could be hidden from management's view. The analysis and standardization could also highlight inefficiencies of some manufacturing processes.

Another major point is that the primary market driver is already in place, and it's not a regulation. Demand is currently driven by Leadership in Energy and Environmental Design (LEED), a program created by the U.S. Green Building Council. Its voluntary building compliance certifications are increasingly in demand, especially in the commercial buildings market. The demands for EPDs are higher for products directly specified by architects whose firms promote green design principles.

We invite NEMA members and product sections to determine their specific stance in respect to these declarations. More detailed information about how EPDs and HPDs will impact NEMA members is available on the members-only section of the NEMA website. Interested members may also contact Andrei Moldoveanu for more information. ☎

NEMA Convenes Transportation Technology Workshop

On March 7, NEMA will convene the first in a series of workshops on connected transportation under the umbrella of the association's strategic initiative on smart cities. The focus will be on emerging technology in the transportation world, which is evolving quickly.

For information on other events and programs, visit www.nema.org/events.

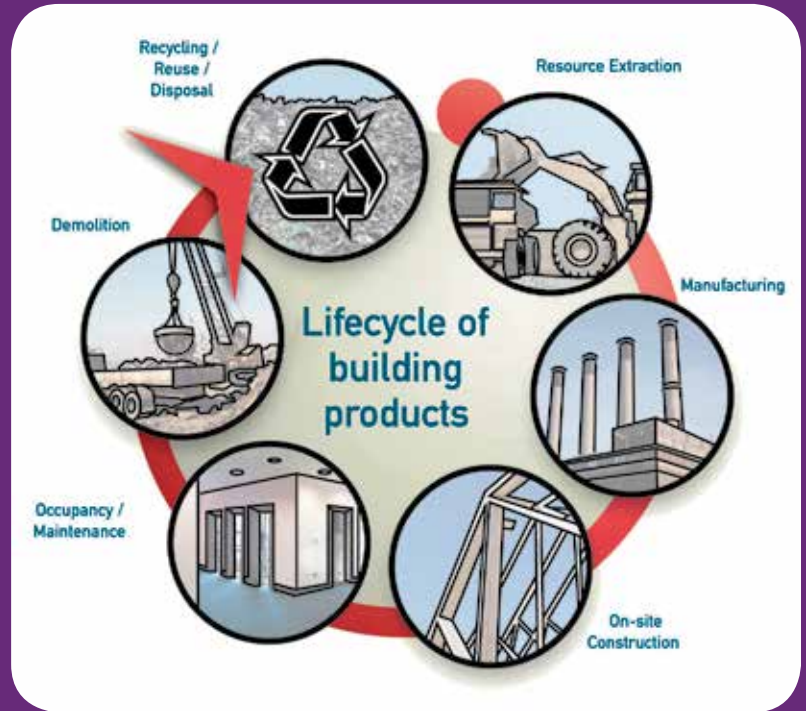


Illustration © Athena Sustainable Materials Institute

Glossary of Terms

Lifecycle analysis or assessment (LCA)

A detailed description of the environmental impact of every material and component used in a product, as well as every manufacturing process involved in making it. LCA studies include the impacts from using and disposing of a product.

Environmental product declaration (EPD)

A structured and validated summary report of the lifecycle analysis.

Health product declaration (HPD)

A document shared by manufacturers to disclose product ingredients and any health hazards associated with these ingredients.

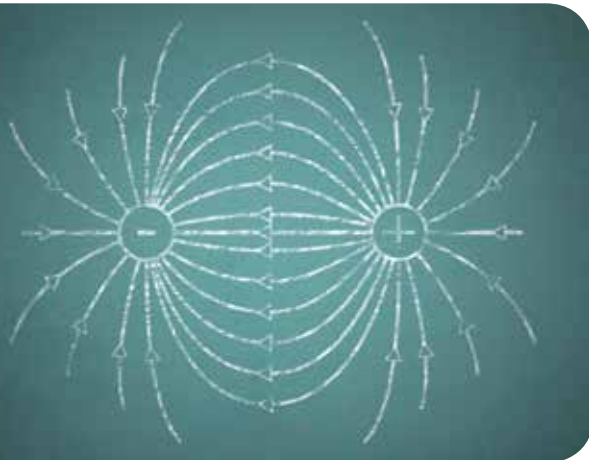
Product category rules (PCR)

Documents that serve as guidelines for LCAs, which in turn inform EPDs. These rules help to promote fairness by ensuring that all the products of the same type are measured with the same yardstick. ☎

Harmonizing Safe Use of Electromagnetic Energy

The Institute of Electrical and Electronic Engineers (IEEE) International Committee on Electromagnetic Safety (ICES) looked at human exposure to electromagnetic fields (EMF) and related safety provisions at a recent meeting.

ICES Technical Committee (TC) 95 addresses potential health effects from human exposure to EMF. Historical concerns for long term or chronic impacts have not been scientifically validated, but continue to be researched. The extensive studies of fields developed by power lines (done in the 1990s), and of more recent widespread use of cell phones and related towers, have not resulted in conclusive correlation.



One standard developed under TC 95 is IEEE C95.2 *Standard for Radio-Frequency Energy and Current-Flow Symbols*. It is used in setting radio-frequency safety programs, such as posting of signs, when access to equipment or areas around equipment needs to be limited. IEEE ICES will update this document, particularly to harmonize it with ANSI Z535 standards.

IEEE is working on consolidating separate documents for frequencies from 0 Hz to 3 kHz, and another from 3 kHz up to 300 GHz, as was done to provide a guidance document for use by the North Atlantic Treaty Organization (NATO). IEEE C95.1-2345 *Standard for Military Workplaces—Force Health Protection Regarding Personnel Exposure to EMF* was implemented by NATO countries and facilities for consistent practices and policies.


The International Commission on Non-ionizing Radiation Protection (ICNIRP) develops guidance concerning human exposure to non-ionizing radiation electromagnetic fields (EMF), which includes ultraviolet, light, infrared, and radio

waves, as well as infra- and ultrasound, but not x-rays or nuclear radiation. ICNIRP is currently focusing on cellular research, particularly the potential harmful effects from electrostimulation, electroporation (cell membranes), microwave hearing (a thermal effect), and temperature elevations above recognized thresholds.

IEEE ICES and ICNIRP are exchanging documents and proposals and working to harmonize the recommended levels of exposure. Both organizations rely heavily on literature review from published and peer-reviewed materials developed in the health and scientific fields. One area of significant effort in the research community is the development and refinement of body modeling to determine the extent of exposure from various sources, given the difficulty of determining actual heating impacts within the human body and the complexity of determining induced current flow.

The work of these organizations can be found throughout the world. In the European Union (EU), the Electromagnetic Fields Directive 2013/35/EU provides the minimum health and safety requirements regarding the exposure of workers to risks arising from EMF. In the United States, exposure to EMF is under the jurisdiction of several government agencies, including the Federal Communications Commission (FCC), Food and Drug Administration (FDA), and Occupational Safety and Health Administration (OSHA).

From the FDA standpoint, exposure of hospital workers in the vicinity of scanners employing strong field producing components and exposure of individuals with implanted medical devices are areas of concern. For OSHA, electric utility and factory workers where welding or electro-heating are used come under scrutiny. The FCC addresses cell towers and other broadcasting facilities where workers and perhaps untrained individuals could be exposed.

Learn more about these documents standards.ieee.org/about/get. 

Jonathan Stewart

Government Relations Manager,
NEMA

Calculating SF6-Insulated Equipment

NEMA Government Relations Manager Jonathan Stewart spoke in January on behalf of the Electric Transmission and Distribution SF6 Coalition at an Environmental Protection Agency (EPA) workshop on SF6 emission reduction strategies in Burlingame, California. The coalition is made up of representatives from the equipment manufacturers and SF6 producers and distributors and is administered by NEMA.

SF6 is the chemical notation for sulfur hexafluoride, the gas used to insulate medium- and high-voltage electric transmission and distribution equipment to prevent electrical arcing. It is a potent greenhouse gas. The EPA's Greenhouse Gas Reporting Program, as well as regulatory agencies in California and Massachusetts, requires users of SF6-insulated equipment to calculate and report emissions annually.

All three regulatory agencies rely on the same equation to calculate emissions. One

variable in that equation is nameplate capacity (i.e., how many pounds of gas the equipment will hold when properly insulated with SF6). Equipment in use, however, usually does not have precisely the same mass of gas that is listed on the nameplate; when the nameplate figure is greater than the amount of SF6 in the equipment, users are forced to report "phantom" emissions.

Mr. Stewart identified common scenarios that can lead to phantom emissions and discussed how to avoid them. He also spoke about the need for a regulatory solution to allow reporting entities to use a figure other than the nameplate designation for reporting purposes. ☺



Jonathan Stewart, NEMA Government Relations Manager, addressed SF6 reporting challenges at an EPA workshop. Photo by Karla Trost, G&W Electric

Andy Dhokai, MPPA

Director, Federal Relations, MITA

MITA Pushes for Medical Device Tax Repeal

Of all the issues discussed during the 2016 election, perhaps nothing stirred up more passion than the future of the Affordable Care Act (ACA). President Trump made its repeal a centerpiece of his campaign and stated his preference for a repeal-and-replace bill earlier this year. Congressional leaders eager to scrap the ACA indicated that the law's taxes, including the medical device tax, would likely be repealed immediately.

MITA is navigating the moving pieces of the repeal-and-replace plan and launched a full campaign to permanently repeal the device tax before the two-year suspension of the tax sunsets at the end of 2017.

While the White House and congressional Republicans quickly coalesced around a legislative strategy to repeal the device tax, the plan hit several roadblocks. A muddled timeline and the question of how to marry the repeal and

replace pieces have left many in our industry speculating over its fate. Senators Orrin Hatch (R-UT) and Amy Klobuchar (D-MN), along with Representatives Erik Paulsen (R-MN) and Ron Kind (D-WI), introduced legislation to repeal it early in the new Congress.

These stand-alone bills provide MITA and others in the industry with a rallying point to communicate the harmful effects of the device tax. Stand-alone bills also provide Democrats with an avenue to voice support for repealing the device tax without supporting full repeal of the ACA. Thirty Democrats in the House and four in the Senate cosponsored stand-alone legislation. If the reconciliation process stalls, these bills serve as an important backstop that can be used later in the year to prevent the reinstatement of the tax before its current two-year suspension expires.

Amid this uncertainty, MITA continues to push for repeal of the tax. ☺



MITA Board President and Senior Vice President of Philips Health Systems Solutions Joe Robinson met with House Speaker Paul Ryan (R-WI) and key congressional staff in January. Photo by Andy Dhokai

Big Win for Electrical Safety



The Manufactured Housing Consensus Committee (MHCC), a committee under the U.S. Department of Housing and Urban Development (HUD), is responsible for maintaining and updating Document 3280, the standard to which manufactured homes are built.

NEMA Midwest Field Representative Don Iverson represented NEMA on a task group of this committee since January 2016.

The group was responsible for reviewing and updating Document 3280 Subpart I—Electrical Systems of the Manufactured Home Construction and Safety Standards, which is currently based on the 2005 *National Electrical Code* (NEC). The task group voted to adopt the 2014 NEC, which includes provisions for tamper-resistant receptacles (TRRs), as well as expanded ground-fault circuit interrupter (GFCI) and arc-fault circuit interrupter (AFCI) requirements.

The main MHCC body, however, voted it down following a long debate. Later that same day, a committee member who had voted against the proposal re-opened the discussion. After further deliberation and some modification of the proposal, the MHCC voted unanimously to move forward with the 2014 NEC.

In the compromise, unfortunately, the MHCC approved two amendments. The first removes the requirement for AFCIs in kitchens and laundry rooms. The second removes the requirement for AFCI protection on dedicated smoke alarm circuits.

The committee action will be re-balloted and is expected to pass. Once that occurs, HUD will decide whether to accept the recommendation or not. If HUD accepts the MHCC proposal, the updated standard will move through the federal rulemaking process before it officially becomes a part of the HUD 3280 requirements, which is not likely before 2019.

NEMA staff will continue to track the 3280 document as it goes through the process and will be ready to provide assistance as needed.

According to CFED, an organization dedicated to alleviating poverty, “between 2011 and 2015, there was about one new manufactured home shipment for every 10 new single-family home starts.” The recent work of the MHCC task force represents a big win for electrical safety. ☺

Sign up for code alerts at www.nema.org/technical/code-alerts to receive up-to-date information on code adoption from NEMA field representatives.



Recently Published Standards

ANSI C78.44-2016 *American National Standard for Electric Lamps—Double-Ended Metal Halide Lamps* sets forth the physical and electrical requirements for double-ended metal halide lamps operated on 60 Hz ballasts to ensure interchangeability and safety. This revision includes the addition of a 2000-watt, M134 double-ended metal halide lamp. It can be purchased in hard copy or as an electronic download for \$204 on the NEMA website.

NEMA PRP 4-2009 (R2016) *Expansion Fittings for Polyvinyl Chloride (PVC) Rigid Nonmetallic Conduit* provides information about when and how expansion fittings are used. It is available as an electronic download at no cost on the NEMA website.

NEMA TCB 3-2001 (R2009, R2016) *User's Manual for the Installation of Underground Corrugated Coilable Plastic Utility Duct (CCD)* covers recommendations for the shipping, handling, storage, installation, and joining of underground CCD for power, lighting, signaling, and communication applications. It can be purchased in hard copy for \$78 or as an electronic download at no cost on the NEMA website.

NEMA TS 4-2016 *Hardware Standards for Dynamic Message Signs (DMS) with NTCIP Requirements* provides the user with safe, dependable, functional, and easily maintained DMS equipment. It can be purchased in hard copy or as an electronic download for \$160 on the NEMA website. 🎧



NEMA MW 780-2005 (R2011, 2016) *Returnable Packaging for 24 × 6 Magnet Wire Reels* provides guidelines for the minimum information required for the design and production of a returnable pallet generally made of a synthetic material, intended to accommodate primarily 24 × 6 reels. It can be purchased in hard copy for \$55 or as an electronic download for at no cost on the NEMA website.

NEMA PRP 3-2009 (R2016) *Expansion Epoxy-Based Fittings for RTRC Rigid Nonmetallic Conduit* addresses the effect of thermal expansion and contraction on long, straight runs of conduit. For this application, O-ring expansion fittings are used to accommodate changes in length. It is available as an electronic download at no cost on the NEMA website.



Can You Hear Us Now?

Listen to Mike Leibowitz, NEMA program manager, and George Straniero, manager of codes and standards at AFC Cable Systems, discuss the purpose and benefits of NEMA Engineering Bulletin 108, *Application of Flexible Conduit for Structural Joints Intended for Expansion, Contraction, or Deflection*, and how this helps in the planning of electrical systems involving structural joints in or on buildings, bridges, garages, and other structures.

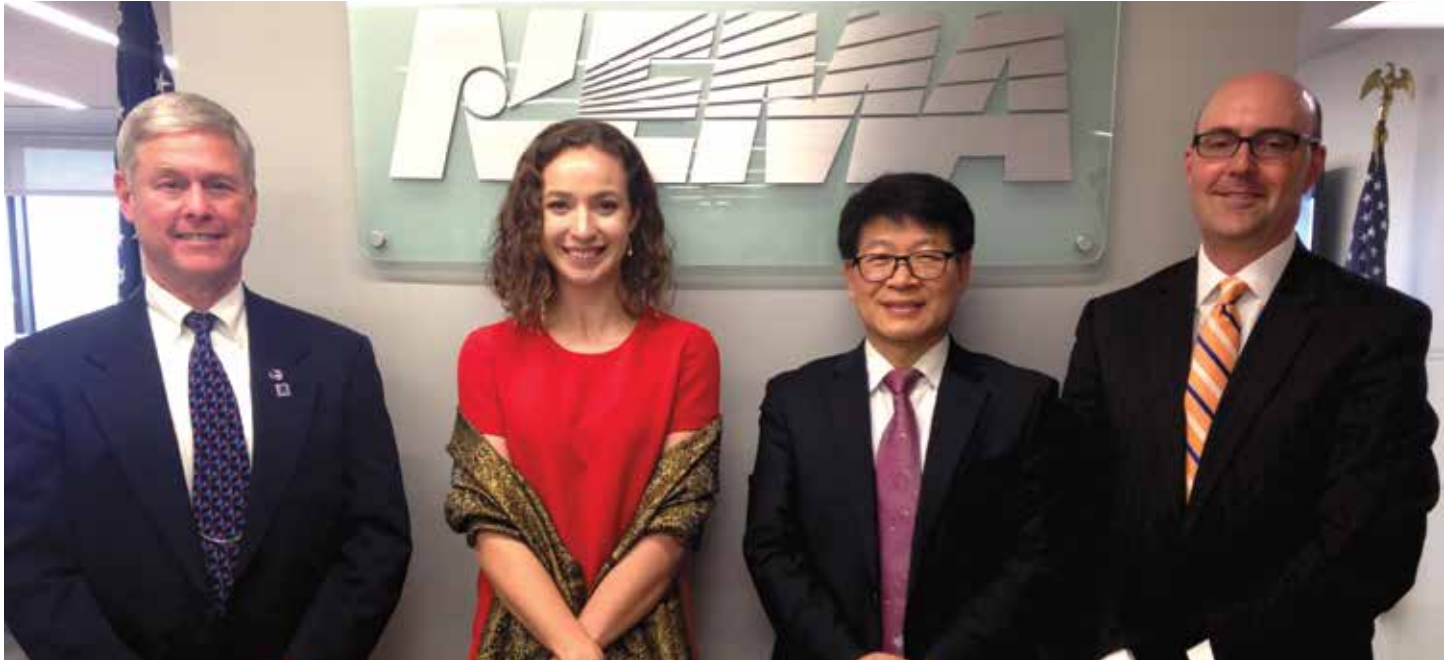
www.nema.org/application-of-flexible-conduit

Adopting Volt/VAR Optimization Technologies

Tricia Breeger explains the differences between traditional volt/VAR management technologies and newer VVO technologies, as well as the benefits to electric utilities of adopting these technologies.

www.nema.org/adopting-voltvar-optimization-technologies

NEMA Welcomes KOEMA to Talks on Collaboration



Byung-II Park, Korean Electrical Manufacturers Association, met with NEMA staff to discuss collaboration between the two organizations. Pictured are (from left) Ken Gettman, NEMA director of international standards; Madeleine Bugel, NEMA program manager of international business; B.I. Park, KOEMA international affairs director; and Craig Updyke, NEMA director for trade and commercial affairs. Photo by Cassie Ricci

Byung-II Park, director of international affairs for the Korean Electrical Manufacturers Association (KOEMA), visited NEMA in February to explore areas of possible collaboration between the two organizations for the benefit of member companies. KOEMA and NEMA staff will review an existing memorandum of understanding (MOU), originally signed in 1994, before proposing updates and considering new activities to benefit the members.

KOEMA represents 220 Korean manufacturers of electrical generation, transmission, and distribution equipment. The leading Korean electrical utility, the state-majority-owned Korea Electric Power Corporation (KEPCO), is also a member. KEPCO has sole responsibility for the country's transmission and distribution, while six KEPCO-owned regional companies handle generation assets, including nuclear power plants.

Mr. Park gave three presentations about KOEMA and its initiatives, with special attention to energy storage systems (ESS). Key points included the following:

- 350 MW of energy storage has been deployed regionally in Korea, solely for frequency regulation.

- Korea's nationwide smart grid will be completed by 2030, with metropolitan areas completed by 2020.
- Roughly 50 percent of electricity meters have been replaced by smart meters, with 22 million total meters on track to be deployed by 2020. In the area of electric vehicle (EV) charging, Mr. Park opined that limited deployment of EV charging stations is restricting adoption of these vehicles in Korea.
- KOEMA and its counterparts in China, Russia, and Japan are studying the possible use of high-voltage direct current for transmission.

KOEMA lead the establishment of the Federation of Asian Electrical Manufacturers Associations (FAEMA), which includes KOEMA and its counterparts in Australia, China, India, Japan, and Taiwan.

The collaboration between KOEMA and NEMA is made possible in part due to a 2012 free trade agreement between Korea and the United States. KOEMA invited NEMA and its member companies to participate in the Seoul International Electric Fair trade show in September 2017. ☺

Strong Dollar Sinks Equipment Shipments

Electroindustry equipment shipments, broadly measured and seasonally adjusted, grew 0.9 percent in December after sliding one percent in November. A strong 2.2 percent gain in battery shipments in December was sufficient to offset a 0.4 percent decline in electric lighting equipment shipments and a 0.7 percent drop in core electrical equipment shipments, which include transformers, motors, generators, switchgear, industrial controls, and low-voltage distribution equipment.

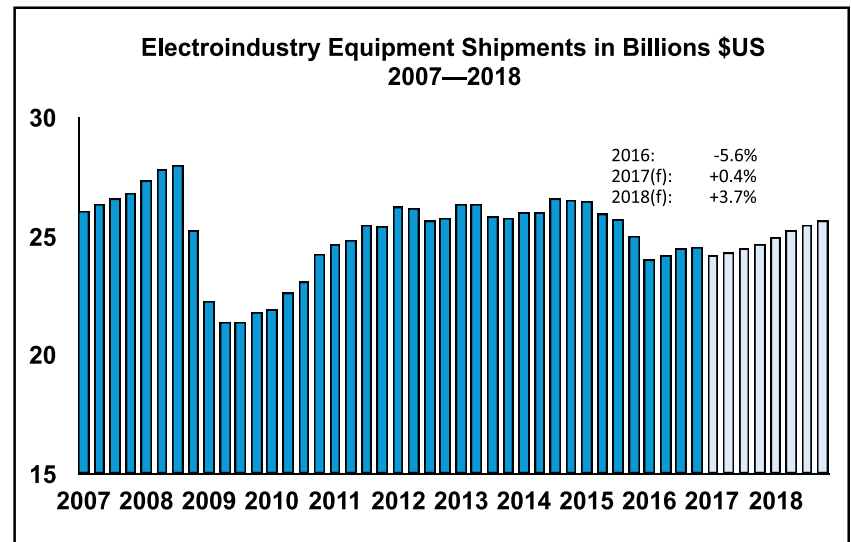
For the year, the value of electroindustry equipment shipments was 5.6 percent below the 2015 level. The December gain helped to keep the change in shipments slightly above the expected decline of 6.1 percent. Core electrical and battery shipments in 2016 saw steeper 8.0 percent and 6.4 percent declines respectively compared to 2015. A 2.4 percent 2016 gain in the value of lighting equipment shipments helped to moderate the larger declines elsewhere in the electroindustry.

Orders were also down in December, slipping 0.7 percent at the aggregate industry level, partially reversing a 1.8 percent increase in November. Electrical equipment orders, which included core electrical and batteries orders, fell 1.3 percent in December after rising 2.6 percent in November. Lighting equipment orders declined by 0.4 percent in December following a 1.6 percent gain the previous month.

Electroindustry orders overall dipped 3.3 percent in 2016. The overall decline represents a 9.5 percent drop in electrical equipment orders and a 2.7 percent slide in lighting equipment orders.

The December data confirmed that the electroindustry suffered a stronger pullback in 2016 than in the preceding year, when shipments fell 1.9 percent. An extended period of wholesale inventory correction, an increasingly adverse exchange rate, the lingering impact of the recent plunge in oil prices, and weak global trade demand were the primary factors leading to the negative 2016 market. The strengthening value of the dollar constrained exports and helped to lift import penetration substantially.

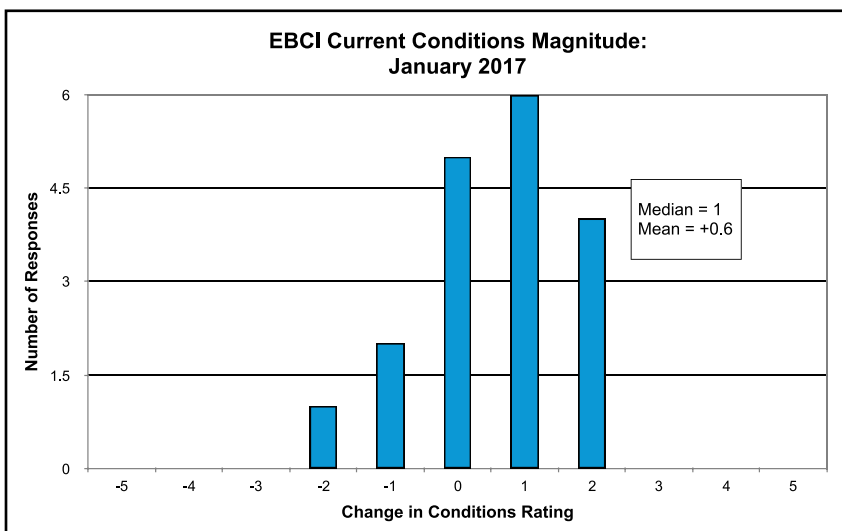
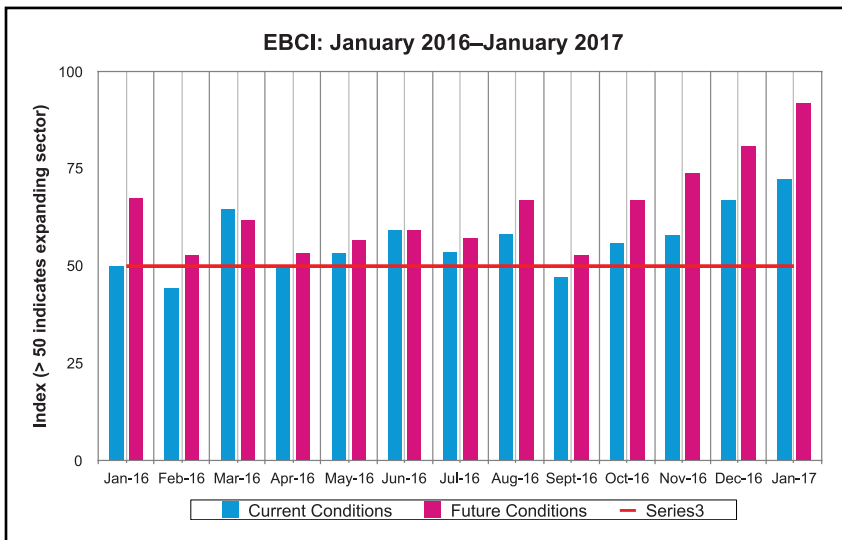
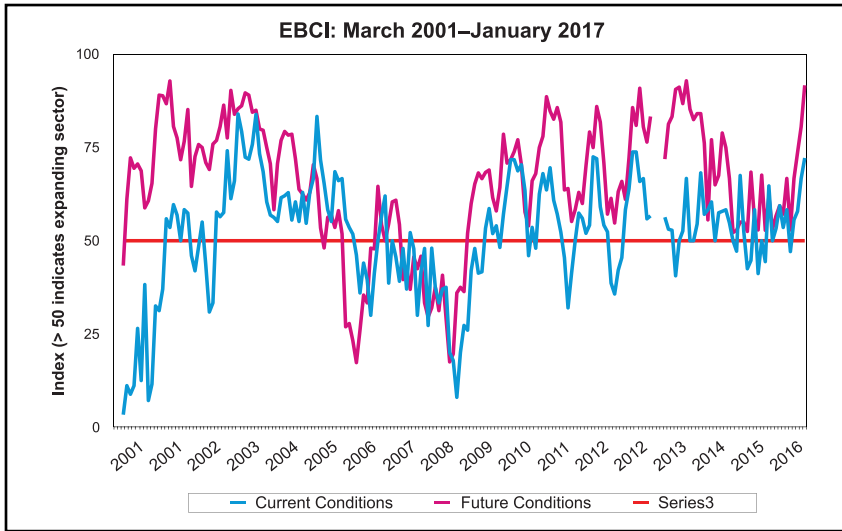
Looking forward, improving economic growth globally is expected to offset some of the adverse impact of the strong dollar value. The extended period of inventory correction is also winding down and will be less of a factor ahead as the U.S. economy picks up steam. An increase in infrastructure spending, to the extent it materializes and includes electricity grid improvements and renewable energy investment, will help to sustain the industry longer term.



Although the baseline forecast calls for the electroindustry to break into positive territory in 2017 and gain momentum in 2018, several potential adverse factors are in play. The Federal Reserve has signaled it plans to raise interest rates several times in 2017 and 2018, which could increase the divergence in the interest rate paths pursued by Fed versus the other leading central banks.

The divergence will likely cause the dollar to strengthen further, exacerbating the industry's trade woes. Another uncertainty is the extent to which U.S. trade policy changes may lead trading partners to retaliate in ways that constrain demand for U.S. exports or disrupt intricate international supply chain arrangements. ☹

Confidence Indexes Soar to Nearly Four-Year High



Mixed with guarded optimism, comments from the Electroindustry Business Conditions Index (EBCI) panel noted some market softness and uncertainty about the policy course being charted in Washington. Nevertheless, buoyed by a surge of respondents reporting better conditions, the current conditions index moved to 72.2, which is the highest reading in nearly four years.

Most of the movement came from fewer panelists reporting unchanged conditions: only 22 percent in January versus 44 percent in December. Although some of that exodus resulted in a six-point increase in those seeing worse conditions, 61 percent registered better conditions now compared to 44 percent in December.

The survey’s measure of the intensity of change in electroindustry business conditions continued to move further into positive territory, as the mean rating increased from +0.4 in December to +0.6 in January. Even the median measure, usually stuck on 0, increased to 1. Panelists are asked to report intensity of change on a scale ranging from –5 (deteriorated significantly) through 0 (unchanged) to +5 (improved significantly).

Optimism for six months out was unblemished by even one respondent who expected worse conditions. In December, six percent had expressed misgivings. Combining the absence of expectations for worse conditions with 11 percent fewer responses foreseeing unchanged conditions boosted the future index to a near-record high of 91.7.

Visit www.nema.org/ebsci for the complete January 2017 EBCI report. 📄

Plugged into Safety



Danny Abbate, NEMA Industry Director, Commercial Products

My friends and family always ask what it is I do at that place called a trade association.

As the NEMA industry director for commercial products, I work with power outlets, switches, fuses, steel conduit, surge protectors, and many other electrical products. Most people don't realize how big an impact these products have on society as we know it. The world's computers and televisions would not be able to function without them. Buildings would not have safe wiring. People would be at risk of electric shock or worse when using electric products.

The vast majority of personal electronics users have no knowledge of standards and product listings, but the manufacturers persistently work to vet these products through standardization, codes, and repeatable manufacturing processes. Without their hard work, we might not find ourselves in the Stone Age, but if everyone's gadgets were suddenly gone, it might feel like that.

The easiest response for me to give when asked what I do is to say that I am proud that my work helps product manufacturers make their electrical products safe and reliable for everyday use. ☺

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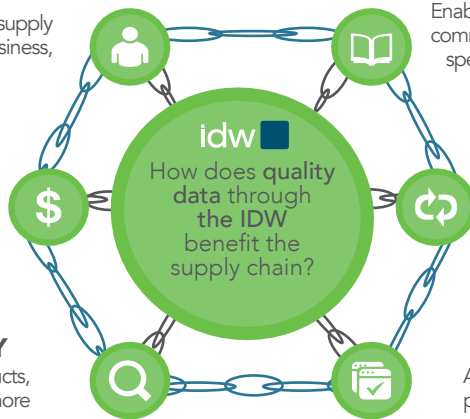
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