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RESCO Electronics

By Joe Tito
Wiring Harness News

If you’ve been reading our Industry Profiles, the history of Baltimore based RESCO Electronics may sound a bit familiar. Their story was recently told by David Copenhagen, President of RESCO.

The company was founded in 1932 by John Bagliani, Sr. as Radio Electric Service Company of Baltimore. Radio Electric’s original business was selling vacuum tubes and other electronic parts to radio repairmen. The counter sales operation eventually expanded to sell parts for TV repair as well, and grew modestly until John Sr.’s sudden passing in 1956. With two sons not yet in the business, John’s wife Edith

had no choice but to take the reins. By the late 1950’s, Edith and her sons, by then working for the company, realized that long-term growth could not be sustained by selling to radio and TV repairmen and began selling electronic components directly to OEMs. In 1978, Edith decided it was time to retire and turned the business over to her son, John Jr.

John had always shared his parent’s commitment to growing the business. When presented with an opportunity from one of their customers to do some value-added assembly in 1990, he jumped at the chance. Overall, the distribution business had a heavy emphasis on electrical connectors which made it easy to segue into assembly work. Harnesses and



Advanced electronic assemblies at RESCO, Acuña facility.

assemblies gained a solid foothold as part of RESCO’s business, although it remained a sideline through the 1990’s. Along the way, RESCO secured several barcode scanning lines that were also sold to OEM’s.

In 2003, David came on the scene and purchased RESCO Electronics when John retired. It didn’t take long for him to realize that being a relatively small player in the electron-

ics distribution industry was a losing proposition. The harness business was growing, yet there was no real push to market those capabilities. As David recalled, “We put our focus and resources behind the cable harness and barcode scanning businesses and deemphasized parts distribution.” Fast forward to today, and less than

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Testing Appliance Cables & Connectors

Driven by the desire for higher capacity appliances within the same external design envelope, and by the more complex functions, electrical design is being steered towards more and more compact solutions – solutions that include combining signal and power lines within a single connector, and reducing the pitch of board connectors.

Consequently, micro-pitch connectors are seeing greater use in appliance board-to-board and board-to-cable interfaces and with narrower pitch comes a higher probability of shorts.

Smaller gauge wires are more difficult to insert, and combined with well-documented contact locking lance issues there is greater chance of continuity breaks especially when Connector and Terminal Position As-

surance devices are neither features of the design nor of the chosen connector.

Additionally, some high performance high-density board-to-board connectors incorporate a ‘floating’ design that mechanically absorbs alignment errors thereby reducing stress & solder cracking. These floating contact systems can move in two lateral axes by as much as ±0.6 mm. During the operation and life of the appliance, there is a probability that this floating contact may move. How can continuity be verified across the full range of available motion?

Testing continuity & HiPot using multiconductor cable testers is an essential part of the workflow. Thorough testing prior to and after instal-

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Basics of Laser Wire Stripping

The following is an adaptation of the presentation titled *Laser Wire Stripping Masterclass* that was given by Dr. Paul Taylor, Founder of *Laser Wire Solutions*, at the *EWPT Expo 2018*. The class covered the history, applications and safety protocols for lasers used to strip wire. Special thanks for Dr. Taylor for helping prepare this adaptation, and also to Robert Tito for taking copious notes during the presentation.

Laser wire stripping has been around for 50 years, yet it remains somewhat of a niche. The first CO2 lasers were developed in 1960 and it didn’t take long for IBM to adapt them for wire stripping. The technology was pushed by NASA for use in the Space Shuttle Program in the 1970’s and 80’s. The Richard T. Miller Company began to bring commercial laser stripping equipment to market for consumer electronics in the 1990’s and 00’s. Along the way crystals, rather than gases, were used to produce laser beams for exotic and specific applications.

not used to pull it off, or to cut the wire (with few exceptions). Because of cost and functionality, blades are generally the way to go. If there is a reason a blade is not working, then it’s time to look at lasers.

There are many things that make lasers attractive. Lasers remove insulation but reflect off the metal conductors. It’s a self-limiting technology in that you don’t have to worry about dialing in a depth, or damaging the wire. The laser doesn’t care about the shape of the wire or the type of insulation. There are no consumables, as with blades, and tough materials like fiberglass can be stripped rather easily. Lasers are also practical where conductor sizes are quite small, like the size of a hair; or where insulation is bonded to the wire and would otherwise require a scraping or grinding process. The color of the insulation is not an issue as every polymer will absorb light and every metal will reflect. In short, lasers give you the confidence that you will achieve the same result every time.

Lasers can be used to either cut a slit in the insulation, or to vaporize the material altogether. The latter is usually not practical as it is time consuming, and generally leaves a residue from the insulation. This could potentially be an issue for a crimp or solder joint. As previously mentioned, bonded insulation may require to-

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The question of whether to use a laser stripper is akin to asking whether a hammer or screwdriver should be used. It really depends on the task at hand. Laser technology is not as versatile as blade technology. Blades have three basic functions. They are used to cut insulation, pull it off and also to cut the wire. A laser is a beam of light that can cut insulation, but is



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Copies of *Wiring Harness News* (ISSN 1097-0789) are distributed bi-monthly to wiring harness & cable assembly shops, cord set manufacturers, companies that process electric wire & cable (including fiber optic) for use in their own products, their suppliers and other interested parties.

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International Harness Resources Inc.,
(IHR Inc.)

Wiring Harness News
PO Box 669
Schererville, IN 46375
USA

Office Hours:
8:00 a.m. - 4:00 p.m. CST -
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Pros and Cons of Private Equity Buyer

By Loren Smith

Harness company owners often ask me whether they should sell to a private equity buyer. Although there is no easy answer to this common dilemma, I can offer some perspectives based on my many years dealing with private equity firms.

Background

Private equity firms in North America number close to 1,000 and range from one or two individuals with limited capital to large organizations with committed funds in the billions of dollars and investments in dozens of companies with revenues in the billions. The firms either have ready capital to make acquisitions or they need to first get a seller to commit to a letter of intent (LOI) before raising the necessary capital.

The business model of most private equity firms is to buy a majority position in a company, create additional value over three to five years, and exit (sell)—providing the equity firm’s shareholders with a healthy return.



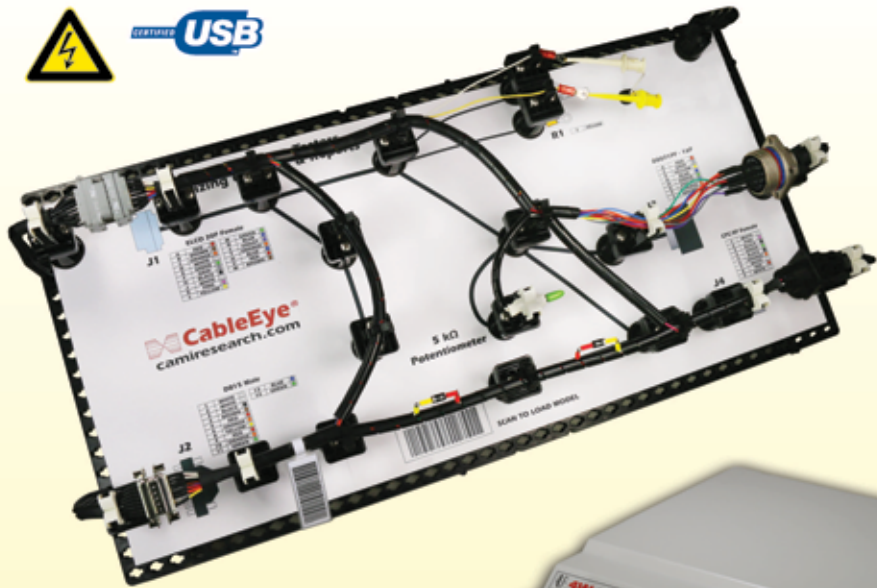
Loren Smith CEO
Blue Valley Capital

Pluses

Because private equity firms’ lifeblood is buying and selling companies, their skill in navigating all the intricacies of getting a deal done can enable transactions to go from the initial stage to closing seamlessly.

A private equity firm’s principals can often bring particular experience and knowledge to their assessment of management teams. As a result, I have

Continued on page 6



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3	32	32	63 mΩ	63 mΩ	< 1 µA	1499 V	> 1 G	0.189 mA	996 V	5 M	
4	34	34	125 mΩ	125 mΩ	< 1 µA	1499 V	> 1 G	0.204 mA	996 V	5 M	
5	36	36	249 mΩ	249 mΩ	< 1 µA	1499 V	> 1 G	0.204 mA	996 V	5 M	
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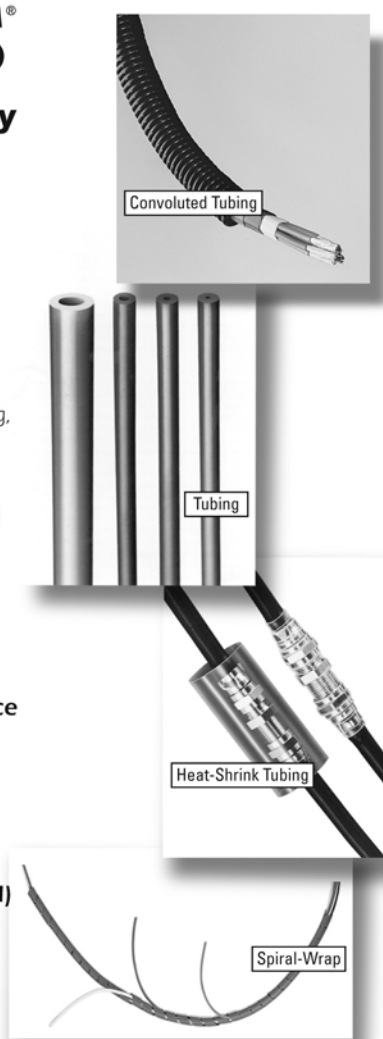
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Pros and Cons of Private Equity Buyer

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seen them provide levels of expertise to existing management teams that have enhanced the team's ability to achieve its objectives.

When a private equity group is already in the harness business and wants to add value by growing through acquisition, I've seen it accomplish this by enabling entrepreneurs to execute acquisition growth strategies they would not have been unable to achieve on their own.

Minuses

I have seen private equity companies undermine the competitive bidding process by providing a strong letter of intent and then, during the due diligence phase, exaggerating findings so they can modify the price and terms of the deal to their advantage.

I have also encountered private equity groups with impressive credentials but little or no relevant operating experience. After acquisition these groups too often try to play a central role in operations and ignore input from existing management with disastrous results.

Bottom Line

As stated, there is no easy answer to the question of selling to a private equity firm. Doing so can be highly rewarding or terribly disappointing. Company owners need to delve into the private equity firm's track record and determine how the firm's strengths align with their company's current situation and potential--as well as their own short-term and long-term goals.

*Loren Smith can be reached
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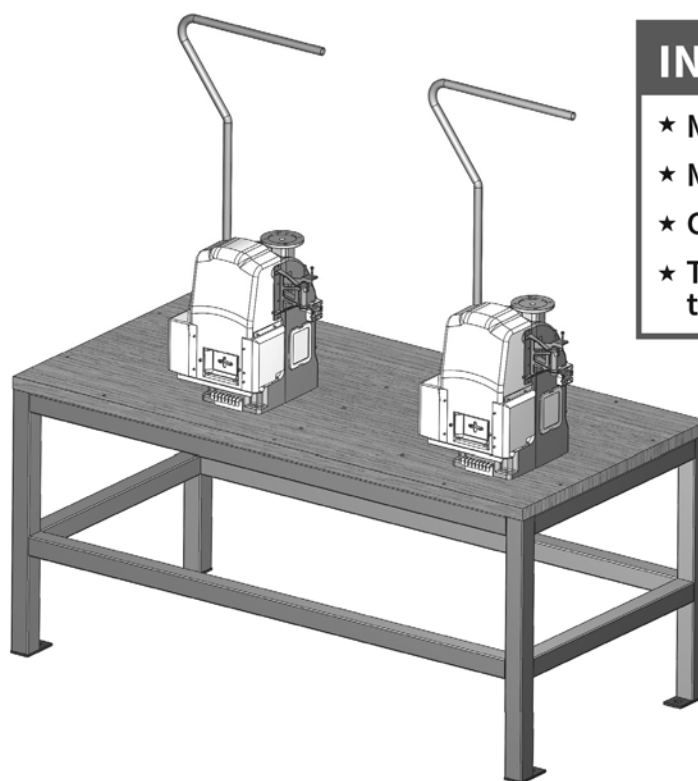
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Myth-busting the IIoT and Industry 4.0

By Paul Hogendoorn

The emergence of Industry 4.0 and the IIoT, or the Industrial Internet of Things, is causing equal levels of excitement and concern. Most manufacturers I visit have heard about its potential and are aware of the building hype, but don't know how it will affect them specifically. Depending on a person's age, the opinions vary from one extreme, to the other, with a healthy percentage of indifference. There is often fear associated with it, and like all fear, it is caused by uncertainty and lack of knowledge, fueled by myths and speculation.

If you are close to retirement, you may be inclined to be indifferent, believing it will be the next generation's problem - or opportunity. If you are in the middle of your career and working on the plant floor, you may fear it might eliminate jobs like yours in the future. And if you are in management, you might be concerned that the new technologies may be obsolete or displace your skills, or require you to learn new ones. It seems to me that the more one group of people get excited about the potential of these new technologies, the more concerned and worried the other group gets.



Paul Hogendoorn

So, let's pop the four myths I see and hear as most prevalent.

Myth #1: "The technology is only applicable for new machines, not for old and 'legacy' equipment". This notion is completely false. It is often perpetuated by companies seeking to sell you new equipment or expensive software or consulting services. The truth is that old machines are often far easier and less complicated to connect than new machines. As an example, I have seen machines built in 1928 connected, "as is", without modification or upgrade, for less than \$1,000.

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Myth-busting

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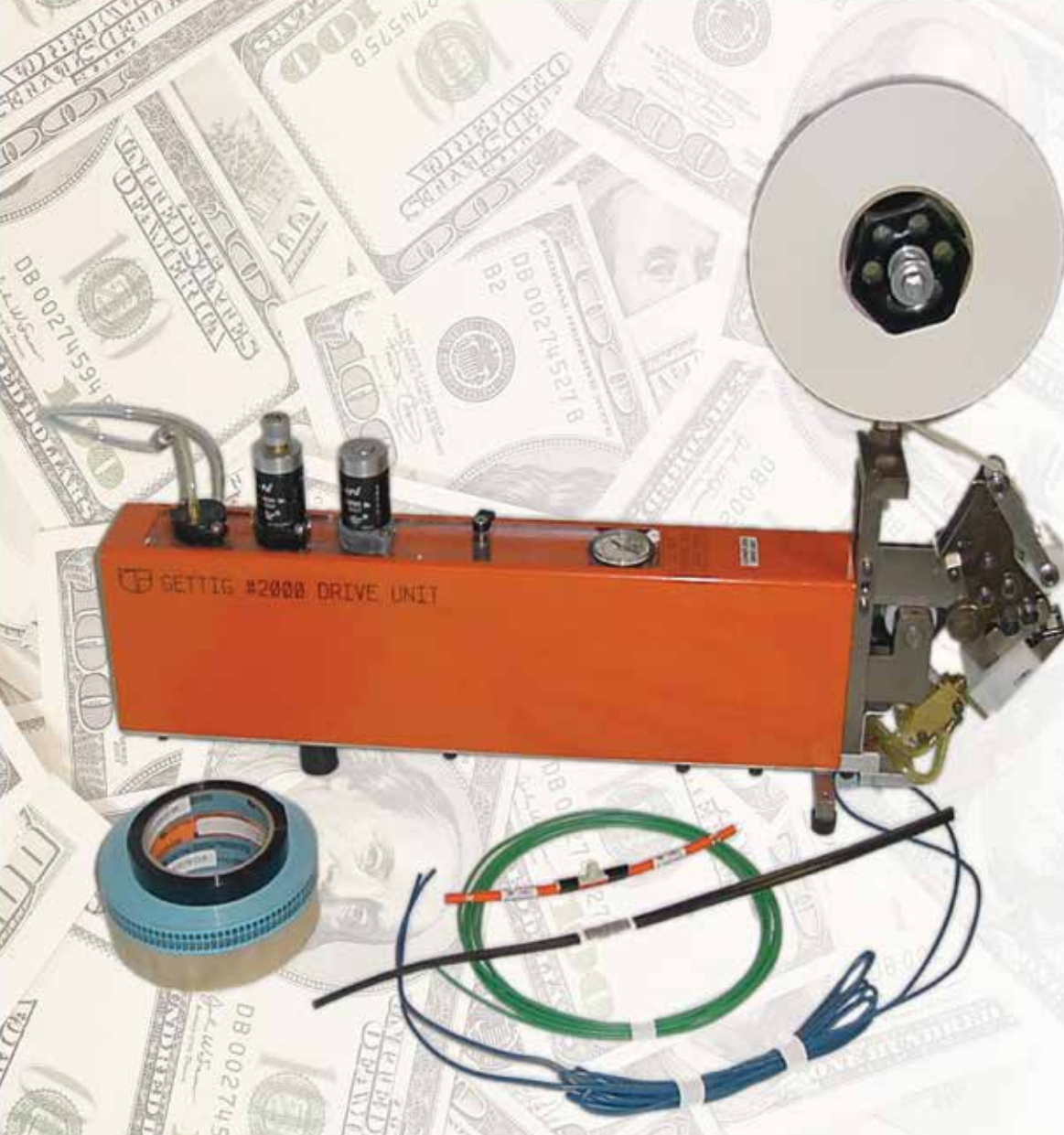
Myth #2: “The IIoT will eliminate people”. While its true that technology does eliminate some jobs, it also creates new jobs, and in many cases actually helps protect jobs by helping companies remain competitive with low cost regions. Properly applied, technology should do more than that – it should also improve the working experience. The purpose of IIoT technologies should be to engage workers, not to eliminate them. (The purpose of most internet technologies is to engage people – the more people engaged by a platform or website, the more successful it is deemed to be. The same measurement objective should hold true for the IIoT.)

Myth #3: “Data is complicated and requires a sophisticated skill set”. If this is true in your situation, you are probably measuring the wrong things. The most important information is the information that lets you see which of your systems and processes are healthy, and which ones are not, and this information is usually very simple to extract, and equally simple to compute. For example, a doctor may see 50 patients in a week. By just taking 3 measurements from each one (pulse, blood pressure and temperature), he or she will know which 47 patients are healthy and which 3 require far more attention. The same is true on the plant floor. Simple run time, stroke count and de-

fect count will let you know which processes are healthy, and which ones require more attention. For the ones that require more attention, you and your people already know the symptoms that are evident. It then becomes a matter of measuring and analyzing those things empirically.

Myth #4: “Big brother is watching”. This is the one I hear most often on the plant floor, but it’s a notion very easily dispelled. The fact is that management already knows the performance of a plant, person or machine; just perhaps not in real time. The only people that don’t know how well they are doing most often are the people actually doing the work. This may have been acceptable for our current workforce, but our emerging workforce – i.e. our young people that have grown up with constant real-time feedback – needs real-time feedback to remain engaged. Properly devised and deployed, IIoT technologies provide relevant, meaningful and engaging information to people. The information may come from a machine or sensor, but its ultimate purpose is still to inform, empower and equip, people.

Paul Hogendoorn is president and cofounder of FreePoint Technologies. He can be reached at paul.hogendoorn@getfreepoint.com or www.getfreepoint.com



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The Power Women of the Wire Harness Industry

Spotlight on Marissa Feinman

This edition of the ‘Power Women’ series features Marissa Feinman, a Mechanical Engineer with TE Connectivity. Like the females featured in past editions, Marissa’s story is unique as her path was illuminated by a scholastic program in secondary school. She is a graduate of Lehigh University in Pennsylvania and works in the Harrisburg area. The following paragraphs will provide more background on Marissa’s journey to becoming an engineer with TE Connectivity.

While her parents are professionals, Marissa does not have family members who exposed her to engineering at a young age. However, she defines her grandfather as a ‘tinkerer’— an engineer without a degree. While visiting him as a child, he always had new inventions to share with her. While her grandfather introduced her to some concepts and curiosities, she really learned about engineering during her high school years. Marissa was fortunate to attend a high school in Suffern, NY that offered a four-year engineering program per the “Project Lead the Way” program. In this program, students could choose a freshmen-level writing seminar, or Introduction to Engineering. As a



Melissa Femia

freshman, she chose the latter option since she performed well in science and math though she really was not certain that engineering would be a fit for her. She was one of only 2 females to enlist in a class of about 30 students. In her sophomore year (in which she was the only female), the engineering program enabled her to 1) focus on particular areas within engineering that were of interest and 2) research colleges that offered programs within those specific areas

Continued on page 14

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The Power Women of the Wire Harness Industry

Continued from page 13

of engineering. The program also included encouraging the students to speak with engineers in the field to inquire as to of what their day-to-day activities consist. The engineering curriculum during her junior year consisted of digital electronics including circuitry, programming of robots, and coding. In her final year of high school, the students were separated into small groups for a capstone-like project. They were to identify and research a problem, then create a solution and present the entire project to a team of engineers. Marissa highly considers the 'Project Lead the Way' program impactful to her professional future.

As she had previously visited an engineering professor at Lehigh as part of the high school program, she decided to attend the university for engineering school. She was interested in the engineering program and also enjoyed the campus atmosphere. At Lehigh, she was again the minority as a female in engineering. However, she did not consider the male to female ratio to be an obstacle as she was already accustomed to being the only female in engineering during her high school years.

Post college, Marissa decided to join TE Connectivity, where she was initially the only female in her group. This past July, she celebrated her fourth anniversary with the com-



Marissa Feinman

pany. For the first 2 years, she was in a rotational program in which she was able to work in 4 different groups for about 6 months each. She is now in a group that focuses on machines for wire harness processing. She supports the AMPLIVAR Product Terminator (APT) product line. She enjoys the large moving parts and considers the field to be exciting as there are always new challenges such as incorporation of new technology. She is the first engineering contact with whom customers work, often involved in troubleshooting activities with field service engineers. She is also involved in new designs and machine development.

Continued on page 16

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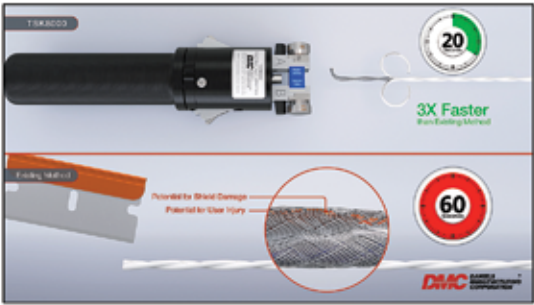
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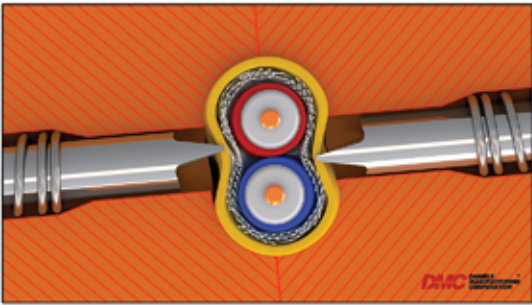
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The Power Women of the Wire Harness Industry

Continued from page 14 _____

As a part of the Women in Networking (WIN) employee resource group, Marissa is also responsible for community outreach in North America. In this extra-curricular role, she helps local TE chapters coordinate and attain funding for events focused on corporate responsibility. She was also a part of a team challenged by TE Connectivity's General Manager, Beth Schroeder, to create a better work environment. The team responded by creating a STEM (Science Technology Engineering Math) group. Every spring, the group puts together various activities geared toward elementary students. The goal is to create fun, relatable exercises while incorporating STEM concepts. This past year, the students worked with the TE STEM Group

to design 3D-printed catapult parts, then played 'Angry Birds'. The students needed to think about which angle(s) to release the contraption in order to knock down the game pigs. The kids were excited and their creative imaginations were sparked at a young age. Marissa is also involved in SWE (Society of Women Engineers) and makes a priority out of talking with the female hire candidates at TE.

Her main message to students in elementary and secondary school is that they do not need to be perfect mathematicians or scientists to pursue a career in engineering. Rather, they should simply have a curious interest in finding solutions. She feels humbled and incredibly fortunate to have attended the high school program offered in Suffern, NY. She knows not everyone has the program or the exposure. If students have any interest whatsoever, she recommends

However, she recommends that they speak with many other females in various types of engineering. Ask the engineers about their daily job activities or inquire as to which classes might be of recommendation. Whether via telephone call, email, or other method—reach out and learn about the opportunities that exist in engineering prior to discarding the career option.

Thank you, Marissa, for being a role model to other females in technology and for taking the time to share your story.

Spotlight story written by Melissa A. Femia, President of Jana Diversity Solutions (J-Di). J-Di is a female-owned small business that manufactures wire harnesses and supplies warehousing & logistics as well as engineering services. If you would like to be spotlighted in a future edition of WHN or if you would like to recommend someone to be highlighted for the benefit of advancing females in engineering, please send the contact information to melissa.femia@janadiversity.com. Inspiring individuals working in or around the wire harness industry are encouraged to participate, but the requirement is that the female must possess an undergraduate degree in an engineering discipline since the premise of the series is to encourage females to pursue and persist in engineering along with work in a wire-harness related industry.

A close-up photograph of several braided cables, showing the intricate woven pattern of the conductive material.

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Mentor Takes the Stage at Siemens PLM World Connection

This past summer, Siemens Product Lifecycle Management (PLM) hosted a massive user forum in Phoenix. The Siemens PLM umbrella of software solutions includes products like Teamcenter, NX, Solid Edge and of course, Mentor Graphic's Capital and VeSys. Mentor fills an important gap in the Siemens PLM platform with their software to help companies develop electronic products, including harnesses.

The Mentor track alone represented over 50 of the 400 total seminars designed to help companies become more nimble in the increasingly complex worlds of advanced electronics,

automotive, military, and aerospace. The seminars were heavily weighted towards electrical system design and wire harness manufacturing.

Here is just a sample of some of the subjects covered in Phoenix:

- Disruptive changes in automotive electronics
- Applying Industry 4.0 in harness design and manufacturing
- Validating electrical design with software analysis
- Aircraft electrical design trends

Whether you are a user of Siemens/Mentor or not, the PLM World event was an excellent opportunity to discover trends with your customers products, and network with other folks as they try to solve some of the most complex problems facing harness manufacturers today.

There was also a Product Showcase exhibit center where attendees could learn more, and get hands-on test drives on the various PLM software platforms. The exhibits were not limited to the Siemens line of products. Many non-Siemens companies who use Siemens PLM software to design and manufacture innovative

new products were also on hand at the Showcase.

Siemens has undergone a substantial business transformation with various acquisitions that have extended the company's reach beyond the traditional PLM domain. With the addition of companies like Mentor, the goal is to provide customers with a holistic platform for digital innovation across the product lifecycle.

If you missed the PLMWorld event, don't worry. More events are planned. Check out the home page for Mentor at Mentor.com.

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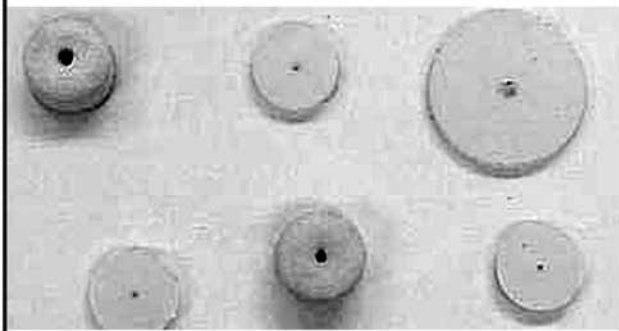
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The Battery Show Continues to Charge Ahead with Top-Tier Content and Programming for Its 2018 Edition

See *Wiring Harness News* at Booth 1758

The Battery Show, North America's largest advanced battery technology event, today announced its Advanced Battery Technologies conference, which will run alongside its 2018 event. Major focuses of this conference include addressing the latest developments across the battery industry, the next generation of battery technologies and the use of simulation and machine

learning to advance battery design. The Battery Show, which runs alongside Electric & Hybrid Vehicle Technology Expo and Critical Power Expo, takes place September 11-13 at the Suburban Collection Showplace in Novi, MI. To register as press for The Battery Show, please visit: battery.am.ubm.com/2018/registrations/Media.

With 24 hours of unmatched conference content delivered through workshops, technical discussions, panel discussions and forum presentations, The Battery Show provides a premiere opportunity to learn

about emerging technologies that will soon take over the industry. In addition to the Advanced Battery Technologies conference, keynote presenter Dr. Donald R. Sadoway will discuss the future of energy storage in his presentation, Pivotal Innovation in Energy Storage.

"The Battery Show is a champion for the thriving battery industries across the U.S., from raw materials through finished cells. We are thrilled to help showcase new innovations within our community and give our attendees an opportunity to learn about them

first-hand," said John Lewinski, brand director, The Battery Show. "We strive to foster an environment at our shows that allows for productive discourse and sharing of new ideas that will help push this industry forward. We are pleased to have many of our conference participants bring their most innovative ideas and presentations to the table at our event."

Some can't-miss battery-focused sessions include:

- Utilizing Battery Pack Thermal Analysis to Minimize Cell/Pack Degradation

Presented by: Saeed Siavoshani, PM - Electrification Program, Siemens PLM

The design of a battery pack system is highly dependent on the thermal management system utilized in the pack. Learn how to take advantage of the thermal behavior of the battery cells and the pack under the dynamic loads for 1D AMESim modeling analysis.

- Reduce Electrode Manufacturing Costs: Transition From Batch to Continuous Production

Presented by: BJ Kays, Senior Process Engineer, B&W MEG-TEC

Find out how certain continuous processes can be easily scaled up to mass production, lower total costs, reduced operating costs, simplified factory layout, improved quality, and increased productivity in this presentation.

— Continued on page 21

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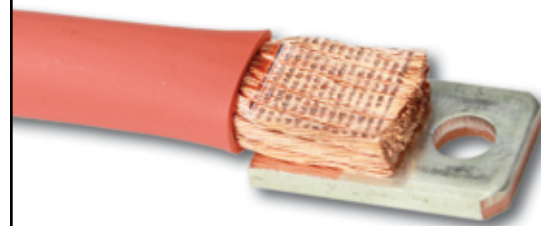


50mm²

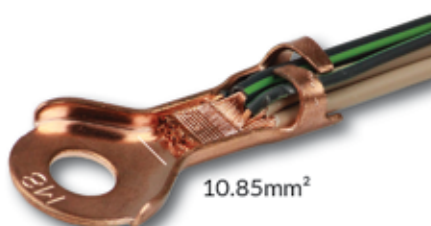
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The Battery Show

Continued from page 19

• Rapid Growth, New Applications, Developments & Market Dynamic in Automotive Batteries

Presented by: Michael Sanders, Senior Advisor, Avicenne Energy

Industry growth and regulatory requirements have fueled advances in many next-generation battery technologies, including Lithium-ion, Lithium-Sulphur, Lithium-air, and solid state. Learn about the latest developments, safety limitations, and best uses for each.

• Increasing Energy Density in xEV Battery Packs

Presented by: Bret Trimmer, Business Development Manager, NeoGraf Solutions LLC

Discover the advantages of replacing aluminum with flexible graphite for thermal management and propagation prevention in pouch cell xEV battery modules in this session all about this conflict-free mineral.

This conference will be accompanied by the Electric & Hybrid Vehicle Technologies Conference and Critical Power Tech Forum to explore innovations within their respective industries. To learn more about the educational conferences at The Battery Show and see the full conference schedule, please visit: thebatteryshow.com/education

The Battery Show was also recently recognized as a winner in Trade Show Executive's Fastest 50 Awards in both exhibit and attendee growth. The Fastest 50 Awards honor the fastest-growing trade shows held in the U.S. in 2018 as the Fastest 50 Class of 2018. Winners were selected based on percentage of growth in each of the following categories: net square feet of paid exhibit space, number of exhibiting companies, and number of attendees.

The Battery Show is North America's largest advanced battery technology event that runs alongside Electric & Hybrid Vehicle Technology Expo and Critical Power Expo. Together the three events bring a comprehensive showcase of advanced battery, electric & hybrid vehicle, and critical power technologies in one event. The Battery Show covers today's emerging advanced battery technology, spanning many established and emerging industries in today's market. The Battery Show is a part of the Advanced Manufacturing portfolio and organized by UBM, which in June 2018 combined with Informa PLC to become a leading B2B information services group and the largest B2B Events organizer in the world. To learn more and for the latest news and information, visit www.ubm.com and www.informa.com.



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RESCO Electronics

Continued from page 1

10% of RESCO’s sales are electronic parts, with those being specialized holdovers from “the good old days,” as David referred. Fifteen percent of their business is in barcode scanning equipment, with the remaining 75% being harnesses and assemblies.

As the assembly business grew, the company made some strategic acquisitions, all in the harness assembly arena. “We have actually purchased three companies in the past ten years as part of our effort to expand that part of the business,” Carlo Capizzi, RESCO’s VP of Accounting and Fi-

nance explained. In 2008, RESCO acquired Sherman Assembly Systems in San Antonio, Texas. Interestingly, Sherman shares a similar history with RESCO. It began in the 1930’s selling tubes and electronics over the counter, moved into more general electronics distribution, then eventually migrated to assemblies.

In 2012, RESCO made perhaps its most significant addition by purchasing MorrCo Enterprises which was located in Del Rio, Texas, but operated a twin plant (maquiladora) in Ciudad Acuña, Mexico. “The importance of the MorrCo acquisition is obvious,” advised Carlo, “in that it gave us a



RESCO’s downtown Baltimore location circa 1950. John Bagliani Sr. is pictured third from the right.

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manufacturing presence in Mexico.” The most recent “bolt-on” acquisition was made in 2015 when J-RAD Technical Services of Spartanburg, South Carolina was purchased.

About 60 percent of RESCO’s business is to medical equipment manufacturers. The other 40% is to what RESCO categorizes as industrial equipment OEMs. The industrial segment is a fairly eclectic group, but the largest sub-segment within the category is sales to companies making semiconductor equipment. Charles Fisher, RESCO’s VP of Sales commented “Our semiconductor equipment customers have a lot in common with our medical OEMs in that product reliability and consistency of production processes are critical,” adding, “the cost of failure is significant which is a common thread that runs throughout our customers.”

Uniqueness

The subject turned to RESCO’s uniqueness. David mentioned three areas that quickly came to mind: Their focus on continuous improvement, their ability to produce in the US and Mexico, and the core values they hold deeply.

The first area where RESCO really separates itself from other businesses is the focus on continuous improvement. At the core of its com-



ESCO Baltimore team



ESCO Acuña team

mitment to continuous improvement are a series of metrics. “As an organization, we collect data and statistics on everything,” Erik Olson, Senior Manager of Baltimore Operations commented, “and we have a fundamental belief that for continuous improvement to take place, you have to have a baseline.” Things like on-time delivery, acceptance rates, productiv-

ity rates, and quote response times are measured by facility and by customer. RESCO has broken these metrics down into four groups. At each week’s staff meeting, RESCO’s leadership team concentrates on one of the four groups so that performance against each metric is reviewed and

Continued on page 25



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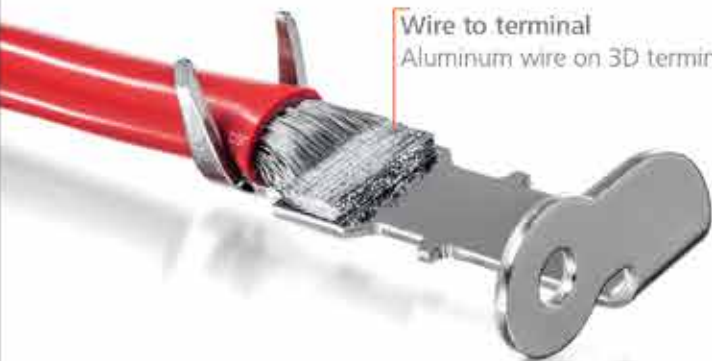
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Connection bolt on aluminum conductor



Wire to terminal
Copper wire on MAK



IGBT application
Copper terminal on
copper plated ceramic



Wire splicing
Copper and aluminum
combinations



Wire splicing
Multi-conductor cables
Twisted wires

RESCO Electronics



Figure 1: RESCO's Core Values

Continued from page 23 _____
discussed every month.

Over the last few years, RESCO has employed lean manufacturing principles to reinforce its continuous improvement efforts. Using tools like value stream mapping to reduce waste or applying 5S concepts to better organize the shop floor have been impactful. According to Tim Wunder, RESCO's VP of Information and Quality Systems "We have leveraged a number of methods to support continuous improvement throughout our organization. The use of lean manufacturing principles is a recent and highly effective example."

The second area that differentiates RESCO is having manufacturing capabilities in both the US and Mexico. Fred Morr, former owner of MorrCo and now RESCO's VP of Mexican Operations shared that RESCO's ability to manufacture in both the US and in Mexico gives it a unique competitive edge. "That has really turbocharged

our growth over the past five years as it has made us extremely flexible and very cost competitive." RESCO's Acuña operation is only about a mile from the border crossing at Del Rio, Texas. According to Fred, "The response time from our Acuña facility is essentially no different than if it was located in Texas. We can export customer shipments in the afternoon and have them to UPS or FedEx for domestic shipment that evening."

The final area of uniqueness that David described was less obvious to the outsider, but is perhaps the most important. "What has perpetuated this company for close to nine decades is our ability to maintain our culture." RESCO defines this culture through a set of six core values (Figure 1). "A lot of companies have mission statements and lists of values, but I think what makes us different is that it's not just a bunch of words; our values define the culture of our

Continued on page 27

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RESCO Electronics

Continued from page 25

company,” he said. They use these values when hiring, promoting, and, when necessary, dismissing employees. In fact, the values govern all the decision making at RESCO. “Most decisions become pretty easy when you are able to go back to a reference point like our core values.”

Where to Build?

Asked what determines which facility RESCO will use when quoting an assembly, Kelly Grato, RESCO’s Senior Manager of Procurement and Estimating said they have put a lot of time in developing their quotation template. It’s a fairly complex spreadsheet that allows them to enter detailed information about what they are building and outputs the cost to build in both Baltimore and Acuña. “One of the most important attributes of that spreadsheet is that it determines the cost to build in the US and in Mexico,” she explained. Ultimately cost is the primary driver but sometimes capacity or specific equipment or tooling takes precedent. “This will come as no surprise, but the higher the labor content relative to the overall cost, the more likely it is that Mexico will be the cheaper option,” Kelly confirmed.

The Future: Growth

Growth was David’s quick answer when asked about the future. “Our biggest challenge right now is keeping up with the growth of the business.” For the past three years RESCO’s compounded growth has been over 23% per year and the staff has grown by about 50% over that period. They currently lease a 15,000 sq ft facility in Mexico but recently purchased and are in the process of renovating a 40,000 sq ft building in Acuña. And the growth is not limited to Mexico. As David shared, “At the same time we are preparing a new home for our Mexican operations, we have been renovating parts of our Baltimore facility to create more production area. Our Baltimore production staff has more than doubled in the last year.”

David and his team are big believers that with growth comes opportunity. “We also believe that if you’re not growing, you’re dying, so there’s a pretty big emphasis in our organization on growth.” The company’s long-term goal is to maintain somewhere between 10% and 20% annual growth, with 15% being the sweet spot. “We hope to do that primarily through the organic growth of existing and new customers,” he concluded, “but as you can tell, we are not afraid to make acquisitions.”

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Basics of Laser Wire Stripping

Continued from page 1

tal removal. Varnished, or polyamide dipped, wires are widely used on stator assemblies in motors, and almost always require the total vaporization of the insulating varnish.

The most common situation for polymer insulated wires is to draw light across the wire from above and below, with just enough intensity to burn a 360° ring allowing you to pull off the insulation (Figure 1). There

are some precise applications where the tiny amount of residue left from the process is an issue, requiring lasers with different angles. Also, large wire gage sizes may require a different laser process, but generally for wires less than .25 inches, the two laser solution works well.

The question arises as to how to get the light to the part, and there are generally three methods: flatbed lasers, rotary lasers,

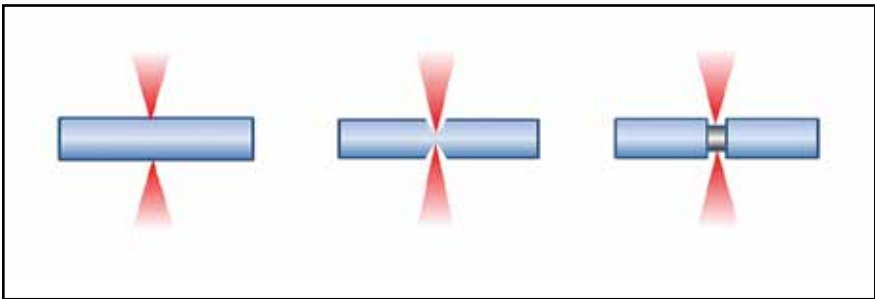


Figure 1. Common setup for laser wire stripping

and galvo scanners. The simplest and most common is the flatbed (think of a document scanner) where you place the cables in a plate or fixture, then place the fixture into the machine. The machine has two lasers on top and bottom that move on an XY plane to draw a series of lines to do the stripping.

What's good about this method is the beams are pointed straight up and down and it's easy to keep them overlapped. These lasers can only be used for cutting across or slitting, and can't be used to remove a large area of material. Also, on a large diameter cable, there may be a significant amount of residue left on the sides where the laser beam spreads and moves out of focus (Figure 2).

For these large diameter wires, a rotary laser is best as the optics move in a circular fashion around the cable (Figure 3). This orientation of the laser is great for any size wire as long as they are round.

Galvo scanners use high speed motor-driven mirrors to steer the laser beam through a lens (Figure 4). The mirrors are mounted on galvanometer drives directing the beam to the workspace. With mirrors, light beams can be moved to any angle very quickly, and these can actually be used for drawing or marking. Galvo lasers are the most versatile in this respect, and are great where you have wires spread out at varying angles. The drawback is that the mirrors have to be relatively close to the port, thus limiting wire size and cutting area (usually 1-2 sq in).



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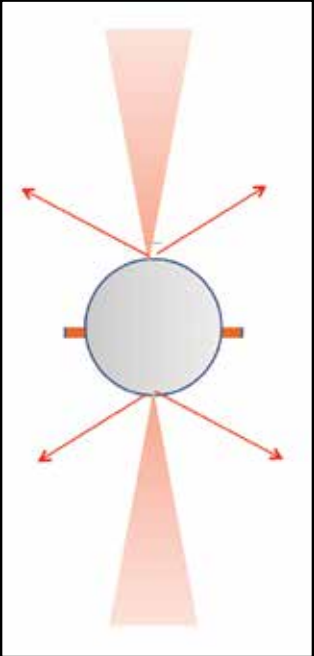


Figure 2. Residue left on large diameter wires

Points to Watch

There are some key points to watch when using laser wire strippers. First, and as mentioned earlier, is the issue of residue in areas where the laser might lose focus as in the area at the sides on larger cables (Figure 2). Another area of concern is with shielding. Where shielding is continuous, as with foil, the light will simply reflect, and there are no issues. But when shielding is woven or braided, the possibility exists for the laser to penetrate tiny holes and damage subsequent layers of insulation. As a general rule, the braid must have at least 80% coverage to make a laser viable.

Lasers can't distinguish between one type of polymer to another, so unless

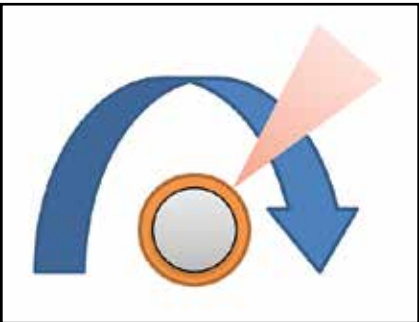


Figure 3. Rotating laser for large wire

there is a dramatic difference in the properties of materials, lasers are generally poor at removing one type of insulation from another.

Choosing Spectrum and Time Domain

When choosing the color spectrum of a laser, consideration should be given to the task at hand. Figure 5 Page 30 shows that lasers in the ultra-violet range will vaporize all materials, whereas most metals are cut within the infrared range. Far infrared is the best part of the spectrum for wire stripping as this is the range where insulation absorbs the light, yet there is no absorption from the metal.

Continued On page 30

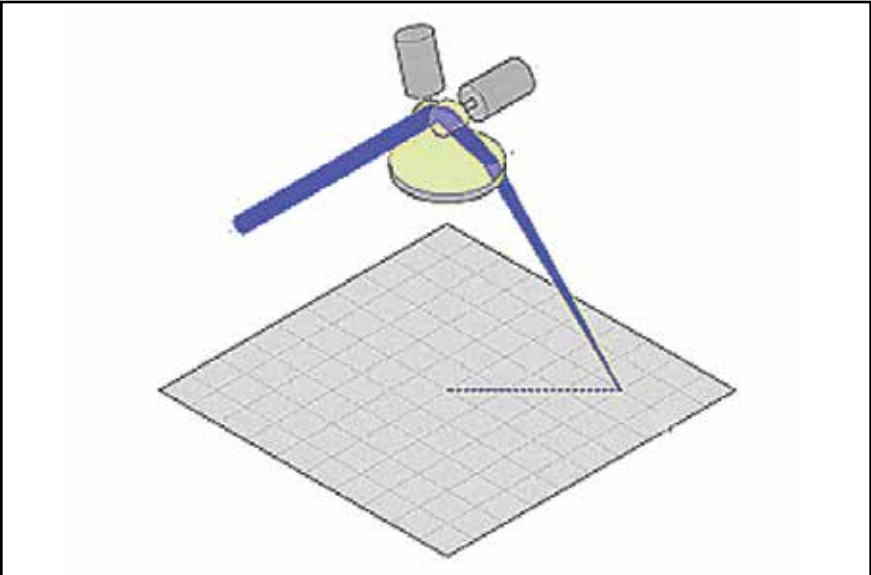


Figure 4. Mirrors reflect light on galvo scanner

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Basics of Laser Wire Stripping

Continued from page 1

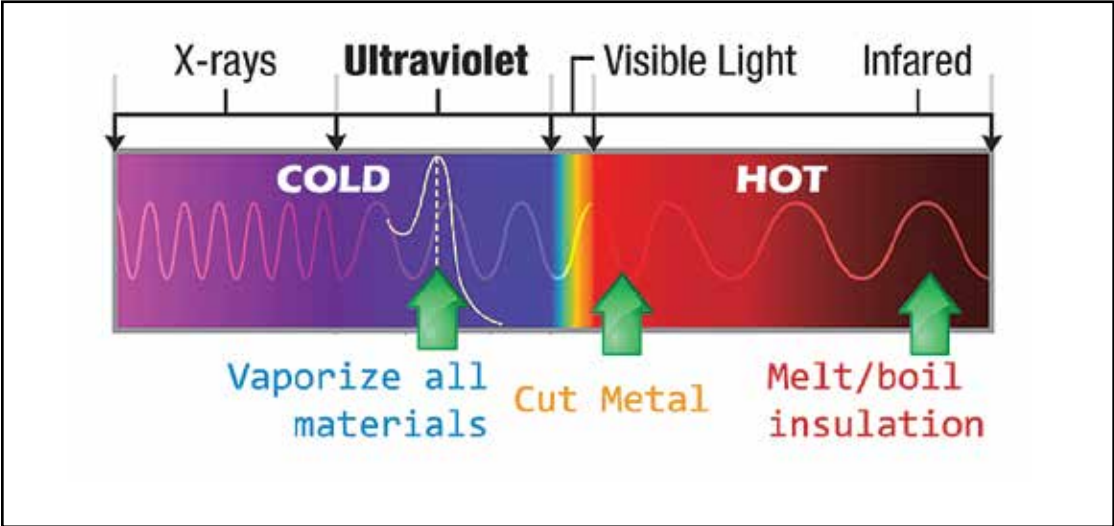


Figure 5. Laser light parameters

Figure 6 shows how the amount of light per unit of time affects the cost and function of the laser. Continuous lasers, like a laser pointer, remain on constantly. Pulse lasers take a comparatively similar amount of light energy and squeeze it into a short powerful pulse. Removal rate is less with pulse lasers, but they are more precise. There is still a time element involved in a continuous laser as its movement over the wire may vary in speed depending on the type or thickness of material being stripped or vaporized.



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Wire Holding
There are three basic methods for holding wire for laser wire stripping. Automatic or inline strippers are great for stripping wire from a spool, but lack the sophistication to process cables that are partially assembled. Single point strippers are the next best option, but the cable is self-supporting, so accuracy is lacking. Equipment that incorporates a plate or fixture to hold the wires offers the highest accuracy, but the equipment is expensive and involves longer setup times.

Safety
Lasers themselves are not inherently safe. All lasers used for wire stripping are rated as Class 4, and cause blindness and skin damage. The best way to safely intro-

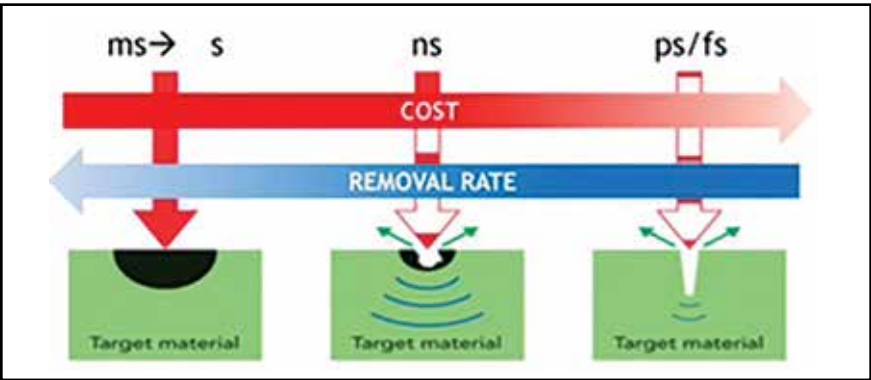


Figure 6. Laser time parameters

duce lasers into an industrial environment is to put them in some type of enclosure. The light cannot escape and everyone is safe. The problem is, the box must be opened as part of the operation. It's best to have at least two ways to stop the laser, so most industrial machines have door switches and lens shutters to prevent accidents.

Wire stripping with lasers produces fumes that present two health threats. First, the gasses produced can be poisonous. Burning PVC insulation produces hydrogen chloride, for example. Also, these gases could contain small particles that are abrasive in the lungs. A laser-specified fume extractor is imperative for the safe use of laser wire strippers.

The Future

There is much more awareness of laser wire stripping in the marketplace today than there was 20 years ago. In the past, they were relegated to usage in more exotic applications to solve specific problems. Equipment for use in medical and data applications has seen a trend towards miniaturization and cost reduction. Other recent developments have produced fully automated, single box machines to cut, strip and crimp wire.

About Dr. Paul Taylor

Dr. Paul Taylor founded Laser Wire Solutions in 2011 to address the demand for advanced laser solutions for stripping wire and cable in all market segments. Strengthened by a strategic partnership with Schleuniger, Inc. in 2016, the company continues to grow. Dr. Taylor graduated from Oxford in 1993, receiving his Bachelors and PhD in physics.





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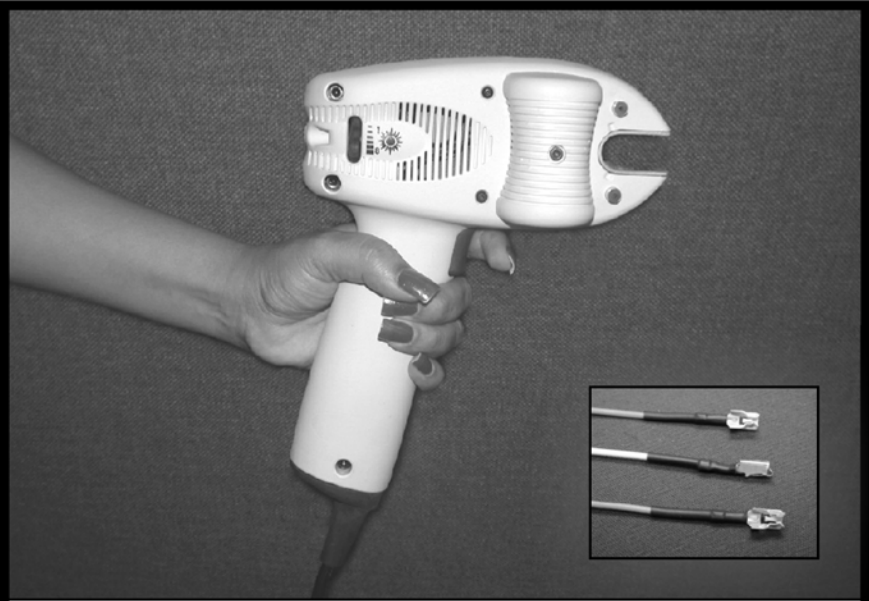


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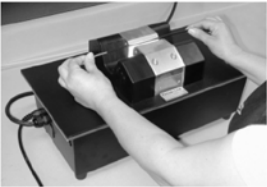
*polyolefin, 5" length

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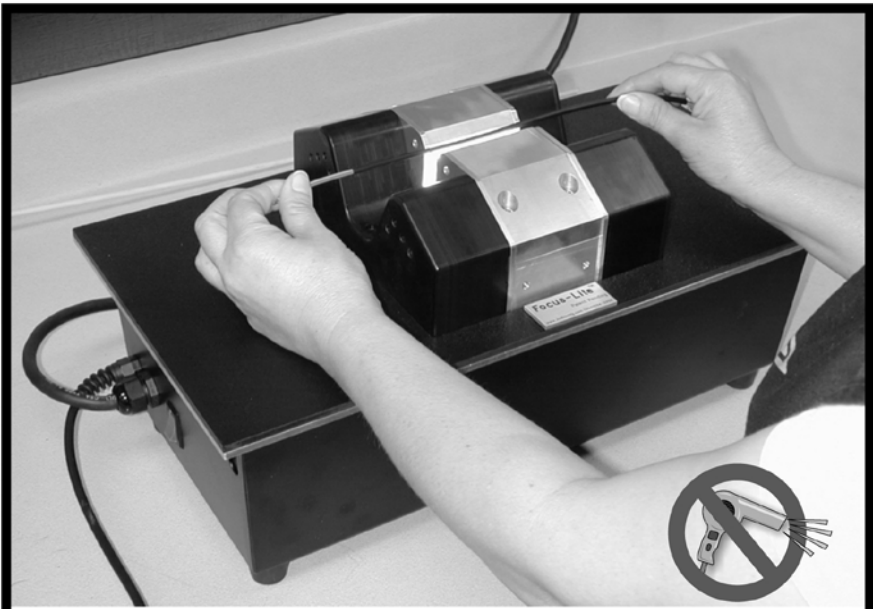
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¹2017 National Electrical Code Handbook, Article 310

²CSA C68.10-14, Table 8

³UL 1072 Edition 4, Table 15.1

⁴Some Lessons learned From Commissioning Substation and MV Switchgear Equipment, IEEE, PCIC-2000



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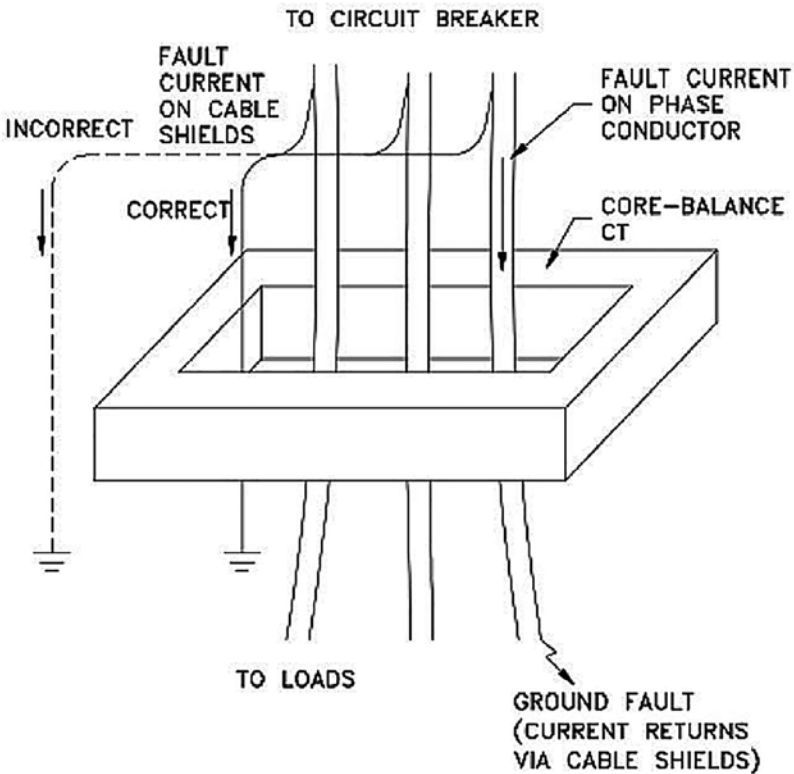
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Wired In

By Christine Siebert
for WHMA

The Wiring Harness Manufacturers Association (WHMA) has enjoyed a long and mutually beneficial relationship with Wiring Harness News (WHN). In fact, over ten years ago, the WHMA Board of Directors declared WHN as the "Official" publication of the association.

WHN has graciously granted WHMA a regular column "Wired In" in each edition to communicate topics, news, etc. to the wire harness and cable assembly industry which it represents. To learn more about the association visit www.whma.org and to submit column suggestions email contact.us@whma.org.

As many things in the wire harness and cable assembly industry today are uncertain, such as the impact that tariffs, new technologies, immigration laws, etc. will have on our industry, a couple things you know you can always count on are requirements from your customers and most of all Industry Standards.

We, at WHMA, find these areas to be comforting during these uncertain times especially industry standards. Industry standards are like a safety harness for your business. By having

recognized standards, your company will not only be compliant with the latest and greatest industry accepted standards but provide quality and reliable products to your customers.

WHMA and IPC are proud to say that they came together to create the IPC/WHMA-A-620 Standard (now, Revision C). This is the only industry-consensus standard for Requirements and Acceptance for Cable and Wire Harness Assemblies and the most widely used inspection specification for the cable and wire harness assembly industry. The A-620 standard prescribes practices and requirements for the manufacture of cable, wire and harness assemblies. This standard describes materials, methods, tests and acceptability criteria for producing crimped, mechanically secured and soldered interconnections, and the related assembly activities (corresponding lacing/restraining criteria) associated with cable and harness assemblies. Any method that produces an assembly conforming to the acceptability requirements described in this standard may be used. This is an international standard being used by harness assemblers in at least 42 countries and more than 1,000 companies worldwide employ at least one person who is certified to train others in the use of the standard.

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harness and cable assembly Industry has a standard for creating their harnesses but there are also many other values that wire harness and cable assembly manufacturers, component and equipment suppliers and even OEM's have found in not only adopting the standard but requiring it for their products and production.

The manufacturers have found that the A-620 standard gives them a competitive advantage. By using the A-620 standard, it sets expectations between them and their customers for what is considered acceptable and quality workmanship for cables and harnesses. This validates their legitimacy and demonstrates a commitment to meeting customer requirements and satisfaction. Also many of these company also continuously invest in their employees by educating them in the IPC standards and it reflects through their quality, productivity, efficiency and delivery metrics.

Component and equipment suppliers are seeing that the standard as a way to differentiate their products. This manual provides a clear understanding of what is required by the industry and these suppliers make sure that their products meet these requirements and it gives them the opportunity to promote them as A-620 compliant. Also giving them a definite advantage over their competitors.

Now one of the values for OEM's is that it clearly sets acceptable standards and a common language be-

tween the OEM's and the wire harness manufacturers. It makes it a lot easier to work together even when a project has unique build specifications. More and more OEM's are referencing the A-620 standards on their drawings, making it easier for the certified companies to work closer with them.

As you can see, the IPC/WHMA-A-620 standard enhances processes for not only the direct wire harness and cable assembly industry but creates improvements for both OEMS and other manufacturing industries. Just by having one "Standard" can make a big difference and bring a little peace of mind for consistency, improving compliance and quality.

If you have any questions regarding the IPC/WHMA-A-620 Standard or WHMA please contact our offices. Visit the WHMA website for more information on how to become certified and/or to become a WHMA member www.whma.org

Also, we want to thank IPC for information provided in this article. "Since 1957, IPC — Association Connecting Electronics Industries® has been guiding the electronic interconnection industry through its dramatic changes. A global trade association dedicated to the competitive excellence and financial success of its more than 3,300 member companies, IPC represents all facets of the industry including design, printed circuit board manufacturing and electronics assembly."

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Case Study:

Tornik Finds Success Adding MES

An Interview with Tornik, LLC President, Ray Swanson

Tornik LLC, a Contract Manufacturer of cable, harness and electro-mechanical assemblies based out of Rocky Hill, Connecticut, is thriving. When faced with the same hurdles as their competition, the Tornik team was able to find success across a wide range of markets without sacrificing what they stood for as a company: reliable service, quality production and great people.

Tornik started out as a value-add

to a large wire distributor before branching out into one of the North East's largest Contract Manufacturers. Now, after nearly 30 years of experience in custom assembly and complex production, they have found more success than ever. This radical growth is in large part due to a new secret weapon Tornik has implemented across their plants: the Quantum Manufacturing Execution System (MES).

"Quantum is a real "WOW" factor for us. Everybody that comes to our plant sees our system running at our

benches and says, 'I really wish we had that,'" mentioned Ray Swanson, President at Tornik.

Since selecting Quantum, Tornik has experienced consistent growth (15-20%) for five consecutive years. The time savings, production control and asset management made possible by connecting each stage of production has impressed both new and existing customers. Tornik used this momentum to get on multiple preferred supplier lists and attract a steady stream of new contract work.

"We had an ERP/MRP that han-

dled our material flow," remembered Swanson, "but we didn't have anything to handle our manufacturing flow on the floor. It was all paper records and different types of digital files spread across various systems..."

After replacing these labor-intensive processes with Quantum, Tornik experienced a cultural shift across their plants.

"The system became part of the business. After getting accustomed to Quantum, we've really taken it to the next level. We're nearly 95% paperless now. That's everything from ISO

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records to revision control on new-to-market product work. It has paid off ten-fold.”

Beyond winning more bids, completing work faster and delivering at increased levels of quality, Tornik has found their time invested in auditing has been reduced by 50% due to Quantum’s ability to capture build data.

When asked about tips for making more preferred vendor lists, Swanson spoke to the power of compliance and reliability:

“We’ve already had eight separate audits in 2018 and every one has been completed in half the time. An audit that should take a full day only takes half a day. From an ISO standpoint it’s been great. Every document we make becomes a permanent record and every revision is automatically stored in one system... If I want to go to ‘Rev 1’, I just jump to ‘Rev 1’. If I need to see ‘Rev 2’, I just click. Quantum eliminated a lot of the manual document control we had performed in the past and the results have been amazing.”

Advice for Wire Harness Plants

When asked what advice Swanson may have for other Wire/Cable Harness Assemblers looking to grow, he kept it simple, saying, “Time is money and it’s all about the ROI.”

By modernizing their plants, the time spent on every task, from planning to execution improved. This increased the profitability of every order that hit the shop floor allowing every member of the Tornik team to make more with less.

“We’ve been able to launch two new product lines without adding additional team members or resources and we’re getting more and more jobs with larger Contract Manufacturers doing subassembly work. We’re on the cusp of moving to the next level and we’re not looking back.”

Next Steps

Tornik LLC is a one-stop shop for wire and cable assembly serving Aerospace & Defense, Medical Device, Electromechanical, Life Science, Industrial Production and more. Offering

new product introduction, generic services and both US and Mexico as a low-cost region options, Tornik is the go-to shop for your OEM and Contract Manufacturing needs. ISO 9001:2015 and ISO13485:2016 certified and located on both the East and West coasts, Tornik is experienced in a variety of techniques and prototyping processes.

You can learn more about Tornik’s offerings at www.Tornik.com or by connecting with the Tornik sales team at Sales@Tornik.com.

If you would like more information on Manufacturing Execution Systems for the Wire Harness industry, visit www.CIMx.com and schedule a live demo of the Quantum MES with a CIMx Application Expert.



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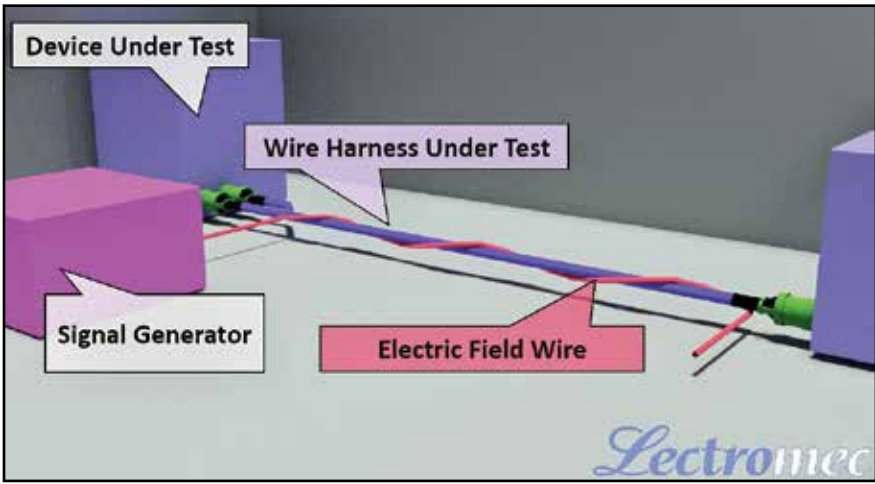


EWIS: EMI and DO-160

By Michael Traskos
President Lectromec

Designing a circuit diagram for a system comprised of Line Replaceable Units (LRUs) is usually a straightforward process: identify the inputs and outputs of the system and connect them with wires and cables. Taking that simple high-level circuit diagram and implementing the physical design

into an application can be quite difficult. This requires the proper connectors, OPTIMIZED THE PHYSICAL ROUTING, and ensuring negligible impact from electromagnetic interference (EMI). From an implementation perspective, it cannot be understated how much EMI can IMPACT SYSTEM PERFORMANCE ranging from degraded performance to make a system completely inoperable. Thankfully, there are test methods to evaluate the susceptibility of electro-



Setup for the electric field test per DO-160. The induced electric field wire will carry 170V RMS at 400Hz.

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magnetic interference of a wire harness design.

In this article, we will review some of the test methodologies outlined in RTCA DO-160 for the performance of EWIS harnesses and the susceptibility to electromagnetic interference. We will talk about the three areas that directly focus on interconnecting cables which include magnetic fields, electric fields, and electrical spikes.

THE SPECIFIC CONFIGURATION

As a starting point, it is important to know that the tests outlined in the DO-160 are for the specific case and require some work to be considered for the generalize case. The testing, as it is outlined in the standard, specifically is focused for the application and the validation of interconnecting cables for a single system. Often with

these tests, two system components are separated by interconnecting cable and the interference is injected into that wiring harness.

Ideally, the equipment and cables should be installed such that they match the installed configuration. Further, any signals or power running between the equipment should be properly simulated during these tests. This would then allow for an evaluation of what can happen to the signals as the interference is injected.

MAGNETIC FIELD

For the consideration of magnetic field interference, the representative system is laid out and a current carrying loop is aligned with the wiring harness. This is done to generate a magnetic field and create mutual in-

Continued on page 42

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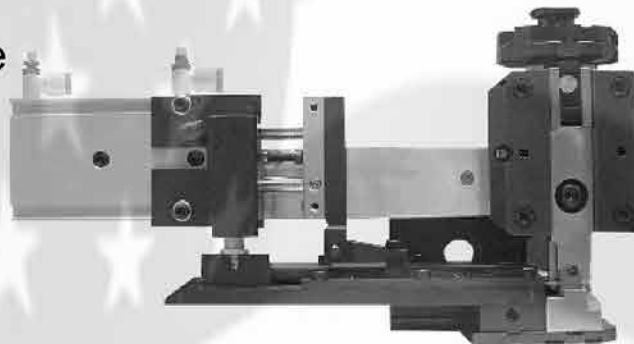


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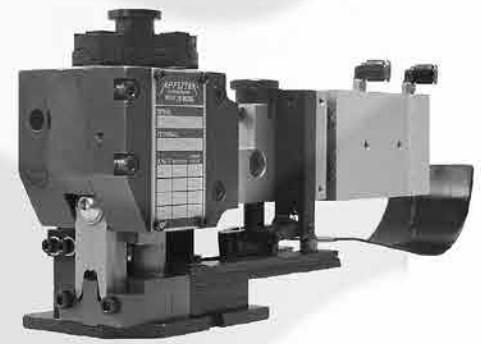


Model 2000

Pneumatic feed mini-style applicators can accommodate terminals with center to center distances up to 2 inches.

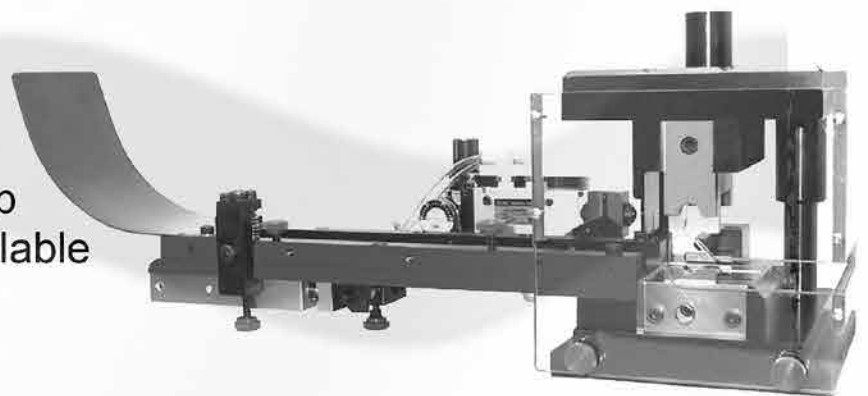


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EWIS: EMI and DO-160

Continued from page 40

ductance between the current carrying loop and the wire harness under test.

Depending upon the application and the power available in the representative aircraft, different power system configurations and voltages are to be used. As each of these creates a different magnetic field the specific impact to the system needs to be evaluated. While it may not be installed along power wires during the initial installation, subsequent modifications to the aircraft may create a scenario in which power wires from other systems may be placed in close proximity. To avoid future problems, the susceptibility of the system to a magnetic field should be evaluated.

ELECTRIC FIELD

The injection of an electric field into the wire harness under test is a little more involved than the magnetic field set up. In this test, the circuit wire is wrapped helically around the wire harness in a specified manner. Unlike the magnetic field tests, the electric field system does not have a closed circuit but rather is attached to a signal generator and the voltmeter to measure the generated signal.

The interesting element of the electric field test outlined in DO-160 is that the only voltage/frequency configuration considered in the testing is that of a 170 V RMS and 400 Hz power system. One would suspect that in applications that has higher

voltages, particularly AC voltages, would augment this test in order to accommodate for it.

INDUCED SPIKES

Induced spikes are probably one of the more difficult elements to detect in in-service applications. As these transients are short-lived and created by other systems with collocated wiring, it can be difficult to identify the source of the problem when occurring in an installed application. To replicate this test scenario, the wire harness under test is set up similar to the harness described in the electric field set up. One change with this test is that, rather than having an AC voltage and power applied

to the system, the system is attached to a 28 voltage DC power supply rapidly activating and deactivating an unsuppressed coil relay. Those familiar with surges and back EMF generated by a relay activation are likely also aware of the impact an unsuppressed coil relay can have on circuitry.

In this test, the relay is rapidly activated/deactivated and the effect on the wire harness under test and system is evaluated as it would be with the other two aforementioned tests.

CLOSING REMARKS

RTCA DO-160 provides a means to evaluate the susceptibility of system wiring to electromagnetic interference. Specifically, these tests evaluate the electromagnetic fields and impacts that could be experienced in a real application. Naturally, these tests specifically evaluate the induced signal susceptibility of the wiring harness and to the subsequent connected equipment.

However, these tests alone do not cover all considerations for EMI protection of the wiring harness or system. Other factors such as radiated fields, cross talk, and a whole host of other EMI sources should be considered before fielding the system. As one might suspect, selecting a quality cable with proper shielding and design can go a long way to protect an aircraft's EWIS from electromagnetic interference.

To find out more about how to evaluate your wires, cables or system wiring harnesses, CONTACT ELECTROMECC. Our team is ready to help.

About Michael Traskos:

Michael is President of Lectromec and has been involved in wire degradation and failure assessments for more than a decade. He has worked on dozens of projects assessing the reliability and qualification of EWIS components. Michael is an FAA DER with a delegated authority covering EWIS certification and the chairman of the SAE AE-8A EWIS installation committee. Contact Michael at michael.traskos@lectromec.com



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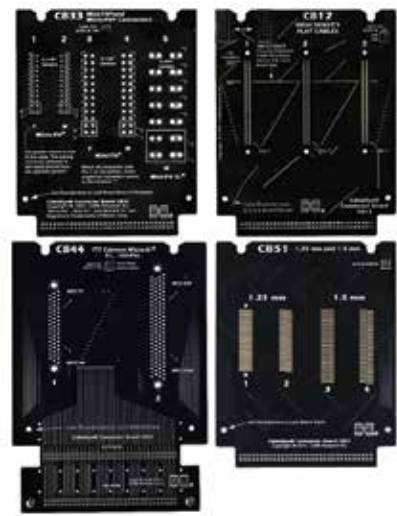


Fig 1: Test fixtures accommodate connectors of different types and pitches.

lation reduces the likelihood of appliance failure including catastrophic events such as fire and flooding. It is simply not sufficient to rely on “glow-wire” specifications to prevent fire.

In this article, we introduce a basic understanding of what ‘thorough’ continuity and HiPot testing entails.

CONTINUITY TEST 1 – Traditional Test

The traditional basic continuity test checks for opens and shorts at an instant in time only. The limitation of the traditional approach is that the result is only true for the test object as it was presented in physical location/orientation at that instant.

Let’s consider a connectorized cable. If such a test was performed yielding a ‘PASS’, it cannot be assumed that the same would hold true when the cable is moved to other points through its full range of motion. Defects such as broken wires, cold solder joints, and bad crimps can cause intermittent failure.

The danger is that companies relying on the Traditional Test are at risk of installing defective cables in their appliances. This result, at best, in appliance failures that frustrate the end-user and, at worst, in a major malfunction or catastrophic event such as a fire.

2 – Enhanced Test

To check continuity thoroughly, an enhanced test should be performed that additionally scans for both intermittent and miswire errors (Table 1).

These can be measured fast (in the ‘blink of an eye’), simultaneously

across all conductors, and in a manner that clearly identifies the type of error as compared to a desired design known as a ‘Golden’ or ‘Master’ cable (Fig. 2). The graphical result of Figure 2 illustrates a multiconductor cable with two faults – an open (yellow), and a miswire (yellow-red stripe). In this particular case pin 4 has been wired to pin 4 (correct locations) but without the specified inline component (a diode) so causing a miswire to

be flagged. Note that correctly wired sockets and plugs will also show up as miswire faults if they have been connected to each other out of specified orientation. Knowledge of the type and position of error provides useful feedback to process improvement engineers and QC.

Connector pins that are not fully seated cause intermittent opens,

Continued on page 45

Continuity		
Checks	Traditional	Enhanced
Opens	✓	✓
Shorts	✓	✓
Intermittence		✓
Miswires		✓

Table 1: Traditional vs. Enhanced Continuity Testing



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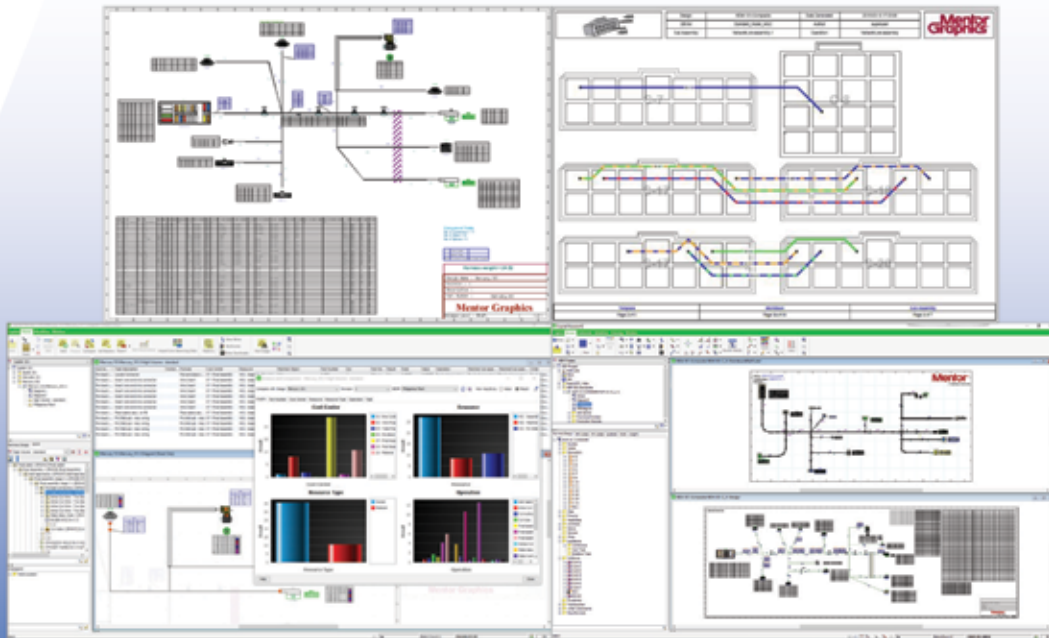


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Testing Appliance Cables & Connectors

Continued from page 43

while conductive debris is often the source of intermittent shorts, especially with micro-pitch connectors. These faults might cause intermittent power disruption to a motor resulting in motor damage, or signal a solenoid to switch the wrong valve or the right valve at the wrong time perhaps delivering bleach or hot water instead of cold, or even causing a flood by not switching off the water.

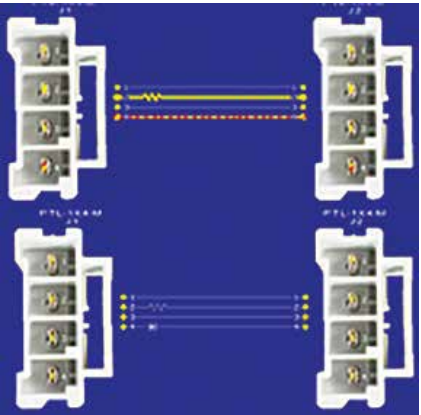


Figure 2: Screen shots of cable with TE PTL connectors a) continuity test result (top) and b) golden cable (bottom). Test result overlays desired design, and highlights type and location of error - open (yellow), miswire (yellow-red striped). Note: A short, if present, would show as a solid red line.

Testing for intermittent faults is very easy - an operator (or fixture such as a design verification 'shake' table) flexes the cable while a continuous stream of test pulses sweep through the full set of test points. Er-

rors are detected and identified only when a test pulse coincides with an intermittent event - an event that itself may be fleeting. Because of this, the test engineer adjusts the cycle frequency so as to capture the most fleeting, random event. The intermittence test of Figure 3 shows that 1.4% of the 434 test cycles (set at 100ms/cycle) coincided with an intermittent event. Clearly, the intermittent fault was hard to trigger and/or was so brief that events tended to occur 'between' the test pulses. However, it takes only one detected event to fail the cable ensuring that you produce only quality product of high reliability. Bear in mind that this is a multi-conductor test and PC-based cable testers such as CableEye® can perform 64 test point intermittence testing at 11ms/cycle over any duration. Being so fast and efficient, and given that there is no additional set-up time compared to a static continuity test, there is no reason to exclude a check for intermittent errors.

The same test process can be used to verify board-to-board connectors with floating designs with the intermittence test being performed while the connector is moved through its full adjustment range. Design verification data (http://suddendocs.samtec.com/testreports/tc1023-3438_report_rev_2.pdf) suggest that between 2 and 9 lbs force is needed to move these connectors to their

maximum range. The motion could be applied manually or through a microcontrolled jig for improved repeatability.

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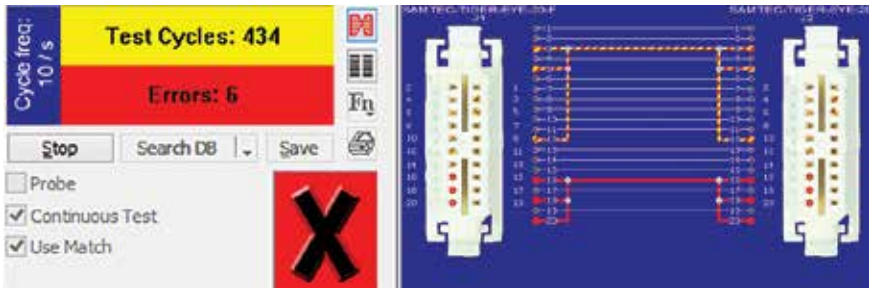


Figure 3: Screenshot of an intermittence test on a cable consisting of Samtec 0.80 mm pitch Tiger Eye™ connectors with discrete wires. An intermittence test allows for adjustment of the cycle frequency test parameter to improve the likelihood of 'capturing' an intermittent event. This cable failed the test - 6 error events were detected while the cable was being continuously flexed. Two issues were identified – an intermittent open (solid yellow line) and an intermittent short (solid red line.)

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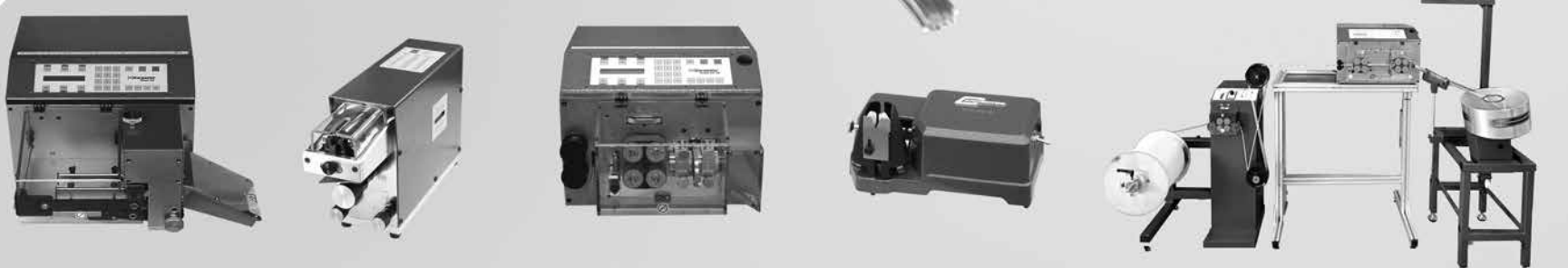
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Testing Appliance Cables & Connectors

Continued from page 45

HIGH VOLTAGE TESTS 1 – Test Portfolio

Insulation integrity is verified with High Voltage (HV) tests and can be carried out with ac or dc voltages. In either case, the test calls for the applied voltage to far exceed the specified operating voltage. For safety reasons, HV tests are performed only after successful completion of

continuity testing. These tests consist of checking the Dielectric Withstand Voltage (DWV) and the Insulation Resistance (IR) and reveal design and manufacturing faults such as insulation pinholes and the presence of gap-bridging moisture. A passing device will be proven to have insulation capable of protecting the consumer operator even during power surges. The same HV tests can also highlight issues with the sharing of sig-

nal and power lines within the same connector, and within connectors of compact pitch.

2 – From Two-Terminal to Multiconductor

Modern PC-based cable testers can readily switch between testing two terminal components (such as transformers) and multiconductor cables & harnesses - and for voltages up to 2100Vdc/1200Vac. Figure 4 depicts a transformer under test with a screenshot of the near-instantaneous result - DWV (top), Leakage Current (middle), IR (bottom). Leakage current measurements are especially useful when determining whether borderline DWV or IR results are really an issue. The same user interface appears and test principles ap-

ply when HV-testing multiconductor set-ups. In this case, the cables connect to the tester via interface boards (such as seen in Figs. 1 and 4), or via interface ‘harnesses’ such as an Amp-modu cable.

Continued on page 59

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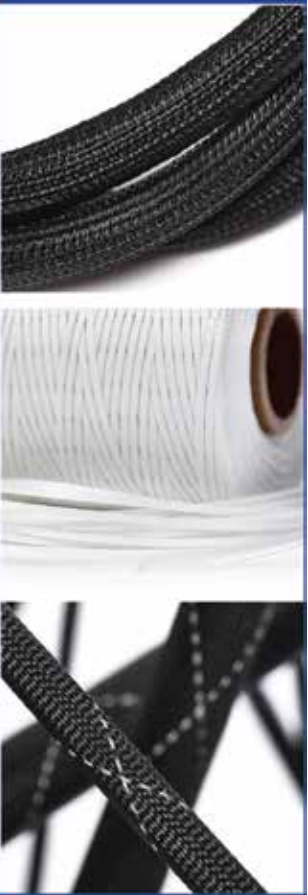
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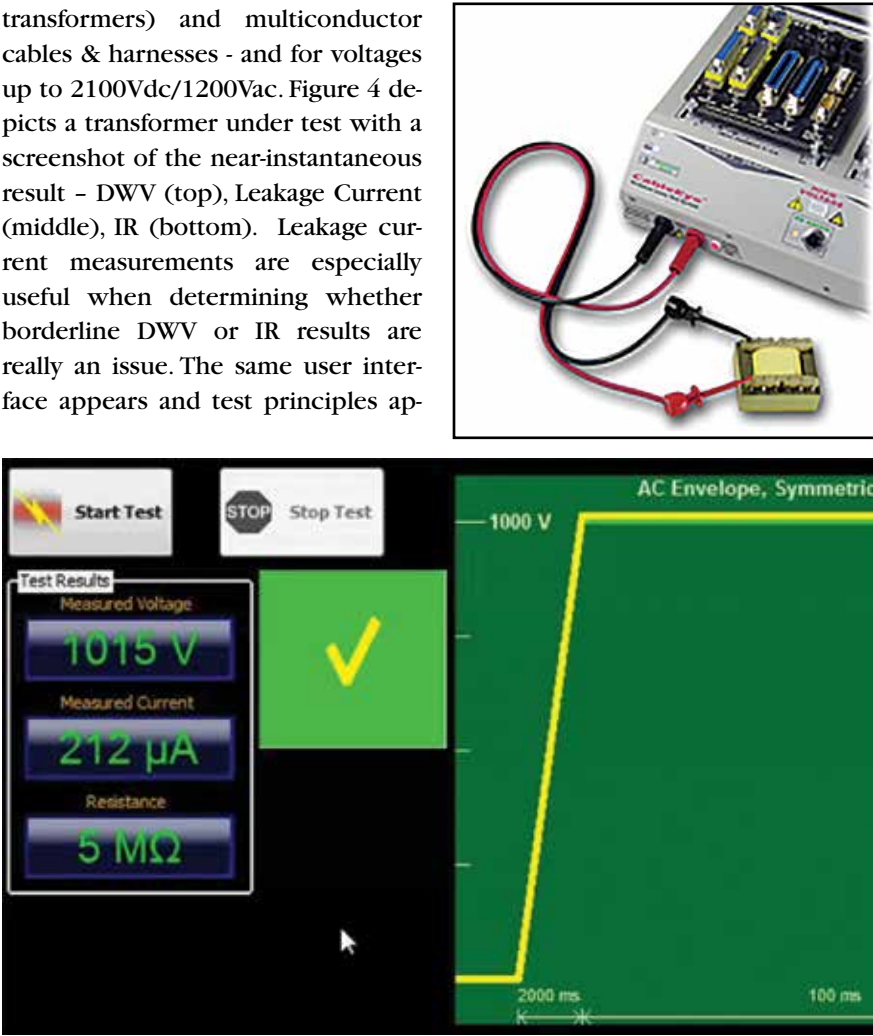


Figure 4: HiPot Test | Leakage & Insulation Breakdown | 2-Terminal Devices

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Customers report something unusual too: Mando’s “can-do” attitude.

George Price, vice president of J&M Products, for example, writes how Mando takes time to answer questions, explain machine operation and even gave “tips on stripping some shielded cable that others said could not be done.”

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NEWS PLUGS



Fairview Microwave Releases New Series of 3.5mm Portable Calibration Kits

Fairview Microwave Inc., a leading provider of on-demand RF and microwave components, has launched a new line of 4-in-1 3.5mm calibration kits for cable verification, antenna measurement and other field test and measurement applications.

Fairview Microwave's new line of integrated, short-open-load-through (SOLT) calibration kits is made-up of two models that have a 26.5 GHz calibration

capability. They feature a compact, lightweight, 4-in-1 design package with gold-plated, 3.5mm connectors and a convenient lanyard. Plus, they are available off-the-shelf with same-day shipping.



Series 3.5mm Portable Calibration Kits

"These new calibration kits offer a very convenient package, while maintaining a high level of precision. They make a great compliment to our line of rugged, portable RF analyzer cables," said Dan Birch, Product Manager.

These new 3.5mm 4-in-1 calibration kits are in stock and ready for immediate shipment with no minimum order quantity.

For detailed information on these products, please visit <https://www.fairviewmicrowave.com/rf-products/short-open-load-thru-4-in-1-analyzer-calibration-kit.html>.

For inquiries, Fairview Microwave can be contacted at +1-972-649-6678

Tinned wires...

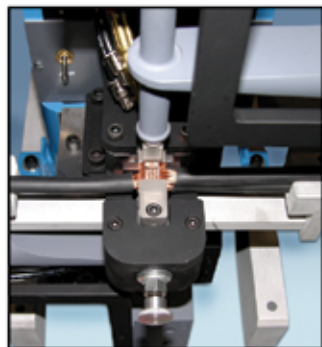
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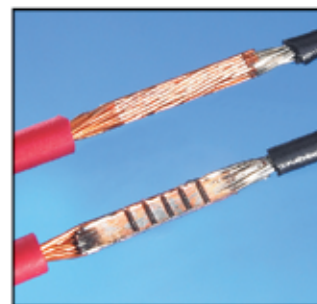
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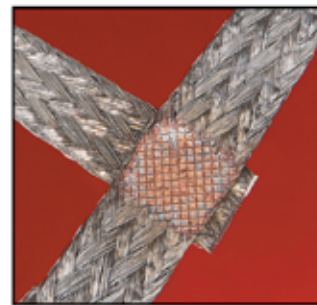


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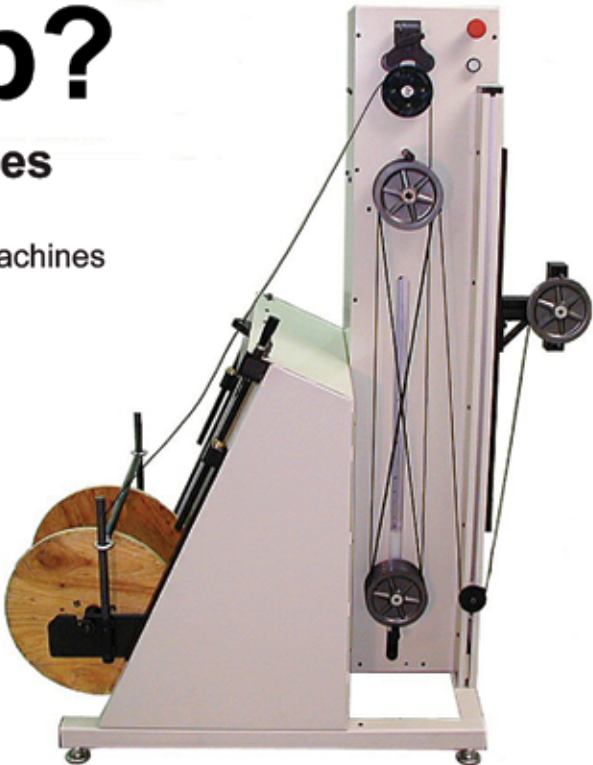
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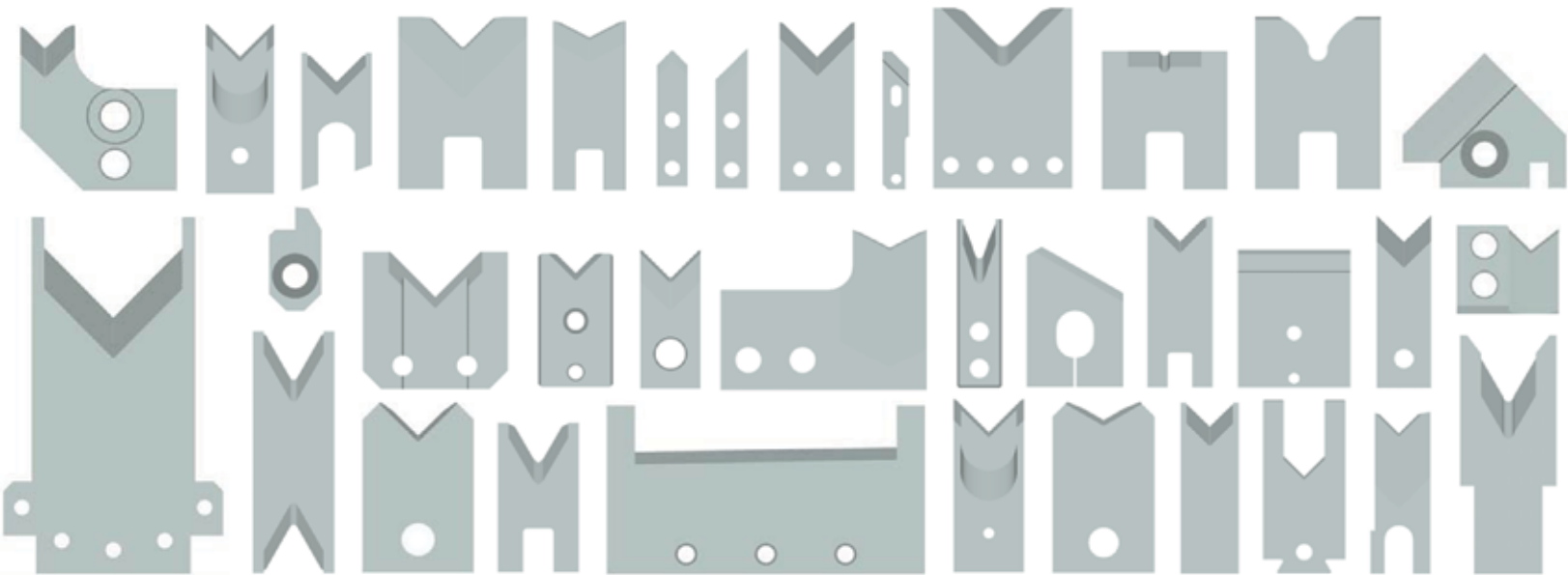
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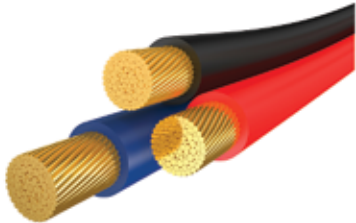
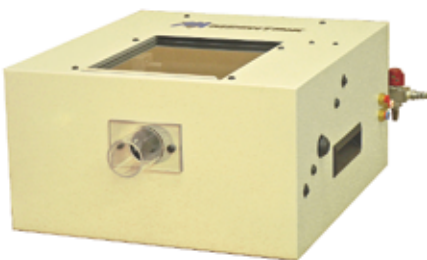
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NEWS PLUGS continued



Novem Integrates TactoTek® Injection Molded Structural Electronics (IMSE™) and Luxury Automotive Interior Finishes

TactoTek®, the leading developer of injection molded structural electronics (IMSE™) solutions, and Novem, the worldwide market leader in high-quality automotive interior trim and decorative functional elements, announced that they have executed a multi-year agreement to develop solutions integrating IMSE electronics into premium interior trim products. The resulting solutions are single

piece, electronically active trim elements for luxury vehicles.

“Novem provides innovative interior trim for premium brands, including Audi, BMW, Daimler, GM and Toyota. With TactoTek IMSE, we can integrate electronic controls into our high-quality surfaces so they blend into the overall design and result in elegant and functional solutions,” said Vice President Operations of Novem Group, Markus Wittmann. “We are actively promoting our IMSE-integrated trim solutions to OEMs and have current projects with TactoTek developing a range of use cases.”

In automotive trim applications, the ability of IMSE solutions to conform with complex shapes in a thin, single piece, structural part, are significant

benefits and enable adding electronics for function, convenience and styling in new locations. IMSE solutions also reduce assembly requirements and simplify installation when compared with traditional electronics.

“As designers become more familiar with IMSE capabilities we are seeing exciting innovation,” observed Jussi Harvela, CEO of TactoTek. “Use cases in which electronic functions such as seat or mirror controls and NFC antennas blend into cosmetic surfaces—easily used when you need them, and blending into the background when you don’t—represent a growing share of our projects in the automotive segment. These designs appeal in other markets as well, such as home automation.”

Novem is a preferred TactoTek partner for luxury automotive interior trim elements. To facilitate Novem’s multiple projects, TactoTek will provide local support for Novem with dedicated team members in Germany.

TactoTek is a leading provider of solutions for Injection Molded Structural Electronics (IMSE) that integrate printed circuitry and electronic components into 3D injection molded plastics. Leading use cases include in-vehicle applications, home/industrial appliances, and wearable technology. TactoTek adapts customer designs to IMSE technology, develops mass production ready prototypes, and mass produces or licenses the technology for 3rd party mass production. TactoTek is funded by Conor Venture Partners, Ascend Capital Partners, Faurecia Ventures, Plastic Omnium, Nanogate, VTT Ventures, Leaguer VC and European Union’s Horizon 2020 Research and Innovation Programme. For more information, please visit www.tac-totek.com.

Novem, based in the German town of Vorbach, is a world leader in high quality trim elements and decorative function elements for car interiors. Their customers include the most prestigious automobile manufacturers in the premium segment, such as Audi, BMW, Daimler, GM and Toyota. They appreciate the innovative technology, exclusive quality and elegant design of our products. Novem has over 70 years’ experience in the automotive industry. For more information, please visit www.novem.com.



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NEWS PLUGS continued

Heilind Electronics to Exhibit at IBEX in Tampa, Florida

Heilind Electronics, a leading global distributor of electronic components, will be showcasing its marine interconnects, electromechanical products and sensors at IBEX – an annual trade show for boat builders and marine professionals throughout the world. At the show, Heilind will be featuring a wide variety of switches, cable glands, wire protection devices and interconnect products.

The company will be displaying products from many leading manufacturers, including HARTING, Molex, Panduit and TE Connectivity.

“As an IBEX exhibitor since 2007, we look forward to offering an increasingly diverse selection of products to our maritime customers each year,” said Andrew Smith, Territory Business Manager, Heilind Electronics. “Heilind experts will be on hand to discuss the latest cutting-edge products and how they can best serve your marine needs.”

The exhibition will be held at the Tampa Convention Center in Florida from October 2 through 4, 2018. Heilind will be at booth #2141 for the duration of the show.

Mentor extends Capital for Efficient Design of SAE J1939-based CAN Networks

New Capital® Systems Networks™ product boosts design efficiency for J1939-based CAN networks by up to 90 percent by enabling a generative design approach

Mentor, a Siemens business, today introduced Capital® Systems Networks™ – an advanced software tool engineered to speed and simplify the creation of in-vehicle Controller Area Network (CAN) communications networks based on the SAE J1939 standard. The solution provides proven, powerful technology to help engineers rapidly develop, optimize and validate J1939 networks.

Commonly deployed in heavy-duty commercial vehicles such as trucks, buses and off-road vehicles, SAE J1939 is a data networking standard used for in-vehicle communications and diagnostics. Commercial vehicles may incorporate as many as six separate CAN networks, requiring new designs and rework for each new vehicle model.

As the number of processors, sensors, and electronic actuators deployed in commercial vehicles rises with each model-year, so too does the complexity of designing the data networks used to connect them. Despite this rising complexity, a lack of robust network design tools often forces engineers to rely on rudimentary, maintenance-intensive technologies such as spreadsheets incorporating in-house macros.

Designed to address these challenges, the Capital Systems Networks product enables holistic network development. As part of the extensive Capital tool suite, the new Mentor tool integrates network and electrical design within a single environment, streamlining development of functional and physical designs for J1939 networks. By supporting a generative design process within a coherent electric and electronic (E/E) architecture, Capital Systems Networks helps dramatically speed network design, validation and optimization.

The Capital Systems Networks tool includes a robust library and unified dictionary of SAE J1939 signals, functions and features. This allows designs, ECUs, and even entire networks to be reused and tailored for specific vehicle models and variants.

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“Capital Systems Networks is a sophisticated tool that addresses the massive complexity associated with today’s automotive network designs,” said Martin O’Brien, vice president and general manager of Mentor’s Integrated Electrical Systems Division. “Designed for optimal scalability and re-usability, Capital Systems Networks’ model-based solution enables a generative

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design approach offering the potential for 90 percent design efficiency improvement for J1939-based CAN networks, while at the same time handling several thousands of signals.”

“Capital supports advanced platform architecture exploration, allowing us to generate rapid iterations and evaluate different implementation options directly within the design environment,” said Rosa Talarico, CVPD ES system integration, networking & methodologies manager for CNHi. “This functionality, together with Capital’s data reusability and scalability across multiple abstractions, allows us to dramatically reduce design cycles and speed time to market.”

About Capital

Developed for transportation applications, Mentor’s Capital Electrical Design Software suite spans an extended flow from concept and electrical architecture definition to wire harness design, manufacture and vehicle maintenance. Combining powerful design automation and modern enterprise integration capabilities, the software creates digital continuity within the electrical domain to compress development cycle time and deliver significant cost reductions. Capital tools can be implemented individually or deployed together in a unified flow that seamlessly matures data within a consistent environment. Robust integration with adjacent domains (such as MCAD and PLM) is fully supported, as is cross-organizational collaboration.

Capital Systems Networks is available now. For more information please visit <http://go.mentor.com>

DUO 10 Simplifies Wire Crimping at any Angle

The new Crimpfox DUO 10 crimping pliers from Phoenix Contact are perfect when diverse workspaces demand flexibility. The Crimpfox’s unique, rotating die permits frontal or lateral insertion of ferrules.

Engaging the color-contrasted release button enables the user to easily rotate the die to the necessary insertion direction, and the Crimpfox’s locking mechanism keeps the die securely in position. The pliers’ self-adjusting mechanism allows them to not only accommodate single ferrules but also reliably accommodate twin ferrules.

These crimping pliers cover a large cross section range from 26-8 AWG single wires or 2x20 to 2x12 AWG twin ferrules. Its perfectly balanced, ergonomic design creates an ideal fit for the user’s hand.

Its carefully engineered design makes it the lightest and most compact tool on the market. No intense force is required to operate the tool, allowing the user to work longer without fatigue all while producing high-quality results.

Learn more at www.phoenixcontact.com/handtools.

About Phoenix Contact

Phoenix Contact develops and manufactures industrial electrical and electronic technology products that power, protect, connect, and automate systems and equipment for a wide range of industries.

Phoenix Contact GmbH & Co. KG, Blomberg, Germany, operates 50 international subsidiaries, including Phoenix Contact USA in Middletown, Pa. For more information about Phoenix Contact or its products, visit www.phoenixcontact.com, call technical service at 800-322-3225, or e-mail info@phoenixcon.com.



The new Crimpfox DUO 10 Crimping Pliers from Phoenix Contact

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Vision, Culture and Vision Systems

By Matt Emery
President H&L Manufacturing

Being a Quality Manager can be a thankless job. When Amy's phone rings it's rarely a customer calling to tell her to "keep up the good work". More than likely it's a call informing her of an issue that will result in containment of product, investigation, corrective action reports and problem solving. A Quality Manager is often trapped between meeting customer expectations and balancing the cost of main-

taining an effective quality management system.

One of the challenges in making your Q.M.S. effective is solving problems in a way that is permanent and prevents issues from reoccurring. In the wire harness industry, this can be especially challenging due to the manual nature of the assembly processes and the human influence on those processes.

Over the last several years, H&L Manufacturing began facing this problem more and more. A defect would be found, we would put a corrective action in place but the prob-

lem would continue to occur. Recently, it got to the point where we felt there was no more training, sign-offs, sensors or preventions we could put in place. Often, during discussions, the subject of vision systems would emerge and we would investigate the cost. This was obviously the best approach to making systemic changes across all production operations but because of the number of assembly and testing stations we had the cost was prohibitive. So, we started to view the problem from a different prospective.

How could we modify our production processes so the return on investment would make sense rather than trying to fit vision systems into our current structure? It turns out the answer was right in front of us. Along with driving quality improvements, we had also begun regular continuous improvement projects to streamline our production floor. Once we married the two activities together the plan started to take shape.

As with any major change, the most immediate challenge was changing the culture from fixing problems to permanently solving problems. Our C.O.O. spent close to a year coaching, mentoring and training employees on the importance of making these changes today in order to make tomorrow better. He also trained our leadership on how to communicate our vision across the company. Before long, our employees began to drive the improvements that were needed because the mindset was changing. Everyone was becoming enthusiastic about how they could contribute.

At the same time, we began the transition to a work cell structure from an individual-operator assembly structure. We found that our output improved by 15% - 30% simply by breaking down the assembly process into level-loaded operations and having a team work together. Weekly kaizen events were held with Management, Team Leads and Production Employees. We even brought in our customers to help with the events. It

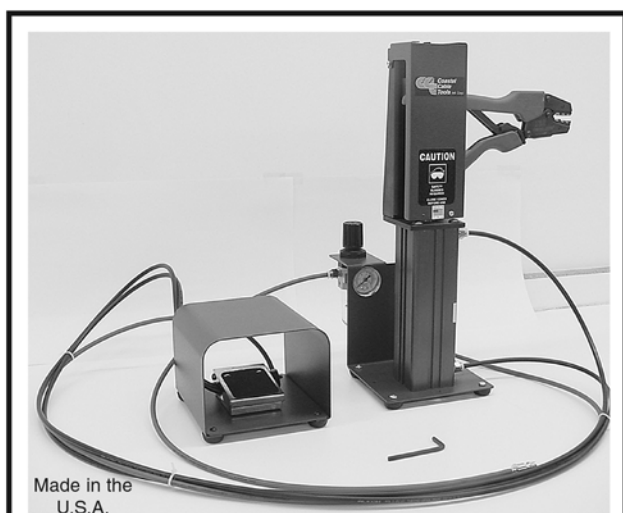
was helpful to have them involved in the improvements so they could not only see the changes but approve them as they occurred. These day-long events began with extensive time studies on each motion of the assembly process. Once the studies were completed, the team would match up the processes by cycle time and create a new work flow that would hopefully, in the end, increase production output. In all cases, it did.

A key step in our kaizen events was to evaluate methods for preventing defects from occurring so the need for detection was reduced. An effective quality management system is focused on prevention so we began to research new technology that would improve our processes and make it harder for operators to make mistakes. After all, if an employee is allowed to fail, the process is not effective. In several cases we were able to use low-cost automation to make these improvements.

The next step was looking at families of parts to determine if similar testing fixtures could be shared on lower-volume programs. We identified six parts numbers with similar dimensions and created flexible testing stations that could be easily changed over. The volume was low enough that we could run all six on only two fixtures with minimal change-over and in doing so we eliminated the need for four additional cameras. The process is still on-going and we have identified five more fixtures where this may be possible.

Finally, we added vision systems as a standard line item in our quotes. The annual impact to our customers is minimal when amortized over a year and they are willing to pay a little extra for a more robust detection method that limits the risk to them. Also, at the end of the day, when you add a vision system to the process, the need for other detection methods like sensors, switches, relays and off-line inspection is eliminated, making the business case even stronger.

Continuous improvement is an activity that doesn't end but we are nearing the final steps in this particu-



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lar phase of activity. Looking back, it is incredible to see the strides we made by bringing everyone together to work towards common goals. In six months we reduced the need for cameras from thirty-eight to fifteen while increasing our production output by nineteen percent. We are also seeing indirect labor savings due to less demand for Quality support, less defects and reduced scrap. Our original estimated time for return on investment was so long that we could not even consider making the investments in the systems we wanted to

put in place. Now, that return is less than three months.

It goes without saying that these changes have had a significant impact on our financial and quality performance. We all expected that. What I personally didn't expect, was the pride I would feel while watching people I care about work so hard and consistently to make our company and themselves better. I witnessed long-term employees who were resistant to change step up and lead teams driving those same changes. I witnessed young, entry-level employees

want to learn and grow. I witnessed employees hiding in the shadows find a skill they didn't know they had and become more advanced in that skill than anyone else in the company.

We knew we would make mistakes and we did, a lot of them. As a team, we learned from them and did our best to hold each other accountable so they weren't repeated. It all comes back to culture. If people un-

derstand why change is needed and how it can improve their lives it becomes less challenging.

After everything was said and done we were able to improve our culture, improve our quality systems and improve the lives of our people. We may have even made Amy's job a little less thankless.



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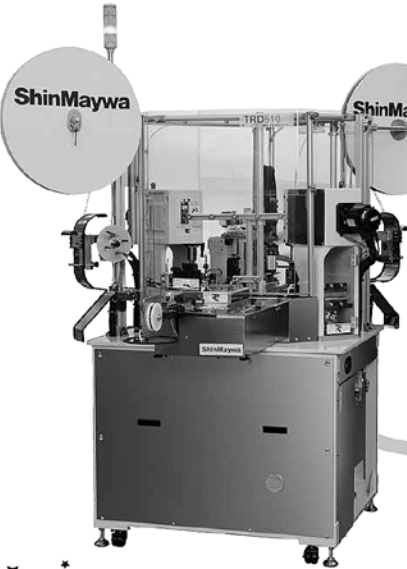
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NEWS PLUGS continued



Heilind Electronics Stocking
Amphenol Industrial

MIL-DTL-26482 Series I Connectors

Heilind Electronics, a leading global distributor of electronic components and authorized distributor for Amphenol Industrial, has expanded its selection of harsh environment interconnects with the manufacturer's MIL-DTL-26482 Series I connectors.

Available in both commercial off-the-shelf (COTS) and MIL-SPEC versions, 26482 Series I connectors feature quick-disconnect bayonet coupling and twice the number of contacts in

half the size of a standard connector. The versatile 26482 I series is offered with either gold-plated solder or crimp contacts, including MIL-C-39029-approved styles. Additionally, the connectors support up to 23 A and wire gauges ranging from 24 to 12 AWG.



Heilind is now stocking Amphenol Industrial's MIL-DTL-26482 Series I connectors – a high-density interconnect solution for rugged environments.

One of the key features of 26482 Series I connectors is their rugged construction. These environmentally sealed connectors are built with lightweight aluminum alloy shells and operate in temperatures ranging from -67 to +257 degrees Fahrenheit. Liquid-tight assembly is enforced with a resilient neoprene insulator and integrated rear wire sealing grommet.

Designed for both COTS and military-aerospace applications, MIL-DTL-26482 Series I connectors are widely used in instrumentation, monitoring equipment, machine tooling, factory automation, communications, geophysics, robotics, oil and mass transit.

Visit Heilind's website for more information about Amphenol Industrial MIL-DTL-26482 Series I connectors.

Heilind Electronics, Inc. (www.heilind.com) is one of the world's leading distributors of connectors, relays, sensors, switches, thermal management and circuit protection products, terminal blocks, wire and cable, wiring accessories and insulation and identification products. Founded in 1974, Heilind has locations throughout the U.S., Canada, Mexico, Brazil, Germany, Singapore, Hong Kong and China.

Infinite Electronics International, Inc. Announces Acquisition of Integrated Network Cable (INC)

Infinite Electronics International, Inc., an operational holding company providing management and back office support for globally recognized electronic components brands, today announced that it has acquired Integrated Network Cable

(INC), a leading online distributor of cables and connectivity products that also specializes in IT and network-installation services.

Founded in 1995, INC provides a full range of voice, video and data network installation services. Additionally, INC is the parent company of ecommerce brands Show Me Cables®, Triangle Cables® and ECore Cables®. INC addresses the business-to-business, IT and audio-visual market and will significantly add to Infinite's capabilities in this segment. The company is headquartered in Chesterfield, Missouri and is led by its president, Peter Foley.

Infinite Electronics and INC share complimentary core values and customer value propositions of satisfying the urgent product needs of customers requiring same-day shipment of cables and components. Under Infinite's management and back office support, INC will continue to operate as a stand-alone business unit in the Infinite family of brands. The company's president, Peter Foley, will join the Infinite executive team and will continue to lead the company's day-to-day operations.

"This exciting merger extends Infinite Electronics' existing presence in the global voice, video and data network marketplace by broadening the products, technologies and services Infinite can collectively offer

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our customers,” said Terry Jamigan, Chief Executive Officer of Infinite Electronics International, Inc.

Peter Foley, President at INC explained, “Joining the Infinite Electronics family offers INC’s businesses the necessary resources and support for continued growth and expansion going forward. Our collective business synergies and corporate philosophies regarding dedication to our customers are sure to carry our mutual businesses to new heights.”

For additional information about Infinite Electronics International, Inc. and its portfolio companies, please visit www.infiniteelectronics.com.

For more information about Integrated Network Cable and Show Me Cables, visit www.showmecables.com

Based in Irvine, Calif., Infinite Electronics International, Inc. offers a broad range of RF components, assemblies and wired/wireless connectivity solutions, serving the aerospace/defense, industrial, government, consumer electronics, instrumentation, medical and telecommunications markets. Operating under the Pasternack, Fairview Microwave, L-com, MilesTek, KP Performance Antennas, PolyPhaser, Trans-tector, RadioWaves, Kaelus, and Aiconics brand names, Infinite Electronics serves a global engineering customer base.

IEWC Announces Pat Rislov as New Vice President of Supply Chain

IEWC is pleased to announce the appointment of Pat Rislov as Vice President of Supply Chain. With over 25 years of sourcing and materials management experience in a variety of roles, Pat brings a wealth of knowledge and business acumen to the role that will help to ensure a successful future for IEWC.

“Pat’s diverse business background spanning strategic sourcing, materials management, logistics operations, and e-commerce aligns well with many of our company’s key needs for sustained growth at IEWC,” stated Lanny Million,



Pat Rislov
IEWC VP Supply Chain

Chief Supply Chain Officer. “In his new role, Pat will work to better align IEWC’s supply side activities with the commercial aspects of our business, and will contribute to the high performing culture that we are building here at IEWC.”

Rislov comes to IEWC from Steinhafels and prior, Kohls Department Stores where he served as VP of Logistics Operations. During his tenure at Kohl’s he also served as Director of Business Operations for Kohls.com.

“It is an exciting time to be part of IEWC,” said Rislov. “I look forward to empowering the Sourcing, Materials Management, and Logistics teams here at IEWC to continue working towards our goal of Supply Excellence.”

Pat began with IEWC on Monday, July 23rd, 2018, and will work out of IEWC’s corporate office in New Berlin, WI. He will report directly to Lanny Million, IEWC’s Chief Supply Chain Officer.

For additional information, contact Dave Burleton, Vice President of Marketing, at 262.957.1124 or via e-mail at dburleton@iewc.com.

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REGISTER NOW!

This is M-EXPO's 2nd year (co-located with the 8th Annual EXPO-MRO) and was initiated as a response to the interest of a more focused and exclusive show for the wire and cable processing industries. There currently are no wire processing technology exhibitions of this type in the El Paso/Juárez region despite being an area with a high concentration of activity.

El Paso/Juárez region is comprised of the largest manufacturing centers in the world. In Juárez alone, there are over 300,000 manufacturing jobs and more than 300 maquiladoras and over 25% of these companies are in the Wire Harness or related industry.

Why attend?

M-EXPO is a regional show with proximity to the State of Chihuahua, known to be the wire harness capital of the world. Companies such as ECI, Lear, Delphi (Aptiv), Yazaki, Sumitomo, Furukawa will attend this show.

If you're a decision-maker who designs, specifies, purchases, installs, sells, maintains or manufactures electronic cable assemblies, wiring harnesses and other related products, this is the Expo for you to attend! M-EXPO Wire Processing Technology will provide an cost-effective way to reach a great number of interested, qualified customers.

Who's Exhibiting?



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Testing Appliance Cables & Connectors

Continued from page 46

IN-PLANT SCENARIOS 1 – Design Verification & Prototyping

Thorough testing of a product starts at the Design Verification and Prototyping phases. Early feedback of the results allows for improved Design for Manufacturability and saves money by catching problems sooner in the workflow.

Typically, harnesses and cables destined for systems such as appliances, are tested within an environmental chamber where the rigors of transportation and a life of operation in a variety of operational temperatures, humidity, and vibration can be simulated. The same PC-based testers used for Continuity and HV tests on the production line are flexible enough to be integrated into these test systems, and can accommodate long test interfaces between the tester and environmental chamber electrical ports (to which the cables under test within the chamber are connected).

The prototyping stage is also prime time to develop test automation processes for the production line.

2 – Test Automation

For efficient testing, many manufacturing engineers prefer to automate Continuity and HV testing. With PC-based testers, they are able to incorporate external relay boards to automatically switch between different circuits during test, or to operate lock & release latches; use API or LabView interfaces to integrate with other equipment; scan ID badges for operator log-in; scan work orders for automatic tester set-up; connect foot pedal or remote controls and a variety of audible and visual Pass/Fail external indicators (such as tower lights).

The test procedure itself is written in a simple scripting language and includes calls to automatically log the test data for statistical process control, and to print graphical test reports for internal or customer use. An example of this procedure, a macro,

```
1 LOAD...DB25M-DB25F-S25D
2 WAIT FOR TEST BUTTON
3 TEST CABLE
4 COMPARE TEST TO MATCH
5 IF MATCH THEN ...
6 BEEP
7 REPEAT 2
8 SEARCH DISK FOR MATCH
9 IF MATCH THEN ...
10 PRINT MATCH DATA SPECS
11 REPEAT 1
12 BEEP BEEP
13 STOP
```

Figure 5: Macro example - (Line 1) Load specific cable from database. (2) Pause to mount cable & press test pushbutton when ready. (3) Measure cable. (4,5) If test data and match data agree, (6) sound single tone and (7) repeat from line 2. (8) If the data disagree, search the database for match. (9) If match is found, then (10) print match data wiring, netlist, notes, and label and (11) restart from line 1 to reload the original cable file. If the database does not contain a match, (12) sound a double tone and (13) end the macro.

is given in Fig. 5 that can be triggered by the inbuilt test pushbutton, or a peripheral such as a footswitch, or relay closure.

SUMMARY

Modern appliances are calling for smaller volume electrical designs yet with greater functionality, resulting in systems that must be more carefully checked for continuity and insulation integrity - incorporation of smaller pitch connectors brings a higher chance of faults.

An enhanced continuity check has been discussed that tests for opens, shorts, miswires, and intermittent faults, and high voltage tests to check insulation integrity were described. The same HV tests can also highlight issues with the sharing of signal and power lines within the same connector, and within connectors of compact pitch.

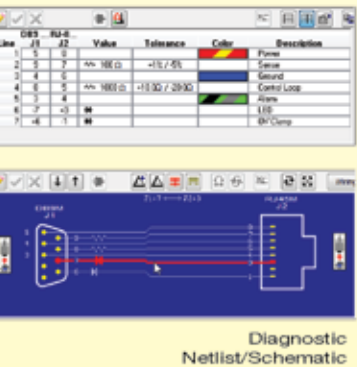
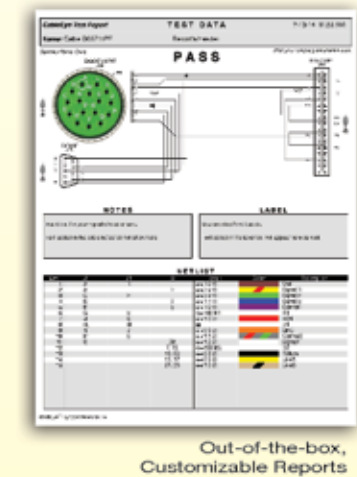
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Trigger Test Signal	Foot pedal, remote control
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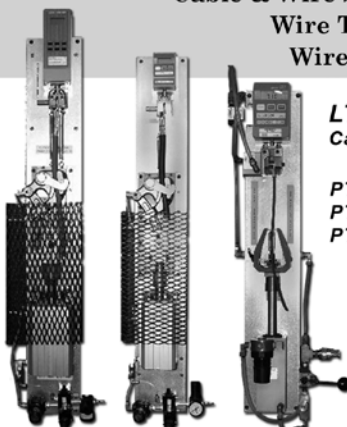
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Case Study: **Schleuniger adds benefit to Northcomm Technologies' slogan, "We Make the Connection"**

Northcomm Technologies, located in Plano, Texas, designs, develops, and implements land mobile radio equipment. They are dedicated to providing customized solutions for mission critical radio communication needs. The company launched in 2014 in a small New York City apartment. In that time, they've grown from a small sized hobby business to a national provider of top tier radio communication products and solutions. The company's customer base currently includes branches of the US Federal Government, Motorola, and countless state and local entities.

The wire processing element of Northcomm Technologies Group focuses on the manufacture of multiconductor low voltage interconnects for land mobile radio communication infrastructure products. Their wire harness assemblies add value to mission critical network providers as they no longer have to create unique or low volume harnesses in-house. Their customers have easy access to top quality interconnect and wire products that are typically made to order. Some of their applications include police and fire repeater stations, radio subscriber interconnect products, and OEM cable harness assemblies for Land Mobile Radio Manufacturers.

As Northcomm Technologies' product line increased, so did their need for operational efficiency and error prevention. According to Senior Director of Product Development, Mark Danon, "We started our business with a single wire harness design that was cut, stripped and terminated by hand, using specialized hand tools. This process was slow, tedious, and led to wasted product." After their research, Northcomm Technologies believed that Schleuniger offered not only world class leading products, but class leading pre- and post-sale product support. "People using hand tools make mistakes, Schleuniger equipment does not."

Shortly after purchasing the EconoStrip 9380, Prefeeder 2200, and Unistrip 2300, Northcomm Technologies successfully reduced their cable production process time by 77.0%. However, time was only one aspect of their physical savings. Northcomm also reduced waste of cable and wire by about 10%. Before automating with Schleuniger products, it would not be uncommon to waste and discard one in every 15 wire harnesses along some point in quality control. "We now only find defects in about 0.7 out of 100 assemblies and typically those are traceable to assembler error and mishandling", says Danon.



EconoStrip 9380

Additionally, the S.ON user interface in the EconoStrip 9380 allows Northcomm to save wire types and profiles for their catalog products. They have the ability to load the material, run the product and rapidly move to final assembly. This precision and repeatability is key to their success.

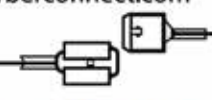
Schleuniger products have not only become useful to Northcomm, but have become integral to their overall processing system and have immensely added to the efficiency of their production time.

Northcomm will additionally purchase a Unicrimp 200 to their wire processing facility as well as a coax processing machine by the end of 2018.

With the addition of Schleuniger's wire processing machines, Northcomm Technologies finds ease in being able to precisely "make the connection".

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NEWS PLUGS continued



Minnesota Wire expands its medical and defense markets with iSTRETCH® patent

Minnesota Wire obtained a patent protecting its inventive wire and cable solution iSTRETCH®: an electrical conductor that stretches. The company's fifth patent supports its iSTRETCH technology, strengthened its medical wearable patient monitoring as well as expanded into the defense and aerospace markets.

iSTRETCH is an elastomeric and flexible cable developed by Minnesota Wire. This cable's conductive materials allow the cable to stretch 40 percent of its initial length without change to its electrical integrity.

In 2006, the U.S. Military requested a cable to support in-field communication with wires close to the soldier's body to reduce snag points and limit bulkiness. Standard wires and cables were unable to meet this demand. Minnesota Wire's dedication to creating custom solutions resulted in the inception of the iSTRETCH cable.

The initial research was funded through Department of Defense and Small Business Innovation Research (SBIR) programs and later supported by the company. Minnesota Wire's headquartered office in St. Paul has four mechanical labs in which all of the development and testing for this patent was completed. Minnesota Wire's 80 percent capture rate for research grants – compared to a 13 percent industry average – and its vertically

integrated infrastructure supports fast developing technology across many industries.

Twelve years later, in 2018, iSTRETCH capabilities grew from communication devices to life or death monitoring connections. This intense honing of technology and Minnesota Wire's dedication to make the best, most reliable wire and cable created iSTRETCH, which can be woven into textiles and survives extreme elements including machine washing and weather. iSTRETCH proves stronger, able to withstand drastic vibration and is more comfortable for the end user than standard wire and cable.

"We are making investments in our intellectual property and the investments are paying off," said Chairman/CEO Paul J. Wagner. "iSTRETCH is better than ever and its applications are infinite."

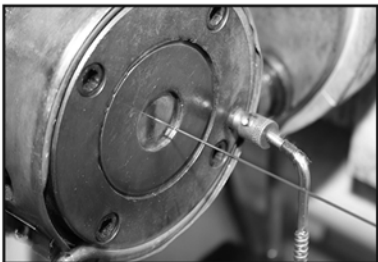
This small, family-owned company based out of Minnesota has capitalized on its electrical capabilities to produce further patents supporting iSTRETCH technology and beyond. Minnesota Wire has developed solutions that before now, have been unavailable to the wire and cable industry.

Minnesota Wire has been engineering and manufacturing custom solutions for complex cable assemblies since 1968. They are a full-service development and manufacturing house for wire, cable, harness and interconnect assemblies, excelling at custom solutions. Minnesota Wire serves the medical, defense, military, industrial, commercial and aerospace markets. They are unafraid to jump over the moon, deploy into battle and create lifesaving connections. Learn more at mnwire.com.

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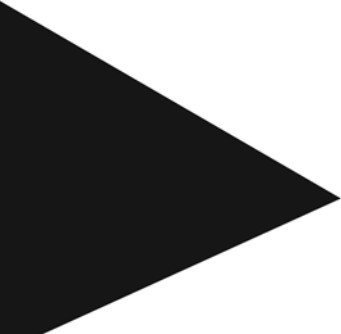
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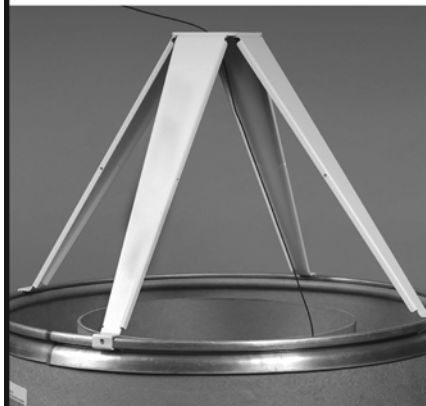
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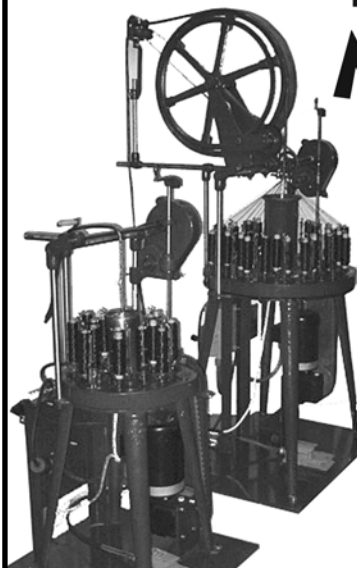
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