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- Are My Blades Sharp?
- Profile: ASI Inc
- HV Cable Terminations
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- Interview with Jim Manke
- The Future of Wire Management
- Tax Incentives for the Harness Industry
- Plus: Many other articles on process improvements

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American Syscomptel Inc

By Joe Tito
Wiring Harness News

Doug Chowning sees his business, American Syscomptel, Inc. (ASI) in Forsyth, MO, as fairly typical among his counterparts in the industry. They have a fairly broad spectrum of customers, and enjoy playing in the low volume/hi-mix arena. But Doug is no typical guy, and ASI certainly had an atypical beginning. Doug told the story in a recent interview with WHN.

Forsyth is a small town of about 2,200 residents located in the south-

west corner of Missouri. But the story actually begins in the even smaller town of Green City, population 700, in the northern part of the state.

It's the early 1980's, and Pastor Jim Rardin is looking out at the congregation in his rural Missouri church, and seeing a lot of suffering. Folks are out of work and there just aren't enough steady, decent paying jobs for his congregants to make ends meet. "They just needed a way to earn a little extra money to keep their farms and houses," Doug told. Pastor Rardin had the idea that if he could cobble together a pool of these reliable lo-



Annette performs some final operations on a harness.

A Look into the Future of Vehicle Wiring Design

By Ted Young
CABLE-I-E LLC

Vehicle OEMs Are Starting to Focus on Equipment Wiring

Vehicle OEMs with new growth products (think Tesla) along with startup aerospace OEMs (think Blue Origin), are creating products that naturally have a higher electrical system con-

tent. As such, they are starting to focus on improving their wiring design methods. These products include, private space exploration, autonomous vehicles with spinoff options and, of course, mainstream electric vehicles and their supporting electric charging infrastructure. In this article, we will concentrate on the latter.

Tesla is leading this focus on improving wiring design in their Model-Y car development (Figure 1).



Figure 1. Wiring system development on the Tesla Model Y could be the harbinger of future auto industry designs.

cals, he could find a way to sell their labor in the marketplace.

Conferring with a church member who worked for one of the local Baby Bell companies, he discovered the need for a steady local source for telephone line cords. They bought some equipment and began producing and selling cords to the small phone companies in northern Missouri. Ironically, it was about this time that Gary Chowning, Doug's father, picked up a copy of Rural Electric Magazine and read an article about Pastor Rardin's noble and successful efforts.

Fast forward to 1988, and Gary is greeted by a new pastor at his local Methodist church. The name and the face seemed familiar. After a discussion, Gary discovered it was the pastor he read about in Rural Electric Magazine a couple of years previous.

Seeing a similar need for steady employment in southwest Missouri, and not enthralled with his vocation in real estate, he approached Pastor Rardin about starting a similar venture. "The pastor explained that this was a much bigger church with more responsibilities, but he would help my father set it up," Doug said.

That was the genesis. Gary made some sales calls from Kansas City to Springfield and got some customers. At that time, they were really just selling labor. "It was mostly assembly of small electronic parts that got snapped together. It had to be done by hand as there were no machines to do it, and that's where it began in 1988," Doug detailed. This is also the time Doug graduated from the Air Force Academy, and began his 30-year

Continued on page 4

Artos Engineering Company Acquired by the Komax Group

Artos Engineering Company, a leader in wire processing automation, has been acquired by the Komax Group, Dierikon, Switzerland, a global automation technology company. Terms of the acquisition were not revealed.

In acquiring Artos Engineering, Komax is expanding its customer base in North America and adding to its expertise in application development. John Olsen, CEO and majority shareholder of Artos Engineering, will continue to head the company after the sale, contributing his expertise to the strengthening of Komax's position in North America. Artos Engineering Company will retain its brand and become one of the Komax Group of more than 30 companies.

"We are excited to join the Komax Group and are looking forward to this opportunity to reach additional markets and to develop innovative solutions for our customers," says John Olsen, CEO of Artos Engineering Company.

For Matijas Meyer, CEO of the Komax Group, the acquisition will be positive for customers: "I am delighted that such a long-established company as Artos Engineering is now part of the Komax Group. Our customers will benefit from the strengths of both companies, plus the move will deliver other competitive advantages."

WHN caught up with John Olsen, CEO of Artos and Tim MacAlpine, President of Komax USA for some specific questions about the acquisition:

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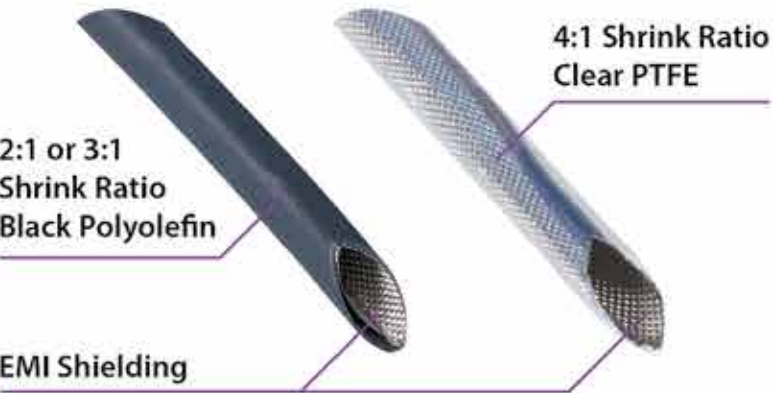
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Continued from page 1 _____

career in the Air Force. More on that later.

Not long after, one of their customers asked if they could cut and strip a small length of wire. "ASI didn't even have a machine to do it," Doug noted, "but the customer guaranteed we would be able to pay for the equipment over a three-year period." And so, began the wire harness business.

ASI continued to network labor efforts with the facility in Green City, but with no one there to run it, it began to wither, and subsequently _____ *Continued on page 10*

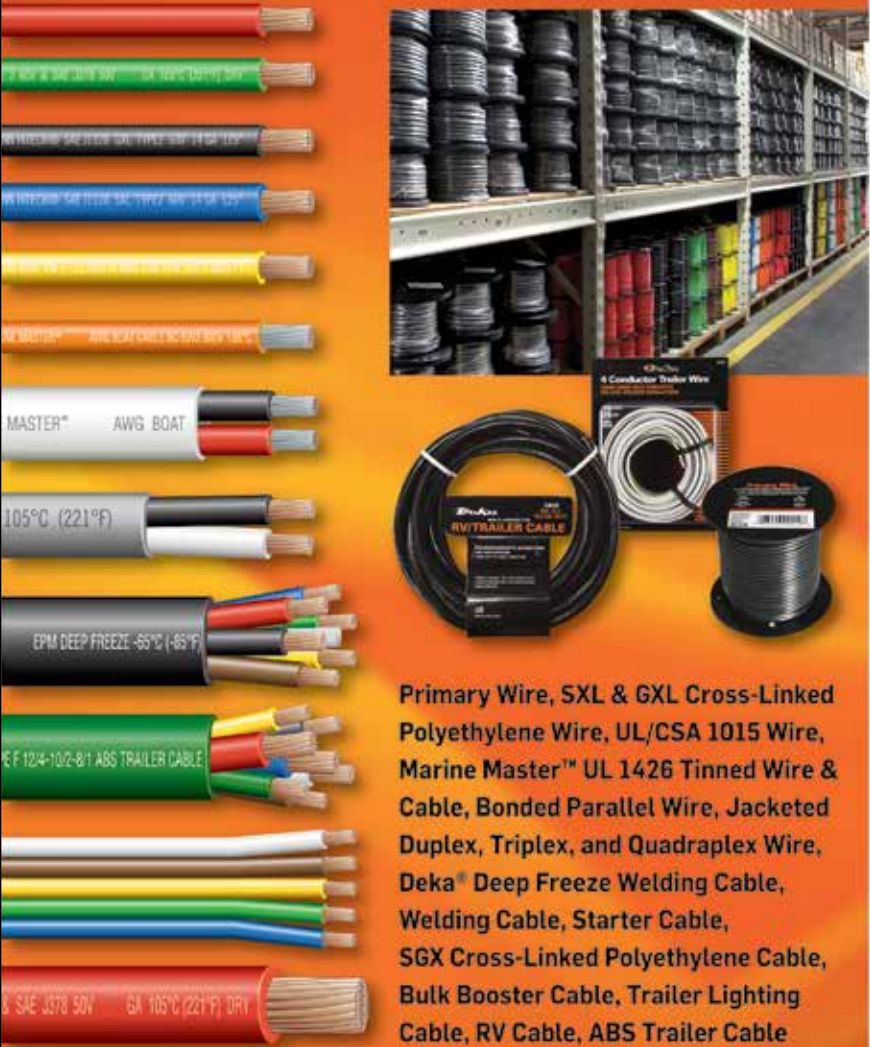
closed in the late 90's. "Eventually, the phone business came to Forsyth, but that business, along with some of the other assembly work, began to dwindle as the wire harness business began to grow." Doug asserted there was no strategic plan to take the business in that direction. It was really driven by the needs of the marketplace and ASI's growing proficiency in wire processing. "We haven't even made sales calls since the late 90's. It's just been word-of-mouth, customer referrals, or



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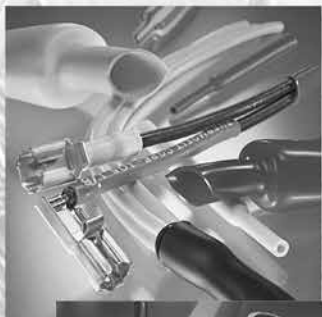
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Artos Engineering Company Acquired by the Komax Group

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What was the strategic purpose for the acquisition?

John Olsen, Artos: From Artos' perspective, joining the Komax Group expands our presence on a global scale. As the market leader, Komax has access to markets and customer opportunities we would never realize as a regional supplier. Additionally, Komax brings strong financial backing to support our product development, application engineering and investment opportunities. Artos' strong support in the North American marketplace as well as our depth of customer application knowledge, combined with Komax's broad product range will provide our collective customers with unmatched solutions for their full wire processing requirements.

Tim MacApline, Komax: Komax has four Strategic Pillars (Solutions Along the Value Chain, Innovative Production Concepts, Global Customer Proximity, Development of Non-automotive Markets) and the Artos Engineering acquisition fits with our strategies, including the development of local solutions along the value chain and increasing our global proximity to our customers. To remain competitive, Komax customers need to be flexible and select the optimal eco-

nomic locations for their production processes – in other words, set up operations wherever their end customers are. This is also true for Komax. To ensure it stays close to its customers, including when these customers choose to relocate their operations, Komax likewise has to show flexibility. For this reason, Komax seeks to expand its global reach in a targeted way whether it be through acquisitions or through the establishment of new sites.

How do the two companies complement each other? What are their strengths?

Tim MacApline, Komax: Artos Engineering has been a leader in wire processing automation for over 100 years and brings an extensive amount of experience in optimizing standard machines with applications that accommodate specific customer needs. Combining this experience with the footprint and added R&D resources Komax has to offer will be a winning combination for the industry.

How will the acquisition roll out -- what will customers see down the road in terms of corporate identity?

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Tim MacApline, Komax: Both companies will continue to operate independently, while leveraging their mutual resources to benefit the market place. The Artos team members with their great know-how and partners were as big a part of the acquisition decision as the machine-installed base. Our organizations will grow together to provide better solutions/products for our partners/customers, which will bring them competitive advantages.

John Olsen, Artos: Through this transaction, both Komax and Artos are committed to retaining the strengths of each of our organizations. We will both remain with our own identities in the marketplace. Artos will retain its name, as a member of the Komax Group, and its focus will continue to be on existing products, with the additional responsibility of utilizing our engineering expertise to assist our total Group's customer base with application and automation opportunities.

What other considerations went into the decision-making process?

John Olsen, Artos: From a personal perspective, I have considered not only what is in the best interest of our shareholders, but more importantly, what is in the best interest of our employees and company long term. Artos will celebrate 108 years since being incorporated in 1911. We have prospered for these many years be-

cause we have always had hard working and loyal employees dedicated first to our customers. Additionally, we have had leadership which has learned to adapt our focus and create new opportunities for our company. I see this merger as the next natural step for our company and remain excited for our future together as a member of the Komax Group.

About Artos Engineering Company

Founded in 1911, Artos Engineering stands out with its customer focus, portfolio of products and wealth of experience in developing innovative applications for wire processing equipment. Headquartered in Brookfield, Wisc., the company has 50 employees and primarily serves customers in the industrial, automotive, and aerospace market segments. Visit Artos at booth 1205 at the EWPT Expo in Milwaukee, May 8 - 9 In Milwaukee.

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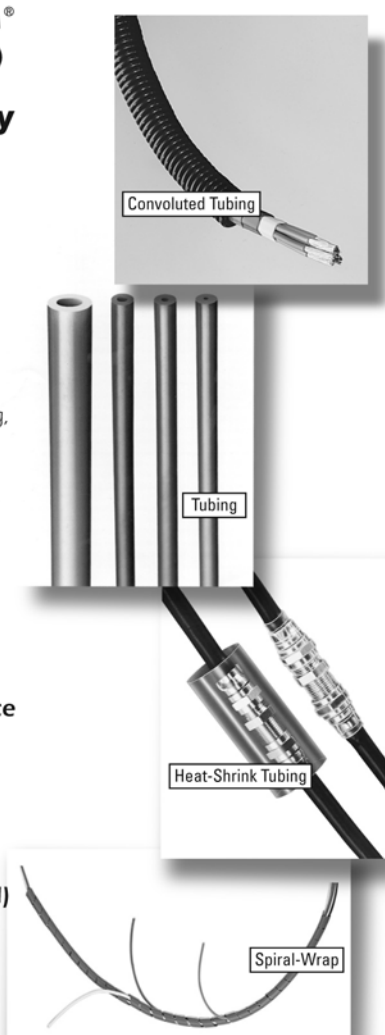
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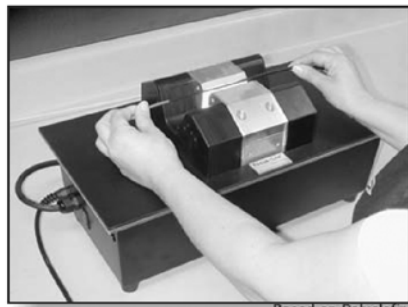
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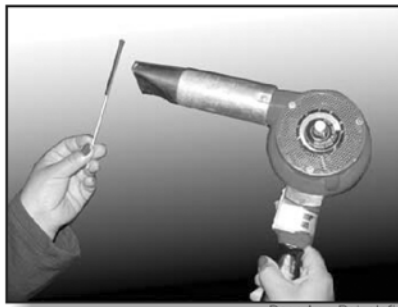
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current customers bringing us new opportunities.”

Doug was a little unclear on some of the exact dates in his chronological description of ASI’s history, and there’s a good reason for that. In 2002, ASI suffered a massive fire destroying everything. Ironically, the electrical fire burned the building on a Sunday. “On Monday, my father ordered more wire, a new wire cutting machine, and cleaned out the local Sears of tools.” By Wednesday they were again shipping the first assemblies from a nearby temporary

facility. “Within 2 months a new building was in place, literally on the ashes of the previous building, and we are still in that building today,” he proclaimed.

Doug Enters the Business

As previously mentioned, Doug is not an ordinary guy, and he didn’t follow a typical career trajectory towards owning a harness business. Upon graduating from the Air Force Academy, he quickly earned his wings and became an instructor pilot in the T-37. He continued his career as a command pilot in the C-130, and

logged more than 3,200 hours in both the U.S. and Italian Air Force as an exchange pilot. At the time of his retirement, Col. Doug Chowning was the chief of Joint Staff Integrated Vulnerability Assessment Team, Defense Threat Reduction Agency.

“I retired in 2014 and needed something to do,” Doug recalled. “I’d lived in Hawaii and Italy and some other nice places, and I wasn’t planning on coming back to Missouri.” But a visit home changed his thinking. “My father was in his 70’s and wanting to dial things back, and I saw the opportunity to do what I loved in the military; which is operational planning, and leading a great team.” So Doug chose to step in and take the reins of the business and continue Gary’s mission. “My father is still here, and even though he doesn’t get involved in many of the day-to-day operations, he is still my senior mentor, and it’s good to have him around.”


Doug has kept the notion of providing jobs in his rural community central to the mission. “That’s what we’re really all about here,” Doug explained. “We were never affiliated with a church, but the idea was born out of a church. More specifically, it was born out of the need in a small community for people who needed a job, and the same thing happened down here.” Another challenge in southwest Missouri is the seasonal nature of the entertainment hub in Branson, where jobs come and go. “Those jobs might pay well for a few months, but then they go away,” he explained. “What we offer is a steady job at a fair wage.”

Today, ASI has about 50 team members at the facility, with another 10-20 doing take-home assembly work at any given time. Interestingly, the customer who supplies the parts for the take-home assembly work is one of the original customers Gary Chowning secured in the beginning.

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American Syscomptel Inc

Continued from page 10

Their current product mix tends towards the appliance, automotive, agricultural and oil & gas markets. “We do a wide spectrum of things with the exception of the very high-end aerospace and medical applications,” Doug detailed. Because they are in a low-cost labor market, and have relatively low overhead, the company is able be very competitive on price. “We don’t have a big engineering staff, and we keep a close eye on cost,” Doug emphasized, “because we are competing not only with others here domestically, but also Mexico and other places.”

Recent efforts at ASI have actually pulled some opportunities out of Mexico and overseas. “Some companies want to regain a level of control on their suppliers. They are finding that we are price competitive and can do a really good job for them.” In addition to the traditional harness shop capabilities,ASI also does some kitting and box builds.

ASI relies heavily on the IPC/WHMAA-620 work standard.That has been a priority for Doug since he entered the business, and attended his first WHMA Conference. “It’s become so important and central to what we do, that we now have an in-house instructor who teaches classes here. It will be a long process, but our goal is to get everybody in the building cer-

tified.” The company is also UL and CSA certified. “We haven’t seen the requirements for ISO yet, but I’m sure that’s not far off.”

When asked what makes ASI unmistakable to their customers, Doug quickly mentioned the word, trust. “They tell us the number one reason they do business with us is that they trust we are going to do the right thing, that we are flexible, and will respond to them where others may not. We ask questions, obviously, because the world can’t be on fire all of the time, but they trust we can be responsive to their needs when they are truly in a bind.”

ASI ships things all over, but the bulk of their business is within a state or two of Forsyth. Consequently, Doug is able to put his skills as a pilot to use in making customer visits. He was recently certified in the Cirrus SR20. “Getting qualified in the Cirrus has enabled me to be more aggressive about visiting customers. It’s been a great tool and I intend to utilize it more extensively.”Those visits are important to Doug. “I know I can do lot of good when they let me walk their factory.” He’s been able to solve many logistical problems for them, and it has occurred to him that’s what ASI is really providing. “We build a lot of harnesses, but at the end of the day,

Continued on page 15



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HDR-64		HDR-64		Value	HiPot Results	DC Current	DC Voltage	DC Isolation	AC Current	AC Voltage	AC Isolation
Line	B1	B2									
1	28	28	16 mΩ			< 1 μA	1499 V	> 1 G	0.150 mA	996 V	7 M
2	30	30	32 mΩ			< 1 μA	1499 V	> 1 G	0.173 mA	996 V	6 M
3	32	32	63 mΩ			< 1 μA	1499 V	> 1 G	0.189 mA	996 V	5 M
4	34	34	125 mΩ			< 1 μA	1499 V	> 1 G	0.204 mA	996 V	5 M
5	36	36	249 mΩ			< 1 μA	1499 V	> 1 G	0.204 mA	996 V	5 M
6	38	38	500 mΩ			< 1 μA	1499 V	> 1 G	0.200 mA	995 V	5 M

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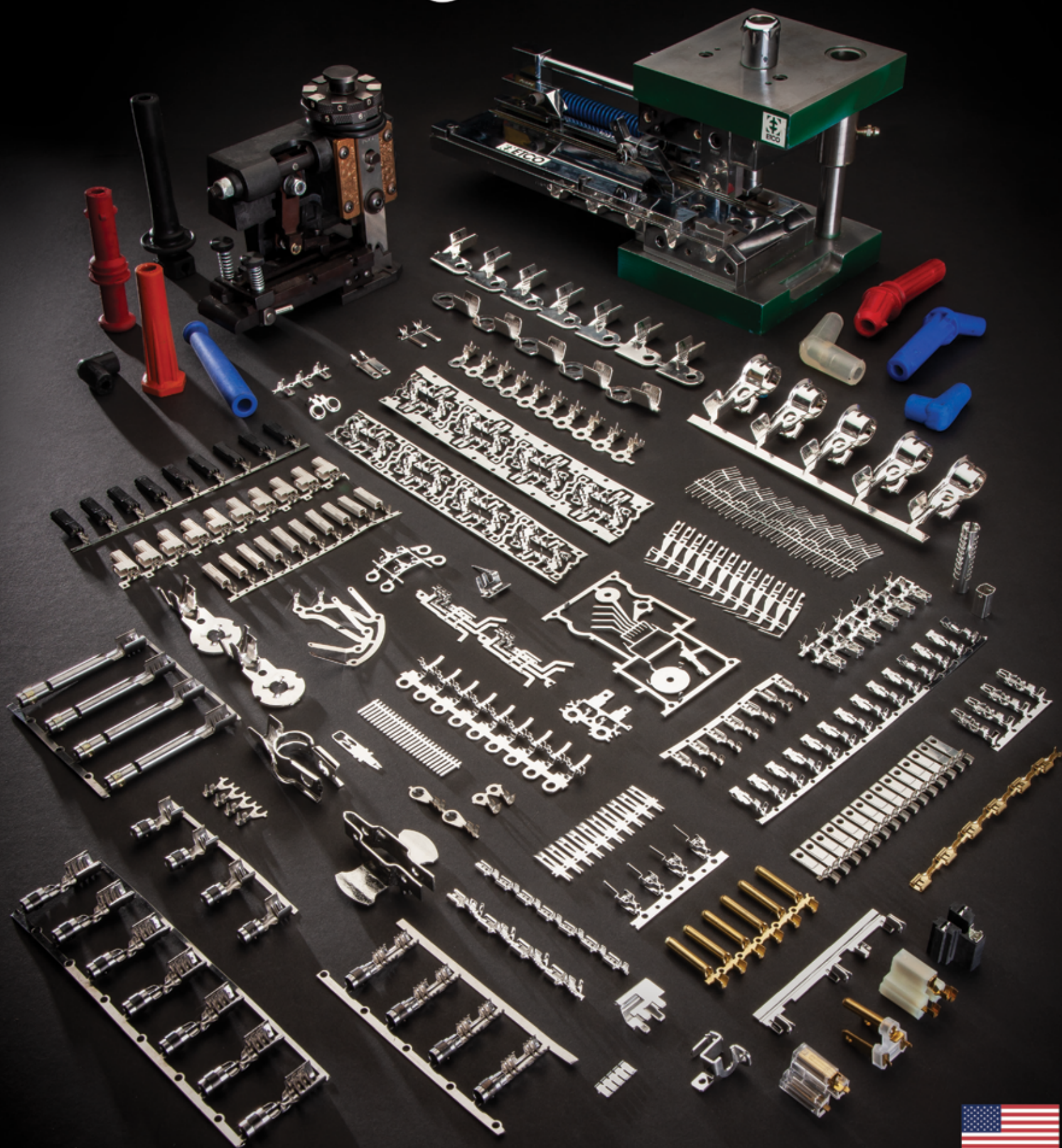
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Continued from page 12 _____
it's just solving problems for customers."

Doug concluded with the following remarks:
"This whole thing has been great for me. I needed something I could feel good about when I came out of the military. In the Air Force, I got to work with the greatest people

in the country. It was a pleasure, a joy and an honor to be with them, and to lead them. And then I came here and found more great people. You don't know what you're going find when you leave the military. But I found great Americans that go to work every day and take care of their families, and it's just an equal honor to be here."



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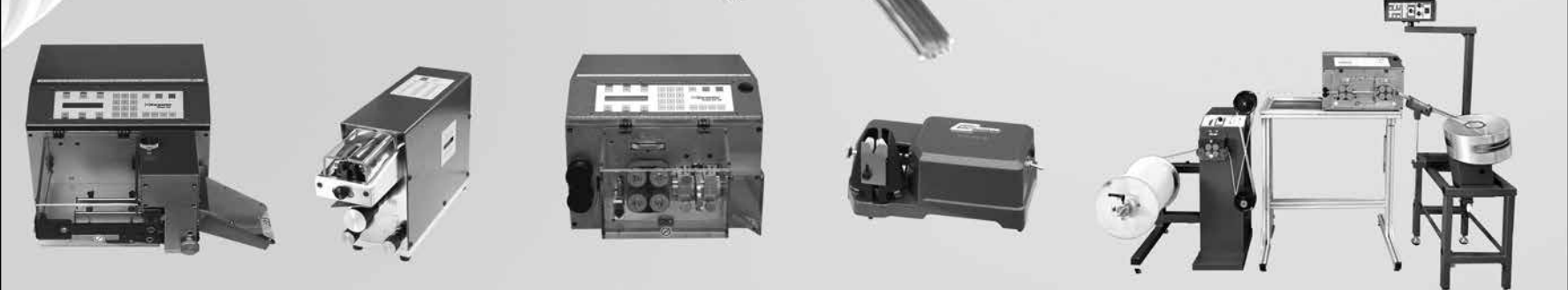
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WHMA UPDATE

WHMA

Wiring Harness Manufacturer's Association

By Christine Siebert

IPC and WHMA Standards Support the Automotive and Wire Harness Industries

One of the most valuable, educational and packed presentations at this year's WHMA Annual Wire Harness Conference, "IPC and WHMA Standards Supporting the Automotive and Wire Harness Industries" was presented by Constantino Gonzalez, Chairman of the IPC Acceptability Standards Committee and President

of ACME Training and Consulting. Gonzalez is also an IPC master instructor for IPC-A-610, J-STD-001, IPC-7711/7721, IPC-A-600, and IPC-WHMA-A-620. He is a member of dozens of IPC standards committees and currently is the vice chair of the 7-31BV IPC-A-610 Automotive Addendum Task Group.

With Gonzalez's expertise and delightful personality, there was no one better to discuss the basics of standards, reasons why standards/training are vital for the automotive industry and cable and wire harness compa-

ny's success and how company staff can be involved in the development of these standards within IPC.

Gonzalez started his presentation by explaining why the IPC/WHMA standards are important.

- Developed and approved by industry peers
- Supports design and layout of products for manufacturing, reliability and excellence
- Provides universally accepted criteria and language for the entire supply chain

- Improves reliability and quality of products, manufacturing to a common specification
- Drives manufacturing efficiencies, reduces cost, minimizes rework and waste

The only industry-consensus standard for cable and wire harness assemblies, IPC/WHMA-A-620, Requirements and Acceptance for Cable and Wire Harness Assemblies describes acceptability criteria for producing crimped, mechanically secured, or soldered interconnections and the associated lacing/restraining criteria associated with

cable and harness assemblies. IPC/WHMA-A-620 can be used as a stand-alone document for purchasing products; however, it does not specify frequency of in-process or end product inspections. Also, there is NO limit placed on the number of process indicators or the number of allowable repair/rework of defects. Such information should be developed with a statistical process control plan.

This brought up the need for developing a standard for design for manufacturing (DFM), repair and rework for the cable and harness industries. By having an addendum to the A-620 to set guidelines and criteria for repair and rework standards, would give the manufacturers a document that their customers can reference when rework is warranted. Such as "Is this Splice Acceptable?" or "What kind of Crimp/Soldering is Acceptable?" This will save money, time and scrap. (Since this presentation, content development has started on "Rework Criteria for Cable & Harness" and "Design for Manufacturing for Cable & Harness.")

The process for creating a project such as an addendum or a new standard is a simple process. First a working group needs to be created. Typically, IPC looks to have a minimum of five companies to launch a new project. A project scope would be approved and IPC follows standard development rules approved and audited

_Continued on page 18

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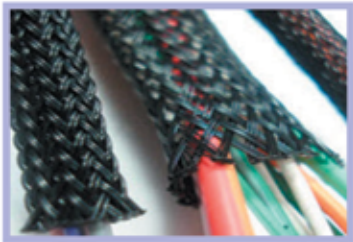


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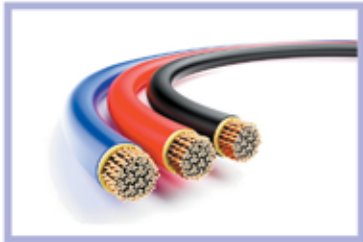
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WHMA UPDATE

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Continued from page 16

by the American National Standard Institute. During the development cycle, interested parties are added to the committee. Staff works to ensure that there is a balance between Users, Customers and General Interest. The process goes as quickly as the volunteer reach consensus. Sometimes it is quick, sometimes not. If a company is willing to place a draft on the table that they are already working on as a starting point, this can significantly accelerate the process. There is no requirement to be a member of any group such as IPC or WHMA. To learn more about the process, reach out to IPC (www.ipc.org). IPC will also be holding a meeting at the upcoming Electrical Wire Processing Technology Expo in Milwaukee, WI on May 8 to formally discuss the format.

The final topic that was discussed in Gonzalez's presentation was the importance of training and certification. Gonzalez stated, "People who are well trained provide better products." He went on to say, "Training should be a constant job every day. Don't give the answers to the operator. If they come to you and ask, 'Is this acceptable?' Ask them, 'You were trained on that. What does the standard say? Where does it say that? Why is it a defect?'"



Constantino Gonzalez

The main point is the operator will know the standards inside and out. If you create the environment where your staff go to the standard, then they will always be training, and they will know the standard. Gonzalez's advice is, "Don't listen to 'I think, I feel, I believe it's a defect, Show me where's it's a defect.'" Great advice!

Last but not least, I'll leave you with "99% of the time when you stick to the standard, it will protect you!"

If you are a WHMA member, this presentation is available in the "2019 Annual Conference Area" of the WHMA member's only area. If you're not a member, join now at www.whma.org.

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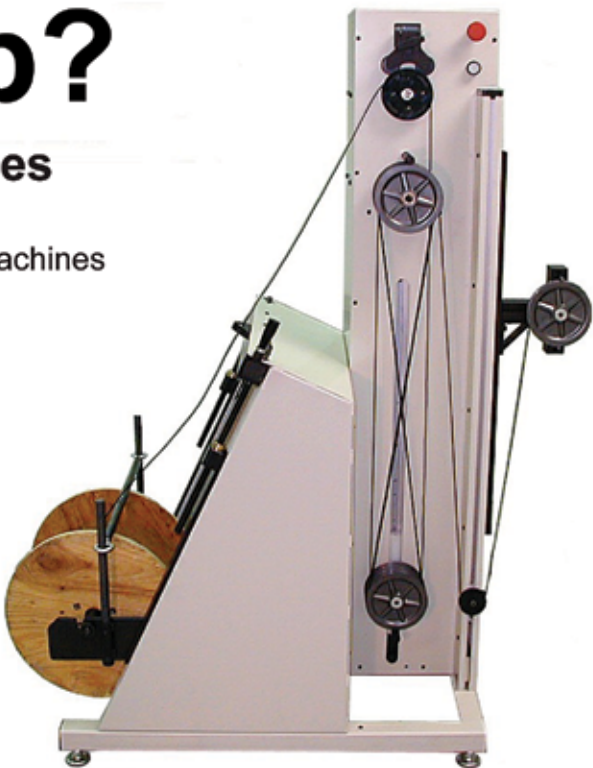
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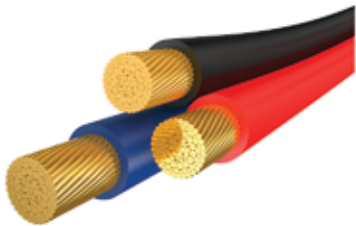
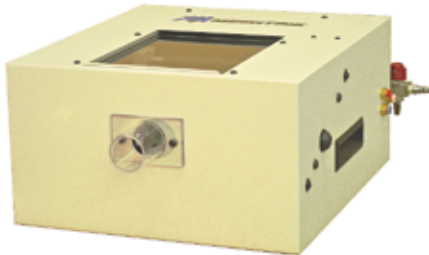
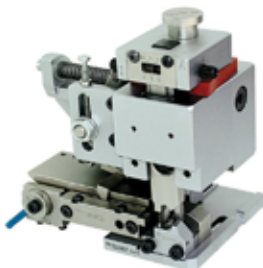
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M & A 101:

Lessons learned from decades of deals

Expertise Matters

By Loren Smith

Some time ago, I received an email from the owner/founder of a \$10M West Coast wire harness company indicating he had reached retirement age and was exploring resources to help him find a buyer for his company. This inquiry set in motion a series of events that illuminate important points about deal making, but first, an interruption:

Frankly, I am a bit self-conscious that this tale, unlike most examples I use in my columns, might come across as self-serving, but I felt it was vital to include details that explain a key component of the M&A world: fees. Now, back to the article.

Normally, when I receive a call like the one described above--after signing a non-disclosure agreement and reviewing basic information on the company--I travel to meet with the owner and discuss all aspects of a potential sale. In this case, however, the owner seemed intent on making a de-



Loren Smith CEO
Blue Valley Capital

cision based on phone calls, and even clearer was his priority of knowing our estimate of his company's valuation and our fee structure. I explained that his company's valuation would fall in an EBITDA multiple range of 4 to 6 (even 7 in some cases), and I told him our fee.

After a few more conversations to exchange additional information, the

Continued on page 23

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- 1 - AUTOMECHA Accufast XL Label Machine
- 1 - AUTOSPLICE Splicing/Crimping Machine, Model SAS/2-40
- 1 - CARPENTER Model 36A Wire & Tubing Cutter, 2016
- 1 - CARPENTER Model 39 Flat Cable, Wire & Tubing Cutter, 2004
- 1 - CARPENTER Model 96 "Compu-Strip" Cut & Strip Machine
- 1 - CARPENTER Model 97A "Compu-Strip" Cut & Strip Machine, 2011
- 1 - CARPENTER 58A Prefeed
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- 1 - EUBANKS 2900 Cut & Strip Machine W/Model 6880-05 Prefeed
- 5 - EUBANKS 2700 Cut & Strip Machine W/Model 6815-05 Prefeeds
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- 1 - HIPRECISE Model HPC-1820 Injection Molder, 2014
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- 1 - KOMAX DPS 272 Coiler, 2012
- 1 - KOMAX Gamma 311 Automatic Crimping Machine
- 1 - KOMAX 106 Prefeed
- 1 - LOCTITE Model 10-50 Posi-Link Volumetric Dual Cartridge Dispensing System
- 1 - LOEPFTE Thermal Transfer Printer, Model TTP4000 (Schleuniger TTP4000)
- 1 - MOLEX TM2000 Universal Press, P/N 63800-8300
- 1 - NICOPRESS AT-330 Crimper
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- 1 - ONDAL Linear TaperS, 2016
- 2 - PANDUIT PAT1M Cable Tie Machines w/Feed Hose, Hand Tools, Bench Mounts
- 2 - PERKINS 3T Presses, Models JR and 3-C, 1-1/8' Stroke
- 1 - PICO 400-BHD Crimper
- 1 - RAMATECH Prefeed, Model ABW 800/300, 2005
- 1 - RONI Mobi-Crane HD
- 1 - SCHAEFER EPS2001 Eccentric Press
- 2 - SCHLEUNIGER CC60 CrimpCenters
- 1 - SCHLEUNIGER CC2000 Cable Coiler, 2006
- 1 - SCHLEUNIGER CP1500 Heavy Duty Coiler
- 1 - SCHLEUNIGER ES9300 EcoStrip, 1998
- 1 - SCHLEUNIGER JS8400 Jacket Stripper
- 3 - SCHLEUNIGER MP8015 Coax Wire Strippers
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- 1 - SCHLEUNIGER OS9400 OmniStrip
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nently withstand temperatures of more than 180°C and perform at voltages of 600V AC and 1000V DC meeting the rigorous demands of high-voltage lines for both on- and off-road vehicles. With shielded and unshielded offerings in single- and multi-conductor products, Coroplast cables meet a variety of global cable standards and requirements and offer functionality for a variety of hybrid vehicle systems.

This is a strategic partnership for both companies. For Coroplast, working with IEWC will help them serve design- and smaller production-stage runs better than they can directly as a manufacturer. For

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ume lengths, as well as a wide variety of value-added services for customers in North American, European and Asian markets."

"Coroplast always operates with the best interests of our customers in mind and we're pleased to work with a like-minded distribution partner. IEWC's extensive connections around the globe and in North America provide the perfect foundation for new business with new customers in new markets for Coroplast," said Michael Lindau, Head of Key Account Management EMEA - BU Wires & Cables at Coroplast.

The addition of Coroplast's high voltage and charging cables is the latest extension of IEWC's continuously expanding portfolio of products and services for the growing automotive wire and cable market. From primary wire constructions to electric and hybrid vehicle battery cable as well as wire management products, IEWC supplies solutions to numerous automotive equipment manufacturers and sub-assembly houses, no matter what the platform.

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Expertise Matters

Continued from page 21

owner called to let me know he was probably going with a competitor because our success fee was twice that of theirs and, at a \$5M purchase price (5 times \$1M EBITDA), he would be paying us a substantial premium. But his conclusion assumed we and our competitor would bring the same deal to the table.

I responded by asking the owner if he would please provide us with the opportunity to show him how we could bring a deal to the table that would yield more cash at closing than what he could realize through other options, and I offered to get on a flight that night and meet him at his plant the next morning. He agreed.

Once I had the opportunity to sit with the owner face to face, I shared the following math: “If we bring a 6.5 all-cash multiple to the table, and our competitor brings a 4 multiple to the table, our deal is likely to net you \$5,850,000 versus an estimated \$3,800,000.”

Of course, I did not promise the 6.5 multiple, but I did emphasize that achieving the high end of a valuation range requires industry expertise. Absent that experience and knowhow, selling a company can result in a mid-range or low-end multiple--or even the inability to find a buyer at all.

Shaking his head, he responded, “That kind of difference sounds improbable. I’m sorry, but I’m skeptical.”

I then described a number of re-

cent examples in which our expertise had enabled us to provide an owner with a deal that substantially eclipsed that of a competitor--while pointing out that in several instances the result was even higher than what we had forecast.


Our track record was now persuading our potential client he might be wise to go with us, but he needed to ask one other question--a question I often get: “How do you consistently achieve these results that you are claiming?”

I answered simply: “Helping founders of wire harness companies sell their business isn’t one thing we do. It is the only thing we do.”

By the end of our meeting, the owner fully appreciated the value of my 30+ years in the wire harness industry as the owner of a wire harness company and then an M&A firm. Our knowledge of the business and our extensive industry contacts enable us to have in-depth discussions with prospective synergistic buyers detailing how the two companies might be integrated to create value post-closing.

We were honored when the harness company owner signed with us, and the deal we put together for him far exceeded his initial expectations. Just as important, it has stood the test of time.

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LEADERSHIP

PUTTING INSIGHTS INTO ACTION

Principle. Process. Practice.

By Paul Hogendoorn

I spent this past weekend volunteering as a timer at a swim meet hosted by my granddaughter's club. There were 800 swimmers and 1,500 race heats. At eight lanes per heat, it meant about 12,000 individual races had to be timed, each lane manned by three qualified timers and a strokes-and-turn judge in order for the time to be "official."

Imagine the confusion, chaos and noise – all those teenage athletes, all the family and friends cheering loudly and the constant churning of water. It all had to be done in about 16 hours, split over two days. And it all ran like clockwork.

The planning required is immense, but the organizers have the benefit of experience and processes that have been refined over many years of running previous events. Everyone has a job to do, and everyone knows their job and has been trained for it.

I got to the event at 8 a.m. The first race is at 9 a.m. All of the volunteers, myself included, have had to attend training sessions to be certified to perform the tasks. At 8:20, the race officials have a quick huddle. At 8:30, the timers and strokes-and-turns judges have an assembly to review and remind everyone of their roles, the objectives and the procedures, and at 8:45 we head down to our assigned positions on the pool deck.

At 9 a.m. precisely, the first race begins. As a timer, the process I have to follow is simple: at first whistle, I check that my watch is reset and ready. The swimmers step on to the diving blocks. Two or three seconds



Paul Hogendoorn

later, the starter says "on your mark" and my focus is entirely on a strobe light that will flash in unison with the starter's horn. About two seconds later, the horn blasts and the strobe flashes, and my job is to start my watch as precisely as possible. The yelling and screaming begins, as fans and teammates exhort their favourite swimmers. About 35 seconds later, the first swimmer touches the finish pad, and then the other seven in quick succession. My job at that point is to focus all my attention on the lane that I am timing and stop my watch as precisely as I can to the swimmer's touch of the wall. Within three or four seconds of the last swimmer touching the pad, the starter whistle blows, and the next group of racers step up to the diving platform. I relay the previous swimmer's time to one of my lane-timer colleagues who records it, then I reset my watch and set my focus back on the strobe light. There is typically less than 60 seconds from the start of one race to the start of the

Continued on page 27

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Principle. Process. Practice.

Continued from page 25

next, and in that time, swimmers are marshalled into position on the pool deck, or out of the pool and out of the way. Six or seven hours later, the day's racing is complete.

The whole experience drills into me the importance of process, of having everyone know their job and do it well. I also think of the swimmers, and the hours of practice they put in between meets, in an effort of shaving seconds, or tenths of seconds, off their times. My granddaughter, for instance, is at the pool training five days a week – two days at 5 a.m. before school, and three days after school. They practice with a purpose, and their purpose is to get better at each stroke, with their turns and with their endurance. With intentional and disciplined practice comes better results.

After my day timing, I got a chance to think about principles and how they can modify a process. About two hours into the event, everything was running in harmony; there was a distinct rhythm and pace to the whole process. Suddenly, the pace changed. Instead of a three-second gap between the end of one race and the whistle to start the next, we paused for about a minute. A swimmer at my end of the pool rolled to the bulkhead in her wheelchair and crawled onto the diving block where she sat instead of stood. Another swimmer on the other end was assisted to the diving

block by an attendant that helped her stand. A few seconds later, the whistle sounded, followed by “take your mark” and the starting horn and strobe light, and the race was on. Six swimmers finished in the typical time range for the event, but the swimmer closest to me didn't have the use of her legs and the swimmer on the other end only had the use of one arm. All the other swimmers cheered them on.

The break in the rhythm and cadence reminded me that the processes of the event are important, but they are not the reason the events are held. The events are held for the swimmers, and clubs are formed to do more than develop swimmers; they develop character, perseverance, a sense of belonging, and a sense of fair play. The clubs, and the meets, develop character in young people, not to mention teaching a thing or two to the old people volunteering.

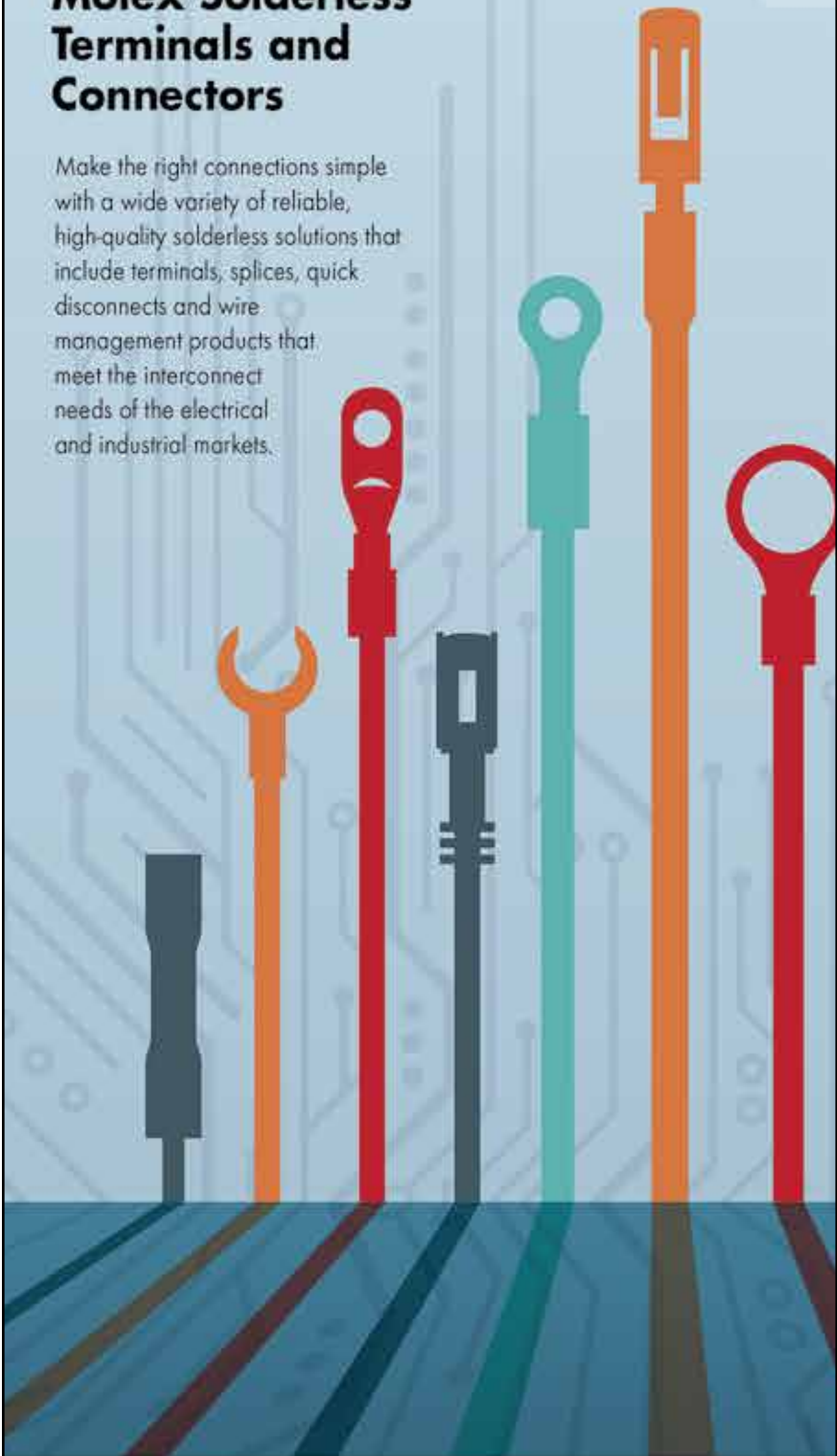
Process and practice are more critical to success in manufacturing today than at any previous time. (Just think of the focus on Lean, for example). But principles still trump process – something to keep in mind as we consider where Industry 4.0 may take us.

Paul Hogendoorn is president of FreePoint Technologies. “Measure. Analyze. Share. Don't forget to share.” He can be reached at paul.hogendoorn@getfreepoint.com

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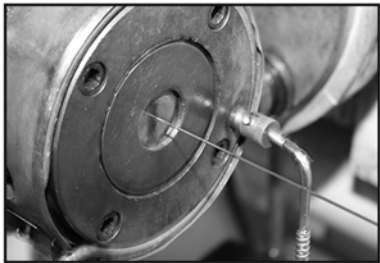
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THE

POWER WOMEN

OF THE WIRE HARNESS INDUSTRY

This edition of WHN features a wiring harness design release engineer from Aptiv who is currently on assignment at General Motors. Nancy Lai is the Engineering Supervisor of the High Voltage, Electrification, Autonomous Group. She has been with Delphi/Aptiv for approximately 8 years since graduating from the University of Michigan with a Bachelor of Science in Mechanical Engineering. She is an example of a person who started on

the ground floor learning and developing her expertise, and now is the Supervisor of a product engineering group similar to the one in which she first started.

Early Years

Nancy's parents immigrated separately to the United States from China. Although her mother went to California through familial connections and her father to Detroit, they ended up reuniting as they knew of each other

having emigrated from the same hometown in China. After marrying, they lived in Detroit, where they had Nancy and her two sisters. Nancy attended Detroit schools, relocating to Troy during her 6th grade year. When I asked Nancy how she gained exposure to engineering, she told me that her 6th grade year was paramount to transforming her future primarily because her 6th grade science teacher recommended that she consider getting involved in STEM, which at



Melissa Femia

the time consisted of weekly after-school lectures often presented by people working in engineering. As the daughter of parents who did not have formal collegiate education, she was unaware of engineering through family or friends and also did not have exposure to STEM-related classes or activities while attending the elementary education system in Detroit city schools. Her transition to Troy was a shock; she had a gap to close as she realized that Troy was one of the highest educationally-ranked school systems in the state and country. After her initial STEM exposure, she continued to be interested in STEM and took advanced science and math classes throughout her remaining secondary school years.

Collegiate Experience

While Nancy was interested in attending some universities located on the east coast, she ended up staying in Michigan due to the cost differential between in-state and out-of-state schools. She applied to both the University of Michigan and Michigan State, choosing to attend U of M upon being accepted to both. During orientation, the person speaking to her group advised the students to look left and look right, then told the group that only one of the three of them would actually attain his or her engineering degree. She recalls being so intimidated at that point, and actually concerned that she may have made the wrong choice. However, she persevered through



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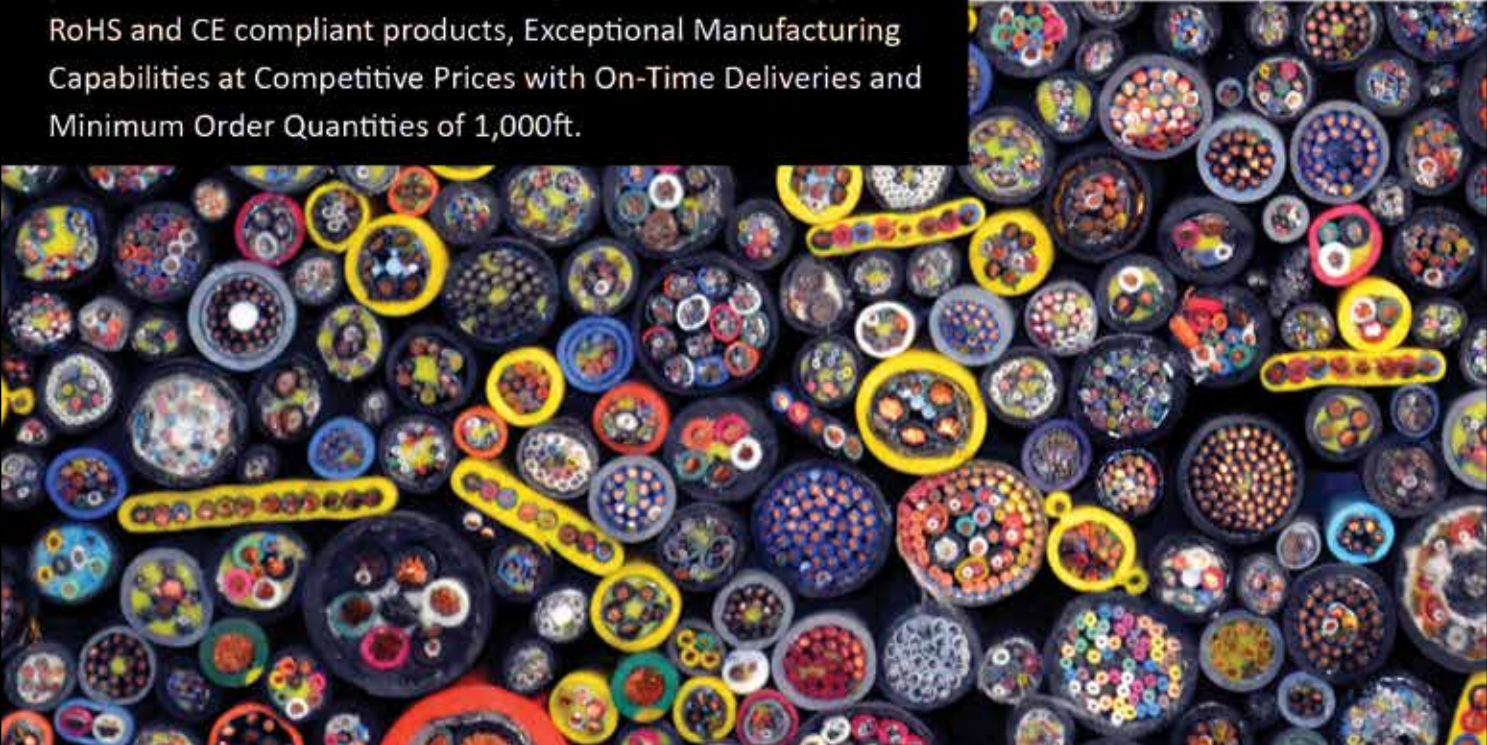
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her first year of general courses. She thinks that she was well-suited for success in college because her parents were not the type of parents that helped her regularly with homework. Although she had unending love and support from her parents, she was already somewhat autonomous in completing assignments timely without the necessity of parental reminders. During her Sophomore year, she declared her major as Mechanical Engineering because she felt that it offered the largest base curriculum that would be applicable to a variety of careers. As common in engineering, the majority of her courses had a significantly higher percentage of boys than girls...with a ratio of 5 or 6 girls to over 100 total students. She did not consider the percentage of female classmates as a detriment, as she already had female roommates. She primarily worked in groups with the males rather than in exclusively female groups, and felt perfectly welcomed and comfortable within those groups.

Professional Career

Nancy learned of Delphi after a career fair at U of M in which 200-300 companies exhibited. Soon after, she received a phone call inquiring as to what she knew about wiring harnesses. Although she had no expertise, she exhibited a desire to learn and was chosen to work as a release engineer on a new truck platform rather than starting in an Application Engineering role or as a DRE (Design Release Engineer) on a current platform with fewer requirements for hitting launch deadlines. As she excelled in her role, she was moved to a Lead Engineer role a few years later. Two years later, to gain exposure to the car side of the business, she moved from the truck program and became the Lead Engineer on a Cadillac vehicle program. Again, after two years in that lead role, she was selected to be the Supervisor of the High Voltage, Electrification, Autonomous Group. Although she is still in the product design realm, this area of technology and customer integration is new and



Nancy Lai

rapidly advancing—definitely an exciting area in which to work.

Reflection on Engineering

Nancy is happy that she chose engineering as her career path as she enjoys the work experience and she has continually progressed in responsibility and promotional levels within Delphi/Aptiv. Her biggest piece of advice to young girls choosing a collegiate major is to simply know that engineering is attainable. Yes, one has to work hard as the coursework is not easy—but the benefits are worth the effort. If a student is willing to put in the time, she wants you to know that engineering is not only suited to the very smartest or those who liked working under hoods of vehicles.

Author's Aside

Thank you, Nancy, for sharing your story. I am thrilled that you and your sisters chose to become engineers.

If you are interested in sharing the stories but missed the original WHN distribution, the articles are available on the Jana Diversity Solutions website at www.janadiversity.com, or at wiringharnessnews.com.

If you know a female engineer who would make a great candidate to feature in the Power Women series, please direct them to me at melissa.femia@janadiversity.com



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Innovation, Growth and New Tax Incentive Opportunities for Material Handlers

By Tracy Lustyan
alliantgroup Managing Director

As a result of new technologies and expanding global supply chains, the material handling and logistics market has experienced rapid growth in recent years. And considering the accelerated pace at which automated capabilities and other advanced technologies such as AI, IoT and RFID are being adopted by material handlers and the manufacturing sector, projections show that we can expect to see even further growth from the material handling market in the coming years.

According to a report released last year by Global Marketing Insights, the material handling market is expected to exceed \$190 billion by 2024. The same report also projects that the robotics segment in the material handling equipment market will see significant CAGR of over 8% to reach over \$20 billion by 2024 as a result of the demand for high-performance robotics systems across a number of industry verticals.

Clearly, the numbers point to a booming industry that is being driven forward by innovation and technological progress. It is also for these very reasons that material handlers qualify for a valuable opportunity that could further accelerate the growth of their industry – the Research and Development (R&D) Tax Credit.

The R&D Tax Credit: Rewarding

Technical Labor and Technological Investment

Originally introduced in 1981, the R&D Tax Credit has actually been around for almost four decades. However, if this is the first time you have heard of the credit (or the first time you have heard of material handlers being eligible for the credit) there are a number of good reasons companies self-censor and fail to explore their potential eligibility. In my experience, they namely relate to what people think of when they hear the term “research and development” and how it is actually defined by an evolving and expanding tax credit.

In the decades following its inception, the R&D Tax Credit has become much more taxpayer-friendly over the years due to new laws, regulations and judicial rulings. No longer is the credit just for companies that perform laboratory research, nor is it just for companies that have created products that are “new to the world.” The credit has been greatly expanded over the years and now rewards companies that are performing the technical activities that are associated with developing and enhancing industrial processes. For hiring technical labor, developing new (or improving upon existing) technology or enhancing the efficiency of industrial processes, material handlers can receive a substantial tax benefit through the R&D Tax Credit.

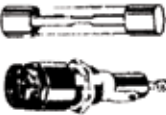
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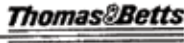


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courage companies to keep production and distribution in the United States. Specifically, this credit rewards businesses that use American components in their products or hire American contractors to handle the fabrication, controls and automation of material handling systems. Additionally, the R&D Tax Credit is now permanent and one of the largest incentives offered at the federal level. Many states now offer their own versions of the federal credit as well.

Real-World Examples

To show the value that this credit can potentially offer, let's look at a few real-world examples.

One conveyor systems solutions provider received over \$1 million in federal and state credits for designing a heavy-weight conveyor belt system for a frac sand mining operation. This company tested various conveyor belt designs and also evaluated different substances to build the conveyor belt itself (such as Kevlar, rubber or polyvinyl chloride).

Another material handling company received \$596,000 in federal and state R&D credits for designing improvements to an existing industrial system. This company determined the optimal layout for the automated system by testing different designs and response times. They redesigned existing components to ensure compatibility with the improved system and rewired the communication system.

While these examples are certainly high end credits results, and the amount of credits received will vary depending upon a number of different variables (wages, supply costs, the amount of qualifying activities, etc.), they do show the value that is potentially on the table for qualifying material handling companies.

Qualifying Projects

Businesses in the material handling industry conduct a broad range

of everyday projects and activities that qualify for the R&D Tax Credit. Here are a few that have traditionally qualified material handlers in the past:

- Developing, designing, programming, manufacturing, testing or fabricating equipment or material handling systems
- Performing retrofits or other system modernizations
- Developing or programming guiding systems software for automatic guided vehicle systems (AVGS) or automated storage / retrieval systems (AS/RS)
- Designing, developing or programming robotic systems
- Developing logistics, order fulfillment or tracking software
- Manufacturing or integrating motion controls or motor systems
- Developing overhead material handling solutions (i.e. cranes, hoists, monorails)

Explore Your Options

Given the spread of new technologies and automated systems within their industry, and considering the technical labor that is needed to implement these systems and their various components, material handlers have become among the best candidates for this valuable tax incentive opportunity.

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*In every issue of Wiring Harness News Anixter will bring you
informative articles about wire and cable technology.*

Red Plague in Silver-Plated Conductors

The phenomenon of red plague becomes news in the wire and cable industry about every ten to fifteen years. It typically appears with a manufacturer new to making high-temperature silver-plated wire or silver-plated braid. Red plague occurs when the silver plating becomes damaged and is subject to moisture and/or high temperatures during the manufacturing process. The technical term for red plague is cuprous oxide corrosion. It is typically visible as spots of red or brown on the silver-plated conductor or silver-plated braid.

Years ago, the term red plague was given to describe the red corrosion (cuprous oxide, Cu₂O) or the black (cupric oxide, CuO) corrosion. The corrosion is caused by the electrochemical reaction induced when a galvanic cell is formed between the copper conductor core and the silver plating. Copper is higher on the galvanic series than silver, meaning that silver is more noble than copper. In the presence of moisture, the

copper will corrode. The corrosion of the copper conductor creates loss of the mechanical properties including strength and ductility. The corrosion can also cause degradation of the electrical conductivity. In the worst case observed, a silver-plated hook-up wire was cut in short six-inch pieces that caused the conductor to turn to a reddish powder that completely poured out of the insulation.

Red plague was first investigated in depth by Anthony and Brown in a 1965 article in Materials Protection Magazine. It was found that in every case where corrosion was visible there was a corresponding break in the silver plating. But not every place where there was a break in the silver plating was corrosion present. To decrease the chances of a gap in silver plating, a minimum plating thickness of silver is present in most wire specifications. Military specifications such as MIL-DTL-16878H and MIL-DTL-17J require a minimum plating thickness of 40 microinches (0.0001 mm). ASTM B298 includes tests for measuring the minimum plating thickness.

To prevent red plague, wire manufacturers must keep equipment in a clean environment. Silver-plated raw material must be kept in a low-

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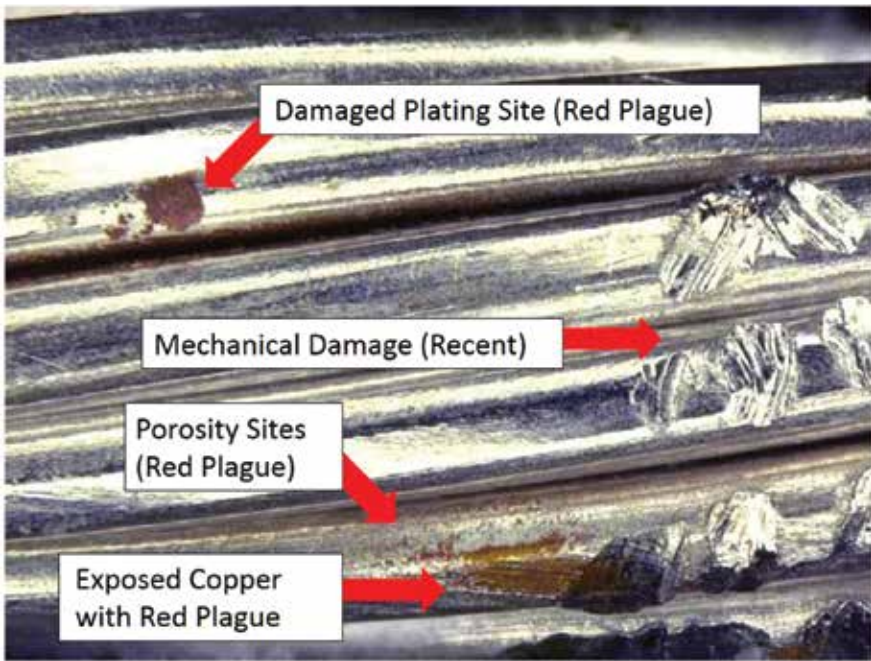
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humidity environment (below 50 percent relative humidity). Most importantly, wire manufacturers should avoid mechanical abrasion of the silver-plated conductor in the stranding and braiding process.

There have been several articles written about this red-plague phenomenon by NASA, ASTM, SAE, and

IPC. One of the most influential presentations was created by Robert William Cooke at NASA in 2010 and is available at <http://hdl.handle.net/2060/20100009723>.

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Interview with Jim Manke, Former Executive Director - WHMA

As mentioned in the previous issue, the WHMA board has decided to enter into an affiliation agreement with IPC. As such, WHMA will rely on the world-wide reach of IPC in its executive management, a role previously held by Associations Solutions, Inc. led by Jim Manke and supported by Kathi Schlieff. Jim and Kathi have been the smiling faces at the booth and welcome table at the WHMA conferences. They have also worked tirelessly behind the scenes to bring the organization where it is today. I thought it would be a good idea to sit down with Jim and go over some of the highlights in his 17-year role as Executive Director for WHMA.

Jim remembers the moment he first got the inquiry from WHMA. “I had taken my three daughters up to a friend’s cabin in northern Minnesota, and on the way back I called the office to check on things. My secretary told me she’d gotten a call from a guy named Norm who knew we managed associations, that he was the past chairman of one, and was inter-

ested in speaking with us.” Jim began. She told Jim it had something to do with harnesses. “You mean like, harness racing?” he asked. “No,” she said, “I think it had something to do with wire.” Having managed associations in the manufacturing sector, he had an inkling of what it was all about. “I called Norm [Sagon] back when I got home, and we set up a time to meet over an afternoon beer.”

The two had a productive chat, and Norm told Jim he’d like to introduce him to the board at their fall meeting that coincided with the Assembly Technology Show in Chicago. “We huddled together in a corner of the Hyatt Regency for about an hour, and I got a call a couple of days later saying they decided to hire our company; so that was the beginning in the fall of 2002.”

WHMA wasn’t exactly in the best of health when Jim took over as Executive Director. They’d gotten beaten up pretty badly in ‘02, as Jim recalled. There was still a great deal of fallout from 9/11, and that had affected the association’s membership. In addition,

the association was reeling from a lackluster performance at the previous February’s annual conference. “The 2003 conference was hopefully going to be the turnaround,” he remembered, “but it wasn’t.”

The conference was in Anaheim, and they ended up with about 30 supplier booths, and about the same amount of member attendees. Because of the surprisingly low turnout, WHMA didn’t come close to fulfilling their hotel contract, and got hit with a huge attrition bill. “They had signed the contract 18 months previous, and had a good indication at the time as to how many hotel rooms they would need, but obviously that didn’t materialize.” Jim informed. “We met with the General Manager of the hotel to ask if there was anything we could do to work this out, and he told us no. Larry Chambly, who was treasurer at the time said, ‘well, I don’t believe in owing anybody money,’ and wrote him a check for \$25,000.”

And that wasn’t the worst of their woes in Anaheim. “Before we left, we had a breakfast meeting with the sup-

plier members where they held our feet to the fire.” Jim remembered. The suppliers told WHMA quite frankly, that if things didn’t improve, they were out. “I knew we had our work cut out for us because if we lost them, that would be the death knell for the association.”

So that left the association in a dismal financial position. “We were in dire straits,” Jim recalled. The next month when they ran the financials, they had less than 30,000 in reserves. “The ASAE, which is the association for associations, says that good practice dictates a 12-month reserve cushion for a rainy day. Well, we’d just had a flood,” he advised.

Jim and the board came up with a marketing plan to help turn things around. At the heart was a phone campaign with Jim and his staff doing the heavy lifting. “It was nothing fancy,” Jim recanted, “just a person-to-person with some of the manufacturer members who had dropped out over the past two or three years.” They did have some help from a number of WHMA volunteers. “We could talk

about the value proposition of the association, but when it got into business discussions, we asked the board to follow up, and they were very good about that.”


Jim remembers that some of the early board meetings he attended were a bit chaotic. He mentioned that tends to be a normal part of an association’s life cycle. “I’m not speaking poorly of anybody, but I’ve been doing this for 42 years and you tend to start out with the pioneers who create the organization. They are typically managers who are good at directing people to get things done, but it’s a little different with an association - you have to get consensus of thought from a diverse group of people.”

Jim credits Lyle Fanning for bringing structure and good governance to the meetings. He acknowledged Lyle as a very good businessman who understands the importance of structure. Together they did two things. “We came up with the first strategic plan for WHMA and got universal buy-in to the goals and vision of the organization. We then used it at board meetings to temper discussion by saying, ‘ok, if it doesn’t have anything to do with fulfilling the goals we’ve created, we really don’t have time for it.’”


The discussion turned to the development of the IPC/WHMA A-620 specification. Jim

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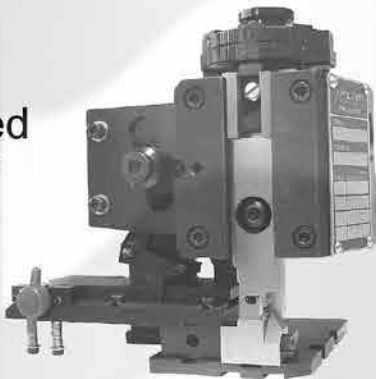


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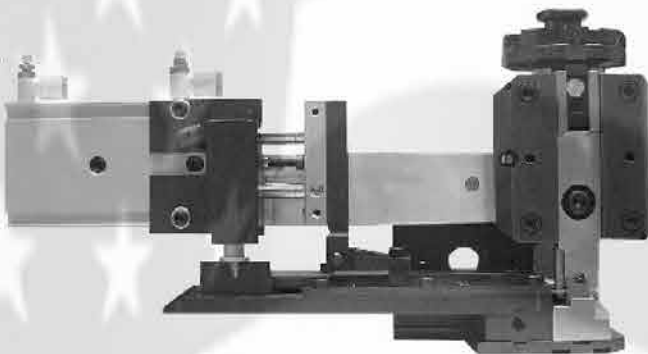


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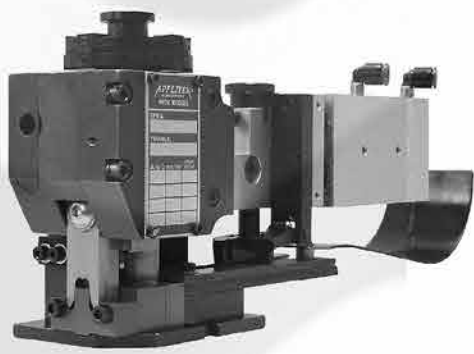


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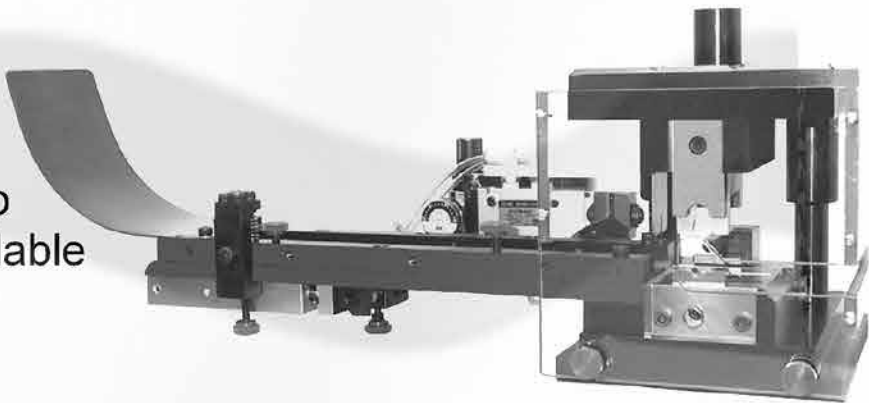


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Interview with Jim Manke, Former Executive Director - WHMA

Continued from page 34

recalled looking over the history of its development. "I saw the minutes and timelines and the countless meetings that took place to develop the standard. IPC brought the much-needed structure and marketing muscle, but it really depended on the efforts of the group for the standard." Still, participation in the A-620 committee meetings began to fall off after the first iteration, and IPC understandably grew frustrated. But, as Jim noted, it can be quite cost prohibitive for small businesses to send folks to A-620 committee meetings. "We finally decided we could spend some money as an association to sup-

port these folks, so there was a dollar amount we could use to support companies sending folks to the A-620 meetings."

After Jim's baptism by fire, there've been a couple of minor bumps along the way. But overall, he seemed quite thankful for his role in helping shape the association over the past 17 years. He also feels lucky to have had his wife, Kathi Schlieff, by his side to help orchestrate the efforts. In conclusion, Jim had the following to say:

"I think the board has been pleased with the direction as we made progress with membership, revenue growth, and attendance at the conferences. It's kind of like I watched the association grow up. We



Always resourceful, Jim and Kathi had this sign made just prior to IPC APEX 2019 after the WHMA booth arrived damaged.

went from a near-death experience, to a very collegial organization with a free exchange of ideas, and I think everybody appreciates the camarade-

rie. Now I see we are in a new period where growth will need to be international. I think that's why the IPC partnership integration was so ap-

pealing, because they do have those international relationships. So there are no hard feelings. It's been a great ride, and I think it was the right call. I said that in Dallas and I meant it. I wish nothing but the best for WHMA moving forward. We had a job to do, and I think we did it well. But we also did it with a smile and some laughs, and I really appreciate that."

Jim and Kathi's plans are full speed ahead with Association Solutions. They will continue to provide general administration, membership services, financial management, and strategic planning services to associations. Past and present projects have taken the into the real estate, insurance, medical research, telecommunications, agriculture, skiing, and fundraising arenas. I've often remarked to Jim that I thought he had one of the best jobs in the world by getting an in-depth look at so many diverse industries.

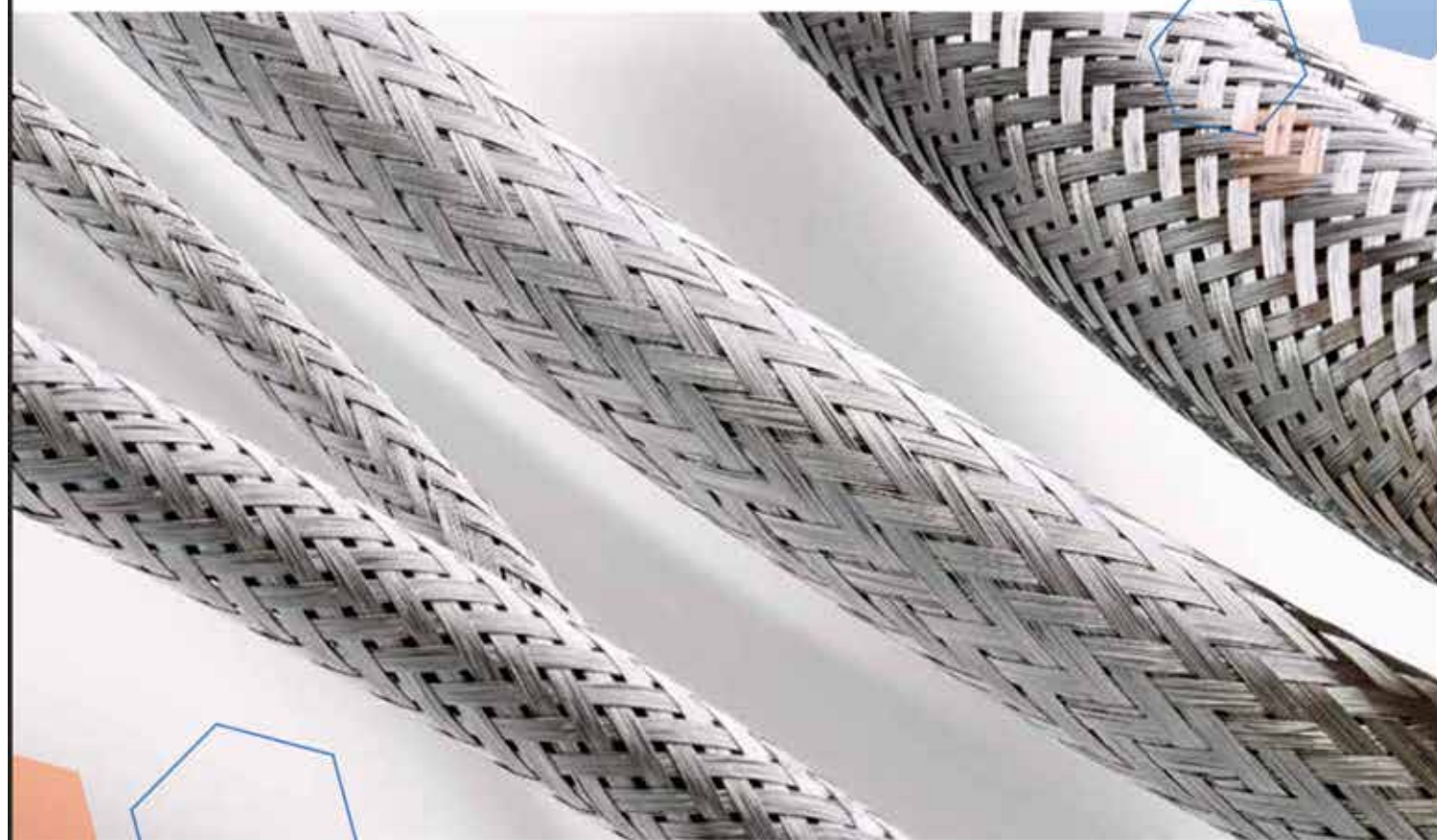
On a personal note, it has been a pleasure and honor for all of us at *Wiring Harness News* to know and work with Jim and Kathi over the years. Although we are separate organizations, we've had the opportunity to get a backstage look at all of their hard efforts for WHMA. They have helped us as well. They've sat for countless interviews for articles, and Jim has supplied many himself. They have always made us comfortable at conferences, and have made so many great connections for us.

Thanks Jim and Kathi!

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Ancient Reflections, Modern Applications

By Wes Garner
SureTech Assembly

Modern man suffers from a cataclysmic concussion. The Enlightenment, the Industrial Revolution and an onslaught of technology have struck our heads with dizzying force and given us swollen egos. With blurred vision and distorted thinking, we are now susceptible to incorrect conclusions about the world we occupy. Illusions of progress have persuaded us to relegate

history as art and embrace invention as savior. In fact, many have come to believe that man has reached its pinnacle of existence. The Ancients were perhaps wise for their day but make no real offering to our present condition. Or so we think.

Over 2,000 years ago, the philosopher Aristotle was born. A full biography is well beyond the scope of this article, but it is sufficient to note, "...the Aristotelian system of logic as well as his unprecedented forays into science, politics, and metaphysics, advanced Western

intellectual thought from ancient times to as far as the seventeenth century." Though his works now sell for pennies on Amazon, his wisdom could be weighed in gold. He was not a perfect man, but his sight was much clearer than our own.

Aristotle penned numerous books while founding the Lyceum and the Peripatetic schools of philosophy. One enduring work, entitled "Rhetoric", addresses the means of persuasion. Most readers are familiar with the lingering grammatical terms ethos, logos, and pathos, which were developed in this

work. In chapter five, Aristotle deals with the definition of happiness. It is here that the great philosopher articulates a transcendent truth, applicable across the ages. He states, "We may define happiness as prosperity combined with virtue." Notice the equation: prosperity times virtue equals happiness. Prosperity alone is insufficient to produce happiness. As Another has said, "A man could gain the whole world and lose his soul."

It's here we move into the realm of business, particularly the wire and cable industry. The bottom line is simply not the bottom line. Happiness requires, "Justice, courage, temperance, magnanimity, magnificence and all such qualities as being excellencies of the soul." Let's consider three areas that bear application:

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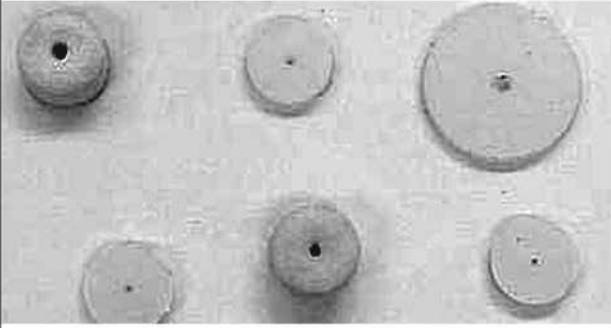
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Ancient Reflections, Modern Applications

Continued from page 40 _____

incorrectly by misplacing the decimal. The result was a significantly inflated price. What to do? I could say nothing, and our profit margins would soar on this build. But the land of plenty void of virtue yields no happiness. A call was placed, the price corrected, and joy ensued.

Employment

Who hasn't felt the emotion of happiness after a week of diligent work? And what could be more rewarding than persistence combined with

success. In 2018, we worked the entire year on one large account. There were weekends and holidays spent in the office cranking through the data to prepare the quotes. Finally, after months of investment, the account came through and the first purchase order arrived. The principle held true. Prosperity combined with virtue (diligence) yielded happiness.

Quality

Years ago, I worked on the floor for a different contract manufacturer who made basic box builds or sub-assemblies. One of our customers was

deeply struggling with their product. It was designed poorly, and they were failing in the field. Undoubtedly, this customer's future was in question. A lot of product was returned to our company for rework and repair. What to do? We decided to spend as little time as possible. We patched up the units poorly and sent them back out. We didn't fix them. We lacked true integrity. Yes, they shipped. Yes, they were invoiced. Yes, we were paid. But the situation and resulting series of decisions brought no happiness.

Thousands of years later, Aristotle's equation proves to be inescapably true. Happiness is not the product of building our own empires at any cost. It is only when prosperity is multiplied by virtue that true happiness can be gained.

Aristotle. Rhetoric. Edited by Paul Negri. Translated by W. Rhys Roberts, Dover Publications, 2004, pp. 34, 371, 463.

Wes Garner is the Director of Sales and Marketing for SureTech Assembly. He holds his BA in Christian Studies. Wes.garner@suretechassembly.com

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Survey Shows Electrification in Heavy-Duty Equipment is Here to Stay

Inaugural survey by Waytek, Inc. and OEM Off-Highway shows long-term cost savings and reduction in routine maintenance lead the way for advancing electrification in off-road equipment

Consumers aren't the only ones moving toward electric vehicles. Waytek, Inc. - Specialists in DC Power Distribution - partnered with OEM Off-Highway to conduct an industry-wide survey on the state of electrification in heavy-duty and off-road equipment.

Survey results showed the benefits of electric systems are clear, but factors such as cost, battery technology and infrastructure play a role in how companies research and adopt their own electric solutions.

"As electrification continues to permeate industrial verticals, we'll

need to work together across industries to tackle the challenges head on," said Gary Christianson, Director of Marketing at Waytek. "Our survey shows several companies are taking steps to explore electrification, and given the complexity of the technology, it's clear that the time to start researching is now."

Battery technology lingers as the No. 1 challenge preventing the advancement of electrification. For electric-powered equipment to achieve widespread adoption, monumental improvements in timely recharging, duration of continuous operation and battery size need to be the focus of research.


The survey also showed 75 percent of respondents say their company either will or might take steps to pursue electrification in the next year, giving industry members a solid

indication of where the market is headed. As companies continue to explore how electrification can supplement their current business models, gradual steps such as hiring new talent, allocating budget and developing hybrid prototypes will lead to big changes in the advancement of electrification.


For more information and to read the full report, visit waytekwire.com.

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A person wearing a white lab coat and white gloves is working on a wiring harness assembly. The person's hands are visible, holding a red connector and a black cable. The background is a blurred industrial setting.

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Pelican Wire: Putting the ‘Custom’ in ‘Customer’

When you visit Pelican Wire at their Naples, Florida manufacturing facility, you’ll quickly hear the word “custom” quite a bit and you’re sure to see tangible evidence of the word, as well. “One of our primary talking

points,” says company President Ted Bill, “is the fact almost every day we have at least one ‘first-time’ wire being produced on our manufacturing floor.” That manufacturing capability, along with the strength of two engineering teams which comprises

about fifteen percent of the entire staff, gives Pelican Wire the ability to custom design a customer’s new wire solution or optimize an existing wire construction.

Pelican Wire Director of Engineering, Brinson White, says “We have designed our entire process around the ‘custom wire’ concept, including specific inventories of a wider-than-normal array of alloys, insulations, compounds and other components necessary to exceed a customer’s expectations.” White continues, “While many customers come to us with specs & drawings in-hand, our detailed onboarding process provides us an opportunity to improve an end-solution by taking the time to better understand the wire application and which attributes are most important to that solution.”

That word, ‘custom’, is also used in their other departments, providing everything from custom account management tools, custom spool labels, custom VMI stocking systems, and custom packing slips & invoices. “At every level of the organization, from the first phone call to the shipment going out the back dock, we work hard to provide a ‘custom customer experience’, which creates the opportunity for us to be as seamless as possible in how we integrate with the needs of our customers” states Frank Balsamo, Director of Sales & Marketing.

Examples of their custom approach to wire manufacturing include:

- A major temperature measurement & sensing company was having leakage with their conventional duplex wire when it was being used in an autoclave. Their team redesigned

their wire to include H-Bond, resulting in a product that prevented 95% of prior leakage.

- A global manufacturer of alternate energy products needed to offer uniform and controllable heating for curing resins in their molds. Pelican teams of Product Design Engineers and Manufacturing Engineers developed a custom Resistance wire solution stranded to the customer specifications with resistance tolerances exceeding industry standards.

- An automotive supplier was struggling with lead times and the expense of expediting materials from the Pacific Rim to North America. The Pelican Wire solution included an improved wire construction to meet the customers exacting specifications. The Maintenance Team at Pelican Wire, which includes the expertise & equipment to operate as a machine shop, custom-built testing equipment to match the customer’s testing equipment. They also began replicating the same testing process as the customer’s on-site quality lab.


Last Fall, Pelican Wire was named the 2018 ‘Manufacturer of the Year’ by the Manufacturer’s Association of Florida (MAF), with ‘Custom Solutions’ being a key element of the judges’ criteria.

“We are committed to growing with our customers and being as proactive as we can in responding to their overall product needs, but further, we strive for being the most effective business partner possible for each of those companies.

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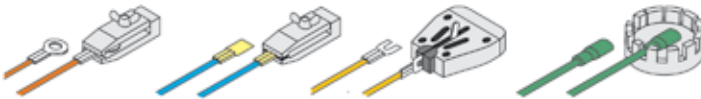
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Cablesan's Series 90 TestRite programs run under the most popular Windows operating systems, and can import wire lists, net lists, and CAD data. TestRite's browser window allows you to provide setup and work instructions using HTML, image, and audio files. With a simple click, everything is displayed, stored, and can be printed in seconds. High voltage and high current models are also available. Put simply, you reduce test and assembly cost dramatically. Visit our website or call us at (909) 483-2436 for more details. Cablesan, Inc., 3022 Inland Empire Blvd., Ontario, CA 91764



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A Look into the Future of Vehicle Wiring Design

Continued from page 1

The Model-Y has been announced by Elon Musk to be a “manufacturing factory revolution”. This focus on improving car wire design means potential improvements have passed Tesla’s “Can we make this 10X better” test. This test is best explained in three of Elon Musk’s famous quotes:

1) “I operate on the physics approach to analysis”, “You boil things down to the first principles or fundamental truths in a particular area and then you reason up from there. Then you apply your reasoning to those axiomatic principles to assess what is really possible and what is simply perceived to be possible.”

2) “Making something just 10% better means you are competing with everyone else in the world.” When you go for ambitious bold, even failures get you important results. Shoot for 10X, reality will degrade to 2X, if you shoot for 2X, reality will degrade it to 10%. When somebody has a breakthrough innovation, it is rarely one little thing. Very rarely, is it one little thing. It’s usually a whole bunch of things that collectively amount to a huge innovation.”

3) “Will the need still be here in 10 years or even 20 years? Do not waste your time on urgent temporary needs (paraphrased).”

The Tesla Model Y will hopefully provide a real-life example on what can be done, when wiring design finally gets an upfront focus. Here are some of Tesla’s cable & wire design improvement goals for the Model-Y SUV (announced March 14 2019, production start fourth quarter 2020).

1. Wiring and Components - The total length of wiring used in the Model-Y SUV, to be 100 meters (330 ft.) versus wiring length used now in the Model-3 car at 1,500 meters (4920 ft.) while sharing 75% of total car components with the Model-3.

- The same cable (sometimes the same conductors too) will be used for power and signal/data. Termination ends of wiring to circuit boards and components, will use smart chips, and new communication chip standards like USB type C

- Some wiring will be converted to flex circuits (where applicable).

- One may not realize electric cars still have lowly 12-volt (usual lead-acid) batteries on board to power the vehicle’s 12-volt systems, but they do. Tesla’s goal is to replace the old 12-volt system components with higher voltage system components, probably 48V. The idea is that the new electrical systems will be powered directly by the vehicle’s main lithium-ion battery. The impacted components will need to be redesigned to operate at the higher system voltage.



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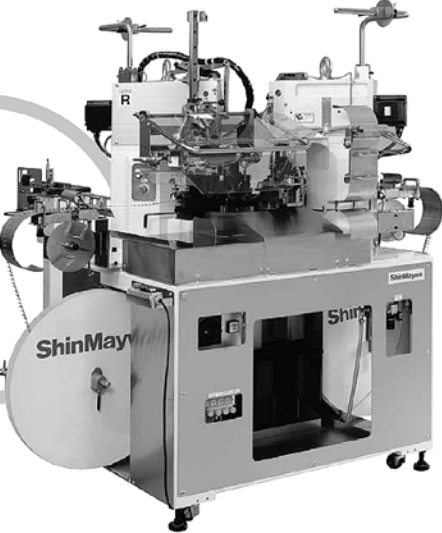
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2. Automation – Tesla is well aware of the limitations of traditional wiring systems towards automation. For this reason, they have patented designs for what they call Structural Cable. The actual October 2018 patent (US20180294075) can be reviewed here: <http://bit.ly/2Yya6Me>

Following is a synopsis of the patent:

Traditional cables are easy to manipulate with human hands for mating with appropriate connectors on different structures or devices. However, the installation of these cables is difficult to automate. The cables lack sufficient structural integrity and rigidity to be easily picked up, moved, and placed by a robotic arm. Further, because traditional cables are not rigid, they may not be easily formed into different shapes and routed to a pre-determined location amidst tight spatial constraints. Routing traditional, flexible cables during manufacturing, for example to connect different components during automobile manufacturing, typically cannot be automated and therefore requires humans to place by hand. Such manual placement is time consuming, tedious, and costly. In addition, while certain traditional cables are designed to serve multiple purposes (such as power transmission, data, and video) over a single cable; specific applications may not require the transfer of all

three types of information. The structural cable, according to the present disclosure, is a cable with structural integrity that may be manipulated into place by a robotic arm as part of an automated process, while providing reliable data connections to its desired location. As part of the form manipulation, the structural cable preferentially allows manipulation into different geometries allowing for placement that avoids obstacles, and can be performed in a reproducible manner so as to be implemented as part of an automated process. This is achieved by:

- Stiffening custom parallel cable into a structural shape for automated assembly into the car by a robotic arm (Fig. 2).

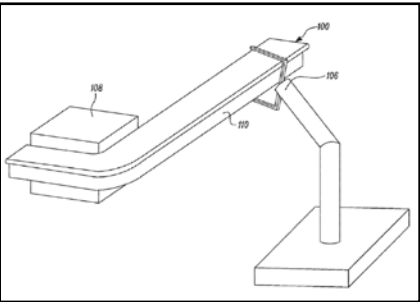


Figure 2. Robotic arm assembly

- Creating custom stiff extrusions with parallel wire/conductors. The majority are optimized for required impedance and shielding for data. Some have conductor cross sections for power (Fig. 3).

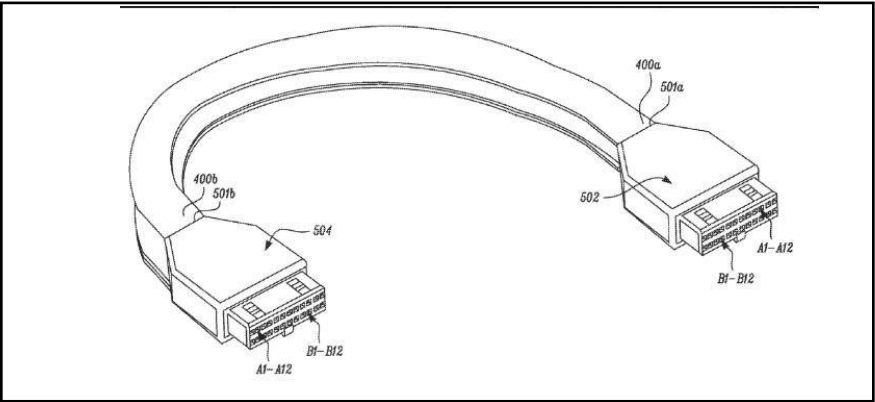


Figure 3. Connector termination process

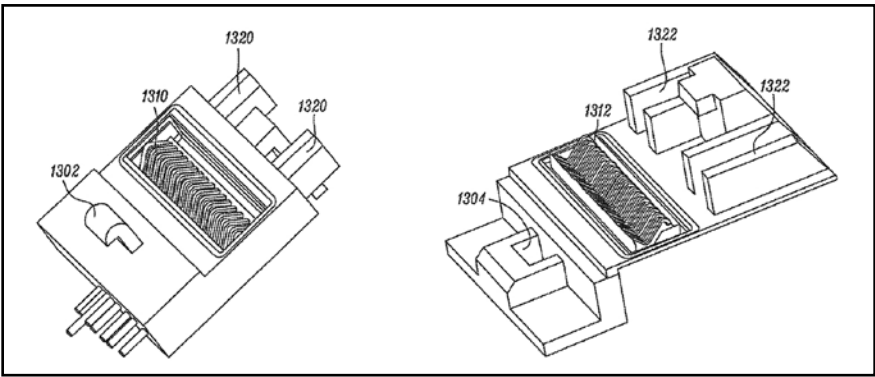


Figure 4a and Figure 4b. Vehicle automated assembly of connections

- Automation of the connector conductor termination process.
- Designing custom electrical connectors so that final vehicle assembly connection mating can be automated (Fig. 4).

Super Charging Cables and Connectors

Tesla’s latest supercharger stations use cable assemblies that are glycol/ water cooled in both cable and vehicle mating DC contacts. These actively cooled cable assemblies are driven by demand for shorter recharging time, while keeping cable DC conductor copper cross section (AWG) small for flexibility and light weight handling (Fig. 5). These are clearly not a typical power cord.



Figure 5. CCS Combo2 Connector

Standardization of electric vehicle recharging connectors is going through growing pains for increasingly high power DC and AC connectors. They are provided by competing companies and government standards, in the U.S, Europe, and Asia.

One can rest assured the development of wiring systems at Tesla is not the afterthought it has traditionally been in vehicle design. Design of the cable & wiring on the new Model-Y is being completed at the same time as the rest of the fundamental car design (mechanical, electrical, software, etc.). The majority is occurring in the virtual design phase, many months before the first physical prototypes are available. Even if these 10X improvement goals degrade to 2X, they will collectively amount to a huge innovation for vehicle wiring.

This upfront virtual wiring design is being made possible by next generation electrical wiring design software:

1. Schematic Wiring Diagrams
2. Mechanical 3D CAD Electrical Routing
3. Manufacturing documentation, with 2D flattened drawings

There is, however, another generation of design software now being developed that changes the manufacturing documentation output. It eliminates the need to create 2D drawings for manufacturing. All information sufficient for product manufacturing resides in the same electronic file as the 3D geometry. This new file type is called Product Manufacturing Information (PMI). As of now, these output files only exist for pure mechanical design using lead-

Continued on page 50

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A Look into the Future of Vehicle Wiring Design

Continued from page 49 _____

ing mechanical design software. These neutral electronic files are intended not only to be complete enough for use by the downstream manufacturing suppliers, but also for direct use by CNC machining centers.

So where does wiring design fit in? There are two PMI electronic file format alternatives, that are just in their infancy, for including electrical wiring design product manufacturing information. These new PMI files are expected to

support cable & harness manufacturing, and wire processing equipment input within 5 years:

1.) STEP AP 242 Edition-2, Developed by Aerospace and Defense

From the “Global Product Data Interoperability Summit 2018”

Planned extensions for Edition-3:

- Equipotential / signal concepts
- Functional information logical link, net, function

- EWIS requirements, safety rules
- Electrical libraries
- Optical fiber specificities
- Manufacturing process (form board)
- 2.) Vehicle Electric Container (VEC) Version 1.1.3, Developed by Automotive
- Includes new semantics for electrical design, 3 layers (Net, Connection, and Wiring Specification)

We wish success to those vehicle OEMs focused on bringing wiring design to the forefront. They have made it a priority to design the wiring systems simultaneously as the vehicle is being designed, instead of being an afterthought waiting for physical prototypes. Not only will the OEMs benefit from these innovative wiring design methods, but so will cable & harness manufacturers, and wiring component suppliers.

Note: May this article spark future WHM articles on the topic. There are many bright people in our industry who are qualified to speak to the details of these trends. This author hopes to hear from you!

About the Author:
Ted Young, Partner at CABLE-I-E, LLC
CABLE-I-E LLC is a startup company in the ownership and minimum viable product development phase. They are focused on creating a cooperative of cable & wire harness manufacturers and of OEM new product design engineering service companies, that want to provide wiring design services to OEMs. Previously at Carestream Health, Rochester NY, Mechanical Product Development Engineer, Technical Project Manager, Responsible for medical X-Ray In-room system, DRX Evolution Plus. Previously at Eastman Kodak, Wire Harness Manufacturing Engineer.

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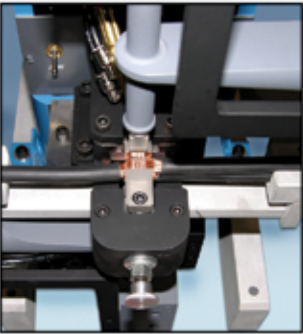


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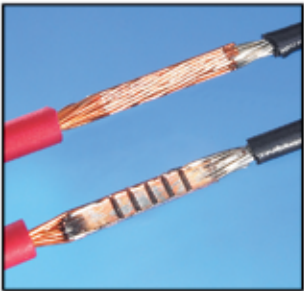


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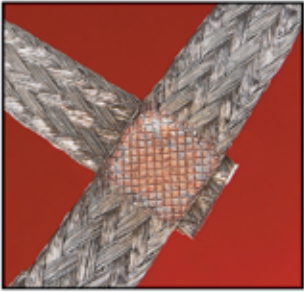


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Zuken USA Announces Process Integration with Delta Sigma Company

Zuken USA announces Harness Builder for E3.series, part of Zuken’s popular electrical harness design suite of tools, will have capabilities to directly drive Delta Sigma Company’s ProjectionWorks. E3.series users can now easily take advantage of an enhanced manufacturing capability utilizing augmented reality. ProjectionWorks, an award-winning manufacturing automation solution, uses projection technology to provide step by step visual instructions for harness assembly. By visualizing the cable assembly connection points, routing and instructions, manufacturing productivity is dramatically improved.

Harness Builder for E3.series supports the custom wire and cable harness market and is designed to be used by harness manufacturers for the accurate quotation and full creation of nail-board/peg-board documentation. Harness manufacturers can now easily create harness documentation from drawings and/or a wire list quickly and accurately. Using Harness Builder for E3.series for design, combined with ProjectionWorks for assembly, it is now possible to quickly produce harness estimates in parallel with designing the wire harness. High-accuracy data is output directly to manufacturing, increasing overall productivity.

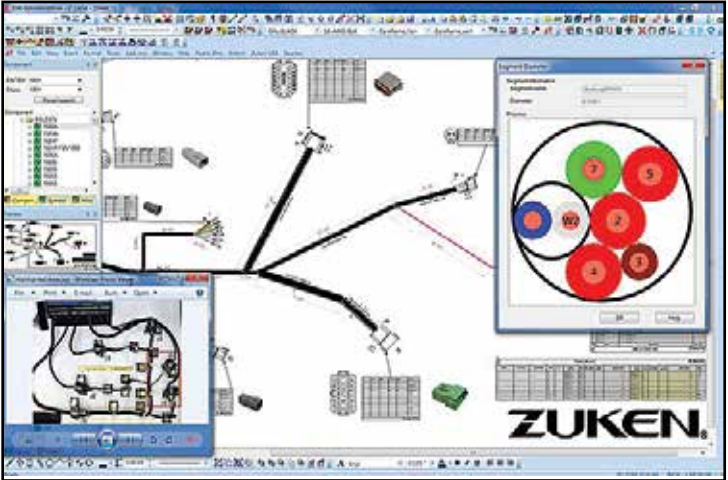
Harness Builder for E3.series utilizes an extensive database of connectors, cables and wires with the modeled clips and cable protection to detail a complete wire harness. The information is then passed to ProjectionWorks for sequencing of tasks. From there, the wires and cables can be sent directly to state-of-the-art wire cut and labeling machines. Working notes and part positioning are projected directly to a formboard to facilitate accurate manufacturing of the harness. Once the harness has been created, test data can be delivered directly from Harness Builder for E3.series to all major harness testers.

Paul Harvell, Product Director for E3.series notes, “Zuken’s partnership with ProjectionWorks enhances our users’ experience beyond the design. ProjectionWorks’ state of the art assembly projection tech-

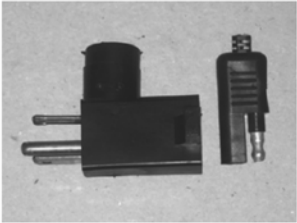
nology, combined with Harness Builder for E3.series, provides an optimal design, assembly and test solution for the wire and cable harness manufacturing market.”

Zuken’s new integration with Delta Sigma Company will be

available to customers in North America with the release of Harness Builder for E3.series 2019 in June of this year. The integration will be presented at the Electrical Wire Processing Technology Expo in Milwaukee, WI, May 8-9, 2019.



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The Future of Wire Management is Already Here

By Missy DeBord and
Bruce Laabs

Remember not so long ago, when products that contain lots of wire – cars and industrial machines, for example – evolved slowly and fairly predictably? No more.

As a manufacturer of products that route, bundle, fasten and otherwise protect and identify wires and hoses, our product managers and engineers must constantly look over the horizon of the industries we serve. That's because,

in the world of industrial product design, wire management is often treated as an afterthought.

Today, we are witnessing a surge in on-board technology being integrated into everything from consumer refrigerators to semi-trucks. Staying ahead of these revolutionary shifts requires new, uncharted ways of thinking about routing technology.

Connected homes, smart
factories

Did you ever imagine we'd be talking about self-aware appliances outside the con-

text of science fiction? Today, such conversations don't even raise an eyebrow. Consumers can purchase a refrigerator outfitted with a digital memo board, technology that adds grocery items to a virtual shopping cart and sends an order via Wifi to a retailer, adjusts the temperature of multiple compartment zones and tells the owner when it's time to change a filter. At the grocery store? Use your smartphone to ask the fridge what you need to restock.

Washing machines automatically adjust cycle times by weighing the load. Clothes dryers stop running when they sense the load is dry.

Oh, the challenges these super-intelligent, modern conveniences add in terms of wire management.

More technology – sensors, for example – means more wires. So, we follow the wires and discover all kinds of opportunities to better protect internal systems while reducing costs associated with assembly.

That can mean bundling fasteners such as cable ties with low profile heads to fit these larger diameter harnesses in the same, tight spaces. Also, data cables often run alongside electrical wires, necessitating shielding or physical separation to minimize interference or cross talk.

Manufacturers want to completely hide their wiring harnesses, both for physical protection and aesthetics. This requires efficient ways to route wiring and more surfaces and edges to consider for mounting. At the same time, these OEMs are always keen on ways to speed and simplify assembly.

Once while visiting a customer, we identified their need for a better blind hole mount as part of a washing machine assembly. Our engineers developed one that attaches with a simple push, no tools, replacing a part that used to get screwed or glued in place. And by making it toolless, installers can reach into deep, dark recesses and complete the assembly faster.

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ments also produce more heat in compact spaces. That can mean choosing parts that reroute a bundle, adding protective sleeving or utilizing fasteners made from resins that withstand prolonged exposure to higher temperatures.

It's not always about making fasteners smaller or using a new material. Sometimes we find changing the orientation of an existing product does the trick.

Then there's the challenge of constant movement. Whether on a consumer product or in a robotic workflow on a shop floor, we're seeing an increase in automation and related systems. Constant motion requires fasteners and protection products designed to withstand not just repetitive movement, but the associated impact and environmental factors.

Identifying these pain points early is crucial in order to more seamlessly integrate these new systems. Just as important, customers and suppliers working together during the design stage helps avoid last minute, custom fasteners that must go through the validation process.

Super intelligence on four wheels

Moore's Law has survived over 50 years as the de facto truth regarding the evolution of electronics. If we apply it to today's automobile market,

we can expect cars to be fully autonomous around 2035. They will require ADAS, or Advanced Driver-Assistance Systems, which sounds foreign now, but will no doubt roll off the tongue when the time comes.

While we're not quite there yet, modern vehicles are giving us more than a glimpse of what this will look like. And things are already moving incredibly fast.

Think about all the systems hidden behind the plastic and sheet metal: cameras, radar and LiDAR (for systems such as blind-spot monitoring) all require mounts and a physical connection to the car's central intelligence hub. Those connections aren't just simple wires any longer; they're coax and high-speed data cables, too. And the number of tech components is increasing over time. New cars contain vastly more cameras and sensors than a short time ago, and this trend will continue.

OEMs aren't making the vehicles bigger to accommodate added technology, and yet they find ways to decrease weight while increasing cargo volume. Together, we're finding new ways to route, protect and mount all those connections and reduce weight further.

We haven't begun to discuss electric vehicles, and they bring even

Continued on page 54

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The Future of Wire Management

Continued from page 53

more challenges for managing wires. They tend to have more sensors and modules, more wiring and, of course, massive batteries. These batteries are heavy, and they can become extremely hot. Managing the temperature has become a regular consideration in developing new fasteners and protection products.

Weight affects EV fuel range as well as fuel economy in cars with combustion engines. So, auto manufacturers are constantly seeking ways to reduce mass. One way we can help is through a part conversion process called “Metal to Plastic,” or M2P. Where it makes sense, replacing metal fasteners and brackets with highly engineered plastic alternatives can result in 30 to 70 percent weight reduction.

The plastic substitutions can consolidate multiple metal parts and fasteners to a single piece. The new part can be smaller yet incredibly strong. They can be designed with low profile features to fit in tighter spaces and protect adjacent bundles against abrasion. They can be made of plastics that withstand an extremely wide temperature range in poorly vented compartments and channels.

Looking over the horizon, tomorrow’s vehicles may actually contain fewer wires and shorter runs. However, the weight of all that wire and cable is expected to nearly double in response to the applications of all the

new technology. The industry continues to throw new opportunities in our path, which keeps the work exciting.

What’s good for the OEM is also good for wire harness maker, installer and many others along the journey. Today’s wire management must check off many boxes – weight reduction, cost control, easy insertion combined with high extraction force, simple or no assembly, impact resistance, high and low temperature considerations, UV and chemical resistance, routing orientation and more.

The best solution isn’t always right in front of us. But experience developing these solutions on a constant basis for a broad range of manufacturers and applications certainly helps get us to the ultimate answer faster.

Missy DeBord, HellermannTyton product category manager – electrical, identifies new product opportunities aimed at meeting customer application needs and current market trends related to the bundling and securing of wires, cables, tubes and hoses in the electrical market.

Bruce Laabs, HellermannTyton director of market development – automotive, is responsible for product management and marketing for the light vehicle, heavy truck, construction and agriculture markets. He also manages our Detroit-based inside sales office to service our light vehicle customer base.

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HV Cable Terminations – Process Steps and Acceptance Criteria Made Easy

By Pete Doyon,
Schleuniger, Inc

For those who aren't experts in high-voltage applications, I'd like to explain the key process steps and acceptance criteria in simple terms. There is no question that hybrid electric vehicles (HEV) and fully electric vehicles (EV) are here to stay. These types of vehicles use special cable to connect the battery pack to the electric drives, charging circuits and electric motor(s). This special type of cable is known as high-voltage or "HV" cable. It is typically orange in color, has multiple layers of insulation and shielding, and has one or more inner conductors. Since HV cables carry voltages up to 600 volts or more and high peak currents, each process step used to prepare the cable end for termination is critical to achieve the required performance of the cable assembly over the life of the vehicle.

Regardless of the type of tool or automated equipment that is used to process HV cables, the requirements are the same. Following is a step-by-step description of the individual process steps required to prepare and terminate a typical HV cable as well as the acceptance criteria.



1. Outer jacket stripping

The first step is to strip the outer insulation jacket to the specified strip length while ensuring that the underlying shielding is not damaged. The outer jacket is typically made of silicone, which is soft and slippery, making it difficult to strip. Sometimes the outer jacket wall thickness is not uniform along the entire cable length, making it even more difficult to strip properly. The cable must be inspected after stripping to ensure there is no damage to the underlying cable layers.



2. Foil cutting

Some HV cables have a thin layer of foil bonded to a polyester backing. This foil layer must be cut cleanly and removed completely before the next processing step. Reworking or cutting with scissors is not acceptable. When cutting and removing the foil, the underlying braided shield must not be damaged in any way.



3. Assembling the inner ferrule

Inner ferrules come in a wide variety of shapes and sizes, making it difficult to automate this process step. The ferrule must be placed in the proper position on the cable without damaging the braided shield.



4. Shield cutting

Due to the high risk of damaging the underlying cable layers, cutting the braided shield is one of the most

difficult steps in processing shielded HV cables. The braided shield must be cut cleanly and squarely at the proper length with no uncut strands. All cut strands must be collected properly to prevent any possibility of a short circuit in the cable assembly or anywhere else in the vehicle.



5. Shield folding

The shield is folded over the ferrule. The individual strands must be distributed evenly around the periphery of the cable or it could lead to faulty crimps during the ferrule crimping step.



6. Cutting filler or dielectric

This layer must be stripped at the correct strip length position without any damage to the underlying cable layers. The main challenge with this process step is that the thin filler or dielectric insulation is not always uniform in thickness. Precise control over the cutting depth and a novel approach to slug removal are required to reach the required quality level.

Continued on page 59

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How the Global Harmonization of Wire Harness Standards Will Impact Heavy Equipment Specification Decision Making

By Bob Rensa

Heavy duty equipment original equipment manufacturers (OEMs) continue to face challenges like global competition, compressed development cycles, fuel economy and regulatory standards, but are also being tasked with the great responsibility of supplying rugged, robust and resilient equipment that can withstand and outlast the world's most

complex, harsh, and remote environments. These individuals, though, are about to get relief from the recent publication of ANSI UL 62275, as it guides solutions toward having consistent quality and performance.

Underwriters Laboratories (UL) introduced ANSI UL 62275, which harmonizes with CSA C22.2 No. 62275 (Canada), NMX-J-623-ANCE (Mexico) and IEC 62275 (Europe), and establishes a scheme for standard type classifications and performance rat-



ings. All regional standards had a stability date of December 2018, with updated standards being introduced this year.

Reducing the number of separate standards and testing requirements provides a substantial opportunity for OEMs to promote products that are high value, have consistent quality, and have a safe and efficient application, while also ensuring product performance and high quality based on the successful completion of test standards.

Solutions affected by ANSI UL 62275 include plastic cable ties, mounts, metallic cable ties and integral cable tie mounts. Testing under ANSI UL 62275 will include tensile

strength, minimum operating temperature, minimum installation temperature, minimum and maximum bundle diameter, UV resistance, vibration for metallic cable ties-cycling, corrosion, contribution to fire-needle flame, and plenum rating.

This new UL 62275 standard will be critical because it creates harmonization between international markets and reduces confusion. Wire management products are undeniably crucial to maintaining organization, functionality and safety in the environments they serve. While countless industries have managed to flourish, and evolve because of consistent benchmarks

Continued on page 58

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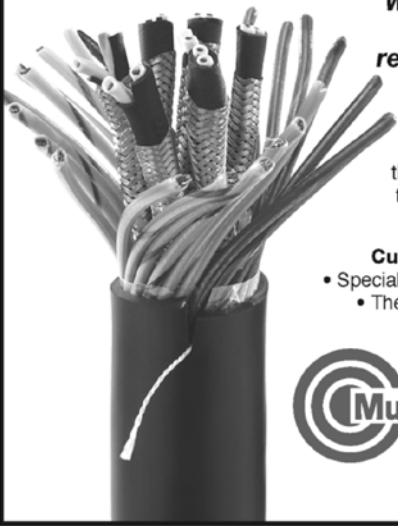
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Global Harmonization of Wire Harness Standards

Continued from page 56

for performance and quality, varying wire harness standards have resulted in slower progress and has created unexpected high total business costs. Internationally harmonized standards also provide a common understanding between international markets, allowing buyers and sellers in different markets to compare products that have each met one common standard and focus on the offerings they deem to be the most critical to their decision.

Previously, wire management products have been overly complicated by base standards, which include various regional standards from ANCE, CSA, IEC, and UL. Due to this complexity, wire management customers have not had a consistent benchmark of performance and quality, often resulting in unexpected total business costs. Due to standards not being harmonized, the industry was being served by varying benchmarks for compliance testing and certifications.

With more than 120 years of expertise, UL is made up of a worldwide network of industry-leading

engineers that look to support the responsible design and production of solutions and innovation. Customers can be assured products meet the highest industry standards for optimizing wire management applications, and OEMs can now bring their solutions to market faster and easier than ever before.

Most of the industries that shape our daily lives have all experienced technological revolutions, and needless to say the heavy equipment and wire management industries are about to experience their own.

For more information, visit Panduit at booth #2251 at EWPT.

About the Author:

Robert Rensa is the Business Development Manager of Wire Management Products for Panduit, a leading global provider of electrical and network infrastructure solutions. Robert has more than 40 years of work experience in sales, product and business management at industry leading companies including Panduit, Eaton, and Furnas Electric (now Siemens Automation). He is also active in industry standards bodies including as the Chairman for NEMA 5FB-2-Wire Management Products, a committee member for NEMA 5FB-2 Technical Committee, Chairman for CANENA-THSC 23A-62275 and technical expert for USNC-SC23A-TAG-WG17 to IEC.

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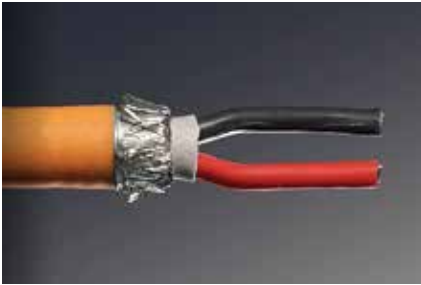
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HV Cable Terminations

Continued from page 55 _____



7. Inner conductor orientation

The inner conductor polarity is extremely important when assembling high-voltage connectors. Errors in polarity will not only prevent proper product function, they also present a safety hazard. Automation systems can orient the wires properly and form them in preparation for the next processing step.



8. Stripping inner conductors

Another critical processing step is stripping the insulation from the inner conductors. The requirement is for strip lengths with very tight tolerances and no cut or pulled strands.



9. Crimping inner conductors

Multiconductor crimping requires precise positioning of each individual wire before and during the crimping process. Automation systems have integrated crimp-force monitoring to verify that the crimp force is within the tolerance value that has been predetermined for a good crimp.



10. Connector housing insertion

Plugging is one of the most difficult processes for high-voltage cable assemblies. Stiff cables, large cross sections and limited space increase the risk of damaging the crimped terminals during the plugging process.

If any of the process steps do not meet the acceptance criteria, the cable end cannot be used. More often than not, the cable end cannot be re-worked, leading to production scrap.

With the relatively high cost of HV cable, as well as the floor space and labor required for rework, production scrap is always an important issue.

The key to higher first-pass yields is automation of all of the process steps. Automation systems reduce operator-induced variation, making it possible to achieve a stable process. Automation systems typically feature in-process quality monitoring to ensure that each step has been performed properly. While it is possible

to use manual production processes to produce HV cable assemblies, increased automation will lead to higher quality and lower overall production costs.

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TE Connectivity's New Dual Wall Heat Shrink Tubing Meets Power/Battery Cable to Terminal Requirements in Harsh Environments

TE Connectivity (TE), a world leader in connectivity and sensors, introduces BATTU heat shrink tubing, a dual wall, fire retardant product intended for battery/power cable to terminal applications in industrial and commercial vehicles, construction equipment, generator sets and more. The BATTU tubing products' polyolefin jacket and thermoplastic inner adhesive wall pro-

vide excellent performance in harsh environments. With an approximate 2:1 shrink ratio, this tubing is tailored for power cable to terminal applications, allowing faster application and potentially reducing applied costs. "Harness makers and OEMs asked us to help lower the applied cost for heat shrink tubing used over the cable to terminal interface on battery cables and other power cables, while still providing protection in harsh environments," said Jing Lu, TE Connectivity's tubing senior product manager. "Our team carefully evaluated the requirements and developed BATTU tubing. We optimized its composition, shrink ratio, sizes and cut lengths for faster application, while offering excellent electrical isolation, mechanical protec-



tion, flame retardance and moisture resistance." TE's BATTU tubing product line comprises three sizes from 12.7 to

25.4mm (unrecovered inside diameter) to accommodate typical cable sizes from 16-120 mm² [6 AWG to 4/0 AWG]. Relatively short cut lengths, 32 to 102mm, are tailored to expected application requirements, with specific lengths offered by tubing size. Additionally, 1.22m long sticks are available.

Full recovery temperature is 135°C, and BATTU tubing can be used in operating temperatures from -40 to 130°C. This new tubing is flame retardant per ISO7622 and is UL recognized, file E85381. Its voltage rating is 600 volts, and its dielectric strength is 19,700V/mm, minimum.

BATTU tubing's jacket offers protection from abrasion and bending, while withstanding exposure to many common automotive fluids. Its adhesive liner can bond to a variety of substrate materials, including plastics, metals and rubbers, and it provides protection from moisture ingress.

To aid in color coding connections, BATTU heat shrink tubing is offered in four standard colors – black, red, yellow and orange.

The tubing can be easily installed using many different types of heating tools, ranging from basic heat guns to conveyor-equipped ovens, for high-volume production environments.

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Are My Blades Sharp?

Understanding the physics of a wire processing blade cutting edge

By J. Ruben Lozano (B.I.E)

Materials, materials, we all are surrounded by them; myriads of materials, each one of them exhibiting unique and interesting physical, mechanical and energy characteristics. I am an engineer by schooling and experience - a manufacturing engineer at that. I have always been fascinated by the methods used to transform random material into something useful for our daily life. In our collective case, it's the plastic insulation and copper into the circuitry that makes our cars, computers, appliances, etc. function day in and day out.

One of my favorite subjects in Engineering College was strength of materials. The theoretical part of it was so complex that it almost always managed to induce a headache on the younger version of me. In contrast, though, I thoroughly enjoyed the materials lab class. It was like a torture chamber for random test samples made from metals, plastics wood and other materials. Not that I enjoy torture. I just found great interest in understanding the theory behind the way materials bend, twist and break.

In this article, we're going to scratch the surface, so to speak, on understanding the role of the cutting edge and sharpness of a wire processing blade.

After measuring a specific length of wire, there are three basic operations to perform to make it a connecting component in an electrical circuit. The first two operations, cutting to length and removal of an insulation slug (normally at both ends of the wire segment) are performed by either an individual function blade (cutting or stripping) or combined function blade (cutting and stripping). The third operation as we all know is the connector terminal crimping operation which involves other types of tooling and process.

Methods of cutting

Before we dive into the sharpness theme, we need to establish the different ways that a blade cuts material: Puncture mode, Tear mode and Slice mode

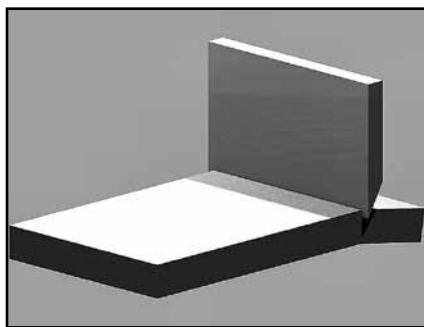


Figure 1. Puncture mode

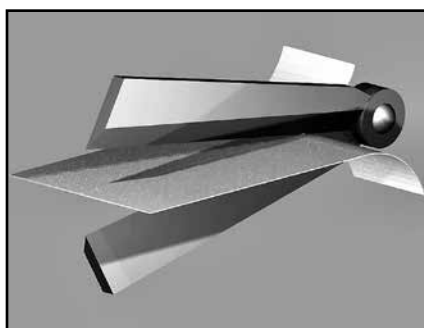


Figure 2. Tear mode

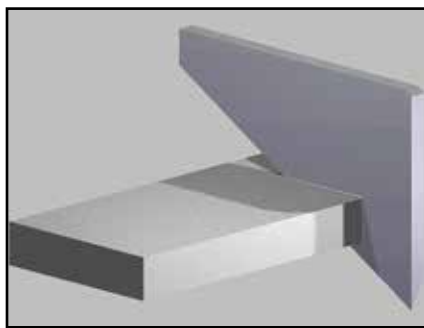


Figure 3. Slice mode

In **Puncture-mode** (Fig. 1), the blade edge exerts a cutting pressure on a perpendicular vector to the material's surface. Common uses for this are hacking, pick fracturing, punch holes, chopping, etc.

In **Tearing-mode** (Fig. 2), a pair of cutting edges mirroring each other on an angular position and pivoting around a common fulcrum exert simultaneous cutting pressures on opposed surfaces of the same material creating a shearing momentum. This is commonly used in cutting thin flat, flexible and semi-flexible sheet materials soft tissue surgeries, etc.

In **Slice-mode** (Fig.3), a single cutting edge with an angled slope relative to the surface, induces a gradual cut across the material's cross-section. Common uses are in surgery, slicing soft food material, or general soft and semi-soft flexible and voluminous material.

Brief description of the physics of cutting

In broad terms, the ability to cut a material can be defined by the Shear modulus:

$$S = \frac{F}{A} \cdot \frac{\Delta x}{b}$$

S = Shear modulus

F = Force required

A = Cross section of material

Δx = linear deformation

b = length of the deformed cross section

Now, don't worry so much about the formula above. It's not my intention to induce a headache on you like the ones I got in College. It's simply

a way to understand a shorthand version of what's needed to cut something. Translating the formula into plain English:

S = (Force required to cut through the material given the cross-section) / (How much does the material deform before failing)

The shear modulus is also known as the modulus of rigidity, and in essence is an indicator of how a given material resists deformation before fracturing or breaking. The higher the number, the more rigid it is. As an ex-

Continued on page 62

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Are My Blades Sharp?

Continued from page 61

ample, steel can have a modulus of 7 to 9, while rubber would have something close to 0.003, and PVC would be close to 0.11. A material with an infinitesimally small number would approach a fluid or a gas. So, that gives you a general idea.

Most thermoplastics used as insulations in our industry have enough rigidity which allows blade penetration and cutting of the material with relative ease. But keep an eye on the extremes such as a thermo-set plastic (too rigid) or rubber-like materials (too fluidic). Rigid materials require high pressure to be penetrated and fractured, while low rigidity materials require controlled slicing speed in

order to avoid seizing the blade with too much induced friction.

Understanding the cut edge characteristics of a wire processing blade.

First, let's take a look at stripping wire via the above three modes mode:

- The puncture-mode would not work very well, unless the wire was flat like a bus wire, or a flat grounding wire, or even a small-gauge multi-conductor parallel extruded wire.
- The tearing-mode would not very useful since the wires are not thin and flat like paper.

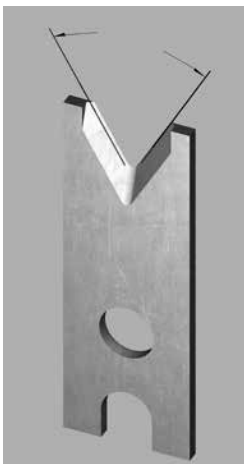


Figure 4. Slice angle

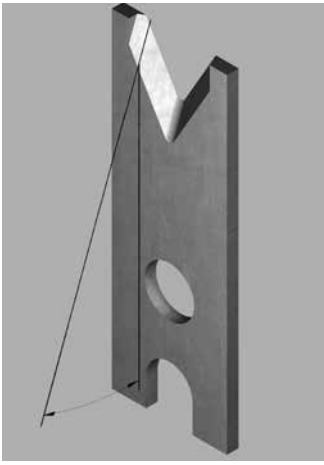


Figure 5. Cutting wedge

- Slice-mode, yes please, since most of the wires we process are round, semi-cylindrical and relatively voluminous.

The Slice-mode cut then explains

the shape and geometry of the common blades we use in wire processing (FIG. 4). The cutting edges are slanted at standard angles forming a "V" shape opening with a radiused vertex at the bottom. The cutting portion of the blade edge is formed by a single wedge shape with a specific included angle (Fig. 5). The reason for using a single wedge rather than a double wedge is because we are using the flat sliding surfaces as dimensional reference points for the strip dimension. The "V" angle opening between the edges is the "Slice" angle, while the wedge included angle is the penetration angle. The bottom radius of the "V" shaped edge of the blade is the conductor core enveloping edge. On that edge, the penetration angle is continued following the radius geometry (Fig. 6).

Next, let's look at the cutting mechanics:

The blades as we all know, are mounted opposite each other on a precisely calibrated blade holder located in the machine's cutterhead section. The cutterhead is set in motion by a servomotor-driven assembly controlled by an on-board computer. As the blade edges close-in surrounding the wire's insulation sleeve, a series of events ensue:

Contact point with the insulation surface - a point on the blade's sharp edge makes contact and deforms the material initiating a fracture at a high-pressure point resultant from the small contact area between metal and plastic (Fig. 7).

2. Slicing action begins - The blade's angled edges transform the cutterhead down-stroke motion into a lateral slicing motion (Fig 8, Fig. 9). The friction generated by this motion, in combination with the wedge angle, propagates the crack

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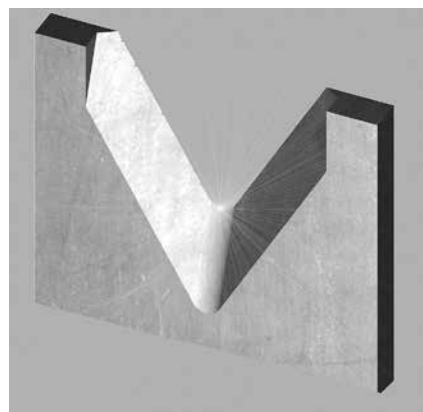


Figure 6. Bottom radiused wedge

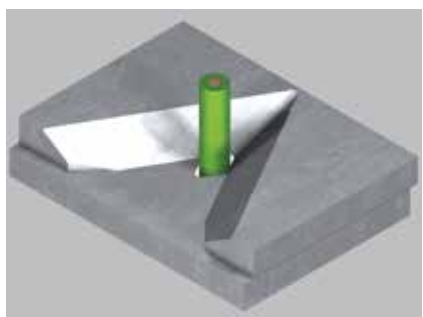


Figure 7. Contact point with insulation

or fracture on the material with a slicing speed. This is a function of the blade's "Slice" angle combined the cutter-head downstroke speed. The slicing speed is a factor to consider, especially on very soft or rubbery insulations.

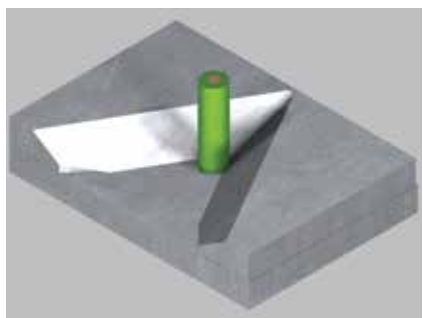


Figure 8. Slicing cut begins



Figure 9. Slicing cut view

3. Bottom radius cut begins - The radiused wedge section penetrates the insulation (Fig. 10 Fig. 11). But because of its relative position on the blade geometry, it's not doing so in a slicing-mode, but rather in a puncture-mode, applying more deformation force to the plastic as compared to the lateral slicing sections of the cutting edge.

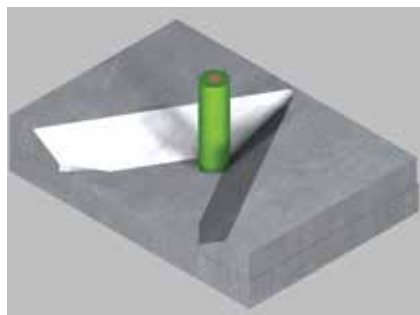


Figure 10. Bottom radius cut



Figure 11. Bottom radius cut view

4. Full-penetration - Predetermined by the cutter-head's on-board computer settings, the blades cut enough material around the conductor without going too deep as to contact the copper, aluminum or conductive carbon fiber filaments, (depending on the core's material). This splits the insulation cross section into two areas called the free area and attached area (Fig. 12, Fig. 13).



Figure 12. Full penetration cut

Continued on page 64

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Are My Blades Sharp?

Continued from page 63



Figure 13. Strip showing torn at-
tached area

5. After the cut operation, the machine sequences the strip motion where the incoming and outgoing sections of the wire are pulled away from the blades to remove the insulation slug. During this operation, the attached area of the insulation cross-section is torn apart from the insulation sleeve, thus freeing the slug to be discarded. Typically, on a regular hexagonal laid conductor core with good concentric extrusion, the torn insulation area is about 16% of the total insulation sleeve cross-section (excluding the core's cross-section). In other words, a 16% plastic donut is torn away while an 84% plastic donut is cut clean.

*The effect of sharpness on the strip-
ping process.*

The generic concept of sharpness is very much related to a qualitative condition of a blade's cutting edge. There have been numerous attempts to create an established parameter or scale to define the concept of blade sharpness. But they all revert to a generic point of comparison, like the sharpness of a surgeon's scalpel, shav-

ing blade, utility blade, kitchen knife, or something that is generically familiar to most of us. The surgeon scalpel is to most people the pinnacle of sharpness, but most knife hobbyists and enthusiasts would probably disagree. The truth is that any blade sharpness can be rated by its inherent intended use, and the methodology applied to achieve the sharpness factor. By the same token, the thickness of a blade does not necessarily imply sharpness, as sharpness is a dimensional condition related to the cross-section of the smallest end of a wedge. This can better be understood by the illustration below showing the relative sharpness on a 40 degree wedge, versus a 20 degree wedge. Even though the 20-degree wedge is thinner, its relative sharpness as compared to the thicker blade is duller.

Figure 14 shows three cutting wedges showing that a thin wedge is not necessarily sharper than a thick wedge. The thin wedge (2.84 degree) has a sharpness radius of 0.000943" and a thickness of 0.35. The thick wedge (6.24 degree) is twice as thick at 0.78" but also twice as sharp with a smaller sharpness radius of 0.000422". The third point of sharpness comparison would be a plain sheet of paper, no wedge, thickness of about 0.0040" and yet capable of slicing through skin, using friction alone.

A better functional criterion of a blade is the concept of relative blade sharpness vs. blade sharpness retention. This concept includes the fact that the sharpness of a blade deteriorates after every use, and thus the edge retention capacity of the blade is a function of wear. This wear factor

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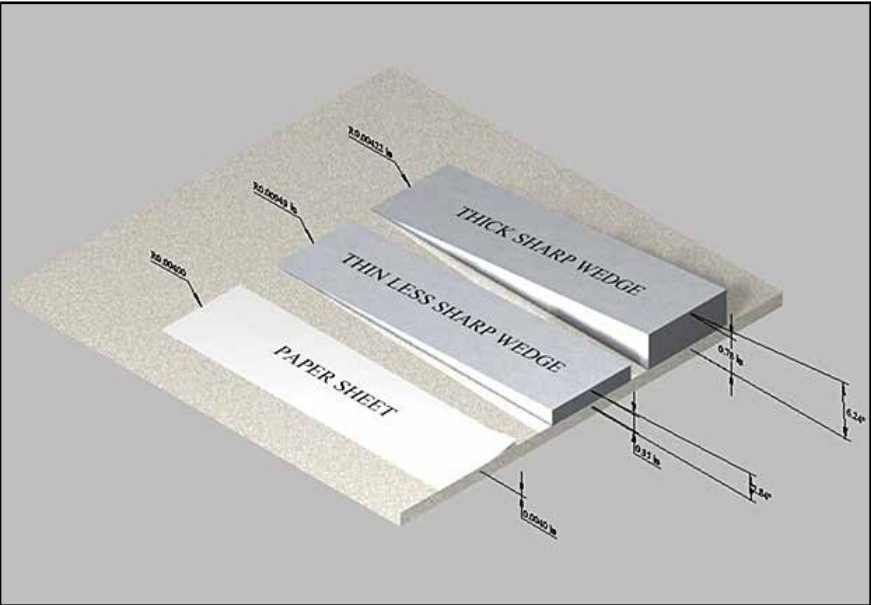


Figure 14. Cutting wedge thickness comparison

has everything to do with the quality of the blade's base material. In the case of wire processing blades, it's the quality of the base steel, in combination with the quality of the manufacturing and sharpening methodology used by the manufacturer.

This also touches upon one of the most asked questions from wire processing blade users. How long will this blade last? What these users are really asking is what is the edge retention capability of this blade? And the answer should be considered in terms of the quantity of cycles. Specifically, the blade sharpness retention capability is a function of the material's characteristics, defined by their physical properties (like the one defined earlier as the rigidity modulus and other related parameters). For example, a Surgeon scalpel inherently has a very short life span.

Depending on the type of operation, he might go through several just for one surgery. Not only because of sterile considerations but also because the cutting edge is no longer precise enough for the procedure at hand. By the same token, a wire processing blade cutting an abrasive insulation material will not retain its sharp edge as long as the same blade cutting PVC or other softer, less abrasive material.

Linearity and non-linearity of material strain

Going back to the rigidity modulus, one of its components is the strain factor or the capacity to deform before failing. The softer or more fluidic the material is, the more non-linear its deformation response is. I guess this can be better explained by illustrating a common

Continued on page 66

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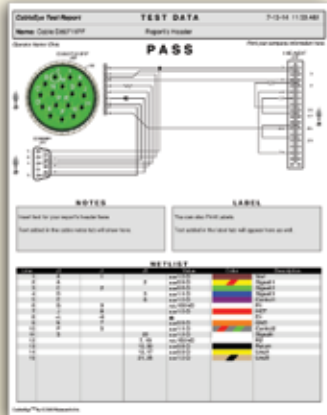


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Are My Blades Sharp?

Continued from page 65

experience we all share. I bet you have experienced the occasion when you are wearing a jacket or sweater with a zipper opening. Under normal circumstances, you simply pull on the tab, and with slight resistance, and the zipper opens. On other, more frustrating occasions, the zipper slider body catches on a protruding section of clothing and latches on and for your dear life. Well, materials with a linear response to strain have molecular chains which react to the blade's edge friction similar to a free-sliding zipper. They break apart and start a chain reaction on adjacent chains, thus collaborating with the cutting action. Other softer, more fluidic materials, have more dispersed molecular chains which get more and more tangled as the blade edge applies pressure and friction. The end result is that this entangling of molecular chains becomes rigid at the fracturing area and prevents or impedes the blade's cutting effect. In this case, slicing speed control is much more effective than a sharper edge, because with slower slicing speeds, you allow the molecular chains to gradually break apart and give you a finer cut.

And finally, let's look at the relationship between the



Example of a no-linear material such as rubber seizing onto a sliding shear at high speed.

blade's wedge included angle and its sharpness:

As we established prior, the blade's included angle is not necessarily the blade sharpness. The real function of the wedge's angle is to apply a splitting force which assists the sharp edge's breaking apart the material's molecular chains by friction. The larger the angle, the higher the splitting force applied by the wedge component of the blade. The wedge angle could be as reasonably wide, or as reasonably narrow as you might want to make it. Wire processing blades, like any other tool in our industry, are part of an economic whole, and as such, we could develop dozens of variations and configurations that would only increase the cost, without offering much in terms of process improvement.

Thus, the industry has pared-down the geometric styles to a few proven configurations. In the case of the wedge angles, the most common are 15, 20, 25 degrees, (favored by some Asian equipment designers) and 25, 30 and 40 degrees (favored by American and most European equipment designers). The most commonly used choice is 30-degree wedges. While the slicing angles are commonly 60 degree (30 degree slope each side) or 90 degree (45 degree slope each side) there are wider and narrower "V" or slicing opening angles, but those are for unique or custom processing.

In conclusion, we can surmise that the condition of sharpness is a very desirable trait on a blade, but it is but one of the many features and mechanical aspects contained in the cutting process. Sharpness is a fleeting thing, while its ability to deliver a quality process is a function of the blade's edge retaining ability. This last feature is directly related to the steel material quality, manufacturing and the sharpening technology used by the blade manufacturer.

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The WHMA board has become quite proficient in keeping the seminar content exciting, fresh, and relevant. This year was no exception with topics including IPC Specifications, NAFTA Changes, Workforce Development, Tax Incentives for Harness Builders, and Harness Industry Economics. The Keynote Speaker was former White House senior economic

advisor Todd Buchholz who talked about his career and some 'lessons from dead CEO's.'


The camaraderie created at the exhibits and networking events is a big part of the value proposition of a WHMA conference. This is exemplified at the round table discussions that capstone all WHMA events. Attendees were able to exchange ideas on a myriad of subjects with many concrete take-aways.

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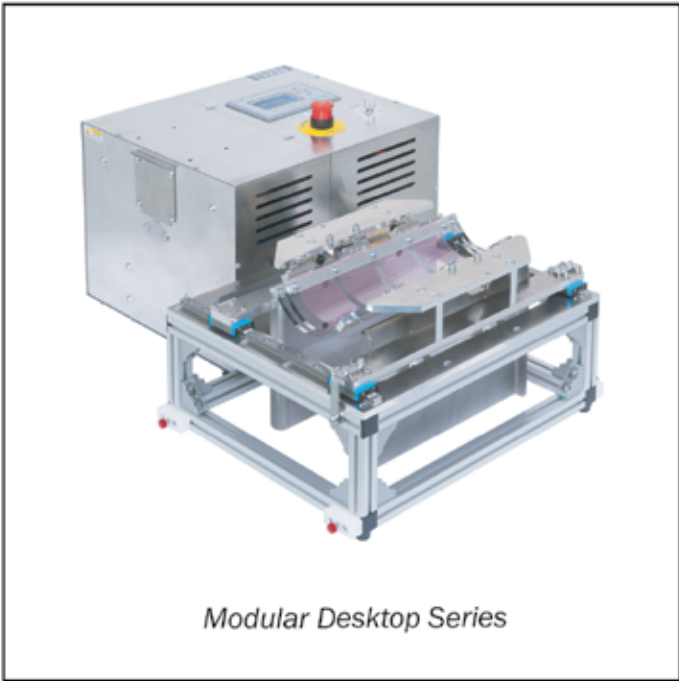
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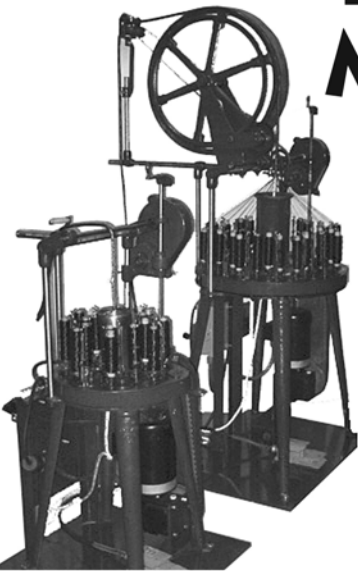
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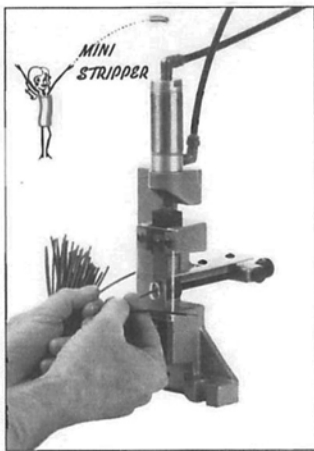
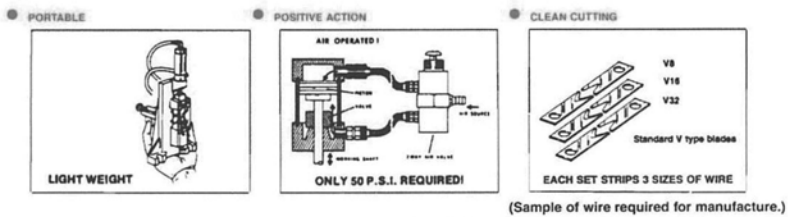
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