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Company Profile: Certified Manufacturing, Inc.

By Joe Tito
Wiring Harness News

I’m always amazed at the niches carved out by the companies we profile on these pages. Often, it’s born out of a hobby or a passion, and other times it’s just happenstance. In the case of Certified Manufacturing, Inc., their niche was perceived well in advance of the company’s inception.

Certified Manufacturing, Inc., (CMI) is located in Holt, Florida, and is owned by Pamela Bechtold. Pamela, President, and her husband Robert, COO and Engineering Manager, run the business along with some key players we will get to later. Pamela, Robert and their daughter Michelle Rasbeck, Director of Administration/ Bids & Proposals Lead, recently sat down with me to discuss their history and some of the exciting things that are happening at CMI.

First a little bit about Pamela and Robert. Both worked for many years for a major prime contractor in the military and aerospace realm. In fact, that’s where they met. Pamela gained experience in manufacturing project management and marketing, specifically in the semiconductor and military satellite communications arena. Robert served in senior level management at the same contractor where he was heavily involved in project management of similar complex systems.

Throughout their roles as project managers in the 80’s and 90’s, Robert and Pamela worked diligently to get the best return on the various programs they lead. “I recognized during that time that big business couldn’t do it all; or they could, but it just wasn’t profitable,” Robert recalled. “I could get a much better return for the stakeholder by outsourcing key components to the competitive



CMI built the harnesses for the QF-16 Modification Program. Here is one of the aircraft parked at Tyndall Air Force Base near Panama City, FL.

small business arena.” He recognized that the prime contractor’s expertise was in system engineering and design development/testing; and that small business was much more adept at building LRUs (line replaceable units) like electro-mechanical assemblies, printed circuit cards and wire harnesses.

Around the mid 90s, Pamela and Robert began to feel the tug of en-

trepreneurship and started searching for opportunities. “As a EE, I realized that the cost of going into an engineering development field was huge, and we didn’t want to solicit additional investors to develop products that were more suited for larger businesses,” Robert outlined. “We recognized there was an opportunity to go

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VMI - Vendor Managed Inventory Agreements

By Joe Tito
Wiring Harness News

Vendor Managed Inventory, or VMI agreements, have been a trend in manufacturing for some time. Under such an agreement, a supplier physically manages the inventory of goods at the customers facility. The supplier makes certain that stock is replenished properly and that the min/max levels are held at the right quantities. It’s a mutually beneficial relationship where both sides can smoothly and accurately control the flow of goods. The goal of an effective VMI program is to reduce the uncertainty that occurs when a supplier is blind to their customers inventory status.

Companies like Anixter and TTI have had VMI programs with harness manufacturers for consumables like wire and components for many years. More recently, however, harness manufacturers are using this successful model with their customers where assembly quantities and demand schedules make VMI programs a plausible solution.

In this article, we will define VMI and discuss various ways a vendor can design them. We then turn to the benefits and pitfalls of these programs and take a look at useful implementation tactics. Finally, we turn

to a recent discussion with Colleen Weber, Business Manager, and Shaun McGuire, General Manager, at Excel Connection, a harness and cable assembly supplier in Milwaukee WI. We discussed how they use VMI programs on both sides of the equation, managing the flow of inventory from their vendors, through to their customers. At the end, you will find some useful links for additional reading, along with links to companies providing some tools you can use to make VMI programs run effectively.

In a typical VMI program, the vendor is on site at the customers location at some point, counting and replenishing stock. In many cases, a vendor may have access to a customer’s MRP/ERP software to see what the actual inventory levels are. In such cases, the customer would need to partition off only that data useful to the vendor.

Some companies choose to use a barcode system where the customer scans the product and gives the vendor daily, weekly or monthly usage numbers. Many companies use a low-tech option where stock on shelves is photographed at the end of a period for an inventory count. It can also be as simple as an Excel spreadsheet provided by the customer to show stock levels.

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Pandemic Sales Practices Prove Worth for Future

As the pandemic era transitions to the post-pandemic era, recovery continues as the business-to-business environment adapts to new norms. Among other trends, the ability to conduct remote business in creative ways has become paramount to a company’s success. E-commerce has been the obvious go-to for remote retail sales, but how does an OEM make decisive process improvement purchases when they have cable, tubing, or wire material that needs to be cut, stripped, twisted, or uniquely processed?

The Eraser Company sought to tackle this issue with their Eraser Certification Program (E.C.P.). With the E.C.P., a customer sends 10-15 feet of raw material to Eraser for them to process with the appropriate equipment. The team also provides a formal evaluation report which they send back to the customer along with the samples. Time studies presented in this analysis provide the customer with data for production planning. It also provides additional program-

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EDITORIAL CONTENT MANAGER

Joe Tito
joe@wiringharnessnews.com
Phone (407) 739-9811

ACCOUNT MANAGER

Jim Brown
jim@wiringharnessnews.com
Phone (708) 594-7764

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From the Editor

Is the cosmos telling us something?

In recent years, we have experienced events that have shaken and disrupted supply chains around the world. Fukushima revealed some single sourcing pinch points that rattled the automotive industry (companies like Honda responded very well to that). We are still reeling from the effects of Covid-19 on critical materials. You could write a book about the supply chain gremlins revealed over the past 15 months.

Just recently, one of the new Golden Class container ships became lodged in the Suez Canal. That event stymied the worldwide flow of goods for almost a week. At the time of this writing, there’s still a log jam of ships waiting to pass through. I can’t wait to hear about the odd shortages this will create.

So, you have to ask yourself, is the cosmos trying to tell us something? Should industry, in general, be paying better attention to critical areas in the supply chain and looking for weaknesses. Should we be considering sourcing at least a portion of materials and components a little closer to home...wherever home is? I understand the logic in taking advantage of the competitive advantage of nations when it comes to labor, but how competitive are we when the supply chain of critical materials is disrupted?

I’m sure this is much easier said than done, but I’d love to hear your opinions and comments. Please email me at joe@wiringharnessnews.com.

Kindest Regards,

Joe



Joe Tito
Editor
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LEADERSHIP
PUTTING INSIGHTS INTO ACTION

“Old is Gold” - Lessons learned from TB12 and Superbowl LV

By Paul Hogendoorn

I confess I am a big Tom Brady fan and was rooting for him to get number seven. Yes, I am in awe of Patrick Mahomes talent, drive and the spark he brings to the game, but there is something very special about Brady, and that is simply that he has been special for a very long period of time. He’s as good old as he was young, perhaps better.

But Brady wasn’t the only old guy on that Super Bowl LV winning team. The coach, Bruce Arians was the oldest coach to ever win it. At 68 years old, he has coached at various levels for 45 years. His mother was there to cheer him on at 95 years of age. How wonderful that must have been for them both. Rob Gronkowski came out of retirement to join Brady. Antonio Brown, passed over by all the other teams, was given a fresh opportunity to prove himself as a player and a teammate. Leonard Fournette was cut from the Jacksonville Jaguars at

the beginning of the year, not fitting into their plans despite being their first over-all draft pick a few years ago. At 34, Ndamukong Suh was 8 years beyond what is considered the prime age for defensive ends, 4 years beyond what is considered the age of effectiveness. At 32, Jason Pierre-Paul is 6 years passed the prime age for his position. All of these discards, cast-offs, and old guys, came together, formed a team, devised a plan to fit their strengths, and then practiced diligently, intentionally, persistently. And then they executed.

From the first game I watched Brady start many years ago, after their star quarterback went down, I noticed a difference in that team. It was a compelling story – a late round draft pick, fourth string on the depth chart, being thrust into the starting role of perhaps the most difficult position in all of sports, filling in for a proven star. And the rest is history.

To get to Super Bowl LV, the team needed to win 3 road playoff games

(a feat never done before), and beat teams quarterbacked by Patrick Mahomes, Drew Brees and Aaron Rodgers – the most skilled quarterbacks in the game today. But a Brady led team won, again. What’s his magic? And what can we, as manufacturers learn from him?

Brady plays with a different kind of intensity than the rest; not a higher level of intensity but intensity focused differently. Most stars in that position play with an expectancy thrust upon them, or that they placed upon themselves; Brady plays with an expectancy he thrusts upon his teammates, and they then play with an expectancy that they place upon themselves. It was evident to me in the first game I watched him start. Receivers ran their routes every down. The line blocked with extra ferocity. Running backs fought for every yard. It was a different kind of leadership. Each one of them didn’t have to be the best at their individual positions, but they as a team were determined



Paul Hogendoorn

to be better than all the teams they faced. It’s why often difficult marquee players that don’t fit anywhere else can fit seamlessly on a Brady led team. Egos are checked at the door. No one is expecting one person to win the game for them; they play believing that there is a high expectation placed upon them every down, and they play up to that expectation.

This is how manufacturing companies work best. The various departments work in concert, every day, every week, every shift. They all have a role to play - offense, defence, specialty teams, coaching staff, and even the taxi squad. Its impossible to de-

liver expected results consistently if one area has to make miracle plays to make up for a dropped ball in another area, or if one department doesn’t execute their assignment. You could win some games along the way, and perhaps even one season’s title, but to win consistently, over a long period of time, you need to be able to marshal your resources, devise a plan the team can execute consistently, and then show up for every game, every practice, and every team meeting ready to execute well; to meet the expectations of your teammates, to set appropriate expectations on each other, and to live up to them, helping your teammates live up to theirs too.

Regular readers of this column have often heard me speak about the importance of attracting, developing and retaining enthusiastic and talented young people to our companies. This is still very true. (Tom was a young enthusiastic rookie once). But that still requires an environment where people, young and old, can succeed and win in together. And if your seasoned leaders help bring those qualities to the team, season in and season out, “old is indeed gold”.

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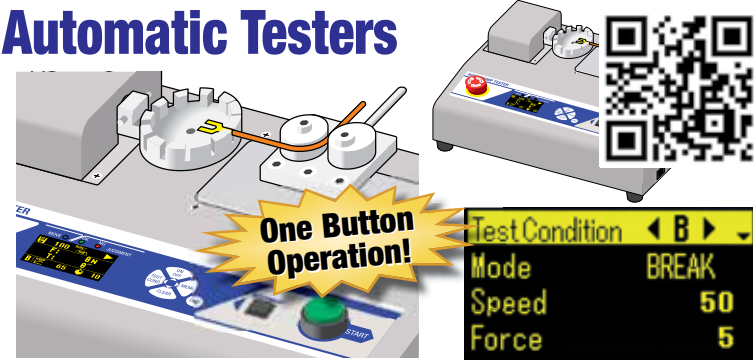
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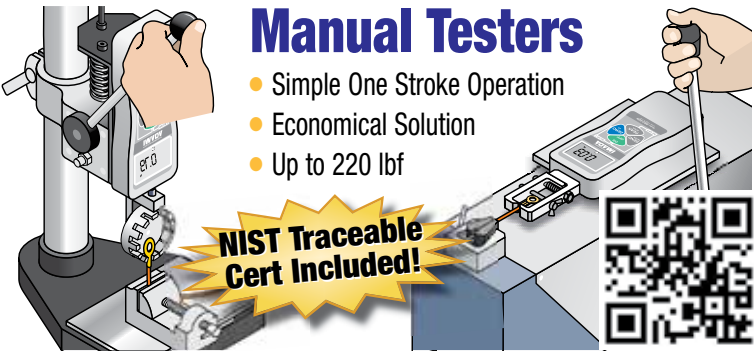
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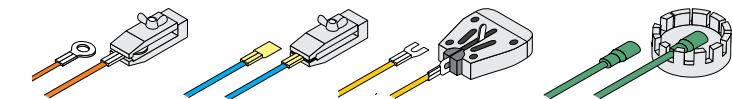
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Pandemic Sales Practices Prove Worth for Future

Continued from page 1 _____
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Eraser has been building industrial products since 1911, and similar programs have been used for most of their existence. But the events of the past year have necessitated efforts to enhance and formalize the program. “It’s has been around over 60 years,” mentioned John Smith, Manufacturer’s Rep Coordinator, “but the pandemic has really brought it to the forefront because it’s a way we can verify machines for customers and find solutions for their particular needs.” Although Eraser still uses reps to funnel in new opportunities, John sees this as an adjunct to their efforts, and a way to reach those who may be working remotely, or unable to accommodate in-person visits at their facility.

Amanda Yaworsky, Sales & Marketing Coordinator, mentioned the enhanced E.C.P. has enabled then to pick up new customers, especially in the medical device industry. “We’ve

got a lot more customers that are making catheter-based products, so we’ve been able to reach beyond our normal pre-pandemic medical device manufacturers. That industry has really taken a new look at this and they really appreciate the remote business aspect of it.”

Marcus BeVar, President/CEO stressed that although the company has always prided themselves on world-class quality and customer service, the enhanced program has helped elevate that status. “Everyone has different requirements, different quality standards and different tolerances. But by getting the processed material in their hands, they can evaluate it with their own eyes and against their own set of specifications,” he explained.

The team feels strongly that the E.C.P is the ultimate method for socially-distanced sales transactions. But they feel confident it’s use will transcend well beyond the current business climate.

Many thanks to John, Amanda and Marcus for sharing time to explain the program further. For more information on the program and Eraser’s products in general, check out their website at eraser.com.

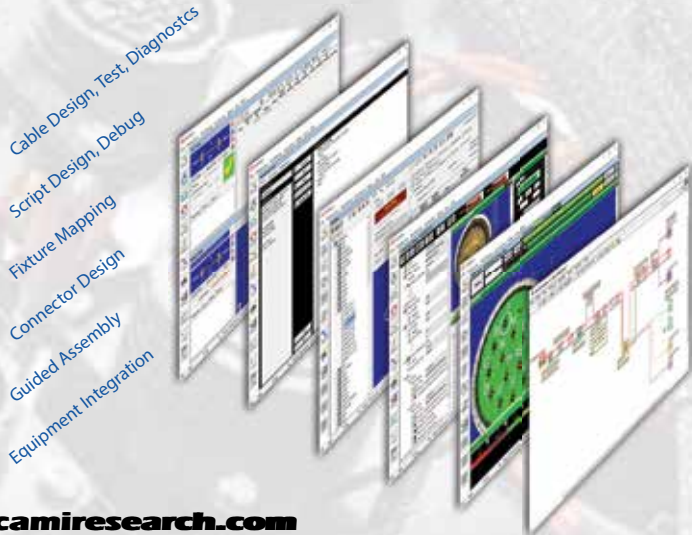
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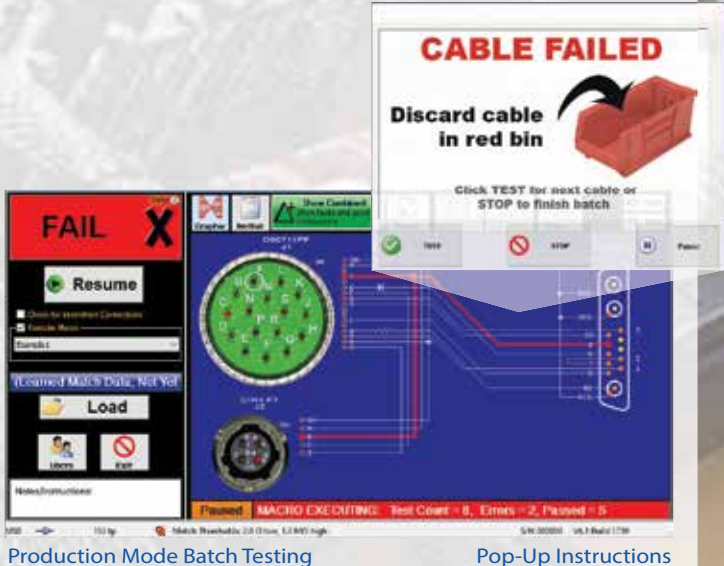
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VMI - Vendor Managed Inventory Agreements

Continued from page 1 _____

Benefits

It costs money to carry inventory, but it also costs money to lose sales due to lack of inventory. A well-tuned VMI program creates a balance that eliminates the lost sales cost of inventory for the seller, while reducing carrying costs for the buyer.

VMI programs can also protect against a customer who can't plan. A well communicated and strictly monitored VMI can actually help a customer plan better and reduce the hassles with expediting materials for last minute orders. It helps smooth out the demand curves for both suppliers and customers.

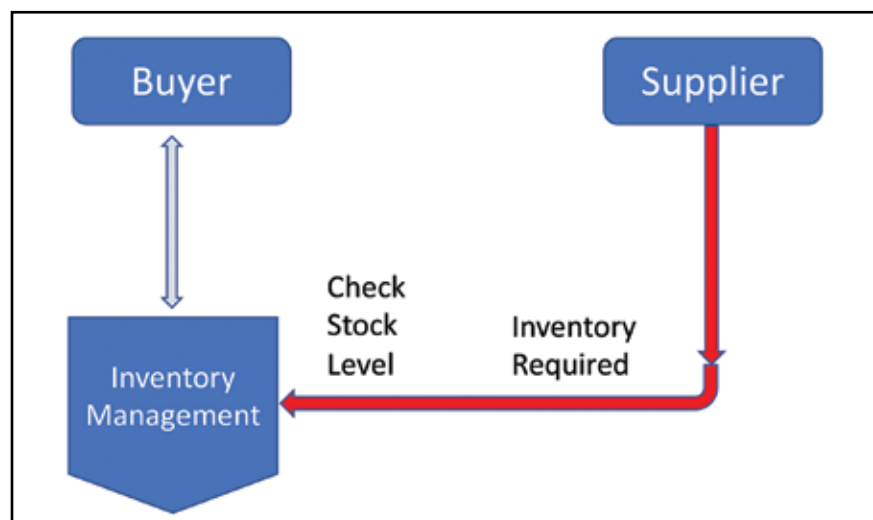
Pitfalls

Almost all pitfalls to VMI programs are the result of poor communication or an unclear agreement between the vendor and customer. Unrealistic expectations, ambiguous demand

schedules and unmonitored min/max levels are recipes for disaster. Suppliers need a great deal of visibility into sales and inventory levels at the customer. Further, even though the customer is typically responsible for WIP and finished goods, this should be clearly spelled out in the agreement.

VMI at Excel

Coleen began our discussion describing how Excel uses VMI programs from their suppliers. A separate cage houses the materials owned by the supplier. Goods have a bar code or part number ticket on the shelf. As goods are pulled, the code or part number, along with the quantity, are entered on a purchase order. The vendor picks up those purchase orders once, or sometimes twice a week, and replaces goods in the carousel. Excel has another VMI vendor whose products they use on a regular basis.



Streamlined VMI Buyer/Supplier Relationship

They have set up a reorder report with appropriate min/max levels. Every week, the vendor looks at it and ships materials based on stock levels. Coleen monitors the min/max levels to verify they are tied into forecasted customer demand.

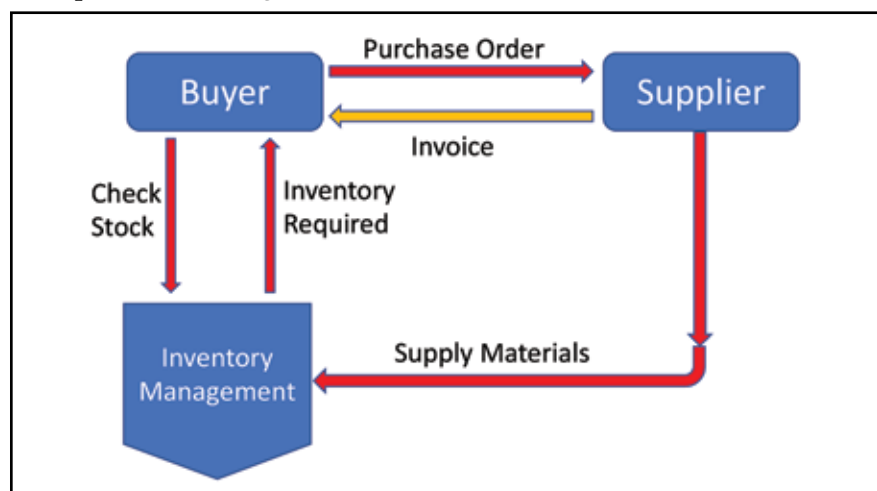
Shaun pivoted to a description of the VMI initiatives with Excel has instituted with some customers. "There's multiple ways of doing it," he advised. "We have customers where we drop off material and they issue purchase orders. We have other customers where we go in and check to see what they have. Our people replenish the stock, they cut us a PO and we deliver the next day." He mentioned they have other customers that have blanket orders. They notify Excel by email when they hit a cer-

tain stock level, and Excel ships the next day.

By using VMI programs on both the supplier and customer ends, Excel is able to keenly manage the flow of goods through their facility. “Think of it as continuous buckets of goods,” Shaun described. “One bucket is coming from our suppliers, one bucket is in our cage, one bucket is in WIP, another one is in finished goods, and one bucket is at our customer’s site. So the faster they use that bucket of finished goods at the customer, the faster we need to dump that load of raw materials.”

When queried about which customers or products they seek to place under a VMI program, Shaun indicat-

Continued on page 13



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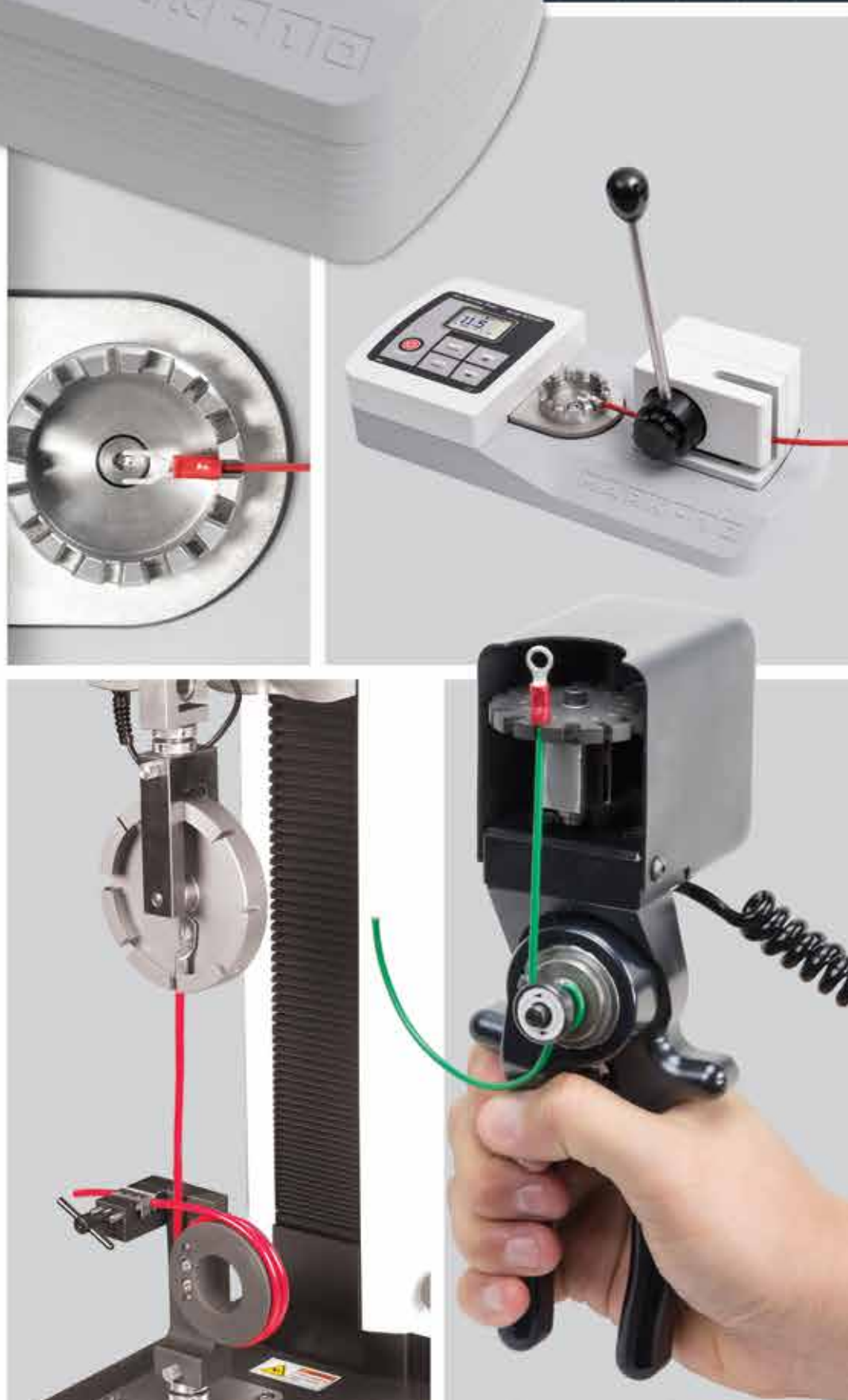


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VMI - Vendor Managed Inventory Agreements

Continued from page 10 _____

ed it has less to do with the dollar amount and much more to do with the product demand. “A lot of manufacturers look at the golden carrot and they want a high dollar amount to justify a VMI,” he explained. “Sure, we look at dollar amount, but it’s really continual usage; even if it’s low-volume, we can still do a VMI if the demand is steady.” At the end of the line, the customers are generally responsible for WIP and finished goods.

The overwhelming theme of the conversation with Shaun and Coleen is that the success of a VMI program rests on the completeness of agreements set forth between supplier and vendor, coupled with the constant communication between both parties. The key seems to be managing expectations. “There’s no one size fits all because it depends on how each customer buys into it, and what part of the responsibility they will take,” Shaun advised.

Emerging Trend - JMI

An emerging trend in supply chain management is Jointly Managed Inventory (JMI). JMI is a broader and more detailed form of VMI with more of a partnership agreement between supplier and customer. The goals are very similar, but the width and breadth of shared information is more intense. It’s really just a more finely tuned VMI where the vendor has access to the suppliers sales data downstream. The increased visibility allows the supplier to gain real-time insight into sales data so they can better improve the replenishment function while improving inventory planning with their own suppliers. Think of it as adding extra buckets in the chain in Sean’s example from above. It may or may not have applications in our industry, but it’s certainly worth consideration.

Following are Some links you can use when setting up a VMI program of your own.

- TE 48V Connector Line: <https://bit.ly/2PArWym>
- TTI’s Advanced Inventory Management Solutions: <https://bit.ly/3cT99Y2>
- VMI and Warehouse Management Software: Fishbowl, Infoplus, Shipedge, Da Vinci Supply Chain Business Suite, iM3 SCM Suite, NorthStar WMS, Conga Contracts.
- Setting up a Vendor Managed Inventory Program in 5 Simple Steps: <https://bit.ly/2R49Yod>
- Overview of Vendor Managed Inventory with Customers: <https://bit.ly/39IZEbS>
- Vendor Managed Inventory (VMI): Three Steps in Making It Work: <https://bit.ly/3cP8uXm>
- Vendor Managed Inventory - A collaborative Supply Chain Concept: <https://bit.ly/31LtacH>

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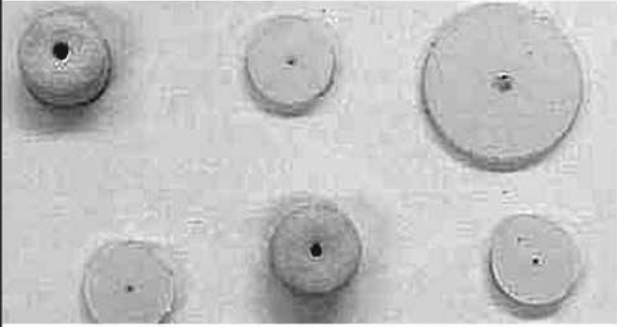
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Overview of 48-Volt Systems in the Automotive Industry

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By Joe Tito
Wiring Harness News

An emerging trend in automotive electrical infrastructure is the development and implementation of 48-volt systems. This article deals with the history of the system's development and the rationale for this new architecture. There is a companion article entitled 48-Volt Systems and Connectors: QA with an Expert on page 15. In that article, we interview Boris Ketscher, Product Manager at TE Connectivity. Boris dives deeper into 48V technology and touches on salient points for our industry. He also discusses TE's development of connectors for 48V systems.

48 Volt System
Since the 1950's, 12V electrical systems have been the norm for the automotive industry. If you venture to classic car shows, you may encounter the old 6V electrical systems common in pre-1955 automobiles. Those systems were adequate to crank a six-cylinder engine, and maybe power an AM radio. But as manufacturers produced bigger, higher compression engines, and options like power seats, power windows, etc., more power was needed. For the past 70 years, the 12V system has proved adequate in starting the engine, charging the system (alternator), and operating the ever-increasing load of electronic devices.

Modern cars now consume much more electrical energy than they used to. Features like

advanced climate control, driver assistance computers, and complex infotainment systems are outpacing the capacity of the 12V system. Enter the 48V system. The 48V system minimizes resistive loss of energy and allows higher currents and greater power delivery so these systems can be more effective and work quicker. The illustration at the top of page 17 shows a basic schematic of how the system works.

But the biggest advantage of the 48V systems is its ability to act as a mild hybrid, thus reducing CO2 emissions. A full hybrid vehicle can travel short distances at slow speeds, solely on electric power. By contrast, the mild hybrid never acts as an electric vehicle. The traditional starter motor and alternator is replaced by an integrated 48V

motor generator unit (MGU). The MGU does two things. When the vehicle is coasting or braking, the engine is shut off and it harvests energy back into the battery. The stored energy in the MGU also provides additional torque during acceleration.


Another way the 48V system helps fill the gaps in the internal combine engine power curve is with an e-charger to replace the turbocharger. Because the traditional turbocharger uses exhaust gases to drive the turbo, there is always some lag in pickup. The 48V system powers an electric blower motor in the e-charger to overcome this lag at low RPMs. The combination of these two systems allows for a smooth power curve and allows for the use of smaller more fuel efficient engines.

The industry has too much invested in 12V components to toss this system into the trash bin of history. So, for now, these systems will act in conjunction with each other, with the 48V system handling the more power-hungry components, and our old friend, the 12V system, powering legacy accessories while the engine is not running.


It is predicted that by 2025, one-fifth of all cars sold globally will have a 48V system. The good news for our industry is the necessity for more wiring systems.

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48-Volt Systems and Connectors: QA with an Expert

Connector manufacturers have responded to the challenge and designed connectors specifically for 48V systems. TE Connectivity is one such company. Wiring Harness News recently spoke with Boris Ketscher, Product Manager at TE Connectivity to ask him more about the attributes of 48V systems, and some of the features that went into designing their 48V connector line.

WHN: We read a great deal about what the 48V systems will power, but what specific advantages do they bring to the table?

Boris: There are a few reasons for having a 48V layer in the architecture next to the 12V network. It depends on where you want to apply 12V or 48V to determine what is the better solution for the increased power demand, and the required CO2 emission reduction. Both challenges need to push mechanical aggregates, such as cooling fans and compressors, towards electrical driven aggregates to 48V.

First, with a classic 12V system, the increase of power would demand a larger current, and thus a larger cable cross section (because power is a linear function of voltage and current). This would also add cost and weight to the harness. The 48V system needs only 25% of the current with a smaller cross section of the cable for the same application.

Second, we have less expensive and more powerful electronics in the car. It becomes increasingly simple to create different voltage levels with converters.

Another advantage of having 48V over high voltage batteries of 400V and more, is that with a moderate power consumption for hybrids, the re-use of existing 12V connectors and cables is possible to a certain extent.

For maintenance and safety regulations of the car, there are electrical safety advantages with a 48V system compared to high voltage system.

WHN: It seems like 12V systems will run in

tandem with 48V, at least for a while, but do you see 12V being eliminated eventually?

Boris: If we look at the cockpit and infotainment applications in the car, it is common that the 12V network reduces to 5V, 3V and below for data connectivity and microcontrollers inside the black boxes. It is more efficient to step down from a 12V towards a 5V voltage application than having to convert from 48V or higher directly into 3V or 5V (e.g. thermal losses). It is also more cost effective to have zones with 12V which only require 1 reduction from 48V to 12V. Once you are no longer in the

high-power applications, but in the signal applications in the cabin, the wire size is more linked to robustness of the harness. Increasing voltage to 48V in signal applications does not lead any longer to reduction in wire size or weight saving. With our NanoMQS and PicoMQS terminals and connectors, we are close to the physical limits of known processes for crimping and handling the wires & connectors.

WHN: Back in the early 2000's there was talk of 42V systems, but that seemed to go away. What's different now to make these higher voltage systems more viable?


Boris: Mainly the CO2 reduction trend and legislation on emissions created the disruption in the industry to think different and step away from the combustion engine as single solution for the powertrain in a car.

Power can be saved if you don't need to continuously drive the aggregates that consume a lot of energy from your combustion engine. Saving power means saving fuel, and this goes directly in CO2 emission reduction.



As the E-motors in hybrids become more powerful and the electronics more efficient to drive these

Continued on page 17

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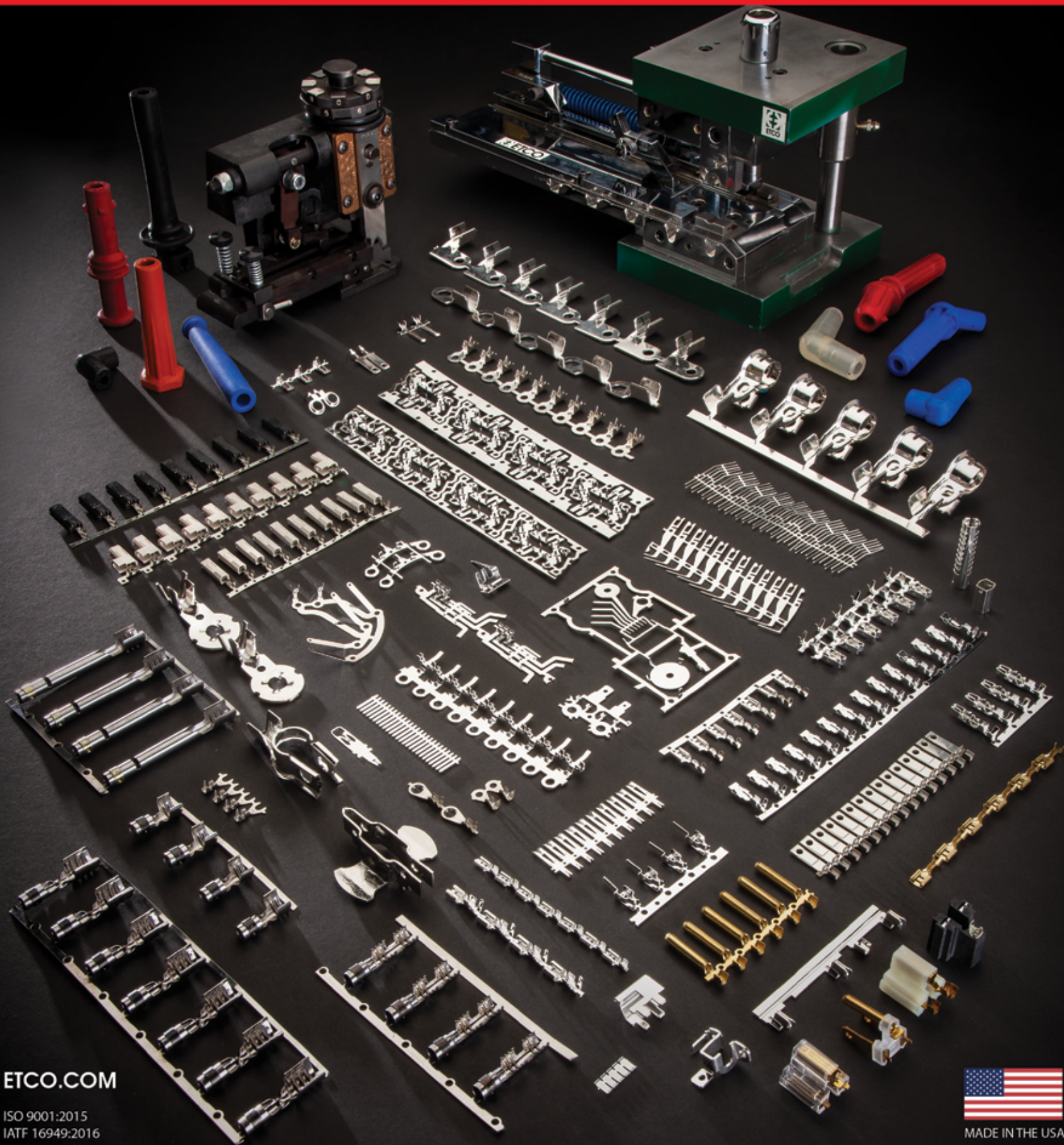


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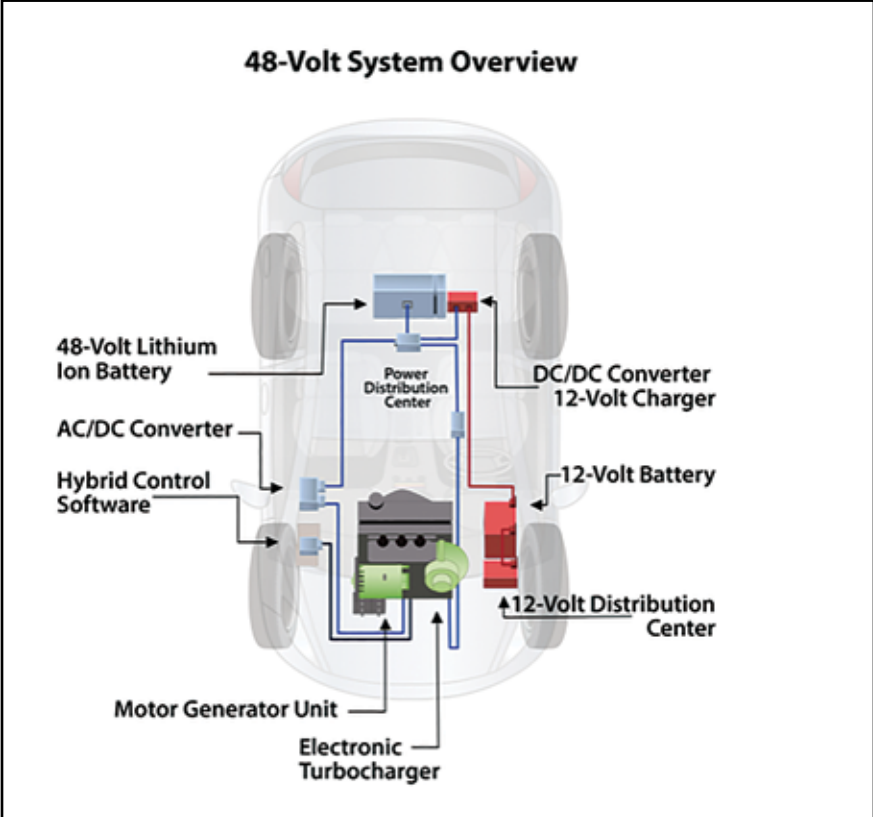
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48-Volt Systems and Connectors: QA with an Expert



Continued from page 15

engines, the batteries don't need to be the size as in a full electrical car. The power density of batteries is also increasing rapidly which helps to reduce battery size.

48V is the ideal solution in between an internal combustion engine and a full electric solution.

The 42V was the base for the set of new specifications that have been introduced for the 48V layer.

WHN: What were the challenges in developing 48V connectors automotive?

Boris: When 48V is used in miniaturization applications, the creep distance (shortest path over the insulation material between 2 conductors) and clearance must be sufficient to prevent short circuit.

And although the touch protection is not required as with high voltage connections (above 60V), the hot unplugging of power connections at

48V is a challenge and must be prevented by locking mechanisms or a HVIL (high voltage interlock function) similar as with high voltage applications.

It is possible to think you need a completely new portfolio of terminals and connectors. This would create a higher market entry price and make the supply chain for our harness maker customers much more complex (inventory increase, higher number of parts for 12V and 48V). But TE Connectivity looks at a more holistic approach where we want to deliver the same products for 48V as for 12V to our customers. Therefore we carefully selected and tested many of our current products and are labeling them as '48V ready'. Our waterproof connectors are designed in such way that they fulfill the requirements.

Our customers can pick any of these products suitable for 48V and process them in the same way they

Continued on page 19



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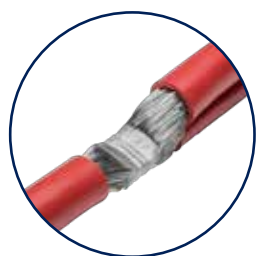
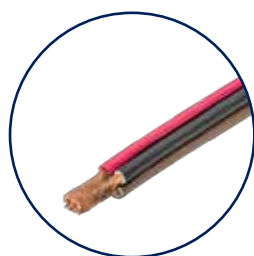
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48-Volt Systems and Connectors: QA with an Expert

Continued from page 17

for 12V harnesses, again, addressing the above supply challenges.

For miniaturized applications, we designed new products with a higher pitch between the wires to overcome the creep distance, while keeping the packaging as small as possible to fit applications such as cell connections in batteries etc.

WHN: What are the typical wire sizes for 48V systems? Different insulation?

Boris: As mentioned, the power in the aggregates increases, and the wire size decreases because of the higher voltage level. This means the wire sizes to be used for 48V are in the same range as for 12V.

The re-use of existing 12V products at our customers fits in the end-to-end philosophy of TE, making sure that we keep the supply chain as lean as possible, providing the best solution to our customers.

WHN: Are the terminals all new for 48 V connectors or will they be different formats requiring different applicators?

Boris: TE has a complete portfolio of terminals and connectors. Terminals are not linked to a voltage level, only to a current carrying capacity and a limitation on wire size based on the crimp of welding flag (if cables are welded instead of crimped to the terminal).

It is possible to use the same terminal for 12V, 48V, 400V and beyond as long as the cable and connector housing provide the correct insulation protection and meet the required safety specifications.

Our terminals start at miniaturized solutions for blade sizes of 0.5mm for wires starting from 0.13mm or even 0.08mm² in specific cases, and extend to high power solutions such as our PCON21, with a 21mm blade size

WHN: What will be the different or new for manufacturers as they create the harnesses for these systems?

Boris: In the coming years, we still see an increase in contact points for the harnesses. There are more electric and electronic controlled functions in a car, and this will require more focus on weight saving on the harness, especially if costs for raw material (copper) would go up. Weight of the harness has a direct impact on CO2 emission and is vulnerable to copper price swings.

This is leading to rethinking the harness and, on a higher level, the number of decentralized electronic controllers. A zonal architecture is the most suitable think path to deal with these challenges, and it doesn't need to be a disruptive change. The move from a classic 12V harness, over 48V towards more zonal defined harnesses can be gradual, enabling the complete industry to adapt.

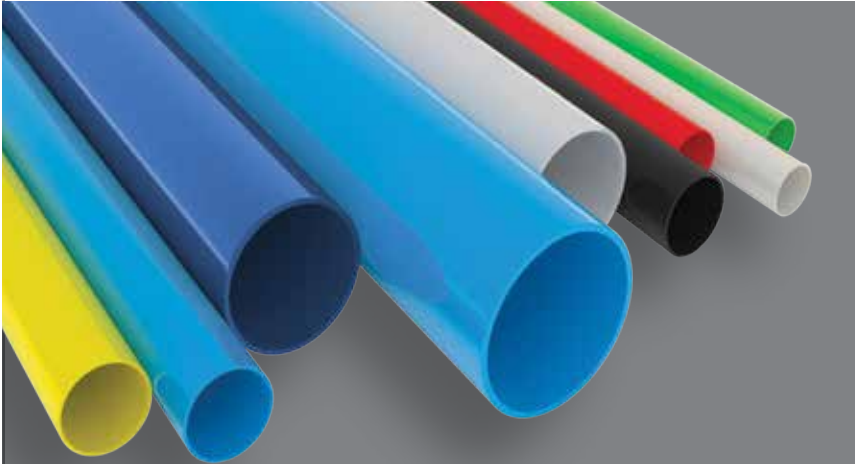
WHN: Do you see aftermarket equipment being designed to operate in the 48V environment? What factors would affect that?

Boris: TE is supportive to all of our customers. If companies design specific equipment for aftermarket that work on 48V, our platform 48V portfolio is available to support this.

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Zuken USA Announces Plans for Zuken Innovation World Digital Edition


Zuken USA is finalizing plans to take its annual Zuken Innovation World (ZIW) Americas conference to a fully virtual platform in 2021.

“With continued concern about COVID-19 and ongoing corporate travel restrictions, it is not yet feasible to safely bring participants together in a face-to-face setting,” said Bob Potock, VP of Marketing at Zuken USA, Inc. “With safety in mind, we have made the decision to hold the ZIW Americas conference on a fully virtual platform.” While the event will be held virtually, Zuken Innovation World will hold strong to its core tenets and offer participants opportunities for networking, learning, and innovation. Participants will be able to schedule one-on-one appointments with Zuken staff and with one another. Discussion rooms will be open throughout the event to network with others who share common interests. The Zuken-360 forum will provide participants with a chance to ask questions of the management and development teams. As an added bonus, registered participants will be able to replay conference sessions for an additional 60 days of education following the conference.

The annual conference will offer three technical tracks featuring topics focused on printed circuit board design, wire harness and cabinet design, and digital engineering. Classes will showcase how-to and best practices using the Zuken tool suites, as well as introduce innovative design methodologies and industry trends such as model-based engineering and architecture-driven engineering. Registration is expected to open in April. For more information about participation in ZIW Americas, please contact the Conference Manager, Amy Clements, at 972-691-3284, amy.clements@zukenusa.com or visit www.zuken.com/us/event.


“The implementation of ISO 13485:2016 represents an important milestone for our company. This comprehensive quality management system for the design and manufacture of medical devices ensures the Customer that the design, development, production, and delivery of their product stays consistent throughout the entire order fulfillment process,” said Jon Crofford, CEO of TLC Electronics. “This standard will ensure our design and production teams have a clear working understanding of the Customer’s expectation, product functionality, and product failure modes. Whether you use our degreed engineers for design assistance or our skilled production team, consistent quality will be met and maintained throughout the project,” said Andy Dahl, Director of Business Development for TLC Electronics. ISO 13485:2016 is a risk based, stand-alone QMS standard that was written to support medical device manufacturers in designing robust quality management systems to establish and maintain the effectiveness of their processes. ISO 13485:2016 requires that consistent quality standards be met and maintained.

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TTI Family of Companies Remembers Founder and Chief Executive Officer Paul Andrews

TTI, Inc., a leading distributor of electronic components, announces the passing of Paul Andrews, TTI founder and CEO. At the helm for 50 years, Andrews' vision has led TTI to extraordinary success as one of the industry's leading distributors.

In 1971, Andrews turned his dream into a self-made success. From humble beginnings at his kitchen table in his hometown of Fort Worth, Texas, Andrews began building the foundation of the company that he would transform into a billion-dollar global business. Today, TTI is home to over 7,000 team members worldwide and includes Mouser Electronics, Sager Electronics and the TTI Semiconductor Group.

Andrews envisioned an organization with a culture of continual business process improvement, with all TTI employees throughout the world thoroughly committed to the best business practices. TTI's success is a direct result of his exceptional leadership. The company's mission established by Andrews early on still resonates throughout the organization. A firm believer in doing what you say you are going to do and providing exceptional service, this credo has propelled the company and its founder to be among the most respected in the industry.

A turning point in the history of TTI came in 2006, when Andrews had the opportunity to meet investment icon Warren Buffett. The following year, TTI became part of the Berkshire Hathaway family of companies. In 2018, Buffett offered this comment about Andrews, "TTI is run by a fellow named Paul Andrews, who's done an absolutely sensational job with us. He's a wonderful man. He's a wonderful manager."

Andrews was not only an entrepreneur, businessman and visionary, he was a pillar of the Fort Worth community. In 2020, the Fort Worth Chamber of Commerce named Andrews the recipient of the annual Susan Halsey Executive Leadership Award. In 2011, Andrews was inducted into the Fort Worth Business Hall of Fame. He served on the board of trustees at Trinity Valley School in Fort Worth. Most recently Andrews was acknowledged for his notable contributions to Texas Christian University and Texas Wesleyan University



Paul Andrews, TTI founder and CEO

and was honored by both universities with honorary doctorate degrees. Their vigorous efforts on behalf of education helped establish the Paul and Judy Andrews Industrial Distribution Conference Center on the Texas A&M campus in 1996.

In 2005, Andrews and his wife, shared their vision and their commitment to their hometown by becoming significant contributors to the Paul and Judy Andrews Women's Hospital, part of the Baylor All Saints Medical Center in Fort Worth.

Andrews, 78, is survived by his wife, Judy, their three children and eight grandchildren.

The Paul E. Andrews, Jr. Foundation, created in 2007, will continue its focus on supporting education and health care initiatives in the Fort Worth community. In lieu of flowers, charitable contributions in honor of Andrews' memory may be directed to:

Andrews Women's Hospital Endowment Fund
C/O Amy Adkins
1400 8th Ave., Fort Worth 76104

Presbyterian Night Shelter
C/O Brenda Rios
2400 Cypress St., Fort Worth 76102

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Certified Manufacturing, Inc.



Pamela and Robert Bechtold

Continued from page 1

into the manufacturing business; so, I said to Pam, ‘you know we could be one of those companies that the big businesses go to for outsourcing.’”

The duo began with a 2000 ft.² rented facility in Crestview Florida in 1998. “One of the first things we did was get a grant from the state of Florida,” Robert mentioned, “and they helped us contract with a company to develop our quality system.” They got started talking to local companies and, pretty soon, they were bringing in steady work. “We thought a \$1000 purchase order was wonderful back then, and then it was 10,000, and then we started getting some six-figure programs in here.”

Within the first year, they were maxed out on space. At the time, their largest prime was very pleased with the work they were doing and told them that if they had a bigger facility, they would send CMI more business.

They contacted their local Economic Development Council to help them find a bigger space. Most of the region’s manufacturing development was in the Fort Walton Beach area where the rents were high. So, the EDC steered them to a brand-new industrial park that was being developed in Holt. “They found us 10,000 ft.² for \$2000 a month, and we thought ‘wow what a deal!’” It was a little bit bigger than they actually needed, but it was right off of I-10, and they saw that was a big plus.

By this time, CMI had veered well away from circuit cards and had gained multiple successes building harnesses and electronic assemblies. They sharpened those early skills subcontracting for programs at Point Mugu, the Navy’s center for electronic warfare expertise. The company continued to grow with harnesses and assemblies for complex defense systems.

In the early 2000’s they were approached by a large prime to bid on a program to upgrade several existing C-130s from cargo planes to gunships. “We were contracted to provide the cabling and rack systems for the avionics, battle management systems, and some of the aircraft wiring itself,” Robert recalled. With their small proficient engineering staff, they were able to tackle some of the issues with the original drawings for these aircraft. “We were dealing with drawings that were 20 years old on those C-130s. A lot of the details or later changes were missing, and we had to reinvent the wheel.” That was actually the key to success with that program, and it opened the doors for a lot of additional business at CMI.

The company encountered a new and frightening hurdle around this time. Pamela was diagnosed with stage-4 cancer. “There were times when Pam would actually come into work after chemo treatments and lay down in her office, but she was determined that if I was going to work, so was she,” Robert remembered. The couple raised the red flag to their daughter and son-in-law Michelle and Tim Rasbeck, who were happily living and working in the Philadelphia area. The couple relocated to the Florida Panhandle to help out with the business and to be close to mom. They quickly became integral and valued contributors to the company. Thankfully, Pamela is doing fine today. “A lot of our customers know what Pam went through, and with the help of Michelle and Tim and a lot of great employees, we made it,” he insisted. Referring to Michelle and Tim, he added, “They’re still here, so we must be doing something right!”

The C-130 program really solidified their mark in the aircraft modification business. Through this and other modification and integration programs, they eventually began to specialize in this complex niche. CMI developed a proficiency for negotiating the maze of legacy drawings. “Some of the drawings we get from procurement are 20-30 years old and we have to understand and fix those drawings so we can grasp what they really want,” warned Robert. “Many times, those parts are no longer available, so you have to find alternatives, but that’s the life we live with aircraft modifications.”

Despite their great success with their largest customer, Pamela felt there were too many eggs in one basket and began to trumpet the need for diversification. “We started doing what Pam suggested and began targeting another local company who was a major player in aircraft modi-

fications on the training and intelligence side,” Robert explained. They made several attempts but were not successful. But the company was purchased, and a management change ensued. “All of a sudden, we were competitive, so somebody had the ‘good old boy’ network going.” CMI was soon winning excellence awards from the company for zero defects and 100% on-time delivery.

In the meantime, space was again becoming an issue. Around 2007, the industrial park made them an offer they just couldn’t refuse. CMI was leasing the current 10,000 ft.² space, but they were told if they purchased the 7-acre parcel across the street, they would be let out of the lease. The industrial park was part of a venture between the electric cooperative and government to bring employment to the region, and the company received other incentives to build the facility. Tim acted as general contractor in the development of the property and brought the project in on schedule and below budget. “We built a 32,000 ft.² facility with the attitude that if we built it, they would come,” Robert proclaimed.

Another significant modification program was with the next generation fighter drone. Retired F-16 aircraft were to be converted into QF-16 aerial targets for the purpose of testing newly developed weapons and tactics. “We were on a conference call with those folks once a week helping them with the drawings for the procurement, and we did that for almost a year,” Robert chronicled. That interaction was key to the prime winning the bid, and it fortified CMI’s position as the key supplier for harnesses and assemblies for the program.

Pamela began to explore another avenue for diversification by seeking to exploit their combined experience with project management. They sought and won another large aircraft modification program, but this time as the prime. It was for an electronic propeller control system (EPCS) upgrade on 30-40 C-130s for the Army and Navy. That involved changing out the wiring and controls for all four engines. “Of course, to do the integration and installation, you have to have a large hanger with fire suppression along with the accredited airframe and power plant mechanics to do

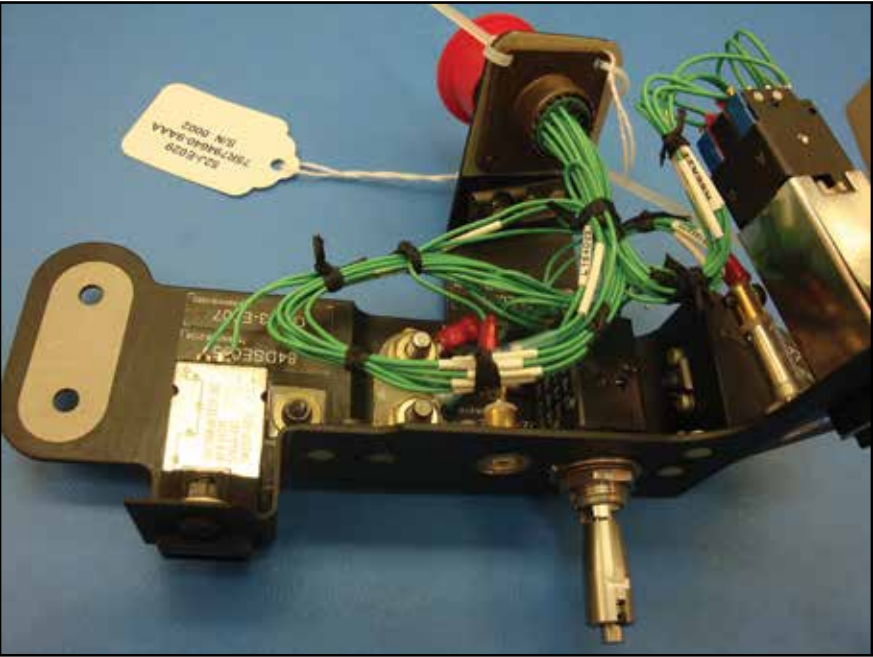
the installations,” Robert explained. They contracted with a company in Mississippi who had the accredited manpower and could tear down and rebuild the engines along with the proper weight and balance calculations. “All of a sudden, we’re program managers,” he exclaimed.

Many of these success stories are the result of the prime contractors being CMI’s biggest advocates. They have leveraged their multiple quality and delivery awards to dig deeper into their existing customer base. “You can try to get into other kinds of business, and we’ve been fairly successful, but the next thing you know is you get bombarded with requirements in modification programs, and we’re actually quite comfortable in that niche,” Robert confirmed.

Pamela stressed that the most important thing about their company is the people they have working for them. “We are absolutely nothing without our people. The majority of them have been here 7 to 15 years and have a great track record,” she boasted. The company has an on-site certified trainer to help folks learn everything from reading a drawing, to final assembly and inspection techniques. And she couldn’t say enough about the contributions of Michelle and Tim. “Michelle came from another industry and has grown into a position of contract administration and customer liaison, and the customers just love her. They call and ask for Michelle and she is a world of knowledge—we are just so proud of her. Tim has become a master scheduler and operations manager, and he just walks on water with the production schedules.”

Michelle chimed in with some other strengths of CMI. “One best things about working here is that we have a team approach to everything we do. We all have our positions, but we meet and discuss any new opportunities and different ways to approach bidding where we can save on time and materials. Mom and dad like to call the conference room the ‘solutions room’ because they don’t want to hear about a problem, they just want to explore ways to solve it,” she instructed. The team also wanted to recognize the contributions of another valuable employee, Tracy Pascal,

Continued on page 25



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The CMI Team

Continued from page 23

the company’s CFO. Tracy joined the company in 2016 and is responsible for all financial matters on a day-to-day basis, as well as being keenly involved in top-level management decisions.

Today CMI has between 30 - 50 employees, depending on the backlog. They are a 100% woman owned small business certified to AS9100. Manufacturing personnel are all trained to J-STD-001, IPC-610, and IPC/WHMA-A-620, with in-house trainers for all. They are multiple year winners of the Boeing Mentor Protégé program honoring 100% on-time delivery and zero defects. They are now fully certified to the DoD’s new CMMC cyber security requirement (see the Jan/Feb and March/April issues for more info on that). CMI is also proud to have achieved the SILVER certification as a

Healthy Okaloosa Worksite.

But their true strength extends well beyond these many accolades and achievements. In concluding remarks, Pamela had this to say:

We are not, and I mean N-O-T in capital letters, a mom-and-pop shop. We have escalated our company because of my husband Bob, our daughter Michelle, son-in-law Tim, along with Tracy, to a world class manufacturer. We are so proud of our people and the integrity that they build into the product. The majority of our people have military backgrounds either directly or through family. We also have a son who was in the Air Force, along with two grandsons who currently serve, so we are very proud flag waivers. We do not take any customer for granted. We love complex work and present ourselves to our customers as their ‘outsource resource’, and they just love that.



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Processing the Wire - A Brief Outlook on Essential Principles

By J. Ruben Lozano
VP of International Sales, Lakes Precision Inc.

Wire harness production is complex. Each component, process and support mechanism depends on the other. It is imperative to understand the building blocks that go into harness production. This article provides a deeper understanding of these building blocks, and how they relate with other to create a reliable and robust wire and harness assembly.

Part 1: ESSENTIAL WIRE PROCESSING PRINCIPLES - WIRE STRANDING PACKS

IT ALL STARTS WITH THE PACK

Philosopher Euclides, Mathematician Lagrange and the bees had it all figured out, the most efficient use of space in a confined perimeter is the hexagon.



In combination with the pack stacking, another key configuration is known as the “wire lay”; There are two kinds of wire lay windings, left-handed or “S” lay and right-handed or “Z” lay. Normally, the outer layer of a wire is always “S” type.



Layering of strands can be concentric with layer windings in the same direction or with layer winding in opposite directions, depending on stiffness or flexibility requirements. It can also be simply bunched, with no regard to arrangement or number of filaments.



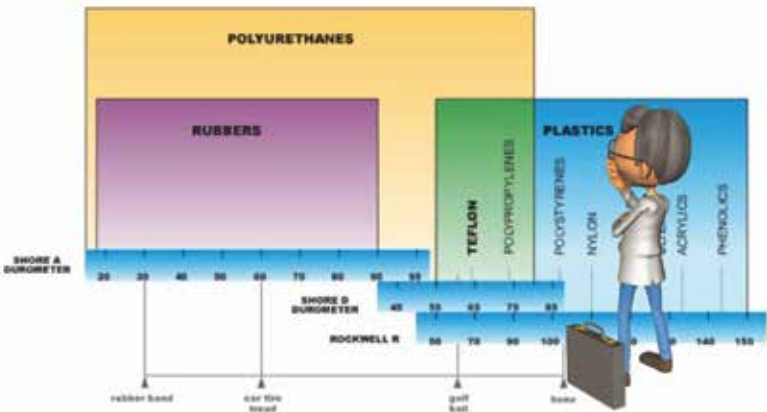
Bunch Layering

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RELATIVE HARDNESS OF PLASTIC MATERIALS



Since we need to feed and cut the wire through the processing machine, we will focus only on the coefficient of friction, the apparent elasticity, and the apparent hardness of the insulation material.

Continued on page 28

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Processing the Wire - A Brief Outlook on Essential Principles

Continued from page 27

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Coefficient of Friction - This property affects how the wire is fed into the processor machine. Also affects the wear factors on the machine's feeding belts or rollers as well as the wire processing blades.



Apparent elasticity. This property affects the temporary or permanent deformation on the insulation plastic caused by the feeding or capture mechanisms in the processor. This property has direct effect on stripping dimension accuracy.



Apparent Hardness - This property directly affects the stripping quality and subsequent stripping blade durability



Thermoplastic Hardness - Thermoplastic hardness comparatively ranges from rubber band attributes to golf ball attributes, wire processing blades must work under this range of conditions.

Part 3. ESSENTIAL WIRE PROCESSING PRINCIPLES - EQUIPMENT CALIBRATION. EQUIPMENT SETUP LEVELS



During the past 5 decades, wire processing equipment has evolved from electro-mechanical clockworks to software-driven semi-robotic units.

The common ground for any past or present equipment design is that the equipment is broken down into different operational layers which insure optimal process efficiencies. These operational levels are:

1. BASE
2. FUNCTIONAL
3. ANCILLARY

BASE Mechanisms:

These elements are the heart of the rest of the equipment components, without these no other function is possible

- Motors
- Levers
- Cams
- Valves
- Electronic Boards
- Power Sources

FUNCTIONAL Mechanisms:

These devices are key elements in transforming raw material to finish product.

- Feed Rollers / Feed Belts
- Swing Arms / Transfer Conveyors
- Wire Capture Clamps
- Cutterheads

ANCILLARY mechanisms:

Support mechanisms which prepare or assist other processing functions

- De-Reeling / Wire Length Pre-Feeders
- Marking or Labeling on Board Devices
- Wire Straighteners
- Pre-Slitting or Pre-Notching on Board Devices
- Guides, Locators
- Inserting Onboard Devices

PROCESS ADJUSTMENTS:

Fine tuning the process to achieve optimal quality control.

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 - Certification of Parameters
 - WIRE END POSITIONING:
 - o Zero State Calibration
 - o Transfer Arms, Conveyors
- Clamp Alignment on XYZ Axes

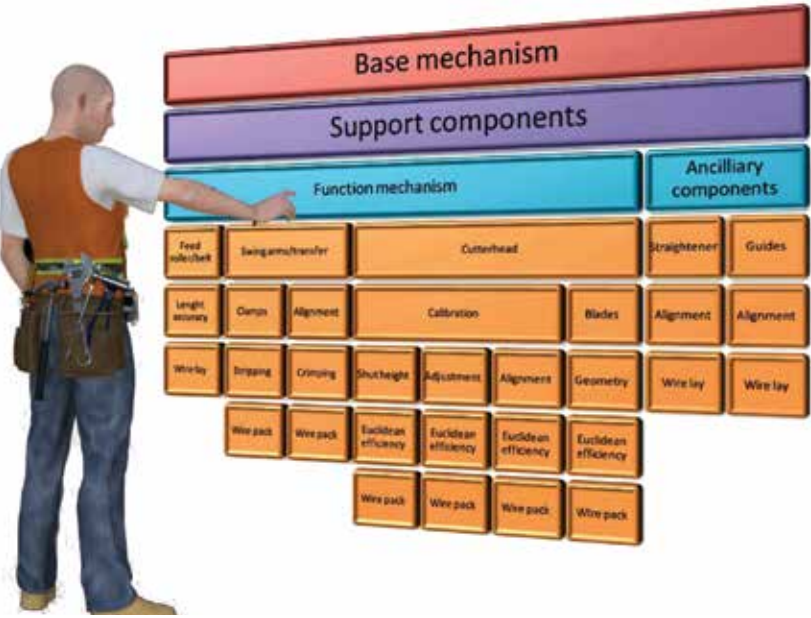
Part 4. ESSENTIAL WIRE PROCESSING PRINCIPLES - ACHIEVING QUALITY.

PREPARING FOR QUALITY PROCESSES: Two major elements of setup are required to achieve maximum quality: Zero state calibration and Alignment on the XYZ axes.

ZERO STATE CALIBRATION: Is achieved when all the machine's key functional mechanisms' starting positions are zeroed in and functional limits are set in accordance to the manufacturer's recommended specifications

ORTHOGONIC ALIGNMENT: XYZ axes alignment is necessary as a prerequisite to ensure optimal quality results, this is achieved when all functional mechanisms are exactly aligned throughout the process path of the wire in the orthogonal X, Y, Z axis.

A properly zero-state calibrated and XYZ aligned machine allows effective process adjustments which can correct minor process flaws during operation and makes it easier to diagnose and troubleshoot processing problems.



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Back to Basics

Slip Ring 101

What is a slip ring?

In electrical engineering terms, a slip ring is a method of making an electrical connection through a rotating assembly. It enables the transmission of power and data signals from a stationary to a rotating structure.

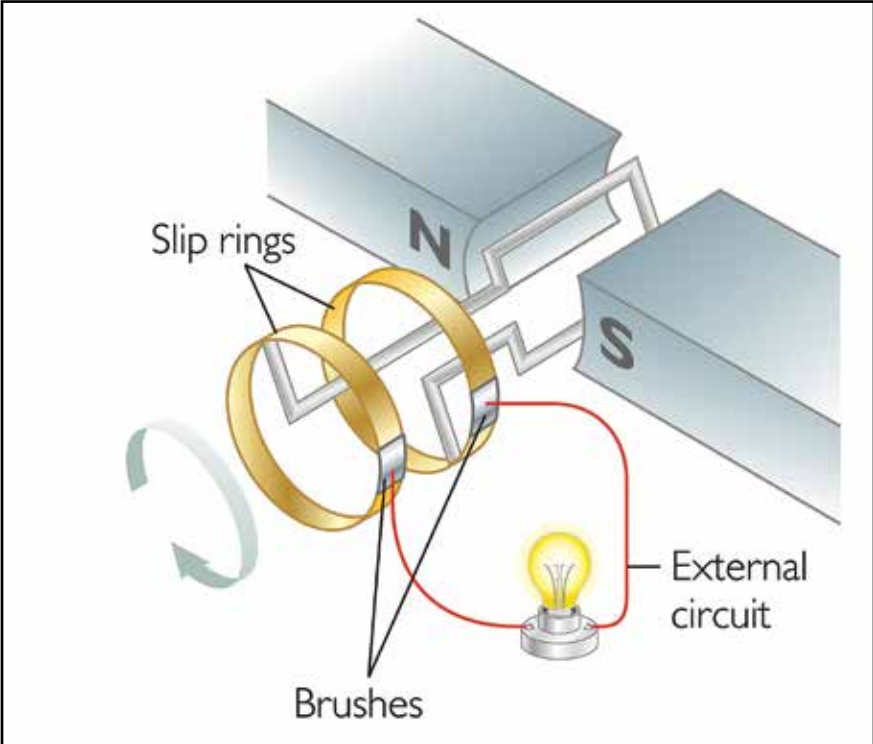
A slip ring is one of two or more continuous conducting rings from

which brushes take or to which they deliver current in a generator or motor.

How does a slip ring work?

Slip rings solve the problem of how to safely run electricity to a continuously rotating part of an assembled product.

Constructed of two main parts, a



Slip Ring

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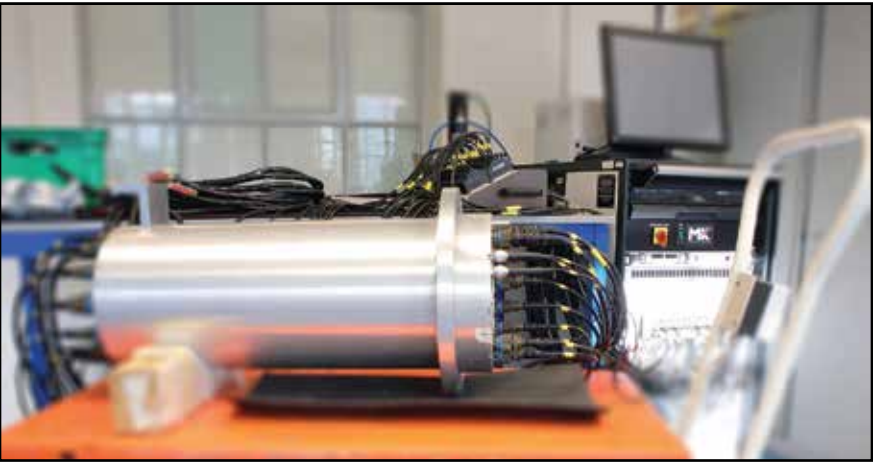
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A slip ring under test using an automatic test system.

metal ring is generally the rotating element, whilst a brush contact is usually fixed.

The outer part (usually the brush) is called the Stator, because it is stationary, and the internal part (the ring) is called the Rotor, as it rotates.

As the rings rotate, an electrical current is conducted through the brushes, making a continuous connection.

Where are slip rings used?

Slip rings are used on a broad range of rotating objects to transfer electrical signals from a stationary to a moving part. Common uses are:

- Defence: Rotating tank turrets, radar and surveillance systems
- Medical: Microscopes, scanning equipment
- Renewable Energy: Wind turbines

What are some other names for slip rings?

Slip rings have many other commonly used names; the main ones are listed below and there are probably many more terms used as well.

- Rotary electrical interfaces
- Rotating electrical connectors
- Collectors
- Swivels
- Electrical rotary joints

Slip rings are also sometimes called a commutator. However, these have a different construction and so are not strictly the same thing. Commutators are used on DC motors and generators and are segmented whereas slip rings are continuous.

How are slip rings quality checked during manufacture?

Most slip ring manufacturers will carry out QC checks on 100% of goods prior to despatch. Standard tests include continuity, insulation resistance, dielectric strength, torque and rotational tests to ensure the slip rings are fit for purpose in the end product.

Thanks to MK Test Systems for compiling this report.

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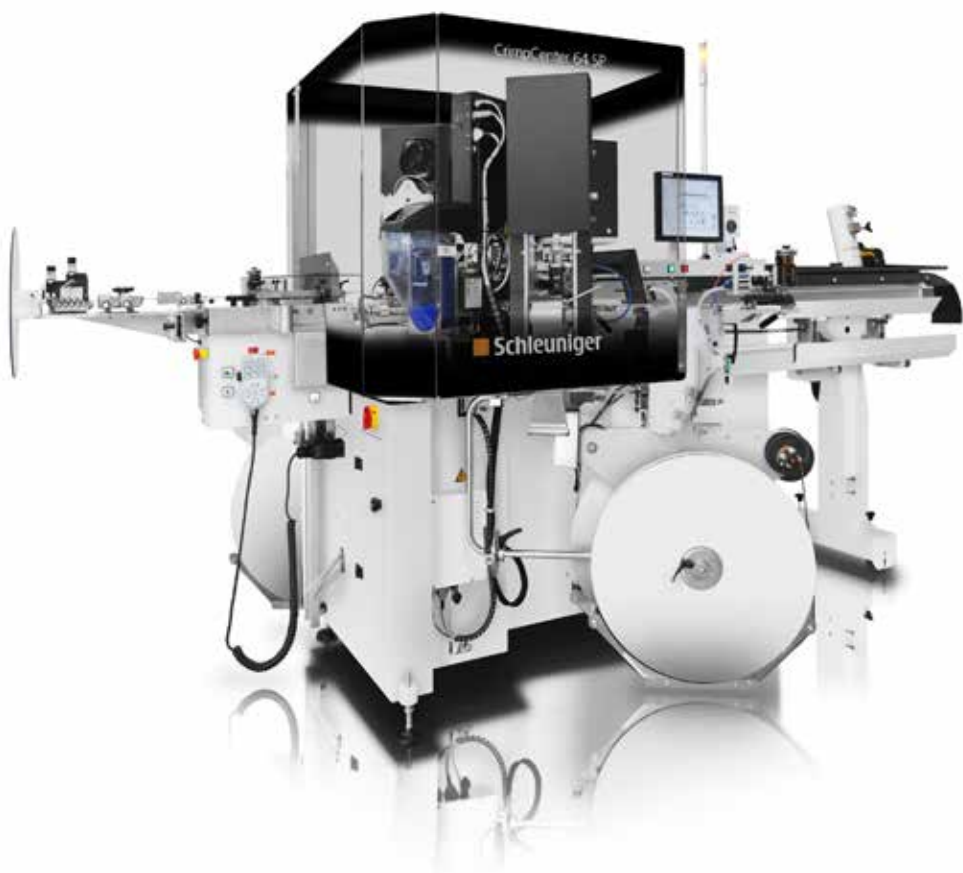
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What is Minimum Bend Radius?

The minimum bend radius is the smallest allowed radius the cable is allowed to be bent around. During installation, cables are bent or flexed in various environmental conditions. Cables are often bent around a curve in conduits or underground ducts. Cables are also bent when pulling a cable around a sheave, which is a pulley set up in a manhole to help ease a cable around a curve.

Cables are composed of different components that may become compromised if bent too far and stress is placed on the cable. For example, while bending a medium-voltage cable consisting of a copper tape shield, the cable may form cracks in the outer jacket. To prevent cable damage, cable standards such as The National Electrical Code (NEC) and the Insulated Cable Engineers Association (ICEA) formed requirements for minimum bend radius.

How to Calculate Minimum Bend Radius?

Figure 1 shows a cable with an outer diameter of 2 inches being bent

around a radius of 12 inches.

The minimum bend radius is based on the diameter of the cable and the type of cable.

The following formula is used:

Minimum Bend Radius = Cable Outer Diameter x Cable Multiplier

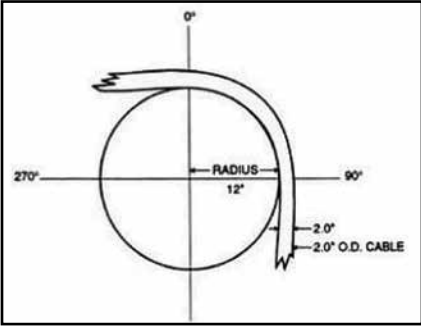



Figure 1: Minimum Bend Radius

Cable Multipliers


Cable multipliers are determined by industry standards and vary depending on the cable type. Table 1 provides a general guide on cable multipliers for various cable types. Please note that the multiplier may change depending on the cable type and industry standard. For more information, see 2014 NEC Articles 300.34, 330.24 and 336 as well IEEE 1185, ICEA S-75-381, ICEA S-66-524 and ICEA S-68-516.



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Cable Type	Minimum Bend Radius as a Multiple of Overall Cable Diameter
Single or multiple-conductor cables without metallic shielding, >1,000 V	Eight times the overall cable diameter ¹
Single-conductor cables with shielding, >1,000 V	12 times the overall cable diameter ¹
Multiconductor cables with individually shielded conductors >1,000 V	12 times the individual conductor diameter or seven times the overall cable diameter – whichever is greater ¹
Portable (mining) cables	Six times for cables rated 5000 volts or less, eight times for cables rated over 5,000 volt ²
Interlocked armor or corrugated sheath (Type MC) cables	Seven times overall cable diameter ³
¹ 2014 NEC Section 300.34 Conductor Bend Radius	
² ICEA S-75-381 Portable and Power Feeder Cables for Use in Mines and Similar Applications	
³ 2014 NEC Section 330.24 Bending Radius	

Table 1: Cable Multipliers for Minimum Bend Radius

Minimum Bend Radius Calculation Example

Example: What is the minimum bend radius of a 1/0, 5 kV, SHD-GC cable?

Answer: SHD-GC is a shielded mining cable. According to Table 1, the minimum bend radius is found to be six times the cable’s overall diameter. The overall diameter of the cable

is given as 2.08 inches in the product catalog. Multiplying 2.08 inches by six, we get 12.48 inches. The minimum bending radius for this SHD-GC cable is approximately 12.5 inches. This cable can be safely bent around a diameter of 25 inches.

For help choosing the best cable for your application, visit anixter.com/contact to speak to an expert.

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On Improving Quality of Testing Motor Racing Cables and Harnesses

Founded in 2003, and located in Daytona Beach Florida, Creative Motorsport Solutions (CMS) has grown from being a data system re-seller to a company that now designs and builds its own complex embedded electronics systems for all types of racing vehicles in the motorsport market. CMS also offers services for wiring system design and manufacturing, and Wire Harness Testing. It is one of the few motorsport wiring houses in the US to utilize a CAD solution for wiring harness design. CMS customers include teams racing the Daytona 24 and Daytona 500.

Motorsport harnesses are usually complex and mission-critical requiring the same level of quality of manufacturing as Aerospace parts. A few years ago, CMS set about finding a test system that would be accurate and flexible enough to handle the high mix, low volume testing. “At


Continued on page 38



Figure 1: CMS customers at the 2017 HSR Classic 24 at Daytona. P1 overall with David Porter's Pescarolo/Judd LMP1 and P3 for Johnny Reisman in his Coyote Corvette Daytona Prototype.
(Photo courtesy CMS)

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- 1 - KODERA C373 Cut & Strip Machine
- 1 - KOMAX BT752 Bench Top Crimper, 2014
- 1 - KOMAX Gamma 333LCD Crimping Machine
- 1 - KOMAX Gamma 263 Crimp to Crimp Machines, 2014
- 1 - KOMAX DPS272 Coiler
- 1 - LASELEC 24-C Braider, Model BRAIDO24, Wire & Yarn Carriers, 12/2018
- 1 - LASELEC Sylade 7d Laser Wire Marker & Stripper, 2017
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Creative Motorsport Solutions

Continued from page 36

that time, we were looking to attach a “primary” connector to the tester with up to 79 pins and use the probe to identify correctness of the other pins. We did not want to build a mating interface for the many smaller connectors, but just have the system read out the name and pin number of the target”, explained Colin Harmer, Owner. “During our tester evaluation phase, we were drawn to the versatility of the CAMI Research CableEye® system, especially its invaluable AutoBuild™ guided assembly function which allows us to have a test lab that talks to us. When set up for 2nd-sided pinning, we probe each pin with the test probe, and the tester reads out the pin number while displaying the same information on the screen.

“The CableEye tester also allows

us to rapidly identify the wiring of an unknown cable or harness using its Learn Cable function. This feature is especially useful when reverse engineering parts for customers who have lost their schematics (Fig. 2).



Figure 3: CableEye High Voltage System for Continuity and Hipot Testing with Test Interface Fixtures. This 256 Test Point (TP) system (comprising a 128 TP control module with one expansion module) is expandable to 1024 TPs. The set-up shown was used to reverse engineer and test the suspect corner looms.

(Photo CMS)

“In this test (Fig. 3), the customer had an issue that pointed at the corner assemblies being “suspect”. These were not harnesses we built but because the CableEye test rig is so flexible we could quickly reverse engineer the harness, check it against

Figure 3. CableEye High Voltage System for Continuity and Hipot Testing with Test Interface Fixtures.

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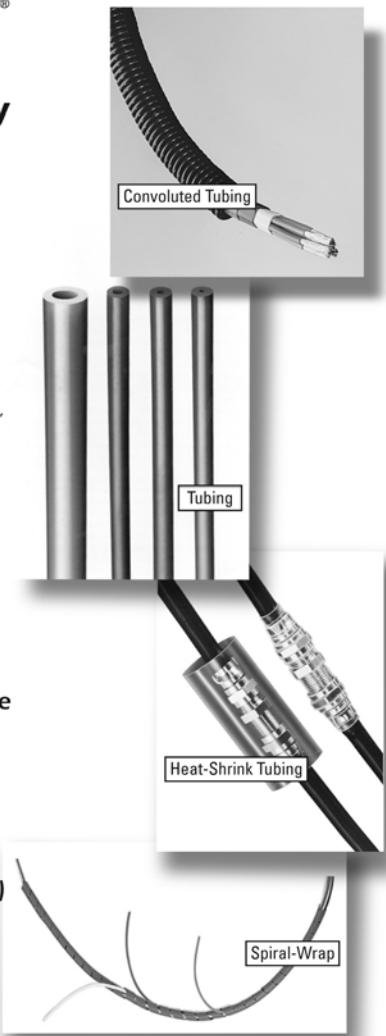
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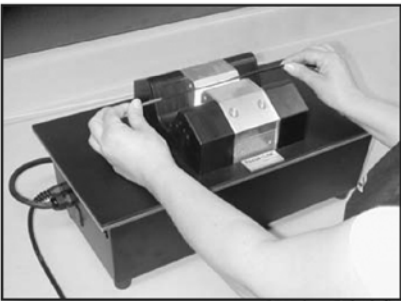
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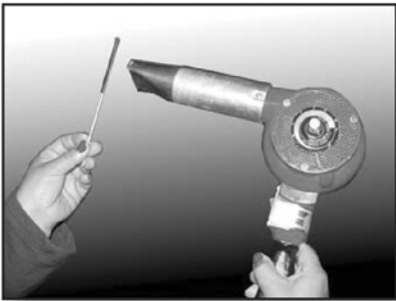
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Figure 4: Historic Steering Wheel — Test Report (Top), Rear View and Front View (Bottom). (Photo CMS)

the supplied drawings, perform a hipot test, and generate test reports showing the wiring in very little time.

“In general, motorsport-type builds are typically low volume, which puts a premium on flexibility with fixtures and ease of use and is a true delineator of the CAMI testers. We now easily hipot test every product we produce which ensures that the client receives goods that are exactly to specification. By keeping records of all the tests, we can easily retest at a future point to ensure that there’s been no change in the harness, for example, in post-race, and post-crash diagnostics. We find it really easy to

generate, store, and print all the test documentation we need within the CableEye system.

“Here’s an example of a device with switches (Fig. 4). This historic steering wheel was in need of repair. Using our CAMI CableEye hipot tester we can use the constant dwell option to function test each button before the wheel leaves the shop.

“Installing a CableEye test system has allowed CMS to test smarter and has contributed to our increase in productivity and growth. We purchased our CableEye tester December

Continued on page 41

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Creative Motorsport Solutions

Continued from page 39

2015, and moved a year later to larger premises to accommodate more efficient workspace and our continued growth. By mid-2016, we made the decision to hipot test everything before it goes out the door, and that's now happening. There are no "off the shelf" test interface solutions for motorsport connectors, so these have to be made. We make ours in-house using blank CableEye test fixture boards from CAMI. Each board has a breakout of 64 test points. Boards are modular so you can mix and match to fit the harness you're testing. We've built up a large library of these (Fig. 5) and are now often able to offer our services without need of creating further custom tooling."



Figure 5: Test Fixture Tool Chest. (Photo CMS)

CableEye testers have many benefits and can be used for the testing of all powertrain harnesses through prototyping and manufacture to post-

crash diagnostics. These multiconductor testers easily link to custom test fixtures and harnesses and instantaneously check for faults, identify the type of faults, and pinpoint fault locations. Depending on the model, the testers detect and dynamically display continuity (opens, shorts, miswires, and intermittent defects), resistance, capacitance, diodes, dielectric breakdown, insulation resistance, and can check twisted pairs for correct orientation. Hipot tests (e.g. insulation resistance and dielectric breakdown) are necessary steps in qualifying insulation integrity. Testing for intermittent defects pre-screens the harnesses for the kinds of faults that can be stimulated by vibration.

As mentioned previously by Colin Harmer, motorsport harnesses are usually low-volume and often bespoke, and so require a tester with a high degree of flexibility to deal with unique test settings, connector types and combinations. Since these testers log the data, post-race and post-crash comparisons of harness integrities are a cinch. The former ensures there have been no changes giving the go-ahead for reinstallation, and the latter can be used for crash diagnostics and the results fed back for potential design improvement. These automation-ready testers provide for barcode tracking and detailed, wire-by-wire, colored wiring reports - even for hipot tests.

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Tensile Testing of Crimped Wire Terminals

Wire harnesses and cable assemblies are used everywhere in connecting electrical and electronic equipment, from aerospace to domestic machines. While some are power conductors, many are signalling, connecting electronic controls and components. Predesigned for easy fitting, most are pre-bound and assembled with a variety of push-on connectors and may include permanent splices. This enables rapid assembly in mass production lines, and complete electrical pre-testing of all connectors.

Simple wire connectors, with terminals on both ends may be made semi-manually with bench presses, or fully automatically by machines that cut, strip, crimp and seal.

Most connectors are designed to be vibration-proof. Generally, they are not designed to sustain any weight, the conductor thickness being related not to strength but to electrical current capacity. Connectors may have ring terminals to screws with or without gripping pro-



files; they may be inline sockets and have clips for a positive fit security. They may be completely stable, or flexibly connect moving parts and control units. Maintenance must still be allowed, so disconnection must remain easy even after extended use, without risk to the crimped joint. In this context, crimped connections and terminals are almost universal.

Application

The crimping process is very precisely specified for strong, protected and durable termination of wires. While hand tools are used for small applications, powered bench crimpers with different forming dies are generally used—electric, hydraulic or pneumatic according to cable size. The principle is to apply sufficient gripping force around the exposed strands of a cable by compressing to a defined dimension, rather than by applying a specific force. The crimping tools are not calibrated as such but verified using gauge tools of calibrated pin size. Tools are dimensionally adjusted as required.

During termination, insulation is precisely stripped back, the strand ends inserted into crimp barrels to defined depth, and the crimping jaws effect the joint. Any risk of damage to strands is minimized in machine processes, but part of quality assurance is always visual testing and electrical testing. When specifying suitable connectors and terminals, other environmental tests may be applied, for example the effects of temperature or corrosion.

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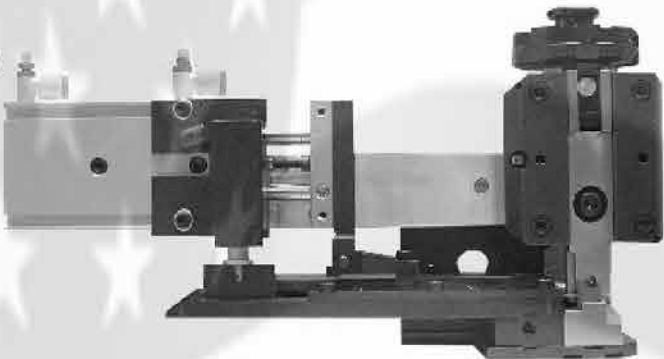


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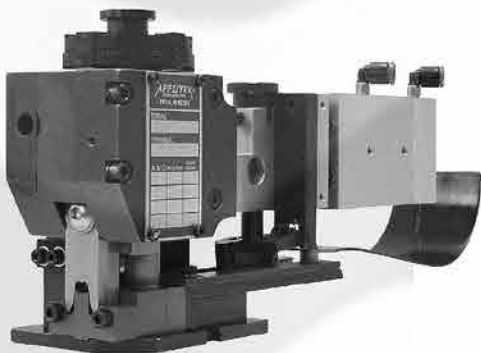


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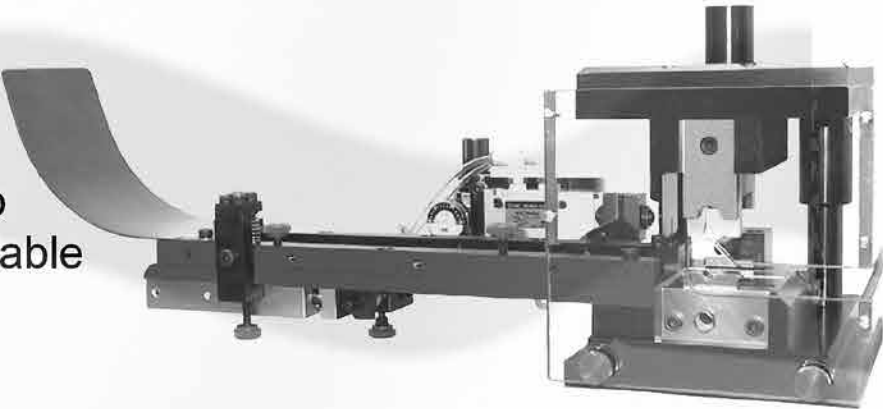


Model 1500



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Tensile Testing of Crimped Wire Terminals

Continued from page 42

quality control, but the only way of really knowing the strength of a crimped terminal is to pull it. This can reveal production problems, where strand nicks, incorrect crimp height, or effects from changes in terminal supply, may not be clearly apparent.

Assembling tensile test data in statistical process control (SPC) systems will also alert for tooling tolerance drift.

Testing

Several international and industry

test standards specify test methods, with little variation in their parameters other than definitions of acceptable load bearing. Those in aerospace or military application are expected to be exceptionally robust. Originally, testing was done by hanging calibrated masses from wires that were gripped by their terminals, but this is slow, cumbersome, and less than precise. Instead, forces are applied by hand lever against a calibrated load-cell, or better, pulled at a known constant speed by motor control.

Machine selection is a matter of suitability for the forces required, the amount of testing being done, and location. Small, horizontal bench-mounted testers that can apply a



Programmable 5 kN tester

force of around 1 kN (220 lbf), allow quality testers to insert single wires quickly, press a single button to activate the pull, and automatically record a peak or break force. Larger power connectors can require up to 5 kN (1124 lbf) applied force.

In design phases, it can be valuable to see not just at what force a crimped joint fails, but the way it fails. Strands can begin to break, a connector itself may deform and break, the whole conductor may break, or slip or pull-out of the crimped barrel may occur. Any elongation in the wire tail, however, must not be construed as slippage in the joint. These features can be identified on a full force-time trace using programmable tensile testers, as part of the development of jointing specifications.

Other features of testing can include changes in electrical conductivity or testing before and after environmental conditioning. Any of these tests may be accompanied by physical inspection, including sectioning and microscopic evaluation of the compacted strands for unevenness or




Manual controlled pull tester






Benchtop 1kN Unit

Continued on page 46



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W H I T E P R O D U C T S

Tensile Testing

Continued from page 44 _____



Pin Grip:
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voids.

Gripping

The simplest assembled terminals comprise a single wire

and a spade or ring connector, but there are many custom requirements, such as angled loops and lateral flags, where

applying an axial pulling force to the conductor requires custom fixtures to grip the offset connector. Grips must be suitable for the terminal type, such that they hold without slipping and do not deform the terminal. Many can be held in a notch that allows a narrower wire through while pushing against the terminal barrel. Similarly, when gripping the tail of an insulated conductor, the grip must not bite and weaken the copper or aluminum conductors, but neither grip the insulation sleeve too loosely, such that it slips and extends.

Terminals themselves are often sleeved—for insulation (typically flexible), or to stabilize the entry of the conductor into the barrel (typically harder nylon, crimped on). In addition, the metal terminal may, for stability, incorporate insulation support. Do these features detract from the tensile test by hiding other weaknesses? Published test standards typically require their removal before pull-testing, but this can be difficult to do without damaging the conductor.

Standard methods

Standard methods are published to make testing consistent and repeatable anywhere, even with different test equipment. ASTM, BS, ISO, SAE, NASA and military standards bodies are among those with published methods. Typically, a constant speed of around 25 mm (1 in)/min is specified for a destructive pull-out test, though the US



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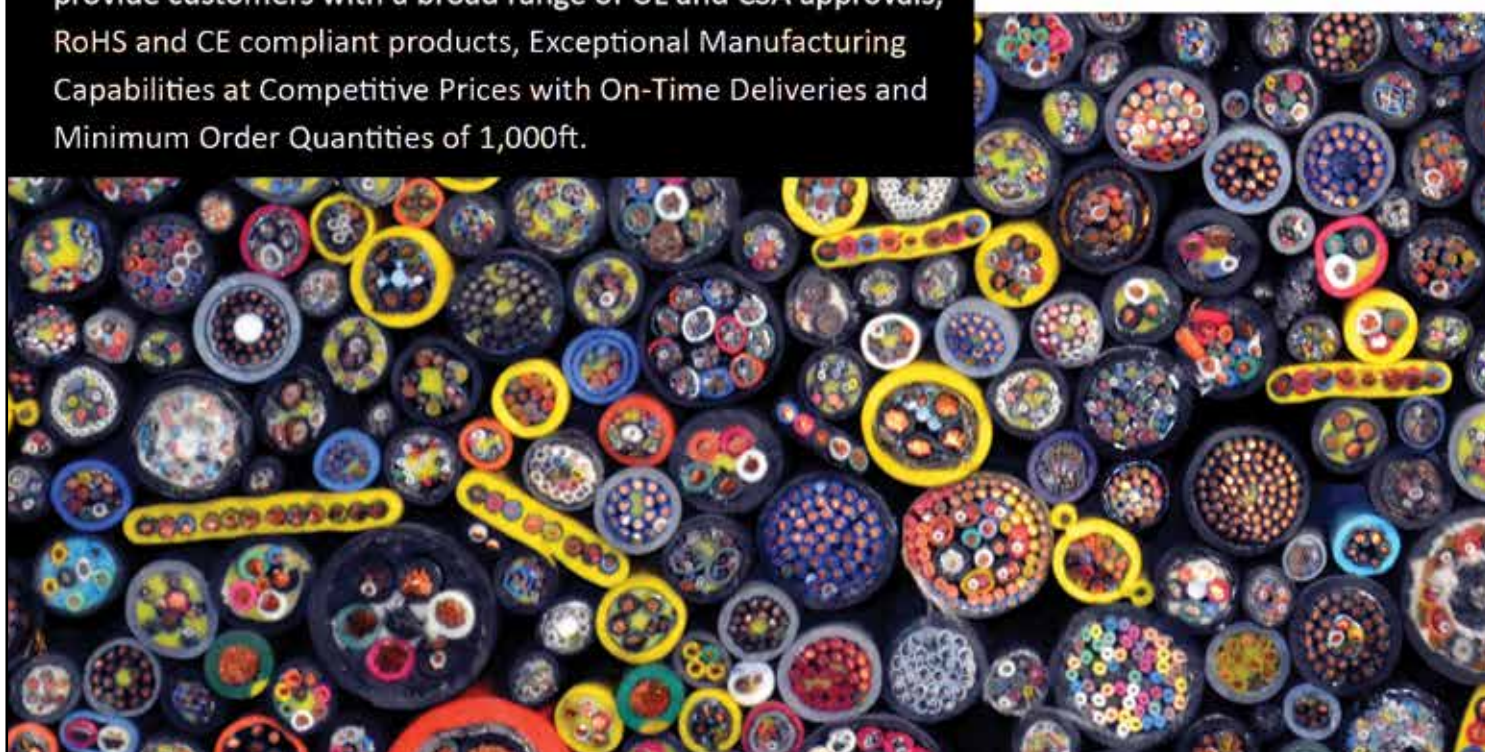


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Underwriters Laboratories standard UL 486A assesses joint security by holding to one minute at a force prescribed for the wire gauge. Pull-out forces in these standards are comparable, except for military applications, which are more stringent.

Universal tensile testers can also be used for connector insertion and withdrawal forces. With fixtures that precisely align male and female components, computer control can insert, withdraw, and cycle this action as required. Peak and average forces can be measured, and a load-time trace used to detect irregularities.



Custom fixtures on this universal tester guide push-on connectors to measure insertion and withdrawal forces.

Test standards references

ANSI/EIA 364-38B : Cable pull-out test procedure for electrical connectors

ASTM B913 -05 : Standard Test Method for Evaluation of Crimped Electrical Connections to 16-Gauge and Smaller Diameter Stranded and Solid Conductors

BS 5G 178-1 : Crimped joints for aircraft electrical cables and wires. Specification for design requirements

(including tests) for components and tools

BS EN 2591 :Aerospace series - elements of electrical and optical connection, test methods

BS EN 61300-3-11 : Fibre optic interconnecting devices and passive components - basic test and measurement procedures Part 3.11: examinations and measurements - engagement and separation forces

BS EN 60352-2 : Solderless connections. Crimped connections. General requirements, test methods and practical guidance

DEF STAN 59-71 : Crimped electrical connectors for copper conductors

IEC 60512-13-1 : Connectors for electronic equipment - tests and measurements - Part 13-1: mechanical operation tests - test 13a: engaging and separating forces

MIL C-39029 /31B : Contacts, electrical connector, pin, crimp removable

NASA STD-8739.4 : Crimping, interconnecting cables, harnesses, and wiring

SAE USCAR21: Performance Specification for Cable-to-Terminal Electrical Crimps

SAE USCAR38: Performance Specification for Ultrasonically Welded Wire/Cable Termination

Author

Paul Montalto is a technical writer at Mecmesin, a Physical Properties Group company.

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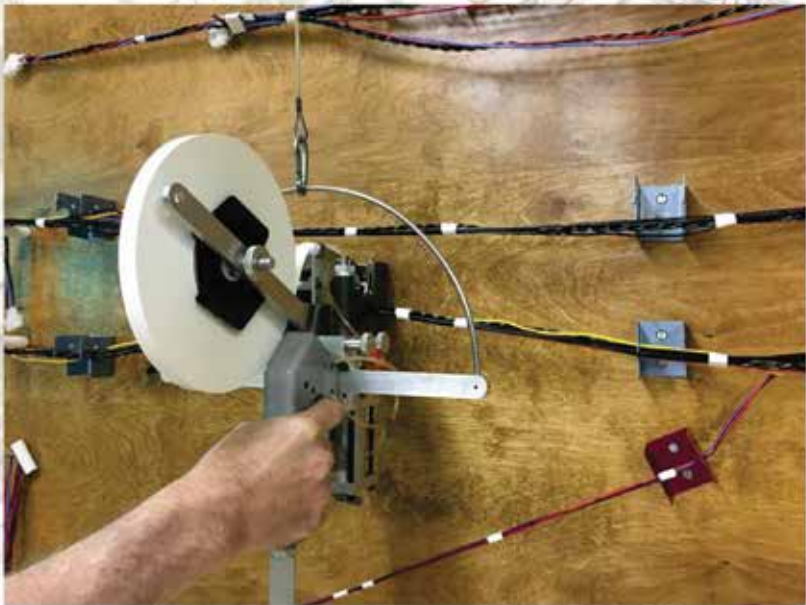
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Schaefer Megomat USA Moves to New Facility

Schaefer Megomat USA, Inc. recently moved from Pewaukee to our new facility in New Berlin, Wisconsin. Due to the strategic measure to use our branch as a sales and service point and the associated decision that the production of fully automatic machines should be relocated back to the headquarters in Germany, we did not require as much space and we found a new location that better fits our needs. We have chosen New Berlin, WI as our new location because it is made up of



three major industrial parks that house many well-known Wisconsin businesses, making building space plentiful and affordable. In addition, the location is a very nice and safe

area that is central for our employees.

The new building is 9,000 sq. feet, contains 1,700 sq. feet of office, and 7,300 sq. feet of shop space. While the space is still currently under construction, when it is completed there will be a main office area and some separate offices. The shop space contains a stockroom, inventory, a shipping area and a small assembly area for building sub-assemblies and customer orders. We also have three smaller machine bays available for stock machines and customer training, run-offs and qualifications.

In the near future, we hope that the construction of the remaining office spaces and IT room will be completed. In addition we plan to finish up a small demo- and conference room to use for customers visits. Once these additions have been finished, we will start our new business model as a service and sales location for the Schäfer Group!

“Once the travel restrictions are lifted, we would like to invite our customers to visit us in New Berlin,” mentioned Todd Miller of Schaefer Megomat Inc. The new address is 2349 S. Commerce Drive New Berlin, WI 53151. (262) 524 1100. www.schaefer.biz





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CLASSIFIED ADS
Pages 59-60

NEWS PLUGS continued

Standby Generator Terminal Products - American Made to Eliminate Supply Chain Woes

Battery terminals, ignition terminals, and various other connector types manufactured in the USA and offered as a single SKU for OEMs to simplify purchasing and inspection have been introduced by ETCO of Brandon, FL.

ETCO Standby and Portable Generator Terminal Products include top post battery terminals which are lead-free and RoHS compliant, locking ring terminals and serrated rings, ignition and spark plug terminals with high retention clips, and insulated terminals. American made to eliminate supply chain woes, they can be packaged and delivered as a single SKU.

Supplied loose or in strip form for automated processing equipment, most ETCO Standby and Portable Generator Terminal Products have an F-Crimp for a more secure connection than conventional rollover style flag ears and permit faster automated wire processing speeds with less fracturing, better wire deformation and a more distinct bellmouth. ETCO has 74 years of experience.

ETCO Standby and Portable Generator Terminal Products conform to critical specifications: ISO 9001:2015, IATF 16949:2016, ISO/TS 1649:2002, and more.

For more information contact ETCO Incorporated, (800) 689-3826, Email: sdunn@etco.com, www.etco.com.

Electrex Electrical System Solutions Announces Promotions

The Electrex team strives to provide best in class harness design, industry-leading speed to quote & prototype and to deliver high quality product on time, every time. These are our unwavering commitments, and our efforts are always undertaken with serving our Partners while living our values as our primary responsibility.

Honoring God, pursuing excellence and stewarding resources is at the center of our culture and is only possible with consistent individual demonstration of commitment, character, connection, and competence.

It is within that context that I am pleased to announce the following Electrex promotions:

Cody Herrin has consistently led his team towards excellence and done so while serving as an Electrex leadership role model. His contributions to continuous process improvement and team development are numerous and



Cody Herrin
Technical Service Manager

valued. Accordingly, Cody has accepted a promotion to Technical Services Manager, and will have responsibility for the entire Electrex Technical Service operation.



Mark Deiter
Director of Quality

Mark Deiter has significantly advanced the performance of one of the important Customer facing operations within Electrex. Through the diligent application of structured problem solving and process improvement, Mark has turned Technical Services into an Electrex center of excellence. Mark also brings a background that includes a deep knowledge of Quality improvement and has accepted a promotion to Electrex Director of Quality.

Although Customer Service will continue to be first point of contact for our Customers, Mark will lead Customer-specific initiatives.

Please join me in congratulating both men on well-deserved recognition of their accomplishments.



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M & A 101: Lessons learned from decades of deals

Sound Advice

By Loren Smith

Years ago, when I was debating whether to leave a secure and promising position with a high-tech company to acquire a small (under \$1M) wire harness company, I was fortunate to receive invaluable advice from a highly respected mentor. He told me, “If you do decide to become an owner, determine the aspect of running your business you love, focus your time and energy on that function, and identify individuals either internally or externally to perform the other aspects of running your business.”

That straightforward advice turned out to be critical to the success I achieved over the 25 years I owned my harness company--MWC. Sure enough, I determined early

on that many aspects of day-to-day management did not appeal to me. I did not like the daily grind of running a factory, and I did not care for the minutiae associated with engineering or purchasing or accounting. Fortunately, from the outset I found folks who excelled at those functions. (And over time, as the business grew and the demands of those functions changed, I was fortunate to continue to find skillful individuals to perform in those capacities.)

What I thrived on, from the very beginning, was dealing with our wire harness customers. Never tiring of those interactions, I continued to perform that function throughout our 25 years of growth. Of course, this does not mean I ignored all of the other functions necessary to operate a business. By closely monitoring key

indicators, I was able to stay abreast of day-to-day activities while concentrating on what gave me greatest satisfaction and where I could provide most value.

The business model I came to adopt focused on a limited number of large accounts--mainly major construction equipment manufacturers. Those individuals appreciated dealing with a business owner, and by closely aligning myself with all levels of their organizations, I was able to understand their needs and translate those priorities to my team. This framework enabled us to set and meet goals that exceeded our customers’ expectations.

When one of our major customers decided to single out a “supplier of the year,” we were chosen as the initial recipient of the award--and later, we became the only supplier so honored twice. Although our team’s consistently high performance justified the recognition, I have to believe there were many other outstanding suppliers who could have won. What I also believe is that my close relationship with this customer--a relationship I deeply enjoyed cultivating--had some bearing on the decision.

Having now had the opportunity



Loren Smith CEO
Blue Valley Capital

to observe the management of a multitude of harness companies, I am struck by the correlation between owners who spread their attention too thin and limitations in their companies’ ability to grow beyond a certain level. So whenever appropriate, I pass on to those owners the same sage advice I was given many years ago.

Loren Smith can be reached at lms@blvcapital.com or www.bluevalleycapital.com.

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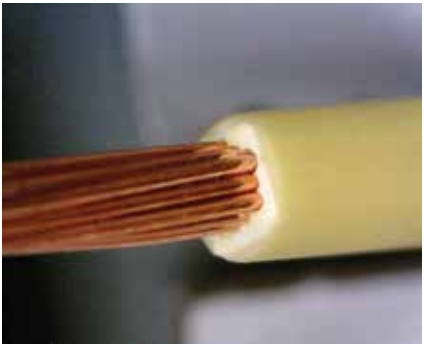
By John Belovrac
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Every customer wants to know how their products are measuring up to some standard, whether it is our own Mecal guide to quality crimping, IPC-620, Volkswagen 63033, USCAR 21 or something else. As a customer of Mecal, you have the option to either follow our standard, or supply us with the standard you would like us to follow and we will do our best. So, lets unpack the Mecal standard and explain in detail what it is saying. It is broken into two sections, unacceptable and acceptable. The values

are put into pictures for easier understanding. Most of the information is widely accepted by others as being the best working conditions. This is not revolutionary information, but good guidelines that unless taught, may not be instinctually understood or recognized. It is simplified and may be best directed toward entry level personnel.

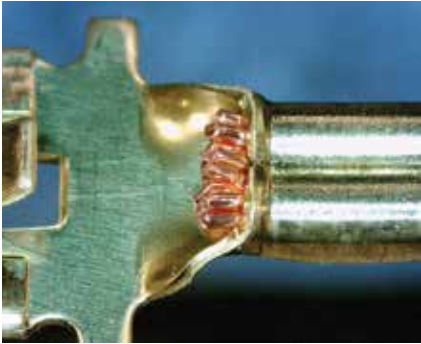
Wire preparation:
This can have a significant effect on the quality of the crimp. If you are preparing by hand, you must use a high-quality pair of cutters to cut the wire cleanly and squarely. They must not be allowed to crush the wire strands at the tips or leave a burr

from not cutting smoothly. The wire must also be held as close to a 90-degree angle to the cutters as possible. If this is not square, then the measurement of the stripping length and overlay or brush (measured distance from the end of the crimp to the end of the wire) is hard to establish. Keep your cutting tools sharp.



Assuming you are stripping with a bench top stripper, it is important to get the proper “stripping diameter”. 7 and 19 stranded wire are in a nice round bundle and you can get the square cut of the blades to come as close to the strands as possible and cut clean. Other wire configurations may not be as round (more egg shaped) and the blades will come closer to some of the strands than others. If they’re too close they will damage some of the strands. If they’re too far away you will need to pull more uncut insulation to remove the slug. Understanding that you have cut into a square shape around a round bundle of wire, what is not cut cleanly must be pulled or ripped apart to remove the slug. Most insulation types rip apart easily, but some do not and can either tear, stretch or leave pieces of trash insulation behind, which are all unacceptable. On the acceptable side would be a good square cut of the wire strands with a clean cut of the insulation at the precise length required by either the terminal manufacturer or by comparing to the terminal itself to insure a proper overlay or brush ahead of the crimp and the insulation cut pres-

ent between the wire and insulation crimp window (more on this later).



There is a set of grippers that hold the wire while the cutting and pulling of the slug. The tension on these grippers can be adjusted and can also cause damage to the insulation. Caution must be taken to not grip the wire too tight.

A solution to the difficult insulation type is a higher quality rotary stripper that take the same V blades and spin them around the wire cutting much cleaner.

Insulation crimping:
ICH (Insulation Crimp Height), ICW (Insulation Crimp Width). For our conversations pertaining to terminal position from here on, let us consider the end of the terminal that is the connector portion as being the front, and the end that is the crimping areas as being the rear.

There are 4 basic insulation crimping shapes. The F crimp (looks like a sideways B, or a heart) is the most prominent. Also is the bypass, where the two wings are tapered and create a round shape with one wing toward the front and the other toward the rear. Next is a round shape that is used more for around a seal and usually ends up measuring the same height and width. Finally, is an overlap crimp where one wing is under the other. Overlap is not the same as round. The name F crimp also pertains to the wire crimp.

There are many opinions on what a proper insulation crimp looks like,

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and most standards are a little vague on this topic. Most only offer what is unacceptable and beyond that is up to you. It is important to not lose focus on the intent of the crimp. Which is to hold the wire from moving around- left and right, up and down, vibrating, all allowing the wire strands to start rubbing in the bell mouth area and possibly causing wear and breakage.

Some of the unacceptable conditions are as follows:

- Piercing the insulation: This is critical and special attention needs to be paid as this issue can arise often. As the crimp is made and the wings are forming down against the insulation, it should not be so tight that it forces the wings into the insulation and splitting it open.
- Most terminals are made for a specific range of insulation size, and when you are out of that range, you can see problems, like the wings piercing the sides of the insulation (too large of insulation diameter) or the wings having to curl under themselves (insulation too small of diameter), this still being an acceptable crimp.
- Some standards have a minimum amount of contact, like 270 degrees around the insulation. Obviously one wire size would be optimal and with the right insulation crimp size, 270 degrees minimum is easily reached. Change your insulation diameter and this amount of contact can change to be an unacceptable condition.
- When determining a good insulation crimp, I teach to always continue to decrease the ICH until you have gone too far. It should become obvious when you get there, then you can increase a bit to arrive at the acceptable range.

Wire crimping:

CCH (Core Crimp Height), CCW _____ Continued on page 54

(Core Crimp Width).

- This is the heart of the matter. This is the mechanical and electrical connection of the wire to the terminal. The correct CCH and CCW are essential to achieve the proper compression ratio and pull force, which are the two main parameters to understand (more on this in checks and evaluations). Properly designed and maintained crimping tools are necessary to meet all the different parameters of any standard you choose to



- use.
- To back up to a comment made earlier, the position of the wire relative to the terminal can change the appearance of the overall crimp without changing any other adjustment. Therefore, high-quality wire stripping is essential. To simply see the insulation cut somewhere between the wire and insulation wings may not be enough, but it must be in a place and be maintained at this place. Same for the brush (overlay) which you may need to ensure is in a precise location, regardless of the tolerance.
 - Symmetry is probably the most significant sign of proper applicator adjustment. It is directly related to the centerline of the terminal wings and the centerline of the crimping tools. If the two are not in alignment to one another, then one wing will curl into the strands longer than the other. The adjustment would be to move

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Quality Assurance

Continued from page 53

the long curl of the terminal wings closer to the centerline of the crimping tools. Symmetry is one of the hardest specifications to measure or see. You need specific cross sectioning equipment to see the symmetry. What is not acceptable is one wing curling so far that it is colliding with the bottom or the side of the terminal.

- Another unacceptable condition is not having the wings contact each other at the top. This is a clear indication that the wire section is too large for the terminal.
- Gaps around the strands is another unacceptable condition. When looking for gaps,



you must make sure your cross-section cut is not through one of the serrations in the terminal. Gaps around the strands would indicate you have not reached the optimum CCH yet.

Checks and evaluations:

- Compression ratio of the strands is measured by cross section equipment and is the difference between the area of all the strands added together in the loose state, to the area of the strands after crimping. The Mecal standard has the compression at 17% to 24% reduction in size. Tighter is not always better.
- Pull test is probably the most common method of detecting a proper crimp. Although achieving an acceptable pull test value is a good thing, it does not measure any of the other parameters needed to make a good crimp. Therefore, if you get a bad pull test, you need to dig deeper into the crimping shape (with cross sectioning equipment) to determine what is wrong in order to make the proper correction.
- Compression ratio vs. pull test.



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John M. Belovarac, Sr.

May 5, 1957 - February 16, 2021

John M. Belovarac, Sr., passed away recently after a bravely fought battle with cancer. After graduating high school, he joined Sarn Tool in Meadville as a toolmaker. John was good at what he did, and as the company grew, so did John's role. In 2007, an opportunity arose to partner with a company in Italy, and John was chosen to lead this new endeavor known as Mecal by Sarn.

As Operations Manager and Lead Engineer, John became one of the best technical leaders in the Wire Crimping Industry, teaching multiple industry specific courses and writing numerous articles that were read worldwide. Hundreds of visitors worldwide have come to Meadville to be a part of classes taught by John regarding the finer art of crimping. There is no denying that he impacted the lives of many during his time as a leader in the industry. "The Sarn Family of Companies, and untold numbers of people around the world, are proud to call John Belovarac a friend. He will be sorely missed, and not soon forgotten," mentioned Bill Sarn.

When he wasn't working, John was an avid motorcyclist, and managed to channel his passion into charitable endeavors. As a member of the Christian Motorcyclists Associa-



John Belovarac, Sr.

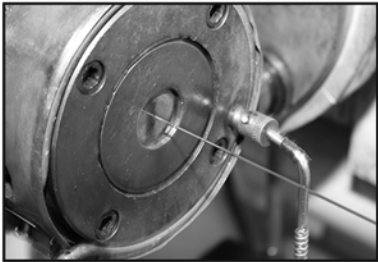
tion, he and his chapter enjoyed serving the Kitchen Ministry at Erie City Mission. He also participated in many rides and events for a variety of charitable causes.

We at WHN were very saddened to hear the news, yet very thankful to have this article as a tribute to John. He contributed a lot to WHN and was a treasure trove of knowledge to the industry—treasures he shared frequently. But most importantly, John was an all-around great guy. Our thoughts and prayers go out to his family and to the folks at Mecal by Sarn.

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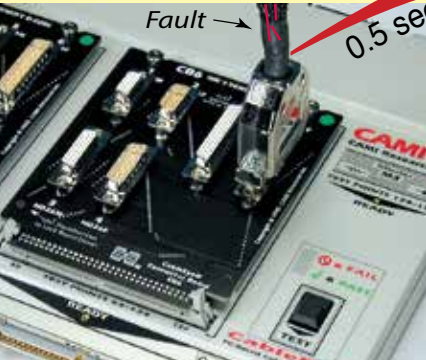
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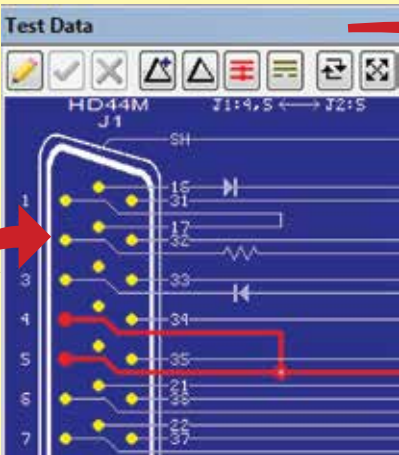
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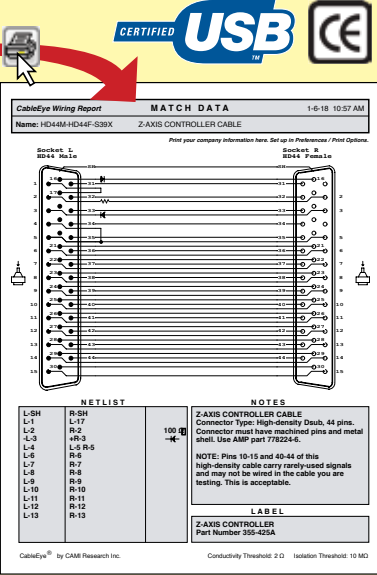
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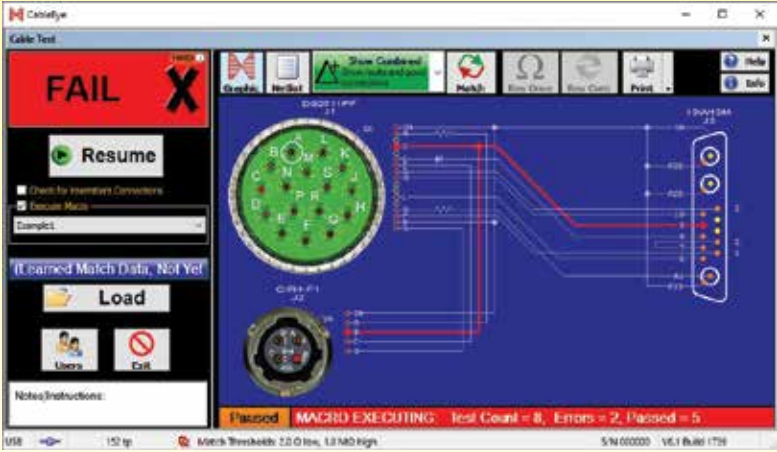
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NEWS PLUGS continued



Expanded Category 5e and Category 6 Punch Down Modular Plug Offering

Stewart Connector, a Bel group company has announced the extension of their RJ45 Punch Down Plug line to now include Category 5e and Category 6 unshielded options.



RJ45 Punch Down Plugs

Stewart Connector's RJ45 punch down plugs are time-saving solutions for Ethernet connections that require field terminations. The easy to use, color-coded pre-load wire manager provides an efficient termination without the need of tools. RJ45 punch down plugs can be used for solid or stranded 23-26 AWG cable with a diameter over the conductor insulation up to 1.6mm (0.063in) and accepts an overall cable OD of 4mm (0.157in) to 6 mm (0.236in). These con-

nectors feature contacts with 50 micro inches of gold plating for increased cycle life. The Category 5e plugs support up to 2.5GBASE-T Ethernet and the Category 6 punch down plugs are suitable for use in up to 5GBASE-T networks. Termination instructions are provided in all plug kits.

Summary: Part number: SS-39300-013, SS-39300-014

Applications: Data, Telecom,
Wireless, PoE Applications and
Industrial Control Connections

Distribution availability: Digi-Key, Mouser, Newark and Heilind

Datasheets: RJ45 Punch
Down Plugs

Stewart Connector is a Bel group company (NASDAQ: BELFA and BELFB). Bel designs, manufactures and markets a broad array of products that include circuit protection, connectors, cable assemblies, discrete components, magnetics and power supplies.

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WHMA Announces the Launch of Quarterly Webinar Series

By Christine Siebert

WHMA is excited to announce the launch of the quarterly webinar series designed to educate both WHMA membership and non-members and to share information on different topics of the wire harness industry. The series started on April 6th with a webinar entitled Over Four Decades of Wire Harness Industry Insight presented by Loren Smith, Blue Valley Capital.

This very interactive, complimentary webinar answered many questions about the wire and cable industry. Such as:

- Do you want to know how the wire harness industry has fared during the Pandemic?
- What has changed over the past four decades?
- How the industry competes with China and Mexico?

Future webinars will include many different topics such as:

1. Economic Data/Reports
2. Outsourcing Trends
3. Fiber Optic assemblies
4. Automotive and Aerospace harness trends

5. Job Training
6. Wire Harness Design
7. Wire Harness Manufacturing Process
8. Overview of member companies
9. More...

Our next webinar will be held in June and the subject will be on the new Wire Harness Operators (WHO) Program. This webinar will consist of a panel of users that participated in the Beta version. They will give their testimonials on their experience with this new training program. There will be a live Q & A session at the end of the webinar. Keep check-

ing the WHMA website for updates. www.whma.org

All webinars will be recorded and placed on the WHMA Member's Only page for viewing. If you're interested in becoming a WHMA member, please email Norm Sagon at norm-sagon@ipc.org.



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- Enjoy a complimentary listing on the **IPC Global Marketplace**
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- Benefit from the advocacy work done by **IPC Global Government Relations** as they proactively engage policymakers in the United States, Europe and Asia to adopt policies that strengthen the talent pool, bolster the value chain, and right-size regulations to spur greater technological innovation and economic growth.

“ **WHMA membership has provided our company the opportunity to share ideas, discuss challenges and innovate through networking opportunities. We have built relationships with colleagues, competitors, and industry specialists. Those relationships have been invaluable to our organization.** ”

Jason Zoubek, Absolute Quality Mfg., Inc.

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For more information, contact [Norm Sagon](#), WHMA/IPC sales representative.

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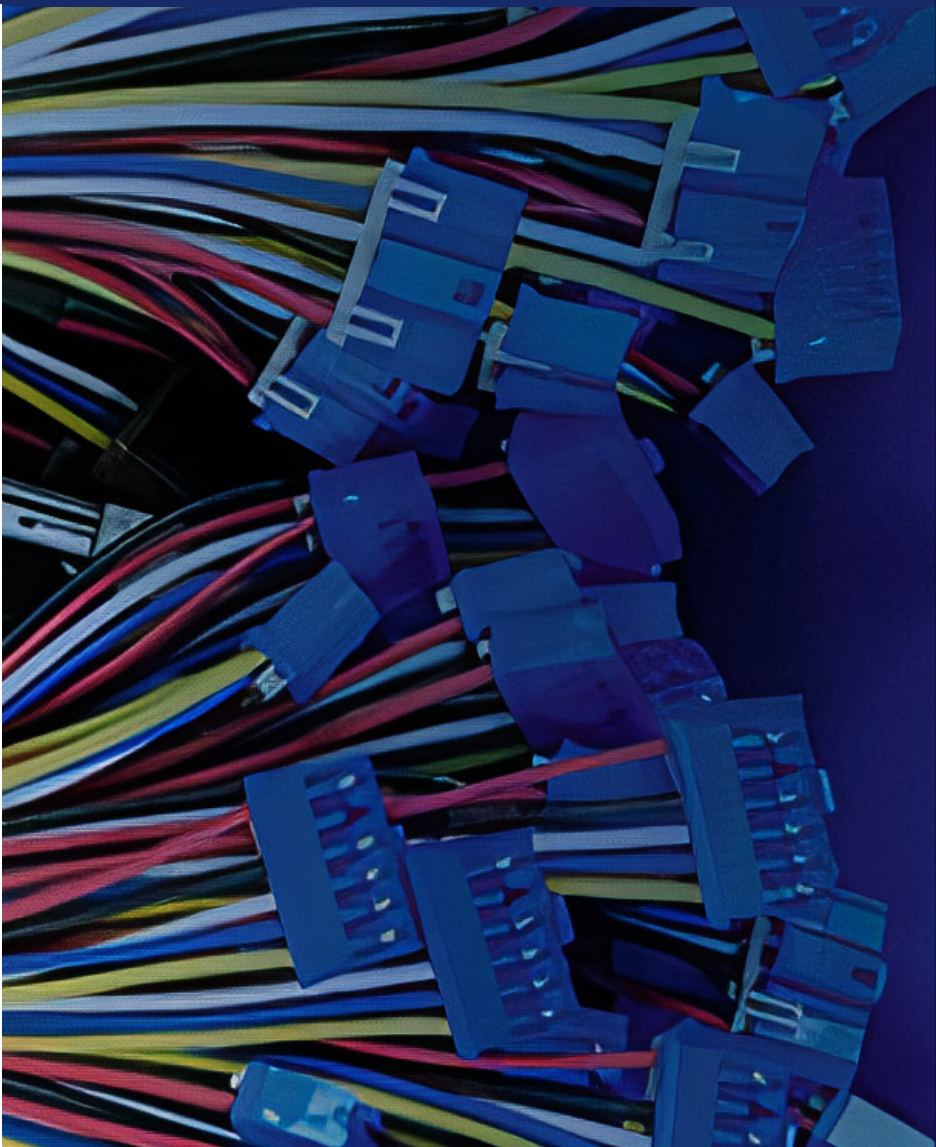
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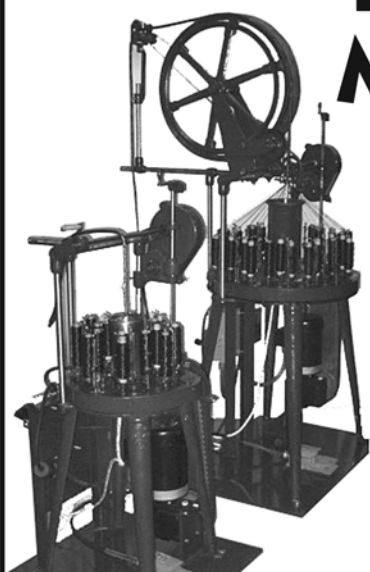
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- Write detailed work instructions, including charts and/or pictures when possible.
- Work with Engineering, Production and Quality Managers.
- Solve problems with customer cable designs.

Must meet ALL Requirements:

- **NO EXCEPTIONS** - 5 years **minimum** wire cable and harness manufacturing assembly experience performing **ALL** job responsibilities listed above.
- Work with limited supervision.
- Knowledgeable in the use of hand tools, wire strippers, crimping applicators.
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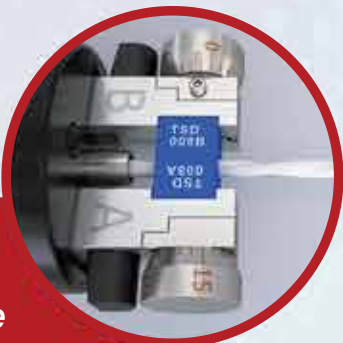




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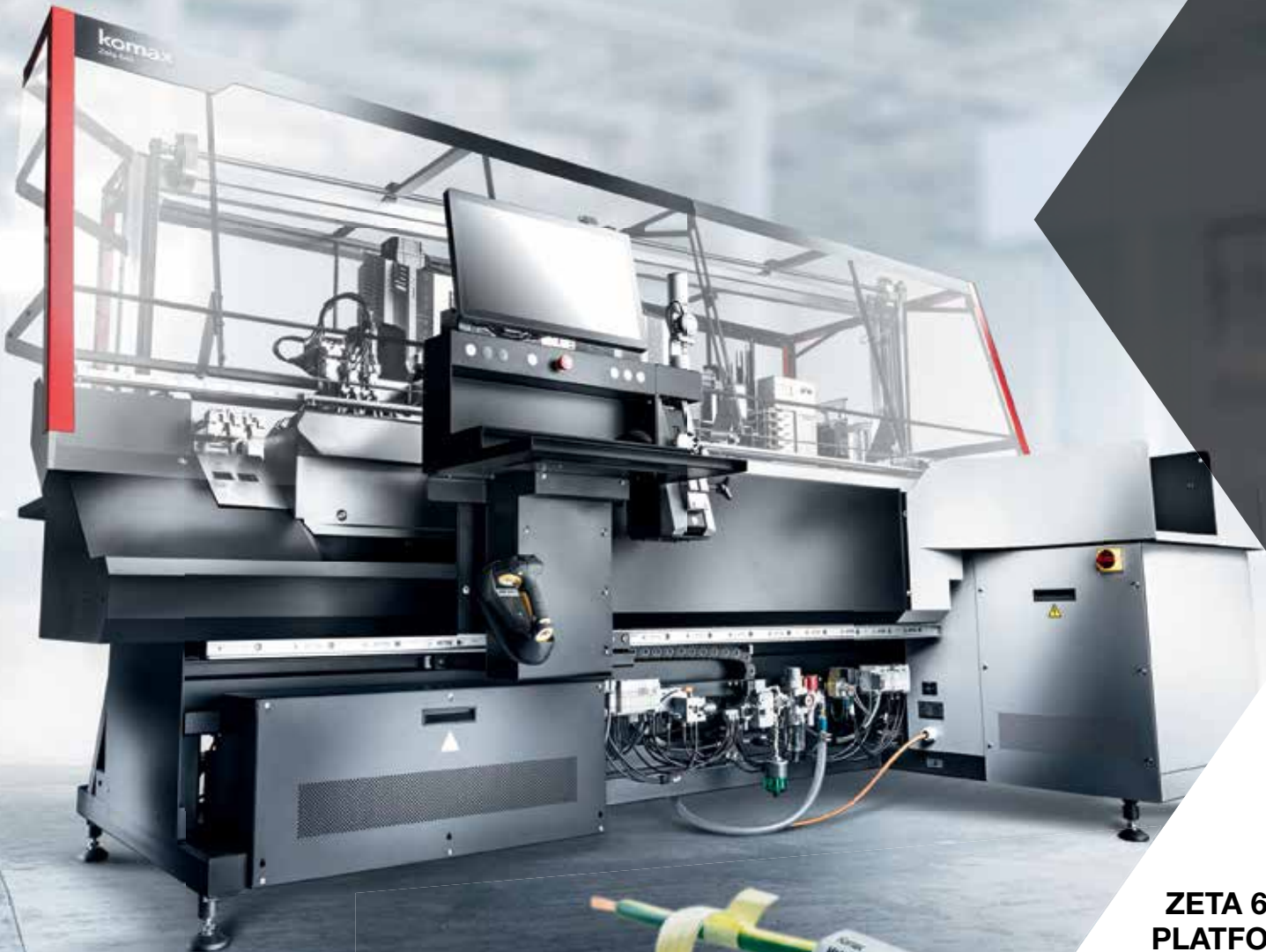
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