

This Issue Features:

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- Are You Still Building Birdhouses?
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- Expanding Ultrasonic Applications in EV's
- UV Laser Marking of Wire Insulation Materials
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Company Profile: MNSTAR

By Joe Tito
 Wiring Harness News

I think we are pretty lucky in this industry. Beyond just the profit motivation, we all seem to be genuinely enamored with cutting, stripping, crimping, testing, and designing of wire harnesses and cable assemblies. It seems to captivate us in a very positive way. Get a few of us in a room and you'll see. Maybe we're all just crazy. If the latter is the case, then it's contagious, and George Klus has it.

I came across George's name through longtime acquaintance Norm Sagon at the WHMA conference in February. Norm came up to me and said he just started representing a company, and I really needed to talk to the owner. I'm glad he did, because George has a slightly different story than we're used to reading

on these pages. You see, George spent much of his professional career in the healthcare industry. He purchased MNSTAR, a harness manufacturing company in northern Minnesota, about 18 months ago. In a recent conference call, along with Tammy Wersal, Vice President of Operations at MNSTAR, we discussed what led George to purchase the company. We then pivoted to some specifics on MNSTAR.

"My background is all healthcare," George informed. "I did that as an executive and then as an entrepreneur owning my own business as a provider to the industry for 20 years." After selling his business, he began consulting with people who were looking for a business venture, or just searching for their next opportunity. "I discovered there were a lot of people with a lot of experience in manufacturing who were looking



Complex assembly work at MNSTAR.

for their next gig. When I listened to these folks talk, I became inspired by how excited they were about manufacturing," he told.

George became determined to harness his own energy and resources, along with these folks who were mostly in their 60's. "I decided I would go out with some of them and start looking for manufacturing companies that I could purchase," he

said. "I could then bring in these folks with their years of experience."

And so, about 24 months ago, George started looking at companies in various sectors of manufacturing. He made offers on several but ended up buying a harness business. "I have fallen in love with wire harnesses," George exclaimed. "I'm fascinated by

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Expanding Ultrasonic Applications in EV's

By Saeed Mogadam
 Telsonic Solutions



Sources of applications for ultrasonic welding - TELSOCAR.

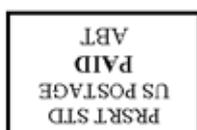
Electromobility is now regarded as the key to climate-friendly driving practices because electric vehicles generate significantly less carbon dioxide per kilometer than vehicles with conventional combustion engines - especially in combination with electricity generated from renewable sources. At the same time, the energy storage systems used by electric vehicles can compensate for fluctuations in the electricity grid by means of wind and solar power, thereby supporting the expansion and market integration of these energy sources.

This presents new challenges for the automotive industry. These new challenges need to be addressed in an innovative manner. This also applies to the manufacturing technologies that are required for all aspects of electromobility, from lightweight body construction to the electrical

and electronic components and battery production. Processes that use ultrasonics open interesting possibilities about quality and from an economic and ecological point of view. Ultrasonic-based processes and electric vehicles have much in common: Efficiency, performance capability, reliability, connectivity, and eco-friendliness are among the essential characteristics that they both possess.

The objective of this article is to introduce some of the breakthroughs in the automotive wire harness and battery manufacturing for both internal combustion engine vehicles and EV. The TELSOCAR image defines challenging applications with solutions that have now been implemented in manufacturing of high voltage terminations and batteries. We highlight metal welding applications of Telsonic's PowerWheel® and SONIQTWIST® technology in this edition as a general introduction with more joining applications to be introduced later in future articles.

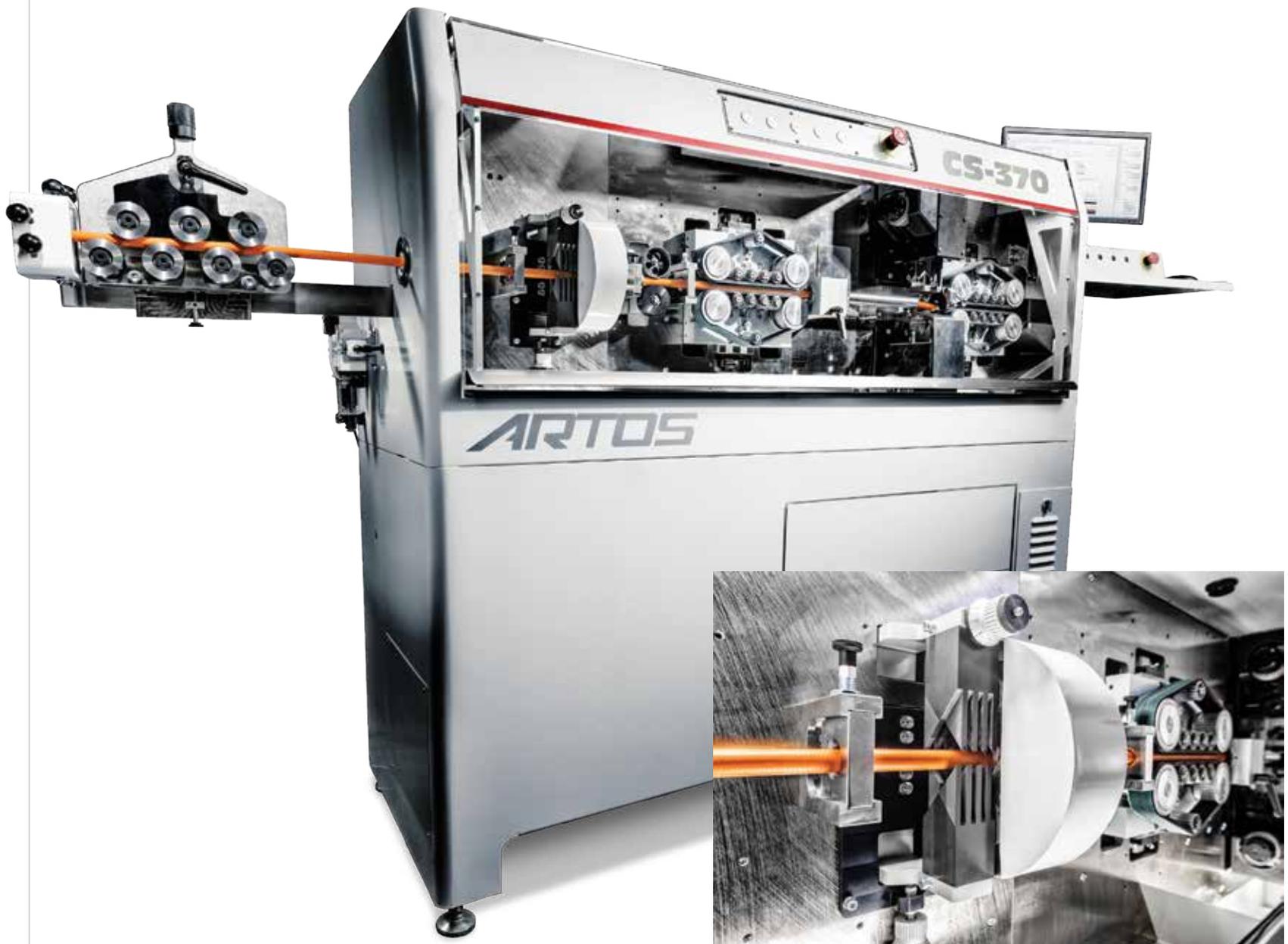
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WHMA - Wired In 60
WHMA/IPC is excited to announce that they will produce the M-EXPO Wire Processing Technology Expo in 2022 in Juarez Mexico. Read the full details here.



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From the Editor

Since 2009, the kickoff of spring for me has been my attendance at the EWPT Expo in Milwaukee. Although I've seen snow on the fledgling daffodils once or twice, it's always an exciting and refreshing time. The familiar faces and emerging technologies have provided a plethora of material for us to cover on these pages. This show is key in helping us provide important content and opportunities for you, our readers. I can imagine how tough it has been on you folks not having face-to-face interaction with suppliers and peers.

But it's 2022, and we've all made our arrangements to exhibit at the show, May 10th - 12th, at the Milwaukee Center. I can't tell you how excited we are. There are some incredible workshops and seminars planned for all three days, with exhibits open Wednesday and Thursday. And of course, all the wonderful food, drink and entertainment. Search EWPT Expo for more information and a full conference schedule.

This issue deals a lot with supply chain difficulties, and I'm sure that will be a large part of discussions at the show. I think you'll find the articles here provide an interesting roadmap through some of the issues we are all facing.

Feel free to let us know some of the issues you are experiencing by contacting me directly. We enjoy researching with our advertiser partners to help you build strategies to grow your business. Alternatively, stop by and see us at booth 1225. We would love to hear your suggestions for the publication and learn about the subjects you would like us to cover in future issues.

Keep plugging away!




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LEADERSHIP

PUTTING INSIGHTS INTO ACTION

Rubbing Two Sticks Together to Make a Fire

By Paul Hogendoorn

It's tough starting a business. Its not for the faint of heart. The first challenge is the biggest - getting it started - but then keeping it going, and then growing it, becomes an ongoing, relentless challenge that only occasionally lets up for momentary reprieves before new challenges present themselves.

Outdoor season is upon us once again, after a long-drawn-out winter made even more dreary by the restrictions and persistent messages of worry and concern. But with the nicer weather, comes outdoor times, recreation, adventures, and campfires. The first campfire of the season brings new life to my soul.

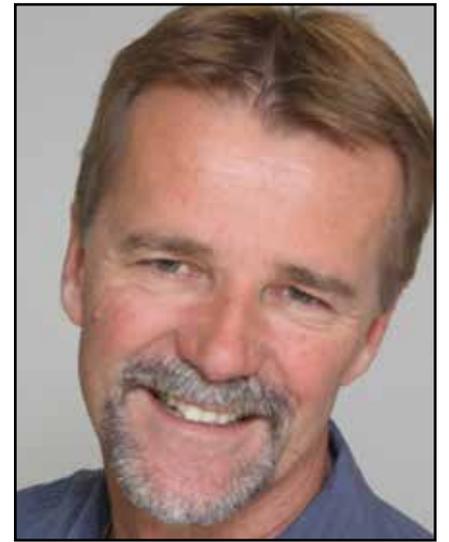
It got me thinking about the many small businesses I've visited over my career, most of them manufacturers, and in the last 10 years, most of them were small companies - sometimes a one plant, one shift operation, sometimes a multi-plant, multi-shift operation. Some are family owned, some were family owned and are now owned by investors, and some have been owned by founding families for generations. Almost all of them though were started by an individual with an idea to do something different, or to do it in a different way, or to do it for themselves. These, in my

mind, are the campfire starters, the people that collect a little bit of dry kindling, squat on their haunches and patiently and persistently rub two sticks together until they make fire. The fire warms not just them, but many people, offering protection for them, and a heat source for the preparation of their food. The small companies that the founders started, mostly armed only with an idea, a belief in their ability, and an unquenchable desire to see it done, end up benefiting many families, sometimes for generations. These are the campfire builders of our society, the true entrepreneurs - people that create something from nothing for the economic benefit of many.

Sometimes the entrepreneur is an individual, but in most cases, the entrepreneur had early help; someone to fetch more twigs, people to chop down trees and split wood, and someone to find and lay stones around the early flames. Such was the case in my case; I had the privilege of starting a couple companies with people eager to see what we could build together and willing to do whatever was needed to be done to get those fires started. And once started, they grew nicely - warming, protecting, and feeding many, many people, creating an estimated 2500 years of employment and \$125M of salaries and wages, plus about a quarter of a

billion dollars in commerce. Not bad for a few folks rubbing two sticks together hoping to make fire! Over that span of 40 years, a lot of homes were purchased and college kid's tuitions paid for, and hopefully a few more campfire builders setting out to pursue their dreams and see what they can start.

Springtime is also the beginning of tradeshow season - a time when industry comes out of their winter shell. One of my favourites has always been the EWPTE event in Milwaukee in May. That show, and indeed the whole industry, is filled with many companies that were started the same way and continue in one form or another to this day. They were not only started by people with passion, commitment, and pride, they continue to be operated by similarly minded people that understand the importance of what they are doing and the impact their organizations make in people's lives. Sure, they make great products, and sure, they make money for their owners, but they've done far more than that - they've built an industry, and they helped people look after themselves, their families, and others. I loved exhibiting at the show and being able to talk with people outside of their individual plants. Yes, they were there to look at new technologies and ideas, but they were also there to meet others in their industry



Paul Hogendoorn

that they have so much in common with. They all seem to be familiar with their company's roots, and at this show, for 2 or 3 days, they revel in it, celebrate it, share it, and seem to motivate each other to ensure it continues for the next generation to benefit from.

When I look at all the great companies in this industry (some are customers, some are 'not yet customers', and some are even competitors), its easy for me to see that a few small campfires can go a long way! And in this industry, indeed they have.

Celebrate your campfire builders, and if you're not one of the people actually rubbing two sticks together to try to make a fire, be one of the people that collects twigs, chops and splits wood, and helps build it.

Enjoy the season folks - and enjoy this year's EWPTE!

Paul Hogendoorn can be reached at Hogendoorn.paul@gmail.com or [linkedin.com/in/paulhogendoorn/](https://www.linkedin.com/in/paulhogendoorn/)

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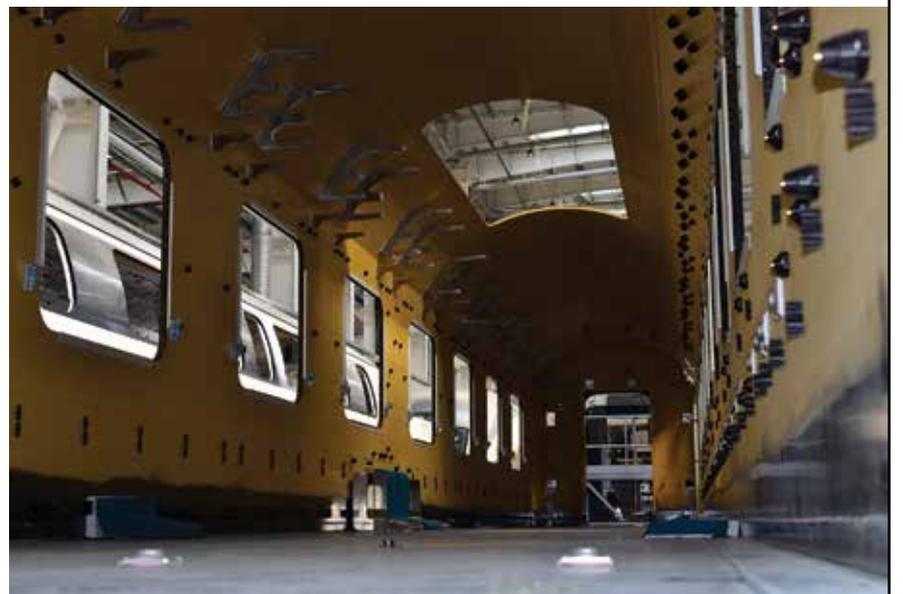
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Supply Chain Nightmare

By Loren Smith

Now into our third year of the pandemic, we would think the harness component supply chain challenge would have been resolved. Not so. Severe parts shortages continue to cause constant schedule disruptions for harness makers, resulting in daily expediting and non-stop shuffling of customer schedules to avoid putting customer production lines down.

Exacerbating the nightmare, component suppliers are raising prices--with no notice or justification.

So, we could lick our wounds and console ourselves with the knowledge that supply chain issues have been creating chaos in countless industries, but our industry often confronts an additional hurdle: When harness customers dictate component sources for harness makers, the leverage that normally exists in customer/supplier relationships dissolves because many component suppliers do not treat harness makers with the respect normally found in customer/supplier relationships.

I learned this years ago as a new entrant into the wire harness community. When a salesperson from

Packard Electric (now Delphi Packard Electric Systems) first called on me, he read me his company's rulebook. In detail. I was flabbergasted at the "power imbalance." And here I thought I was the customer.

Over the years that I owned and ran a harness company, my depth of experience did not make much of a dent in this lack of leverage. I still bear a scar from the disaster when my customer, a sizable construction equipment manufacturer, specified a major connector supplier that then failed to deliver product. But this deeply flawed business model might be about to change.

Like many changes the pandemic has accelerated, wire harness manufacturers are now often provided sourcing authority for the components that go into the wire harnesses they produce. As this stride grows, it will gradually eliminate the frustration of having to tolerate a supplier with chronic delivery issues and unsupported price increases.



Loren Smith CEO
Blue Valley Capital

This shift is not widespread yet, and the supply chain nightmare is still suffering the consequences of the pandemic, but brighter days appear to be on the horizon. Meanwhile, know that you have many peers who feel your pain.

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



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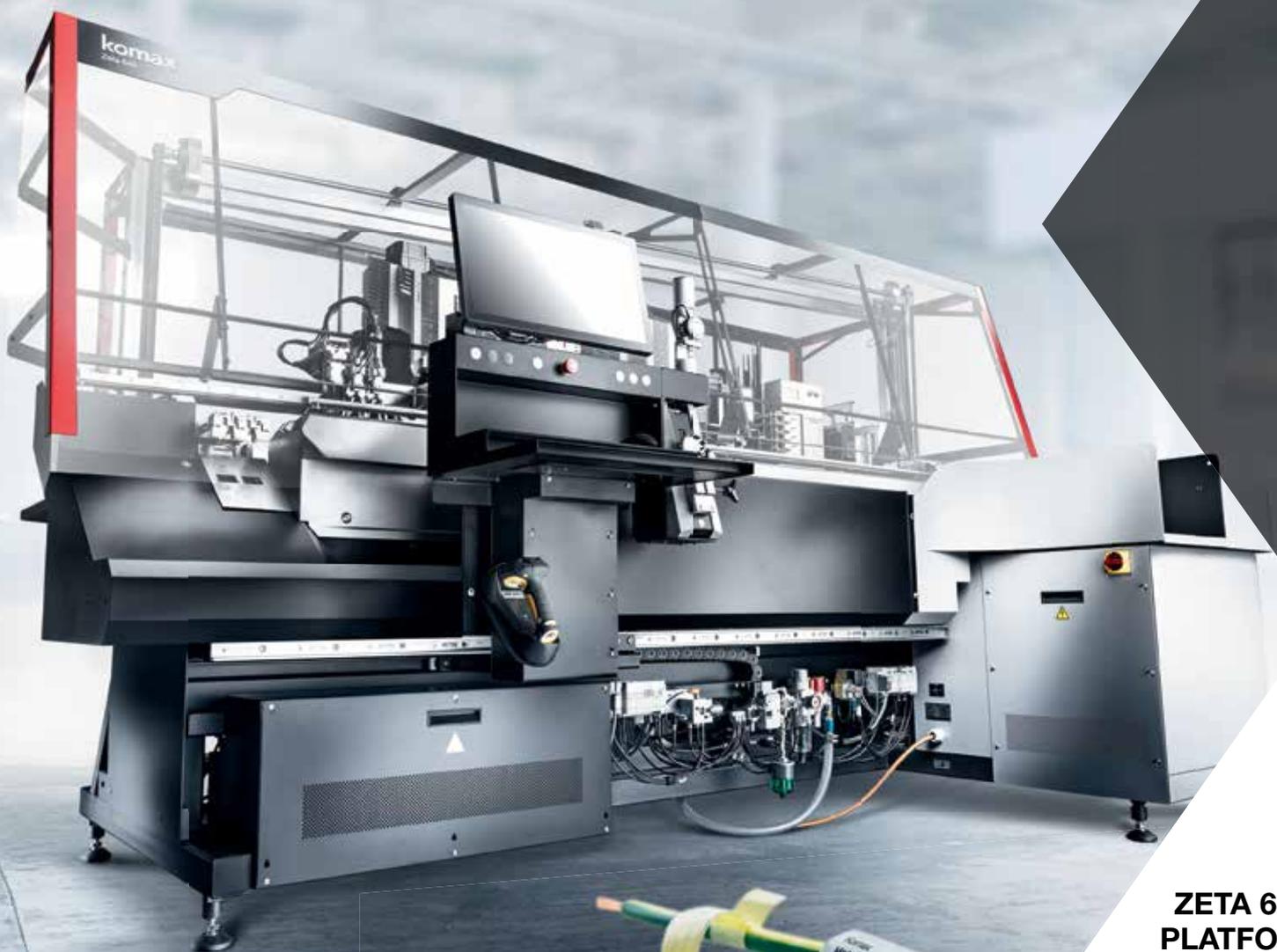
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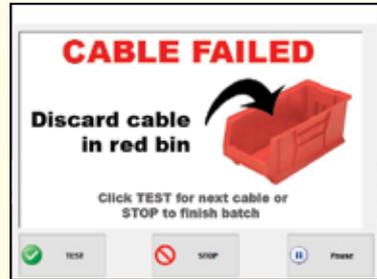
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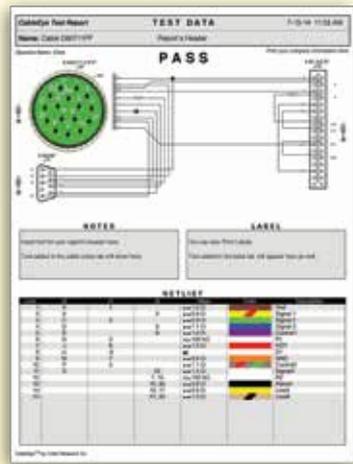
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5	5	5	100	±0.1	Black	5	Control Line
6	6	6	100	±0.1	White	6	Control Line
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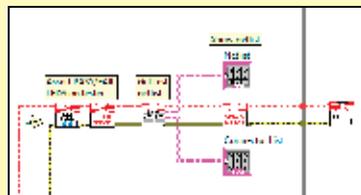


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UV Laser Marking of Wire Insulation Materials

By Igor Murokh, Ph.D.
Tri-Star Technologies

According to the IOP Handbook of Laser Technology, in 1999 approximately 22,000 laser marking machines were in use in various industries worldwide. Hexa Research expects overall laser market to reach \$3bln USD in 2024. It seems quite possible that in a few years everything that needs to be marked will be marked with lasers including fruits and vegetables and most definitely wires and cables.

This article describes the basic principles of UV laser marking of wires and cables for aerospace industry and its applicability to other markets.

Direct printing on wires and cables with Ultra-violet (UV) lasers has been extensively tested and accepted within the aerospace industry both by OEMs and by the end users. It is covered by several documents and standards issued by SAE International (<http://www.sae.org/> AIR5558, AIR5468B, AS5649) and reflected in the production specification of large and small frame aircrafts for commercial, industrial, and military use. The OEM list includes Boeing, Airbus, Lockheed Martin, Sikorsky, Gulfstream, Bombardier, Pilatus, and many others. It is also used by governmen-

tal agencies such as DOD, NASA, FAA, etc. End users employ UV laser marking machines during scheduled maintenance and repair procedures.

UV lasers leave a permanent indelible high-resolution mark on the substrate surface. To understand the phenomenon, we must consider how a laser beam interacts with material. For example, the beam can be completely reflected from a surface, as a sun ray from a mirror, or propagate unaffected, as a sun ray through clear glass window. In these cases, no trace will be left on a surface. To mark a material, at least part of the laser radiation must be absorbed directly on or near the material's surface.

Depending on laser and material properties there are a few possible scenarios (Fig.1, page 12):

A. *Ablation*. The irradiated material evaporates, leaving relatively sharp border trenches on the surface.

B. *Melting*. The irradiated material melts and spills from the inside out, creating hills and valleys in the middle of a plain.

C. *Burning*. The irradiated material heats up and produces gaseous components that react with atmospheric oxygen, depositing a product of combustion (such as soot) on the surface.

D. *Color change*. The material

Continued on page 12

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UV Laser Marking of Wire Insulation Materials

Continued from page 10

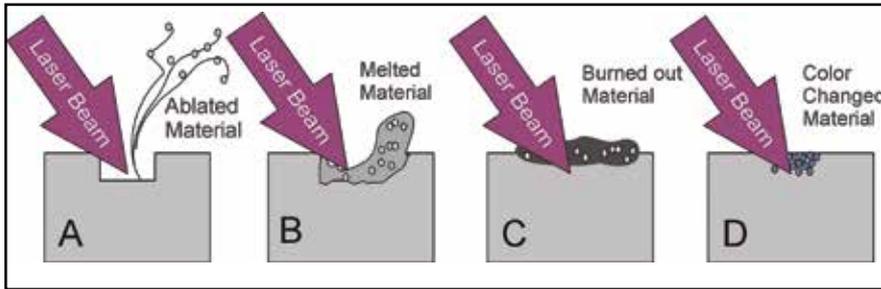


Figure 1. Laser-Surface Interactions.

changes color without any other visible surface modifications.

E. All of the above.

Ablation is the cleanest way to alter the surface but provides low marking contrast because the affected area does not change color. Making deeper and wider marks improves legibility but reduces material integrity that is clearly unacceptable for aerospace applications. One possibility is applying additional layer of wire insulation and then selectively removing it exposing the undercoat of a different color, but this does not look very practical either.

Melting and burning marking pro-

cesses are subject to long-term durability problems because the melted material and burned-out deposit may not stick well to the unaffected area. That resembles a 21st century hot stamping technique. Of course, this version is more advanced, flexible, and precise but it is still hot stamping with all its well-known deficiencies.

Color change can be an excellent solution under the conditions that it does not alter the material properties, provides sufficient contrast, good durability, and long-term stability. UV laser marking of aerospace wires and cables satisfies all these requirements.

Fig.2 shows ETFE, and PTFE insu-

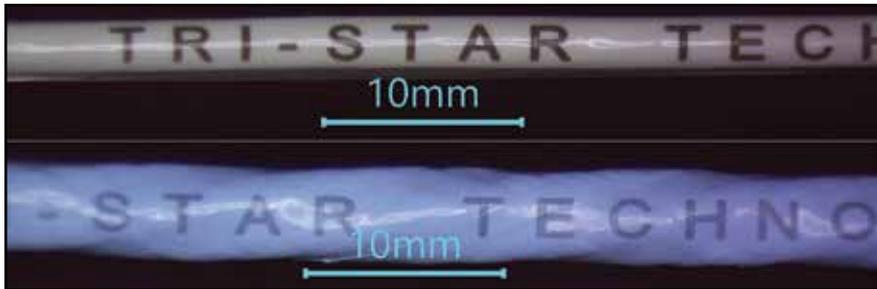


Figure 2. UV laser marking on ETFE (top) and PTFE (bottom) wires.

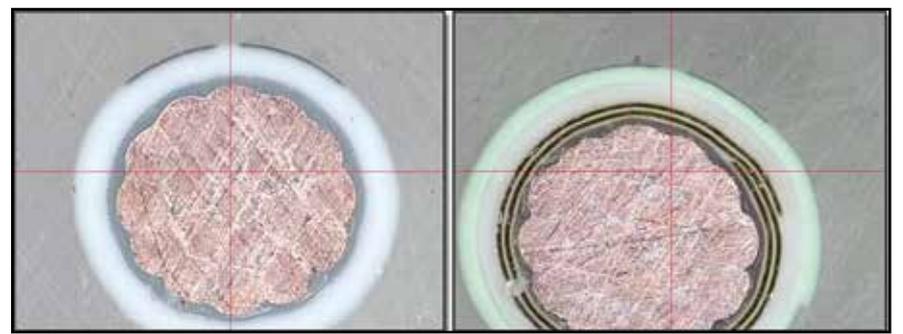


Figure 3. Marked wire cross sections for BMS13-48T10C01G022 (left) and BMS13-60T44C01G022 (right).

lated wires processed with Tri-Star Technologies M-100L-FG wire marking system. Well defined, legible prints stay intact even after extensive accelerated thermal aging.

Marking cross sections (Fig.3) confirm that darkening zone extends 10-20um under the surface ensuring that marking cannot be altered or removed without physically destroying the top layer of the insulation.

The question is how a light-colored polymer surface turns dark under laser exposure without burning or melting. The answer is magic substance called Titanium Dioxide (TiO2). Luckily enough, this is a commonly used pigment that wire manufacturers use to make insulation look white or otherwise light-colored, such as gray, blue, green, yellow, pink, etc.

An optical band gap around 3.1 electron volts accounts for TiO2's intense absorption of UV radiation with wavelengths shorter than 380 nanometers. Irradiation with a UV laser permanently turns TiO2 particles from white to blue/black. The same effect occurs when those particles are embedded into a substrate. Ideally, laser radiation does not react with the base material and passes freely through the substrate surface. In contrast, the pigment particles within the substrate interact with the laser

beam that modifies the particles' structure and appearance, including color. For example, thin PTFE films are practically transparent to the UV light while small (~0.3u) TiO2 particles randomly distributed through the insulation layer strongly absorb the light and change color.

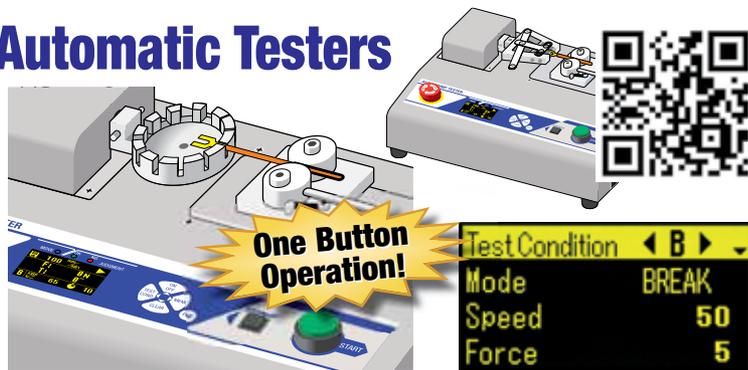
Fig.4 illustrates the process in space and time. An incident laser beam penetrates freely through the first material layer losing a small fraction (e.g., 1%) of its total energy on interaction with originally white TiO2 particles, turning them black. The same happens on the second layer and so on until most of the laser pulse energy is absorbed within the top 50-100 layers. In reality, the process is quite limited both in time and space as total pulse duration is normally below 30ns and marking depth does not exceed 50um or so.

Short nanosecond laser pulses prevent regular heat exchange between the additives and the surrounding material, limiting any structural and/or chemical modifications to the pigment particles themselves. Clearly this mark cannot be easily removed as most of it is distributed through the top layer but not on the very surface.

Continued on page 42

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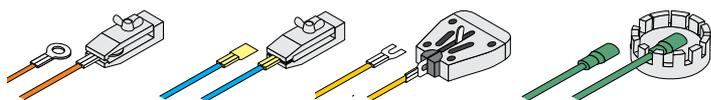
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NEWS PLUGS



MULTIFLEX 512®-PUR UL/CSA Receives NEK 606 Approval

HELUKABEL, a leading international manufacturer and supplier of cables, wires and cable accessories, recently announced its MULTIFLEX 512®-PUR UL/CSA and its shielded variant (MULTIFLEX 512®-C-PUR UL/CSA) are now certified according to the internationally recognized Norwegian Electrotechnical Committee (NEK) standard TS 606, which defines the requirements for halogen-free cables that are resistant to drilling mud. This approval is found primarily in applications associated with the oil and gas industry. Additionally, MULTIFLEX 512®-PUR UL/CSA and MULTIFLEX 512®-C-PUR UL/CSA comply with the more stringent Det Norske Veritas (DNV) ship approval tests for flexible electrical cables (CP-0417) making it ideal for offshore applications.



Oil and gas production platforms, oil tankers, refinery ships and offshore wind turbines have one thing in common: they put extreme strain on electrical equipment. Therefore, to function reliably, the cables installed must be resistant to oil, petrol, ozone and UV radiation as well as withstand coolants and lubricants or cold cleaning agents. HELUKABEL's MULTIFLEX 512®-PUR UL/CSA and MULTIFLEX 512®-C-PUR UL/CSA series perform optimally under these demanding conditions.

Conventional jacket materials tend to swell when exposed to aggressive agents such as lubricants and coolants, which negatively impacts the cable performance and shortens its service life. The polyurethane (PUR) polymers used by HELUKABEL are significantly

more resistant, which ensures that the cables can withstand the toughest operating conditions. With this, downtime or disruptions in the production process can be drastically reduced.

About MULTIFLEX 512®-PUR UL/CSA Drag Chain Cables

MULTIFLEX 512®-PUR UL/CSA, available with or without a shield, is a drag chain-rated control and power cable suitable for nominal voltages up to 1000 volts (UL AWM). It is designed to withstand extreme mechanical stress and can be used in ambient temperatures from -30 to +90 degrees Celsius. The wide operating temperature range also benefits the cable's service life because higher temperatures tend to deteriorate conventional insulation materials causing their mechanical properties to fail sooner. The cable is flame-retardant, resistant to weathering and retains its high tear and abrasion resistance even at low temperatures. Additionally, it is extremely flexible with a minimum bending radius of five times the cable diameter for moving applications, and three times the diameter when static. It has been tested to withstand approximately 10 million alternating bending cycles ensuring it performs reliably in multi-shift operations and when it's exposed to the tight bending stresses. Finally, it is UL 758 (AWM Style 212090) and CSA C22.2 No. 210 (AWM I/II A/B) approved making it ideal for export-oriented manufacturers.

HELUKABEL USA, Inc. is the wholly owned U.S. subsidiary of HELUKABEL GmbH, a leading international manufacturer and supplier of cables, wires and cable accessories with 58 locations in 37 countries throughout the world. In its 75,000-square-foot, suburban-Chicago facility HELUKABEL USA stocks over 4,000 cable, wire and accessory line items for a multitude of application areas including mechanical and plant engineering, industrial automation, oil and gas, building technology, infrastructure, mobility and renewable energy.



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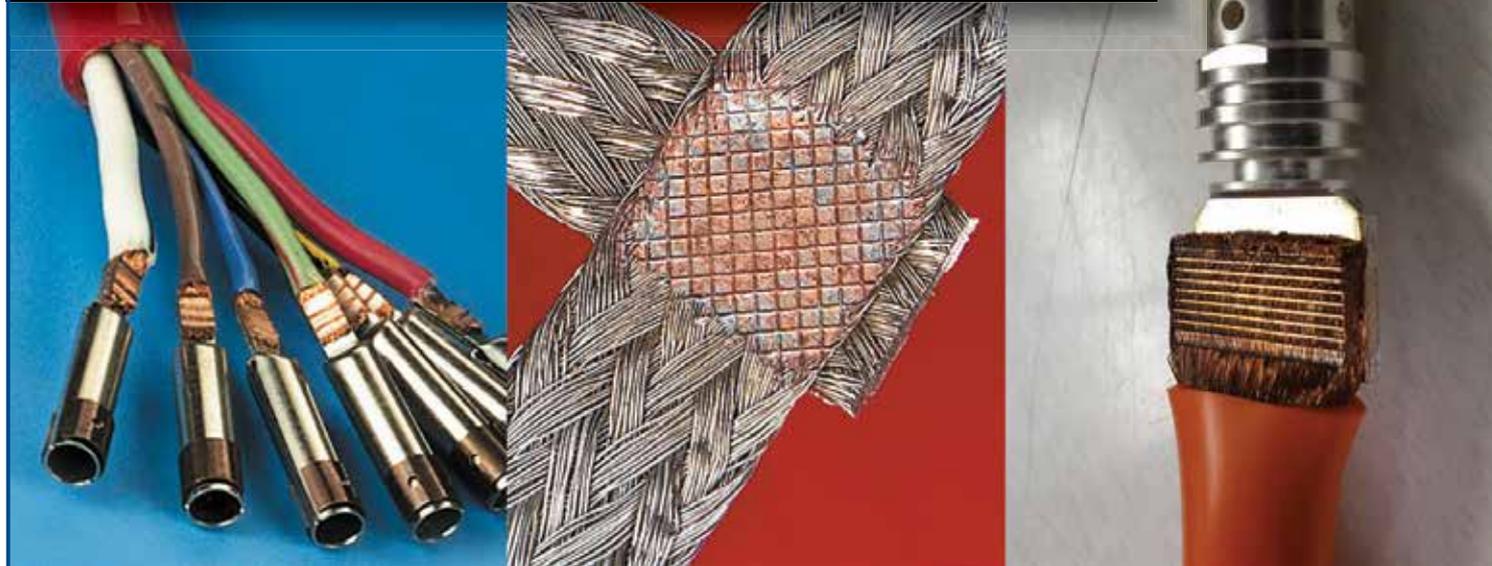
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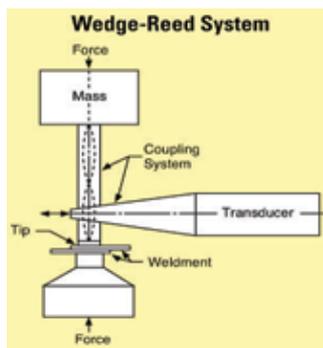
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Expanding Ultrasonic Applications in EV's

Continued from page 1

Ultrasonic welding technology is a proven joining process that is increasingly specified by carmakers for use in EV for cable to terminal connections, bus bars, battery manufacturing and power electronics. The automotive wire harness manufacturing industry has traditionally been the single largest user of ultrasonic welding, mostly splicing of wires, since the late 1980's. Linear welding is the more common technique known and used by all equipment manufacturers and a standard process for the splicing of the wires. However, like many other joining processes, there are limitations in size, welding in smaller area, geometrical shapes, orientation of welding, and vibration effects on peripheral components.

Torsional Metal Welding Technologies

Torsional PowerWheel and SONIQTWIST technology have made innovative solutions for EV joining applications that were impossible otherwise. The Torsional technology allows welding of larger size welds, gentle vibration and out of reach joining areas. This has expanded the ultrasonic application spectrum significantly. These innovative techniques allowed many joining applications that were impossible by Linear welding as we know it. These torsional technologies opened the door to new design of components

as well as new manufacturing methods never possible in the past. In fact, this technology is sometimes found to be the only solution for electric car battery manufacturers and in the termination of high-voltage cables. Other examples where torsional ultrasonic welding proves to be the superior method are bus bars, 3D terminals and integrated gate bipolar transistors (IGBT).

PowerWheel welding technology application overview for stranded wire on terminals



Following are some specific applications and challenges for ultrasonic welding of stranded wire on terminals:

1. High voltage cable set with tubular cable lugs - Welding is proven to work with PowerWheel.
2. Shielded cables - Larger cables up to 200 mm² in a smaller weld area is possible when there are restrictions on surface area of the connector.
3. Short cables welded on both sides - Welding both ends of a short



cable by Linear welding could allow the vibration for the second weld breaks the first weld. Torsional welding has much less vibration affect and therefore, it makes welding of cables as short as 4 Inch possible.

4. 3D terminal - in this situation, PowerWheel offers the advantage of more access to the weld area.

5. High power lock box terminals ask you for with Al cable - The Royal Power Solutions terminal, SQ4, in this case is about 17 mm high. PowerWheel® is the method to access the weld area.

6. Terminal two stranded braided cord - Braided wires have very fine strands which can be damaged if it was not for the gentle Torsional vibration. IGBTs (insulated gate bipolar transistors) are designed for high voltage switching applications. Due to their high efficiency and reliability,

they are the perfect match for (plug-in) hybrid vehicles and electric cars.

SONIQTWIST welding technology application overview for metal components



Continued on page 20

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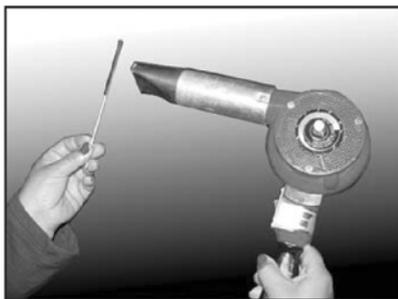
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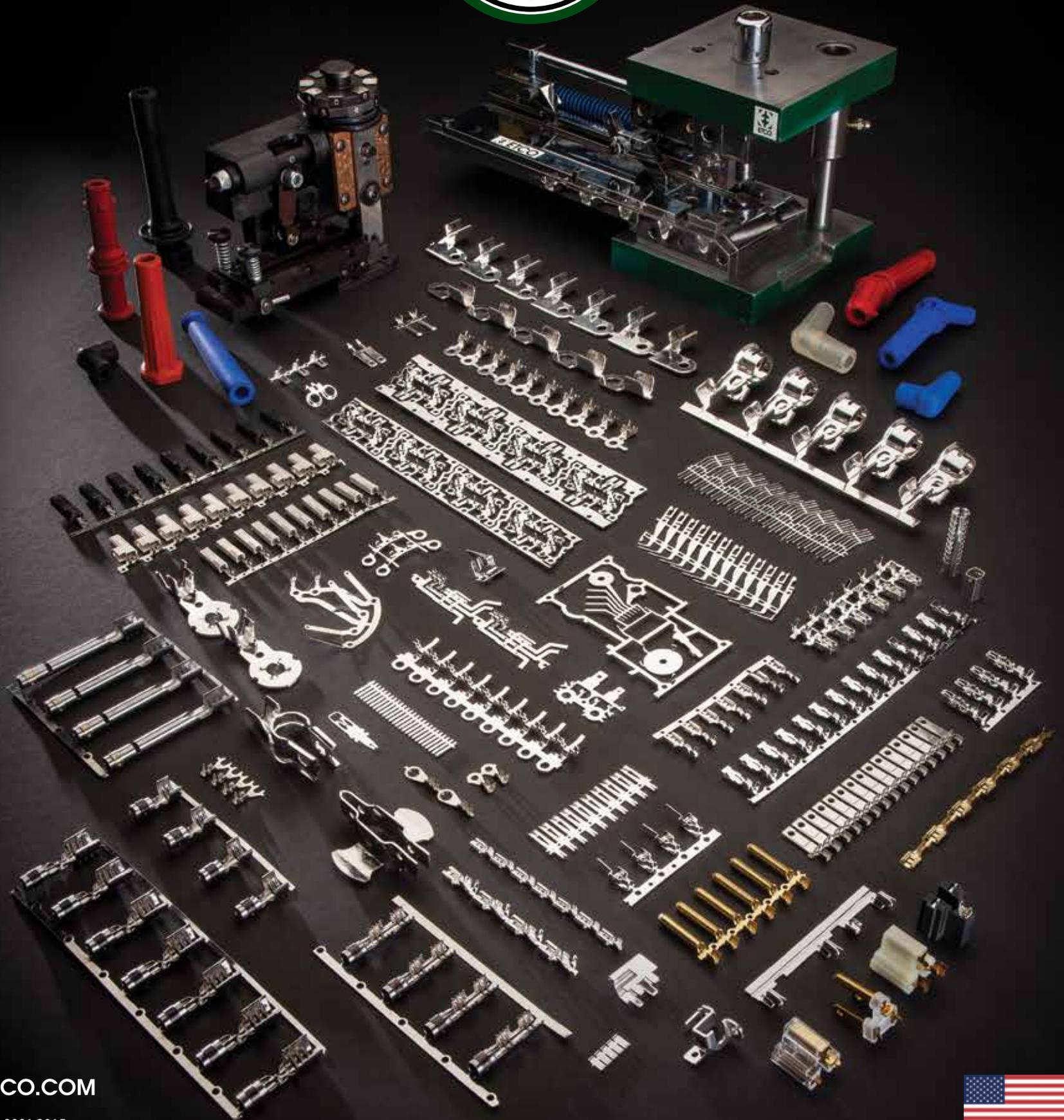
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Expanding Ultrasonic Applications in EV's

Continued from page 18

Following are some specific applications and challenges for ultrasonic welding of electrical components:

1. Ultrasonic welding pole - The application requires the welding to take place at the bottom of the cylindrical cell through the jelly roll, so the ultrasonic welding tool has to have a long reach.

2. Stator welding of magnet wires - Reaching inside this IGBT* is much easier with TSP equipment. The gentle vibration allows more consistent welds without damaging the ceramics.

3. Connection bolt on current conductor - This is a 360° weld around the bolt that requires a recess on the ultrasonic tool. Connecting the bolt on the connector conductor allowed significant manufacturing cost reduction.



4. Battery cap welding - The space is limited as the film-style electrical conductor must be welded into an embossed channel in the battery cap.

5. Hermetic seals on cylindrical cans - Hermetic seal in the circular shape for applications like airbag sensor

6. Electrical connection on IGBT - The Cu-plated ceramic printed assembly board in IGBT modules for welding the conductor. The gentle vibration allows more consistent welds without damaging the ceramics. The process is also very forgiving on the fine wire bonds on the DBC.

About Telsonic:

The Swiss Telsonic Group has been offering its industrial ultrasonic solutions through representation in Europe, America and Asia since 1966. Constant innovations help to ensure that, in many applications, Telsonic has established a lead over competitors that offers added value to customers. With over 250 highly qualified staff, the owner-managed company specializes in plastic and metal welding as well as ultrasonic cleaning and sieving. All over the world, customers in fields such as automotive, packaging, and medical technology value the company's comprehensive services and broad range of ultrasonic components for system construction as well as its complete welding systems.

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Strategies to Protect Our Supply Chains

By John Olsen - Komax

The consequences of Covid caught us off-guard. Suddenly we realized how vulnerable our supply chains are. Do we now have to abandon the just-in-time principle that has proven itself for decades? Below we present four strategies to better protect our production systems from shocks.

HIGHLIGHTS

- Industrial OEM manufacturers of lower-volume, higher-mix wire harnesses desperately need to push automation.
- A digital ecosystem that provides production transparency can produce valuable data to understand and avoid unexpected supply disruptions.
- According to one study, companies with smart factory initiatives are experiencing 10% higher production output, 11% higher capacity utilization, and 12% higher labor productivity.

In the 1970s, Toyota and other companies began to develop lean supply chains based on the principle of just-in-time (JIT) manufacturing. The “ultimate goal” of this is to ensure a balanced, fast production flow that is precisely tailored to the customer’s needs. Three techniques are used to achieve this: eliminating disruption, using flexible system designs, and eliminating waste (especially inventory). To achieve the goals of a lean production system, we focus on four building blocks: product design; process design; human resources, and organization; and planning and control.

Outsourcing to low-wage countries

In the wire harness supply industry, JIT and lean manufacturing gained strong acceptance in North America in the 1980s by focusing on manufacturing design (decentralized cutting) and assembly work (moving to low-cost labor). Under the leadership of many large automotive suppliers, production moved from a centralized cutting model (often a self-contained plant) to a decentralized model. Now the wire processing machines were in the factory for wire harness assembly. Mid-market OEMs often outsourced to local manufacturers or offshore suppliers to simplify their production line. Thanks to duty-free zones, they could also outsource production to Mexico with lower labor costs. A high concentration of wire harness “maquiladoras” emerged in Ciudad Juarez and other border cities.

In the 1990s, manufacturers moved further inland. At the same

time, a new market with even lower labor costs developed in China and many OEM manufacturers moved their production facilities there. Lean supply chains in markets with low labor costs have been the driver of the wire harness industry over the last 20 years.

The shock was profound

The pandemic shockingly showed us how sensitive our supply chains are. After the total shutdown of the economy, it was extremely difficult to get our collective economic engine going again. In addition, there were further demands on our supply chain as demand in the US shifted from services to goods.

Today, most manufacturers face four common supply chain challenges: logistics delays and costs, component bottlenecks, labor shortages, and supply chain surprises. In a survey of global supply chain managers (2021), McKinsey found that 61% of respondents cited increasing inventory levels as a strategy for dealing with supply disruptions.

It certainly looks like wire harness manufacturers will continue to be under pressure. The last two years have taught us that we need to develop more robust production systems to insulate the production system from external shocks. From the four general challenges mentioned above, four strategies emerge, which we will discuss in more detail below.

Strategy 1: Nearshoring and insourcing

According to the global online freight marketplace Freightos, between 2018 and 2021 the transit time for sea shipments from China to the US doubled from 40 to 80 days. In addition, the price of transporting 40-foot containers rose from \$4,500 to over \$20,000. Freightos predicts similar delays and costs for the current year. This implies that we will have to accept severe disadvantages for long transport routes in the future as well. A similar result is evident in the US with long-haul trucking, where costs are rising, and delivery times are getting longer. The American Trucking Association estimates that the US was short over 80,000 long-haul truckers in 2021, and this shortage is expected to continue to increase.

A McKinsey survey of global supply chain leaders found that 90% of respondents are aiming for some degree of regionalization in the next three years. Mr. Murat Aksel, VW’s purchasing chief, was quoted in the WSJ: “We still want competitive prices, but my priority is securing supply. Without components, you can’t build cars. And zero production means zero profit.”

Continued on page 23

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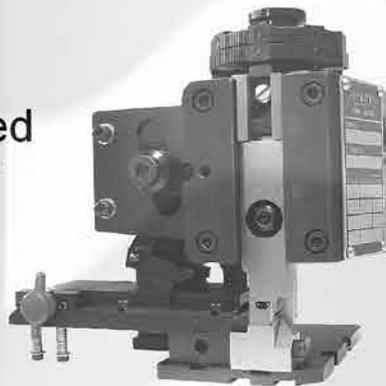


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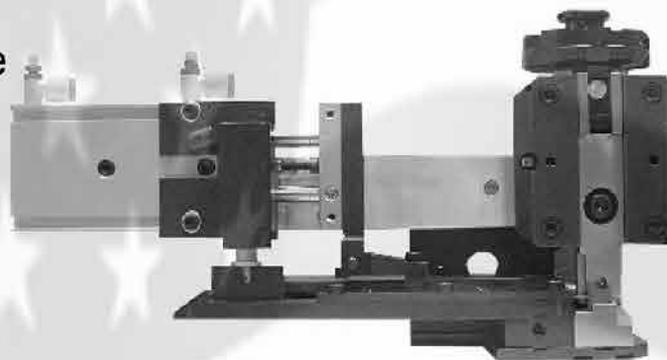


Model 1700

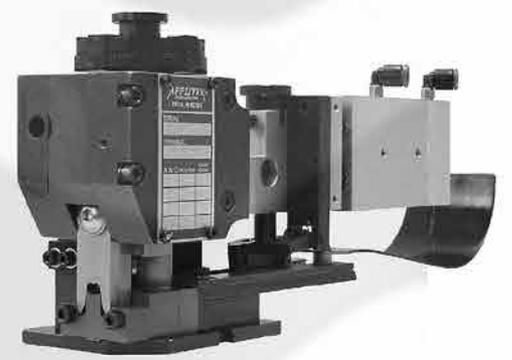


Model 2000

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

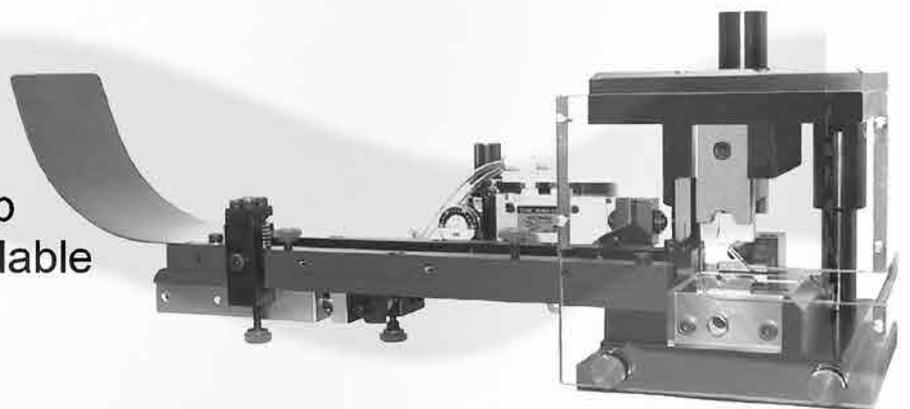


Model 1500



Model 2100

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Strategies to Protect Our Supply Chains

Continued from page 21

Thus, supply chain insourcing and nearshoring strategies are currently on the rise to protect production systems from disruption. When evaluating the location and design of their production systems, it is important to weigh the benefits of low-cost labor against the vulnerability of the supply chain to disruption. Mid-market industrial OEMs are potentially more vulnerable with distant supply chains, as their production volumes and logistical requirements are too small. Nearshoring and insourcing strategies help eliminate supply chain risks including transportation bottlenecks and geopolitical risks, while providing the additional benefit of lower total inventory and improved responsiveness to changing demands.

Strategy 2: Simplify and modularize wiring harness design

There is enormous potential in simplifying product design. The simpler and more common the designs, the smaller the need for different components. This allows us to reduce the impact of supply disruptions by reducing the complexity of our supply chain. We also increase the volume of remaining components and gain more purchasing power over our suppliers. Let's consider a simple industrial product wiring harness. Here the rule is: as few different wire gauges, wire colors, end-of-wire terminals and connecting blocks as possible, the better the design for supply continuity.

This is especially true given the growing challenges industrial OEM manufacturers face. Disruptive technologies including connectivity and IoT are driving new connectivity technology and forcing many companies to redesign their electrical systems. OEMs should take this opportunity to also consider designing for automation by standardizing and modularizing their wiring harnesses.

Strategy 3: Automation

Even before the pandemic, the labor supply in the US was sliding into crisis. The US Bureau of Labor Statistics estimates that between 2020 and 2030, the number of people over 65 will increase by 17 million – compared to 3.4 million for those aged 25-64. This means a loss of up to 13.6 million working-age people. Covid exacerbated this problem by accelerating many retirements and causing many people to rethink their career choices.

Between 2018 and 2022, Mexican minimum wages nearly doubled (from 88.36 to 172.87 pesos per day), while the exchange rate between the peso and the dollar remained nominally stable. As nearshoring continues in all industries and manufacturers look for local low-cost labor, the

Mexican labor market will continue to tighten, and costs will continue to rise.

In high-volume automotive wire harness production, it is understandable to continue to rely on low-cost labor, especially when the design is standardized and protected from disruption as described above. But industrial OEM manufacturers of lower-volume, higher-mix wire harnesses desperately need to push automation as Mexican labor markets shift to more efficient and profitable options. This will also be the best guarantee of security of supply.

In the last 10 years, automation technology has made great strides, with easier-to-use platforms with higher levels of automation and faster set-up times. Add to that a system with physical and digital services that ensures high overall equipment effectiveness, OEE. A good example of this is our customer SPIE Nederland B.V., a subsidiary of the SPIE Group and independent European market leader for multi-technical services.

For years, SPIE produced the wire harnesses by hand, including cutting to length, stripping, and attaching ferrules. With the Komax Zeta 640, SPIE got a flexible and complete automation solution that generated a lot of enthusiasm. "Now the Zeta 640 assembles the wire harnesses for the assembler. So, they are ready in a short time while the mechanical part can be prepared. Everything can be prepared in advance, which reduces the lead time. We save 30-70% on wiring time, depending on the number of wires per cabinet. With 100, of course, the time saved is less, but with 4000 it could well be 70%. We also benefit from having less product standing around. So we have more production space and therefore a higher capacity."

Strategy 4: Visualize and analyze with a digital infrastructure

The biggest challenge from the pandemic is the constant impact of unplanned production delays. If the lead time is extended but adhered to, we can at least plan around the new lead time to balance our production flow. But Covid also leaves us with bottlenecks in our own system. Fortunately, there is a solution to this provided by utilizing a digitally transparent production system. In his recent article, Dr Vishal Gaur of the SC Johnson College of Business at Cornell (NY) explains how the Internet of Things (IoT) and blockchain technologies can be used to strengthen supply chains. This includes tracking and sharing production data using secure blockchain designs. This results in predictive models that can identify potential supply chain issues before they impact our production system.

Continued on page 25

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Strategies to Protect Our Supply Chains



Smart robot feeding of loose terminals on the Artos CrX-44HD.

Continued from page 23

Deloitte has developed a dynamic circular model that no longer looks at a supply chain in a linear way. Rather, it duplicates the physical system with a digital twin, which is used to visualize and analyze the production system. This analysis triggers actions or measures to address disruptions in our supply.

Systems that visualize and analyze production in real time are highly recommended. They can identify potential delivery delays at an early stage so that appropriate measures can be taken to avoid these. According to McKinsey, digital supply chain technology is being implemented in every industry studied. In the automotive, aerospace, and defense sectors, it is even 100% of all companies.

There are already developed solutions for the wire harness industry. The Smart Cabinet Building Initiative, of which Komax is a founding member, plays a key role. By networking technology and know-how across all process steps, it is developing integrated solutions for current and future challenges in cabinet building - from component selection and the pre-assembly of wire harnesses, equipment, and housings to assisted final assembly and testing before commissioning. The basis for networking the process steps is the digital twin, a complete digital description of the control cabinet and its components, which can be used to control the process steps and track any specific item through the production process.

Whether an OEM or contract manufacturer, a digital ecosystem that provides production transparency can produce valuable data to understand and avoid unexpected supply disruptions.

Best results with a holistic approach

Each of these four strategies protects our supply chains and production systems from disruption in a particular way. However, it is appropriate to implement them all together as a holistic approach. For clarity, we have

arranged these strategies in a hierarchical order to show the impact on the following strategy: By bringing the supply chain closer to the original equipment manufacturer (insourcing/nearshoring), the producer can better influence product design. This reduces the diversity of components. This in turn facilitates automation. Automation in turn enables the use of a digital infrastructure.

Smart Factory by Komax: shaping the future of wire harness production

The manufacturing model for wire harness production has evolved enormously in recent years. The most important factors were Industry 4.0 and IoT. The best example is the Smart Factory by Komax. It is uncompromisingly shaping the future of wire harness production through more advanced automation, shorter set-up times, and self-learning AI - all within a digital ecosystem. A global study by Deloitte looks at the impact among companies with smart factory initiatives. These achieved an average of 10% higher production output, 11% higher capacity utilization, and a 12% increase in labor productivity.

Sure, just-in-case inventories are a prudent stopgap. But more robust and economically advantageous are strategies in line with our JIT goals. This is especially true for industrial OEMs in the wire harness industry. Now they have the chance to score even in times of crisis.

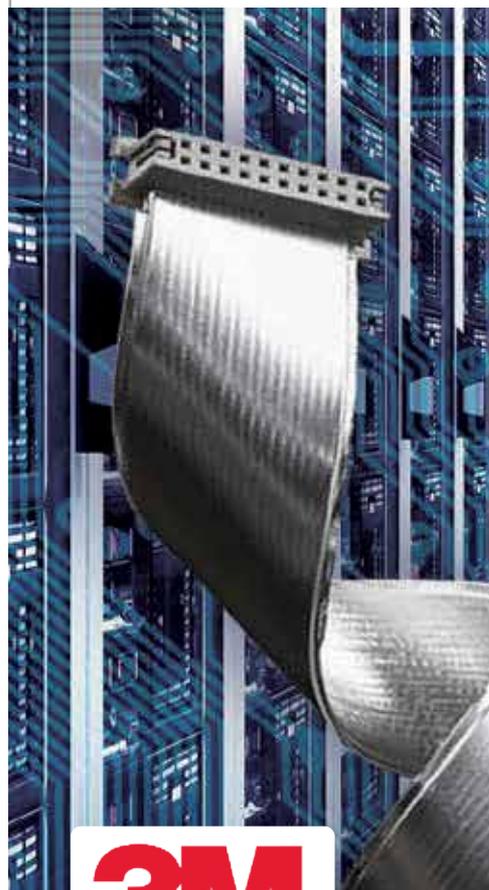
Where to begin on the path to a protected, reliable supply chain?

The best starting point is comprehensive consulting. Komax can support customers not only with highly automated machines, but also, for example, with a manufacturing execution system specially developed for wire processing and services that help it optimize production and material flow.

John Olsen has over 30 years of experience in the wire processing field. He is the Co-manager of Komax Corporation and leads efforts on advanced and custom wire processing automation solutions.

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Continued from page 23 _____

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NEWS PLUGS continued



Schleuniger, Inc. to Demonstrate Latest in Wire Processing at the Electrical Wire Processing Technology Expo

Schleuniger, Inc., a global technology company and innovative solutions supplier to the wire processing and testing industry, will be among more than 160 world-class suppliers and service companies to exhibit at the 2022 Electrical Wire Processing Technology Expo (EWPT). The exhibition will be held at the Wisconsin Center in Milwaukee, WI on May 10-12, 2022. Schleuniger will be at booth #923 providing hands-on demonstrations of innovative wire processing and testing solutions.



New for 2021, Schleuniger will debut its newest stripping machine, the Strip Series B300. The portable, high-performance B300 opens up new possibilities for fast and reliable stripping of cables with cross-sections from 0.03 to 8 mm² (32 to 8 AWG). Repeat accuracy, mechanical precision and short working cycles ensure high productivity in common strip applications. And the new ergonomic machine design and revised user interface offers unrivaled ease of use. The B300 is the right choice for those who require a particularly powerful and user-friendly stripping machine.

The new StripCrimp 208 stripping and crimping machine will also be highlighted. The programmable semiautomatic machine combines the standard working processes of cable processing in a single machine and is suitable for high-precision stripping and crimping of rear-feed and side-feed, open barrel terminals. It features a new touchscreen display for intuitive programming, expanded job memory, and barcode job recall. And the new HMI doubles as the interface for the optional crimp force monitor. The StripCrimp 208 also features more stripping power, a new gripper assembly to aid with smoother wire placement into the terminal, as well as shorter breakout lengths. Other new options include an integrated bad piece cutter and carrier strip chopper.

Attendees will have the opportunity to experience hands-on demonstrations of TechSpeed's BM 50 and TM 100R. The BM 50 is a versatile spot taping machine for bundling, insulating, and marking wires and cables. The design allows the use of various tape widths up to 50 mm wide and taping of wire and cable bundles up to a diameter of 21 mm (0.83"). The TM 100R is an easy-to-use spiral taping machine for taping wire harnesses up to 20 mm

(0.79") (optional 35 mm (1.38")) in diameter and can accommodate tape widths from 9 – 19 mm (0.35 – 0.75") wide. The TM 100R uses servo motors to control the taping head speed and the rate of feed which results in very repeatable tape overlap. All types of adhesive and non-adhesive tapes can be used. A foot switch controls the winding head speed up to 1,200 rpm.

For the first time at the Electrical Wire Processing Technology Expo, the new Schleuniger Testing Alliance will be represented in the Schleuniger booth. The leading manufacturers of wiring and functional test systems (Cirris, adaptronic, and Schleuniger Test Automation), form an integrated testing alliance, allowing the Schleuniger Group to address all aspects of the wire processing industry. The portfolio of the Schleuniger Testing Alliance consists of easy-to-use benchtop testers, customizable high-end testers / test tables, and automated test systems to address virtually any application. With 100 years of combined testing experience, the alliance members provide innovative products and complete solutions to address our customer's testing needs. We strive To Be Best in Test. More information can be found at Best-in-Test.com.

In addition to the exhibition, attendees of EWPT are encouraged to attend training and education workshops and technical seminars presented by industry experts. Schleuniger is offering a workshop on "Quality in Wire Processing – Troubleshooting Techniques and Tools" on Tuesday, May 10 from 8:00 to 10:00 A.M. and a technical seminar on "High Voltage Harness Automation – Trends, Challenges and Solutions" on Wednesday, May 11 from 9:30 to 10:30 A.M. The Schleuniger Testing Alliance is offering a workshop on "From Design to Test in Minutes: Fast Setup of Cable and Harness Testing Equipment" on Wednesday, May 11 from 11:00 A.M. to 12:00 P.M. and a conference on "Solutions for Final Assembly and Test in Large Installed Applications" on Thursday, May 12 from 10:30 to 11:00 A.M.

More information about these products can be found at www.schleuniger.com. Should you have any questions, please e-mail sales@schleuniger.com or call (603) 668-8117.

About Schleuniger

Founded (1975) and headquartered in Thun, Switzerland, Schleuniger is a global technology company and innovative solutions supplier to the wire processing and testing industry. Schleuniger solutions are found everywhere precise connections, maximum productivity, reliable data traceability, and coherent value chains are required.

Collectively, Schleuniger and its subsidiaries DiIT, adaptronic, and Cirris boast nearly 1,000 employees worldwide and serve customers spanning a broad range of industries, including: automotive, information and communications technology, industrial and consumer electronics and appliances, aerospace and defense, railway and transportation, medical technology.

With hubs in Europe, the United States, China, and Japan and a strategic network of distribution and service partners across the globe, Schleuniger is always close to its customers.

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A New Model for Data Exchange

By Mike Wurzman
RSJ Technical Consulting

Like Let's face facts: We have a costly industry-wide compliance data collection problem, and it's only getting worse. As contract manufacturers, we are asked to collect and report this compliance information for all the materials and parts we use. For a PCB, this can mean hundreds to thousands of parts from companies worldwide.

Yet we only have access to distributors, and they rarely have the full material data we need to do our job correctly. This has given rise to an entire multi-billion-dollar data collection industry, with associated costs springing up that we are expected to absorb. With the new legislation passed in the EU, we will be required to provide full sustainability data as well as the current RoHS and REACH data for every part and material. As a result, the data collection problem will con-

tinue to grow, with crippling costs that will become unsustainable with today's business model. To avoid this reality, we as an industry have to drive change in the data collection process.

A little background on what is changing: The EU has passed its EU Green Deal, a set of policies aimed to create a sustainable future. They have also passed the Circular Economy Action Plan (CEAP) and the Chemical Strategy for Sustainability (CSS) to start making supply chain and design requirements actionable. Individual legislations are to be re-written to harmonize and drive the move to sustainable products. The battery directive is the first piece of legislation being rewritten to require a greatly expanded data set, wherein the suppliers will be required to provide not only the chemical substance content but also the greenhouse gas and other sustainability data. Once rolled out, it will be expanded to RoHS, REACH, ELV, and others. The legislation has also mandated that in the future we will be required to provide Life Cycle Assessment (LCA) data to support our design and supplier choices. Right now the LCA companies make the majority of their money by reformatting the data and entering it into their software. I assert that we cannot afford these costs going forward.

In addition to increased costs, we are facing additional liabilities from data collection as well. The data for REACH, RoHS, and other legislations are being used to determine and report compliance. If the data we collect and provide is bad, we will likely be on the hook for product recalls, or otherwise held responsible for a prod-

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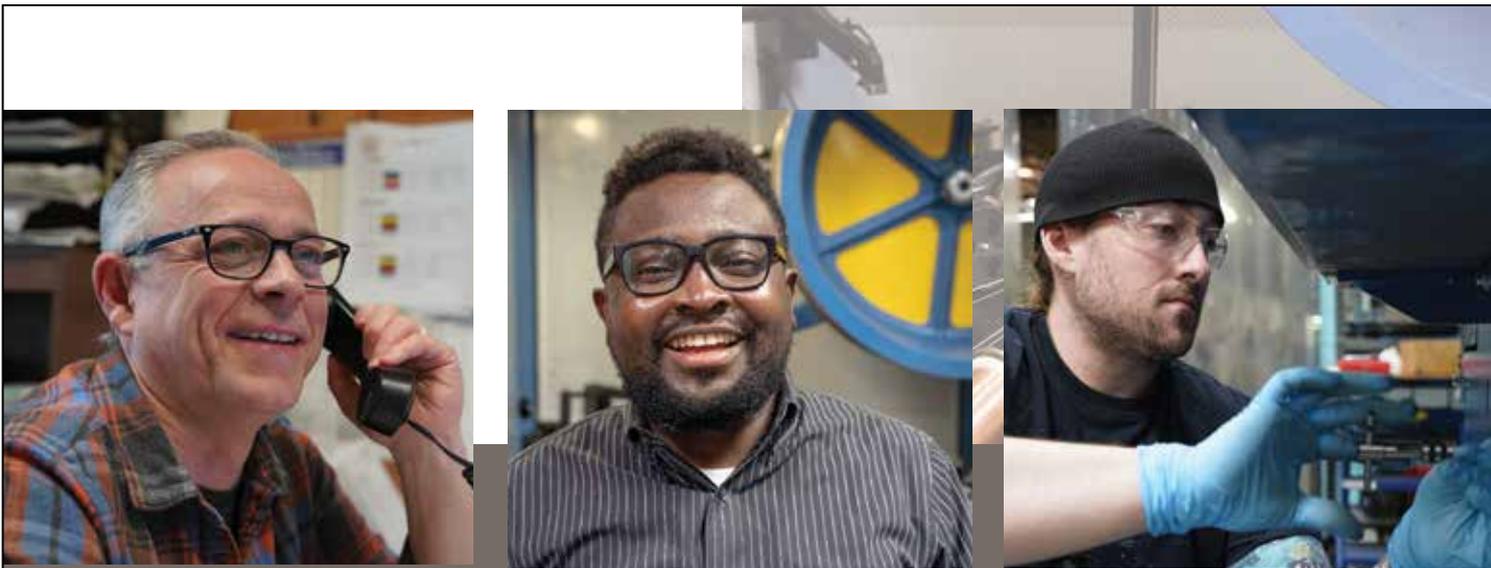


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uct being banned from a region. The EU has recently passed legislation to step up their enforcement efforts, so the days of this being a “don’t worry about it” potential problem are coming to an end. Of particular concern is the amount of counterfeit or just plain fraudulent data swamping the data collection market. As an engineer who has spent 18 years in data collection management, whenever I see the phrase “to the best of my knowledge,” I know the data is suspect. Simply put, if it is accurate, it is already known to be correct. Often, I see data that includes a wild card, “Misc. not to disclose”. This is of course acceptable if it comes from the actual manufacturer of the material, who knows what it represents and is tracking it against the global declarable substance lists. But all too often I see instances where someone doesn’t get the disclosure from the material company and puts this wild card in to give the data a veneer of being official.

This leads to a problem, namely, how do we know if the data is real or made up? In a recent review, it was noted that there were over 100 data submissions floating through the supply chains for Velcro that incorrectly stated the material used, and therefore their data could not have come from the manufacturer of Velcro. With the difficulties in extracting data at multiple levels of depth in the supply chains, companies are under pressure to speed up reporting and often just take report data that looks real, but may not be from the actual manufacturer. This is especially true for some overseas suppliers. Right now, we have no way of discerning if the data being collected are complete and real, counterfeit, or entirely fraudulent. Some sources are much better than others, but all have weaknesses. When you consider, for example, substances like PFASs with a future reporting requirement of 25 PPB, you start to gain an appreciation of the scope and depth of the problem that our multi-level supply chain creates.

A problem of this magnitude won’t be solved with tweaks and band-aids but requires an approach from an entirely new angle. We must accept, and demand that the needed compliance information be considered as a component of the physical part we are buying. It must be shipped along with the part, in digital format, and follow the part throughout the supply chains all the way to the OEM. With the data becoming a fundamental component of the hard part, we need assurance that it is assembled with the same quality as the hard part. All the same basic quality principles used in part manufacturing can be applied to compliance data. But if it is not, we are the ones on the front lines of liability.

Current compliance data reminds me of the quality issues in the parts industry from the 60s and early 70s, before the move to zero defects. Most data outside of IMDS in automotive, for example, is exchanged point to point between various systems where there is no traceability. So when there is a problem, how do we know if it was fixed by the person who actually knows the real data, versus whether it was done by someone who made it “look” right? The attitude today seems to be, that if the customer accepts it, it must be good enough, and if there is a problem, they will send it back and we will try to fix it. Is this “good enough” approach sufficient in light of our future realities—both costs and liabilities? I think not.

The Solution:

We need to rethink compliance data collection and realize it is part of a greater sustainability issue. To limit liability, the data will need to be verifiable, that is, traceable to the material manufacturers who know what actual substances are contained in the product as shipped and what they become after the product is cured (if needed). To contain the runaway costs of current compliance data collection, we also need to establish a new cross-industry data structure that includes a full material declaration (FMD) for the basic part which supports RoHS and REACH analysis. This new data structure must go beyond the standard formats such as IPC-C1752A or B to provide an exchange format that will allow for future integration directly into LCA software. This forthcoming data structure will be included in what is currently called the “Product Passport,” as an aggregate of the substance content with the greenhouse gas impact, conflict mineral and recyclate content, recyclability, and much more. As an industry, we need to get behind this effort.

Efforts are underway to create the factory of the future. I envision this to include designing the product not only for sustainability but also for sustainable manufacturing. This will require us to integrate material data collection efforts into the “factory of future” efforts. It is time for us to begin demanding that the data be supplied with the purchase of samples to the designers of the products we manufacture, or directly to us with the purchase of parts. However, this will only happen if we band together as an industry to put pressure on our customers, suppliers, and component manufacturers. To make this happen we must create the change we need. We need to force the creation of a future where data no longer is collected but received with the shipping paperwork. We need to drive on organizations, such as IPC/WHMA to establish industry standards so this can happen.

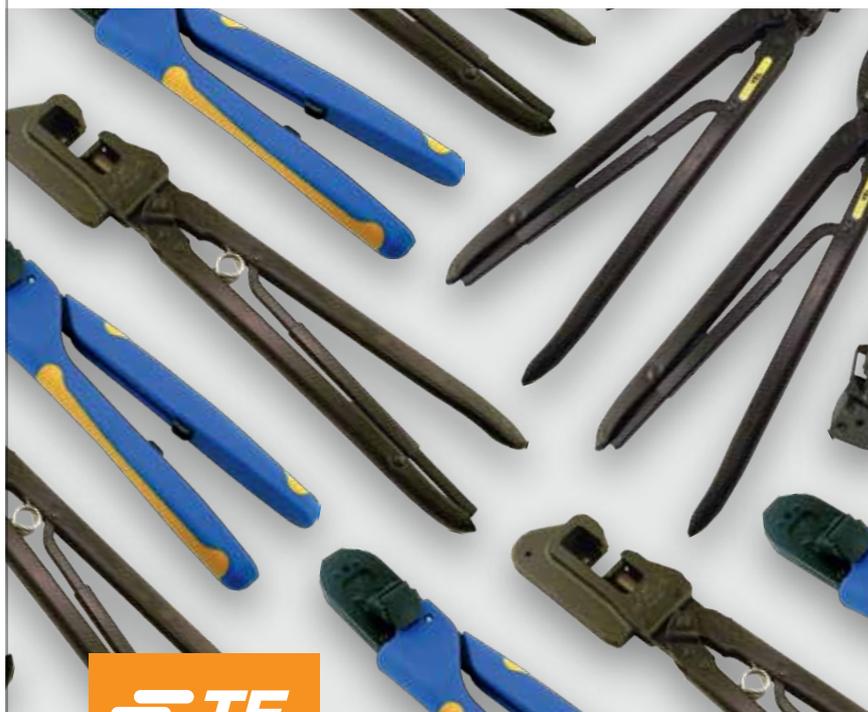
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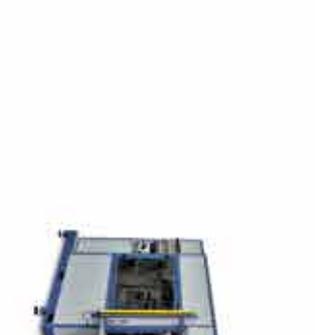
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MNSTAR

Continued from page 1 _____

all the different areas that are using harnesses and the variety of industries they cross.”

George proceeded to give some historical perspective on the company. “When I bought MNSTAR, they had been around for about 20 years. I think it had a very nice brand and was known in different industries for building quality products.” But he indicated the business was at the point where it needed fresh ownership and capital to flourish. “I started 18 months ago with 28 Employees, and now we’re up to 44 and continuing to grow and do new things.”

George handed the conversation _____ Continued on page 33

over to Tammy who he brought in to manage MNSTAR’s operations. But he quickly made an important clarification that she, no doubt, appreciated. “Now I want to make sure you know that Tammy is not part of that age group that I described earlier, but she’s one of the best people I’ve ever hired, and I depend on her a lot. She is a just a phenomenal leader for me at this business.”

Tammy indicated that MNSTAR has historically been a supplier of build-to-print harnesses, cable assemblies and panel builds for ma-



Manufacturing Marvels filming at MNSTAR.

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THE POWERHOUSE OF ULTRASONICS

MNSTAR

Continued from page 31

rine, government/D.O.T., first responder fleets, agriculture and other industrial markets. Like many in the industry, they have become much more involved in the design phase, but they do so with an added twist. “We’re a little different in that we go on site to our customers to help them with design,” she informed. Whether its crawling around in the hull of a boat, taking measurements on a berry picker, or ascertaining the best dimensions for a panel on a fire truck, MNSTAR engineers go to the source when determining proper fit, form and function.

Many of the assemblies and panels that the company makes go into products exposed to harsh environments. One application the company is particularly proud and excited about is the control panels and assemblies for snow-plow vehicles. That’s because the components they are replacing were made by MNSTAR and have been in service for over 15 years. “In northern Minnesota there is salt on the roads nine months out of the year with extreme temperatures of 37 below — and that’s air temperature, not windchill — and they are just now having to replace these components,” she revealed.

MNSTAR takes great pride in their high-quality standards. They use Cirris test equipment as their gold standard for quality assurance and do 100% testing. “It doesn’t go out of the plant unless it is tested,” Tammy assured. “When we do first articles, they always get the test data report, and some customers prefer the data with every harness we build for them. But even if they don’t request the data for each product, those test results are stored on our database and we can pull them up at any time.”

Like everyone else, MNSTAR is facing supply chain issues. One way they have sought to overcome this is through the standardization of components where possible. “We do a lot of braiding, and because of the marine



and fire industries, we have to use a premium quality braid,” Tammy advised. “I don’t carry two different types of braiding material, I only use the highest standard, so all of our customers benefit from that.”

They operate in a similar manner with Deutsch as their preferred connector supplier. Overall, this strategy gives them leverage in buying power.

Continued on page 39

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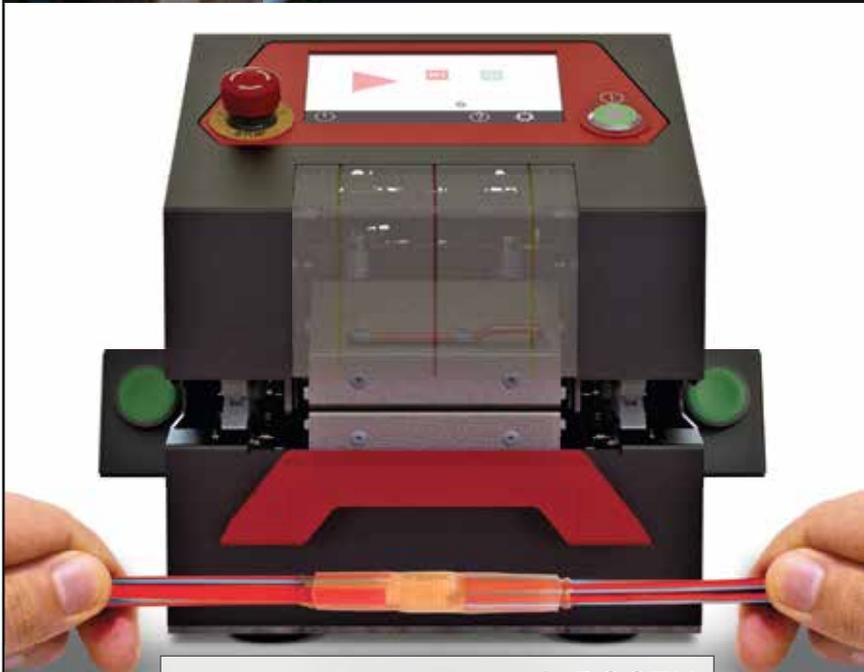
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Navigating Supply Chain Challenges in Wire and Cable

By Wesco International

Like many other industries, the electrical wire and cable industry has faced new challenges over the last two years. And as we all know, the global supply chain is more complicated and dynamic than ever before. Increased manufacturing demands and shortages of labor and products are just a few of the issues we face. Let's review market trends impacting the industry and how effective planning and informed decision making can help you adapt.

STATE OF THE INDUSTRY

Tariffs

Some of the supply chain challenges the industry is currently experiencing can be traced back to 2018 tariffs on goods from China. From a cost standpoint, this involves the importation of products and the reduction of transport services. This impacts the number of imports that the U.S. currently receives and the time it

takes to receive those imports.

Labor Shortages

Tariffs also multiplied the number of manufacturing companies reshoring and bringing manufacturing facilities from overseas to North America, increasing manufacturing demands. While labor shortages have been an industry challenge for some time, the Covid-19 pandemic has exacerbated the situation. Availability of labor is one of the biggest challenges we have seen for manufacturers to produce cable and keep the lead time short. Manufacturers surveyed by Deloitte in 2021 found that it's 36% more difficult to hire talent than in 2018.

Rising Costs and Inflation

In addition to labor shortages, the rising cost of commodities and inflation has caused many manufacturers to allocate material so supply may continue to be constrained. According to the U.S. Consumer Price Index, in 2021, aluminum hit a 13-year high, and the price of copper ended 44% higher in Q3 2021 than the prior year, with consistent increased demand in



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all sectors. In February 2022, the U.S. Bureau of Labor Statistics noted that inflation rose 7.9% over the last 12 months, the largest rise in a 12-month period since 1982.

Transportation Costs

Accenture found that the pandemic created supply chain disruptions for 94% of Fortune 1000 companies. As of March 2022, transportation costs continue to rise. Truck freight costs have seen a sharp impact, growing more than 16% year over year in October 2021, with the Producer Price Index continuing to climb. Airfreight prices continue to climb as well, with rates up more than 50% year over year as of December 2021, according to the Consumer Price Index.

Since freight costs are related to how far products ship, partners with global facilities can help reduce costs on transportation services. For example, Wesco has facilities in more than 50 countries, helping provide lower total shipping costs compared to other supply channel providers that may source materials from offshore or across the country.

Increased Product Lead Times

We have seen delays on near-term order shipments pushed out due to manufacturing disruptions and an increase in the number of long-term orders placed. The combination of the two is driving up product lead times to unprecedented levels. New urgent orders may be pushed to the back of the line due to manufacturing capacities being consumed by speculative forecast planning. That cycle can repeat, creating longer lead times.

In this market, construction planning is taking place further in advance to secure raw materials, contributing to extended timelines and rising costs. In the manufacturing industry, many organizations are placing orders for products months in advance.

Global Market

While you may source locally and try to utilize domestic manufacturers, global events still impact us all. Oils are used to manufacture plastics and metals are used to make wires, cables and enclosures. Those commodities trade on a world-wide platform. Disruptions in the global supply can impact your local pricing and availability. Long-term planning and utilization of inventory services can help you minimize supply volatility and smooth out cost variability.

ADAPTING AND EVOLVING

Forecasting for Dedicated Inventory

Wire and cable customers can mitigate uncertainty by partnering with a supply channel solution expert. The first step we encourage our customers to take is to share a material resource planning (MRP) forecast to

plan at least six months out. Disruptions to the supply chain forced many supply channel providers to operate on a first-come, first-served basis. To help solve this additional complexity, we secure inventory with specialized programs for end users or customers. For example, many of our customers put vendor-managed inventory (VMI) programs in place to dedicate inventory on-site, so we can anticipate their long-term needs.

At Wesco, it's our job to keep the material flowing, so the process is seamless. Proactive partnership and communication with customers are essential to understanding and anticipating demands.

Product Substitutions

Once long-term forecasts and VMI programs are in place, it's important to have approved product substitutions for a diversification strategy. Identifying substitutes has never been more relevant to customers than now. Over the last year and a half, we've seen more manufacturing customers get deviation approvals on their building materials. If one product has a shortage, customers need to look at the application parameters.

To accomplish this, start by asking the right questions. For instance, we need to understand the voltage and temperature requirements and what the operating conditions need to be for products to be used in certain environments. It's important to know if products are exposed to oil, gas or anything corrosive. Also, will the product be operating in a high-temperature environment?

Our customers rely on us to provide product recommendations that are not only available but can safely meet those parameters. We have experience working with regulatory bodies including Underwriter Laboratories, the Canadian Standards Association, the Society of Automotive Engineers (SAE) and the International Standards Organization (ISO). Having worked with industry associations that dictate what products can and can't be used within certain applications, we make recommendations to find the best solutions.

MOVING FORWARD IN TODAY'S MARKET

The global supply chain is under pressure. Having a partner who understands how to navigate disruptions and leverage global capabilities has never been more important. We guide customers through forecasts, reserving products and sourcing substitutions. Our teams can help you adapt and find alternatives when faced with shortages. We welcome the opportunity to leverage our \$2 billion inventory, industry-leading knowledge and value-added services to help build a more resilient supply chain and drive efficiencies to your bottom line. the protected metal.

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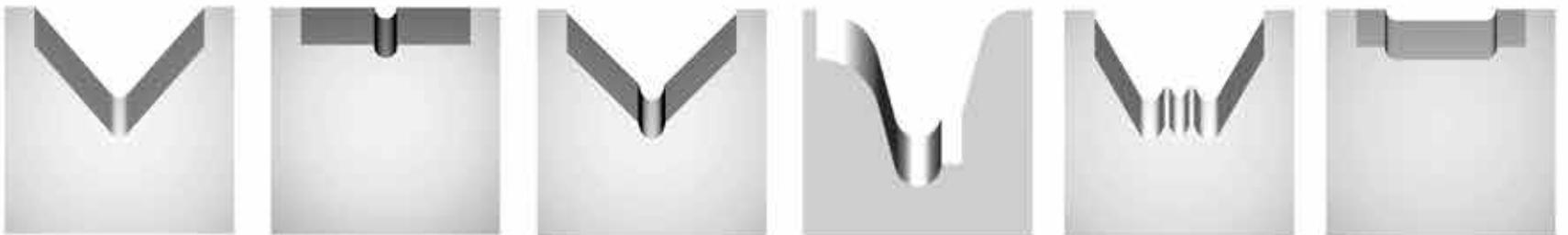




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MNSTAR

Continued from page 33

"If the customer did the designs, we always ask their permission to substitute a more readily available option. If we do the design, we will make that call but let them know what we are using. Either way, we always make sure that with any substitution, the form fit and function are exactly the same so there is no impact on quality or performance," Tammy detailed.

To bring in new business, MNSTAR has one full-time salesperson, Jim Johnson, who has been selling for them for 10 months, but has years of sales experience. They have also brought on Norm Sagon along with another independent contractor. These entities are already busy expanding the company's customer base by looking for opportunities nationally.

Knowing how difficult it is to onboard new employees over the last couple years, I asked how they've been able to grow so quickly from a personnel perspective. Tammy indicated that because they're in a rural setting, there is much less transiency than one might get in a big city. As

such, they've had great success in pulling folks from surrounding towns to employ. It's not the big city life, rather it's a much more deliberate and dedicated culture. "The people who live here love to be out in the country. They like their acreage, and they like to hunt and fish," she asserted.

To increase the attractiveness of MNSTAR to the locals, the company has increased wages, added a benefit package for the first time, and has also instituted flexible work schedules. "They are all very proud of what they do and that's something you don't always find in a bigger city. We are lucky and fortunate to have that."

In order to promote their visibility in the community, George and his team have opened up the facility to anyone who would like a tour. "We want the community to understand what we do and what we provide for our employees and the community, so that's just been a fun thing for us to do," George revealed. This strategy has proven to be a great recruitment tool for the company. It also helps

George assure the local community that MNSTAR is there to stay. "I will tell you this," said George, "one of my philosophies when looking at a company to buy is that I will never move it. These employees have made MNSTAR what it is, and it belongs to

this community and I want everyone to know that I came in to grow the business, because I'm a grower, not a maintainer."

The company already has plans to

Continued on page 40



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MNSTAR

Continued from page 39

more than double the footprint of the facility. "I have worked on the financing, and within the next 24 months we will go from a 24,000ft.² facility to 54,000 ft.², and that's just phase one of our growth," George informed. There is a constant push to upgrade tooling and equipment to build more quality products for current and future customers.

George and Tammy. They've fallen hard for this industry, and they have dedicated their professional future to it. George is currently under contract to purchase another harness manufacturer and has already made plans to look at a third. I look forward to hearing more from him as he continues to grow in the industry.

MNSTAR was recently featured in fox businesses manufacturing marvels. You can watch the video by following this link: <https://bit.ly/36WJ4qV>.

Like most of these interviews I do, it's tough for me to put into words the passion and enthusiasm that came through in my discussion with



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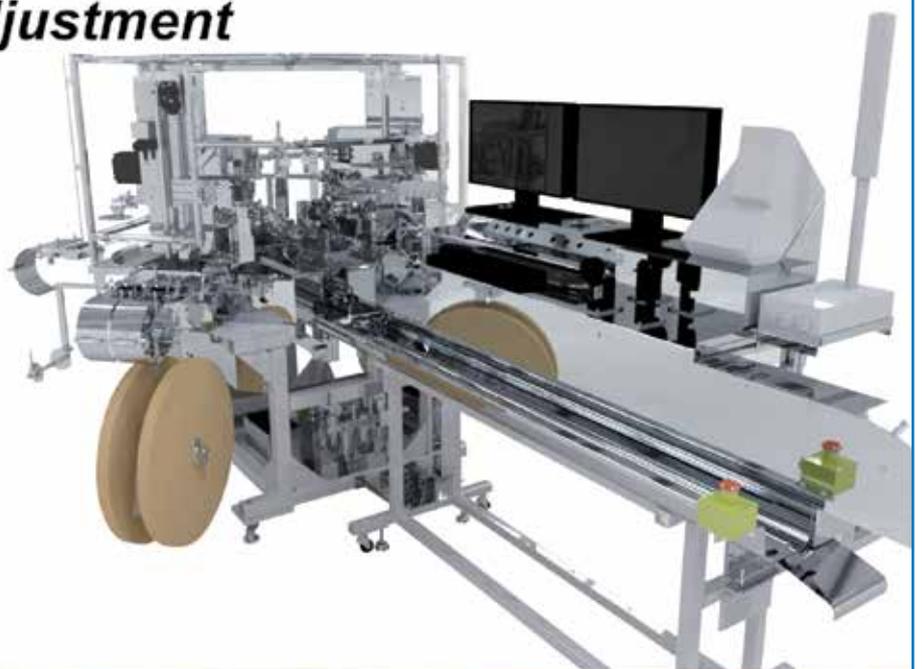
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CAMI Increases Production Capacity for Developing Automation Ready Cable and Harness Testers

CAMI Research Inc. (Acton, MA), has extended their production facility by adding 2000 sq ft of new production space for manufacture of their innovative CableEye® wiring test systems.

Despite the pandemic, 2021 sales were the highest ever for CAMI. CAMI is an essential manufacturer in the supply chain for defense and medical industries, so all areas of the business have remained operational through the pandemic.

The company has been a leader in innovating highly configurable test solutions for simple and complex multiconductor cables and harnesses for nearly thirty years. CAMI provides these advanced wiring analyzers and guided assembly systems to discerning global customers who require accurate and dependable assembly and testing in order to deliver top quality product. Systems are used for countless test applications of products destined for Transportation, Aerospace, Energy, Appliances, Medical Devices, Defense, Robotics, Telecom and much more. Trusted by industry leaders such as CERN, Ford, GE, Hitachi, NASA, Abbott, TESLA, Lockheed Martin, Raytheon, Airborn, Furukawa, TE Connectivity, and the Nobel prize-winning group, LIGO, thousands of test systems have shipped globally over the years.

The Production View for Pass/Fail checks while running an automated test is shown in the screenshot (Fig. 1). Displayed on any sized screen you desire, the color-coded graphic-rich display provides clarity and, at the click of a button, you may visualize the wiring schematically or by netlist. Components are automatically detected and displayed (including Diode orientation), wiring

faults are color-coded, and full measurement data is provided for every pin-to-pin connection. Another click provides a detailed customizable report, complete with wiring schematic and netlist, for your own records or for your customer. A short (red) is clearly identified in this screenshot, and

both audio and visual signals indicated the harness test has failed.

Learn about the advantages of CAMI and CableEye equipment at the EWPTE show in Milwaukee (Booth 1505). Ask a CAMI representative how to win \$500 in CableEye accessories.

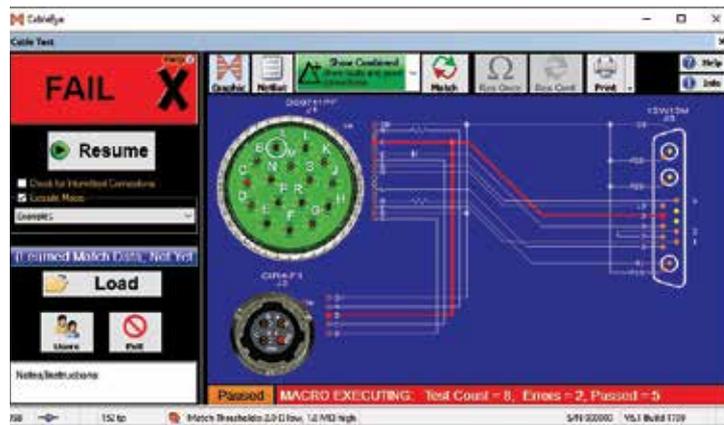


Figure 1. CableEye Wiring Tester Production Screen

DIAGRAPH



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PAGES 63-64**

UV Laser Marking of Wire Insulation Materials

Continued from page 12 _____

The question of what exactly happens to TiO₂ particles under intensive UV light exposure is outside of the scope of this article, but the resulting change of color is irreversible. For example, long-term stability of UV laser marking on TiO₂ doped ETFE films was investigated in McDonnell Douglas Research Laboratories in 1990. The marking showed little change during either thermal aging (770 hours at 229oC) or simu-

lated solar irradiation (equivalent to 17 years of UV exposure in the Arizona desert).

The marking contrast is proportional to TiO₂ concentration; however, excessive amounts may damage the insulation. Normally 2-4% by weight is enough to achieve a good contrast. Table 1 specifies typical contrast levels achievable by direct UV laser printing on the wire con-

Continued on page 44

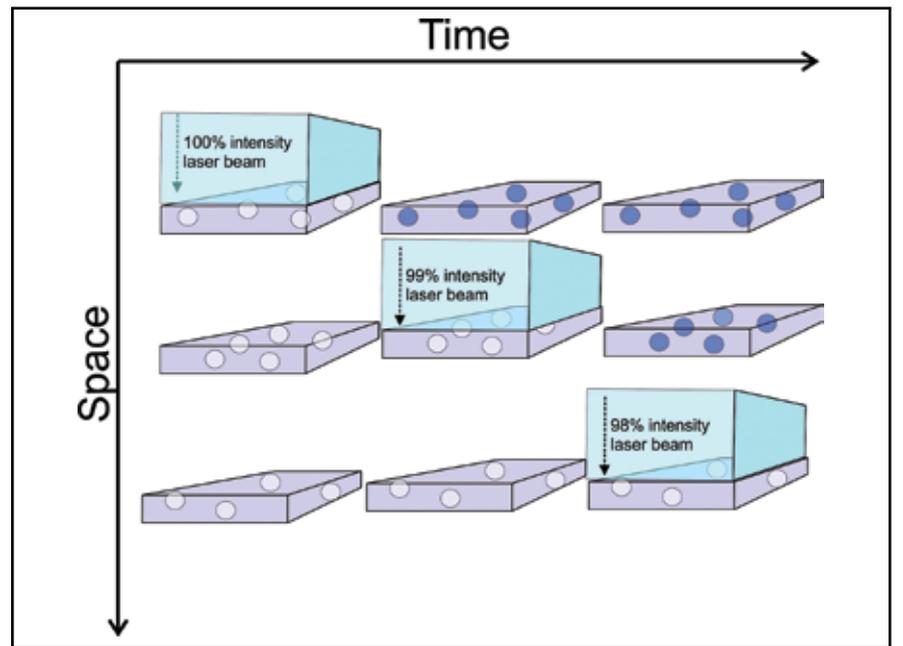


Figure 4. Schematic representation of UV laser beam path through a transparent media doped with TiO₂ particles.

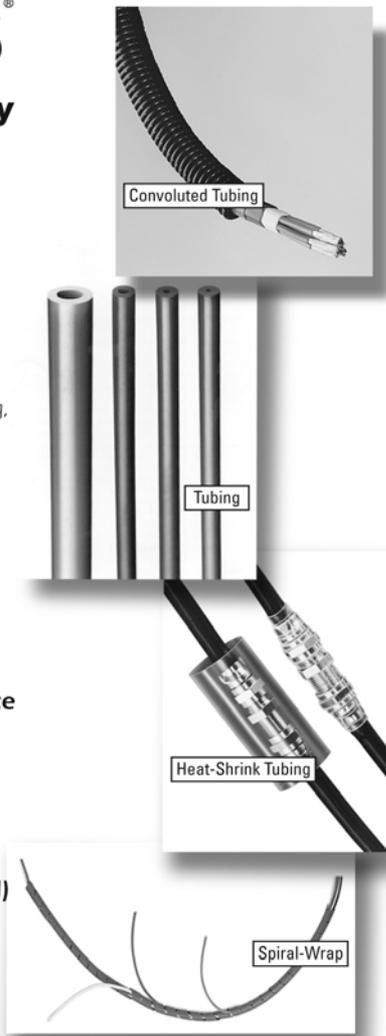
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UV Laser Marking of Wire Insulation Materials

Continued from page 42 _____
 structions commonly used in the aerospace industry.

Other wire types can be marked as well for as long as they contain the magic pigment. The requirement of having TiO2 in the outmost layer of a jacket is the primary limitation for

the marking technology described above. In most applications, TiO2 is used as a white pigmenting agent and it turns black upon UV laser irradiation. Therefore, only light-colored wires can be legibly imprinted.

The rest of the wires can also be marked with a laser via the different mechanisms depicted in Fig. 1.

However, these marking most likely will not be in compliance with strict aerospace standards unless we find another magic pigment that, for example, turns white from black upon the green laser exposure.

Tri-Star Technologies is happy to evaluate customer samples and can generally turn them around in a day

or so. If you would like to submit samples for testing, please contact Tri-Star Technologies at (310) 347-5767 or sales@tri-star-technologies.com. Check out Tri-Star's wire marking, crimping, and plasma treatment equipment at www.tri-star-technologies.com.



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BMS 13-58	Gray	PTFE Tape wrap	Good
BMS 13-60	White	PTFE Tape wrap	Good
BMS 13-60	Green	PTFE Tape wrap	Marginal
M22759/05,06,08	White	Extruded PTFE	Poor
M22759/07	White	Extruded PTFE	Marginal
M 2 2 7 5 9 / 0 9 , 1 0 , 1 1 , 1 2 , 20,21,22,23,28,29,30,31	White	Extruded TFE	Marginal
M22759/16,17,18,19	White	Extruded ETFE	Good
M22759/32,33,35,41,42,44,45,46	White	Extruded XLETFE	Very Good
M22759/34,43	White	Extruded XLETFE	Excellent
M22759/80,81,82,83,84,85,86,87,88,89,90,91,92	White	PTFE Tape wrap	Good
M85485/5,6,9,10	Violet	Extruded XLETFE	Very Good
M25038	White	PTFE Tape wrap	Poor
M27500 SP2S23	White	Extruded XLETFE	Very Good
M27500/20 L3T08	White	Extruded PVDF	Excellent
M27500/20 P2G23	White	PVC/ NYLON	Very Good
M27500/22 C1G23	White	PVC/GLASS/NYLON	Very Good
M27500/22 SP5S23	White	Extruded XLETFE	Very Good
M27500/24 C3G23	White	PVC/GLASS/NYLON	Very Good
M81044	White	Extruded PVDF	Excellent

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THE POWER WOMEN OF THE WIRE HARNESS INDUSTRY

By Melissa Femia

This edition of the series features Caitlin Feltner, a High Voltage Battery Development & Release Engineer in the BEV Hardware Group at Stellantis. Caitlin's roots were in Novi, Michigan though her college experiences including scholastic internships took her to California, Iowa, North Dakota, and Indiana. She returned to Michigan post-college once she accepted a position with Stellantis.

Although Caitlin grew up in Novi, she attended Northville Public Schools. She is the middle child of three female siblings who all attended college in various fields. She pursued engineering while her older sister graduated in speech pathology. Her younger sister is currently attending college to be a teacher. While her parents are professionals, neither is involved in engineering. Her father is a medical doctor working as a pharmaceutical developer and her mother is an entrepreneurial attorney. Her parents inspired their children to read and innovate. Her parents also demonstrated hard-work ethic. Caitlin's engineering story started out in 4th grade when she took a math test and scored well. The defining moment was not the 'A' that the teacher placed on the paper, but rather the note stating 'should be an engineer'. From that point, Caitlin had other teachers who continued to encourage her through the years. As a high school freshman, she took an engineering design and drafting course. Later in 10th grade, she became involved in FIRST (For Inspiration and Recognition of Science and Technology) robotics.

Caitlin knew she wanted to be an engineer during the collegiate application process, though she was uncertain about the discipline within engineering. She opted to enter college as an environmental engineer, which was a subset of Civil Engineering. She chose Purdue because it was highly ranked, affordable, research-intensive, and there were many project-based opportunities. She enjoyed team projects since having exposure to them during FIRST. Although the typical

engineering curriculum is 4-years, she attended Purdue for 4 ½ years so that she could experience additional internships.

Caitlin's first internship was at a paint company during her freshman year. She was a mechanical engineering intern working on paint processes. She focused on process improvements for paint systems and ovens at an automotive paint supply company working mostly with Audi and Ford vehicles. Pending that assignment, she decided to switch her major to Mechanical Engineering in her sophomore year. She spent time researching the types of jobs available for environmental majors versus mechanical majors and realized that she was most interested in the dynamics portion of mechanical engineering. After her sophomore year, she worked at the John Deere Global Crop Harvesting Product Development Center in Iowa. She was a quality engineering intern for prototype and experimental combines. She enjoyed the hands-on aspect of

the job since she was drawn to legos and other building projects during her early years. She had a second internship in Iowa with frequent development trips to North Dakota with John Deere after her junior year. She was in the Product Development Engineering Group, working again with combines. After that point, she realized that her interest level in agricultural equipment had weened and that she was more of a city girl rather than a rural personality.

For her next internship, Caitlin worked in California at Tesla. She worked within the electrical engineering area as a resident engineer. She was focused on the quality of wiring and sensing systems. She dealt with plant issues daily and really liked the fast-paced plant floor environment. As typical in manufacturing, there was always something that did not occur according to plan, and the need to focus attention utilizing problem-solving techniques was ever-present. Her adjective to describe the position was 'thrilling',



Melissa Femia

so there is no question that she really enjoyed both the assignment and the environment.

Outside of the internships, I asked Caitlin about her experiences at Purdue, especially in terms of being fe-

Continued on page 46

APPLICATORS / CRIMPING PRESSES / TOOLING



Mini
Left to Right



Mini (2 Post) Air
Left to Right



Heavy Duty Slide
Quick Change Tool Pack



Mini (Power Drive II)



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End Feed



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Quick Change Tool Pack



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The Power Women of the Wire Harness Industry

Continued from page 45

male. She mentioned that one of the best aspects of her Purdue engineering education consisted of being a part of the Formula One SAE (Society of Automotive Engineers) team. She and her team were able to design and build a race car within a school year, and ultimately raced their vehicle at the Michigan International Speedway. She was particularly involved in the composite material selection for the air frame, wings, and side pods. Speaking to the female portion of her collegiate experience, she indicated that females comprised about 25% of her mechanical engineering classes. She never felt like there were gender issues, though she did note that the majority of the females were of international descent and that there were not many young, blonde Caucasian students like herself in the engineering programs.

After undergrad, she had several job opportunities from the companies where she previously interned. She again wanted the excitement of working within the automotive industry and chose to work at FCA (now Stellantis), in part because she had personal reasons to locate within the Ohio/Michigan area. Additionally, Caitlin mentioned that she is a die-hard Jeep fan; she loves the brand and specifically the Wrangler name plate. She has now been at Stellantis for five years. In her first 1 ½ years,



Caitlin Feltner

she worked as a triage engineer. In this assignment, she was responsible for analyzing failed parts and determining the root cause for active chassis-related components, wheel speed sensors, and engine systems parts. She gained exposure to powertrain and electrical systems within the vehicle. She was interested in the assignment and employing her ME skills, but also still had an interest in environmental systems as well as working on problems in which there were yet no solutions. One of her mentors then introduced her to the electrified powertrain group. She met an area manager who suggested that she work in this area because they are developing new high voltage battery products to address

unsolved problems. As the job hit her key interest points, she took on a new role as a high voltage battery system hardware design release engineer. She has been in this group for nearly 4 years and still loves it. She likes the environmental focus, complex systems, and the innovative necessity. She is currently working on a Maserati electrification project and has become very passionate about energy storage.

In December 2020, Caitlin received her Masters of Engineering in Systems Engineering through Cornell University as a part-time graduate student working full-time at Stellantis. Through Cornell, she was able to publish two papers as a co-author through Cornell University titled 'Data Driven Prediction of Battery Cycle Life Before Capacity Degradation' and 'Efficiently Evacuating Lower Manhattan'. Caitlin received a Fellowship from Cornell University Systems Engineering for her graduate studies and financial support from Stellantis, making the choice to pursue her masters at Cornell very easy. Additionally since graduation from undergrad at Purdue University, Purdue Research Foundation pursued a past project of Caitlin's and published US Patent Application Number: 16/013,645, 'Strength and Endurance Training System', where Caitlin is a co-inventor.

Outside of job activities, Caitlin was on the Purdue recruiting team at FCA. She was also the Society of Women Engineers (SWE) Newsletter Chairperson within Stellantis's SWE Chapter and held other previous leadership positions within SWE.

In her current group, she is one of only 2 females on a project team of

roughly 25 people. Fortunately, she can find additional female camaraderie in the Stellantis SWE group which is comprised of many young females. She said that it is nice to have some female conversation as she is often the only female in her meetings. Being one of the only females has not discouraged her, however, as she strongly recommends that females consider engineering for a collegiate major and career. She believes there to be more independency and freedom in engineering. She thinks engineering offers women a good work/life balance as the hours are not overly demanding. She also loves the aspect of the financial independence at a young age that engineering offers. The field is engaging and challenging and permits a person to think creatively and technically at the same time. As many of the previous Power Women candidates have advised, she also encourages students to stay curious and not worry if they aren't the smartest kids in the high school class. There is a belief in society that only the super-intellectuals can become engineers but according to Caitlin—there is little accuracy in that idea.

Thank you, Caitlin, for sharing your story and Stellantis, for creating a positive environment for female engineers.

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

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

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Wire Harness Manufacturing Automation Ideas in a Tight Labor Market

By Sanu Warrior

Wire Harness Manufacturing Automation

The move towards electrification across the machinery and transportation sector is increasing the demand for wire harnesses. Simultaneously, the booming industry is battling the overall labor market shortages. The wire harness production process has been predominantly labor-intensive. The most commonly sighted reason is the lack of viable wire harness manufacturing automation options. That may have been true a decade ago, but not today. Several options are available today for automating the wire harness manufacturing process.

Even so, without the right tools, wire harness design teams struggle to gather the information required to adopt an automated manufacturing process. A detailed, intelligent design and layout accelerates the documentation process and sets the stage to drive automated assembly and production machines.

Let's look at the leading automa-

tion options with significant advantages over traditional manual processes.

The process of cutting, stripping, and preparing wires for the harness is often labor-intensive and time-consuming. The next step of completing the wire terminations is error-prone as well. Furthermore, any errors in picking and finishing the wire terminations will significantly impact the project. Indeed, automated wire processing machines have the potential to save more than 50% of labor costs and deliver additional time savings.

Automated wire processing machines eliminate a large portion of the wiring challenges. The latest machines cut, strip, and mark the wires and have options for adding the wire terminations. For instance, machines like the Komax Zeta have advanced bundling capabilities to group processed wires to supercharge the assembly process. Using the right design tools can help generate the required data in a suitable format to drive machines from major vendors like Schleuniger, Argus, and Komax.



Augmented reality formboard from DeltaSigma.

Automated Wire Harness Testing

Testing a wire harness to ensure connectivity and continuity is vital for quality control. The automated wire harness testing machines provide various test options like connectivity, impedance, signal integrity, and more. However, setting up test routines or manually conducting tests has overheads that design teams tend to avoid. Automated wire testing machines deliver significant time savings, but more importantly, have the potential to cut the error rate by half.

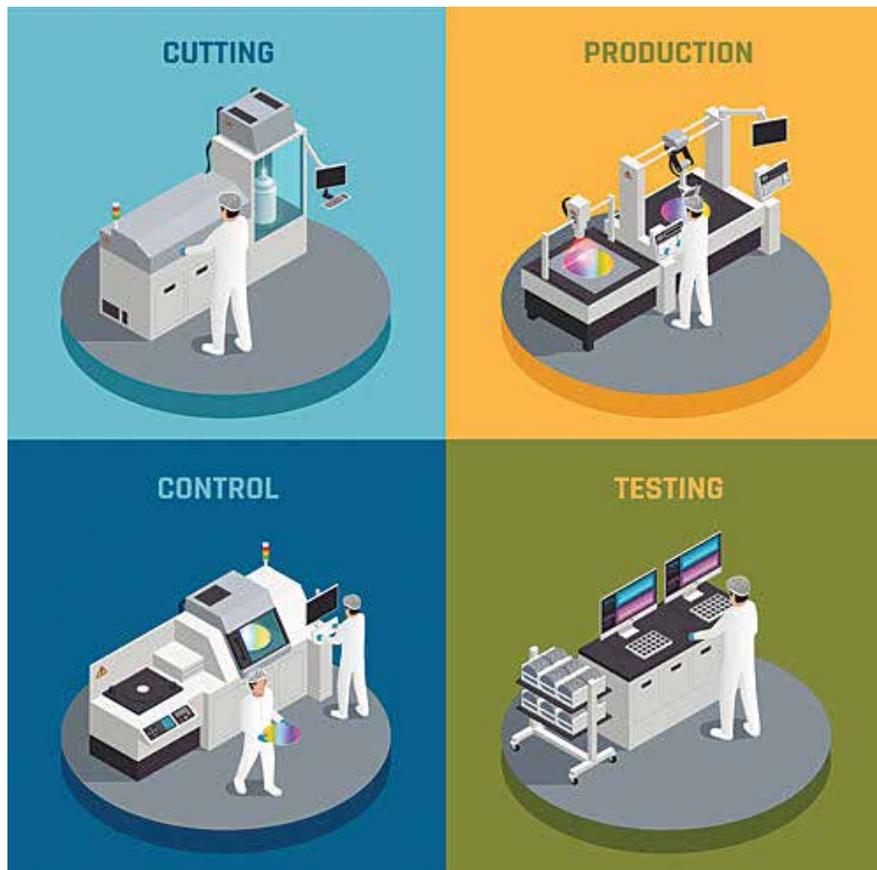
Leading automated testing machine OEMs like DeltaSigma, Cirris, DIT-MCO, Dynalabs, CamiResearch, Nexeya, CKT technologies, and others can drive testing from intelligent connectivity data. Using purpose-built wire harness design tools like Harness Builder for E3.series, design-

ers can automatically capture and produce data required to set up the test routines.

Digital Formboard with Augmented Reality Wire Harness Assembly

The harness assembly process on physical formboards or nailboards demands a great deal of set-up, maintenance, and storage overhead. The next step in the evolutionary process is to reimagine wire harness assembly fundamentals. Augmented or mixed reality has significant benefits over the traditional visualization process with 70% potential time savings. Augmented reality solutions are perfect for resolving complex assembly challenges across many domains. A

Continued from page 48



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Wire Harness Manufacturing Automation Ideas

Continued from page 47

game-changer is the on-demand digital delivery of dynamic and accurate assembly and manufacturing data.

Augmented reality systems like ProjectionWorks from DeltaSigma are leading the way in transforming wire harness assembly from a paper-based formboard into a digital formboard process. Digital formboard solutions reduce wire harness manufacturing

overheads by:

- Reducing set-up time and improving the reuse of formboards
- Removing the need to store every legacy formboard
- Lowering the impact of experience and knowledge gap between new and seasoned employees
- Simplifying the training and ramp process to bring on new employees
- Producing step-by-step instruc-



Preassembled harness, automating part of the assembly process.



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tions directly from design tools like E3.series

Automated Wire Harness Assembly

Imagine providing the interconnect details of a harness to a machine on the shop floor and receiving a complete wire harness. Although not possible yet, technological advancements bring automation options previously available in mechanical manufacturing practices to the wire harness industry. Unsurprisingly, parts of the wire harness assembly process will be manual for the foreseeable future. As a result, the possibilities for automatically assembling harnesses have been very limited in the past. Furthermore, the variations

in connector sizing, wire application, and terminations also significantly impact the automation process.

Thankfully, many manufacturers are taking up the task of overcoming the challenges. Notably, the latest automated assembly machines deliver complete wire harnesses with connectors and wire terminations. For instance, the Komax Zeta series delivers wires plugged into connectors to automate a significant part of the wire harness assembly process. Automated assembly options are ready to reduce labor costs and improve quality and consistency.

Continued on page 50

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- 1 - DDM NOVASTAR GF-12HC-HT-1611316 Benchtop Reflow Oven
- 2 - DIT-MCO 2115 Benchtop Testers
- 2 - DMC APLHATRON MPT-250B Pull Testers
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- 1 - JST Press, Model AP-K2N, w/four (4) Applicators
- 1 - KOMAX BT752 Bench Top Crimper, 2014
- 1 - KOMAX Gamma 263 Crimp to Crimp Machine, 2014
- 1 - KOMAX DPS272 Coiler
- 1 - MAJOR 5002 Bench Top Stripper
- 1 - MECMESIN MultiTest 5-I Tester, 2015
- 1 - MOLEX TM2000 Crimp Press
- 1 - MOLEX Crimping Tool, P/N 1928 60107
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Wire Harness Manufacturing Automation Ideas

Continued from page 48

Automating Manufacturing Work Instructions

Although not a production option, clear work instructions lead to higher productivity in the manufacturing process. Design teams are often left picking between two bad options. They are either manually creating work instructions or skipping them and leaving it up to manufacturing. The first option increases the design cycle and cost. The second option is worse, skipping manufacturing instructions to save time upfront only to spend time fixing issues and going back and forth between engineering and manufacturing. Either way,

the dreaded engineering change order rears its head, and the overhead around managing the ECOs adds to the pain.

Intelligent tools like Harness Builder for E3.series help design teams simplify and expedite the manufacturing work instruction creation. The balanced mix of automated and semi-automated templates caters to different requirements across projects.

Automate Printing and Labeling

Label printing for projects is an umbrella term covering markings for components, locations, wires, and other visible data. The partial automation of label printing has been around for many years with popular printers



from suppliers like Brady, Brother, Hewlett Packard, and many more. The design tool has a significant influence on the printing process.

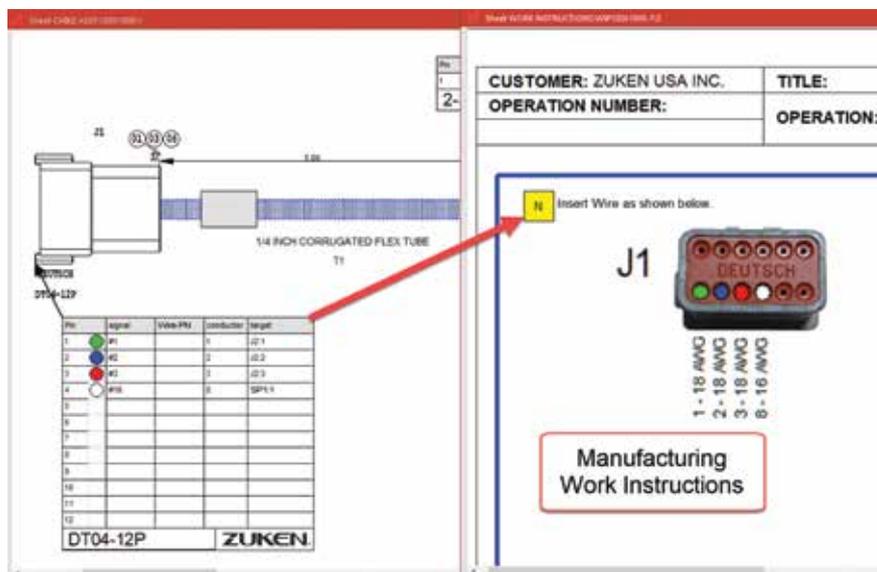
The labels play an essential role in increasing productivity and improving the overall quality of production and services. Assembly and service teams need clear indicators for components, locations, wire identifiers, and critical equipment data. Using solutions like E3.series, design teams can automate multiple printing requirements. The data captured during the design process is readily available in multiple formats to drive the labeling machines.

Conclusion

Automated manufacturing, testing, and assembly options have a huge potential to positively impact every aspect of the design to manufactur-

ing journey. Considering labor shortages and price pressures, companies willing to act early stand to gain a significant advantage. However, the most critical step in the manufacturing automation journey is to produce accurate data capable of driving the automation. Above all, an intelligent design tool is a prerequisite for adopting efficient automated processes. The E3.series design suite offers unmatched capabilities to augment the assembly and manufacturing process quickly while reducing errors and design overheads.

Many thanks to Sanu and his team at Zuken for compiling this article. You can check out more automation solutions on the Zuken website, or visit them at the EWPT Expo at booth 618.

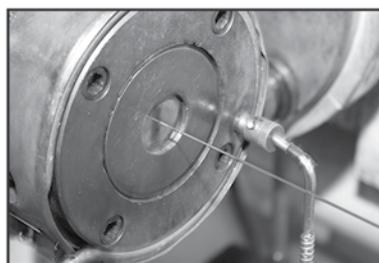


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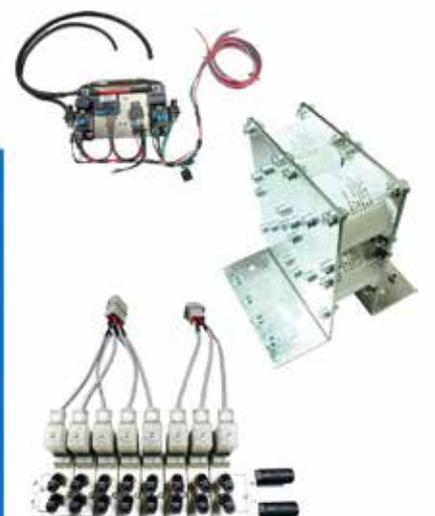
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Are You Still Building Birdhouses?

By Joe Tito
Wiring Harness News

At the WHMA conference in Tucson this past February, I ran into Scott Morris of Marsh Electronic's/MarVac Assemblies division. He was getting ready to host a roundtable discussion entitled, Qualifying & Quantifying New Opportunities. The purpose of the discussion was to exchange ways to prioritize new opportunities and juggle existing customers in these troubling times of supply chain issues and personnel shortages. This is a not new problem for MarVac, and it's unlikely that it's new for most companies. But activities of the last two years have really brought the issue to the forefront.

Scott discussed the early days of MarVac and how it has led to some of their current challenges. In those early days, they grew the company by taking orders for assemblies that other companies did not want to build. "Heck, we probably would have built bird houses if someone had asked us — we had lumber, we had nails, we had hammers..." he joked. "The same thing that got us here is actually hampering our growth." Scott confirmed this issue is currently front and center at MarVac.

I arranged a conversation with Scott and Steve Banovich, Manager of Mar-Vac, after the show to discuss some of the ways they are dealing with the constraints. "The goal is not to take anything away from our top 25 customers," Scott said. If you build a \$1000 assembly for a \$1000 a year customer, or if you build that same assembly for a \$4 million a year a customer, it takes the same amount of time and resources. And once you accept that order, you are morally, ethically and somewhat legally bound to make it," he asserted. As such, MarVac is taking a more critical look for better opportunities that align with their core competencies. "If you invite the wrong people to the wedding, eventually somebody

is gonna step on the brides dress," Scott analogized.

MarVac is trying to create a better sales funnel/filter so the opportunities that come in fit their overall strategy for growth. They are introducing guidelines to their salesforce to help them better define a well aligned opportunity. Scott indicated it can be quite a balancing act, however. There are no hard stops, and they try not to push back too hard. They want to sharpen their focus without undermining their enthusiasm. "We want to look at opportunities that make the most sense for us in allocating our resource-

es. That's not to say we want to close the spigot off for everyone, we just want to be smarter about how we go forward."

In order to achieve their goals, MarVac has had to say goodbye to a few customers. "It's a multi-pronged approach," Scott described, "and we've already invited people to the wedding that we shouldn't have, so we are setting up some criteria for when that business comes up for quote again."

Steve realizes that many of their competitors may be slightly ahead of them on this,

Continued on page 52

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Megomat 600

Are You Still Building Birdhouses?

Continued from page 51

but their situation as a distributor and manufacturer, requires special handling. “Marsh/MarVac is a lot different in that we are a very sizable distributor (Marsh Electronics) who also has a rapidly growing value-added center (MarVac Assemblies). There’s not too many manufacturers who have our big footprint as a distributor, so that adds to the complexity.”

Larry Manz Director of Sales & Marketing at Insource had chimed in on the original conversation and was also kind enough to share a few minutes on a follow up call. “The last two years have been very difficult. We went from not having enough people, and not sure how orders were going to continue, to realizing the world didn’t burn down, and we were still going to be building things. Orders started quickly pouring in.” he chronicled.

Insource has instituted a capacity utilization plan. They’ve looked at each customer’s utilization over the past two years and have tried to keep them at the same relative percentage. “The only way they can get more business,” Larry mentioned, “is if we find more people, which we are slowly doing.”

Like MarVac, Insource has had to release some customers.



“We’ve had to look at how they match our core competencies and, unfortunately, we have had to send some out into the greater good of society to find their next wire harness supplier.”

In making these tough decisions, Insource has had to look at not only how they fit in their strategic growth plan, but also how they contribute to the labor problem (high usage versus relatively low usage). But the main criteria tend to be financial. “Many of these decisions were based on profitability. I think we had three price increases last year, and we didn’t lose a single customer. We thought that was a lever we could pull to filter out some of those customers, but they just kept coming,” he instructed.

Larry indicated that, because of Insource’s great track record with quality and OTD, they actually have a list of past

customers who wish to be notified when capacity issues improve. “We’re currently adding people to our staff, and whenever we have an opportunity or an opening to slip someone in, I know exactly who I’m going to start calling.”

Let us know what steps you’re taking to combat capacity issues. You can email me at joe@wiringharnessnews.com. I look forward to hearing from you!

Interesting Side Note

This might be fodder for a future article, but Larry made one final very interesting point. He is hoping the sales skills Insource has perfected over the years will not atrophy during this period of customer selection. I think the mere fact that they are aware of this will help them sidestep that issue in the future.

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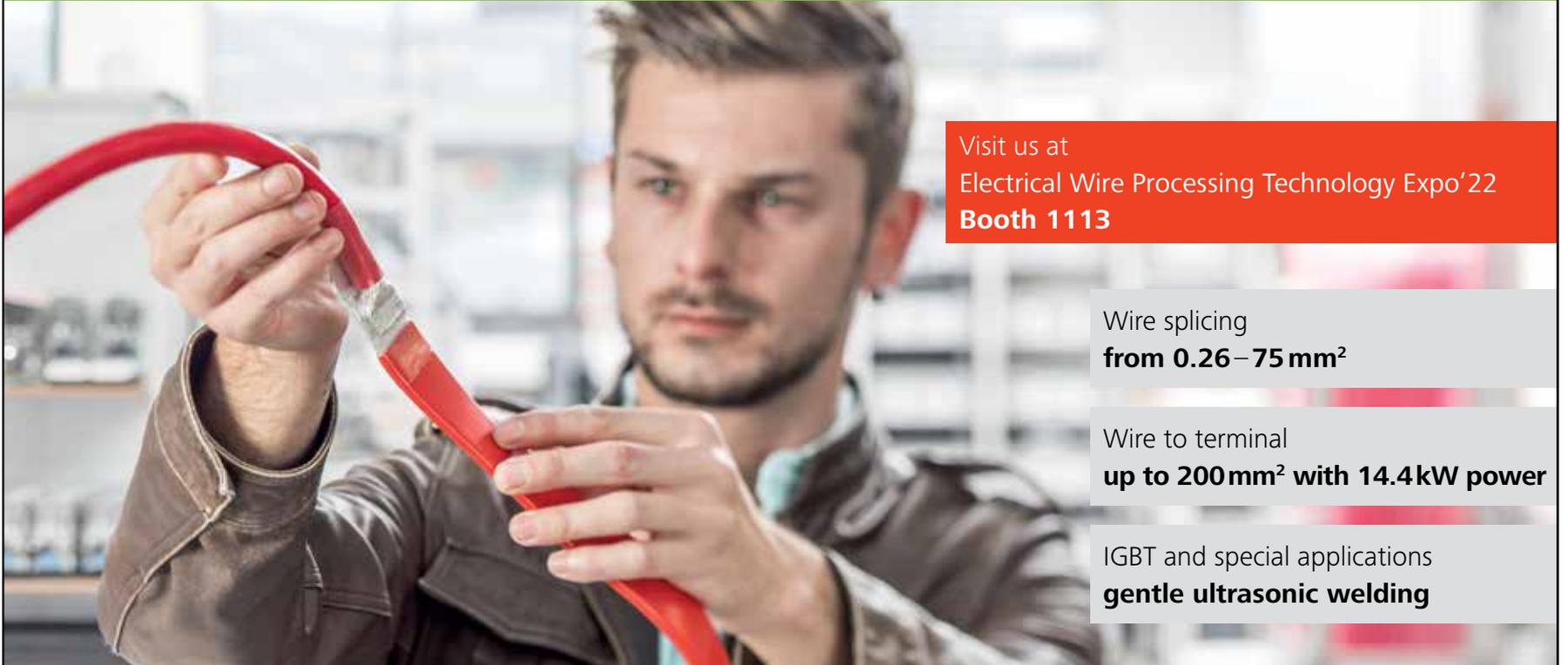
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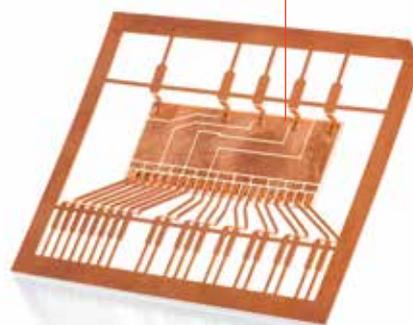


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NEWS PLUGS continued



Introducing PinMate, a Guided Wire Insertion Tool for Harness Manufacturers

DIT-MCO International, a leader in electrical wiring test equipment, introduces PinMate, a guided wire-insertion tool.



PinMate visually directs assemblers inserting wires into electrical connectors, assuring that each wire is placed into the correct cavity. Designed specifically for harnesses in which each wire has a unique wire number or ID, PinMate has proven to dramatically reduce the number of mis-wire errors found at the final electrical test. The operator enters a wire ID via keyboard or barcode scan, and PinMate utilizes a super-bright micro-projector to project a target image on the connector, clearly showing the target cav-

ity for the indicated wire. Additional instructions or information can also be projected to both sides of the connector. The operator inserts the wire into that location and repeats the process until all wires are correctly pinned. In addition to wires, PinMate is helpful for inserting spare pins and sealing plugs, which can be programmed in groups with multiple cavities highlighted at the same time.

PinMate is being jointly developed by engineers at the Boeing Defense Group in Mesa, AZ, and DIT-MCO.

David Shier, DIT-MCO president, stated, "PinMate continues our commitment to develop innovative products, providing complete quality solutions to the wire harness industry. PinMate will save time and help eliminate wiring errors. We are excited to continue to develop this product and bring it to the market."

About DIT-MCO

DIT-MCO International LLC is a worldwide leader in automated cable/harness test systems with over 60 years' experience providing test equipment for interconnect verification. Engineering, QC/QA, manufacturing, and test personnel around the world use DIT-MCO systems to verify the quality of their products. DIT-MCO testers are used extensively in the aerospace (military and commercial), defense, and transit/rail industries. Headquartered in Kansas City, Missouri, DIT-MCO has sales and service offices in the US and UK, plus authorized agents and distributors around the world.

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equipment and booters. Featuring spark plug and distributor terminals, insulation boots, and battery terminals, all of these parts are manufactured in the USA for rapid delivery.

Designed to simplify automated and manual assembly operations for OEMs and harness makers, ETCO Automotive Products can be supplied in strip form or loose. They can be stamped from brass, tinned steels, stainless steels, beryllium copper, phosphor bronze and other alloy with thicknesses ranging from 0.006" to 0.078" and tolerances to 0.0005".

ETCO Automotive Products are priced according to terminal type and quantity. Custom quotations are provided after receipt of prints.

For more information contact Sean Dunn, VP Marketing(800)689-3826, E-mail: sdunn@etco.com

THERMOMARK GO Portable Printer Controlled by Smart Device

Middletown, Pa. – The new THERMOMARK GO label printer from Phoenix Contact makes it easy to create labels anywhere. When used with the MARKING system app, electrical contractors and maintenance technicians can quickly design and print labels for wires, cables, components, or general identification on their smartphone or tablet.

The lightweight THERMOMARK GO can be used with or without a computer. It operates on a rechargeable lithium-ion battery, so there is no need for an external power source in the field. New die-cut and continuous label cartridges can be easily swapped for different types of marking.

The MARKING system app is available for free download for iOS and Android devices. It has numerous filters to search for the desired material by label type quickly. It includes smart edit features, such as the insertion of barcodes and standard electrical and industrial symbols.

About Phoenix Contact

Phoenix Contact is a global market leader based in Germany. Phoenix Contact produces future-oriented components, systems, and solutions for electrical controls, networking, and automation. With a worldwide network reaching across more than 100 countries with over 17,100 employees, Phoenix Contact maintains close relationships with its customers, which are essential for shared success. The company's wide variety of products makes it easy for engineers to implement the latest technology in various applications and industries. Phoenix Contact focuses on the fields of energy, infrastructure, process, and factory automation.



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NEWS PLUGS continued



Sequel Wire and Cable Welcomes Todd Eagan as Sales Manager, Expands Capabilities and Staff

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



Todd Eagan
Sequel Wire and Cable

Todd Eagan was sought out by Sequel and selected as Sales Manager due to his depth of knowledge and experience for 30+ years in nearly every aspect of the wire and cable supply chain and major components. His diverse background covers the process from start to finish, including cast copper rod, compounds, and commercial uninsulated and insulated wire. He understands the interrelation of purchasing, manufacturing and selling the raw materials necessary to make insulated wire. He is also just a really enjoyable person to work with who has a strong reputation in the industry.

What makes Todd a perfect fit for Sequel is his unique approach of serving as a liaison between manufacturing and the customer and treating both sides equally. He values working as partners to simplify interactions and be fully transparent, so everyone knows what to expect. Mike Frigo, CCO, shared "Todd has a stellar reputation in the industry. His granular follow-up to details and natural rapport with customers are just something you can't teach. He is culturally a fit at Sequel and is already a huge contributor."

In January of 2021, after six months of insulating products, Sequel needed to initiate expansion of product production to meet demand. As of January 2022, the Phase 1 expansion is fully completed and operational. This facility expansion doubles internal wire drawing capabilities, and raises PVC output by a third. These investments benefit the customer with shorter lead

times and better flexibility for reacting to demand. Furthermore, quality control is enhanced since the need to source uninsulated wire externally is significantly reduced. Our culture of empowering our employees to be their best and produce excellent quality products was a key to early and future successes.

Sequel is committed to constantly evaluating and reacting to ever-changing customer needs and being agile to meet that demand.

For more information on Sequel Wire and Cable, visit www.sequelwire.com, email sales@sequelwire.com, or call 574-626-1515

TE Connectivity Launches Innovative New Hybrid Inline Connector

New Generation Y 68P Sealed Hybrid Inline Connector addresses wire harness complexity in next generation passenger vehicle by combining signal, power and data connectivity into one connector

In today's data-intensive automotive environment, there is an increasing amount of electronic content in modern vehicles, which is leading to an ever-increasing cable harness complexity impacting manufacturing, supply chain, costs and vehicle weight. OEMs are therefore seeking to reduce this complexity by simplifying architectures and consolidating connections within the car.

To address this need, TE Connectivity (TE), a world leader in connectivity and sensors, has launched an innovative Generation Y 68P Sealed Hybrid Inline Connector that enables ease of manufacturing for OEMs, reduces the number of connections, simplifies supply chain complexity and reduces cost. The new Generation Y 68P is an all-in-one solution that combines signal, power and data connectivity into one connector.

"Often data connectors are found running alongside low voltage signal and power connectors creating a complex harness, which leads to higher costs, additional weight, more space and complicated manufacturing," said Kevin Presnell, product manager at TE. "The Generation Y 68P sealed hybrid inline connector is a compact and reliable solution that supports the ongoing industry challenges faced by OEMs and can positively and cost-effectively impact supply chain."

The Generation Y 68P sealed hybrid inline connector combines the robust and reliable Mate-AX mini coaxial connector with a combination of 0.64/1.5/2.8mm power and signal circuits into one hybrid connection. It is compact in size for a 68P inline connector making it an excellent miniaturized hybrid solution for inline connector consolidation.

The most common use for the Generation Y 68P sealed hybrid inline connector is applications where separate low voltage power and signal connectors are running alongside traditional data connectivity, including high-resolution cameras and displays, antenna connections, transfer of video and sen-

sor signals.

For more information, visit te.com/automotive.

TE Connectivity is a global industrial technology leader creating a safer, sustainable, productive, and connected future. Our broad range of connectivity and sensor solutions, proven in the harshest environments, enable advancements in transportation, industrial applications, medical technology, energy, data communications, and the home. With more than 85,000 employees, including over 8,000 engineers, working alongside customers in approximately 140 countries, TE ensures that EVERY CONNECTION COUNTS. Learn more at www.te.com and on LinkedIn, Facebook, WeChat and Twitter.

Herrmann appoints André Deponte as Head of International Headquarters

Karlsbad, - Herrmann Ultraschalltechnik GmbH & Co. KG is optimizing its global structures, and has made André Deponte the new head of international headquarters. Deponte is to oversee closer global collaboration to ensure a standard customer experience around the world.

The post has been created primarily in response to the increasing importance of global customers and the company's corresponding growth on international markets. To step up strategic support for the three head offices in the USA, China, and Japan, the CEO Thomas Herrmann is handing over their management to André Deponte with effect from April 1. Deponte's role is to coordinate the sites more closely to leverage resources, standardize processes, and thus secure international growth.

Herrmann is also seeking to strengthen bonding within the Group through greater exchange. The aim is to develop a global Herrmann culture over the next few years with shared values and shared objectives.

"There is only one Why for us and that is 'bonding – more than materials'". And we want this same commitment to excite customers at all our sites globally," explains André Deponte.

The qualified mechatronics engineer and experienced sales manager joined Herrmann four years ago. To date, he has been instrumental in building up the global METALS business unit and headed development of ultrasonic welding solutions for lithium-ion bat-

teries, cable harnesses, power rails, and terminals. He is to continue as the global head of sales alongside his new role. Michael Leipold, who already manages the PLASTICS business unit, is taking over André Deponte's duties as METALS global business unit director.

Three questions for André Deponte, Head of International Headquarters

1. What goals have you set yourself in your new role?

The most important goal is once again "Bonding – more than materials". We don't just want to bond materials, we also want stronger bonds between us all, which will ultimately attract even more customers. That is why we are seeking to establish standard processes in our departments, and achieve a shared understanding and common objectives to become a globally networked Herrmann family. This means building strong links between the various headquarters, and this is where I see my role as a bridge-builder and communicator.

2. What will your first steps be?

The most important thing initially will be networking with the headquarters. I traveled to the US in early March, taking part in the Culture Journey camps that we run all over the world to share our Herrmann culture with staff.

Trips to China and Japan are next on the agenda. The first thing is always to get to know colleagues better and to listen to what they have to say. What are the processes? What are we doing now, and where do differences still remain? How can we achieve a more standardized approach? Step by step, this will bring us closer together and drive globalization.

3. What do you see as the most exciting aspect of your new role?

I am most looking forward to global bonding, for ultimately, everything centers on interpersonal relationships. We have so many good ideas and so much energy all over the world. We need to harness those ideas and that energy together. How? By getting to know each other better and creating a firm basis of trust so that we can progress together as a company. The task of turning the global Herrmann team into one cohesive unit and inspiring customers around the world is hugely exciting. tool.



Herrmann welcomes André Deponte as Head of International Headquarters.

The Problems With Tinning Wires

By James Dunbar
Product Marketing Manager
PCC, Phoenix Contact USA

Having problems with tinned wires coming loose in screw terminal block? Many companies and manufacturers use the practice of solder-dipping wire ends, but this can lead to loose connections. Beyond ensuring that all screws are tightened to the proper torque specification, this document shines light on why your tinned wires are coming loose.

Moving away from tinning and exploring other ways to prepare bare wire could save time and the headache of retightening connections.

Why tin wires?

Stranded copper wires are commonly connected to PCBs or other devices with a screw-style terminal block. "Tinning" is the practice in which a stripped wire is coated with a thin layer of a tin compound. However, there is the associated problem of the wire becoming loose when used with screw-style terminal blocks.

One common reason for tinning is to prevent wire strands from fraying when connecting to the termination site. For example, stranded wires can be tedious to work with when pushing into the cage of a screw-type terminal block. In this case, there is the possibility for wire strands not to be pushed all the way into the cage, which could cause a short. If the wire will be frequently installed and removed from its termination site, the wire can become increasingly difficult to work with. Tinning might appear to be a good solution.

Why does tinned wire become loose in screw terminals?

Root Cause

The root of the problem stems from when the wire is tinned and the tin material flows into the small space in between the copper strands of the wire. This makes the copper wire and tin into a solid mass of material.



Once the wire is inserted into the terminal block, and the cage closes and clamps on to a tinned wire, the tin/wire block is compressed and can change shape. In doing so, the tin can fracture and cause wire strands to pull apart from one another, creating voids (Fig. 1). Essentially, as the wire is screwed down, it breaks apart the tin, which can start to loosen the wire. While the wire may be secure

initially, normal operation can cause the wire to become loose.

Operation and Thermal Expansion

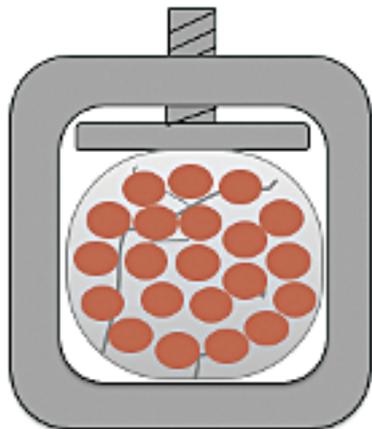


Figure 1. Cracking of crushed solder

During operation, wires will heat up and cool down as the environment heats up and/or current flows through the wire. As the wire increases in temperature, thermal expansion can be the culprit behind loose terminations. The higher temperature in the wire and the tin material causes the metals in each of them to naturally expand and take up a larger volume. However, the material properties (coefficient of thermal expansion) cause the different metals to expand different amounts. In this case, the tin material expands more than the copper cage (Fig. 2).

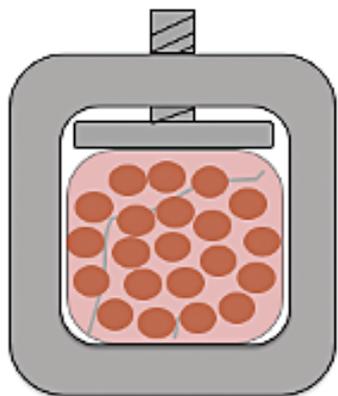


Figure 2. Thermal expansion of solder.

As the metals cool, they shrink and take up less volume. The expansion and contraction can cause the shape of the tinned wire to change slightly, and no longer be properly clamped between the cage and pressure plate (Fig. 3).

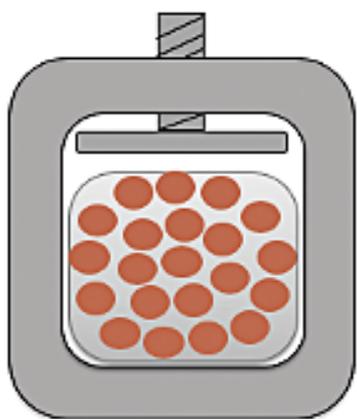


Figure 3. Cooling and loose connection

Other Common Misconceptions

Tinning wires will increase corrosion resistance.

Yes...but when the tinned wire is compressed in the terminal, the tin breaks apart, so that the connection might no longer be gas-tight. Bare wire strands will create a better, gas-tight connection, and can be a more effective way of reducing corrosion.

Tinned wires will still fit into the terminal block.

In some cases, added material will prevent the wire from fitting properly in the block. Adding tin can make the

wire larger than the terminal block is rated for. This will prevent terminal from properly closing/clamping on to the wire.

Final Thoughts

All things considered, tinning wires could be the reason for loose connections in screw terminal blocks. While tinning does have benefits, there are better alternatives that could save you the headache of loose terminations. A great alternative is to use ferrules and ensure the screws are tightened to the proper specification.

Three Reasons to Seal Electronics with Vacuum Impregnation

On average, a new automobile has approximately 40 electronic controllers, five miles of wiring, and more than 10 million lines of software code. Electronics, coils, and wires used in automobiles will expand to meet fuel efficiency and consumer standards.

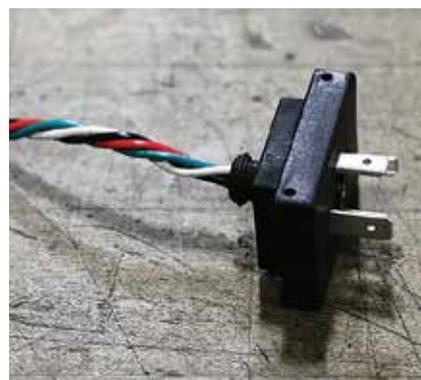


Figure 1. Metal pins and wires imbedded in plastic housing.

In these parts, metal pins and wires are embedded in the plastic housing (Figure 1). When the parts experience heat during manufacturing or normal use, the plastic and metal expand at different rates. This expansion creates microscopic voids between the materials. While these leak paths are unavoidable, they can cause a field failure if not sealed. The massive expansion of these parts in automotive electronic components has made sealing leak paths critical.

The two most common methods of sealing these voids are potting and vacuum impregnation. While potting is a popular method, the process has some disadvantages that vacuum impregnation addresses. Here are the three main reasons why vacuum impregnation is the preferred method to seal electronics.

Seal Leak Paths

Vacuum impregnation is a subsurface process that seals leak paths by filling the void between the two dissimilar materials. If not sealed, then fluids may penetrate the connector.

Vacuum impregnation prevents fluids from leaking by sealing the leak paths.

Prevent Corrosion

From either oxidation or galvanization, corrosion reduces current-carrying capacity and causes the part failure. Vacuum impregnation prevents corrosion by sealing the leak path that oxygen and moisture can follow.

Enable Design Freedom

Vacuum impregnation does not change the part's dimensions, allowing engineers to design and make parts to the net shape. Since the process does not leave any sealant on the part's surface, an engineer does not need to incorporate dimensional allowance (Figure 2).

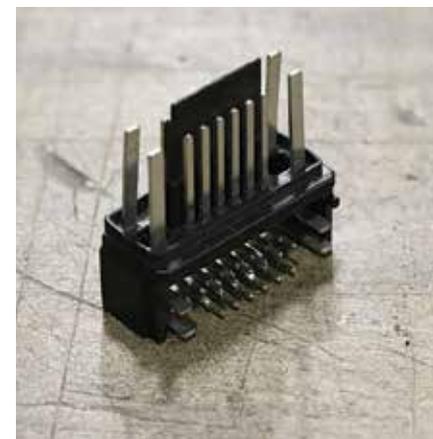


Figure 2. No dimensional allowance needed for sealant.

In Summary

The surge in automotive electronics has made porosity sealing crucial. Properly sealing the porosity ensures the component's quality meets its performance requirements. Vacuum impregnation is the most effective solution at sealing leak paths and preventing corrosion while enabling design freedom.

For more information on vacuum in pregnant and technology, visit godfreywing.com. Look for more information in future issues.

Dimensional Life of Heat Shrink Tubing

By Laura Wishart
Lectromec

We are told that low humidity and cool temperatures are the best

way to extend component life, but even in such environmental conditions not all components can sit on a warehouse shelf indefinitely awaiting the day of installation. One of the more susceptible EWIS components to aging on the warehouse shelf is

heat shrink tubing. Here, we examine the concept of the dimensional life of heat shrink tubing.

Intro

The function of heat shrink tubing is straightforward: to shrink from an initial expanded diameter to a smaller target diameter when heat is applied. When manufactured, the tubing is made at the target diameter and is then expanded as part of the processing.

In other words, the “shrunk” target diameter is the original relaxed state of the material. This provides confidence that the tubing will remain in the shrunk state throughout use without re-expanding; the material tends to “want” to shrink back to its original dimensions.

Even in controlled storage conditions heat shrink tubing will begin to gradually shrink back to its original size over time. This is a very slow process (on the order of years) but is still important for any heat shrink products held in storage for an extended amount of time.

Dimensional life is the minimum amount of time that a heat shrink product will maintain its dimensions within a defined limit and remain acceptable for use; it is similar to the idea of a product’s shelf-life.

Concepts of Dimensional Life

The detailed specification of a tubing product defines dimensional limits that the material must maintain for proper use. These dimensional limits apply to the tubing’s inside diameter

(both as supplied and after unrestricted shrinkage) and its wall thickness (figure 1). As long as a heat shrink product aligns with these limits, it is considered acceptable for use.

The heat shrink product’s dimensional life is the minimum duration the product will remain within these limits as verified by the manufacturer (and/or qualifying activity). Verification can be made at any time within the identified dimensional life by measuring the inside diameter and wall thickness of the tubing as specified in AS23053.

While the dimensional life defines the minimum duration a product is rated to maintain acceptable dimensions in controlled storage conditions, this is not the same as an expiration date. The tubing can be used at any time past the dimensional life so long as its dimensions are within the specified limits.

Extension of Dimensional Life

The manufacturer or distributor may extend a product’s dimensional life up to an additional half of the initial value if it can be verified that the dimensions of the product reliably remain within the specified limits in the detail specification for this additional duration. The maximum limit for dimensional life is 12 years, with or without extension, but the purchaser may continue to use the heat shrink product beyond that point so long as the dimensional limits are met.

Impacts on EWIS

While it may not seem like the



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dimensional life is important to consider, anyone who has had to fit a wire bundle through an undersized heat shrink tubing will say otherwise. Typically, specific parts will be identified for harness build fabrication. If the tubing does not fit, there are two likely actions:

1. consult engineering about the defect, or more likely
2. use the next larger size of heat shrink tubing.

Putting numbers behind option #2, if a M23053/7-111C replaces a M23053/7-110-C (1.050-inch and 0.963-inch inner diameter, respectively), this adds 9% more heat shrink weight. Slowly, this additional 9% stealthily erodes weight budgets and is a hidden cost of not addressing heat shrink tubing dimensional life.

In Summary

All things have their limits, heat

shrink tubing is no exception. The latest revision of AS23053 includes information on this and should be considered when selecting heat shrinking procurement type and quantity.

Contact Lectromec with any questions regarding the dimensional life of your heat shrink tubing. Our ISO 17025 accredited lab is happy to offer consultation for the selection of components in your application.

About Lectromec:

Lectromec has been a leader in wires and wire interconnect systems since 1984 and has provided expertise to the aerospace industry, both military and commercial. They help organizations worldwide improve the safety and readiness of their air fleet and reduce the costs associated with aircraft maintenance.



Figure 1: The figure shows the cross-section of a sample of heat shrink tubing both before and after unrestricted shrinkage. To verify the dimensional life of the sample at any time, a measurement of inner diameter is recorded followed by unrestricted oven shrinkage of the sample. After the shrinkage, the inner diameter is re-measured and the wall thickness is measured.

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1	28	28	16 mΩ	Pass	< 1 μA	1499 V	> 1 G	0.150 mA	996 V	7 M
2	30	30	32 mΩ	Pass	< 1 μA	1499 V	> 1 G	0.173 mA	996 V	6 M
3	32	32	63 mΩ	Pass	< 1 μA	1499 V	> 1 G	0.189 mA	996 V	5 M
4	34	34	125 mΩ	Pass	< 1 μA	1499 V	> 1 G	0.204 mA	996 V	5 M
5	36	36	249 mΩ	Pass	< 1 μA	1499 V	> 1 G	0.204 mA	996 V	5 M
6	38	38	500 mΩ	Pass	< 1 μA	1499 V	> 1 G	0.200 mA	995 V	5 M

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M-Expo Wire Processing Technology Expo 2022

By Christine Siebert

WHMA/IPC is excited to announce that they will produce the M-

EXPO Wire Processing Technology Expo in 2022. M-EXPO is now in its 4th year and its first year as an independent wire processing event. The expo will take place on September 27-29, 2022, at the Complejo Polanco in Ciudad Juárez, Chih., Mexico. M-EXPO is the first wire processing exhibition in the Ciudad Juárez region. This event was created as a response to the industry's request for a focused and exclusive show for

the wire and cable processing industries. In addition to providing greater value to its manufacturing and supplier members through WHMA/IPC, M-EXPO offers cutting-edge education access for the Northern Mexico Maquiladora Wire Processing Industry. By providing attendees with the opportunity to participate in free WHMA/IPC seminars on IPC/WHMA-A-620-related standards and the new Wire Harness Operators (WHO) program, as well as visiting first-hand with suppliers in their industry, this is an event they will not want to miss.

There is no better expo at which to exhibit if you are looking to expand your business in Northern Mexico. M-EXPO gives you the opportunity to showcase your latest wire and cable processing equipment, tools, materials, and technologies to Mexico, the Maquiladora Industry, and the State of Chihuahua - the "Wiring Harness Capital of the World"!

M-EXPO is taking reservations for exhibit space and can accommodate more than 50 exhibitors. Heller-Tyton, Lapp Tannehill, Schleuniger, Schunk Sonosystems NA, Strunk Connect, Wardwell Braiding, etc., are among the exhibitors who have already committed. Booth spaces are still available, but they are quickly filling up.

As one of the main benefits of working with M-EXPO, CSI LOGISTICS will handle all of the logistics and move of materials and equipment to and from the M-EXPO site. CSI LOGISTICS is an El Paso company that specializes in border logistics, packing, and freight to and from Mexico. All you have to do is get your equipment and tradeshow supplies to El Paso, and CSI LOGISTICS takes care of the rest!

As you consider exhibiting at M-EXPO, bear in mind that Ciudad Juárez has massive potential and tremendous interest in wire and cable processing equipment, tools, materials, and technologies suppliers and distributors. M-EXPO is an incredible opportunity for suppliers/equipment manufacturers to exhibit to qualified decision makers of international firms and national businesses.

For more information on M-EXPO, visit www.mexpowire.com or contact Alicia Balonek, IPC/WHMA senior director, tradeshow & events, at AliciaBalonek@ipc.org.



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



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EXHIBITION: September 28-29, 2022

Complejo Polanco
Ciudad Juárez, Chih., México

Event Organized By:



ABOUT M-EXPO WIRE PROCESSING TECHNOLOGY EXPO

Now in its 4th year, M-EXPO is the premier exhibition for wire processing in the Ciudad Juárez/El Paso region providing an opportunity to **learn, grow, share, and discover** new approaches to many aspects of the wire harness industry.

M-EXPO is produced by the Wiring Harness Manufacturer's Association (WHMA), the **ONLY** trade association exclusively representing the cable and wire harness manufacturing industry including manufacturers, their suppliers and customers.

WHY ATTEND?

M-EXPO will feature expert-led training and education focused on the cable and wire harness manufacturing industry. You will have access to the industry's leading suppliers featuring the latest equipment, tools, materials and technologies for the wire and cable industry.

WHY EXHIBIT?

Put your latest products, services and innovations in front of key decision makers. M-EXPO offers you a unique opportunity to gain important prospects, make new contacts, and establish a presence for your company in the most cost-effective way to reach this qualified audience.

LOCATION

The El Paso/Juárez region, also known as the Wire Harness Capital of the World, is a key part of the global supply chain and home to over 300 maquiladoras, 25% of whom focus on wire harness and cable related industries.



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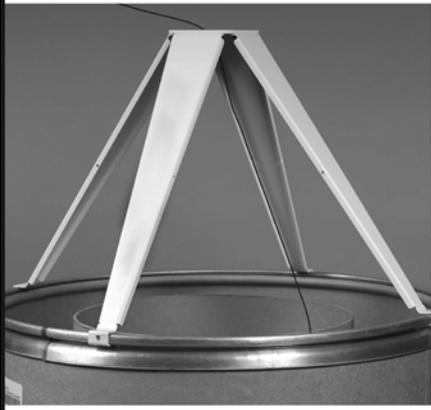
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