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September October 2022

INDUSTRIAL INFO-TAINMENT

# Company Profile: Heltronics

**By Joe Tito**
**Wiring Harness News**

Without fail, the final minutes of the final hour of the final day of the EWPT Expo bring us some new opportunity. This year it was Daniel Helder, CEO/Owner of Heltronics. Daniel stopped by to compliment us on our publication. Since no good deed goes unpunished, I asked Daniel if he would let us interview him for an upcoming issue. He agreed, and we subsequently set up a call.

Heltronics is a contract manufacturer in Reading, PA. They build custom wire harnesses, electromechanical assemblies, and control panels. We will explore much more about the business, but a better place to start is Daniel's unique background.

Daniel's father was stationed in Germany while in the U.S. Air Force. During his seven-year post, he met Daniel's mother and decided to stay in Germany, eventually working for Motorola. "So, I was born and raised in Germany and have both German and U.S. citizenship. I went to college at the University of Applied Science in Offenburg which is on the German side of the French border," he detailed. There, he received a degree in Electromechanical Engineering. Just before graduating he received a job offer in Washington DC working for the Federal Highway Research Center (FHWA), a part of the DOT, as a research engineer. "That was what I wanted to do anyway – see more of the world and move to the USA."

A few years later he moved to South Carolina where he went to work as an Engineering Manager for a large electromechanical relay manufacturer. After another job in Portland, Oregon and six years working for others, he felt the tug of entrepreneurship, and began to explore opportunities. "I figured purchasing an existing business would be easier than starting one, especially from the banks perspective," he explained.

Daniel was made aware of a business in Reading, PA through a broker.

**Owner, Daniel Helder, reviewing the lead maker setup.**

They were building custom electromechanical components, control panels and some harness and cable assemblies. "The really odd thing is that this is where my dad grew up before he joined the Air Force and moved to Germany, and suddenly this business pops up in Reading." Daniel called his dad who advised him that Reading was a nice place to live at least back when he was growing up, so Daniel did his due diligence and purchased the business in 2018.

The business was called Wunsch Technologies and they did a lot of work for the military, especially for high-speed communications. The company was started in 2008 and had always stayed about the same size with little reinvestment.

Since the purchase, Daniel has made a number of changes. "I took over at the end of 2018, and we moved about a year and a half later to a new larger location. We have been growing ever since and I've been keeping the money in the company. We purchased a lot of capital equipment and have made many operational changes to become ISO 9001 compliant," he cited. Even with the move to the larger facility, they have begun to outgrow it and have started to use space in an adjacent unit.

From the beginning, Daniel and his team have been pushing the wire harness side of the business. They invested in fully automated equipment including Komax cut/strip/crimp machines, an automated battery cable cutting machine, ultrasonic welders, applicator tooling and plenty of bench-top processing equipment.

*Continued on page 18*

# Komax Receives Clearance for Combination with Schleuniger

Nothing now stands in the way of the combination of Komax Holding AG and Schleuniger AG announced on 9 February 2022: The relevant competition authorities have granted clearance. The next steps will be the closing of the combination on 30 August 2022 and the implementation of the associated capital increase, which was approved by the Annual General Meeting on 13 April 2022. The 1,283,333 newly issued registered shares will be allocated to Metall Zug AG in exchange for 100% of the Schleuniger shares and traded for the first time on the SIX Swiss Exchange on 31 August 2022. Metall Zug AG, the current owner of Schleuniger AG, will then hold a 25% stake in Komax Holding AG. Consolidation of the Schleuniger Group will take place from 1 September 2022.

Implementation of the capital increase will make two further proposals approved by the Annual General Meeting effective from 30 August 2022: Dr. Jürg Werner will become a member of the Board of Directors of Komax Holding AG and the existing restrictions on registration and voting rights (15%) for Komax Holding AG shares will be abolished without replacement.

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# September/October 2022

## FEATURES



## IN EVERY ISSUE



**EDITORIAL CONTENT MANAGER**
Joe Tito
joe@wiringharnessnews.com
Phone (407) 739-9811

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

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# Can you please help our friend, Tim Crider?

*Tim Crider, Komax*

Dear Reader,

We were saddened to learn that one of our industry friends, Tim Crider, has recently been diagnosed with ALS (aka Lou Gehrig's disease). ALS is a rare disease with no cure or treatment. It is a progressive and terminal disease that affects nerve cells in the brain and spinal cord causing loss of muscle control. It is extremely costly to manage (up to $200,000 per year).

As you can imagine, this diagnosis came as a shock to Tim and his family. We cannot begin to understand what they are going through as they grapple with the uncertainties in their future.

The only thing we can do is take steps to improve Tim and his family's quality of life. A GoFundMe page has been set up on Tim's behalf. It is fully supported by friends and family, Komax and by Wiring Harness News. Tim has been a tremendous resource to us and an overall friend to the industry. Any donation will help and would be greatly appreciated:

**https://gofund.me/be7e44c6**

**Thank You,**

The Team at Wiring Harness News

Please share with others in our industry!

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**Schaefer Technologies LLC**

751 N. Raddant Road
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# Intricacies of High Voltage Cable Processing

Since the 1970s, little has changed in automotive wiring. Manufacturers have added more wire and connectors, but everything still ties to legacy 12-volt systems. Thus, the architecture has remained basically the same. That is until the advent of HEVs and EVs. We have all heard the forecasts and read the OEM press releases about the coming electric fleets. And electrification doesn't end there. Startups are testing and marketing electric buses, trucks, aircraft, lawnmowers… you name it and there is an electric version.

That's really changing the landscape for cable assembly suppliers. A greater understanding needs to be gained about the intricacies of working with large diameter cable. To learn more, we scheduled a zoom call with Martin Rosten, Global Sales and Field Service Director at TE Connectivity based in Bensheim, Germany. To say Martin is an expert on the subject would be an understatement. He's not only studied it, he's done it.

**Martin Rosten, TE Connectivity**

Following was our Q & A session with Martin.

*WHN:* Let's start by defining a large diameter cable.

*Martin:* We usually define large diameter wire as anything over 10 mm² (6 AWG). The wire size is actually a function of the current needed in the vehicle. Hybrids go up to 150 amps and require about 30 mm² wires. Complete battery electric vehicles have a much higher current requirement – up to 300 amps. There, we are already seeing sizes of 60 mm² to 90 mm². Even up to 120 mm² cables will likely be common in the future.

*WHN:* What is the typical construction?

Martin: The high voltage cables themselves are very different from low voltage wires. They are comprised of multiple layers (Figure 1). Typically, you have an inner conductor with an inner insulation. Then you have an electric screen which is usually a tin-plated copper braid and, most often, a foil over top of that. This is to prevent the very high currents being carried in these high-voltage cables from interfering with the data connectivity or other systems present in the vehicle. And then finally, the cable has an outer jacket which is usually an orange silicone. Orange is the standard color to differentiate high voltage circuits in vehicles.

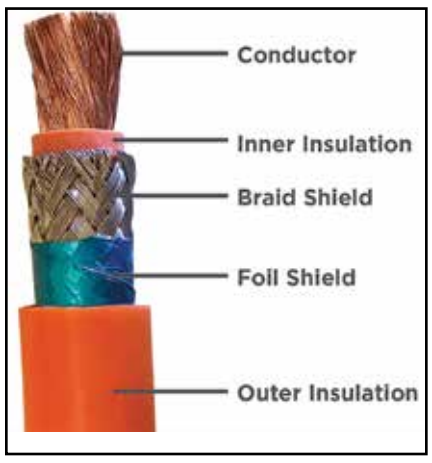


**Figure 1. Components of a typical shielded high-voltage cable.**

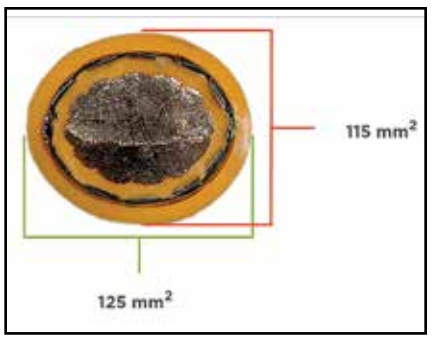


**Figure 2. Example of "Footballing" in a 120 mm² cable.**

*WHN:* How are large diameter cables different as it comes off the reel?

*Martin:* The first thing that you will notice with high-voltage cables is what we call "footballing". Because these cables are extremely large and heavy, and fed off fairly large spools, you get this footballing effect (Figure 2) which is basically where the wire end becomes slightly oval in shape. So, the first thing you have to do when you're preparing the wire for a high-voltage cable is to make it perfectly round again. *

*WHN:* How is stripping these cables different?

*Martin:* You have more or less four separate processes that you need to carry out to get the wire ready for crimping. First is removing the outer jacket. The secret here lies in cutting deep enough so that you don't risk tearing the insulation, but not so deep as to damage some strands in the copper braid underneath. That can cause a very unpleasant short circuit in the high-voltage system.

Continued on page 8

# High Voltage Cable Processing

Continued from page 6

Once you get rid of the outer jacket, you need to remove the shield. First comes the foil which is basically a metal coated plastic tape. That has to be done very cleanly because you can't have any of that inside the connection area between the ferrule and the braid. Once you remove the foil, you need to cut the copper braid itself. This must also be done very cleanly. Also, the braid has to be flared so that you can crimp the ferrule over it before you crimp the terminal to the inner conductor.

Finally, you have to strip the inner jacket. Like the outer jacket, you have to be very careful that you cut deep enough so you're not tearing the insulation, but not too deep to risk nicking the inner conductor, which could cause issues to the electrical characteristics once you've completed the crimp.

*WHN* What are the crimp challenges with large cables?

*Martin:* Obviously the main difference is the force needed to crimp wires of this size. With low-voltage wire, you're typically crimping at less than 3000 lbs. With high voltage cables, you'll be crimping around about 10,000 lbs. for midsize wire (upwards of 6 gauge) and then you can be as high as 40,000 pounds for the larger cables like the 90 and 120 mm². I would say most high-voltage terminations at the moment are in the 10,000 and 20,000 lb. range in terms of crimp force.

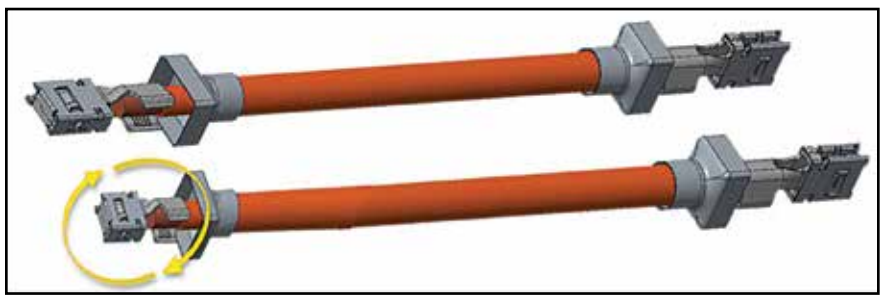

**Figure 3. Example of "clocking."**

The next difference compared to small wire sizes is what we call "clocking". It's very important to know exactly where the center line of a conductor is because, if you can imagine, it's almost impossible to twist a high-voltage cable. For long leads, you have some give in the cable. But for shorter leads and asymmetric terminals, the terminals will need to be installed in the proper orientation compared to the terminal on the other end of the cable (Figure 3) & this is what we mean by "clocking" the conductor.

The third difference to look for with crimping high-voltage cables is extrusion. Extrusion happens when you crimp any wire size, but obviously the larger the conductor cross-section, the more significant effect. Just to give you an idea, a 70 mm² wire will extrude about 5 mm. So, it's very important to take that into consideration when you are calculating exactly where the wire needs to be inserted prior to crimping. Again, this is more important for shorter cable assembly lengths.

The last issue I want to talk about with respect to crimping, is cracking. Cracking can occur when crimping very large size wire terminals. It's particularly unpleasant because you usually can't see it with the naked eye. The only way you can detect it with a cross section analysis, so you really want to avoid any risk of cracking.

Usually cracking happens for three reasons. First, it can happen if you over crimp the wire. That's why it's very important to follow the manufacturer's recommendation for the crimp height. It can also happen if you are using inappropriate wire sizes. So, for example, if you're using a wire which is too big for the terminal, you might get cracking. Finally, and most important, it can also occur if the crimp cycle is too fast. We have found that in crimping very large wire sizes, that speed is very important. That's why TE, and other high-quality crimp presses, have adjustable speeds. Typically, the larger the wire size the slower the optimal crimp speed.

In rounding out the discussion of crimping, I should mention that ultrasonic welding is also being used quite a bit in high-voltage terminal connections. With ultrasonic welding, you avoid some of the challenges that I've just described with crimping. However, ultrasonic welding is a costly capital outlay. It's also slower than crimping and it requires very high levels of energy. It's definitely an option, but I would say the majority of high-voltage connections today are still made with the crimping process.

The last area where we have a significant differential compared to small wires is the handling. That's quite simply due to the sheer weight of these high-voltage cables. Just to give you an idea, A 50 mm² cable that is only 2 m long weighs 1.5 kg. That really does limit how you manipulate these cables in the assembly area. You can't form large bundles of wire as you might with small wire sizes. It would just be inconceivable to move such a weighty assembly. This also limits the extent to which high-voltage cable production can be automated.

Continued on page 10

# High Voltage Cable Processing

Continued from page 8

There are some automated cable processing systems already on the market. Komax and Schleuniger, among others, are producing fully automatic systems, but I would say that the majority of production of high-voltage cables assemblies is still carried out using semi-automatic equipment. This is simply due to the fact that production volumes are relatively low for the time being. That, coupled with what I was just saying about the difficulty of handling such heavy cable assemblies, means that semi-automatic processing is also more easily integrated into an existing harness assembly plant.

We do see full automation coming, that's for sure. Most forecasts show the volumes increasing very significantly after 2030 which will make the necessary investments to automate much more cost effective.

*WHN:* What advice would you give manufacturers to be successful with high-voltage assemblies?

*Martin:* I guess I would start with the most obvious and that is you need to use high-quality tooling. It's very important that the tooling is easy to set up, and that it's going to be stable to allow consistent crimping quality.

Another point to mention with high-quality tooling is you will typically get much more durable and longer lasting wear parts. As you can imagine wear parts for these very large crimp applicators are quite expensive. The longer they last, the better the economies in the production cycle.

Also, the applicator has to be set up correctly. You have to use a skilled operator who understands how the applicator needs to be adjusted. It's very important this operator follows the manufacturer's recommendations for the correct crimp height to avoid the issue of cracking.

And then, as a follow on to high-quality tooling and correct set up, we do absolutely recommend you use a good CQM (crimp quality monitor). Given the safety critical nature of high-voltage assemblies within the vehicle, as well as the cost of that assembly, it's very important to ensure that you are crimping correctly and consistently. As a complement to the CQM system, we at TE are also able to offer a vision control which is integrated into the press (Figure 4). It scans the terminal, the wire and the applicator. It basically ensures that everything is in the correct position

**Figure 4. TE's Integrated Vision System.**

before the crimp is carried out. It will also allow you to visually inspect the crimp terminal once the crimp cycle has been completed, verifying that both the terminal and all the other components are in the correct angle and in the proper position.

Next, we would strongly recommend harness manufacturers equip themselves with a high-quality cable prep machine. It doesn't really make sense to economize there because you're going to end up with a high scrap rate. High-voltage cables and terminals are extremely expensive compared to low-voltage. You will definitely benefit by reducing the scrap level to an absolute minimum.

And then the last comment that I would like to make here is that a high-voltage cable assembly is made up of multiple different components, many more so than a low-voltage connector and cable. So, you really need to think about the order that you're going to assemble these parts and ensure the assembly area is well prepared and has the right tooling for each individual operation. And if you do that, you'll certainly find that you will be able to make significant improvements in the speed of production of these cable harnesses.

** Martin mentioned it would be quite complex to explain exactly how TE does that in this article. He did mention that the patented technology TE has developed for their HV-CP cable prep machines ensures that the cables are returned to a round shape before the final incision is made. We will explore further in a future article.*

*Many thanks to Martin Rosten, and also to Michael DiLeva, Director of Communications – Technical Transport Solutions, for facilitating the interview. Special thanks to Deanna Mccoy, External Communications Consultant at TE who always comes through in connecting us with awesome experts at TE!*

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# THE POWER WOMEN OF THE WIRE HARNESS INDUSTRY

**By Melissa Femia**

Melissa Femia

This edition of the Power Women series features, Estefania Fong Garcia. Estefania was born and raised in Guaymas, Sonora, Mexico. Throughout elementary and secondary schooling, she consistently achieved excellent grades in all subjects, including math and science. Since she is very fond of children, she aspired to become a teacher. Estefania explained that during her preparatory, or high school, education, she focused on classes for students planning to attend college within the scientific/mathematical field. Commonly in Sonora, students choose their fields of interest and select course agendas to complement their interests to prepare them for college or work in that field. Since she intended to teach math or science, the curriculum for a teacher in these subjects was also relative to the coursework for students intending to pursue engineering. As a youth, however, she had many conversations with her aunt, who has an engineering degree and works at a wire harness company. Her aunt continued to expose Estefania to engineering, often sharing work activities, experiences, and challenges. By the time that Estefania was ready to enter college, her aunt successfully provoked the engineering interest in Estefania. Not only did Estefania find engineering and problem-solving interesting, she also had so much admiration for her aunt that she desired to follow in her aunt's footsteps.

Deviating from the original plan to study teaching, Estefania enrolled in the Industrial Engineering Program at the Universidad Interamericana de

Continued on page 14

# The Power Women of the Wire Harness Industry

*Continued from page 12*

Guaymas, a private college located in her hometown. As with many engineering programs in Mexico, her program was a 3-year format, attending the full year (no summer break). During her first 2 years, she worked evenings with her mother selling lottery tickets at a stand in town. During her 3rd year of college, Estefania joined St. Clair Technologies, a wire harness manufacturer located in Guaymas, Sonora. Her student experiences at St. Clair Technologies continued to fuel her fire in engineering. She is thankful to have worked for an excellent boss, Leonel Torres, who not only supported her but provoked ideas and challenged her as much as the other male students. She also appreciated the company, as it not only focused on corporate performance and financials, but also had a strong emphasis on employee satisfaction and growth.

Estefania's first assignment was in the tough environment of production. In this area, her responsibilities were focused on meeting the daily production goals while assuring high-quality wire harnesses. She participated in continuous improvement activities to reduce waste and improve efficiency. She collected data to report downtime and scrap, then worked with the management team to utilize the reports for improvement purposes. She was also responsible for working with management to ensure that the employees followed their work instructions and safety protocols.

After graduating, Estephania continued to work for St. Clair Technologies until she received an opportunity to follow her previous boss to a newer, female-owned wire harness manufacturer, Jana Diversity Solutions (J-D). Since J-D and St. Clair Technologies have a strategic partnership whereby J-Di began to produce harnesses that were not an optimal fit for the St. Clair strategic sales plan, Estefania was a strong candidate for the products and environment at J-D. Once in the role of Process Engineer, she began to focus on new product launches. Her assignments included installation of new build areas encompassing line balancing and process flow, while minimizing necessary build space. She coordinated the construction of new assembly fixtures, implemented lean techniques, and employed continuous improvement methodologies. She also strengthened and further applied her knowledge of IATF-16949, Six Sigma, and core tools.

After nearly two years in the role, she was promoted to Process Engineering Supervisor. She now performs the various process engineering responsibilities, but also focuses on developing and supporting her team. She has significant exposure to the top levels of her company, where she and her team often present highlights of continuous improvement and cost-mitigating activities.

**Estefania Fong Garcia**

When I asked Estefania about her collegiate experience, she advised that of 23 graduating seniors in her field—only 3 were female. However, she did not experience any negativity, nor did she feel excluded due to being female. Along with maintaining a job, Estefania was also an event coordinator at the school for two years and interacted with other females through those activities. Once joining St. Clair along with 9 other students in engineering, she was one of 2 females. Again, she touts that she had a very supportive boss who did not treat the women any differently from the men and provided them all with excellent guidance and growth opportunities. Estefania was smart enough and tenacious enough to make the most of her opportunity!

Also, in talking with Estefania, I noted that she was raised by a single mother who did not have a prominent or high-paying career. Her mother felt bad that Estefania had to work through school and at a young age. However, she developed a hard-work ethic and overcame all obstacles, creating her own success story. As a Hispanic female, she is atypical and a member of an underrepresented group in engineering. If she could choose a career again, she would select the same path and advises others to consider engineering, as well. The opportunities are endless and there is so much pride in breaking the paradigm of male engineers, especially in machismo Mexico.

*If you are interested in sharing the stories but missed the original WHN distribution, the articles are available on the Jana Diversity Solutions web- site 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*

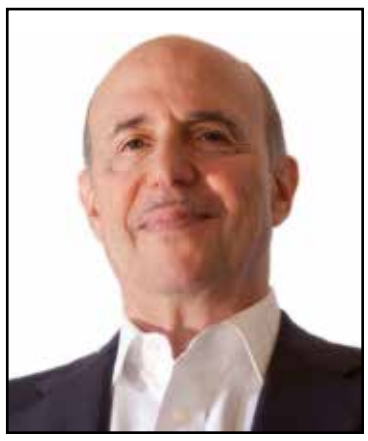
# M & A 101:
## *Lessons learned from decades of deals*

# The Perils of Due Diligence

**By Loren Smith**

I'm frequently asked about due diligence, which is the routine process of confirming everything a buyer is told and shown initially when considering the acquisition of a harness company. While this process is standard, all companies go about this information gathering differently. The process is usually quite demanding. But it's much smoother if a seller never asks the following two questions when confronted with a request.

- Why do they want that information?
- I already communicated this.



**Loren Smith CEO**
**Blue Valley Capital**

As a buyer moves through the diligence process it's his right to request any information he needs to confirm his decision– in any format. Asking why a buyer wants this information is not productive and can waist time. Even though a seller might think he previously answered a question or provided the requested material. an answer is still needed. The failure to provide timely cooperation by asking questions like these can sour the process.

Due diligence is not fun but doesn't have to be unpleasant, and unless information requests are greeted with "no problem", I'll get back to you"" the process can be very wearing.

Despite my early warning, occasionally a harness owner will greet information requests with one or both of these questions. When this happens, the process can quickly become confrontational it can even spin out of control and become adversarial, making it much harder to get to a closing.

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

# Heltronics

Continued from page 1

"We have some pretty heavy and sophisticated machinery, especially for the size of our company." Daniel indicated they could at least double their business with the current setup.

It has been a challenge to build that cache of equipment, but Daniel and his team have been able to purchase a lot of it used. "For a young company, it's not easy to fork over $30,000 for an ultrasonic welder, for example. But being an engineer, and always liking to repair things, I've been able to buy used equipment, or parts of equipment, and put them together and they've been working fantastic," Daniel emphasized. Except for the large automated Komax machine, they have been able to purchase almost everything on the used market, modifying most for their purposes.

Heltronics started with the legacy products produced under the previous ownership. These were mostly electromechanical assemblies, PCBs for industrial and military communications and some harnesses. They still continue to build those products, but almost all of their growth has been in harnesses for other markets. "Surprisingly, we have found ourselves with many new customers in specialty automotive, especially in support of the trucking industry."

Continued on page 20

**Soldering components to harness assembly.**

# Heltronics

Continued from page 18

Daniel pointed out they do well with small to medium sized companies with small engineering departments. "Usually, they come up with some kind of drawing and ask us how we can build it more cost effectively with more readily available parts. That's especially important with supply chain issues, and so we end up doing the final drawings."

In addition to Daniel, there are two engineers on staff. "One is a little more production centered, and one is more R&D oriented, working on new projects. But we all work together engaging with customers and working on solutions."

A lot of Heltronics' new business comes through their website, but Daniel is also receiving many inquires through his WHMA membership. Google searches are also very helpful, and the company is at the point where word-of-mouth inquiries are beginning to build at a healthy rate. They have also exhibited at a Design-Build Expo held outside of Philadelphia and plan to attend more of these events.

**Wire harness assembly with fully automatic testing.**

Their location in Eastern Pennsylvania has provided them many opportunities in the specialty automotive and trucking businesses. But the geographic nature of their business is beginning to change. Small and medium size companies well outside their region are beginning to discover them. "There is a company out of Norway, and we build harnesses for their drones used for industrial purposes like power line inspection," Daniel listed. He speculates the company is trying to break into the U.S. market and aligning themselves with burgeoning suppliers.

Other exciting projects at Heltronics are in support of companies with emerging technologies. One of their new customers is requiring harnesses for fully automated lawnmowers "It's not a huge chunk of business right now, but its growing and we are very excited about it.

Daniel and his team are also very proud that an automotive company offered them most of their wire harness business due to the previous vendors' long lead times and lack of communications. "Since the harnesses were made by suppliers in Mexico, process improvements and optimizations were needed so that we could manufacturer the assemblies more cost effectively. We were able to win the bids and reshore the harnesses with lower pricing and quicker turnaround time, usually from 3 to 6 weeks, depending on the harness," Daniel added.

Daniel pivoted to why he thinks the company has been so success-

**Production Manager, Rich Sanders, verifying the applicator crimp specifications.**

ful since the transition. "We stepped away from dealing with penny-pinching purchasers early on. Our slogan is 'Your Manufacturing Partner' and that's what we are really looking for – partners," he stressed. "We are not afraid to invest in equipment for a specific order and we are dedicated to keeping components and finished goods on the shelf so we're not a bottleneck for our customers."

Recently, a key customer shared that they love Heltronics' flexibility and ability to expedite products that were not even on the schedule.That's the kind of feedback Daniel is looking for and is quick to share with his team members.

Prior to Daniel buying the business, there was little attention to efficiency. "When they took an order, they would go into the stockroom and physically count the different connectors, terminals, and wires to determine what they needed," he recalled. To achieve Daniel's vision for the future, they hired an experienced wire harness engineer to oversee production. They also purchased an ERP system, cross-trained employees, and implemented many lean initiatives. As a result, they have been able to increase sales at a steady rate, while keeping the number of team members relatively constant.

Daniel is convinced that much of their success the past couple of years can be attributed to their more experienced and mature staff members, as well as the company and team culture. In fact, he has a few members of staff who are at or beyond retirement age. "I'm probably the second youngest one here and we have a lot of people 50 and above. These folks want to continue to be involved in our workplace and enjoy the environment here."

We rounded out the discussion by exploring what makes Heltronics an outstanding supplier to their customers. "I think one of the things that has defined us over the past couple of years is we've been able to look at a drawing and give customers suggestions for equivalent parts that are readily available and are still certified to UL, CSA or whatever they require. The feedback we get is that their larger harness suppliers have been unwilling to work with them like this, and that's how we have gained many customers," Daniel revealed.

The ability to be nimble with quick turnarounds has also endeared them with many if their recent new customers. "We have done a lot of stopgap orders for large companies lately. We just did a very large battery cable order for a well-known boat manufacturer. They just couldn't get it in a timely fashion from anyone else. But for us it was a quick and easy process." Heltronics hopes to see more orders from this customer.

In just a few short years, Daniel and his team have transformed this small business into a powerhouse of capability in the harness industry. They have managed to reshore a great deal of business and continue to build a strong foundation for growth. It will be interesting to check back with them in a couple of years to see where their partnerships lead them.

**Wire splicing with ultrasonic welder.**

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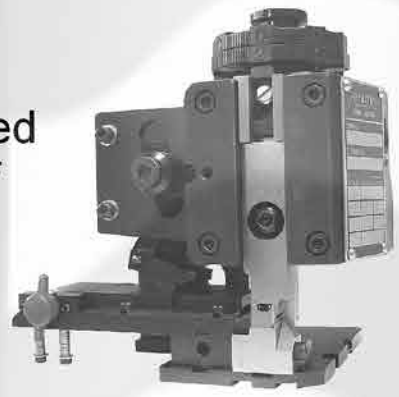
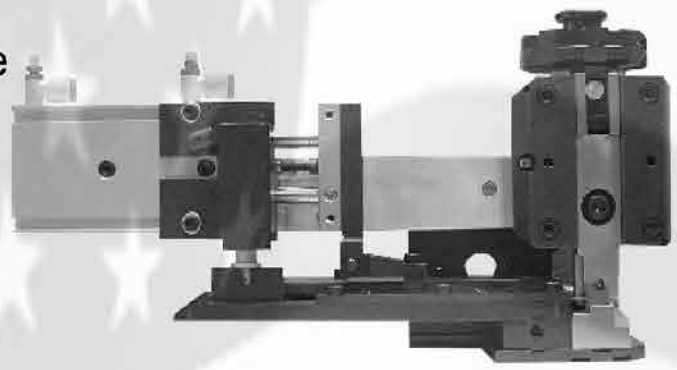
Mini style applicators with mechanical feed mechanisms are supplied in a variety of feed configurations. Adaptable to most crimping presses.



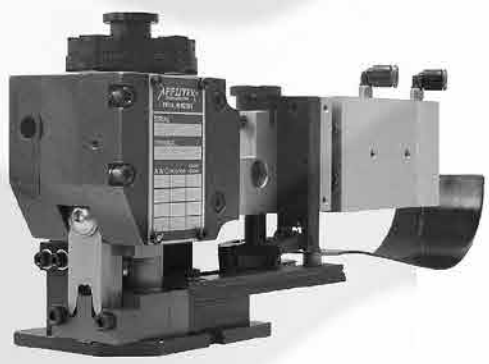
Model 1700

Model 2000

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

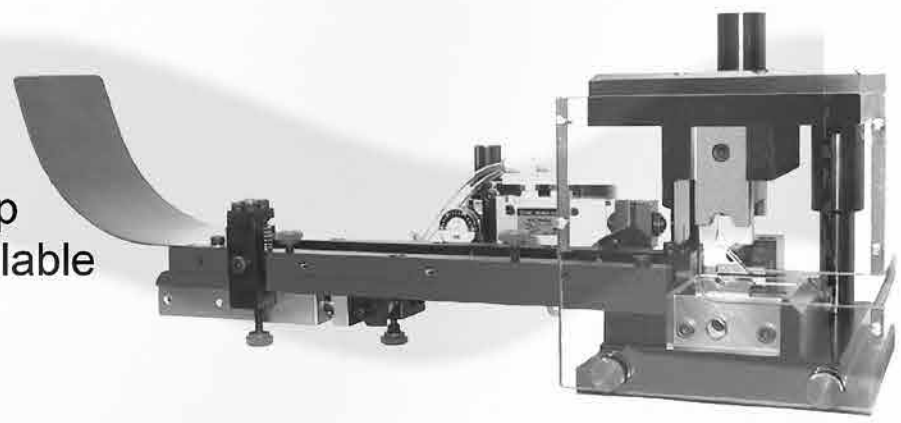


Model 1500



Model 2100

DSA applicators are designed for large terminals manufactured from heavy gage material with center to center distances up to 3 inches and widths to 3.5 inches. Available in left to right, right to left and rear feed configurations.



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# Processing Electric Vehicle Heavy Cables

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

The EV market is growing exponentially and is expected to grow approximately up to 27.5% by 2030.This new industry is slowly being introduced into the existing wire harness global manufacturing realm.

EV vehicle's power train as well as their sophisticated electronics have introduced specialized wire requirements into the traditional wire harness mix alongside other traditionally processed wires and cables.

In this article I'm focusing on one kind of these new specialized types of wires, and how they impact traditional manufacturing methods. I call these wires "heavy layered cables" (or HLC for short). Figure 1 is a depiction of those wires, (the flattened layer graphic is for further illustration).


**Figure 1. Heavy Layered Cables**

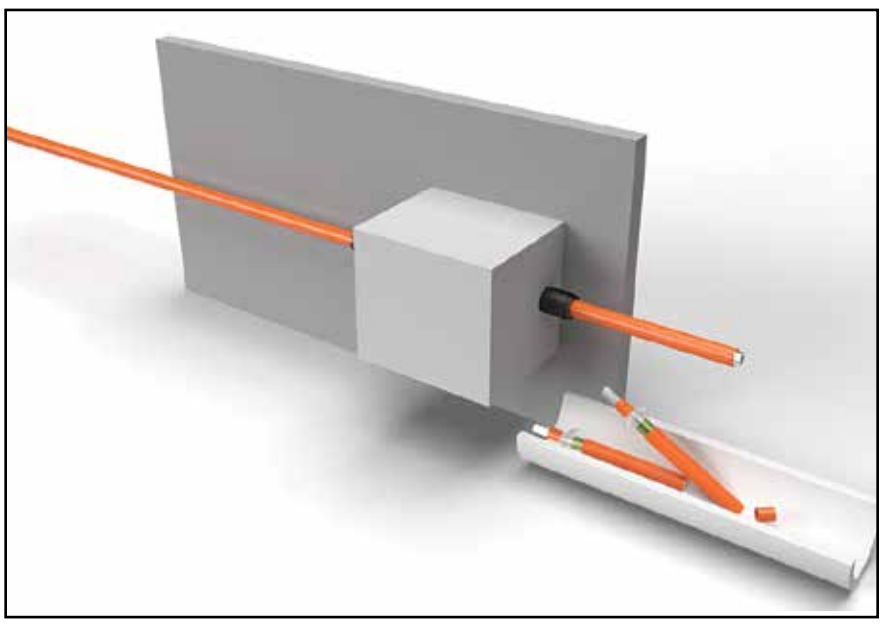

**Figure 2. Inline Processing of HLC Wires.**

Because of the layered construction of these wires, a multi-function processing approach is needed. Our current manufacturing in-line processes are sufficiently capable to handle traditional fuel-based vehicle single-layered cables. But with the advent these heavy, multilayered cables in many instances, the in-line processing equipment capabilities have been overwhelmed. That's because an in-line full process machine for HLCs requires all the necessary processing modules be contained within a common multi-process "toolbox" built around the physical perimeter of these wires. That can be an extreme challenge (Figure 2).

Multi-function processing also means labor intensive manufacturing methods. However, labor intensive manufacturing approaches also include challenges in coordination, precision, floor space, operator training and so forth. Because of this, new manufacturing equipment designs, and advances are being developed. These machines, in contrast to in-line processing, are based on the lateral processing method. This automatic processing system allows the equipment to have individual processing modules intended to work on each one of the layers of the HLC separately and individually. This reduces the complexity of designing a single multifunction processing module. (Figure 3 Page 25).

*Continued on page 25*

# Processing Electric Vehicle Heavy Cables

*Continued from page 23*

**Figure 3. Lateral Processing of HLC Wires.**

**Figure 4. Clockwise from top left, peripheral bayonet and tangent slicers.**

**Manufacturing challenges.**

By far one of the major challenges that EV wire manufacturers face is the exposure and/or removal of each single layer. Each layer presents differences in material and thickness; thus, the tool used to expose or remove these layers has to have the design capability of doing so. The tools currently being used are rotary slicing blades. Although there are many distinct OEM designs, we can classify them into three major types shown in Figure 4:

- Bayonet.
- Tangent.
- Peripheral.

**Periphery slice cut and slug removal.**

**Slice cut.**

Bayonet and tangent slicing blades are designs used for rotary processing systems that allow penetration adjustability by programmable adjusting parameters on the equipment's processing module. This achieves precise cuts on each one of the layers. On the other hand, the round geometry of peripheral slicing blades is sized for a specific layer, based on the layer's cut perimeter. So, for each layer to remove or expose, you would need individually sized peripheral slicing blades.

**Layer removal.**

Once you have cut into each layer, the next challenge is to remove the resulting slug. In order to do this, you either use the pushing method or the pulling method. The vast majority of the current stripping modules use the pushing method to do this. Which method to use strongly depends on the material's property as well as the dimensionality of the material Itself. Materials such as films are exceedingly difficult to remove since they are extremely thin and neither a push nor pull approach works 100% of the time. Woven materials such as shields are also difficult to remove because of their loose construction and thinness. Shield layers are normally folded back to expose the subjacent insulation layer.

**Insulation slug removal.**

Heavy layered cables for the EV powertrains require sufficient flexibility for efficient installation in the available space in the vehicle. Flexible insulation material has "rubbery" qualities. This translates into elasticity and compressibility characteristics. The combination of the elastic attributes of the insulation with the conductor core structure complicates the slug removal operation because

*Continued on page 27*


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# Processing Electric Vehicle Heavy Cables

Continued from page 25

there is synergy between them. The size of these wires requires hundreds of filaments to make the conductor core. As we all know, tightly twisted cores require more material per inch as compared to loosely twisted cores. For this reason, these wires contain "bunched" filament cores. Bunched cores are notoriously prone to uneven concentricity. They have peripheral filaments located either by themselves or in bunches away from the apparent core periphery. In order to avoid cutting or damaging these "satellite" filaments, the operator may sometimes limit the penetration parameter of the tangent rotary blades. This action creates a significant area around the core which is not physically separated from the insulation's cross section. Even if allowing the operator to cut through the satellite strands, there still is an untouched cross section leftover around the remaining peripheral strands which is still attached to the rest of the insulation sleeve (Figure 5).

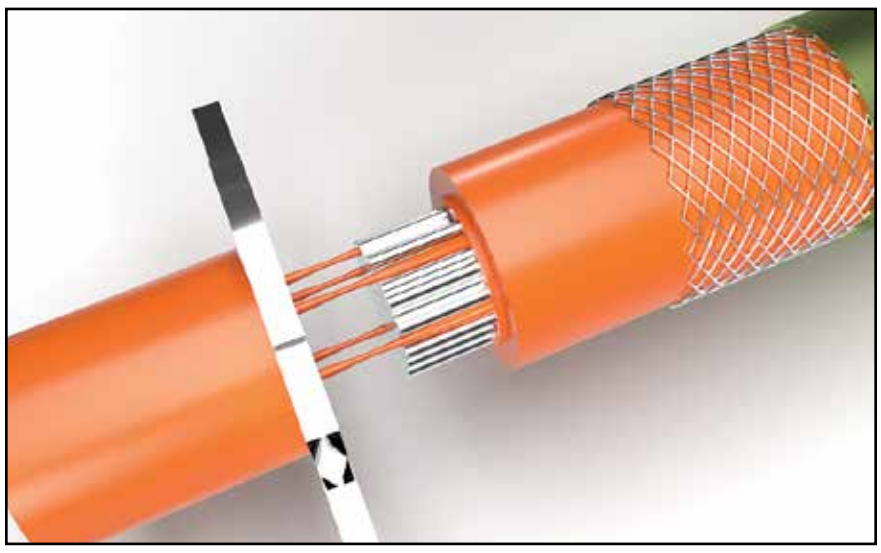

**Figure 5. Closeup showing attached cross section insulation elastic strands being pulled in the stripping action.**

**Elastic attributes, mechanical.**

Some elastic materials are made out of randomly oriented cross-linked polymer chains such as the model depicted in Figure 6. The mechanical and thermal characteristics of these types of plastics inherently work against the slug removal process. In mechanical terms, pushing against the material compresses the polymer molecules. This action increases the wrapping force exerted on the underlying conductor core thus making it more difficult to cleanly dislodge the slug. Pulling against the material "unravels" the polymer molecules and extends the length of the material while reducing its cross section. When the elastic material gets close to its failure or rupture point, the polymer chains increase their resistance to the point that you need to exert added force to overcome the molecular resistance to split apart. The elongation limit of the material is dependent on its composition but an elongation of 115% (my own experimenting with a physical sample of an insulation section) at resting length is very possible.

**Elastic attributes, thermal.**

Rubbery materials present a particular reaction to heat. Increases in temperature cause polymer molecules to compress and loss of heat loosens the molecular structure. I am not knowledgeable on the exact methodology used to manufacture these wires, but I would assume that considerable heat needs to be applied to the raw plastic material in order to make it fluid enough for the extrusion process. I would further assume that (because of the heat) the extrusion process deposits compressed polymer chains around the core periphery, forming the insulation cover. The resulting product is a wire which ultimately presents an insulation sleeve exerting some de-

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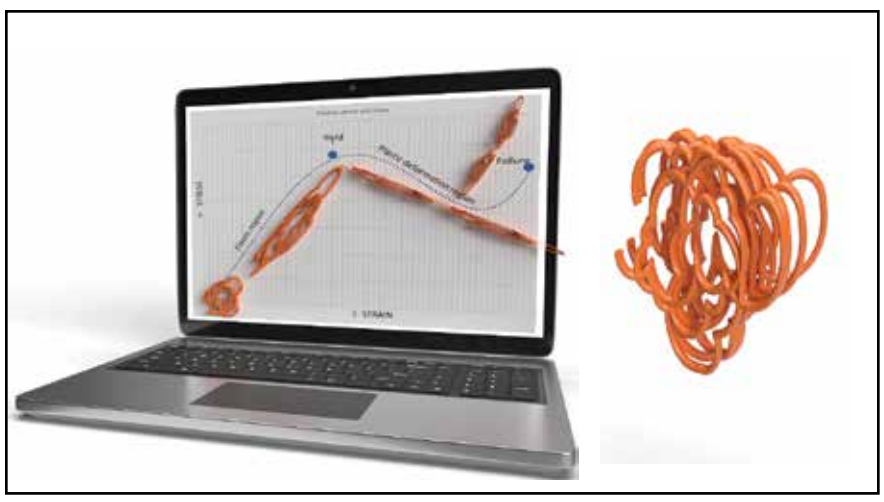


**Figure 6. Model of cross-linked polymer chain molecules.**

# Schleuniger to Exhibit Latest in Wire Processing at Expo WireTech

Schleuniger, Inc., a global technology company and innovative solutions supplier to the wire processing and testing industry, will be exhibiting at Expo WireTech, the largest expo dedicated to the electrical harness industry. The 2nd annual event will be held on September 7-8, 2022 at the Expo Chihuahua Convention Center in Chihuahua City. Schleuniger will be at booth #46 providing hands-on demonstrations of innovative solutions for stripping, cutting, crimping and marking all types of wire and cable.

New for 2022, Schleuniger will be demonstrating its newest stripping machine, the Strip Series B300.The portable, high-performance B300 opens up new possibilities for fast and reliable stripping of wires with cross-sections from 0.03 to 8 mm2 (32 to 8 AWG). Repeat accuracy, mechanical precision and short process cycles ensure high productivity in common stripping 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 powerful, efficient, and user-friendly stripping machine with an excellent price-performance ratio.


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.

Additional equipment will be on display including the CrimpCenter 36 SP, SawInspect System 6, EcoStrip 9380, and CoaxStrip 6380. Several of Schleuniger's Sales and Technical Service experts will be on hand to discuss any and all applications and to offer feedback on Schleuniger's complete line of wire processing solutions.

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.

# Processing Electric Vehicle Heavy Cables

Continued from page 27

gree of compression force over the core's peripheral area. This compression force thus plays a significant role in the difficulty dislodging the insulation slug, given the inherent coefficient of friction between the insulation material and the subjacent core metal. This would be especially apparent on longer slugs.

**Sleeve compression factor of elastic material.**

So how would you measure or at least have an idea of how difficult it can be to dislodge an elastic insulation slug? One method I devised is to compare the circumference dimension between the mounted sleeve and the dislodged sleeve (Figure 7). The assumption would be that the mounted sleeve material is being stretched around the underlying core periphery. As such, it is under tension, but this tension force is not enough to break the polymer chains. When you remove the slug off the core (or underlying layer), the molecules relax and shrink the sleeve to their natural at-rest circumference length. Comparing the at-rest length to the mounted peripheral length, gives you a percentage factor which suggests how tightly the insulation is wrapping the underlying layer. I have tried this method with a few wire samples which I know were problematic to process. I found that this "compression factor" fluctuated between 6% to 14%. The common denominator between these samples was that they all had problems being dislodged by means of a rotary blade "pushing" them off. It was most problematic trying to dislodge them using bayonet or tangent type slicing blades. Peripheral slicing blades were more successful but would fail when there was variation of concentricity between different lots of the same wire being processed.

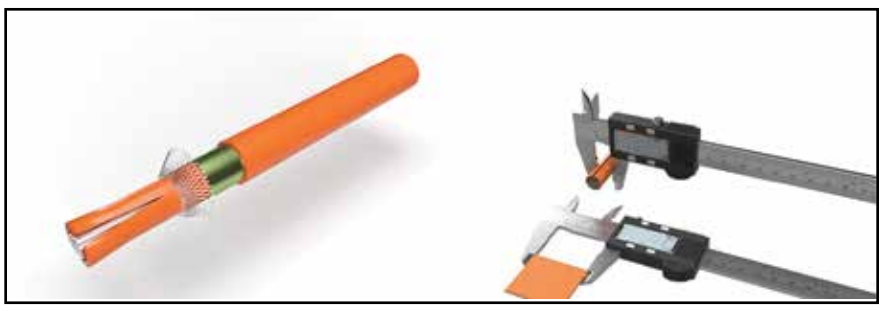


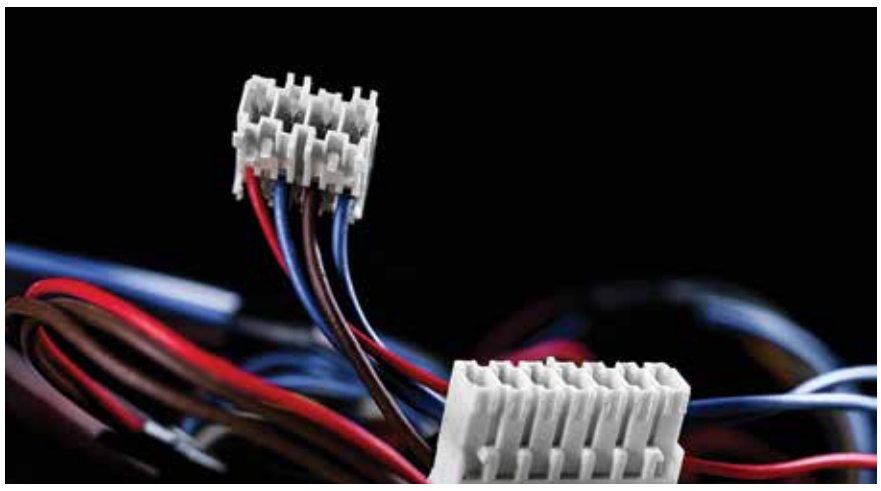
**Figure 7. Caculating the compression ratio between stretched (mounted) insulation and removed and flattened insulation slug.**

The formula for calculating this compression ratio (CR) is

$$CR = (1 - \left(\frac{measured\ width\ of\ flattened\ removed\ insulation}{\pi * average\ insulation\ diameter\ while\ mounted}\right)) * 100$$

More successful and routine automatic processing of these types of wires is in the near future as improvements in the individual lateral process modules of modern equipment are implemented by the OEMS as a result of real time experience in the manufacturing floor. Meanwhile, the alternate solution is to apply manual labor or bench processes to these problematic issues.

# Ensuring Wire Harness Connection Reliability in Electric Vehicles



Wire harnesses in cars are often compared to the human body's circulatory and nervous systems: Both are responsible for transmitting critical energy, signals and information. Utilizing 5G, AI, and IoT technologies, tomorrow's electric vehicles (EVs) and autonomous vehicles will send more signals, process more data, and make more decisions, than ever before. The average car features more than seven hundred connector assemblies that support thousands of individual terminals and this number is expected to increase to over one thousand connectors in the next few years with the addition of these new technologies. This poses OEMs with a new set of engineering challenges and added risk as a new potential point for failure arises with each additional connector added to a vehicle.

In EVs, high-current connectors are required to transfer power from the battery to the motor. Charging station plugs are another example where the reliability of high-current connectors are crucial to the operation of hybrid vehicles and EVs. When it comes to EVs and increasing autonomy levels from advanced driver-assistance systems (ADAS) to full autonomy, these failures can result in much bigger issues than just a quiet radio. Traditional mechanical and hydraulic systems are being replaced with electronically controlled systems like brake-by-wire and steer-by-wire technology. Connectors also play a critical role in transmitting a wide range of electronic data and control signals that are required for safety features like pedestrian detection, lane departure warning, automatic emergency braking, and blind spot detection – all of which must operate without a hitch.

The failure of wire harnesses in EVs can pose safety issues, increase recall and warranty costs, negatively affect technology adoption, and impact brand reputation. Therefore, preventing connector failure should be a top priority for design engineers. Corrosion, fretting, water intrusion and high insertion force are all factors that can lead to connector failure. Luckily, all these issues can be prevented with specialty connector lubricants.

**Protect Against Corrosion**

The automotive environment challenges even the highest quality connector. Corrosion protection will become even more important as EVs and their components often get higher usage and are expected to last longer than vehicles with traditional internal combustion engines.

Many connectors in EVs must survive heating and cooling cycles as well as water, road spray, and road grit. Power mirrors, door locks, and other external systems are exposed to rain, snow, and car wash detergent solutions. High levels of humidity can also threaten connector performance between door panels.

All of these conditions are catalysts for oxidation and corrosion, which create resistive oxides and in turn result in intermittent faults or electrical failure. Connector grease acts as a seal to protect connectors against water, dirt, and other corrosive elements that can lead to power failure. For automotive assemblies, a connector grease with good water washout and salt spray properties are recommended.

**Reduce Insertion Force**

When a thin layer of grease is applied to a connector, it reduces friction between the connectors which eases mating. If mating force is reduced, it puts less physical strain on assembly workers — keeping the manual assembly force within the legal limits set by OSHA and reducing the risk of work injuries such as carpal tunnel syndrome that may occur when repeatedly mating connectors with high force. Insertion force isn't just a problem on the assembly line, high insertion force can also negatively impact the quality of connections. Even though most connectors have a locking mechanism, high insertion force can prevent proper mating, resulting in increased electrical resistance or a separated connector. A properly selected lubricant lowers insertion force by decreasing the coefficient of friction between mating surfaces. It reduces mechanical wear by placing a film of oil between the mating surfaces. Lower insertion force ensures solid connections and reduces the physical strain on assembly line workers, which can reduce worker compensation claims.

**Prevent Fretting**

One of the most common reasons for electric connector failure is fretting corrosion – when electrical ter-

Continued on page 33

# Ensuring Wire Harness Connection Reliability in Electric Vehicles

*Continued from page 31*

minals and contacts become worn after exposure to micromotions from vibration and/or thermal expansion caused by heating or cooling cycles. Throughout the vehicle, connectors are subject to vibration from the road surface, engine, drive train, suspension system, and other related components. Micromovements wear through metal plating into the base metal that then oxidize, eventually creating an open connection and ultimately, power failure or signal loss. As this oxide layer builds up, it acts as an insulator between the contacts, increases the electrical resistance and voltage drop across the terminal and may eventually result in an open circuit and total loss of connection and conductivity. Fretting corrosion has been reported on some of the most popular connectors used today for ADAS, including FAKRA, USB-A and USB-C connectors.

Sometimes, unmating and re-mating connectors may solve intermittent power failures. However, unless a connector lubricant is applied, the connector will continue to wear and will eventually oxidize and corrode. Connector grease has two primary benefits. The grease reduces physical wear between the connecting surfaces as they undergo micromotions and fretting wear. This wear reduction preserves the connectors' layered coatings designed to prevent oxidation and minimize resistance. It also insulates the system from the surrounding environment, preventing insulative oxide layer buildup, which increases resistance and signal loss.

Although connector lubricants are nonconductive, they still allow the microscopic asperities of the contacts to transfer signal and power, while filling in the valleys of the connectors where oxides and wear debris can form. The insulative or dielectric properties are especially important in multi-pin connectors where excess conductive grease could cause a short between the pins (just like water).

### Connector Grease in Action: Preventing Thermal Failures

Wire harness issues can have serious consequences. A prominent Automotive OEM had to fix a quality issue with the vehicle headlights after the electrical resistance increased in the connectors of the wire harness powering the headlights. This caused the connectors to overheat and presented a potential fire hazard. To prevent the same issue from occurring, the OEM came to Nye Lubricants in search of a grease that would prevent an increase in connector resistance in their new headlight harness.

Short circuits may occur if connector terminals become corroded, worn, or oxidized. Nye provided the OEM with 25-gram tubes of their industry leading connector grease, NyoGel® 760G. The OEM was pleased with the results and was able to distribute the grease to dealerships around the country.

*About Nye Connector Greases*

*For more than 25 years, OEMs like Ford, General Motors, Navistar, Paccar, and Chrysler have been protecting their contacts with NyoGel® 760G, the universal, industry leading connector grease. NyoGel® 760G is just one product in our complete line of connector greases formulated specifically to address high temperature and high vibration operation. In trucking, automotive, and marine applications, it is particularly important that the lubricant within your assembly can withstand harsh environmental conditions. To address these needs, our connector greases have superior salt spray resistance with little water washout or grease evaporation. With some wire harness assemblies, material compatibility can become an issue as you must ensure that the lubricant will not eat through plastic components. NyoGel® 760G, along with our other connector greases, are resistant to harsh chemicals and are compatible with a wide range of plastics and elastomers.*

*As a trusted supplier, we work directly with design engineers to form a partnership and assist with the selection of the proper grease to ensure performance even under the most demanding operating conditions, avoid warranty claims, and prevent costly, time-consuming repairs. For applications outside of the automotive industry, we also offer specialty connector greases with low outgassing properties or biocompatibility to meet the unique requirements of wire harnesses in aerospace, semiconductor manufacturing, and medical applications. To accommodate different requirements, Nye offers a variety of grease packages to suit both high-volume production dispensing and small volume manual dispensing. If you would like to learn more about how our connector lubricants can work in your wire harness assembly, please contact Jeff Wheeler at jwheeler@nyelubricants.com*

# Understanding PowerWheel® for EV Cable Terminations

**By Saeed Mogadam**
**Telsonic Solutions**

Ultrasonic welding of non-ferrous metals has been a proven technology for decades. However, since the early 1980's, ultrasonic metal welding has dominated the automotive industry, with automotive wire harness manufacturers as the single largest user of the technology. Due to its efficiency and unbeatable quality, ultrasonic welding replaced mechanical crimping and resistance welding for all car brands almost immediately upon inception. The utilization of ultrasonic welding for automotive wire harnesses has seen even more rapid growth in the last decade due to the increase in electrically powered vehicles (EV). Telsonic's innovative and industry changing torsional welding technique has in large part contributed to this rapid growth due to its unrivalled ability to address challenges such as weld size, welding in smaller areas, geometrical shapes, reaching the weld area, orientation of welding, and vibration effects on peripheral components.

Telsonic's Torsional welding technique has overcome many of the current limitations in longitudinal welding and has created breakthrough applications that were previously considered impossible or not up to quality standards prior to last decade. Now, the technology is increasingly specified by carmakers for use in EV for weight control, battery packaging, cable to terminal connections, bus bars, battery manufacturing and power electronics.The higher power and faster charging of EV batteries requires larger battery cables with, sometimes, unconventional connectors. Telsonic's PowerWheel® welding technology, which utilizes torsional welding, provides a solid assembly solution that satisfies the high-quality requirements in the Automotive industry.

### Challenges of Longitudinal Welding with Larger Cables

There are several obstacles one needs to overcome when welding larger cables.These can include:

1. The larger the weld width, the better the transfer of vibrating energy to join the cable and the connector. However, as there are limitations for the connector, there are also limitations on how large the sonotrode (vibrating tool) can be. In addition, the wider the weld width is, the more nicking of the strands can occur at the transition area of the weld. The connector's surface area, geometrical

shape, and the weld orientation will add to the challenges even further.

2. The larger the cable to be terminated, the larger the generator power and welding force need to be. For cables sizes of 150 mm², we need generators with power above 10 KW and forces up to 8,000 Newton. Such high force is not sustainable for conventional welders if it is not a direct force to the weld area. Otherwise, significant bending of the sonotrode makes it impossible to create consistent weld quality between the cable and the connector.

3. Conventional welders allow one orientation and thus create limitations for differently design connectors and orientation of the welding. Telsonic's PowerWheel® allows more freedom for accessing the parts to be welded due to the orientation of tooling and vibration, creating a solution for each of these challenges. The tooling orientation of PowerWheel® allows welding on surfaces that are otherwise hard to reach with conventional welding.

**Figure 1. Nicking of Cable Strands**

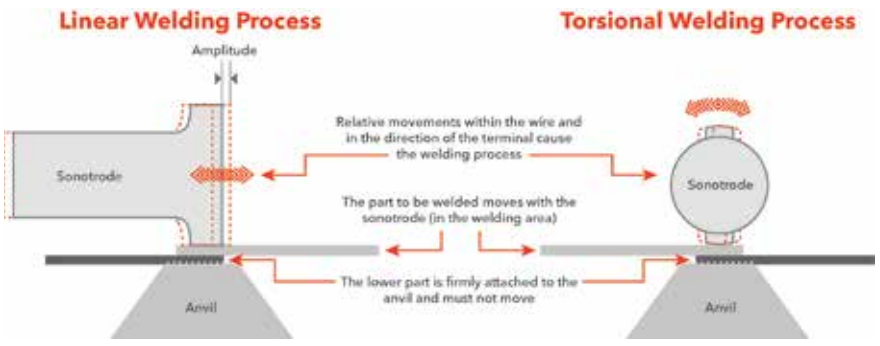



**Figure 2. Basics of Linear and Torsional Welding**

4. Even if none of the above challenges are present, there is always one quality criteria that can be an issue to meet. The relative movement of sonotrode, known as amplitude, is how the scrubbing/friction between the parts interface is created. (see Figure 2). Conventional welding amplitude is highest at the welding transitional area. This can be an issue when welding larger cables at a prespecified weld width and high power and force. The higher amplitude near the start of the weld nugget causes nicking of the cable's strands due to extreme extrusion of strands (see Figure 1)

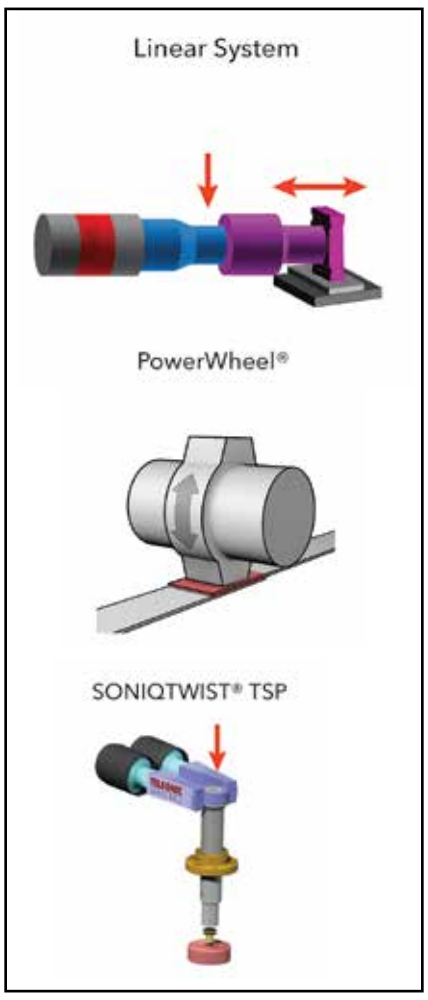
### How Linear and Torsional Welding Work

Figure 2 demonstrates the basics of how longitudinal (Linear) welding works and is essential to understanding the differences between traditional longitudinal and Telsonic's innovative PowerWheel® welding technology.

- The term 'amplitude' describes the extent of sonotrode's motion - expansion and contraction.
- The amplitude correlates with the scrubbing effect at the interface of the weld seam. This movement in combination with pressure is responsible for the welding process.

**Table 1. Major Differences in Linear and Torsional Welding.**

| Description | Linear system | SONIQTWIST® TSP PowerWheel® | Benefits |
|---|---|---|---|
| Pressing force | Indirect force Maximum pressing force 5000N | Direct force Pressing force up to 8.0 KN Highest at the center | Direct force and highest amplitude at the center of the weld allows larger size welds with gentle vibration |
| Amplitude | Transducer assembly bending due to pressing force Highest at the end of the horn | Highest at the center | Less stress at the transition area |




### PowerWheel® for Cable Terminations

PowerWheel® welding technology uses an innovative concept to vibrate the sonotrode, which is excited in a torsional manner. With a scalable welding power of between 7.2 kW and 14.4 kW, the optimum welding power can be selected for each application.

Continued on page 39

# Understanding PowerWheel® for EV Cable Terminations

*Continued from page 37*

The torsional technology allows for welding of larger size welds, bus bars, 3D terminals, more geometrical shapes, out of reach joining areas and applications where gentle vibration is required. This has expanded the ultrasonic application spectrum significantly. Many joining applications that were previously impossible with conventional longitudinal welding are now possible.

**Benefits of PowerWheel® Welding Technology**

Welds can be produced up to 30% narrower and higher compared to those produced by a linear system. This can often result in considerable savings in both material and space required to position the assembly. A further benefit is that thicker terminal connections can be welded with great strength. The welding takes place in a swaying and rolling motion directly above the weld area. As a result, the maximum amplitude is always in the center of the welding area and the energy is directed and focused within the welding zone. With direct force at the welding interface and smaller amplitude in the nugget transition area, the welder can drive more energy for a larger cable because the damage to the wire strands is minimal, if at all. Due to the torsional movement of the sonotrode, there is practically no load on the surroundings of the welding zone due to the ultrasound. The torsional process is therefore particularly suitable for sensitive applications where vibrations outside the welding zone could cause damage. The slow rate of vibration propagation along the cable's axis makes PowerWheel® more desirable for shorter cables. Often there is a concern for short cables being welded on both sides as the second weld vibration may weaken the first weld. Studies were conducted in 2011 for 50 mm² cables of 180 mm using PowerWheel®. The results showed that no difference could be found on the weld strength of both ends of cable. In addition, the mechanical strength was about 30% higher than those done with the traditional longitudinal process.

Telsonic's PowerWheel® standardized sonotrodes are optimized for copper and aluminum wires, meet the requirements of OEM's and harness makers, as well as the USCAR 38 standard (performance specification for ultrasonically welded cable terminations). As with conventional ultrasonic welding, the PowerWheel® system can also be used to weld nonferrous metals.

**PowerWheel® Welding Advantages at a Glance:**

- Maximum output of up to 8 kN with 14.4 kW
- For large cable diameters, large terminals/tubular cable lugs
- Welding of up to 160 mm² cop per/200 mm2 aluminum wiring
- Up to 30% narrower welds
- Significantly improved wire compacting
- Excellent welding strengths
- Adjustable weld directions for universal feed
- Excellent accessibility to weld zone

**Necessary Equipment**

Like conventional ultrasonic welding, ultrasonic torsional welders have a generator, converter and sonotrode. In contrast to conventional systems, however, the sonotrode does not oscillate longitudinally but torsionally, which is how stress on the parts is reduced. At the same time, an ultrasonic output of up to 14.4 kW can be passed through the sonotrode. Consequently, the electrical vibrations formed by a generator in torsional processes are relayed into a PZT vibration transformer to be converted into mechanical vibrations through a piezoelectric effect. Converting linear generated vibrations into torsional movement is done by assembling the acoustic components in the SONIQTWIST® vibration head in a particular order.

*Continued on page 42*

# LEADERSHIP
## PUTTING INSIGHTS INTO ACTION

## Top 10 Tips: Don't Ignore Your Inner Compass

**By Paul Hogendoorn**

**Paul Hogendoorn**

When I started this series of sharing the Top 10 Tips gleaned from leading manufacturing companies (and their leaders), I planned to share this tip last. I had pretty much shaped the column in my mind and had begun writing it when out of the blue, a friend of mine lent me a book that covers this topic very well. The book: The Bomber Mafia, by Malcom Gladwell.

Although the book uses WWII as a backdrop and speaks specifically about how technology can alter the course of human life, and in particular how wars are fought, it clearly identifies the unique critical elements required for invention, radical innovation and technical advancement.

In our manufacturing world today, similar to how armies and navies were structured and run in those days, adherence to process and discipline is and was revered and rewarded and doing things differently than the accepted practice was not tolerated. Its not surprising then that history altering, paradigm changing technologies, do not come from within large, established organizations, but from outside of them – and usually by people that don't fit well in those kinds of large organizations.

The book articulates key concepts better than I could: 1) having a clear picture of something that's not yet in existence "in your mind's" eye (I'd call than "vision"); 2) having the tenacity, or as Gladwell refers to it as "obsessiveness", to see something through to completion despite a world of barriers and a legion of naysayers (I'd call that "entrepreneurship" - the ability to create something tangible and beneficial from nothing); and 3) the ability to attract and engage others into your dream as full heartedly as you are yourself (I'd call that "leadership"). I haven't finished the book yet – I'm only on page 30 as I'm writing this, but each new page seems to have another "aha – that's it!" example of this special ingredient that I suggest is the primary differentiator between good companies and great companies; the best companies I had the pleasure of working with

over the last 40 years had leaders that understood the importance of consensus, delegation, operational discipline, effective communication and team building. But even more important than all of that, they had leaders that trusted their inner compass.

Think of it another way. No one gets to lead by following. If you're the best adherent of a policy, or the best practitioner of a proven practice, you can get medals pinned to your chest and move up in the ranks, and maybe even be the top dog one day yourself. But will that change the course of history, or will that create the next technology or the next new market? No, it won't. If you want to differentiate your company, you can't just aim to do everything as well or better than all your competitors, you have to do something significantly different. And being able to sense what that is, is where the "internal compass" comes in.

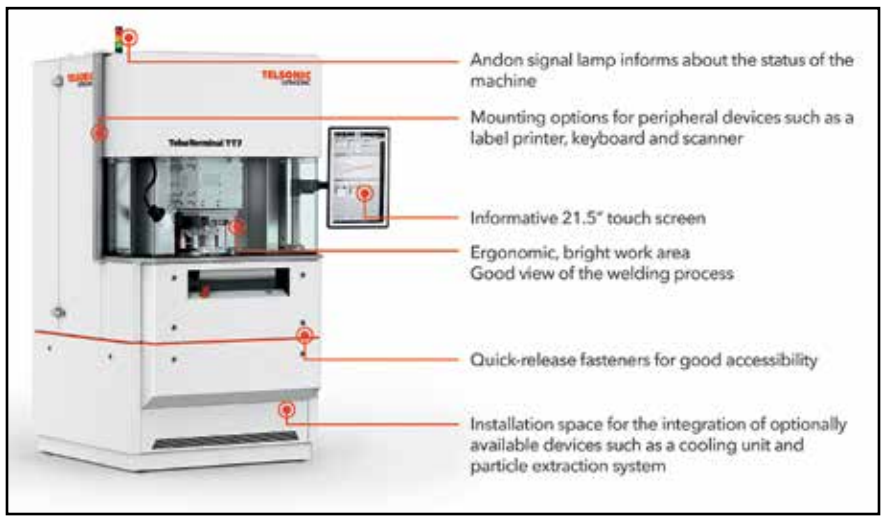
Many people make the mistake of believing that everything needs to be properly mapped out, organized, and understood, prior to committing to a course or pursuing a goal. That would be true – if you are content to being only as good as someone else in your space, or perhaps just a little bit better. (If you follow "the Toyota way", for example, would you really expect that to take you beyond what they've achieved as a great company, or are you hoping just to do it well enough just to pass a few people in your space?)

One of the most influential people in my (business) life recently shared with me why he never did patent searches and never looked at his competitors' products, literature or websites; if he was setting out to do something new and different, he didn't want to be influenced by decisions and directions others had chosen to take. He saw something "in his mind's eye" that he wanted to apply himself to thoroughly, without being unwittingly pulled off course by paying more attention to what others had done than to what was taking shape in his mind. If you are perfecting what others had done, you are still "following" – you are not leading until you finally eclipse them - if you indeed eventually do. The best companies I observed weren't doing their own thing purely out of a smug sort of arrogance of "not following anyone", they were (and still are) following an internal compass that is pointing to their true north. The fact that they are successful shows that they have good internal policies, strong committed teams with great communications, and affirms they have good products and loyal customers. But to be an exceptional company, doing exceptional things and accomplishing exceptional goals, takes more than that; it takes leaders that are willing – and able – to follow their internal compass, even though all the maps aren't yet complete. That's the ingredient that some companies have but that most don't.

My final thought on this point as I reflect on the first 9 of the Top 10 Tips I shared in this series: many of the first 9 tips may seem counter-intuitive, but most of the leading companies I gleaned these Top 10 Tips from were doing 7, 8 or even all 9 of them. To me, this indicates that they are companies that aren't just following an approved playbook, they are in the habit of always paying close attention to their inner compass.

*Feel free to send me a note at Hogendoorn.paul@gmail.com if you have tips to share. We are in this together!*

# Understanding PowerWheel® for EV Cable Terminations




**PowerWheel® TT7 for battery cable termination.**

*Continued from page 39*

The new PowerWheel® Telso® Terminal TT7 ultrasonic metal welding system is versatile and can be used for various applications, including cable assembly and battery production. Its applications include HV cables, battery terminals, 3D terminals, bus bar and cell connectors, which are welded in a wide variety of designs.

Based upon a compact and modern design, this modular system delivers a host of advantages including outstanding process control using digital technology, standard interfaces for digital networking and easy integration into automation systems. The new system also incorporates the latest version of Telsonic's proven PowerWheel® welding technology as a standard feature, ensuring maximum reliability and optimum process control for welding metal cable with cross sections up to 200 mm2.

**PowerWheel® TTs7 welding area.**

*Continued on page 44*

# Understanding PowerWheel® for EV Cable Terminations

Continued from page 42

### PowerWheel® Welding Technology for Terminating Stranded Wire - Actual Application Cases:

**1. Small weld width without damage to fine cable strands**

**Figure 3. ProEVTM cable, produced by Promark Electronics a Division of ECI, welded to a Rosenberger male Silver-plated connector.**

In the application shown in figure 3, a high quality 35 mm2 ProEVTM cable is welded to a Rosenberger connector, which supplies limited space for a cable of that size. ProEVTM cable was selected for this application due to its high flexibility. However, the available weld width of 10 mm as opposed to 11 mm and flexible finer strands presented some challenges. A solution that could provide a weld on a smaller space where the required weld compaction can be achieved without damages to the finer strands in the weld transition area was needed.

**Solution:**

The torsional PowerWheel® welding technology system was utilized to achieve a superior quality weld between the flexible ProEVTM 35 mm2 cable and the connector with 10 mm width. Tooling design and configuration had to be arranged to compensate for the limited clamping force due to the inherited connector radius. This tooling design and configuration solution allowed for sufficient welding energy to achieve a quality weld.

**2. Weld area is out of reach**

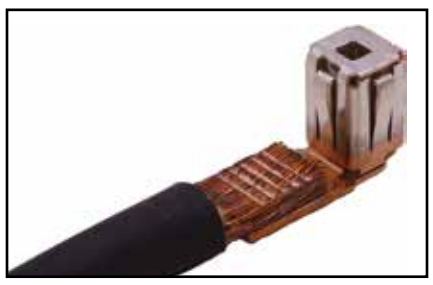


**Figure 4. 90° SQ4 terminal welded to a 50 mm2 cable.**

The 90° SQ4 terminal, shown In figure 4, is made of C15100 Copper alloy without pla plating in the weld area. This application required welding both 35 mm² and 50 mm² cables. The terminal blade width for 50 mm² was changed to 18 mm from 13 mm to accommodate a weld width of 15 mm. This also allows for 1.5 mm of clamping width on each side of the terminal when utilizing a 15 mm sonotrode. However, the connector height of about 17 mm presented a challenge for the sonotrode's clearance in conventional longitudinal ultrasonic welding processes. It is not physically possible to design a linear sonotrode that can clear the 17 mm height and still efficiently deliver the 20 kHz. frequency required.

**Solution:**

The torsional PowerWheel® system was utilized to clear the connector height and achieve a superior quality weld for both 35 mm² and 50 mm2 cables with the SQ4 terminal. The sonotrode's orientation allows for the clearance with the 90° terminal and delivers sufficient welding energy to achieve a quality weld without effecting the finer strands in the transitional area or the connector itself due to the gentler application of the vibrations.

**3. More examples of challenging applications (Figure 5).**

The following represent some additional applications and challenges in the ultrasonic welding of terminals on stranded wire that the Telsonic PowerWheel® system can address:

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


**Figure 5. More examples of challenging applications.**

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

4. 3D terminal – PowerWheel® offers the advantage of more access to the weld area.

5. High power lock box terminals 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 exceptionally fine strands which can be damaged without the gentle torsional vibration.

The innovative and rapidly growing EV market demands new, developing solutions for the challenges ahead. Torsional welding has become a significant joining process in the industry. In addition to solutions for battery cable terminations with a variety of connectors, the technology has provided welding solutions for EV weight control, battery packaging, bus bars, battery manufacturing and power electronics. The application capabilities have expanded beyond what was previously imagined. As product designers and process engineers continue to familiarize themselves with the torsional welding process and its capabilities, the technology is positioned to help propel the EV industry to even greater heights.

# What You Need to Know About Control Cabinet Marking

**By Scott Nizolak, Connor Norton, and Logan Morrow, Phoenix Contact USA**

### Introduction

If you have experience in the industrial world, you might know how important it is to mark and identify the components in your control cabinet. Marking allows you to identify products, wires, and cables with a quick glance. This makes your cabinet easy to maintain, work on, and organize.

There are so many industrial printing options, such as different printers and marking materials, that it can be a challenge to find what best suits your needs. Here are a few essential things to understand when choosing the best marking system for your needs.

### What should you mark – and why?

Everything in and around a cabinet can be marked. Whether it be terminal blocks, conductors, a power system, or even buttons for your industrial equipment, a properly marked cabinet is an organized cabinet (Figure 1).

Maintaining organization in a cabinet makes identification and maintenance much easier. Terminal marking ensures that the wiring in the control cabinet is clearly assigned. This helps prevent errors during setup, maintenance, and repair work.

While marking is always a best practice, marking is required for some certifications. For example, UL states, "Many electrical, electronic, and related technology products are required to be permanently marked with specific safety-related information including hazards, warnings, cautionary markings, installation instructions and electrical ratings."

### Cabinet marking essentials

There is a multitude of printers and materials that can meet the needs of any marking application. Common types include card, roll, mobile, and heavy-duty engravers. Each type has its own unique capabilities, so it can be challenging to decide which printer is best suited for your application. Selecting the right software can be just as important as selecting the right printer, as detailed below.

The roll and card printers will fit the needs of nearly every application. These printers use thermal transfer printing technology to provide a clean and reliable mark. The card printer can print on both flexible sheets and rigid plastic cards (Figure 2). With the flexible sheets, you can make adhesive labels for equipment marking, warning signs, and component marking. Rigid plastic card markers will generally be used for snap-in marking on terminals and clip-on wire marking. The roll printer will mainly be used for wire marking and equipment marking. This includes wire shrink sleeves, self-laminating wire wraps, push-button marking, and magnetic markers.

Stainless steel and aluminum engraving are well suited for harsh environments. This method can also print on card and sheet materials like the roll and card printer. Many consumers use these products for high-quality and high-volume applications.




**Figure 1. Marking allows you to identify products, wires, and cables with a quick glance.**

***Ease of use:*** Depending on your workflow, you might have a few different people operating the software and printers. Choosing a user-friendly software can limit training and troubleshooting time. Typically, software based on the Microsoft Office platform will be familiar and easy to learn for diverse groups.

***Cost:*** This can vary from free to hundreds of dollars. If you choose to pay for software, find out if you are paying for a single computer license, or if you can use the software on multiple computers, as this can impact your final cost.


**Figure 2: Card printers use thermal transfer printing to provide a clean and reliable mark.**

### Software

There are numerous software options for designing and printing your labels and marking materials. Handheld/portable printers typically have self-contained software that allows you to print on the device. Some feature smartphone apps that connect via Bluetooth. Desktop printers generally are connected to a PC that runs printer manufacturer-specific software.

When evaluating software options, consider the following three points: capabilities, ease of use, and cost.

***Capabilities:*** Different applications have different needs. You might need a software that allows you to do some or all of the following: type electrical and other symbols, format font size and style, save files, sequential auto-numbering, import functionality, integration with planning/design software, barcode and QR code marking, and importing of images/logos.

### Conclusion

While picking the right marking equipment can be challenging, a well-marked cabinet is surely worth the effort. Marking doesn't have to remain just inside the cabinet – it can be used almost anywhere.

Marking can be used to meet a certification or to organize your cabinet for ease of maintenance. With many printing options on the market, most consumers will meet their needs with either a roll or card style printer. A printer is only as good as the software it runs on. Make sure to consider the capabilities, ease of use, and cost of your printing software.

Learn more about marking solutions at https://www.phoenixcontact.com/en-us/products/printers.

# Driving Innovation in Aerospace: Adapting High-Speed Automotive Technologies for Aerospace Wire Harness Testing With Ultrasonics

**By Sally Antilles**
**MK Test Systems**

This article looks at the heritage of real-time testing in the automotive sector, and how the R&D team at MK Test have succeeded in adapting this technology to meet the demands of testing wire harnesses for the aerospace manufacturing industry.

There are numerous examples of the automotive sector being ahead of aerospace when it comes to new manufacturing technologies or processes. The concept of the production line itself is an obvious example; we all know the story of Ford. Lean production, 3D printing, and even augmented reality were all widely implemented within car manufacturing before being adopted by countless other sectors including A&D.

Another recent technology to be adopted by aerospace is e-vehicles. In 2021, battery-powered cars have become mainstream, with charging points commonplace at motorway services and garage forecourts. Meanwhile, the first commercial all-electric aircraft are not planned for flight until 2026.

Through history, as cars became more driven (pun very much intended) by electronics, so too did aircraft with the first 'fly-by-wire' airliner launched by Concorde in 1969.

Why is this? Automotive R&D and methods teams are focused on faster and cheaper manufacturing and are also racing to implement new technologies for the end-user before their competition does. In contrast, aviation tends to focus on implementing process or technology associated with safety and quality. A report on quality management notes that "Aerospace has adopted many well-established ideas, practices and…solutions from the automotive industry, borrowing from those lessons to drive future progress as the aerospace industry goes through it's own era of rapid technological advancement." (EASE, 2016.)

Methods engineers in the large aerospace OEMs - Airbus and The Boeing Company - are increasingly crossing over from the automotive sector. Time and cost savings are evergreen KPIs within manufacturing, and for these, automotive beats aerospace. Experts from the automotive sector are bringing their knowledge of technological gains and systemic improvement methods – such as high-speed testing – to aerospace. Paul Meloche is VP Sales for Fori Automation, a Michigan-based business who have successfully transitioned from the automotive sector to also supplying support vehicles for aerospace assembly. In a 2014 interview, he said *"During the downturn of the economy, a lot of automotive engineers started fil-*

Continued on page 48

# Driving Innovation in Aerospace: Adapting High-Speed Automotive Technologies for Aerospace Wire Harness Testing With Ultrasonics

Continued from page 47

*tering out into aerospace companies. [These companies] are more receptive to learn from automotive suppliers because many aerospace engineers have seen automotive automation in action, and we offer them a different view on things."* (Schoenberger, 2014).

As a technology business predominantly working with aerospace customers, MK Test Systems turned to auto for inspiration with their latest round of R&D; a high-speed test system named RTS (Real Time Scanning). A major aerospace OEM customer approached MK seeking ways to improve upon the current method of wire harness testing at their FAL (final assembly line) stage, with the goal of improving aircraft manufacturing speed.

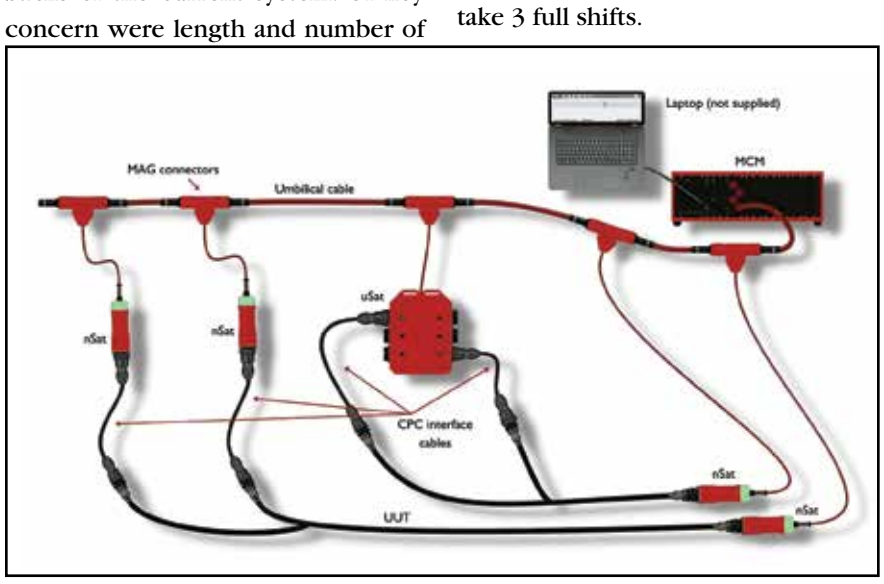
Heading up the RTS project team was Nick Baker, New Product Development Manager at MK Test. He summarized the adaptation by saying *"Automotive is very much a pass-fail industry. The wiring either works or it doesn't. In aerospace, you're testing for resistances and taking measurements much more accurately. The RTS system is designed for that kind of pass-fail testing, but with vastly improved accuracy. Not only are we saying 'yes, it's passed' but we were also able to provide a resistance measurement to within ± 0.5Ω."*

**Example of the system at wire harness build stage, using around 90% fewer interface cables.**

Using real-time scanning technology for aircraft testing meant adapting several elements. The project was a significant R&D investment for MK Test Systems and took two years from initial concept to the first customer signing off the system.

RTS began by looking at the drawbacks of the current system. Of key concern were length and number of interface cables, hook-up time, and the fact that testing could only take place at the end of the final assembly.

The ongoing headache of cable maintenance, and testing hook-up time is a stand-out bottleneck in the production process – testing comes at the end of manufacturing and can take 3 full shifts.




**Simplified diagram of the RTS system.**

The customer's current system uses a standard 19" rack construction. The large footprint of the rack means it needs to be positioned away from the plane under test. This therefore requires a huge amount of interface cables to connect to the aircraft. So far, so standard. The system and its physical set-up are extremely common and in line with what is typically found at aircraft FALs around the world. But at a time when Industry 4.0 looks to digitize as much as possible to simplify manufacturing, 'standard' is beginning to feel outdated.

Looking at all these points holistically, the two overriding requirements were the actual speed of the test and the ability to identify the types of faults as quickly as possible. From this, it became apparent that a version of a real-time scanning system – as commonly used in automotive – was the best solution. RTS enables operators to see in real time where the failure is and to fix it immediately, rather than carrying out a full test before going through the results and fixing the faults later.

On a standard eTester system, the switching modules are normally in the cabinet, with a huge amount of interface cables – typically up to 170km of wire for a full aircraft – running across the shop floor and into multiple locations around the aircraft. The maintenance and physical usage of interface cables is a massive burden on time and money. Not only is the maintenance extensive and expensive, but the hook-up is time-consuming and messy. The RTS system has eliminated much of this burden by miniaturizing the switching modules and positioning them inside the aircraft, so typically there are now only 8 umbilical cables for a full aircraft test system.

Not only is RTS fast, but it's safe. Addressing the need for speed meant looking at how the operators could carry out testing during the build process rather than waiting until the end. High voltage testing is perceived as inherently dangerous, which is why testing can't typically be carried out alongside manufacturing with equipping teams inside the aircraft. However, discussions with the customer determined that HV testing was carried out at several previous stages so were unnecessary at FAL. RTS operates at low voltage and low current, which enables operators to work around the system whilst it's running tests. It's taking some getting used to, but Baker believes it has the potential to be a huge benefit for the aerospace industry: *"When we demonstrated it, people ask if it's running, and I love that. They're so used to hooking up, hitting run, hearing the slow relays clicking, waiting for it to finish and see the results. But RTS is just going all the time. The behavioural change of just hitting go at the start, and then plugging it all in and watching the green lights come on as you build; that's a big gain for the industry."*

RTS is now in use by a major aerospace OEM on their final assembly line in France. Another RTS project is in development with a different customer for testing aircraft power panels. The system is best suited to high pin count and high connector count assemblies, formboard harness tests, and for carrying out in-vehicle installed harness tests.

In summary, automotive technologies can drive innovation in aerospace, with adaptation made possible by knowledge of aerospace systems. RTS is the result of a collaborative approach to engineering, drawing from expertise in both sectors.

*About MK Systems*

MK Test Systems was established 30 years ago in 1992 and are a world-leading manufacturer of automatic electrical testing systems. The systems are widely used within the aerospace, rail, defence, subsea, power & control industries worldwide to ensure high performance electrical systems are correctly wired and undamaged. With the main headquarters in Wellington, Somerset, the company has satellite offices in the US and Hong Kong, as well as a network of partners and distributors offering sales, service, and support around the world. Please contact Sally Antilles, Marketing Manager (+44 (0)1823 661100, sally@mk-test.com) for all enquiries.

*References:*

Schoenberger, R. (2014). From cars to planes. Aerospace Manufacturing and Design, [online]. Available at https://www.aerospacemanufacturinganddesign.com/article/amd1114-aerospace-assembly-automation/ [accessed 15 April 2021].

Ease (2016). From Automotive to Aerospace: Key Cross-Industry Learnings on Quality Management [online]. Available at https://www.ease.io/automotive-to-aerospace-quality-management-cross-industry-learnings/ [accessed 12 April 2021].

# Heavy Duty Terminals for Automotive Applications

**Compiled by ETCO Inc.**
**Research and Development**

Problems within the electrical system have long been an issue with automobiles. One of the most common areas for an electrical circuit failure is with battery connections. The heavy-duty terminals required for large AWG wires like those used on battery connections are gaining attention with manufacturers that provide terminals to the Automotive Industry. Electric terminal manufacturers utilize a good portion of their engineering resources focusing on the development of new product or improving existing terminals for an industry that is also focused on, costs, improving fuel mileages, reducing the use of lead ( RoHS) and vehicle weights.

Many things have to be considered when developing a terminal for heavy duty automotive applications. This report will share several concerns vital to manufacturing a robust, heavy duty automotive electrical connection that must meet or exceed customer specifications and SAE standards.

**1) Material selection for terminals**

Since the implementation of the RoHS directive, lead terminals are being replaced by those made of other lead-free materials. Terminals can be manufactured from steel and exotic alloys with various plating options including bright and matte finishes. A great choice of material for a heavy-duty battery terminal is Tinned Brass. Its properties are superior to Lead for electrical conductivity, corrosion resistance, tensile strength, hardness and durability. All of those metal characteristics provide for an optimal heavy-duty terminal. For those looking to reduce weight a lead-free stamped battery terminal made of Tinned Brass is an idea substitute for a heavy cast terminal.

**2) Terminal Design and Features**

A good engineering team will develop a terminal design that allows it to be part of the best connection possible and include design features that facilitate the terminals processing by the wire harness manufacturer. Some things they will consider beyond the metal choice are:

a) Overall size and wire range of terminal. Determine how much metal is needed to produce the best terminal. The Length of terminal and material thickness are evaluated.

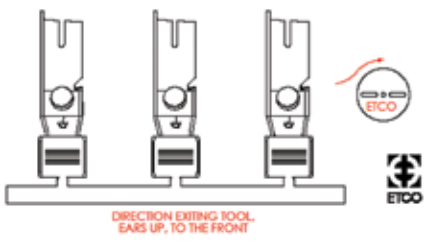
b) Crimp area of terminal. The pocket / U shaped area of the

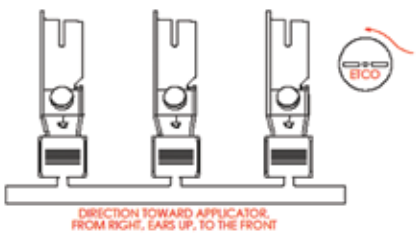

DESCRIPTION - The test bed for many of ETCO's automotive terminal innovations is the company's record setting 2004 GTO. ETCO's Race team recently relocated the battery from the front of the vehicle to the trunk, which helped transfer weight to a location over the drive wheels. To accomplish this, a special wire harness was fabricated using terminals from a line of RoHS compliant, Heavy Duty 12V battery and ring terminals developed for heavy duty, high performance applications.

terminal that will form the bond to the wire. This section is designed with specific coin, rib and serration features that will aid in this union.

c) Mating area geometry. The portion of the terminal that will mate with its opposite to form the connection. This requires coupling features that will ensure the integrity of the circuit. Matching forms will provide maximum surface to surface area contact that will maintain a solid bond.

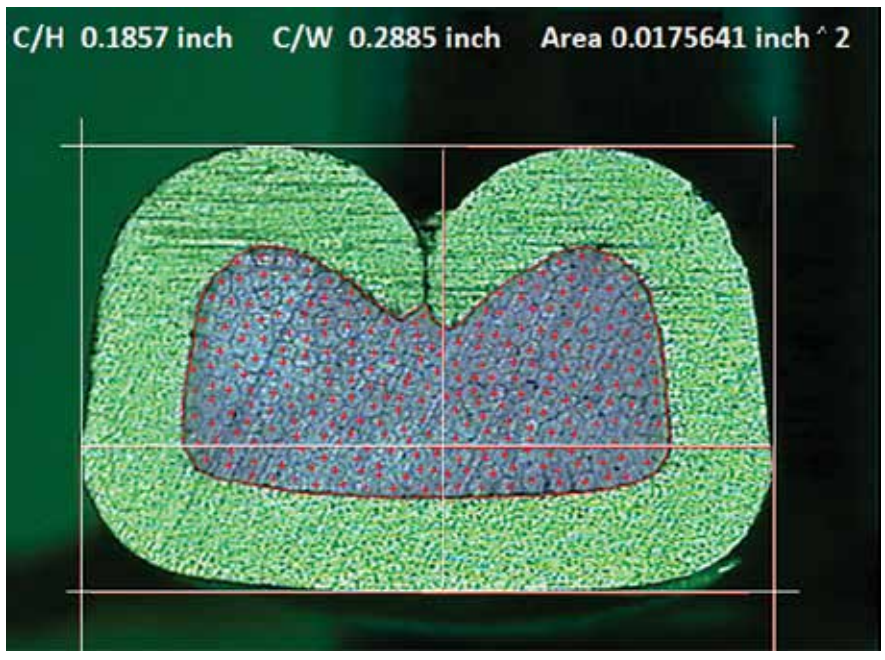
d) Layout considerations for a terminal's production will include determining a side by side or end to end configuration and its feed length. Attention is given to the direction of the terminal strip as it will need to be wound onto reels in a fashion that compliments the needs of the application process.




### 3) Terminal Crimp

The crimp is a solder-less termination method used to fasten the terminal to the wire. There are several styles of crimp terminations. One type incorporates a straight cylinder shape located at the back of a terminal where an insulation stripped portion of a wire is inserted. The cylinder is then pinched onto the wire. The collapsed portion of the cylinder forms the union between the terminal and the wire strands. Another type of crimp preferred by most quality wire harness manufacturers is the F type crimp. This type of crimp has a U-shaped portion at the back of the terminal designed to form an envelope around the exposed wire strands and be swedged between a sized punch and die, also known in the industry as roll tool and anvil. The resulting connection of the F type crimp is a union so tight that every wire strand is distinctly reshaped by the geometry of the crimp tooling and the compression force. A good crimp is imperative to having good retention to wire. Proper tooling and terminal selection in the recommended equipment and with correct settings will consistently yield quality crimps like the one shown below. A good terminal manufacturer will develop and provide tooling that will offer the best possible crimp. One that has a properly flared bell mouth on the wire side to reduce cut strands and yields a joint that offers optimal wire retention with the lowest electrical resistance.



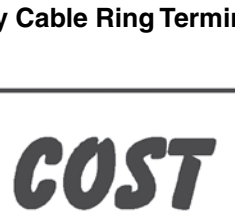

**F type crimp Cross Section of a Heavy Duty terminal crimped to 6 AWG wire.** DESCRIPTION - A cross section of an ETCO 52042 terminal attached to 6 AWG Copper Strand wire. Crimp Height is .1857 inch and Crimp Width is .2885 inch. Strand Count is 268. This cross-section shows every conductor strand has been compacted by the crimp. The terminal "ears" are evenly rolled and there are no voids between conductor strands.

### 4) Terminal Variety

Major manufacturers of heavy duty terminals for automotive applications would market battery post terminals specifically designed to mate with the different geometries of the Positive and Negative battery posts. Terminals featuring engineered ribs or serrations that work within the connection to insure best possible unification. These terminals would be clearly stamped with the + and – symbols identifying them as positive or negative terminals. A large assortment of heavy duty ring terminals also made to SAE specifications in a

*Continued on page 52*

**F Battery Post Terminal**



**Battery Cable Ring Terminal**

# Heavy Duty Terminals for Automotive Applications

*Continued from page 51*

diverse selection of hole sizes to accommodate customer requirements would be available. The terminals made for superior electrical for durability and corrosion resistance and are supplied on reels as continuous strip with the crimp ears up for automatic or manual termination.

**5) Applicator Equipment**

A trusted supplier's applicator department should offer all the equipment needed to ensure an optimal terminal-to-wire crimp. Engineered tooling and applicators used in recommended presses offer best results. A variety of attaching equipment should be offered to accommodate the manufacturer's range of terminals. Heavy-duty applicators used for heavy-duty terminals are designed for five-ton electric presses and 10 -15-ton heavy-duty air/hydraulic presses. The applicators should accommodate terminals for up to "00" gauge wire and offer detailed set-up and operating instructions. An applicator can be designed for semi-automated and fully automated crimping processes. Direction of feed and type of application should be clearly explained in accompanying collateral. Look for applicators that are designed to terminate more than one terminal.

Applicators built with engineered tooling constructed of hardened tool steels machined and polished to specific geometries are designed to repeatedly produce quality crimps. Heavy duty presses for heavy duty terminals provide for an efficient and simple application process. Air/Hydraulic presses are easily maintained and require little or no adjustment when changing wire size.

*[Applicators not shown to scale and some guards not shown.]*

**A lightweight RoHS compliant, battery post terminal attached to wire using 15 ton Air/Hydraulic Press is readu for installation.**

**Terminal retention to wire**

The chart offers retention values showing the minimum force required to separate the wire from the terminal's wire crimp ear in both Newtons and lbs. /force. (Measurements taken without influence of an insulation ear) In some cases the manufacturer will recommend higher pullout forces to increase conductivity and specify crimp height to accomplish best all-around crimp performance.

The photo below shows the battery location with new set of optimally crimped battery cables.

| Size Of Conductor AWG | Pullout Force mm2 | Pounds | Newtons |
|---|---|---|---|
| 28 | 0.08 | 2 | 8.9 |
| 26 | 0.13 | 3 | 13.4 |
| 24 | 0.20 | 5 | 22.3 |
| 22 | 0.324 | 8 | 35.6 |
| 20 | 0.507 | 13 | 57.7 |
| 18 | 0.823 | 20 | 89.0 |
| 16 | 1.31 | 30 | 133.5 |
| 14 | 2.08 | 50 | 222.5 |
| 12 | 3.31 | 70 | 311.5 |
| 10 | 5.261 | 80 | 356.0 |
| 8 | 8.367 | 90 | 400.5 |
| 6 | 13.30 | 100 | 455.0 |
| 4 | 21.15 | 140 | 623.0 |



# NEWS PLUGS

### Chief Enterprises Partners with Altran Magnetics as Value-Added Distributor

Chief Enterprises, a specialty distributor of electro-mechanical components and provider of value-added services to various on and off-road industries, has added Altran Magnetics to their line card. With over 30 years of experience, Altran is an innovative manufacturer of electrical and electronic solutions including motors, blowers, EMI filters, DC contactors, photoelectric controls, solid state relays.

Chief will be stocking and supplying Altran's High Voltage DC Contactor product line. Altran contactors have competitive features such as resin and ceramic bases which accompany ratings up to 1,500VDC, epoxy sealed to IP67, and UL / CE pending approvals. Along with a compact structure and high safety designs, Altran's offerings can meet a wide variety of market needs.

Chief brings a unique resource to Altran's distribution network by offering value-added services to their customer base. Chief has the ability to customize Altran High Voltage Contactors by adding a variety of connectors, adding protective wire coverings, creating custom labels, and much more. These additional services help the end-user implement Altran's High voltage DC contactors into specific applications quickly & efficiently. Chief's services will eliminate the need for OEMs to perform on-site modifications.

Competitive Advantages of Partnering with Chief Value-Added Services

- Cost-efficient; saves customer time & resources
- Supply Chain Consolidation; Chief sources product and makes specified modifications
- On-staff Degreed Engineers; can assist in design-in support, testing coordination, and technical documentation
- North America Inventory; Inventory stocked and services performed in Elmhurst, IL
- Customization; Ability to quickly design and implement OEM needs through OnShape™ CAD design software, 3D print prototyping, and more.

Chief is looking forward to this new partnership with Altran and bringing these custom solutions to market fast.

Altran Magnetics Inc

Altran Magnetics has 30 years of experience being a global supplier of specialized electro-mechanical products. Their extensive list of products ranging from DC Contactors, Motors & blowers, Photo controls, and more has led them to serve a variety of markets. Altran uses its engineering capabilities to determine the most innovative but cost-effective solutions possible. Between their two manufacturing facilities in the United States and China, they are able to provide international solutions to all customers with quick lead times. Altran's two manufacturing facilities are ISO 9001 certified and have robust verification and quality inspections to have products that meet all needed requirements. To find more information go to www.altranmagnetics.com

Chief Enterprises LLC

Over the past 30 years Chief Enterprises has served as the critical link between the electro-mechanical component manufacturer and on and off-road Original Equipment Manufacturers. This role has been carved in the industry through four vital functions: logistics, engineering, power distribution expertise, and their integral relationship with Robert Bosch Powertrain Solutions. Chief supplies the highest quality components & assemblies available through strategic vendor partnerships and their own design & manufacturing capabilities. Chief specializes in connection systems, automotive relays, power distribution, circuit protection, audible warning devices, and more.

Chief is also the Sole North American distributor of Bosch Connector Parts handling all sales, customer service, engineering & quality support in the US, Canada, and Mexico. Chief is a Great Place to Work™ certified company with locations in Elmhurst, IL, and Chihuahua, Mexico. ISO 9001 & ISO 14001 Certified. Private Equity Company in the Cyprium Partners Portfolio. For more information please visit website at www.chiefent.com

### Switchcraft 157/157G 1/4" Strap Nut End-Pin Jacks at TTI

TTI, Inc., a leading specialty distributor of electronic components, announces the availability of Switchcraft 157/157G 1/4" Strap Nut End-Pin Jacks from stock at TTI.

Switchcraft 157/157G 1/4" Strap Nut End-Pin Jacks offer the same trusted quality as a standard Switchcraft End-Pin Jack with the added functionality of a removable strap nut. These jacks are ideal for acoustic guitar applications, eliminating the need to drill a second hole into the instrument for an output jack, and include a handle and a cable clamp to ensure critical connections are protected and all hardware is included for easy installation. The 157/157G End-Pin Jacks feature a durable and copper alloy strap nut with nickel- or gold-plated options. Target applications include musical instruments and speaker connections, to name a few. They are in stock and available today.

To learn more, visit Switchcraft 157/157G 1/4" Strap Nut End-Pin Jacks | TTI, Inc.

About TTI

TTI, Inc., a Berkshire Hathaway company, is an authorized, specialty distributor of electronic components. Founded in 1971, the emphasis on a broad and deep product portfolio, available-to-sell inventory and sophisticated supply chain programs has established TTI as a distributor of choice to manufacturers in the industrial, defense, aerospace, transportation,

medical and communications sectors worldwide. TTI and its wholly owned subsidiaries, the TTI Family of Specialists, Mouser Electronics, Sager Electronics and the Exponential Technology Group employ over 8,000 people in more than 136 locations throughout the Americas, Europe, Asia and Africa. Globally, the TTI Family of Specialists maintain over 3 million square feet of dedicated warehouse space in 30 distribution centers. For more information about TTI, visit www.tti.com

### DIN-Rail Mount Adaptor Kits for Panel Mount 1- and 3-Phase Filters

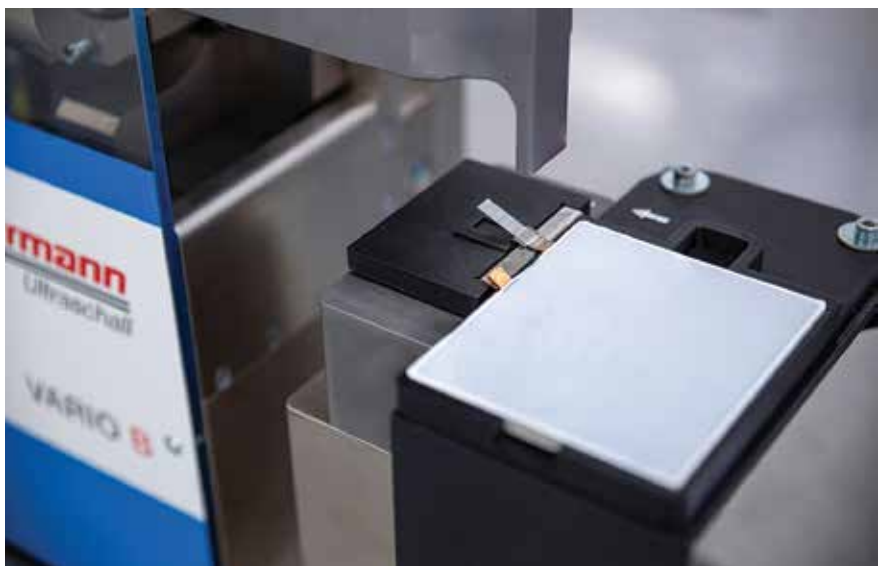
SCHURTER now offers DIN-Rail mount adaptor kits with metal clips. The kits provide a simple solution for converting panel mount block filters to DIN-Rail mount for use inside control cabinets. Simply affix the clip to the filter using the screws provided in the kit, then snap the converted filter onto the DIN-Rail.

Panel mount block filters are commonly used in equipment to filter interferences that are potentially harmful to the operation of the equipment and other equipment nearby. With more applications using intelligent devices emerging in the industrial market, the need for EMC filters is also increasing, although identifying and sourcing DIN-Rail mount types for use in control cabinets can be a challenge. Like other DIN-Rail adaptors for other types of products, SCHURTER's DIN-Rail adaptor kit addresses this need with a simple design for quick and easy installation. Sustaining a good ground connection is carefully considered in the clip design, which uses heavy-duty metal to ensure a constant ground connection of the filter housing to the rail. The DIN-Rail mount adapter kit fits with SCHURTER's compact range of EMC filter series: FMAB NEO, FMAB HV, FMBB NEO, FMBB EP, and FMAD CP. It is also suitable for use with other panel mount filters, provided the mounting holes are the same.

Pricing for the DIN-Rail mount adaptor kits start at under $4.50 in 50-piece quantities. Packaged in 20 pieces. Link to DIN-Rail Clip Data Sheet. For sales and product information, contact Savannah Lee at (800) 848-2600 or by email at info.sinc@schurter.com.

Continued on page 58

# Process Stability in Welding of Battery Cells With Ultrasonics




**To insure battery production with the lowest possible reject rates, the ultrasonic welding system must be precisely matched to the application.**

Systems from Herrmann Ultraschalltechnik GmbH & Co. KG reduced the reject rate for CUSTOMCELLS® during the production of a new battery application and thus increased efficiency for this manufacturer.

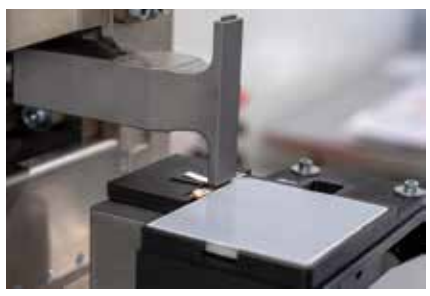
As one of the world's leading developers of customer-specific lithium-ion battery cells, CUSTOMCELLS® pursues the lowest possible reject rate in battery production with maximum process reliability. For the welding of its applications, the development and production company relies on ultrasonic technology in one of their production lines. The ultrasonic welding systems from Herrmann Ultraschall used there minimized the reject rate and optimized production efficiency.

### Optimization of the reject rate

In the associated production line, CUSTOMCELLS® performs the pre-welding and main welding on pouch cells. The first step in the pre-welding process is to pre-weld the individual layers of copper foil for the anode and the individual layers of aluminum foil for the cathode. In a second step, the main welding, the so-called tabs are welded to the cathode and anode.

Both pre-welding and main welding require strong, material-to-material connections to ensure the functionality of the battery cells. If individual foil layers are not completely joined together or if there are tears in the foil, which are only a few microns thick, this can lead to rejects and then to the disposal of the entire cell.

The ultrasonic welding machines from Herrmann provide a stable process for these connections. The HiS VARIO B 20 kHz systems have been specially developed for welding battery applications with multilayer foils. They reduce production waste and production costs.



**As a particularly material-friendly joining process, ultrasonics is perfectly suited to permanently join the thin foils of the cathode and anode to the tabs in a reproducible manner.**

### Special battery design as a challenge

The special feature of the battery cell developed by CUSTOMCELLS® is the size of the tabs. They are significantly smaller than what is typically used in the industry. In order to ensure a reliable connection between the tab and the anode or cathode, the sonotrodes of the ultrasonic welding machines were adapted to the respective size.

Thanks to ongoing research and development work, Herrmann Ultraschall was able to draw on an existing, special sonotrode design right at the start of the project. This guaranteed a reliable welding process for the CUSTOMCELLS® battery application. After a short time, the appropriate welding parameters were also evaluated in the ultrasonic laboratory. The changeover to Herrmann welding systems could be implemented with virtually no downtime for production.

**Because of the variable size of the tabs, specially adapted sonotrodes must be used for the main weld.**

### Automation planned

Both Herrmann welding systems are permanently used for the welding of cell tabs at CUSTOMCELLS®. Within the scope of series production, the ultrasonic welding systems will be integrated into the automated production line in a next step. Ongoing consulting as well as the development of suitable welding solutions by Herrmann Ultraschall enable a smooth process integration.

### Conclusion

Only by using ultrasonic welding systems that meet the demand and requirements, can reject rates in battery production be kept permanently at a low level. Flexible service by the ultrasonic partner is important for the success of a welding project in order to be able to react immediately to changes in the production process if necessary. The interaction of suitable welding solutions and good service forms the basis for safe and efficient production of battery applications with ultrasonics.

**Currently still used as a manual workstation, the ultrasonic welding systems are to be integrated into CUSTOMCELLS' automated production line in the next step.**

*About Herrmann*

As a specialist in ultrasonic welding, Herrmann has aimed to excite its customers for more than 60 years. For this purpose, Herrmann Engineering was developed which includes a combination of services. It enables more than 600 employees in over 20 countries to sucessfully implement projects together with their customers. The company's mission "Bonding — more than materials", stands for a close and trusting relationship. As a result, more than 2,000 different applications in key industries such as automotive, medical, hygiene and packaging can be solved every year. Visit www.herrmannultraschall.com

WIRED IN WHMA UPDATE

# WHMA/IPC Offer Wire Harness Operator Training in English and Spanish

**By Christine Siebert**

The Wire Harness Operator's (WHO) course introduces operators to the key tools, materials, and processes required to consistently produce quality wire harness assemblies in both English and Spanish.This course is designed to encompass the entire wire harness assembly process, including a customizable selection of modules to address the current needs and future goals of operators and organizations.The course's seven mandatory modules will be covered in this training, enabling participants to earn a qualified IPC wire harness assembly operator certificate.

Modules include introduction to wire harness assembly; safety; engineering documentation; materials and components; tools and equipment; wire preparation and processing; and inspection and training.

Modular training allows for flexibility in implementation to your team. Each learning module contains meaningful opportunities for students to engage with the content and apply what they learned in real-world contexts. The program's carefully curated video presentations, detailed illustrations, interactive activities, and practice quizzes are all formulated to make even the most complex topics easy to understand and master.

"IPC learning specialists teamed up with industry experts to provide the knowledge and skills that every operator needs to build quality wires and cable harnesses," said Carlos Plaza, IPC senior director of education.

WHMA/IPC's workforce training programs are available in online self-paced and instructor-led formats. Self-paced courses can be completed independently from any device with an internet connection. The instructor-led format similarly allows instructors to stream the course to their students from any connected device.

More information on this program can be found at https://whma.org/resources/wire-harness-assembly-for-operators/.

# Innovation Advances Ultrasonic Metal Welding of Large EV Battery Cables

**By Craig Birrittella, Business Development Manager, Automotive, Branson Welding and Assembly at Emerson**

The amount of time required to charge electric vehicle (EV) batteries — compared to the quick fill-ups available to gas or diesel-powered vehicles — are a significant drawback to their acceptance. In their desire to overcome this obstacle, OEMs have attempted to deploy much faster charging systems that have peak charging power of 250kW or more. While these charging systems need only about 20 minutes to produce enough charging capacity for roughly 160 miles of driving range (depending on the car or truck), they also create a variety of problems.

To improve charging speed and capacity, EV batteries needed higher-capacity wire harnesses and much thicker power cables. Today, typical EV batteries and charging stations use copper cabling of up to 95 mm2, but to satisfy the demand for faster charging speed, these cables will likely soon exceed 120 mm2. In fact, until recently, manufacturers have had problems welding cables in the 60 mm2, 90 mm2 or 120 mm2 cables needed today. The problems are caused by the increased power and amplitude requirements needed to weld the thicker charging cables, including:

• The increased bending and stretching of the cable strands during welding often led to greater strand fatigue and increased risk of failure.

• The greater weld forces that were needed produced excess friction and heat in the weld zone that not only spread to nonweld areas but also demonstrated the inefficiency and waste of electrical power needed to create the heat for welding.

• The increased cable diameters caused the tooling to lose its grip and allow cables strands to slide across the tooling surfaces, rather than gripping and holding the strands in place. This caused faster tool wear, more frequent tool replacement, greater energy consumption and unnecessary stress on the welding equipment.

These are formidable challenges to an industry experiencing rapidly growing demand for faster, more efficient EV charging systems. Emerson engineers studied the problem and found that the increased weld forces needed to weld thicker cables pushed the cantilever-type actuator arms used on typical ultrasonic welders to their mechanical limits. It caused vibration, decreased clamp stability and greater inefficiency. The current ultrasonic welding technology needed to be re-engineered.

**Figure 1. Branson GMX-20-DP "Direct Press" Ultrasonic Metal Welder from Emerson (left) represents a new generation of Metal welding technology.** (photo courtesy of Emerson)

To address the problem, Emerson engineers developed an innovation technology included in the "direct press" ultrasonic welder, the BransonTM GMX-20-DP.

The GMX-20-DP welder (Figure 1) employs a new vertical actuator motion that is able to apply a much greater clamp force (as high as 6100 N) than was practical using a cantilevered actuator arm. The more-controlled motion and increased downforce available with the new vertical actuator eliminate the stress and vibration caused by cantilevered actuator arms.

In addition, Emerson engineers addressed the problem of cable slippage by redesigning the tooling on the GMX-20-DP ultrasonic welder in two important ways. The horn and anvil both have a specialized coating that increases their hardness and durability, and the welding surfaces on each component incorporate knurling to significantly improve the gripping strength of each component. The result is more consistent, repeatable large-cable welding than cantilevered tooling can deliver.

The GMX-20-DP's increased downforce, combined with the redesign of the gripping surface of the horn and anvil eliminates the slippage that occurs with cantilevered actuator arms. The parts are held firm while the weld energy is delivered much more efficiently — all resulting in the stability required to successfully weld cable cross sections of 20, 30, 50, 60, 70 and 95 sq.mm as well as other large parts. The new technology also provides a "gentler," higher-quality, low-stress cable weld that requires typically 30% to 40% lower amplitude than previous ultrasonic technology used for welding EV battery cables.

The new tool design, combined with the vertical weld motion of the direct-press welder, also eliminates the rapid tool wear caused by slippage on cantilevered actuators. This decrease in tool wear not only ensures more consistent tool performance but also measurably increases the interval between tooling changes (see Figure 2).

Overall, the remarkable improvement in large-cable metal welding available with the GMX-20-DP welder is the result of a unique combination of innovative tool design, enhanced

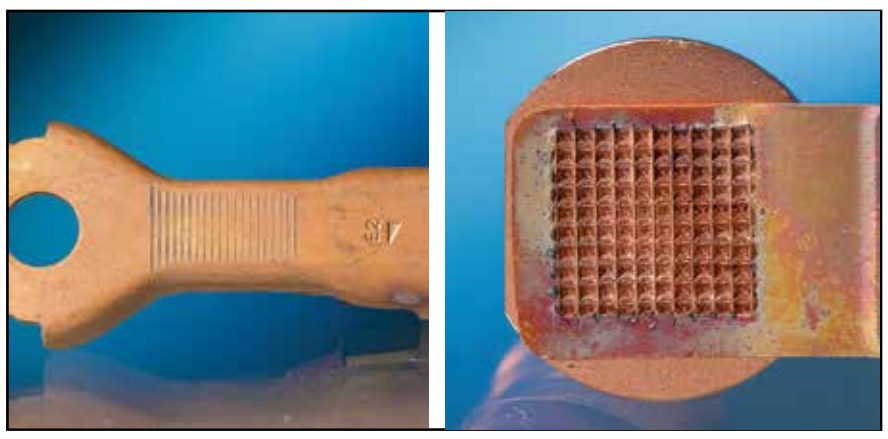


**Figure 2. Conventional, cantilever-type ultrasonic metal welders can be stressed when welding thicker materials, resulting in "slippage" marks (left) from high amplitude and limited tooling grip on the part.** (photo courtesy of Emerson)

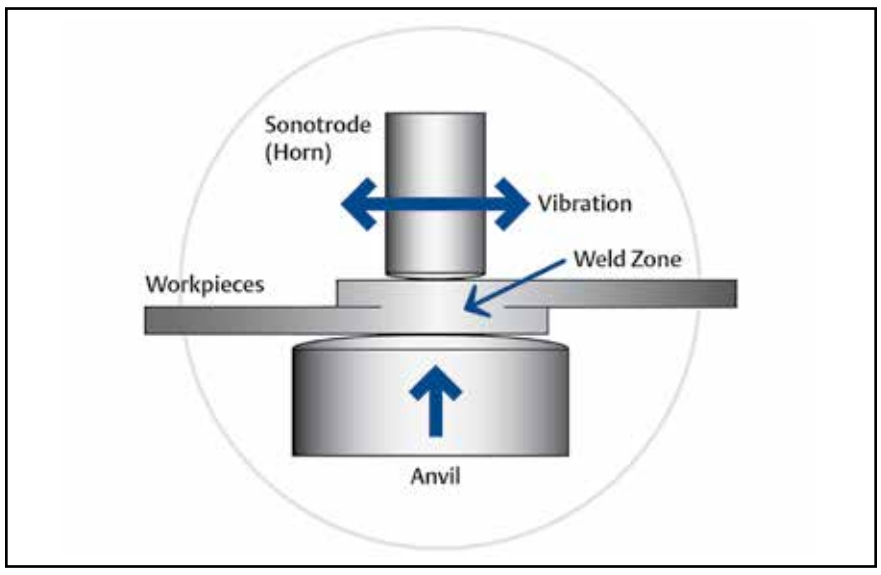



**Figure 3. Diagram of the ultrasonic metal welding process.**

(photo courtesy of Emerson)

direct-press downforce, and a more controllable weld process than has been possible with previous cantilevered actuator technology.

SIDEBAR: Understanding the ultrasonic metal welding process

The soft, nonferrous metal foils used in EV batteries cannot be successfully joined using resistance or laser welding (processes that are excellent for bonding high-strength ferrous metals) because they can melt the delicate foil surfaces during welding. The thin, fragile metal foils typically used in batteries require ultrasonic welding, which uses the heat from friction to join surfaces, rather than melting the metal. The problem is melting the surface of these softer, nonferrous metals can form intermetallic compounds and galvanic corrosion that cause material deterioration, as well as connection and battery failure. In addition, because EV batteries require as many as 90 or more thin foils, it would be complicated to assemble because the foils are so fragile.

Ultrasonic welds are created by applying high-frequency vibration to two metal components held tightly between an upper sonotrobe (or horn) and a lower anvil (Figure 3). One component part is placed on the lower, stationary anvil and held there by a knurled pattern on the tool surface. The welder's actuator brings the horn down to hold the metal components together under a specified pressure. Vibration is then applied, and welding occurs as the horn vibrates horizontally across the stationery anvil, first "scrubbing" away surface oxides and other potential contaminants. The oscillation continues, generating the heat that joins the clean bonding surfaces.

The heat generated by the oscillation is generally about one-third to one-half the melting point of the materials being used. That allows for joining the materials with strong bonds without melting, burning through the thin foils, or creating unwanted intermetallic compounds that could degrade the quality of the bond between the component parts. Rather than melting the material surfaces, it breaks down surface asperities and creates a continuous weld bond characterized by atomic diffusion across the interface that crystallizes into finely grained structures when the vibration stops. The process, which happens in a fraction-of-a-second weld cycle, creates a bond similar in structure to cold-worked metals.

Ultrasonic welders are also uniquely versatile in that they are capable of operating gently enough to join multiple layers of thin, delicate metal foils or, using different parameters, powerful enough to generate strong bonds between large metal parts and conductors (Figure 4).

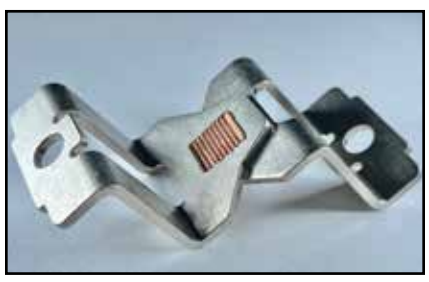


**Figure 4. Strong highly conductive ultrasonic welds splice not only small wires and large conductors but also wire terminations.**

(photo courtesy of Emerson)

**Ultrasonic metal welding and splicing: Process benefits**

- Works with many types of nonferrous metals, from thin films to large conductors
- Creates permanent, metallurgical bond between dissimilar metals
- No melting required — no change to chemistry or metallurgy of materials
- Ideal for joining highly conductive alloys: Reactivity of materials does not matter
- Creates no intermetallic compounds, particulates, or corrosion-causing reactions
- Connections offer maximum conductance, minimum resistance
- Multiple methods of control enable process customization, repeatability and SPC
- Low energy input (30x lower energy use than fusion or resistance welding), no consumables
- Lowest total cost per weld of any welding technology

*About the author*

Craig Birrittella is the Business Development Manager, Automotive, Branson Welding and Assembly at Emerson. During his 25-plus year career at Emerson, Craig has received a U.S. patent for lens adaptation to improve laser energy and has focused on a variety of additional technical areas, from vibration, clean vibration, and infrared welding. Birrittella has a BS in mechanical engineering from the State University of New York, Buffalo.

# Telsonic Tech Days a Big Success

Telsonic Technology Days event took place on June 7 & 8. Many people visited our facility on both days. It was a refreshing feeling to see gathering of so many customers and prospects after the two years of Covid and isolations. Telsonic was able to show a few new products, developments and of course, the new trends in applications for ultrasonic welding.

There was noticeable interest in educational presentations during the two days. Our expert team covered the following subjects during the event:

1) Ultrasonic Basics presented by Reinhard Züst, Technical Consultant,

2) Ultrasonic Metal Welding presented by Greg Ruscak, Application Manager,

3) Digitalization Platform-Process Quality presented by Mustafa Ayabakan, Head of Software Development.

4) Vibration Welding presented by Jochen Bacher, President.

This was a unique opportunity to not only meet our ultrasonic specialists, but also to get an inside look at the latest developments in Telsonic joining technology. The Telsonic team enjoyed the open dialogue and technical discussions with our visitors. Thanks to all visitors and interest in learning about our technology. Telsonic hopes to continue the annual event moving forward. Special thanks to Schleuniger for joining us in this event and sharing their experience with all visitors.

## NEWS PLUGS continued

*Continued from page 53*

### Connectors & Terminals for EVs, Hybrids and Charging Stations

A wide range of standard and custom electrical and electronic connectors and terminals designed for the electric- and hybrid vehicle market have been introduced by ETCO Incorporated of Bradenton, Florida.

ETCO EV, Hybrid Vehicle and Charging Station Products include battery connectors and terminals, heavy-duty ring terminals, ignition components, PC board terminals, insulated connectors, and custom OEM products. Totally manufactured in America, they can be supplied loose or in strip form for automated processing equipment and packaged and delivered as a single SKU.

Conforming to UL, NEMA, ISO 9001:2015, IATF 16949:2016, ISO/TS 1649:2002, and RoHs compliant, ETCO EV, Hybrid Vehicle and Charging Station Products are all precision stamped in the USA. Most incorporate an F-crimp for a uniform crimp with all strands inside for a more secure connection than conventional rollover flag ears and permit faster wire processing speeds.

ETCO EV, Hybrid Vehicle and Charging Station Products are priced according to configuration and quantity. ETCO has over 74 years of experience.

For more information contact: ETCO Inc., Sean Dunn, VP Marketing, Bradenton, FL (800) 689-3826 Email: sdunn@etco.com, www.etco.com

**Volunteerism and Charity Matching Program Touch on TTI's Legacy of Giving**

TTI, Inc. is pleased to announce a new employee Paid Volunteer Time Off (VTO) program that brings a special opportunity for North America TTI Family of Specialists team members to dedicate time off to a charitable organization of their choosing. The heart of the program's mission recognizes that the time spent participating in charitable activities not only contributes to the overall well-being of our communities, but it also enriches the lives of our employees.

Accompanying the rollout of the VTO program, TTI is offering a charity matching donation program that has been established to provide employees with the opportunity to donate to designated 501(c)(3) organizations that mean the most to them. Monetary contributions made by employees will be matched dollar for dollar up to a designated annual amount by TTI through Fidelity's Workplace Giving platform.

In announcing the launch of the program inspired by the legacy of TTI's late founder, Paul Andrews, Traci Nelson, TTI Vice President of Human Resources, offered, "At TTI, we are truly grateful for our employees and the communities in which we work and live. In order to show our GraTTItude, we want to collectively put the strength of the TTI family behind our employees' efforts to give back to the charities they care about with both their time and monies."

About TTI

TTI, Inc., a Berkshire Hathaway company, is an authorized, specialty distributor of electronic components. Founded in 1971, the emphasis on a broad and deep product portfolio, available-to-sell inventory and sophisticated supply chain programs has established TTI as a distributor of choice to manufacturers in the industrial, defense, aerospace, transportation, medical and communications sectors worldwide. TTI and its wholly owned subsidiaries, the TTI Family of Specialists, Mouser Electronics, Sager Electronics and the Exponential Technology Group employ over 8,000 people in more than 136 locations throughout the Americas, Europe, Asia and Africa. Globally, the TTI Family of Specialists maintain over 3 million square feet of dedicated warehouse space in 30 distribution centers. For more information about TTI, visit www.tti.com.

**LEDtronics New Low Voltage LED Bulbs are a Bright Solution to Compact Illumination**

LEDtronics® adds two new low-voltage, single-contact, bayonet-based LED bulbs to its series of ultrabright, direct incandescent replacement lamps in automotive, accent lighting and compact illumination applications that offer up to 90 percent energy savings.

The 8-LED B608-SIW-006M uses only 0.8 watts and produces luminous intensity of 63 candelas, while the 18-LED B618-SIW-006M uses 1.7 watts and produces 77 candelas. Both bipolar lamps use a 15mm single-contact bayonet for lines running 6 volts DC and readily adjust to direct-current polarity. They are ideal in maintenance-intensive and low-voltage applications such as automotive and gaming candle indicators, indicator lights for instrumentation, panel mount pilot lights, as well as accent and task lighting. They are also suitable for use in open luminaires.

Both compact LED bulbs provide 3000K warm-white illumination with an inline beam angle of 55 to 60 degrees, with B608 offering more than 47 lumens at an efficacy of 57.5 lm/W, while B618 produces 85 lumens at an efficacy of 48.8 lm/W. They boast lumen maintenance of over 70 percent at 50,000 hours, operating reliably year-after-year within a wide operating temperature range of ~-22°F to ~+122°F (-30°C to +50°C).

These energy-efficient and long-lived illuminators come with a single-contact bayonet Ba15s brass base and a white Rynite FR530 sleeve. Their solid-state design renders them impervious to electrical and mechanical shock, vibration, frequent switching and environmental extremes. They provide sharper, higher intensity illumination and better visibility than standard lamps, and achieve full brightness more rapidly, with a faster turn-on and reaction time compared to incandescent lamps.

All this translates to maintenance-free operation results with substantial cost savings.

The new B6x8-SIW-006M LEDtronics compact, ultrabright, low-voltage SC bayonet-based LED lamps come with an unconditional 3-year U.S. factory warranty, and they are available through LEDtronics distributors. Options available for large quantities and qualified applications: Other colors and white color temperatures, other voltages, other miniature and subminiature bases –E12, E14, E17, Ba15d, etc.

For more details and technical data, visit the product web pages:
https://www.ledtronics.com/Products/product_select.aspx?id=B608-SIW-006M
https://www.ledtronics.com/Products/product_select.aspx?id=B618-SIW-006M

**Auxo Investment Partners and Precision Products Group Add to Specialty Manufacturer Platform with Acquisition of Breyden Products, Inc.**

Private investment firm Auxo Investment Partners announced today that it has acquired Breyden Products, Inc., which will operate under the Precision Products Group (PPG) platform and brand. PPG is the parent company of Paramount Tube—a premier manufacturer of industrial tubing—as well as Euclid Medical Products.

As PPG's first acquisition under the ownership of Auxo, the deal advances Auxo and PPG's plans to build a diversified platform of niche manufacturers with defensible market positions that unite ecofriendly solutions, mechanical strength, and material know-how under a collective focus on heat solvation, thermal control, and electrical insulation. The platform is seeking additive acquisitions with like-minded manufacturers focused in the electrical, defense, medical and consumer packaged goods sectors.

Headquartered in Columbia City, Ind., Breyden Products manufactures a complete line of military specification braided lacing tapes, twines, cords and sleeving that are used to secure and protect electrical components in the electric motor, defense and aerospace markets. Drawing on over 75 years of manufacturing experience, the company has refined a highly technical braiding and coating process that results in industry-leading products that are preferred by discerning end-market customers.

Since 1991, Breyden has fostered relationships with best-in-class distributors in the aerospace and defense industries, as well as the burgeoning electric motor and transformer sectors.

"The Breyden team is beyond excited about the partnership with Auxo, PPG and their portfolio of world class manufacturers," said Mike Zuber, Vice President of Sales for Breyden Products. "Our deep and long-standing relationships with leading channel partners will support the continued growth and diversification of PPG in the aerospace, defense and electrical markets."

Added Chad Heathco, CEO of Precision Products Group: "We are thrilled to add Mike and the Breyden team to our growing PPG portfolio of specialty manufacturers. By bringing Breyden and our Paramount Tube division together under one roof, we will be able to provide the electric motor, defense and aerospace markets with an unprecedented product offering that leverages deep manufacturing expertise and material know-how."

Specialty Manufacturing Platform Poised for Growth

Beyond continued growth in the defense and aerospace markets, the combination of Breyden and PPG's Paramount Tube division is expected to greatly expand opportunities and market share in the electric motor market. Pairing the former's braided manufacturing process with the latter's state-of-the-art spiral-wound manufacturing process will offer customers a wider range of product solutions that improve product quality and performance.

Paramount Tube is the dominant player for mission-critical, small diameter spiral-wound and extruded tubular products known for providing highly customized, tight tolerance and uniquely shaped solutions. Applications include components for electric motors, transformers, fuses, automotive, single-dosage medications, pharmaceutical packaging, eco-friendly consumer packaging, and military ordinances.

"The acquisition of Breyden expands Paramount Tube's portfolio of offerings which enables our team to better serve our customers by providing a deeper and broader product line of custom solutions," said Tim Shaw, Vice President of Sales and Marketing of Paramount Tube. "We look forward to maximizing the value and benefits that this combination brings to existing and new customers."

"From the moment we met Mike and Jay, we were immediately impressed with Breyden's unique manufacturing capabilities, customer-focused culture and dominant market position," said Auxo co-founder and Managing Partner Jeff Helminski. It's clear the company's values are closely aligned with ours -- and its success has been driven by the leadership team's unrelenting pursuit of excellence and customer service. We're excited to honor the legacy they have built and support them in leveraging their unique capabilities to expand their global footprint both organically and acquisitively."

Advisors and lenders on the transaction included Miller Johnson PLC, Barnes & Thornburg LLP, BDO USA LLP, Marsh & McLennan, Aon Plc, Krauter & Co., Thomas Brady & Associates, Mercantile Bank of Michigan, and Greyrock Capital.

Prior to Breyden Products, Auxo acquired 16 companies, most recently Golden State Assembly, a wire harness and cable assembly manufacturer, and Securit, a manufacturer of solid metal rivets. In late 2021, Auxo acquired Genesis Rail Services and Ferrovia as part of its burgeoning rail platform. Earlier, Auxo acquired Bernal Rotary Dies, Atlas Die, AtlasFlex, Midway Rotary Die Solutions, DieCraft Engineering & Manufacturing, and GC Dies, which comprise the Impact Converting and Systems Solutions platform. It's marine platform, Auxo Marine, was formed by the acquisitions of M/G Transport Services, a leading inland barge transportation and logistics company, and Andrie, the premier Great Lakes marine services company serving customers with challenging safety and specialty material handling and transportation requirements. Other acquisitions include: Paramount Tube and Euclid Medical, niche manufacturers of custom-engineered spiral wound tube and pharmaceutical packaging; Prestige Stamping, a high-speed manufacturer of custom engineered stampings for the fastener industry; and Altus industries, a leading supplier of medical carts and workstations.

A Long-Term, Collaborative Approach

Auxo continues to pursue additional opportunities in the specialty manufacturing space, and more broadly seeks to partner with companies that meet the following investment criteria:

- North America-based
- Manufacturing, industrial, value-added distribution or business services industries
- EBITDA (cash flow) of $2-$20 million
- Owner-operators seeking retirement, family succession planning solutions or existing teams seeking to grow their businesses
- Prefer majority-control investments but will consider select minority-partner opportunities

About Auxo Investment Partners

Auxo Investment Partners is a Grand Rapids, Michigan-based private investment firm that partners with owners and management teams of companies at transition points in their history. Auxo's flexible capital model allows for long-term, growth-oriented decision-making without artificial deadlines. The structure was specifically designed for family businesses facing a generational transition or management teams seeking a partner to fuel growth and achieve their full potential with a long-term investment approach. Auxo's unique philosophy aligns the interests of its companies, their employees, the communities in which they are located and its investors to achieve optimal outcomes for all. As our name reflects, we are not merely investors, but partners. For more information, please visit www.auxopartners.com

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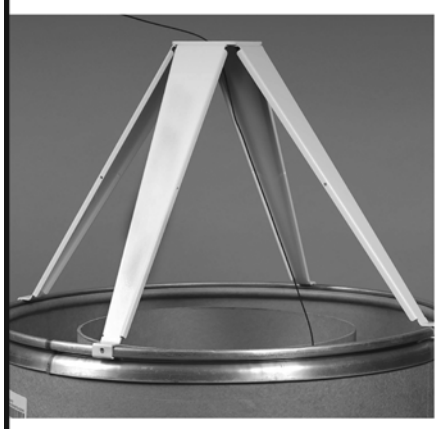

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