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- Demystifying Injection Molding
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- Tips to Help You Make Your Company Great
- Plasma Treatment for Marking & Bonding Wire
- From Design to Production by a Collaborative Team
- Portable Crimp Tools: Selection, Use and Maintenance

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# Company Profile: LEDA Corporation

By Joe Tito  
Wiring Harness News

There’s nothing better than a trip to Southern California this time of year. That’s where we find LEDA Corporation, a well-established supplier of harnesses, electrical assemblies and specialty PCBs. Wiring Harness News spoke with David Tung, Vice President, of LEDA Corporation about his family’s story in the industry. David’s father, Joseph, started the business in 1985. But his path to that point is fascinating, so we’ll start further back.

Joseph graduated with a degree in electrical engineering from SMU (Southern Methodist University) in 1959 and was quickly snapped up by Boeing in Seattle. He was then assigned to the Saturn V program and moved with his wife, Dorothy to

Huntsville, Alabama. That’s where his two children Leslie and David (LEDA) were born. Following his work on that program, the family moved back to California where Joseph took a job with Lockheed.

Feeling the pull towards electronics sales entrepreneurship, Joseph uprooted his young family and moved back to his home country of Hong Kong. He operated that business quite successfully, but as the kids reached college age, he wanted them to attend American universities. “So, we moved back in 1982. My father was semi-retired, but he got bored and started LEDA in 1985,” David recalled.

The business began making audio/visual products for education. “We used to make record players, overhead projectors and other basic electronics,” David detailed. But the



LEDA is providing assemblies for NASA’s SLS super-heavy lift launch vehicle.

breakthrough product was a video projector that sold for under \$1,000. “Back then, if you remember, video projectors were in the tens of thousands of dollars. My father created a design and manufactured a video projector that was the first LCD model on the market, and we sold them for 800 bucks!” The design was portable, durable, and allowed customers like schools and church missionaries to

quickly set up a theater with nothing more than the projector and a bed sheet.

Things were going quite well until their main supplier took notice. “Our LCD supplier thought it was such a great business that they raised our prices and kept the technology to themselves,” David lamented.

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# Cables in Motion: How igus Builds Dynamic Cable Assemblies

By Joe Tito  
Wiring Harness News

Usually when we think about cables and movement, we think about cables inside a train, plane or some other vehicle traveling at various speeds. But what about when the cables themselves do the moving? Motion is what igus is all about. igus is a German manufacturer and distributor of linear guides, cable carriers, continuous-flex cables and both plain and spherical polymer bearings.

Worldwide, they employ just under 3,000 with 430 of those working out of their 189,000 sq. ft. Rhode Island facility. Many of the flex or dynamic cables that igus makes go in their self-lubricating plastic guides and carriers. Because they have achieved such proficiency in dynamic cable assemblies in their own products through the years, that business has become a strong, stand-alone product line.

Wiring Harness News recently spoke with Joe Ciringione. Joe is the igus Division Manager for Energy Chain Systems (ECS), which includes their e-chain® cable carriers, cables,



igus chainflex® Flexible Cables inside their e-chain® Cable Carriers.

cable assemblies and connectors. Joe dug right into what makes their dynamic chainflex cables unique by discussing the selection of jacket materials. “Most static cables use rubber jackets like neoprene that have great high and low temperature resistance, but you can wear through them quickly.” igus has done extensive research into the way cable jacket materials wear on the crossbars inside their e-chain and have found that certain polyvinyl-chloride and polyurethane blends that are abrasion and UV resistant work best. Likewise,

core insulation materials must be made from similar abrasion resistant materials to achieve peak efficiency in multi-axis movement.

The actual strand design of the cable itself is also very important. Joe mentioned it’s actually not super-fine like many may think. “It’s not the smallest, finest stranding you can get because that actually does not have a good tensile strength, so over time, and over longer travel distances, it’s not as good as fine to medium strand-

Continued on page 22





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January/February 2022

IN EVERY ISSUE

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LEDA’s story is one of pride and perseverance. With a beginning in consumer electronics, the actions of a single supplier pushed them on a path that led to space.

Cables In Motion . . . . . 1

WHN usually discusses cables in products that move. But what about when the cables themselves do the moving? Learn about the special processes involved in making flexible cable assemblies.

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The cascade of new electric ve- hicles and batteries into the market poses ongoing challenges for our industry. Discover how the supply chain has become a collaborative player in the electrification revolution.

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The EPA has issued a new pro- posal prohibiting the processing and distribution of PIP (3:1). WHMA/IPC has been gathering data and will be sending the information to EPA for review. If this substance is part of the products you process, this is a must read.



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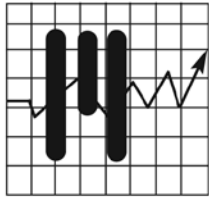
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# From the Editor

## Let's Connect This Year!

2021 was a year of resiliency for the harness industry. I was fortunate enough to speak to many of you throughout the year. What I heard were stories about material shortages, staffing challenges and general uncertainty about what the next day would bring. Yet somehow, you managed to turn out record amounts of product. What an inspiring story of perseverance! I constantly brag about you folks to my friends in other industries.

Let's hope the worst is behind us and that new and exciting challenges lie ahead. And let's plan to connect, in person, in 2022. There are three amazing opportunities to do just that in the early part of the year:

**APEX EXPO 2022** - San Diego, CA, Jan. 22 - 27. As a premier event for the electronics manufacturing industry, you'll have access to professional development courses and presentations as well as exhibits from over 400 industry leaders and innovators. **See us at booth 3019.**

**WHMA Annual Conference** - Tucson, AZ, Feb. 15 - 17. This is the best opportunity in the wire harness industry to spend quality time with some of the top suppliers, and network with your peers. Bring your biggest challenges and come away with workable solutions. **See us at booth 114.**

**EWPT Expo** - Milwaukee, WI, May 10 - 12. This is it...the granddaddy wire processing event. With 200 exhibitors and 3,000 attendees, it is devoted solely to wire and cable processors. You'll find training, education, expanded networking and the largest single group of suppliers to the harness industry. This show has so much to offer, but it's also a lot of fun! Just ask a past attendee. **See us at booth 1225.**

Come say hello!

Joe



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The current standards for ultrasonic wire splicing and termination have been developed globally by both industry OEMs and their Tier1 suppliers. One recent standard starting to be used commonly are SAE/USCAR 45 for wire splicing, and the SAE/USCAR 38 for wire termination.

There are several opportunities to follow best practice guidelines for ultrasonic welding, initially during trials in the laboratory and ultimately in the production plant environment where process validation takes place. Necessary information and easily accessible

visual display for quick reference can be very effective for the staff in the plant and the development laboratory.

Based upon existing industry specifications and valuable contributions from many of our customers, Telsonic has produced an informative single page poster to act as a guide covering common wire splicing and wire termination welding applications. Important quality and operational criteria are highlighted using text and images, together with test criteria and a useful table of wire sizes.

Access to this user-friendly guide will enhance user confidence in the operation of ultrasonic technology for metal welding which in turn will enhance consistency and quality on every application.

The poster is available in landscape format size A0 (4619/24" x 331/8", 119 cm x 84 cm). If you are interested in obtaining this Telsonic "Ultrasonic Metal Welding Quality Guideline" poster, please send an email to [sales.boston@telsonic.com](mailto:sales.boston@telsonic.com).

**Ultrasonic Metal Welding – Quality Guidelines**



**Ultrasonic Wire Splicing**

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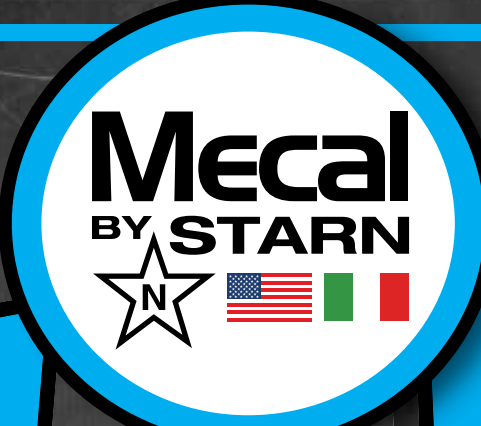



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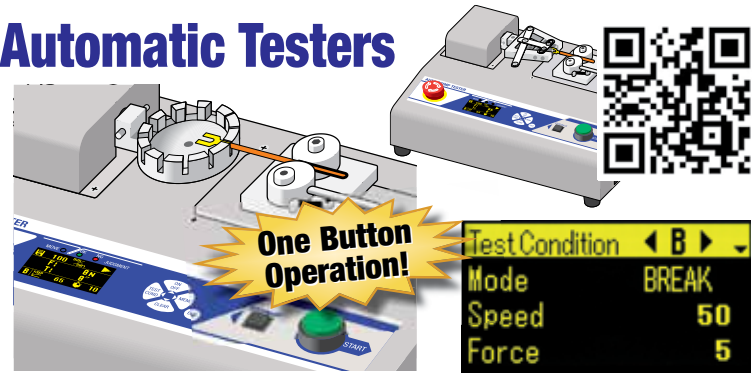


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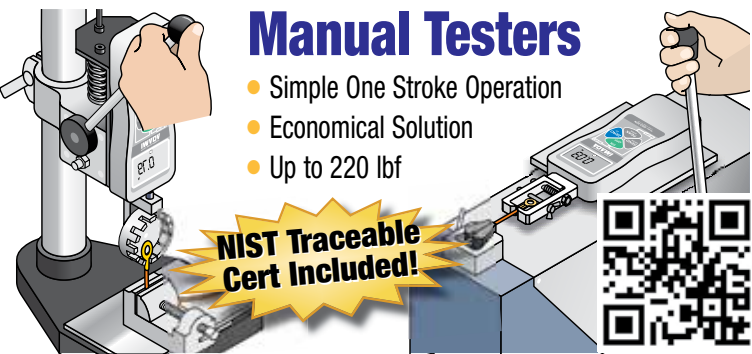
# Wire Crimp Pull Testers

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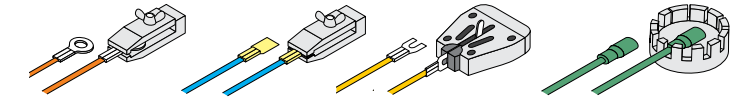


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# LEADERSHIP

PUTTING INSIGHTS INTO ACTION

## Leading for Success: Tips to help make your company great!

By Paul Hogendoorn



Paul Hogendoorn

I’m continuing the series of sharing the top 10 tips I’ve learned from manufacturing companies I had the privilege of working with. These companies are clearly succeeding and thriving, not just surviving. Sometimes they seem like simple common-sense things to do, but often they are counter intuitive.

In the first column, the two tips were: 1) “Don’t make a big production of it”, and 2) “Your people are the smartest people in the room”. The two tips in the last column were 3) “What gets measured gets improved”, and 4) “You can get a lot more done when you don’t care who gets the credit”. They all seem relatively straight forward, but there’s more to it than just an easy-to-remember slogan. Feel free to revisit the columns online.

Tip #5: “Digitize your proven processes first”. A common and

expensive mistake many companies make is they tamper with proven plant floor processes in order to digitize them to achieve their stated “Industry 4.0” goals. The mistaken belief is that its ok to change an effective plant floor process to accommodate a new digitized system, and that the new process with a digitized system will be inherently better than the

Continued on page 10

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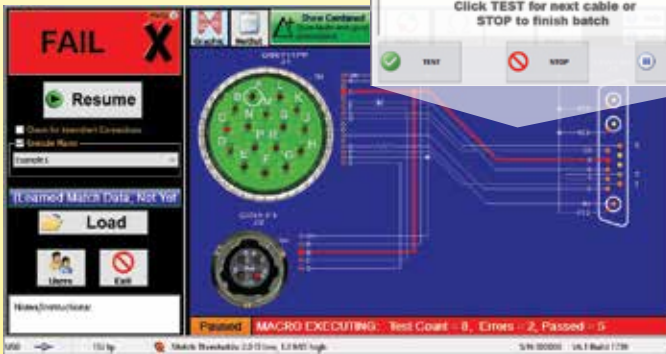
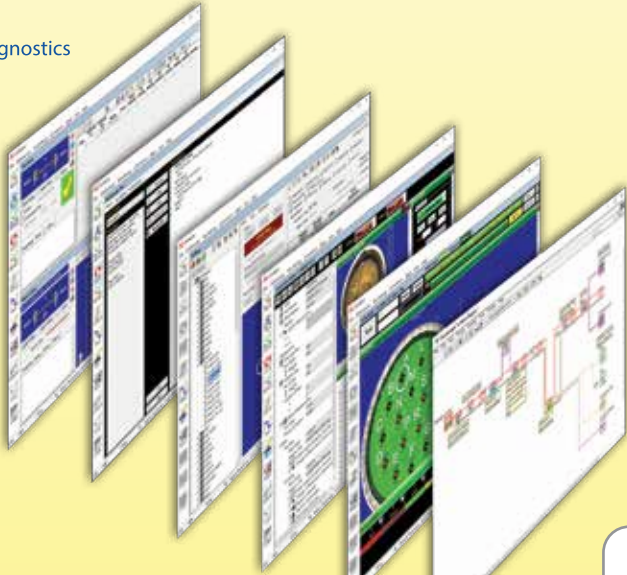
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# Leading for Success: Tips to help make your company great!

Continued from page 8

current process with an older manual system. This is a mistake on two accounts; the first is that you may have reduced the effectiveness of a fairly effective production process,

and you make money on the production process not on the administration process. The second is that you will likely have made gaining buy-in on the implementation of any new digital system even harder to achieve by starting out on the wrong foot.

There's a natural tendency to leave working processes alone and tackle problem areas first, but in this case, it's better to eliminate one major project variable by digitizing a process that you know already works; you are not trying to do two complicated things at the same time by introducing a paradigm shifting technology and trying to fix a broken process. Fixing a broken process is a major task and

objective by itself, as is digitizing a working process. For your whole Industry 4.0, plant floor digitization plan to have the best of success, you need to an early win. Digitizing a manufacturing administration process you already know works well (check lists, scheduling, buy-off forms etc) can get you that early win. Taking on a broken process and trying to fix it with technology could stall your digitization initiative or send it in the wrong direction.

Tip #6: **"Know your internal customer, and what's in it for them"**. The larger an organization is, the more layers there are, and the more important this tip becomes. Advancing an idea or trying to get something critical done often means moving the conversation up the ladder one rung at a time. Or, it may mean delegating it down, but again, one rung at a time. Each rung on the ladder has a different stakeholder with a different agenda. A few years ago, my company's marketing department developed a "persona chart" to help

our sales team be more successful by aligning their pitch and terminology with the audience they were addressing. Seeing it all laid out on a single chart revealed how complex manufacturing organizations really are, and how important it is to understand "what's in it" for everyone on the other ladder rungs.

On the far left of the persona chart are the machine operators and "value adding, hands on" people in your organization. On the far right is the C-suite, with the CEO on the very far right. In between you have supervisors, department managers, plant managers, CI, maintenance and other functional managers, and perhaps division managers. The two main things that change as you go from left to right are the metric of concern and the period of interest. On the left the metric of interest is parts, cycles, and rate, and the period is this hour, this shift, this day. On the far right, the metric is financial and the time view is this quarter, this year, this stage. On the left the interest is personal financial security and stability. On the right

its profitability, sustainability, and growth. On the rungs in between, its, well, somewhere in the middle. Knowing how to advance your cause up the ladder, or delegate an objective down the ladder, requires a good understanding of what constitutes success for all the folks you are working with. The better you understand their position and what's in it for them, the better your chance of achieving a collective success.

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

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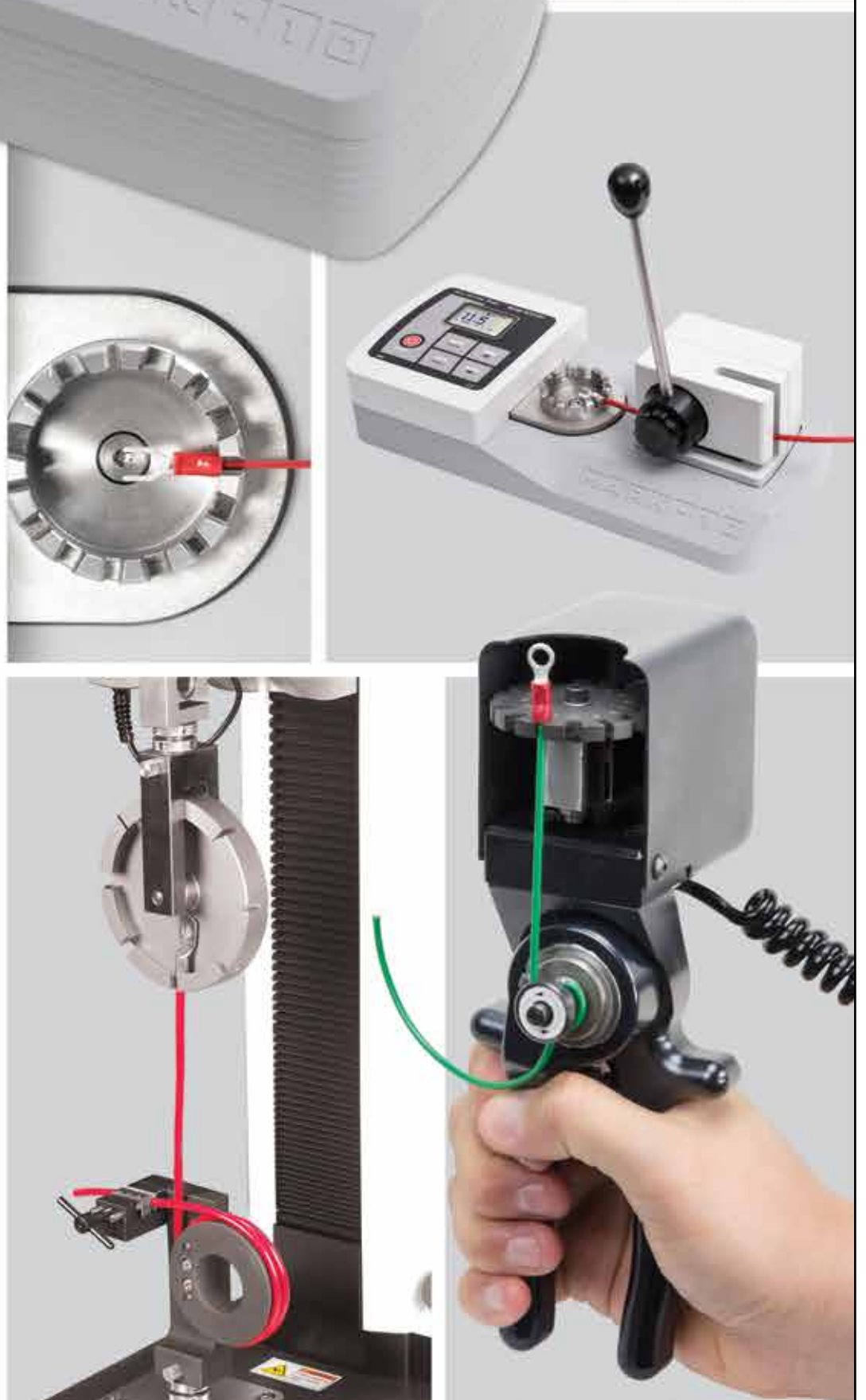


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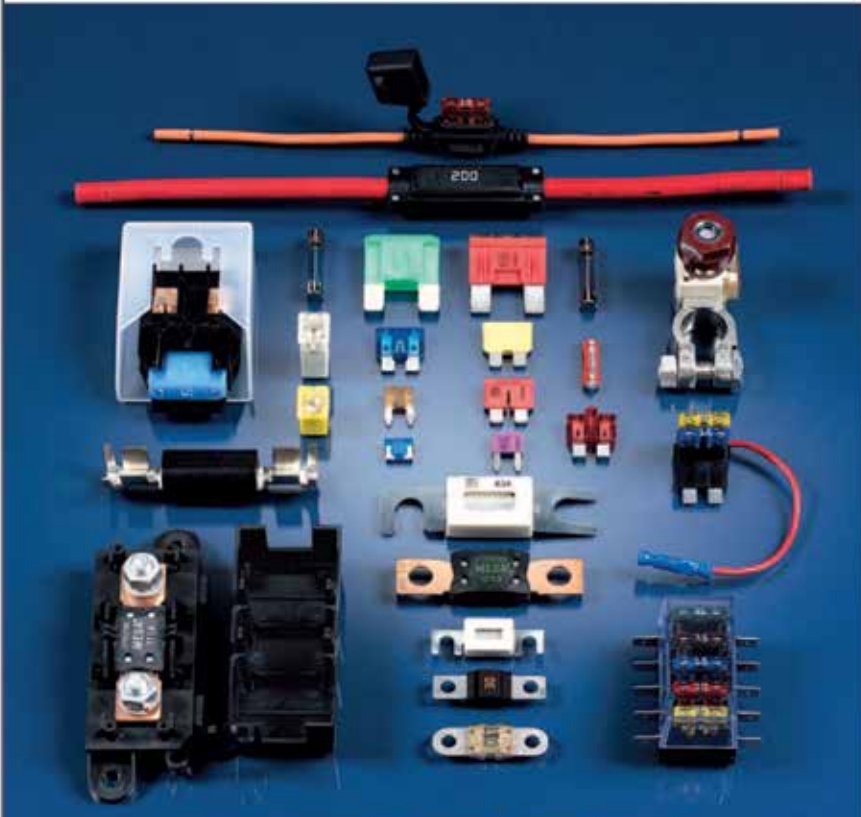
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**THE  
POWER WOMEN  
OF THE WIRE HARNESS INDUSTRY**

By Melissa Femia



**Melissa Femia**

This edition of the Power Women series takes us across the globe to India, where Swapna Mangar is currently working for TE Connectivity. Unlike all of the other female engineers featured in the series, Swapna has not lived in the United States nor has she traveled to the US. However, she has worked for US-based companies in India. The article will provide some insight as to the similarities and differences between the educational and career paths of students in the two, distant countries.

Swapna was born to a Nepali family in Siliguri, India. Her father was a government employee of the school system, where he was a lab attendant and arranged experiments. Her mother was a homemaker. Although her father had no formal engineering education, Swapna’s childhood was filled with memories of her helping her father to repair mechanical and electrical systems. She was always intrigued by how items functioned. Because the geographic area in which she was born was very conservative, women were seldom engineers. Swapna’s mother suggested that she pursue a government job such as teaching. On the other hand, Swapna’s father encouraged her to become an engineer due to her interest in science.

In 6th grade, Swapna took her first STEM-related class during her time at Kendriya Vidyalaya Sevoke Road in Siliguri, India. Subsequently, she continued to follow the science path during high school, enrolling in classes like physics, chemistry, math, and computer science. After high school, Swapna took a college entry test and scored within the top 10%. Because she was so proficient in science and math, she decided to attend college for engineering. She chose a public university in southern India, Annamalai University, though she was from

Continued on page 14

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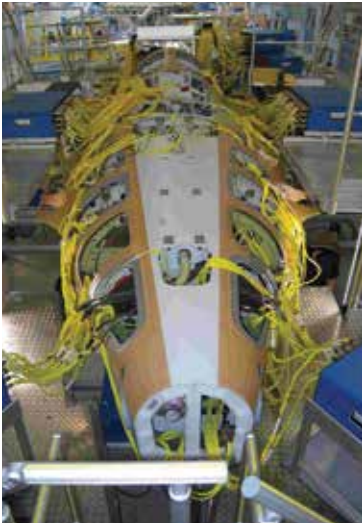


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## The Power Women of the Wire Harness Industry

*Continued from page 12*

a northern Indian town. Like in the United States, there are both public and private schools in India (with a significant different in tuition fees). She majored in Electronics and Communication. She said that she had to convince her parents to allow her to travel so many kilometers across the country, as it was so uncommon for females in her hometown to not only pursue engineering but also to veer such a distance from home. After a little swaying, her parents were very supportive. I questioned Swapna about her coursework because it is less common for an electrical/electronics engineering degree to be combined with a communications major in the United States. She confirmed that her program did include all of the technical classes and also had a large amount of coursework in communications.

Her classes were comprised of about 70% males. She mentioned that there were a few situations in which she was subjected to traditional thinking—that women should be at home or in traditional female jobs while men were more prominent in the technical workforce. However, such situations were counterbalanced by a few professors who always encouraged the females and treated them with the equivalent respect as the males.

After graduation, Swapna was hired by Automotive Axles Ltd. as a graduate engineering trainee. She was promoted to Senior Engineer, spending a total of 3 years there. As she strived for growth potential, she then decided to work for Honeywell Aerospace as a project analyst for 2 years. Due to personal reasons and wanting to care for her parents, she left Honeywell to return to her hometown. During her 6 months of unemployment while supporting her family, she furthered her education by taking a PMP Certification class. This class was heavily focused on project management, an area of interest to her. Once she re-joined the workforce, she returned to the Banglor province in the south, and was hired by TE. She has since held several roles at TE. Her first assignment was as a project analyst responsible for schedule management, cost management, expense reporting, risk management, program execution, and stakeholder management. Now, she is a project manager working with PBL (private brand labelling) projects. She explores new opportunities and markets, acquires new business, launches products, and prepares business cases while still managing corporate risks and being responsible for the successful management of a program. She is currently working in program management on cable glands and terminal blocks.



**Swapna Mangar**

In terms of obstacles, Swapna admits to having some struggles in her earlier career. She remembers supervising 5 employees in one of her roles. One of the senior-level male employees was resistant to taking direction from a younger, female boss. After some time, Swapna's expertise and work performance gained her his respect and he began to follow her instructions. In other instances, she was paired with male counterparts on assignments when she was very capable of completing the tasks independently. In her current role, however, she is regarded as equally as her male counterparts.

Swapna advises students to consider engineering as a career if they are curious and have an interest in the ever-changing technological developments of society. With all of the emphasis on gender diversity, she believes there is so much opportunity for females in entry level roles as well as in leadership. There is also significant learning opportunity. Further, engineers drive innovation and gain exposure as they present their projects to upper management and customers. She encourages students to learn the concepts and learn them well—become expert in an area or two. To do so, they shan't be afraid to 'get their hands dirty'.

Outside of the standard work day, Swapna takes part in a PMI team to encourage other females in industry. She also is involved in the TE Women in Networking group, which hosts female events and is attended by various levels of management at TE. Female leaders provide support to the newer members, often discussing their own personal challenges and work/life balance concerns.

Thank you, Swapna, for sharing your story and best wishes for future successes.

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

If you know a female engineer who would make a great candidate to feature in the PowerWomen series, please direct them to me at [melissa.femia@janadiversity.com](mailto:melissa.femia@janadiversity.com)



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M & A 101: Lessons learned from decades of deals

The Lure of the Entrepreneurial Life

By Loren Smith

At the beginning of my recent WHMA webinar, I mentioned moving my new blended family from Boston to a town of 1000 in rural Iowa years ago to acquire a small, struggling wire harness company. I had left income security and taken a big risk because as long as I could remember I had wanted my own business. At the root of my entrepreneurial dream was the freedom and independence that I had seen ownership give my uncle, a childhood role model.

My family consisted of my new wife and three pre-teen kids: my two sons and my new stepdaughter. The move was a daunting adjustment for each of us. When our kids got on the

school bus other kids actually poked them in the arm as if they were arrivals from another planet. When my wife tried to schedule work on our new house, to her consternation she was asked when the man of the house would be home. And I quickly learned the company I had gambled on acquiring through sweat equity was in much more trouble than I had realized.

So after about a year in Iowa, when I got a call from a headhunter who was doing a search for a substantial connector company on the West Coast--and my Texas Instruments background coupled with my entrepreneurial experience appeared to qualify me--I listened. At that point I had not consummated the transaction to acquire the Iowa company, as my deal had been turning it around first and then working out an owner-

ship arrangement.

After the headhunter flew out to meet me, we scheduled a trip to the West Coast so I could interview for the position as president of the connector company. My wife and kids were excited about the prospect of getting back to civilization, and the salary and perks in the offing were way beyond what I would be able to draw from a harness company just beginning to show signs of rebounding.

I interviewed with a number of people in California and was offered a job on the spot. We had hit it off, and my credentials were a fit. I told them I wanted a few days to think about it and discuss the change with my family.

On the way back to the airport, however, I reflected on what I had seen. The position was an excellent



Loren Smith CEO  
Blue Valley Capital

opportunity with a substantial, well-run company, but it was a move back into the corporate world.


By the time I reached the airport, I had made up my mind. I called my wife and told her I wanted to stay in Iowa. I recognized that she and the kids favored moving again, but the freedom and independence of ownership had handily won the day. My wife, understanding my long-held entrepreneurial dream, was not surprised by my decision and was extremely supportive. As for our children, they showed the resilience of youth and soon forgot all about the short-lived possibility of uprooting again.

In retrospect, the business decision I made several decades ago was the best one I have ever made. I have enjoyed the good fortune of achieving leadership serving the construction equipment industry, with the help of my outstanding team, and doing well financially. But the driving force in my decision process was not money. It was the desire to achieve the feeling of freedom that I had observed as a kid in my uncle--and which I was already starting to experience myself in my short time in Iowa. That feeling has never left me.


Loren Smith can be reached at [lms@blv-capital.com](mailto:lms@blv-capital.com) or [www.bluevalleycapital.com](http://www.bluevalleycapital.com).

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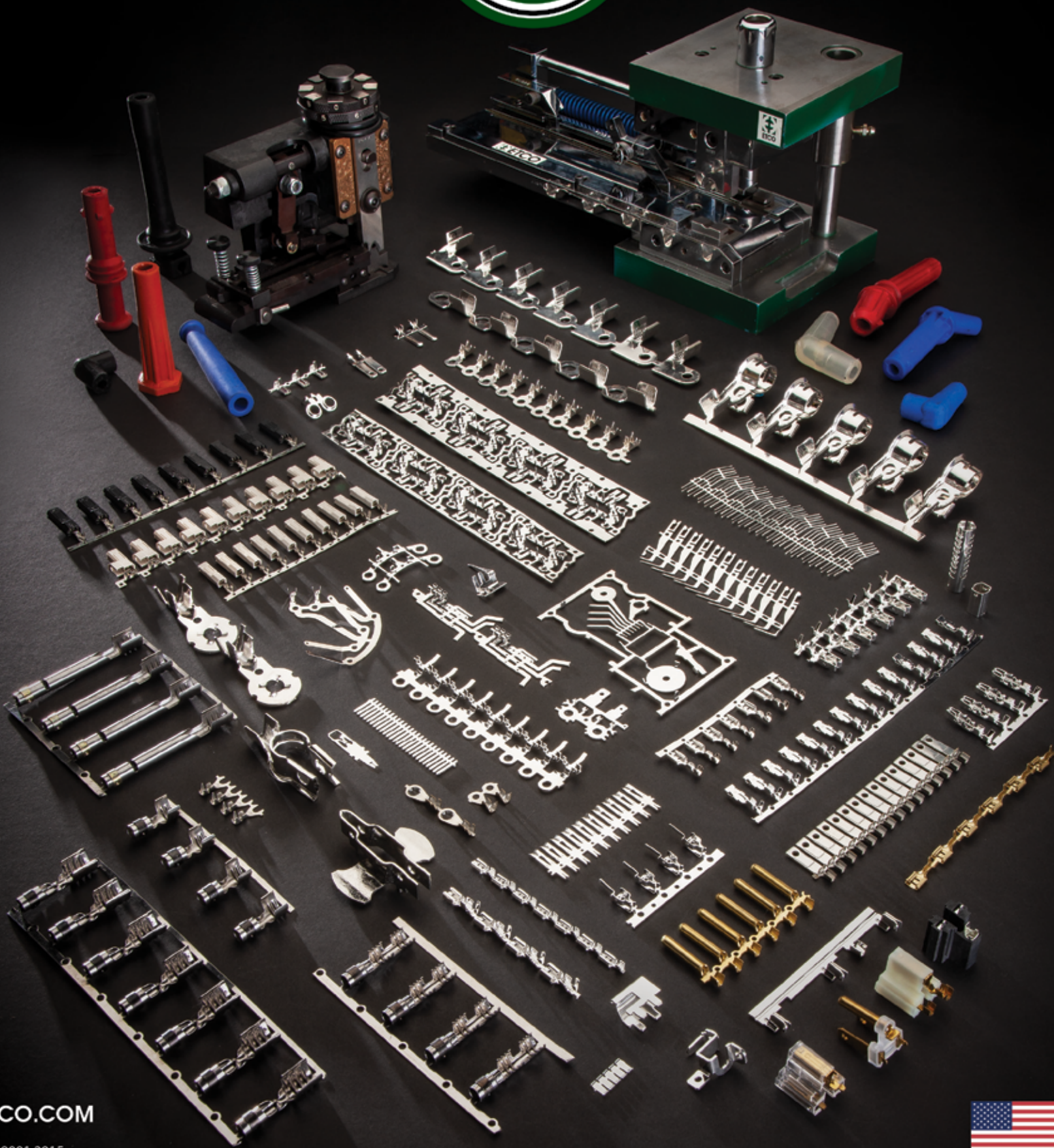
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# LEDA Corporation

Continued from page 1

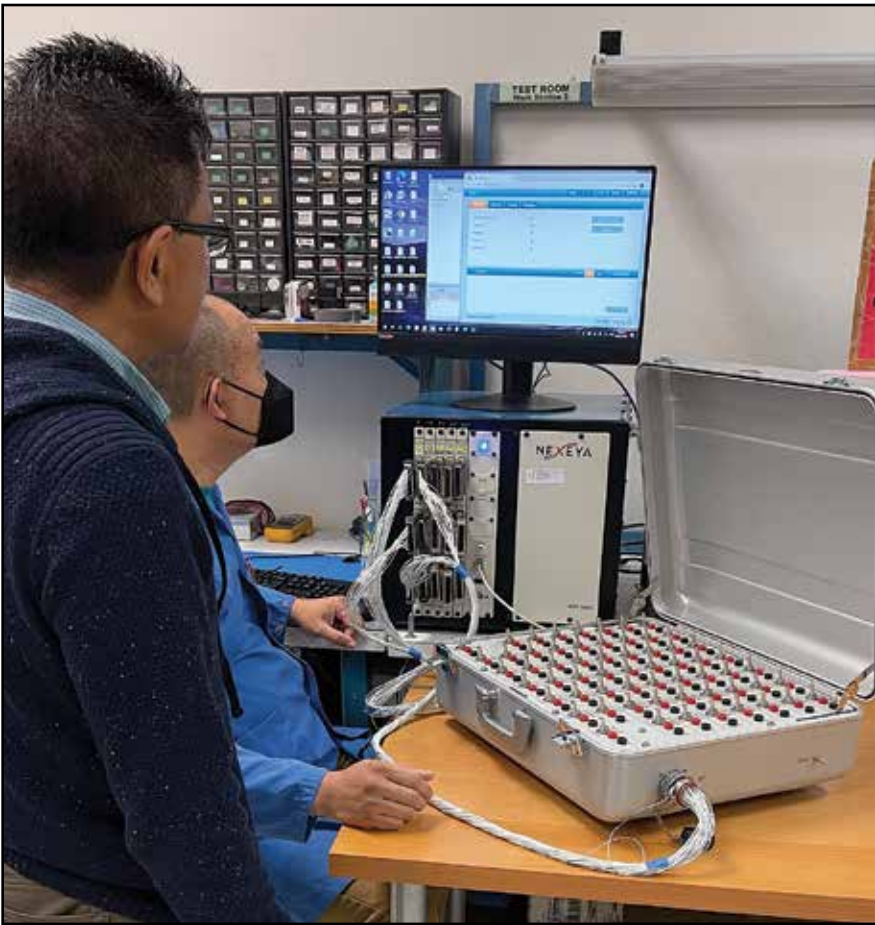
As one door closes, another opens, and LEDA was then presented with an opportunity with a DoD contractor. “We got our first taste of military wiring harnesses with a company called Brunswick Defense. It was for a missile system and it was just a rinky-dink \$100 PCB, but they were building thousands of these vehicles.” That opened the door with Rockwell, and Joseph was back in the mil/aero game.

The 80’s were good, and LEDA was increasing their defense program footprint. Through the years, their growth closely followed the trajectory of overall defense spending. The company saw a downturn in the early to mid 90s and an increase in the late 90s through the mid 2000s. “We were busy and growing until 2008-2013 when sequestration really kicked

our butts, but from 2018 to today we have been very busy and prosperous.”

LEDA started out in a 6,000 sq. ft. rented facility where they remained for 20 years. They purchased the current 19,000 sq. ft. Huntington Beach facility in 2004 and then purchased the adjacent 9,000 sq. ft. building the following year. The entire space including labs and production areas are temperature controlled.

With just under 30 employees, LEDA is a low-volume, high-mix manufacturer. The company makes highly specialized cable assemblies, electro-mechanical devices and PCB assemblies for aerospace and defense. More recently, they are working on commercial space programs like Blue Origin. “So basically, our work has gone from commercial to weapons, and all the way up to manned space flight.”



Chana Hou (left) looks on as a complex assembly is tested at LEDA.

LEDA has a very low turnover and David attributes that to their philosophy of developing highly skilled, highly trained employees in a cohesive atmosphere. “We do all the training in-house,” he mentioned, “and it’s not just book training. We focus on high-reliability assemblies, so there is plenty of hands-on learning with our highly skilled trainers.” That training capability is essential for LEDA to maintain their AS9100, NASA-8739, and Boeing BQMS certifications. It is also key to their adherence to several Mil-Standards, J-Standards and countless electrical test and measurement thresholds.

When LEDA brings on a new team member in engineering or production, David urges them to take the customer’s print with healthy skepticism. “I tell people we are classified as a ‘build to print’ manufacturer, but that it’s actually ‘build to kind-of print.’ We build to a drawing, but

when we find problems, we are going to stop and let them know, and our customers just love that.” LEDA will take the initiative to recommend design changes so the customer receives a product that will perform as desired, no matter whose mistake it was. “Our customers have a high level of confidence in us. Sometimes they will actually have the drawings half-way done and they’ll send it to us and say, ‘just go ahead and finish it,’” David revealed. LEDA will also help with design for manufacturability as well as research and recommendations on alternative materials.

The marketing is a pretty straightforward function at LEDA. “All of our new business comes from internal programs,” David advised. “We have three main customers who keep us very busy, and as an engineer in these companies finishes one program and moves to another, they bring us with

Continued on page 20



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# LEDA Corporation

Continued from page 18

them.” In addition to Boeing, LEDA enjoys status as a valued supplier to Rocketdyne, McDonnell Douglas Aerospace, Pratt & Whitney, DRS Technologies, JPL and Blue Origin.

LEDA’s vertical integration also works in their favor when bringing in

new programs. “We are vertical and we do everything in-house and that’s why people like us. They don’t have to send the harness to supplier A, and then go to supplier B for the machine work. We do all the program management, and we do everything on site here in Huntington Beach.”



Joseph (left), Dorothy and David Tung



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Supply issues are on everyone’s mind these days, and LEDA has not escaped the effects of shortages. But they have been able to maintain a steady flow of goods to their customers, with relatively few expedited shipments. “Our manufacturing is very efficient, and I would say if we’ve had any issues with delivery it’s because of recent abnormalities in the supply chain. But because of our efficiency, coupled with our persistence and ingenuity, we have been able to make things work for our customers.” David added that a certain amount of begging and pleading with suppliers helped.

WHN asked if there were any specific challenges being a California based manufacturer. “Politics aside, it’s a great location because many of our customers are here in Southern California, and there is a good base of skilled folks in engineering and electrical manufacturing.” Their customers on the East Coast really enjoy

visiting them, especially in the winter. “When the snow starts flying and the temperatures plunge, they say, yep, it’s time to go visit LEDA.” The only other challenge David mentioned was traffic. “We only live a half hour away, but in California, that’s only a couple blocks.”

David had these concluding remarks when reflecting on the family business:

Our customers promote us and it’s because of the quality and ingenuity that we have. It’s kept our business very busy for the last 36 years, and I’m definitely very proud of that. We’re still a family company but we are always growing. So, it’s my father my mother and myself. My father is 90 and my mother is 88. And they’re still working every single day. I joke with my dad he needs to work...he can’t just sit at home. We’ve got things to do here! It’s definitely been a blessing to be able to work with my father.



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# Cables in Motion: How igus Builds Dynamic Cable Assemblies

Continued from page 1

ing,” he explained.

The way the conductors are wrapped inside of the cable is also unique in two ways. “First, we braid or bundle it around a strain relieving, high tensile-strength fiber core. That helps to prevent the conductors from kinking as you bend the cable.” igus also designs the cable with a very tight or high pitch, meaning the number of times it wraps around the core over a meter distance is relatively high. “Think of a telephone cord or something like that,” Joe described. “The tighter (higher) the pitch, the easier it will flex and bend. Whereas

with a longer pitch, it’s almost like a coat hanger and will have a tendency to break over time as it bends.” He added that cables with a comparatively lower pitch are inexpensive to manufacture because they are produced very quickly compared to higher pitch cables.

Joe then mentioned the unique inner jacket in their chainflex cable. “We don’t use any textile wraps between the outer jacket and the inner conductors. Static cables use a cloth-like wrap. We actually use a powder-like talc instead of a wrap because we found that in dynamic applications, textile wraps tend to bunch up inside the cable and cause failures.”



igus cable assembly



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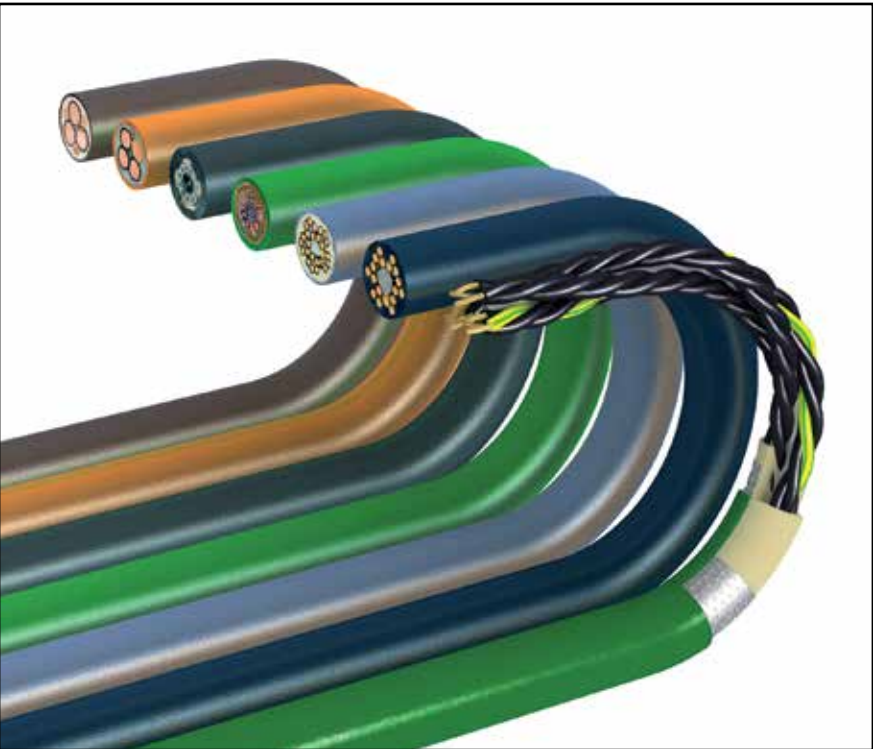
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Some of the many varieties of igus flexible cables.

The conversation turned to the special shielding used in dynamic cables at igus. “Most standard shielded cables use a longer braiding compared to the much tighter braiding we use. The longer weave braids work great as an effective shielding for electrical properties, but they don’t perform well mechanically when you bend them,” Joe instructed. “Tighter braids use more copper and are more expensive to produce, but they provide a much higher quality shield for dynamic applications.” He pointed out that this optimized braid angle prevents the shield strands from breaking over the linear axis and increases overall torsional stability. igus shields have an optical coverage of about 90%.

These exacting details mean igus cables are rated for up to 10,000,000 cycles of flexing and rolling. With proper installation in an igus e-chain, they can achieve an operational travel range of up to 1,312 ft. Cables are available that are oil and bio-oil resistant, flame retardant and hydrolysis and microbe-resistant, which are critical features in many applications. The cables also have a very small bend radius compared to other cables which means they will not need as much space for operation.

Because of the years of field experience, coupled with rigorous in-house testing, igus has no qualms about standing behind their prod-

ucts. “We actually offer a three-year flex life guarantee, and nobody else in the industry does that. That’s because we do the testing and we are confident that these cables will work, and we get almost zero returns.” Joe mentioned they can tweak these design parameters to address specific needs and they also produce less expensive cables for less stringent dynamic applications.

We then began to focus on the typical igus customer. “Our ideal customer would be a manufacturer of automated machinery. That’s a pretty broad term as automation equipment extends across many industries,” Joe cited. igus has customers in the entertainment, food and beverage, construction machinery and energy sectors. You will find their products on amusement rides, stadium roofs, at busy seaports and on oil platforms. Basically, anywhere there is movement, igus products are in action.

Another aspect of their business is with motor control cables. igus stocks motor cables for the top five brands of motors. “You can call us and say, ‘I have a certain Allen Bradley motor,’ and we will have the part number for that in our system.” The cables will come complete with the OEM connectors and are also available in catalog form on the igus website.

There are situations where igus builds static cables. Although it’s

*Continued on page 25*

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# Cables in Motion: How igus Builds Dynamic Cable Assemblies



Cables inside e-chain.

Continued from page 23

a much smaller part of their business, they end up building a sizable amount. “There are some that run into pretty high volumes,” Joe outlined. “They usually have a lower dollar value as they don’t use the more expensive cable, and we do them in situations where we are already providing a customer with a dynamic cable and we don’t want them to have to look for another partner.” He noted they use virtually the same tooling for these assemblies as they do for chainflex.

igus realizes that as automation is on the rise, many contract manufacturers of traditional static cables get requests for dynamic cables from their customers. “When that happens, they often pick out a cable that doesn’t work very well in that application because those companies don’t have the experience putting wire through a cable carrier like ours,” Joe stated. In order to provide the best outcome, igus is happy to work seamlessly with the harness manufacturers for the best solution. “Actually, there are a lot of harness houses that buy our e-chain along

with our chainflex cable and do the work themselves,” he detailed.

As far as connectors, igus uses a lot of TE’s Intercontec plug & play type connectors for power, signal, and data connections. “It’s all customer specified, but those are the common connectors for automation,” Joe revealed. They also use a fair amount of RJ connectors for data communication and MIL-SPEC circular connectors.

In a world quickly ramping for automation, igus seems well poised for growth. “There are exciting new developments in technology to address some of the global challenges that we are facing that will use our products like robots that can disinfect a hospital room to prevent the spread of viruses, and ship to shore cranes that can offload container ships faster at seaports to reduce their backlog and help improve the speed of the supply chain.”

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# Demystifying Injection Molding: LPMS Helps Harness Companies Get Started



Brian Betti and Michael Pierce, owners of LPMS.

The ability to provide injection molded assemblies opens up many markets and opportunities for harness producers. Assembling the equipment and expertise to bring this technology onboard, however, can be daunting. Designing and machining the molds for prototype and production is yet another skill to master.

There is a way to jump start the process of adding this capability to your arsenal. *WHN* recently interviewed Brian Betti, President at LPMS. His company is a manufacturer of low-pressure molding equipment, distributor of resins, and a purveyor of knowledge to the wire harness industry.

Brian began with how he and his partner, Michael Pierce came to acquire LPMS. We moved into a brief history of low-pressure molding, then branched into the ways LPMS is guiding harness manufactures in the development of this capability.

Brian and Michael have been friends for 18 years. They met at a customer site, each pitching competing encapsulation technologies for different business units at Henkel. In late 2016, the two purchased Chicago-based LPMS. They have leveraged their combined experience of 45 years in low pressure molding technology to take advantage of the opportunities the industry has to offer.

Low pressure molding began in Germany about 40 years ago to service the automotive wire harness industry. “It was developed to replace heat-shrink tubing in many applications, provide strain relief, and seal the back of connectors from the effects of harsh environments,” Brian detailed. It uses a combination of relatively low pressure, pushing relatively low temperature resin to encapsulate components like connectors into a part or assembly.

Continued on page 28



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# Demystifying Injection Molding: LPMS Helps Harness Companies Get Started

Continued from page 27

Brian then described how the need for low pressure injection molding developed. Back in the late 1970's, automotive electrical systems were becoming more complex. Heat shrink tubing just wasn't holding up to the increasingly rigorous testing standards. Also, the traditional method of connector sealing by backfilling them with epoxy was proving to be inefficient and time consuming. "People did try to use

high-pressure molding but the force and pressure of the material damaged the connector," he cited. Low pressure molding provided a faster more repeatable and reliable option. As automotive wiring evolved into increasingly complex integrated assemblies, this method of protection became even more vital. "We started encapsulating things like sensors, and then those sensors got integrated into harnesses," Brian explained. "Almost every vehicle today, consumer or com-

mercial, uses this technology in one way or another." As mentioned earlier, the LPMS business model transcends far beyond selling equipment and resins. They actually help usher in this technology to contract manufactures not currently offering it. "We offer a turn-key service from prototype to full production," Brian asserted. He described a typical situation where an OEM or contract manufacturer runs into an application for injection molded parts. "We can start by

reviewing the drawing and saying, hey, if you move this or change that, you can mold that part a lot more efficiently."

LPMS will then produce a prototype tool, then move into production tooling when the time comes. The production tooling is then mated with one of the 15 different molding platforms the company offers. "The production platforms are picked based on the size and geometry of the component, along with the amount of throughput the customer needs to get into the market," Brian indicated. The equipment ranges from small tabletop units for low volume, to large dual-nozzle rotary shuttle machines.

"During our tooling trial we have already validated that the tool works and developed a repeatable process. So, the shift to production at the customer's site is pretty easy," Brian stated. When the day does come for that shift, LPMS is on site to set up the equipment and train employees on operating and maintaining it.

The transition is usually a one or two day process where LPMS personnel watch the operators run the machine and make sure they address any questions the customer may have. "As soon as they see how the



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LPMS Kappa 1000H

process works and how easy the machines are to run and maintain, companies will find more and more ways to use this technology.”

The conversation then turned to the choice of resins used. It’s a key parameter to the success of any design, as some assemblies may be in direct sunlight while others might lurk underneath a truck frame. “Every customer fills out an application form so our material science team can understand the application and testing requirements,” Brian said. As a distributor for Henkel, Bostik, Toyobo, as well as their own line of resins called Spectra-Melt, the company is well poised to help their customers pick the right resin.

LPMS is committed to making injection molding technology financially obtainable. “I would say that before we came along, the barrier to entry kept many small to medium size businesses from introducing this technology. The upfront costs of the equipment alone was just too high,” Brian advised. For LPMS a prototype tool usually cost between \$4,000 - \$7,000 with a production tool being 2 to 3 times that depending on the size. Their machines range from \$25,000 - \$125,000, with a wide variety to meet a vast array of part geometries and production runs.

Brian, Michael and their team are convinced that this technology makes suppliers much more valuable to their customers, especially in the burgeoning EV market. “Electric vehi-

cle development is really pushing the wire harness market to improve and deliver new and innovative technologies, and we are happy to be part of that. We’re helping develop new materials and new resins that can meet the higher voltage demands, while making sure these new materials are able to withstand evolving testing parameters,” Brian asserted.

There are also many doors to be opened in the medical device industry by adding injection molding to your capabilities. “The medical market is really growing with this technology and we’ve launched medical certified materials which are tested for cytotoxicity as well as many other medical standards,” Brian informed.

In closing our conversation, Brian wanted to mention the global footprint of LPMS. “Many of the customers we work with here in North America do design and prototyping, but the manufacturing can happen anywhere around the world. We have a global service and support team that are in all the main manufacturing centers throughout the world, and can handle the transition from here to there.”

LPMS is located just outside Chicago, and Brian invites you to come see the equipment and processes in action. They are molding parts every day and are happy to perform demonstrations. You can meet the LPMS team at the WHMA conference in February. Or you can reach out to them at sales@lpms-usa.com, 800-353-7773.

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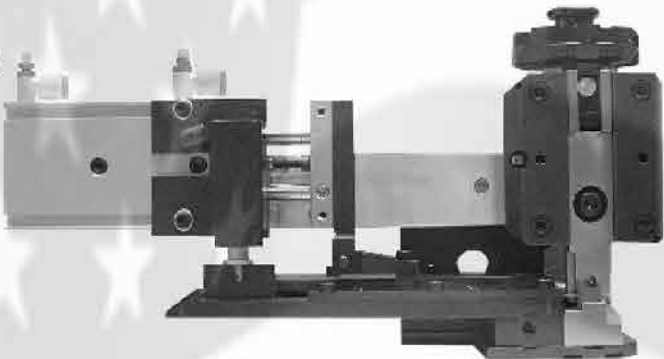


Model 1700

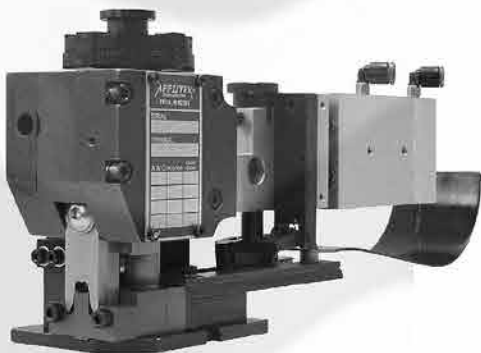


Model 2000

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

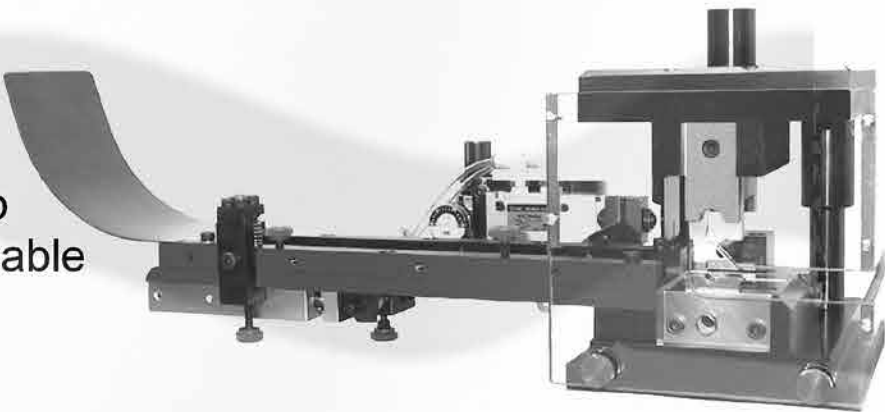


Model 1500



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NEWS PLUGS continued



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Komax Purchases Property Next to Headquarters and Will Consolidate its two Swiss Sites

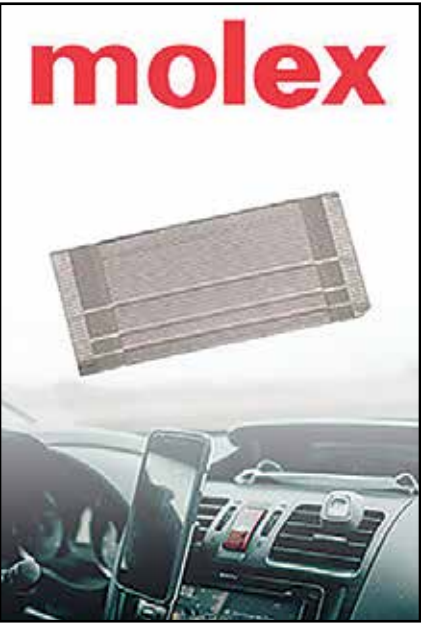
Komax purchased land with a production and office building in Dierikon from elevator manufacturer Schindler at the end of last week. The property is located immediately adjacent to the Komax headquarters and will make it possible to bring together all Swiss activities in Dierikon in the future. Komax is planning to sell its building at the existing production site in Rotkreuz.

Komax has been working for a number of years on consolidating its activities in Switzerland at a single site to further optimize logistics and processes. The new building at its headquarters in Dierikon, which staff moved into in early 2020, was a first step in this direction. The purchase of a property from Schindler located directly adjacent to the headquarters, which was completed several days ago, means that Komax is now in a position to merge its Swiss sites.

Before vacating the site in Rotkreuz, Komax will spend the next approximately 9 months renovating the production and office building purchased in Dierikon. After completion of the renovation, Komax will initially rent out part of the building as it does not currently require the entire space. Komax plans to sell its building in Rotkreuz.

The plot purchased in Dierikon includes 6,400 m2 of currently undeveloped land. Komax has therefore created an opportunity for further growth at its largest production and development site worldwide.

Komax is a globally active technology company that focuses on markets in the automation sector. As a leading manufacturer of innovative and high-quality solutions for the wire processing industry, the Komax Group helps its customers implement economical and safe manufacturing processes, especially in the automotive supply sector. The Komax Group employs more than 2000 people worldwide and provides sales and service support via subsidiaries and independent agents in more than 60 countries.



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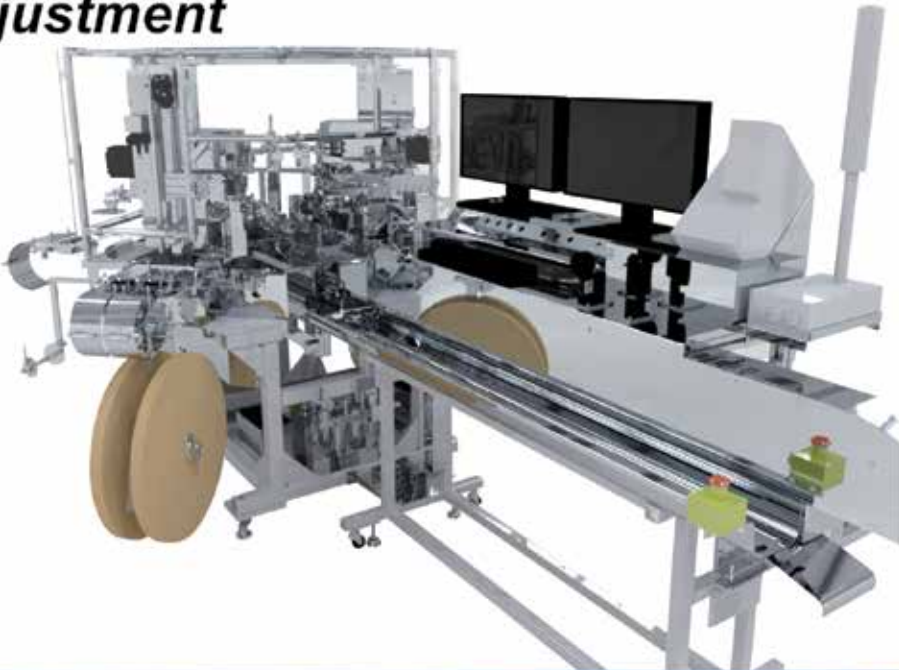


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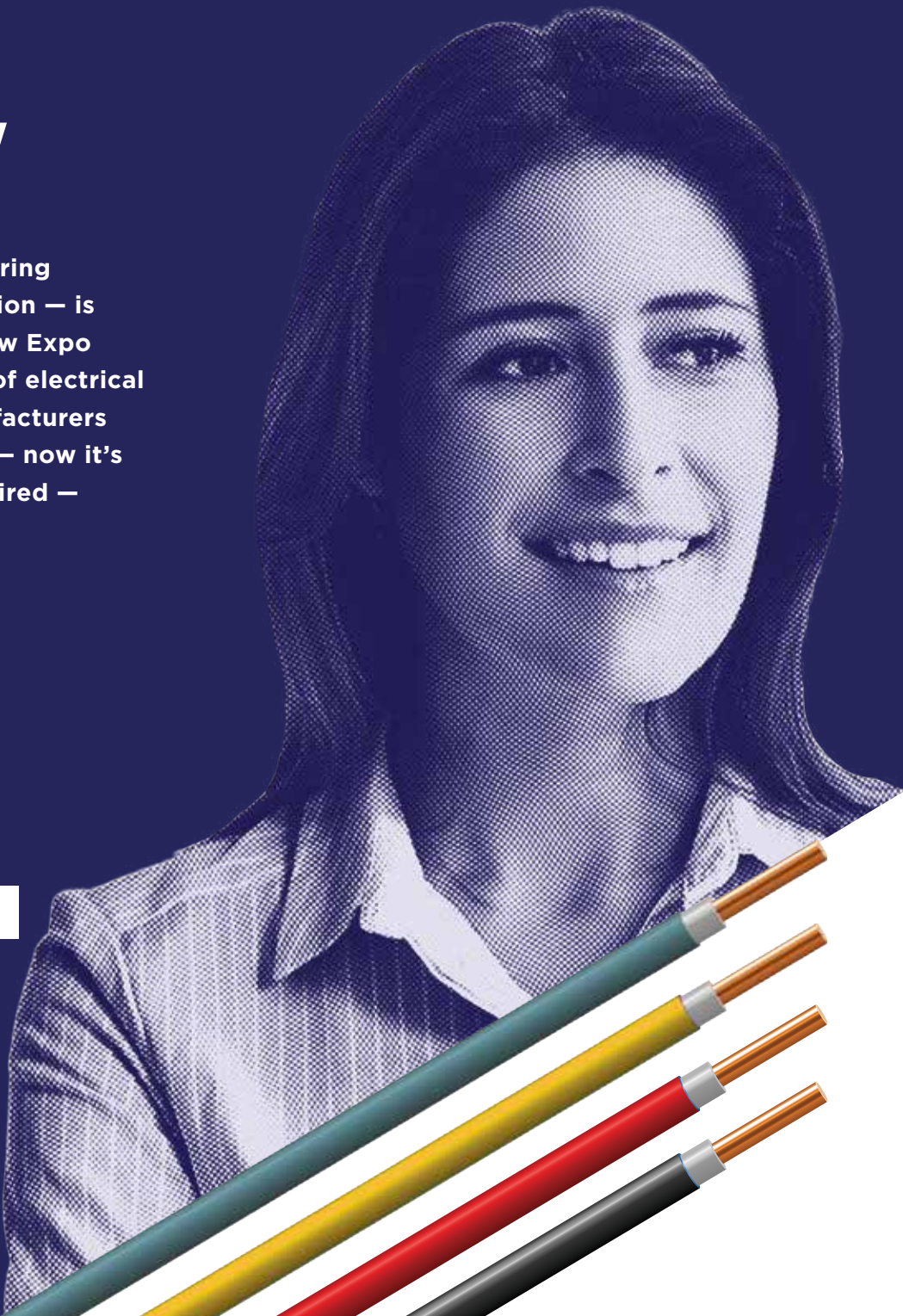
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Cable Factors That Can Affect Attenuation

Attenuation is the loss of signal strength in electronic/electrical cables, fiber systems and their connections. This is typically measured in decibels

(dB). Attenuation or voltage can occur due to a variety of influences. As the signal travels through the copper wire conductor, some of the signal will be absorbed. It may cause signals to become distorted or undetectable. An example of this is Wi-Fi signal at

home – signal strength can become noticeably weaker the farther away your device is from the router.

When measuring attenuation in a wired network, the greater the signal strength over a long distance, the more effective the cable is. Less efficient cables will struggle with signal attenuation, and networking administrators may need to adjust the cable type or insert amplifiers or repeaters to boost the signal strength. Keep in mind that the more signal amplifiers applied, the slower the signal speed will become between end points and the more distortion occurs due to the extra components that have been added.

Amplification can also affect the noise in the transmission, potentially degrading the quality of the signal. Noise can come in the form of electromagnetic frequencies, electrical currents, wire leakage or wireless signals. All networking and electrical/electronic cables give off an electromagnetic frequency within the cable. The more frequencies there are within a particular space on the factory floor, the more noise there is. This can further attenuate and hinder the signal's strength.

Attenuation will occur with any cable type or wireless connection, including the following:

- Electrical/electronic cables
- Coaxial cables
- Fiber cables
- Satellite
- Radio signals
- Wireless networks

Attenuation is generally associated with data cables and is calculated as a ratio of the power input signal to output signal, which is measured in

decibels per unit length (db./ft.). Attenuation is a result of resistance in the conductor and associated dielectric losses. This is exaggerated by longer run lengths and higher frequency signals. You can lower the attenuation by improving the dielectric properties of the insulation and increasing the conductor size. The lower the attenuation figure over any given measurement of distance, the more efficient the cable is.

Coaxial Cable Attenuation

It may seem obvious that the longer the cable run, the greater the loss. With coaxial cable, or coax, it is also found that the loss is frequency dependent, broadly rising with frequency, though the actual level of loss is not linearly dependent upon the frequency. The attenuation of coax cables also tends to increase with time.

There are three main elements to the coax cable loss:

Resistive Loss

Resistive losses within the coax cable come from the resistance of the conductors and the current flowing in the conductors, which will result in heat being dissipated. The actual area through which the current flows in the conductor is limited by the skin effect (at higher frequency on the outer surface of the conductor). This becomes increasingly apparent as the frequency increases. To help alleviate this problem, stranded conductors are often used. To reduce the level of loss due in the coax cable, the conductive area must be increased, resulting in low loss coax cables being made larger. Importantly, the resistive losses increase with the square root of the frequency.

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Dielectric Loss

The dielectric loss denotes another of the major losses arising in most coax cables. You may recall that the power – because of dielectric loss – manifests itself as heat dissipates within the dielectric material. The dielectric loss is independent of the size of the coax cable, and it increases linearly with the frequency. This means that resistive losses dominate at lower frequencies. However, as resistive losses increase as the square root of frequency, and dielectric losses increase linearly, the dielectric losses are larger at higher frequencies.

Cable Loss Due to Flexing

Although many coax cables are flexible, the level of loss or attenuation will increase, particularly if the coax cable is bent sharply – even if within the recommended bend radius. This increase in loss can arise as a result of distortion of the braid and as a result of changes to the thickness and stress dielectric material when bent.

Additional Factors

Other coaxial cable factors that can negatively affect attenuation include:

- Increased attenuation due to braid contamination
- Losses due to moisture entry into the coax
- Losses due to degradation of braid

Regarding degradation of braid, the loss in coax cables that are designed with bare copper braids or tinned copper braids often exhibits more degradation than in those with silver-plated braids, though the silver-plated braids can be more expensive. Moreover, braids using tinned copper plating often exhibit about 20 percent greater loss than those using bare copper.

The loss introduced by a coax cable is significant – power lost that can never be regained. The loss of power will degrade the overall coaxial cable’s system performance. Any decision regarding the type of coaxial cable construction to be used will be a balance of factors including application, temperature, loss, size, weight, cost, impedance, flexibility, chemical resistance, long-term stability and velocity of propagation.

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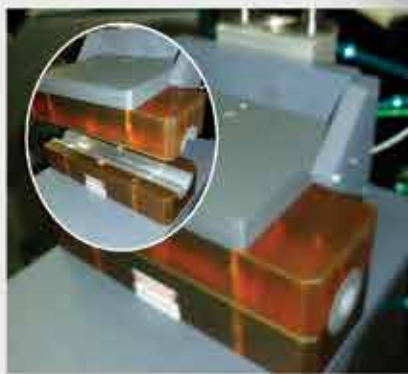
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# Plasma Treatment for Marking & Bonding Wire

By Joe Tito

**H**arness manufacturers are constantly faced with challenges bonding, molding or potting wire and cable assemblies. Wire marking or stripping with ink can present an additional set of quandaries associated with the relatively low wettability. Think of your freshly waxed car. Water beads up on the finish instead of spreading over the surface. Here the binding forces between water molecules themselves are stronger than the interface forces between the water and the wax.

Most of the wire insulation materials like PE, PVC, PP, PTFE (Teflon®), XLPE, ETFE, FEP, EPDM and silicone have similar interface issues. The intermolecular forces on the solid surface are too weak to attract the liquid. That leaves unfilled micro gaps on the border, which limits the contact area, and therefore reduces the strength of adhesives and epoxies, durability of marking, etc. In many cases additional surface modification is required to bond these materials to others, especially when the products have to meet tough aerospace or medical device manufacturer standards.

Two methods are commonly used to alter the surface properties of plastics. One is chemical etching, and another is plasma treatment. Both have certain advantages and deficiencies that need to be considered for a particular application.

In the July August issue of *WHN*, we discussed chemical and abrasive treatments of wire in the article entitled, *Fluoropolymer Insulation Etching for Bonding Applications in Harness Assembly*. These methods prove very effective, especially for insulation materials like Teflon. They are, however, time consuming and labor intensive as they require secondary treatment of the wire before processing. In addition, they typically need to be carried out in ventilated areas as fumes and/or dust can be at least minimally harmful.

This article describes some aspects of plasma technology for treatment of wires and cables.

Plasma is ionized gas. The degree of ionization varies from almost 100% in the core of the Sun to a fraction of a percent in the Earth ionosphere, and close to nothing (but not zero) in the ambient air we breathe in and out.

When these charged particles (ions and electrons) are accelerated in an electrical field, they can accumulate significant amounts of energy. The currents in a regular lightning bolt can easily reach 100KA and destroy any solid surface, but the currents in atmospheric glow discharges that are used for surface modification are measured in milliAmp. It is just enough to modify the very surface layer without altering the bulk material properties. That includes both

physical and chemical changes such as breaking the C-C bonds of the polymer chains, crosslinking, attachments of more reactive species, localized charging, making microscopic hills and valleys on the previously flat surface, etc.

In treating wire insulation with plasma, the wire is drawn through the glow discharge (Figure 1).

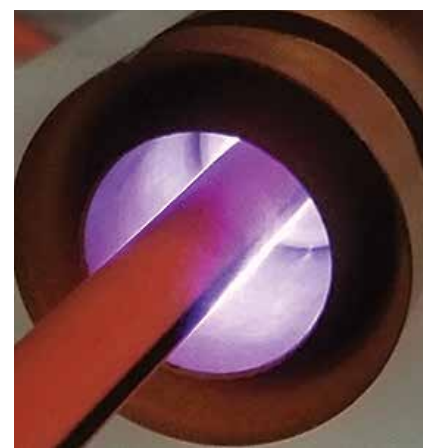


Figure 1. Wire exiting plasma field.

The result is a more wettable functionalized surface that is adaptable to bonding and printing.

A great deal of plasma treatment is done in batches inside enclosed vacuum equipment. Thankfully for wire producers and processors, in-line equipment is available to perform this task. One such producer is Tri-Star Technologies who has been building this equipment for 25 years. Dr. Igor Murokh, Senior Scientist at Tri-Star, was kind enough to walk through the basic operation of the equipment and discuss its applications and limitations.

The operation is really quite simple. Wire is fed from the spool through the plasma channel as seen in Figure 2.

The amount of treatment depends on the amount of exposure time within the plasma chamber.

The lower the speed the more surface modification is done. However, there is a danger of creating a weak boundary layer when the modified area no longer bonds to the bulk. In this case the ink sticks nicely to the surface, but then can be easily removed together with the layer of material it adhered to. Tri-Star Technologies works with customers to determine the appropriate level of treatment for their applications.

For higher speed applications, longer plasma chambers can be fitted to the equipment, but four inches is standard. In certain applications, gas other than ambient air can be used. For that reason, the equipment also has a flowmeter to adjust the amount of gas used. As an example, Igor mentioned that ammonia can be used on fluoropolymer materials such as Teflon for more aggressive etching. There is also a remote version available with a power supply separate from the plasma chamber. This works well when space is limited or when

Continued on page 42



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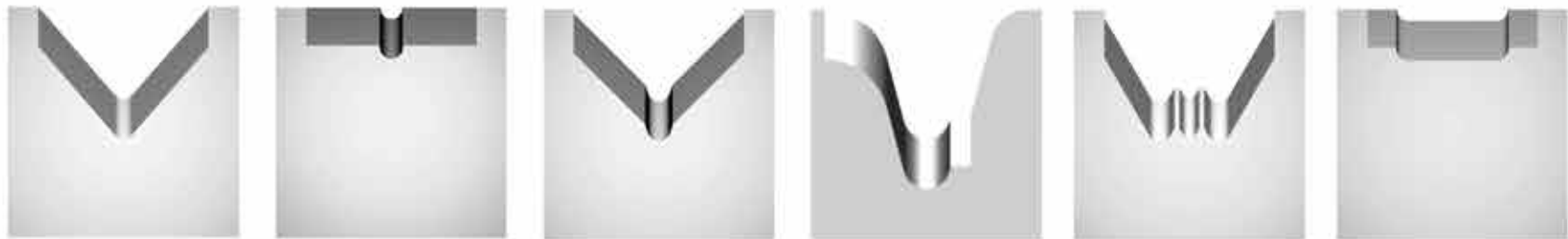




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# Plasma Treatment for Marking & Bonding Wire

Continued from page 40

adding the technology to a production line.

When wire producers use this technology to increase bondability for marking or stripping, Igor mentioned they tend to opt for a version with a split electrode that closes around the wire (Figure 3).

The standard electrode length on the split-electrode equipment is 12

inches. That is typically adequate for 600 ft./min extrusion lines. The technology of both machines is the same from a treatment perspective and both can be used to treat wire sizes from 32 gauge to two-inch diameter cable.

There are many advantages in using plasma treatment versus chemical etching. First, there are no messy chemicals to deal with. Plasma treating is done in-line as opposed to the



Figure 2. Wire fed through plasma chamber.

secondary process of chemical baths. Since etching solutions begin to degrade as soon as they are exposed to oxygen, it can be much more challenging to dial in the results of chemical etching. Plasma treatment produces more repeatable results and happens in seconds versus minutes or hours to do chemical etching. Finally, chemically etched wire tends to change color when treated. This phenomenon does not happen with plasma treatment. However, plasma treated surfaces decay faster depending on material, handling, temperature, and humidity. Silicon is a typical example when the effect lasts no more than 24 hours.

The reason, Igor explained, is that whatever etching method is used, only the surface layer of the material is being modified. Diffusion will eventually return the material to a state of equilibrium, giving any treated wire a shelf life. Since plasma treatment is not as aggressive as chemical etching, diffusion has a bigger impact on

shelf life. But since plasma treatment is done in-line, immediately before marking or bonding, special handling or storage is generally not an issue.

Sometimes using plasma treatment is simply not enough. Teflon, for example, is a special case. Plasma does improve its wettability but not necessarily the adhesion. Teflon modifications always require trial testing and is one of the more challenging materials to work with.

Tri-Star is happy to plasma treat customer samples for evaluation and can generally turn them around in a day or so. Igor and his team can attach basic wettability measurements, but actual testing is application dependent and is generally carried out by the customers.



Figure 3. Split electrode equipment.

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

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# In Dedication

We at Schiffer would like to dedicate this Ad to our special friend Mr. Irwin Zahn, the inventor of the Autosplice splicing machine that he developed over 50 years ago. The technology which is still being manufactured by his original company, Autosplice Corporation in San Diego.

It is with a heavy heart that we recognize his passing at age of 95 years old.

Until we worked closely with Irwin, we did not realize how many languages he could summon. Whether he was in Japan, France, Spain, Italy, Germany or Brazil, his greeting and conversations included many common local words and phrases with pretty good local accents.

Of course, Irwin was not one bound by rules. When our country was swept into Second World War, Irwin at age 17, lied about his age so he could enlist in the Air Force.

Irwin was a classic entrepreneur, a fast decision maker who took enormous risks. His enthusiasm was infectious. He could sell fantastic concepts to customers and come back to the office and tell the employees to figure out how to carry out his promises.

Irwin was largely self-taught with expertise in areas like finance and marketing. He was always in motion with boundless energy and constantly seeking new experiences. He was creative and had several patents that were breakthrough products.

Irwin was philanthropic and taught his children at a very early age, about charity and giving back to the community.

After Irwin sold Autosplice Corporation, he activated the Moxie Foundation. He was intent on making an impact and will be greatly missed.

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# From Design to Production by a Collaborative Team

Written by Saeed Mogadam, Former President at Telsonic Solutions, and Catherine Dela Cruz, Global Strategic Partnerships and Marketing Leader at ProMark Electronics.

The dynamic development of new electric vehicles and batteries present ongoing challenges. For the connector designer, cable manufacturer, joining and assembly processes, these challenges demand due diligence, hard work, and collaboration by all involved. New ideas, new designs, cost reductions, higher voltage products, are all customer demands that are no longer unexpected but the norm for all involved.

Exciting and at times challenging, it is fun to see how innovation is developing in such high speed in this industry. The necessity of everyone’s expertise has created an environment where suppliers and customers are working together as a collaborative team to achieve OEM requirements. The ultimate but common goals for the team are reaching objectives for a smooth manufacturing process, building a 100% reliable quality process, and manufacturing a functional product with another breakthrough.

Ultimately, the results and action plans always encourage this collaborative team’s spirit development. We share each other’s challenges, obstacles, and difficulties by cooperation, dedication, and best technical practices to get the job done. A relationship is developed that will go on for the years to come as this exponential growth in the battery electric vehicles market evolves.

### Tasks

In the wire harness industry, any new HV connection with a welding application needs to be developed at an early stage. In order to successfully accomplish a new welded HV connection, the functional requirements are as follows:

- Connector’s design for functionality, material, plating, and ultrasonic welding feasibility.
- Cable size, material, purity, and construction of the cable.
- Welding requirements, meeting the specifications such as SAE/USCAR-38, volume, production rate.
- Connector’s prototyping, welding evaluation, and assembly.
- Equipment selection and the tooling design for the welding application
- Engineering validation of the equipment, application, and process

Although welding in the cable assembly may be a small part of the big picture, without a good joint, the entire assembly would fail.

None of the functions above can be done without the involvement of both the manufacturer and welding experts. It is the close cooperation in the team that always allows a smoother release of the equipment, from the start of production and a long-term production with minimal stumbling issues. The design details of the connector and selection of the cables are

and must be established at the early stage upon which the welding feasibility can be verified and confirmed. At this stage, the project starts moving forward towards the ultimate final step which is the release to production. But the process must be proven to be statistically capable. The statistical Process Control is the study that determines the best parameters for the highest standard quality requirements and monitors a consistent process of the quality of the welds.

### Validation of application

It is both parties’ intention to ensure a smooth transition from installation to full production. Consequently, substantial effort is required by both sides in the pre-validation of the application in terms of tooling and the process. The idea is to find the range of welding parameters where we can have a statistically capable process. From the perspective of a welding machine supplier, the process capability is evaluated by tensile strength and visual attributes. Telsonic will conduct the following studies to predetermine the range so that the customer can achieve good results within CPK parameters in the long run.

Although the study results may not fully match the validation at the plant due to variety of influencing factors, this makes the startup less challenging with much less effort by both the customer and the equipment supplier. Although during the development phase, it is costly to conduct this study, the results are worth the investment as opposed to when production starts.

### Procedure:

1. Determination of the limits that can be used for the main parameters, namely Pressure, Amplitude, and Energy. It will take about 200 test samples to determine the minimum, nominal, and maximum values of each parameter.
2. DOE - Having the range of the acceptable parameters would allow us to perform a Design of Experiment to determine how much each parameter affect the tensile strength and visual attributes.
3. A capability study of 50 to 100 samples, ensures that a normal distribution of data is collected (See Figure 1) before the final validation step.
4. A study is then conducted for Minimum, Nominal, and Maximum settings of all three parameters. Normally one should use 100, 30, and 100 for min, nominal, and max settings. Sometimes the results may indicate that the range needs to be shifted. In such case, we must shift the range slightly based on the DOE conducted prior to the study. The shift in the range may change in the plant during the validation per USCAR specs. However, if the adjustments are made within the limits determined by the DOE, the tensile strength and visual effects would be within the acceptable range.

All these prior efforts result in a much smoother release of the equipment. Although at times costly, it is

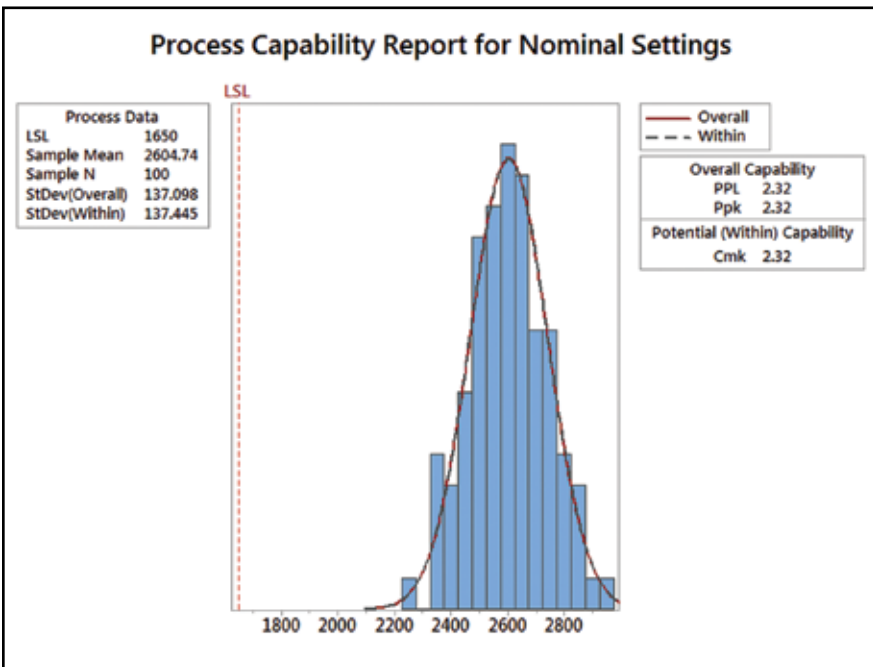


Figure 1. Process Capability Report for Nominal Settings.

imperative that the testing of material be prepared in advance. The testing described above allows time for resolutions on any issue that might otherwise arise during production.

Ultrasonic welding is the method of choice for battery cable assemblies. These days, with the new designs and customer requirements, Telsonic is encountering more fun and creative applications which bring new challenges.

Increasingly, there are more varieties of connectors with different geometrical shapes and sizes: cables’ constructions, material and size must be suitable for the specific connector for the best quality weld. The current ultrasonic welding technology is capable of handling the growing welding sizes due to the increase in demand of larger High-Voltage cables. Currently, 120 mm<sup>2</sup> cable is the maximum size used for welding in the battery cable assemblies. However, the Telsonic PowerWheel® machine can manage cable sizes up to 200 mm<sup>2</sup> - the connector shape and size and orientation of the connection have influence in the results.

Sometimes when a welding application just seems impossible, the engineers must go back to the drawing board. But due to this close cooperation among the parties involved, the impossible becomes a solution. We can say a new team is born because our collaboration will continue for many more applications and the way we work together becomes the most efficient way for successful results. Telsonic and Promark have been working together as a collaborative team with excellent experi-

ence in providing solutions for different battery cable assemblies in 2021. The relationship between the two companies opens the path for all new product development that are in early stage with quick turn prototypes, design, and engineering support. Once production begins, Promark and Telsonic are there to fully support at scale with OEMs, to ensure they can continue to grow at the pace required. This business structure and cooperation provides a true convenience for the OEM.

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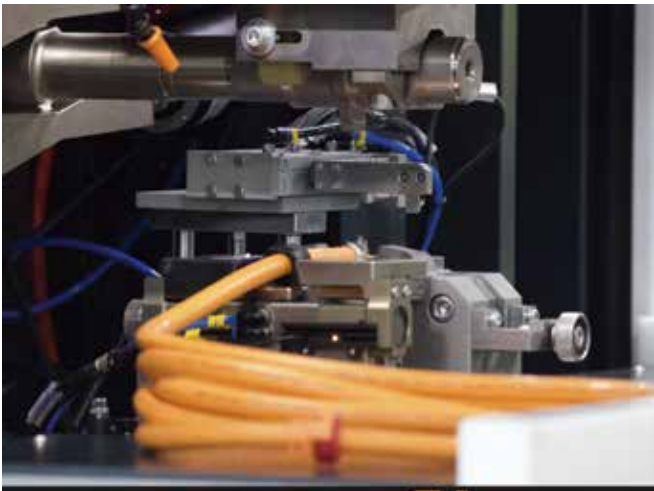
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sonic solutions through representation in Europe, America and Asia since 1966. Constant innovations help to ensure that, in many applications, Telsonic has established a lead over competitors that offers added value to customers. With over 250 highly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

**Recent application development by ProEV™ and Telsonic:**

The ProEV™ 95 mm<sup>2</sup> cable with 3,000 flexible fine strands of 0.2 mm diameter is used to terminate the Stäubli terminal with limited space for required weld width of 22 mm. ProEV™ cable was used in this application for its high flexibility. The available weld width of 18 mm as opposed to 22 mm presented challenges of providing a welding solution on a smaller space where the required weld compaction can be achieved without damages to the finer strands in the weld transition area.

The Torsional PowerWheel® welding system was utilized to achieve an excellent quality weld between ProEVTM 95 mm<sup>2</sup> flexible cable and the Performore connector with 18 mm width. Tooling design and configuration had to be arranged so that we could allow sufficient welding energy to achieve a quality weld without affecting the finer strands in the transitional area.



**PowerWheel® system released to production.**

The PowerWheel® system allows higher clamping force for the Stäubli terminal which is an advantage when welding a large cable in a smaller area. The weld nugget height in such case is higher than in a normal scenario. Since the Torsional welding amplitude is at its peak at the center of the weld nugget, one can apply more required energy for the thicker height with minimal chance of affecting the strands in the weld transition area. This ideal feature of Torsional

welding allows an acceptable weld quality with minimum efforts. The quality control variables such as final weld height, welding time, and power are monitored and controlled for every weld while production data is recorded for traceability.

**The whole is greater than the sum of its parts**

In sum, as we progress in this electrification revolution, it has become imperative for the supply chain to

become a global collaborative environment. Telsonic and ProEVTM's strong cooperation have led us to quickly accelerate from design to production during this demanding and fast-paced era. Together they have solved multiple challenges through deep innovation which lets customers deliver and achieve their goals. Telsonic and ProEVTM continue to succeed and to collaboratively advance technology in the wire harness industry.



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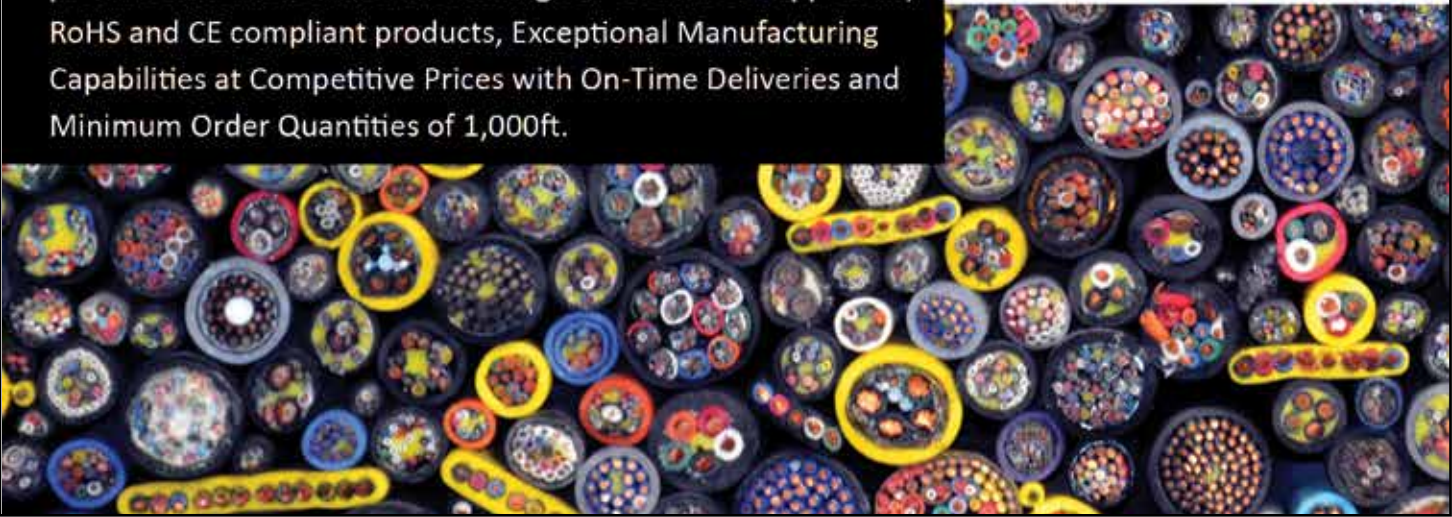
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W H I T E

PRODUCTS

NEWS PLUGS continued



**Panasonic and Zuken Complete Agreement for Electronic Design Solution**

Imaging Business Unit to upgrade its Electronic Design Environment with Zuken’s CR-8000 and DS-CR

Yokohama, Japan, - Zuken Inc. is proud to announce that Panasonic Corporation has ordered the Zuken CR-8000 series of solutions for leading-edge electronic designs and DS-CR design data management systems for its Imaging Business Unit sites under the Entertainment and Communication Business Division in Japan and China (Xia-

men). The contract is equivalent to roughly 150 million yen.

Panasonic has been working with Zuken, Inc. to configure a data management system for electronic components that enables sharing and use throughout the entire company. The Imaging Business Unit’s complete migration to Zuken solutions from a third-party design environment for printed circuit boards will accelerate the circulation of component information and product development data across product and business segments at Panasonic. This migration is expected to usher in broader sharing of CAD libraries, electronic components, and technology.

Tatsuo Ogawa, Executive Officer and Group Chief Technology Officer of Panasonic,

described why the Imaging Business Unit decided to migrate to Zuken solutions by saying, “The evolution of electronic components is remarkable. We must quickly replace old parts with new components. Standardizing our electronic components and more widely sharing designs is an extremely important challenge at Panasonic because we develop such a wide range of products.”

Jinya Katsube, President and COO of Zuken, Inc., added, “Panasonic uses Zuken solutions across all of its product lines. We will strive to become a partner who will contribute more largely to Panasonic’s product development beyond the boundaries of its product lines.”

Zuken is a global software company delivering electrical and electronic design solutions. Founded in 1976, Zuken has a consistent track record of technology innovation and financial stability in the electronic and electrical design automation (EDA) industry. With its CR-8000 and E3.series product families, Zuken provides a robust lineup of system-level 2D/3D electrical and electronic toolsets complemented by comprehensive design data and configuration management capabilities.

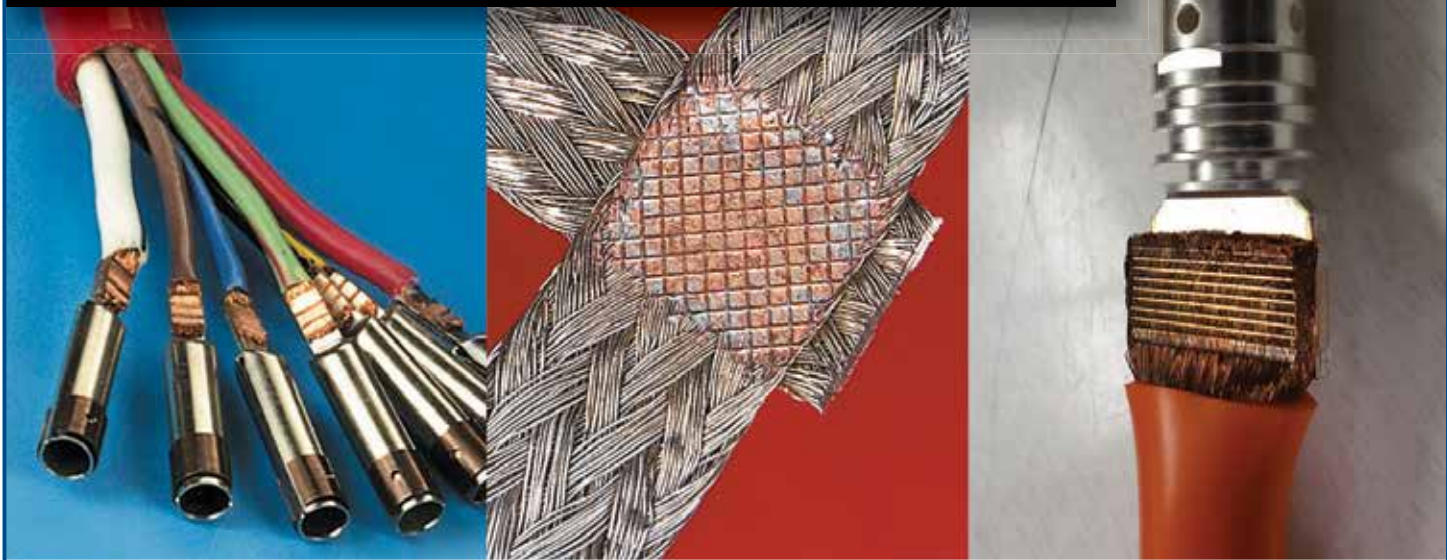
Most recently, Zuken has embraced the digital transformation and, more specifically, digital engineering as the way forward with its entry into the Model-Based Systems Engineering (MBSE) industry. Today, Zuken delivers world-class design solutions combining MBSE products and services with a mature, proven electrical and electronic design suite to address the needs of a broad range of industries across the globe. For more information about the company and its products, visit [www.zuken.com](http://www.zuken.com), [www.zuken.com/blog](http://www.zuken.com/blog), or [www.linkedin.com/company/zuken](http://www.linkedin.com/company/zuken)

**ShowMeCables Releases New Line of Fiber Optic Transceivers**

ShowMeCables, an infinite Electronics brand and a leading supplier of connectivity solutions, recently announced its new line of fiber optic transceivers designed to meet the needs of telecom service providers, the data communications industry and IT departments.

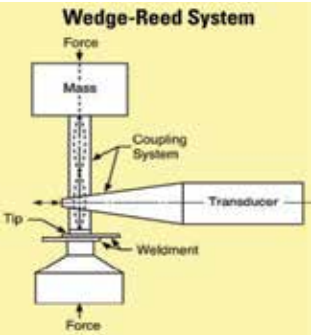
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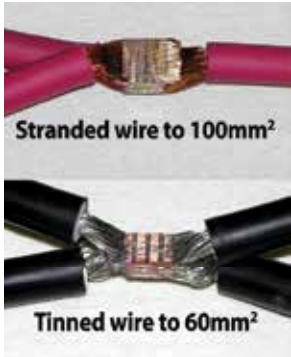


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and router platforms. They represent a wide selection of form factors, distances supported and data rates. Form factors offered are GBIC, SFP, SFP+ and XFP. Distance options range from 220 meters to 120 kilometers and three transmitter wavelengths are available – 850 nm, 1310 nm and 1550 nm. Operating data rates cover 100 Mbps to 10 Gbps.

Other options include Single-mode or Multimode optics and latching LC or nonlatching SC connectors. Most of these new transceivers were designed to withstand extreme temperatures found in many industrial applications.

“We are excited to now offer our customers these new, high-quality, reliable transceivers. We’re confident they will meet the needs of the telecom and datacom industries, wireless service providers, those involved with cloud storage and hosting, and the enterprise network sector,” said Paul Hospodar, Product Line Manager.

ShowMeCables’ new fiber optic transceivers are in-stock and available for immediate shipment.

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About ShowMeCables:  
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About Infinite Electronics:

Based in Irvine, Calif., Infinite Electronics offers a broad range

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# Portable Crimp Tools: Selection, Use and Maintenance

Hand tools have been a cornerstone product at TE Connectivity since the company's inception in 1941 when they were known as Aircraft & Marine Products (later AMP). There has been a lot of development in tooling and applications over the years, yet some things have remained constant.

WHN recently had a discussion with Mandar Deshpande, Global Product Manager of TE Connectivity. Much of the conversation centered on TE's portable hand tools, but we did explore the tool selection roadmap that manufacturers tend to follow as they move into higher volume production. Mandar covered aspects of crimp technology of interest to everyone from the novice to the seasoned pro.

WHN: Can you describe your role, and give us an overview of TE's crimp tool platforms?

Mandar: My responsibility is for what we call the portable tools. Hand tools are a part of it, and I will explain that and how we move from one level of automation to the next. When we talk about portable tools, we mean hand tools, along with their battery, pneumatic, and hydraulic tool counterparts. These are mainly used in aerospace/defense, rail, marine, mining equipment and commercial transportation like caterpillar.

If the frequency of crimping is very low, customers prefer hand tools. What we see, however, is that among workers, there can be a variance in terms of hand strength and

Continued on page 52



TE CERTI-CRIMP Hand Crimp Tools



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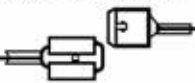
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# Portable Crimp Tools: Selection, Use and Maintenance

Continued from page 51

dexterity. This can be an issue, especially for larger crimps. What customers are looking for is, instead of replacing a person with automation, they would rather replace the hand tools with a power assisted version so they can just squeeze the button and do it.

That gives you two things. First it is giving you better ergonomics in that you don't have to squeeze the tool every time. It also increases speed. On average, the battery tool gives you more productivity than hand tools and then pneumatic tools will give you even better productivity. You can step through those things when it comes to the volumes in the markets just described.

**WHN:** Can you talk about the features that make hand tools such a viable and repeatable technology?

**Mandar:** There are two features that have always been with the tools that, I would say, are poorly understood. When you look at applicator/terminator combinations, there are so many different adjustments. When it comes to hand tools, they are perfect every time. And the way we ensure this is with two things. First is



TE PRO-CRIMPER

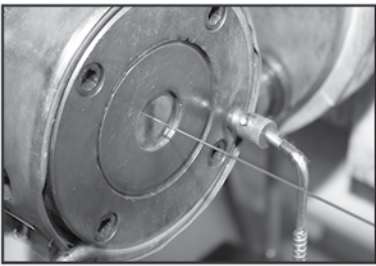
the ratchet which makes sure the handle is completely closed before it can open, thus verifying the crimp is complete. The other feature is the bottoming dies. What that does is stop the travel to prevent over-crimping. So, each time, we get an exact execution of the crimp. That is the strong point for hand tools.

**WHN:** What are the proper calibration intervals for portable crimp tools?

**Mandar:** We get that question often from customers. I will talk about two things. First, each and every tool comes with an instruction sheet, and those instruction sheets have a repair and maintenance section specific to that tool. There you will find a recommended timeframe and cycle count for recalibration. Those instructions

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may say something like 5,000 cycles or six months for example. Normally, if a customer is using tools day in and day out, they have a pretty good idea of cycle count, so they go by that metric. But when they do not use the tools regularly, it is better to go by time duration. So that establishes the maintenance schedule.

Also, in the same instruction sheet you have the gauging information. In most cases, you have go/no-go gauges to make sure your tool is still in prime condition. That is something we recommend customers do.

Some customers will make a group of samples for crimp height or crimp depth tests to verify calibration. Others will go beyond that and do a cross-sectional test where they cut the crimped area in half and see what is going on inside the crimp microscopically. But most of the time, the tools are being maintained according to the maintenance schedule in the instruction sheet.

WHN: I know you deal mostly with TE's portable tools, but can you describe how customers move into more automated crimping solutions?



TE SDE Micro with Light — Battery Operated

Mandar: As mentioned, for prototypes, repairs and low volumes, people use portable tools. But when they are going into higher production, they look at the requirements... is it 500, 1,000, 5,000 crimps per hour? From there, you might move into applicators and terminators. That is a semi-automatic solution. Semi-automatic means you are preparing a wire in one station and crimping in another. So, you have a wire prep machine cut and strip the wire, and then you have the applicator/terminator for crimping.

If you have much more than that you could go to a fully-automatic solution. In the case of a fully-automatic machines, which TE also offers, you have a wire reel and a terminal reel coming in and the machine is making the complete assembly.

WHN: Going back to the portable tools, are the crimp dies interchangeable from hand tools to battery and pneumatic?

Mandar: Absolutely. That's the modularity that we strive for. If we design a die for a specific terminal and wire combination, you should be able to use it in any if the portable tools. As you get into applicator/terminator tooling, you have a feeding mechanism to align the terminals, as well as many other adjustments. Then you have adjustments for the applicator tooling. It's a combination of many things going on, so that's why the dies are not interchangeable from the portable tools.

Continued on page 54



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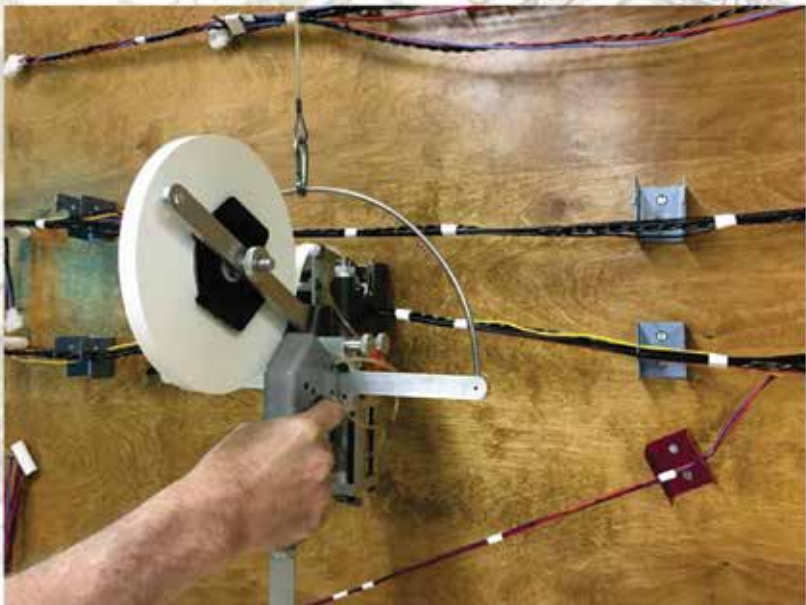
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# Portable Crimp Tools: Selection, Use and Maintenance

Continued from page 53

**WHN:** How do customers select the right tool/die combination?

**Mandar:** We focus on the terminal and what the crimping specifications are for that terminal to get the best performance. So, we would ask which terminal and wire you are using, and based on that combination, we will offer you the correct tool and die combination. That information is all available on the TE website, or you can speak with a TE representative.

**WHN:** What else should folks consider when selecting tooling options?

**Mandar:** We talked about tool selection where there is a terminal and a wire being crimped. But there is also an application. Think about the case of aerospace, defense or marine for example. You need to have that exacting specification because failure is basically not an option. For those kinds of things, we provide our Premium Tools or Certified Tools. On the other hand, when we are repairing a refrigerator or an air conditioner or some relatively simple equipment, we suggest Commercial Tools which offer a more cost-effective solution while still providing good quality crimps.

**WHN:** What other things should folks consider when looking at a range of tools, or a manufacturer?

**Mandar:** I've described a broad range of tooling like non-automated hand tools, through semi-automatic (applicator/terminator) all the way up to fully automated solutions. But the most critical portion in all of this is service and training. All this equipment can get very complex depending upon what terminals are being applied to what application. And so training and service becomes a very critical piece, and that is our fourth pillar. And customers only appreciate it when they stumble upon it or they get stuck. What we at TE are trying to do is reach out to stress that when you are making a decision to buy tooling, think about service repair and training, because it is critical to your success.

At TE, we have four service centers across the world: North America, Europe, Japan, and China. Customers can send tools back and get them repaired, recalibrated, reconditioned and have them returned quickly. Also, for applicator/terminator tooling, we have field service engineers who are geographically located across the world, and can actually go in and do those repairs, help with installation or do the calibration.



TE Crimp Applicator

For large customers, who might have hundreds of tools, instead of sending them all in every six months or one year, it might be wise to have a tooling applications engineer visit them. He or she basically works there for two or three days to calibrate and certify the tools and also assist with installation of new equipment.

**WHN:** I see there are a lot of training materials and resources available directly from the TE website. What sort of training options do you folks offer?

**Mandar:** Actually, there are many. It could be an on-site training where we go and visit the customers location. The customer can alternatively visit our facility for training. It could also be online or virtual. Those are the three areas we focus on. And we can focus on basic training like how to make a crimp, how to recognize a good crimp from a bad one, and how to measure it.

For the person who is a little more experienced, we can 'train the trainer' so that person can train others within their company. We can also do

certifications on those trainers going forward so they are current with all the technology and all the new advancement in tooling.

**WHN:** Thanks so much Mandar. Is there anything else you would like readers to know?

**Mandar:** Yes! TE's vision is to create a safer, more sustainable, productive and connected future with our customers. Our entire strategy, whether it is for the connectivity portion or the sensors, is to follow that methodology. And application tooling is there to absolutely make sure that happens. For hand tools, we stress ergonomics and quality. And what I mean by quality is repeatedly getting a good crimp to exacting specifications. Those are the combinations we commit to give the customer every time.

Many thanks to Mandar for taking the time to speak with us. If you would like more information on TE's portable or application tooling, go to [www.te.com](http://www.te.com)



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NEWS PLUGS continued



Telsonic Launch Telso®Terminal TT7

Telsonic AG, recognised as a world leader in the development and manufacture of Ultrasonic Technology for welding, cutting, cleaning and sieev-ing, once again demonstrate their com-mitment to product development and innovation with the launch of the new Telso®Terminal TT7.

This new system is set to revolution-ise ultrasonic metal welding applica-tions in a variety of areas, especially within the fast-growing Electromobility Sector where there is an increasing de-mand for the highest levels of quality and process control in cable assembly, terminal assembly and battery produc-tion applications.



The Telso®Terminal TT7 incorporates the latest version of Telsonic’s proven PowerWheel® welding technology which ensures maximum reliability and optimum process control for weld-ing metal cable cross sections up to 200mm². Additional benefits include the ability to change tools in under 5 minutes, thanks to the TT7’s new quick-change system. The Telso®Terminal TT7 also features standardised interfaces for digital networking and ease of inte-gration into production systems.


The new Telso®Terminal TT7 features a modern, innovative system design and multiple features which guarantee the highest levels of quality and perfor-mance for metal welding applications.

About Telsonic

The Telsonic Group, headquartered in Bronschhofen (Switzerland), has been providing ultrasonic technol-ogy solutions in Europe, America and Asia since 1966. Continuous innovation helps to ensure that, in many applica-tions, the company maintains a lead over competitors, offering added val-ue to users. With more than 250 high-ly-qualified staff the owner-managed family company specialises in plastic and metal welding, together with ultra-sonic cleaning, screening and cutting. Current trends mean that these skills are in strong demand, e.g. for lightweight construction, electromobility, battery production, the packaging industry, medical technology and 3D printing.

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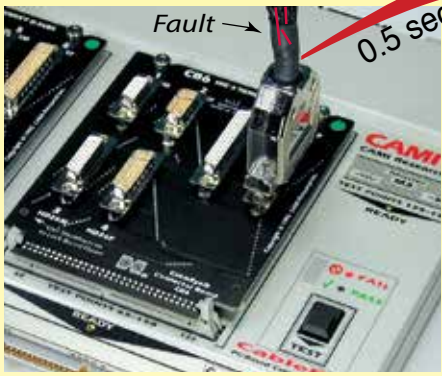
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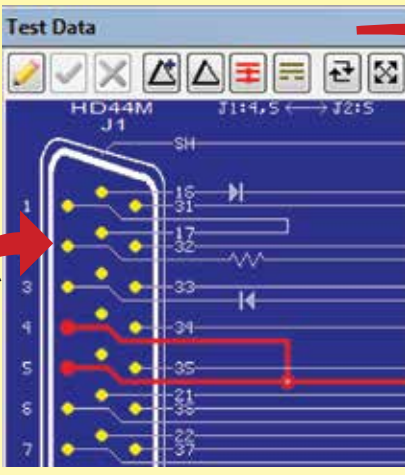
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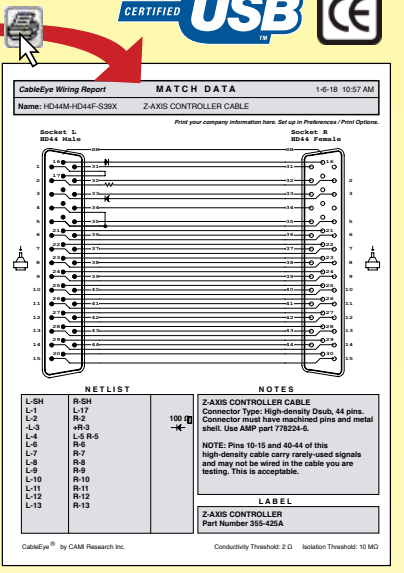
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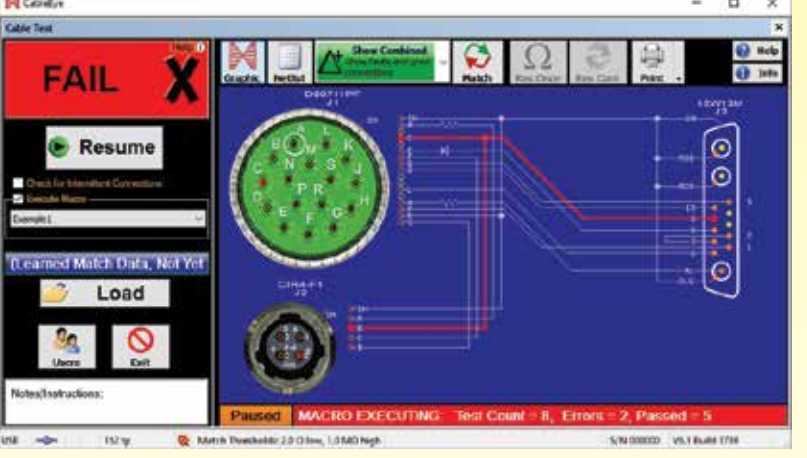
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FOCUS: MILAERO

Detailed Discussion of MIL-STD-1353 (Part 2): Nickel and Gold Plating

By Laura Wishart  
Lectromec

Plating materials used on electrical connectors are imperative to the connector maintainability and dependability throughout its service life. In the last article on MIL-STD-1353, we discussed Tin as a plating metal, its restrictions in practical use, and the potential of whisker formation which can lead to destructive arcing or short circuit events. Here, we discuss the use of gold and nickel as plating metals and their effectiveness when used together.

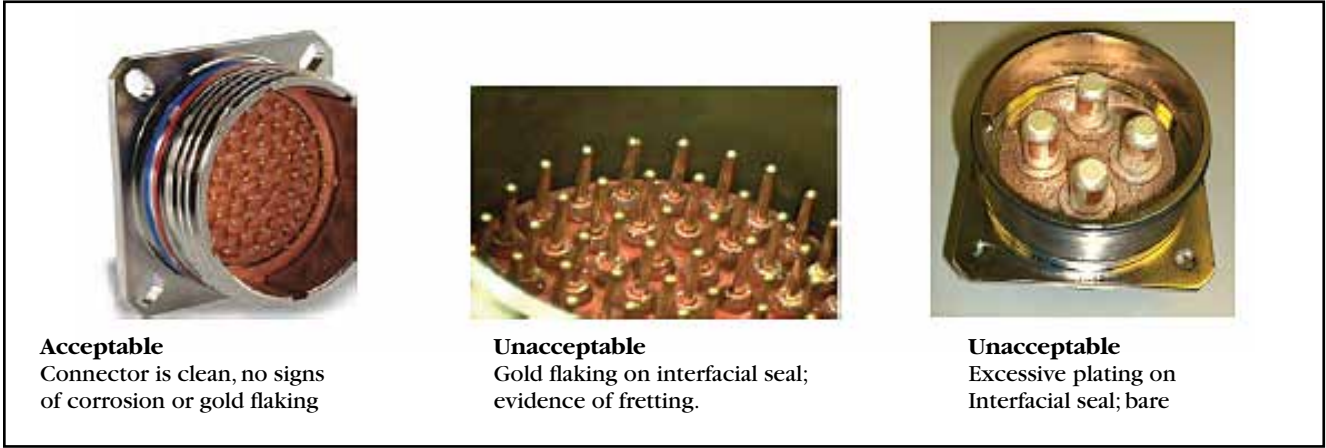
NICKEL

Nickel is a very supportive underplating metal and is often desired for its hardness and resistance to wear as well as is high conductivity. There are several variations of nickel plating (thicknesses, alloys, etc.) but these all maintain high conductivity across the board (see table). SAE-AMS-QQ-N-290 is a standard exclusively covering electrodeposited nickel plating and has been adopted as a reference for MIL-STD-1353; all nickel plating on conductors must adhere to the guidelines in SAE-AMS-QQ-N-290.

Low stress sulfamate nickel in accordance with SAE-AMS-QQ-N-290 is explicitly recommended by MIL-STD-1353 as it reduces the possibility for mechanical stress relaxation caused by exposure to tensile or compressive stress.

GOLD

Gold is an extremely beneficial choice in plating metal for electronic



A visual set of guidelines provided by MIL-HDBK-522 regarding the acceptable and unacceptable conditions of a gold plated connector.

purposes. Due to its high resistance to oxidation and corrosion, gold is better able to maintain conductivity over time than metals that are apt to form surface oxides (such as iron or copper). The high malleability of gold makes it possible for a thin gold plating over a nickel underplate; the manufacturing of gold plated contacts has advanced to a point that the plating thickness can be very tightly controlled.

The melting point of gold is nearly 2,000oF (~1100oC), far higher than any temperature expected to be encountered in most aerospace applications. This makes gold plated connectors very reliable in high temperature environments. Gold also has a relatively low coefficient of friction, enabling gold connectors to endure a large number of mating and unmating cycles without degradation. The ability to endure these cycles is crucial to the maintainability of any systems or components relying on the connector.

The most significant obstacle in gold use is simply the cost. Gold is a

very expensive material and is not always the most economically feasible option when designing a large electronic system.

COMBINATION

The combination of nickel and gold in electrical connector plating is extremely effective and one of the most common plating combinations in use. When used together, the two metals support the beneficial qualities of one another with negligible detriments to the other's function.

It is common knowledge in connector construction, that dissimilar metals present a real possibility for functional problems. For instance, when copper and gold are plated directly to one another, the copper tends to diffuse rapidly through the malleable gold, diminishing the hardness and non-oxidizing properties that make gold so useful.

Nickel, on the other hand, maintains its own beneficial properties while also lending them to the gold outer plating. Nickel underplating is mechanically supportive of the outer layer of gold as it increases the hardness and wear resistance of the entire plate. Nickel also creates an effective barrier against diffusion, inhibiting corrosion due to porosity. In fact, the MIL-STD-1353 standard requires a nickel underplate any time that gold is used as a plating metal.

Plating thickness is crucial when using nickel and gold together. The MIL-STD-1353 standard requires the nickel underplate to be between 50 and 150 μ inches thick (1.27-2.54 μm); thicknesses below this threshold are likely to peel off and thicknesses above this threshold have a

tendency to crack. The thickness of the gold layer is dependent on the type and grade of the gold in use as defined by MIL-DTL-45204; all gold plating on connectors must conform to MIL-DTL-45204. The minimum allowable thickness of gold plating on connectors is 20 μ inches.

CONCLUSION

Gold and nickel are excellent choices in conductor plating when their use follows the guidelines laid out in MIL-STD-1353. Though gold is often one of the more expensive material choices, the benefits of its use in terms of functionality, longevity, and dependability should certainly be considered when weighing long-term costs. If you are looking to test your electrical connectors to military or other standards, contact Lectromec today!

Read Part 1 of this article in the Sept./Oct. issue of *Wiring Harness News* at [www.wiringharnessnews.com](http://www.wiringharnessnews.com).

About Lectromec

Whether it is a wire, cable, harness, system, or new/old aircraft, if it is in aerospace, it needs to be certified. But without the knowledge and data, certification cannot happen. Lectromec has been a leader in wires and wire interconnect systems since 1984 and has provided expertise to the aerospace industry, both military and commercial.

Helping our clients advance and achieve their wire system and component goals is what Lectromec has been doing for 34 years. We have the tools, knowledge, and credentials necessary to certify components and systems through the entire lifecycle.

TABLE II. Properties of various plating's. 1/ 2/						
Plating designator	Description	Shell material	Salt fog (hours)	Upper temp	Electrically conductive	Shell-to-shell conductivity (millivolts)
A	Cadmium over nickel, light gold	AL	48	175°C	Yes	2.5
B	Cadmium over nickel, olive-drab	AL	96/500	175°C	Yes	2.5
C	Anodic, black	AL	48/500	200°C	No	N/A
D	Tin	CRS	24	150°C	Yes	10.0
E	Passivate	SST	48/500	200°C	Yes	50.0
F	Electroless nickel	AL	48	200°C	Yes	1.0
G	Electroless nickel	AL	48	200°C	Yes	1.0
H	Passivate	SST	500	200°C	Yes	10.0
J	Cadmium over nickel, olive-drab	C	2000	175°C	Yes	3.0
K	Passivate	SST	500	200°C	Yes	10.0
L	Electrodeposited nickel	SST	500	200°C	Yes	1.0
M	Electroless nickel	C	2000	200°C	Yes	3.0
N	Electrodeposited nickel	SST	48	200°C	Yes	1.0
P	Electrodeposited aluminum	AL	500	175°C	Yes	2.5
R	Electroless nickel	AL	96	200°C	Yes	1.0
S	Electrodeposited nickel	SST	500	200°C	Yes	1.0
T	Nickel fluorocarbon polymer	AL	500	200°C	Yes	2.5
U	Cadmium over nickel, light gold	AL	96	175°C	Yes	2.5
W	Cadmium over nickel, olive-drab	AL	500	175°C	Yes	2.5
X	Cadmium over nickel, olive-drab	AL	1000	175°C	Yes	2.5
Y	Passivate	SST	500	200°C	Yes	10.0
Z	Zinc nickel	AL	500	175°C	Yes	2.5

1/ Shell material: AL = aluminum alloy, CRS = cold rolled steel, SST = stainless steel, C = composite  
2/ Table taken from MIL-DTL-38999.

Table detailing the properties of various plating metals covered in MIL-STD-1353 (directly from the standard).

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## PIP (3:1) – What is it? And Why is it Important to the Wire Harness Industry?

By Christine Siebert

EPA issued a new Proposed Rule to extend the risk management compliance date for PIP (3:1) -containing articles to October 31, 2024. The prohibition on processing and distribution of PIP (3:1) and PIP (3:1) - containing articles will be effective on that date unless we can make a strong case otherwise during the open comment period. We anticipate that the electronics/wire harness industry will have new or additional data and information based on its efforts to identify PIP (3:1) in its supply chain since the January 2021 final risk management rulemaking. Also, we anticipate industry members will have more economic impact information to support a request for an exemption for spare and replacement parts. As of writing this article, the open comment period and the date to make a strong case by is December 27, 2021.

WHMA/IPC has been gathering data and will be sending the information to EPA for review. Currently, the intent is to request the rule be based on a ‘manufactured by’ compliance date, which would allow companies to continue to sell non-compliant stock that was manufactured before the cutoff date. They also plan to request for the rule to incorporate a de minimis concentration allowance and to establish specific exemptions (e.g., research and development).

So why is this important to the Wire Harness Industry? Uses of PIP (3:1) affect many areas in your industry. This chemical substance is found in plastics that can be used in the components of the wire harnesses. Also, this chemical can be found in the following electronics articles:

- Terminal and fuse covers
- Cable sleeves
- Tubes
- Casings
- Harnesses
- Clamps used with cables
- Float switches
- Connectors (housing)
- Condenser covers
- Internal tapes
- Gaskets
- Sheets
- Adhesives/Sealants
- More...

As you can see, PIP 3:1 is likely incorporated into many electronics articles, mainly because of its utility: it is used as a plasticizer to make plastics more malleable or flexible and it can be used as a flame retardant. These multi-functional uses of PIP 3:1 have utility in other products that may be used with electronics, such as lubricants and greases, industrial coatings, adhesives, and sealants.

PIP (3:1) is not currently regulated under other chemical or product regulations, therefore, many of you have probably never heard of this chemical and didn’t even know

it could be incorporated into all of these different products and articles. But it’s likely being used and it’s definitely being regulated by EPA, and the industry must be ready to comply. A prohibition on processing and distribution in 2024 means that we need to act now to minimize the impacts

to the supply chain. Please work with your suppliers and your customers to check your products. If you have international suppliers, you will need to work with them as they will be impacted, too.

WHMA/IPC is glad to work with you and make this process a little eas-

ier. If you have any questions about the proposed rule on the compliance date for the prohibition of PIP (3:1)-containing articles, please reach out to Kelly Scanlon, director of environmental policy and research at IPC, [KellyScanlon@ipc.org](mailto:KellyScanlon@ipc.org).



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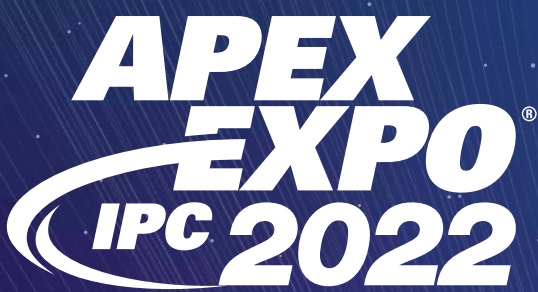
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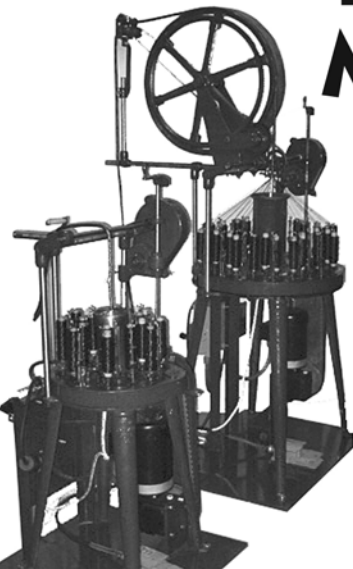
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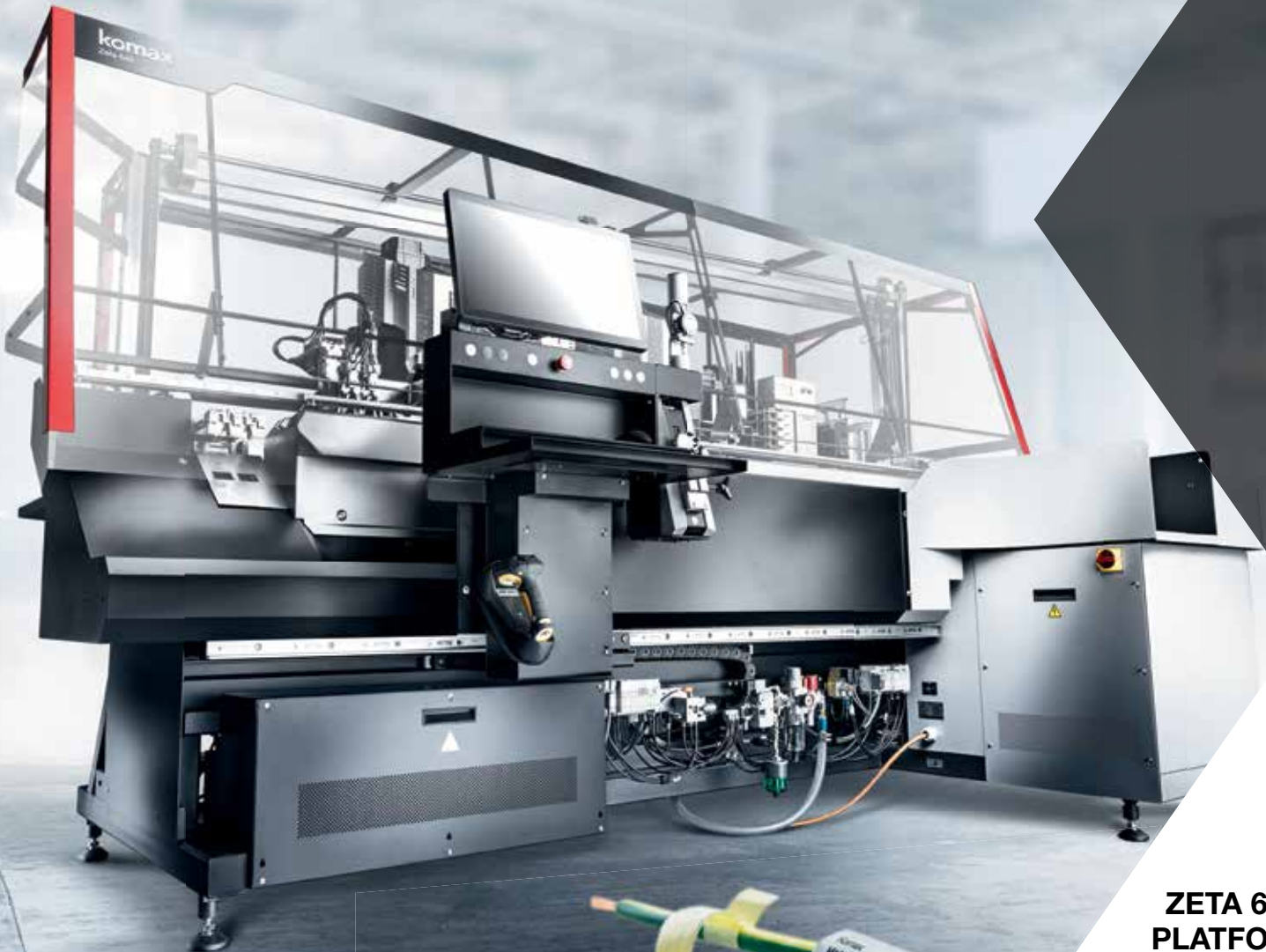


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# MAXIMUM FLEXIBILITY

## FULLY SEQUENTIAL AUTOMATION FOR PANEL BUILDS



### ZETA 640/650 PLATFORM

Equipped with 13 process modules allowing many possibilities for small batches or sequences. This new generation Zeta automates all processes such as cutting to length, stripping, termination, ink-jet marketing, ultrasonic welding, and tube insertion, simultaneously on both wire ends, enabling production without the need for changeovers. The automatic wire changer provides up to 36 different wires over the entire cross-section range 26awg – 10awg.



M1650 TUBE MARKER

For additional information visit



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