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- Guideline for the Design and Selection of Powered and Non-powered Hand Tools



Fourstar Connections

By Fred Noer

Phil Holman is aiming to make Fourstar Connections a five-star company, among the brightest in the wiring harness and cable assembly universe.

One of Holman's goals is his firm attaining \$20 million in sales by the end of 2018. Having closed 2015 with \$11 million in revenue, his company will have to grow 82 percent in three years.

Fourstar Connections (FC) was founded by Holman, 60, and began operations in 1987 in Hudson, Mass. The company still operates in the city of 20,000 people located 40 miles west of Boston.

The contract manufacturer specializes in wiring harnesses, cable assemblies, electromechanical assemblies and box builds for OEMs. The more complex a product or project, the more appealing it is to FC.

The firm is involved in a variety of industries - robotics, military, aerospace, medical, industrial, instrumentation and computer. No one industry is more than

25 percent of the FC portfolio.

For FC to grow substantially, Holman continues to take his firm in a new direction, one that was begun in 2011. "In 2010 we had \$10 million in sales but zero profit. Absolutely none," he said. "That was painful. We bottomed out. Our cables and harnesses had become a commodity that our customers could buy five different ways through bidding.

"That was the turning point, and since then we have been rebranding ourselves," Holman said. "We're now working on the proposition of value by developing intimate relationships with customers and bringing value based on their needs. We help them improve their products and reduce their costs."

The FC rebranding is based in part on Future State. The model directed company executives to first develop a profitable and sustainable business plan and then base current decisions on it to achieve its goals.

The next step of the rebranding was a process called Value Opportunity Profile (VOP). A consultant compared FC to a publicly traded corporation and developed a report to address the weaknesses



Fourstar Connections employees pinning wires on an extensive array of equipment.

of FC and to complement the Future State business plan. VOP mandates FC managers' involvement in the plan development.

In addition to customer intimacy, the plan strategies focus on solution selling, market penetration and continuous improvement. They are carried out by emphasizing how the experience, expertise and equipment of FC can enhance its customers' introductions of new products and designs for manufacturing.

"We found that companies needed help with new-product introductions and engineering, and that became our new business plan and business model," Holman said. "We're a completely different business now. We have moved up the food chain and followed the market where OEMs are placing purchase orders at a higher level.

"The dynamics of OEMs is that they have gone from being vertically integrated in the early 2000s to going outside

more and more," Holman said. "We try to sell as high as we can where there are the most value and the most sales. Besides doing harnesses and cables, we do electromechanical assemblies and box builds. We ask customers what else we can build for them so we can provide one-stop shopping and so they don't have to go elsewhere."

Holman pointed out FC sales per unit have more than doubled since the change in direction. It prompts his firm to look for opportunities in which, for example, an order for a \$60 cable has other facets that would lead to a \$1,500 electromechanical assembly.

The number of FC customers dropped from 150 to 100 in 2015 because they did not fit the FC business plan anymore. Holman would like to release 20-30 more.

"We have set a threshold of \$100,000 a year in sales," Holman said. "Our ideal

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Guideline for the Design and Selection of Powered and Non-powered Hand Tools

By Joe Tito
Wiring Harness News

Two years ago, there was an industry roundtable discussion at the WHMA conference on hand tool ergonomics and the reduction of injuries related to their use.

I sensed frustration at the conclusion of that round table and in subsequent conversations with others in our industry. As such, I set out on creating a guide for design and selection. I am by no means a scientist. The information supplied is from a cross section of industries and researchers, and represents the major points of agreement. But as we know, science is never settled.

1. Introduction

Advances in automation and robotics have insulated humans from many of the demanding tasks once performed by hand. New technologies like voice

recognition and touch screen interfaces have further reduced the physical demands on the human hand. Still, many

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why do it twice when once is better

Grey Beards and Blue Plaid: How to keep from falling behind.

By Paul Hogendoorn

Walking through a major trade show last month gave me cause to realize how lucky we all are to live in these times, and made me pause to reflect on my own personal 35 year journey. We (myself, and other people approximately my age) straddle two great industrial generations; an older generation that brought the PLC into the mainstream, and a new generation that is doing the same thing with the IoT.

Both generations started with a common attitude towards innovation. In each case, the incoming technology wasn't a mere evolution, it was (and is) a revolution. Technology revolutions are disruptive, and disruption (in manufacturing especially) is always avoided. Both generations required more than a brand new technology, they each required a brand new way of thinking. They both required persistence, determination, and sometimes even a bit of arrogance and bravado. In my first go-round, I was often put in the position of "prove it", which meant doing it for free to demonstrate to all the naysayers that it would work. And, there were a lot of naysayers. One of the problems we had then, which is exactly the same as the problem the



Paul Hogendoorn

new generation faces now, is that we were young, and in the industry's eyes, inexperienced. To us, in our youthful confidence, "experienced" often meant "stuck and well-practiced in doing it the same old way". But, we persisted, earning enough opportunities to eventually gain a solid foothold and start our businesses. And now we are the "grey beards", looking suspiciously at what the young guns, wearing their blue plaid shirts, are heralding as the new way of doing IT on the plant floor.

As I was walking the show, these were some of the thoughts on my mind.

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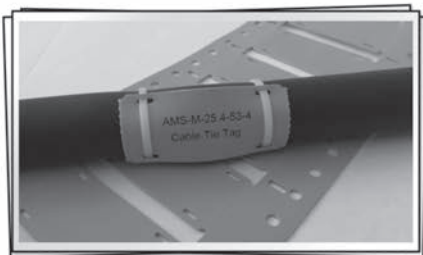
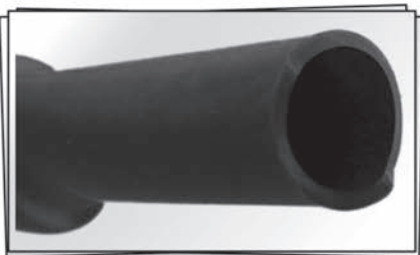


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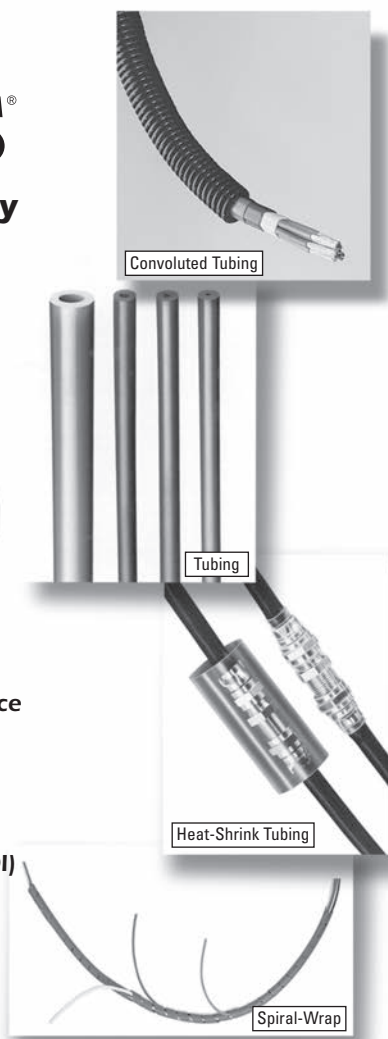
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Grey Beards and Blue Plaid

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A couple years ago, I helped launch a start-up company to help bring the IoT into manufacturing, and we hired some really bright young people to get it started. Interestingly, blue plaid seemed to be their favourite fashion style, regardless of the occasion. The initial idea was that I would be a coach and mentor, but they soon convinced me that "every company needs a few grey beards". This was a different attitude than the earlier revolution, certainly from my personal experience. But, I think it's an excellent attitude, and an excellent idea: blue plaids and grey beards, all on the same team.

Manufacturers make trust based decisions; their decisions are based largely on brand, on what they are familiar with, and on relationships - in other words, things they trust. New technology is instantly something they are not familiar with, and new technology brands are not yet unrecognizable to them. (And, if they do recognize the brand, it's likely that the company has an evolutionary technology and not really a revolutionary technology.) So, to even get a chance to present, requires having a long term relationship, and a long term relationship often comes with a grey beard (at least in manufacturing).

There's another difference between "then" and "now"; back then, I believe there were far more independent companies, and far more autonomy for individual plants of foreign controlled companies. Decades of having a currency advantage (in Canada), or

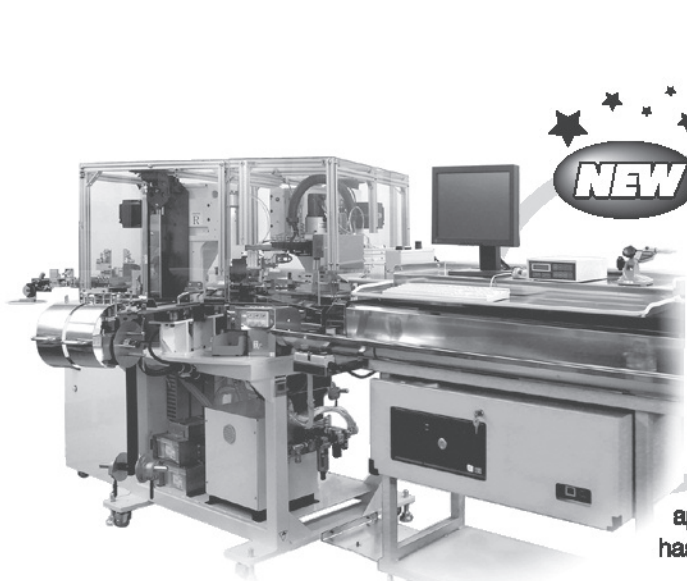
a low cost labor advantage (in other regions), has lulled many of our companies into complacency, perhaps stymying a more aggressive attitude towards adopting, or at least trying out, revolutionary technologies. Most seem satisfied with evolutionary rather than revolutionary, unaware that simply keeping up is actually falling behind. Although our universities, colleges, and innovation acceleration centers, all seem eager to marshal their energies to drive the sector into the new age, it will take more than that; it'll take a new attitude, and a collaboration of multiple generations - the grey beards supporting the ideas of the blue plaids, and the blue plaids willing to get their hands dirty, proving their ideas out on the shop floor.

At the end of the day, it's not about manufacturing, or machines, or processes, or even IT. It's still about people, just like it always has been. Whether its people to build it, or use it, or buy it, or just even to try it. Our companies need people to drive innovation, to be imaginative, to be creative; to be sustainable, generation to generation.

Welcome to the new age of IT in manufacturing; it looks vaguely familiar. It's a great industry to be in, and a great time to be in it.

Paul Hogendoorn is co-founder of FreePoint Technologies. "Measure. Analyze. Share." (Don't forget to share!) He can be reached at paulh@getfreepoint.com or www.getfreepoint.com

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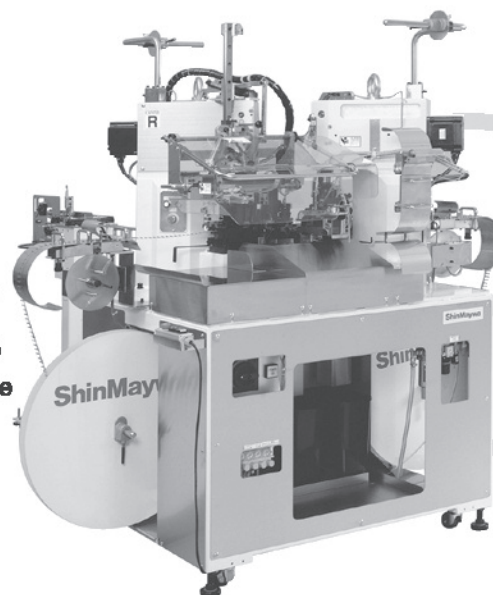


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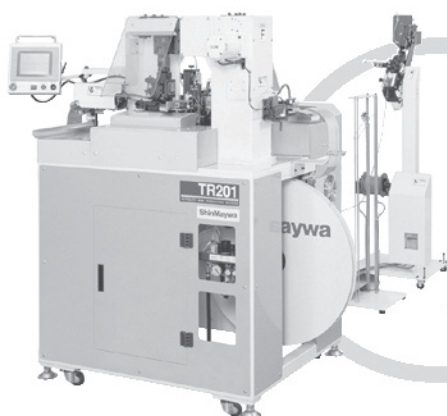


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How Not to Recruit

By Loren Smith

When harness companies experiencing growth have not been able to develop sufficient management talent internally, they might recruit from one of three basic pools: the corporate world, competitors or suppliers. Which is the safest bet?

The answer is none of the above because all three routinely fail, as I have heard repeatedly from CEOs and learned from my own experience as an owner. Let's briefly examine why the process is so challenging and then identify the most important steps to ensuring success for small and medium harness companies.

Corporate recruits from large companies are eyed warily in the private equity and venture capital world because veterans of corporate culture often have to unlearn many of their approaches to operate effectively in a small-company environment. I have experienced this frustrating phenomenon myself.

Recruits from competitors can be a disappointment for similar reasons. Competitor environments may seem quite parallel, making it appear that a recruit will hit the track running, but the learning curve is often much steeper



Loren M. Smith, CEO
Blue Valley Capital

than expected. In fact, the "this is the way we did it" at ABC company can be a real obstacle. In one case where recruiting a competitor's employee misfired for me, I had received glowing input about the candidate from a shared customer, but the recruit was wrong for my company.

Recruits from suppliers know our business intimately, but from a different side. I once hired a buyer from a good customer to be my purchasing manager. This individual had a work ethic I had

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How Not to Recruit

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admired for a number of years, but he never became as effective with me despite continuing to work hard. It was almost as if he became a different person in my organization because the fit was wrong.

So how do we take out insurance? How can we minimize mistakes? I have two suggestions:

Don't fall in love with outward credentials. Knowing a potential recruit has achieved success in corporate America or with a highly regarded competitor can create blinders that lull us into taking our eye off the ball. A candidate who has luster because he or she appears to have been a star for 20 years might not be nearly the fit as someone who is just getting started or as a solid veteran who

has never had the right opportunity to maximize his or her talent.

Match a carefully crafted job description to prospective candidates' attributes. When you do this, you might find that where you find candidates is less important than achieving that critical correlation. In fact, when we look at why conventional approaches have failed, we often realize the root is the lack of correlation between the needed attributes and what a candidate brought to the table.

The suggested approach may seem counterintuitive, and that may be the precise reason so many of us have found successful recruitment to be such a challenging endeavor.

Loren Smith can be reached at lms@blvcapital.com or www.bluevalley-capital.com

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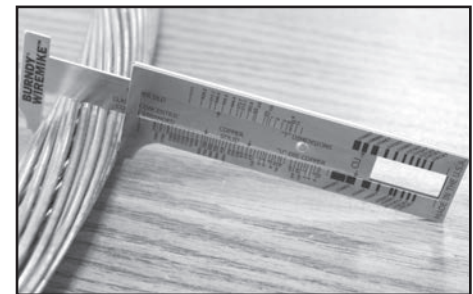
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English



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Guideline for the Design and Selection of Powered and Non-powered Hand Tools

Continued from page 1

tasks dictate the manipulation of powered and non-powered hand tools to produce wiring systems for high-reliability equipment or prototyping. Surely, the hand will be a dominant feature for years to come, and the careful ergonomic design and selection of hand tools will continue to be an important and worthwhile endeavor.

The Science

The science of ergonomics is not new. The term was first coined by Wojciech Jastrzebowski in the mid 1800's. It has generally been defined as "fitting the task to the person." Much has been written on the subject of ergonomics as it relates to hand tools. This data exists in several texts and white papers, and is spread across various industries (medical, poultry, automotive assembly, etc.). The purpose of this guide is to compile the best known interdisciplinary data on ergonomic design and selection to be used as a baseline for both powered and non-powered hand tools for the wire harness industry.

While research on repetitive stress/strain injuries (RSI) and work related musculoskeletal disorders (WRMD) continues to grow, it is generally accepted that the root causes are a combination of applied force, poor posture, contact stress, and lack of task diversity. The goal of ergonomic design

criteria is to minimize any or all of these risks wherever possible. While it is prudent to optimize the ergonomic performance of all hand tools, powered equivalents should be sought if possible.

The term "guide" is of particular relevance to the use of this material. It seems inconceivable that any tool could be optimized under all of the criteria set forth here. Even with the best intentions, no single tool can be designed that will optimize the anthropometric attributes of an entire population of users. It is almost impossible to be universally ergonomic. Optimal designs are usually the result of compromise with certain ergonomic principles taking precedence over others.

Also, as familiarity is a less tangible, yet extremely important aspect of good ergonomics, it is not the intention that this guide is used to critique and challenge any well established designs. The most efficient use will be with new tool designs and selection. No changes should be made to highly familiar tools without extreme consideration. To do so would surely result in a huge amount of complaints and injuries.

The science of ergonomics has two distinct and often conflicting tenants. Initially, one can study the more measurable tenants of ergonomic theory, such as anthropometric and physiological

Continued on page 12



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Guideline for the Design and Selection of Powered and Non-powered Hand Tools

Continued from page 10

aspects, as they relate to tool manipulation. But more challenging to measure are the cognitive attributes to ergonomics, such as perception, motor response, sensory feedback, and familiarity. A systems approach for evaluating tools on both quantitative and qualitative aspects must be adopted.

Finally, what was good ergonomic theory 30 years ago may not be the case today. Anthropometric attributes of a population of users can change over time. This can be due to changes in the gender and ethnic makeup of the population, along with changes in the level of complexity of a given task. It is reasonable to think that the best practices in the field of ergonomics will continue to develop as time goes on.

2. Ergonomic Design Criteria for Hand Tools

Grip Span

The optimum grip span for hand tools is 2.0 inches in the closed position,

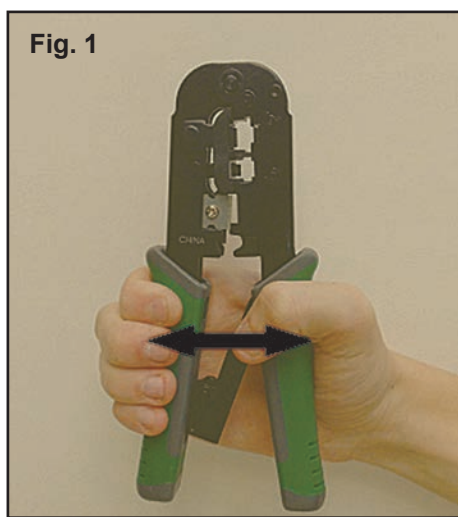


Fig. 1

and 3.5 inches when opened. Grip span is defined as the distance between the thumb arch (where it meets the tool) and forefingers when the tool jaws are open or closed (Fig.1). Often times, for larger wire gauge sizes, the width of the open crimp tool will exceed these limits in order to maximize the mechanical advantage of the tool and reduce the stress on the hand. This is one of many examples where one ergonomic principle takes precedence over another. Considerations for power tool options may be suggested in these circumstances, especially for instances where repetition is high.

Required Grip Strength

It should be noted that peak hand strength occurs between 2.0 - 2.75 inches and drops off precipitously outside of

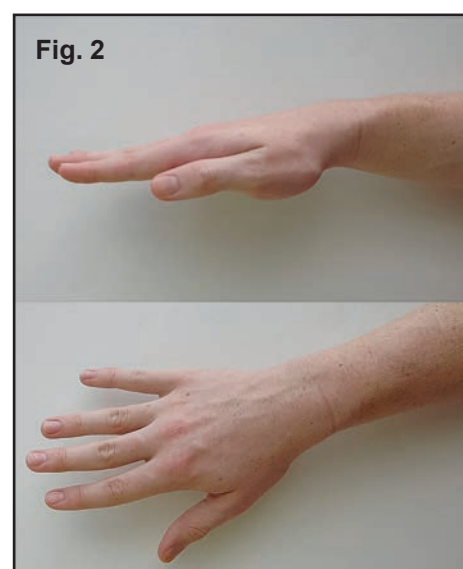


Fig. 2

those ranges. This is referred to as the power range. Peak forces should be kept within this range where possible. Attempts should be made, to design and choose tools that maximize the mechanical advantage of the tool outside the power range. Tools that require the least force outside the power range provide the best ergonomic benefit.

Springs and Release Switches


Handles should be spring loaded in order to minimize any extra motion necessary to open the handles. Releases should be easily accessible to the user, and should not produce excessive pressure on the thumb or finger.

Handle Length

Tool handles should generally be longer than the widest part of the hand. The tissue on the palm of the hand is shallow and full of pressure-sensitive nerves and blood vessels. It is important to have handles of sufficient length so the ends do not press into these tissues. The optimum handle length is 4 - 6 inches. Longer handles should be considered for tasks that require a comparatively high amount of closing force. Though not true for everyone, longer thicker handles require less force.


Handle Angle

Every attempt should be made to select hand and powered hand tool designs that limit extreme hand postures. For this reason, tool handles should be angled to perform the task with the least amount of wrist deviation. The wrist and the forearm should be aligned as much as possible during tool operation. Figure 2 shows the hand in what is commonly referred to as the neutral position.




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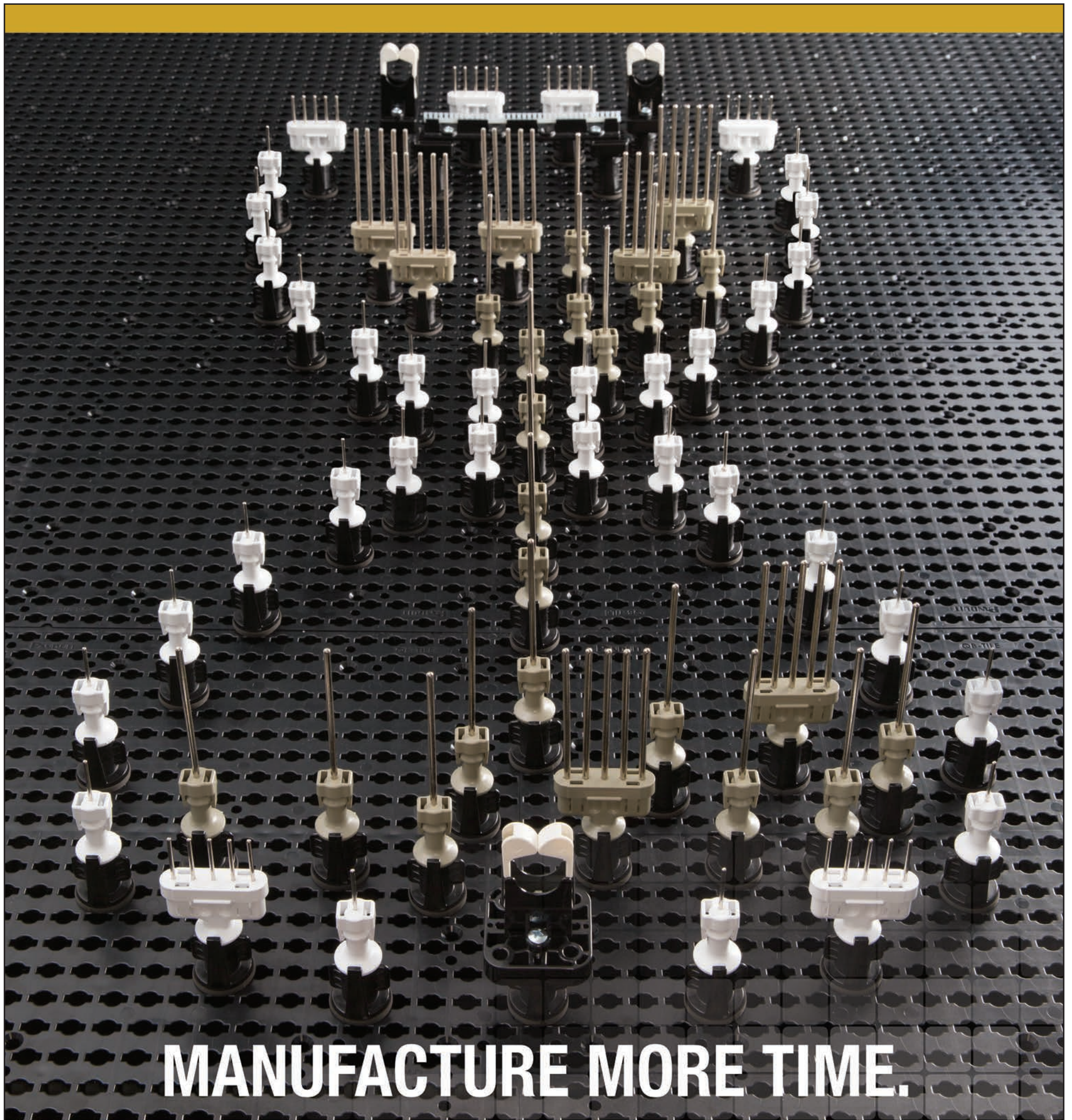
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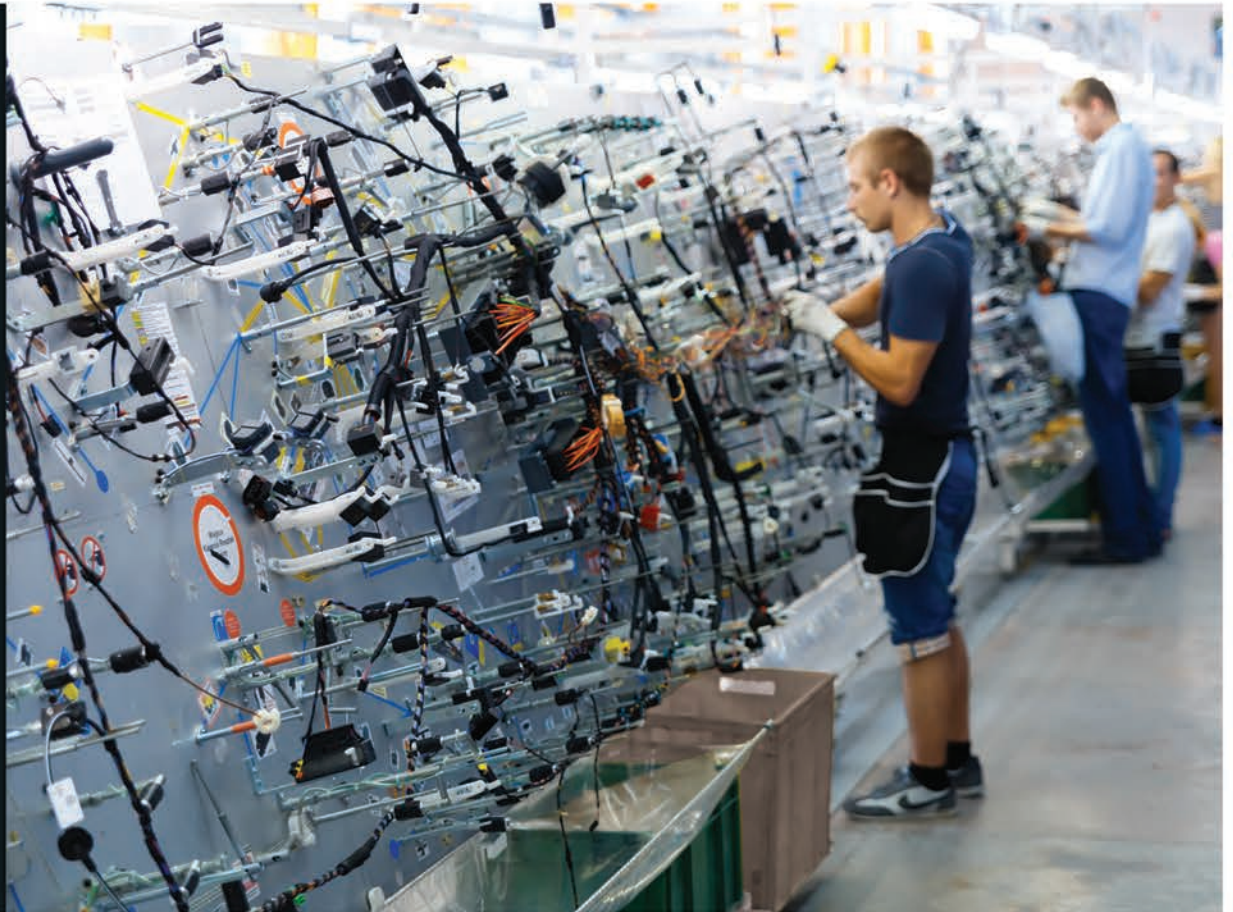
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NEWS PLUGS continued**Galaxy Wire & Cable Launches New Website and New Brand**

Galaxy Wire & Cable announces the launch of its new website (www.galaxy-wire.com) that features the new company logo and branding. The new website now provides users with deep, rich information about Galaxy's products and services so that customers can better understand Galaxy's extensive offerings and easily qualify Galaxy as a wire and cable supplier. The website's responsive design makes it easy to view and use on computers, tablets and mobile devices. The new logo and tagline provide a modern, tech-savvy look to match Galaxy's broad capabilities and vast experience.

Galaxy's website now features new sections on their custom wire and cable offerings as well as standard products. For Custom Wire and Cable, Galaxy provides a long list of insulation and jacketing materials (www.galaxy-wire.com/custom-wire-cable/jacket-insulation/) that can be utilized, along with conductor, shielding and other enhancement options. Customers can use the Custom Cable Quote Form to provide their required specifications and get a quick response from Galaxy. The section on Standard Wire and Cable describes the offerings for commercial applications, those that meeting MIL specifications, and UL/CSA approved products, along with tubing, sleeving, and wire management products and molded cord sets.

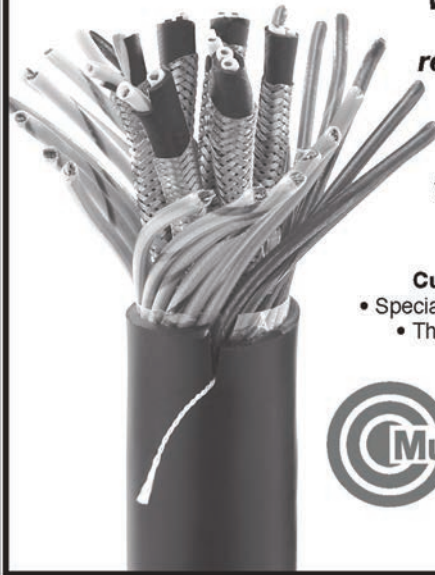
The Assemblies & Harnesses section (www.galaxywire.com/assemblies-harnesses/) highlights many of Galaxy's value-added services and manufacturing capabilities for cable assemblies, wire harnesses, box builds, coaxial cable/RF cable jumpers, overmolded cable assemblies, and wire lead manufacturing. The category for Applications shows two dozen uses for Galaxy's wire and cable such as Low Smoke Zero Halogen (LSZH) (<http://www.galaxy-wire.com/applications/low-smoke-zero-halogen-cable/>), Extreme Environment, and Military Power/M3432/CO cables. And the Industries area describes many of the sectors that Galaxy serves.

"With its deep product content, the new Galaxy website makes it easier for customers to do business with us," said Galaxy Vice

President Eric Lutz. "Users can easily find what they need, get detailed product information on standard and custom wire and cable, and contact us easily for assistance."

About Galaxy Wire & Cable, Inc.

Galaxy Wire & Cable is a leading supplier and manufacturer of custom and stock wire and cable, in a variety of insulation and jacket materials, with many conductor, shielding and enhancement options, with design and engineering assistance available. Offerings include cable assemblies, wire harnesses, box builds, jumpers and wire leads. Cable and wire from Galaxy is used for in a variety of industries and applications. Galaxy is a certified woman-owned business/women's business enterprise (WBENC), ISO 9001:2008 certified and ITAR registered. Visit Galaxy Wire & Cable online at <http://www.galaxy-wire.com> for complete information on all wire and cable products.

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Looking Forward - Manufacturing Execution Systems for SME's

By Pete Doyon
VP Product Management
Schleuniger, Inc.

A Manufacturing Execution System (MES) is a software program that manages and monitors production work in a factory. The

MES controls and monitors all manufacturing data in real time, so there is no guesswork as to the status of any given job, machine, operator, etc. The focus is on short-interval scheduling (shift or day) with an emphasis on optimizing the distribution of work orders. Larger manufacturers have employed MES's for years but many small to medium sized

enterprises (SME's) have yet to adopt such systems. The benefits of using an MES are many. Looking forward, I predict that even the smallest manufacturing companies will employ MES systems in the future.

An MES is integrated into a manufacturing operation by networking all of the production and quality equipment. It is programmed to know what type of jobs can run on which machines and it allocates jobs based on those capabilities. Jobs are sent to the machines electronically, thereby eliminating operator keystroke errors. The MES groups similar jobs together and optimizes the work by reducing the frequency of machine changeovers. If a production machine breaks down, the MES can reallocate jobs to the remaining machines. The MES optimizes work based on the due date and time to complete the individual work steps and finished assembly.

Even though the MES makes it possible to go "paperless", a paper work order is often used to make it easy to identify work-in-process as it moves through the manufacturing process. Barcode scanners are used to scan the work order at the beginning and end of a job. This makes it possible to know exactly how long each job took and the percentage

of completion can be displayed in real time.

The MES can be programmed to ensure that any required quality tests are performed. If the quality test(s) is not performed, the MES will not allow the operator to go to the next production step. The MES can also require the operator to scan the barcode on the raw materials and tooling to make sure everything is correct before a production run. All data is stored with each job, making traceability extremely simple.

The MES can monitor the performance of the entire manufacturing operation by calculating the Overall Equipment Effectiveness (OEE). OEE is a key performance indicator based on a calculation which takes availability, performance and quality into consideration. Being able to easily monitor the OEE makes it easier to drill down and target where improvements can be made.

As the cost of technology continues to drop, even small to medium sized companies can realize immediate savings and a quick return on investment by implementing a Manufacturing Execution System.

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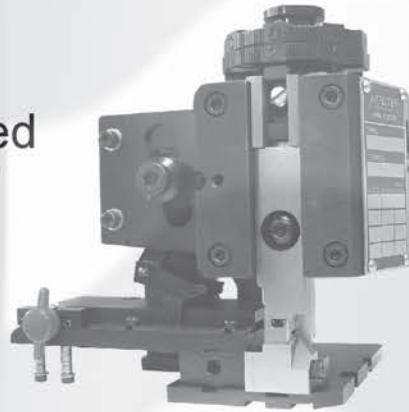


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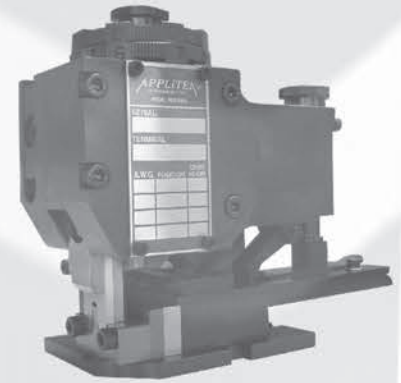
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Mini style applicators with mechanical feed mechanisms are supplied in a variety of feed configurations. Adaptable to most crimping presses.

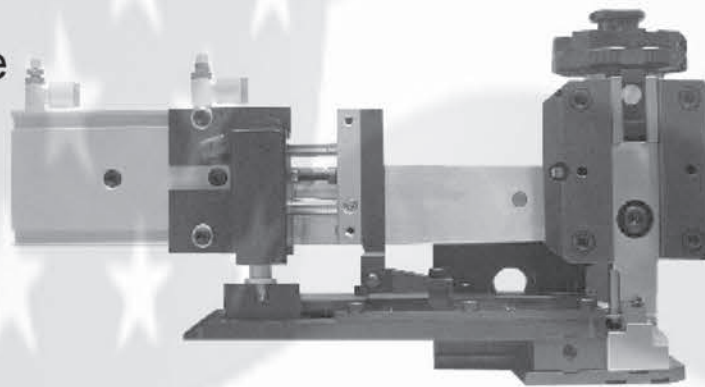


Model 1700

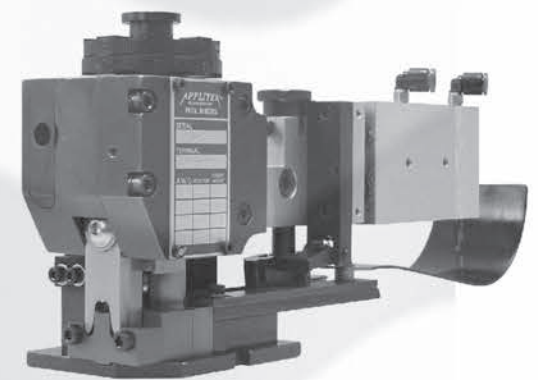


Model 2000

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

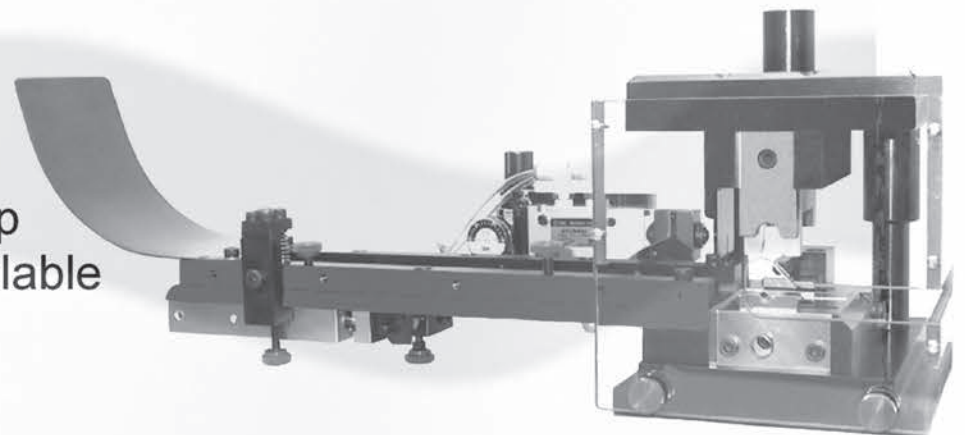


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Elk Grove Village, IL 60007 Phone: (847) 290-8686**NEWS PLUGS** continued**Molex Ultra-Fit™ Power Connectors for Industrial and Consumer Electronics Now Available from Newark element14**

Newark element14 has introduced the addition of the Molex Ultra-Fit™ range of high-density, low-mating force power connectors, with a maximum 14A rating and only 3.5mm pitch, to its product portfolio. This small-sized yet power-dense range of connectors eliminates same-circuit-size cross mating, optimizes space saving and facilitates easier assembly. It is suited for applications in industrial, telecommunications, lighting, medical and consumer electronics.

There is a wide range of power connector challenges faced by each industry, such as space constraints in electronics design, potential errors in assembly and malfunctions in the end-products. Molex's new Ultra-Fit power connectors address these challenges with features that include:

- Multiple mechanically keyed color-coded options
- Footprint reduced by 17 percent over similar power connectors
- Ultra-low mating force terminal
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The Ultra-Fit range is part of the family of Molex Fit power connectors for wire-to-wire, wire-to-board and board-to-board configurations and offers space-saving sizes, cutting-

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The Fit family from Molex includes Micro-Fit, Mini-Fit and Mega-Fit. To learn more or make a purchase, visit www.newark.com/molex.

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New from The Eraser Company, Model MMC71 Multi-Material Cutter is capable of cutting a wide range of materials, including flat material up to 3.3" inches wide, tubing up to 3/16" OD, and wire up to 14 AWG stranded or 16 AWG solid.

The MMC71 works great on flat material such as heat shrink tubing, tapes, foils, ribbon cable and more, and is even capable of cutting silicone tubing.

The machine is easily programmable, offering ten fixed feed rates, ten fixed cut rates, and storage for up to 99 batches and 10 kits (depending on available memory).

Material guides are easily adjustable for each application. Additional guide kits are available to allow multiple pieces of the same material to be cut at the same time, increasing operator efficiency and production rate. The unit is fully electric and does not require an air supply.

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K-Sun® Corp., a leader in industrial identification and labeling solutions, introduces the next generation of cost-saving, multi-industry, label, heat-shrink tube and bar-code printers—the LW-PX900.

K-Sun and Epson co-developed this rugged, portable and PC-compatible thermal transfer printer by creating exclusive smart features based on user feedback. Leading the industry with a lifetime warranty, the LW-PX900 is designed for TIA 606-B and cabling installation standards, safety/compliance, quality improvement and 5S/lean/visual workplace labeling.

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The Model G II terminator is the latest and most advanced design in the long-standing series of AMP-O-LECTRIC machines for terminating wire using reeled terminals and contacts. This unit is designed and built to continue the tradition of work-horse terminators from TE Connectivity (TE).

The new terminator improves key performance areas for operators. For operator convenience, we've improved access to, and significantly updated, lighting in the under cabinet and target area. A variable speed option was also added to provide more flexibility for those complex applications that benefit from slower ram and feed speeds.

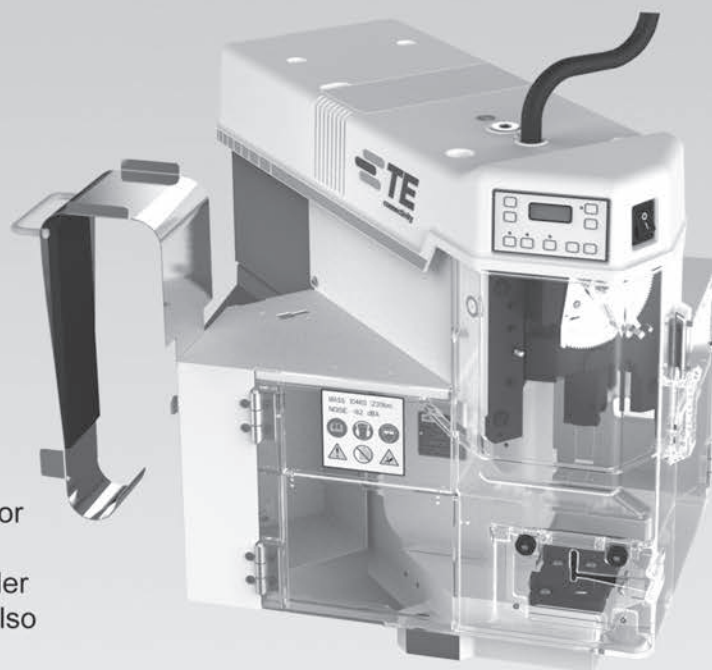
The Model G II terminator is one of the quietest machines available and the improved guarding meets applicable CE and domestic safety requirements. The improved guarding also creates open access for quick and smooth installation of both end-feed and side-feed applicator style.

User Friendly

At the push of a button, you can power the motor on or off, jog forward or reverse, switch to split-cycle operation, turn the work light off or on, power the air feed on or off, or reset the batch counter. And, it's all reported on an LCD display. The controls will also detect and report errors in the machine, and stop cycling when a bad crimp is detected by the CQM II. The operator must then push the reset button to continue. The Model "G II" will accept all existing TE miniature applicators.

Product Features

- Quiet operation
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- Tool-less changeover of applicators
- Precision manual adjust for crimp height
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- Reduced maintenance requirements
- Split-cycle operation
- Standardized 1 5/8 [41.3] stroke
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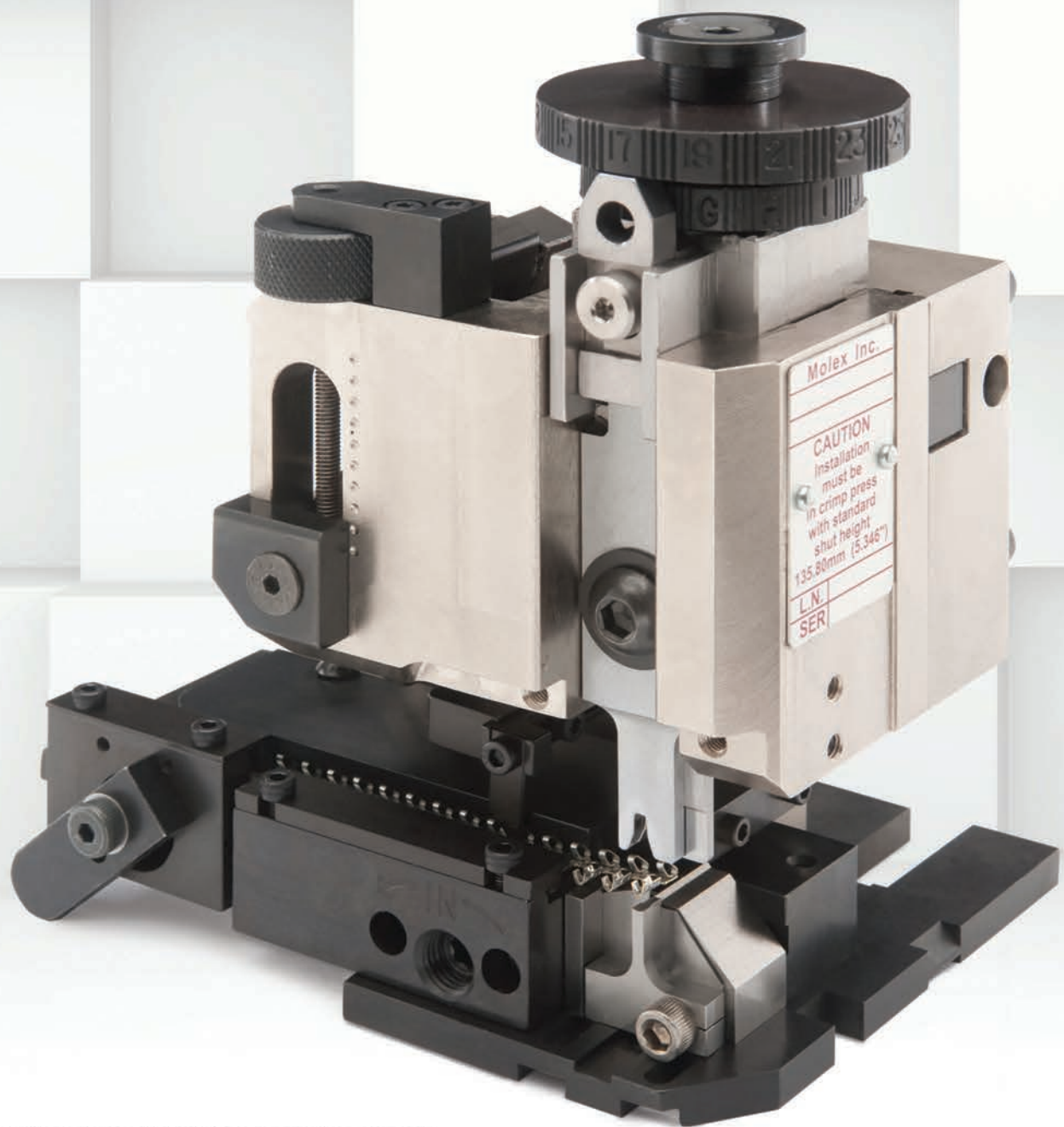
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Continued on page 40

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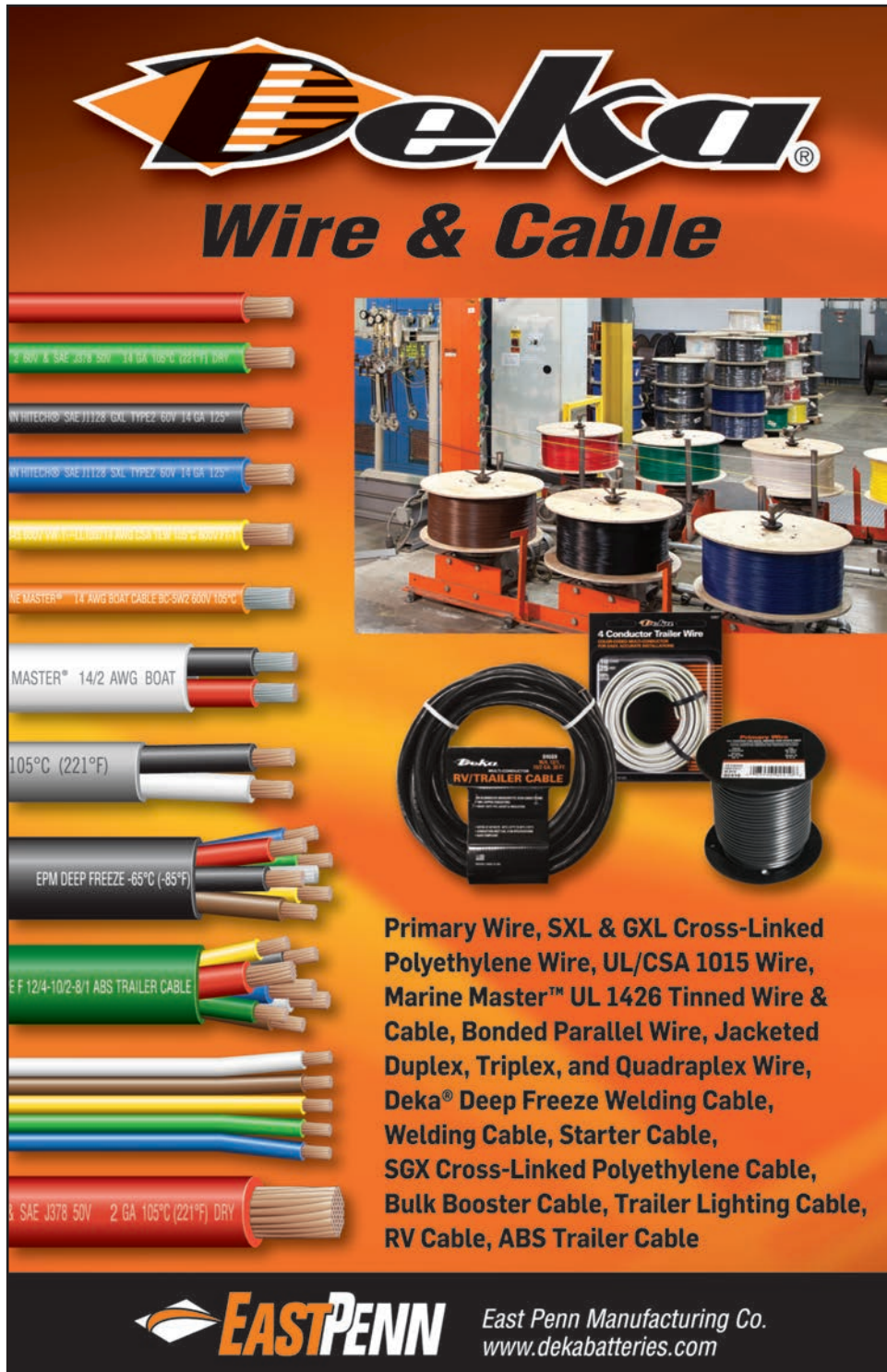
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Fourstar Connections

Continued from page 1

customer is in the \$200,000 to \$300,000 range. We know this is a very risky business plan, so we have to execute it properly.”

The new approach, which also had input from Corporate Value Metrics in Westborough, Mass., is embodied in the company slogan of “Finding A Better Way.” It is part of a marketing effort conceived with the assistance of Grant Marketing in Boston.

FC uses several media to market its services - video, e-mail, Facebook, Twitter, LinkedIn, Google Plus, an e-book, a Web site and a blog. They are part of inbound marketing in which potential customers are prompted to engage with FC.

“There is a lot of strategy that goes into our marketing, but it’s working,” Holman said. “There is a lot of positive stuff happening. We got one customer worth hundreds of thousands of dollars through our marketing effort.”

Holman spends 40 percent of his time on sales, complementing the work done by Pete McGuire, vice president of sales and marketing, and four account managers, who have two administrative assistants. Sales also is handled by one in-house rep and four outside rep firms, all in charge of specific accounts on a commission basis.

The largest sales percentage - 25 - is in robotics. Customers include the Massachusetts companies of iRobot in Bed-

Continued on page 22



Four Star's harness forming and assembly department.



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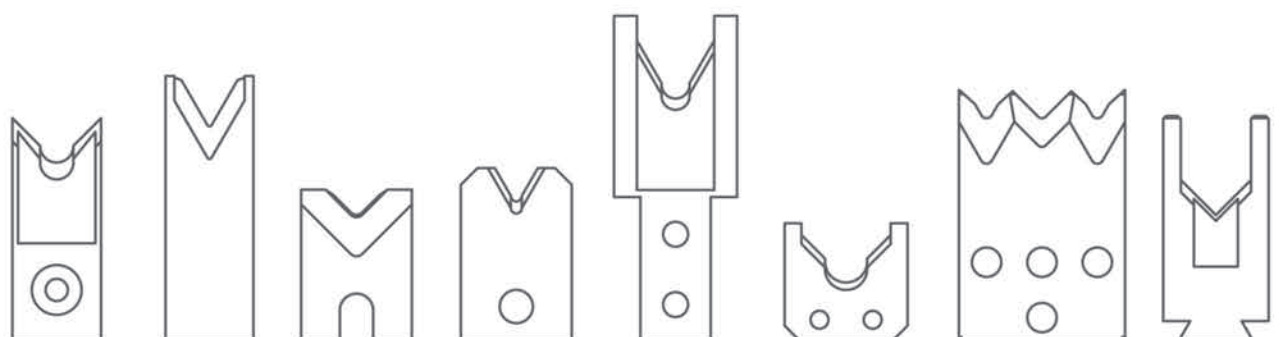
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Four Star's harness forming and assembly department.

Fourstar Connections

Continued from page 20

ford, Rethink Robotics in Boston and Amazon Robotics (formerly Kiva Systems) in Woburn.

Sales in the military and aerospace category is 22 percent. Among the clients are Boeing in Chicago, Ill.; Kidde Aerospace and Defense in Wilson, N.C.; UTC Aerospace Systems in Charlotte, N.C.; Atrenne Integrated Solutions of Minneapolis, Minn.; and Moog in East Aurora, N.Y. FC products are used on such aircraft as the military P-8 Poseidon, C-130, F-35, Global Hawk and commercial Boeing 787.

Medical and industrial are 19 percent each. Customers include the Massachusetts companies Hologic in Marlbor-

ough, Lytron in Woburn, Newcastle Systems in Andover, Olympus Surgical Technologies in Southborough and Candela Laser in Wayland.

The instrumentation market is 11 percent. The balance is computer at one percent and miscellaneous at four percent.

Production runs are 25-50, with the largest typically at 100. Manufacturing processes are according to applicable certifications: ISO 9001:2008, UL, CSA, ITAR, IPC/WHMA A-620B and IPC J-STD-001.

Equipment consists of Komax and Schleuniger machines that cut, strip, terminate and crimp wires. Each machine

Continued on page 24

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Fourstar Connections

Continued from page 22

has inkjet labeling capability. Half of the machines are dedicated to certain customers' set-ups. More equipment will be purchased this year to replace older equipment that uses more power.

All documentation is electronic and protected by passwords. A computer is at each station in the production area. FC has 85 computers, and they are equipped with the Sage 100 MRP system.

Holman pointed out one advantage of his company is its tooling. "We can build cable assemblies with 30-40 different product families, and we have actual tooling for 200-plus different connector families," he said. "When an order comes

in, we have an 80-90 percent hit ratio on having the tooling for products."

Quality is based on first-pass lot acceptance and parts per million defects. The former is 97 percent, and the latter is less than one percent. Every item is tested on Cirris equipment, and every connector in the MRP system has a test fixture.

On-time delivery is at 99 percent. FC does supply-chain management with customers that includes JIT, pull, stock and replenishment programs.

In turn, FC is, as Holman said, "only as good as our supply chain." It has approximately 200 vendors but is concentrated among 10 that provide 80 percent of FC purchases. The top suppliers include



Assemblers working on one of Fourstar's box build lines.

Heilind Electronics, Sager Electronics, Avnet and Anixter.

FC has value-added reseller programs with six companies. Samtec in New

Albany, Ind., offers connectors on customizable cables, and Cicoil Corp. in Valencia, Calif., makes flexible wire that functions in high cycles and extreme temperatures.

The other companies are EXM in Southborough, Mass., NEMA-rated enclosures; Cobra Products in Hudson, Mass., nylon cable ties; L-com Global Connectivity in North Andover, Mass., cables, connectors, adapters, antennae and WiFi boosters; and Weidmuller in Richmond, Va., DIN rail-mounted content inside enclosures.

Production is handled by 48 people. The rest of the staff consists of 14 people in administration. The key managers are Tom Barczak, vice president of operations; Pete McGuire, VP of sales and marketing; Juvenalia Chaves, engineering manager; Don Glencross, quality assurance manager, IT manager and ISO management rep; and Sarah Holman (Phil Holman's oldest daughter), accounting and HR manager.

Holman stresses sustainability in several ways. It is evident in the mutual funds offered in the company 401(k), staff participation in community charitable organizations and a three-year management training program for employee wellness.

Sustainability efforts also consist of single-stream recycling and the 2014 installation of \$400,000 worth of solar panels and better HVAC systems on the building, which is owned by Holman. The improvements dropped energy usage from approximately \$4,500 to \$1,500 per month. Another 50-percent reduction is possible if he has the fluorescent lighting switched to LED.

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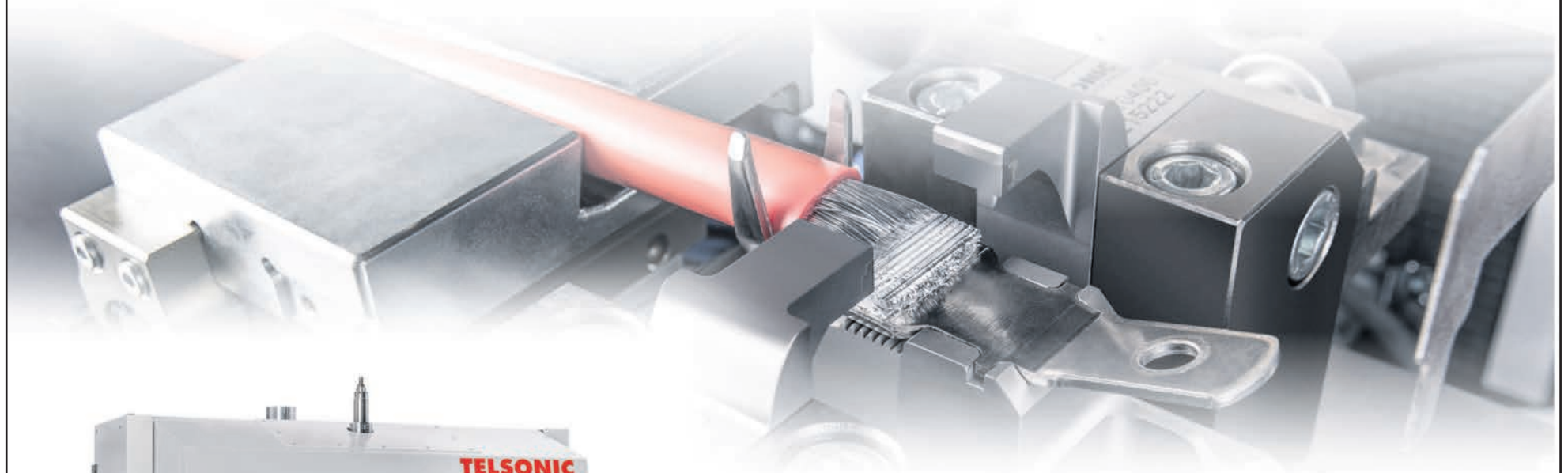
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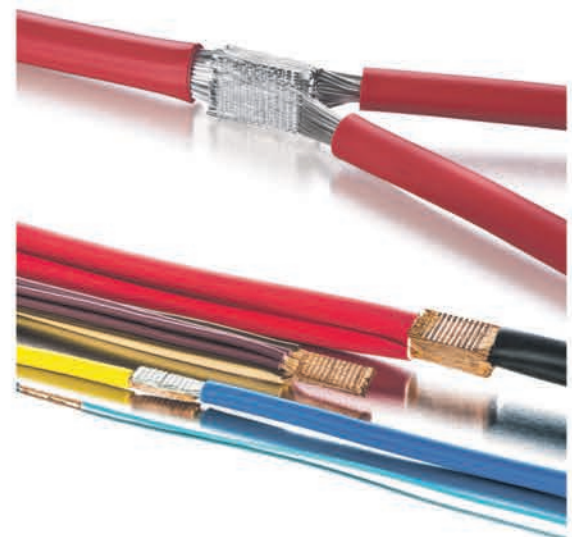
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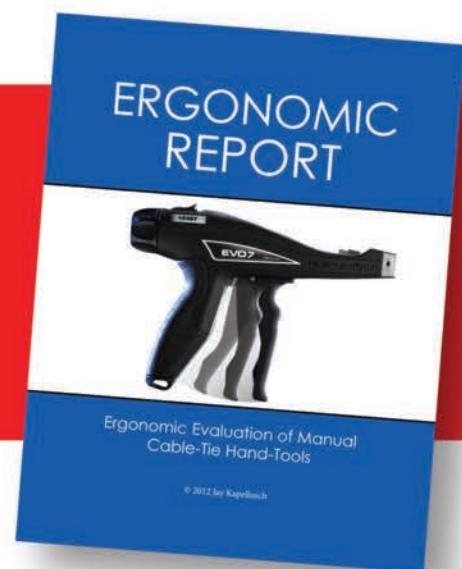
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Fourstar Connections

Continued from page 24

The building, which FC has occupied since October 2010, measures 28,000 square feet on a five-acre lot. A 30,000-square-foot addition is being considered.

FC always has been located in Hudson, which Holman termed "a very pro-business city in a significant high-tech OEM growth area." The company was in four previous locations.

The first location was the basement of Holman's home where he started assembling cables at a time when OEMs had all their harnesses and cables produced in the United States. He had made the decision to start FC after working for other companies.

Holman began his career as the quality manager for DataCon, a contract manufacturer in Burlington, Mass. He held the same position and then operations manager when the company opened a plant in California.

Next, he was VP of operations of Test Systems, a Phoenix, Ariz., company that built automatic test equipment. He returned to Hudson in 1981 as the VP and general manager of a Act Manufacturing, a tier-two cable manufacturer.

FC moved to other locations as it grew to a staff of 130 people at its



Fourstar technician assembling complex electro-mechanical control boxes.

highest point. A single order of \$300,000 required production of 5,000-10,000 pieces per month.

Then the 2000 dot.com crash occurred. Holman lost half of his OEM business to Mexico and China. He assumed, as others did, the crash was a temporary correction to the economy.

"We kept everybody on for six months, but when we got \$500,000 in the hole I had to lay off 50 percent of the workers," Holman said. "I call it Black Friday because it was the worst day of my career. It was humbling. We made money the next month and were down to a \$320,000 loss at the end of the year. That was the only year we ever lost money."

That experience prepared Holman for The Great Recession in 2008-09. FC maintained break-even status for 18 months due to cost-cutting that included staff members taking pay and benefit cuts.

"I'm proud that we've managed through the tough economic times and been able to help people," Holman said. "People are surprised that we are a company that is almost 30 years old. I enjoy running a company with 60 employees and keeping them and our customers happy."

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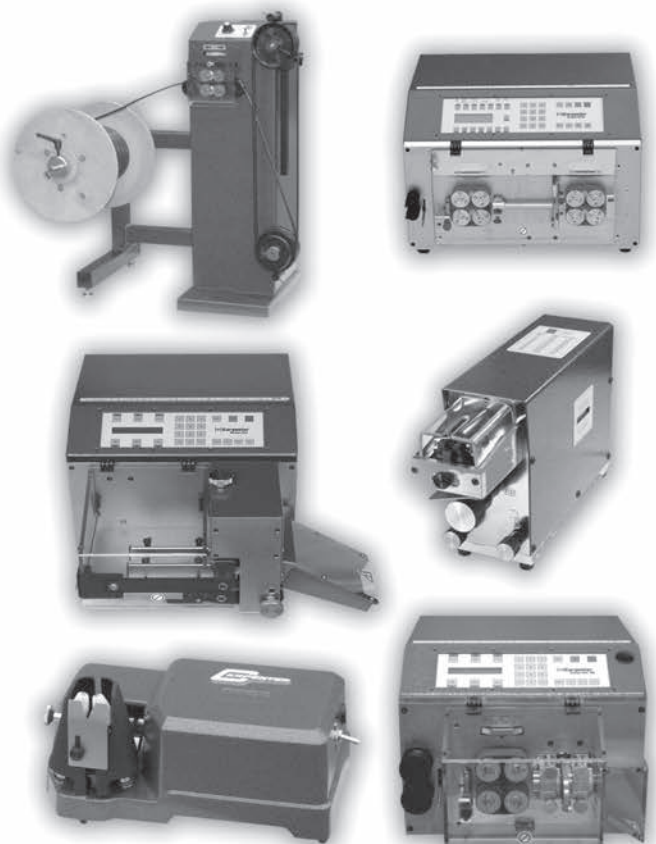
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Guideline for the Design and Selection of Powered and Non-powered Hand Tools

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It is the most comfortable position and is where the hand can perform optimal force and precision maneuvers. Although extension beyond the neutral position cannot be entirely avoided, the wrist should stay within the neutral zone of 20 degrees dorsal extension (Fig. 3), 40 degrees palmar flexion

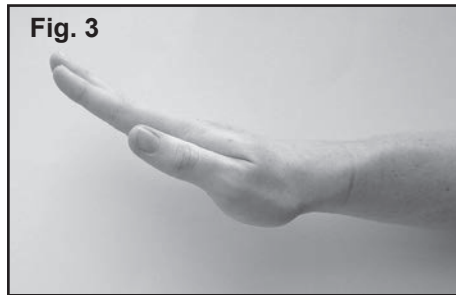


Fig. 3

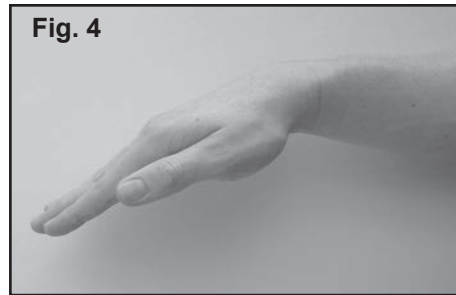


Fig. 4



Fig. 5



Fig. 6

Contouring and Curvature of Handles

The conventional wisdom on the contouring of tool handles ranges from minimal to none at all. Over-contouring of handles can actually have the opposite of the intended effect by forcing the hand into an uncomfortable position or increasing slippage. This is especially true for individuals with hand sizes outside the anthropometric averages. For the purposes of this guide, contouring should consist of gentle rounding, be used mostly for smaller tools requiring more precision and wrist movement, and should rarely exceed a radius of curvature of .5 inch. Curvature should tend towards nonexistence for larger tools requiring higher closing forces.

Rounding

In general, wherever two planes meet, a handle should be rounded. Rounding should be sufficient to avoid any "hot spot" pressure areas (more than 22 psi). This type of measuring is daunting. Grip sensor gloves are available but are costly.

Texture and Material of Grips

Some light texturing of rubber or viscoelastic handle grips is acceptable to provide sufficient friction for a good grip that will reduce and additional mus-

(Fig. 4), 15 degrees radial deviation (Fig. 5) and, and 25 degrees ulnar deviation (Fig. 6). Extreme wrist movements should not occupy more than 30% of total manipulation time.

It is important to note that over applying the principle of angling can produce a tool with too narrow of a purpose. At some point, attention must shift to the orientation of the task and workspace.

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Guideline for the Design and Selection of Powered and Non-powered Hand Tools

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cle tensioning to keep the tool in place (reduce slippage.) A texture that is too coarse, however, can cause skin and muscle damage and may actually impair operating efficiency.

Finger Grooves - Contrary to some popular misconceptions, finger grooves should be avoided in tool handles or grips. They can force the hand and wrist into uncomfortable positions. Because of the wide range of anthropometric dimensions, specifically dimensioned grooves could only accommodate a very small portion of the user population. For these reasons, they are to be avoided along with any robust contouring of the grips.

Raised Ribs and Complex Texturing - Some manufacturers think they are improving their ergonomics by introducing exaggerated ridges, but what it actually does is create pressure points and limits ease of movement. Any ridges should be cut in to, rather than protrude out from, the handle, and should be no more than 3mm in width. Subtlety is key, avoiding any areas that produce 22 psi of pressure on the skin.

Material - The material used in the grips should be of adequate cushioning to reduce stress, but of a sufficiently high degree of coefficient of friction to reduce slippage. Grip materials should be non-porous so as to resist the accumulation of dirt and grease particles. Newer materials exist that provide great cushioning with a higher coefficient of friction and should be considered on newer designs. It is important to reiterate that because familiarity is a strong component of ergonomics, changing the material on the well established designs is not recommended.

Handle Diameter
Hand Tools - There is no significant standard for the diameter of individual handles on tools. It should, however, be noted that handles that are too thin can cause pressure points on the palm of the hand that can lead to injuries. Handles should be thick enough to avoid producing more than 22 psi on

the skin and underlying joints of the fingers.

Thickness of tool handles is dictated more by the ability to achieve optimal grip span and should be of limited thickness so as to achieve the desired 2.0 - 3.5 inch span. It is important to note that wider handles allow the grip force to be distributed over a wider surface, thus reducing grip strength required for operation.

Powered Hand Tools - Handle diameter should be 1.25 - 2.0 inches, with grip, and should be of a round or oval shape. One useful rule of thumb for evaluating handle diameter is that the size should

allow the slight overlap of the thumb and fingers of a worker with relatively small hands.

Weight and Center of Gravity Hand Tools - The target weight for non-powered hand tools is 11lb. or less.

Powered Hand Tools - Since the function of the hand is generally for support and guidance, the target weight for powered hand tools is greater but should be limited to 5 lbs. Tools of higher weight, or used with sufficient frequency, should be supported with a counterbalan-

Continued on page 39



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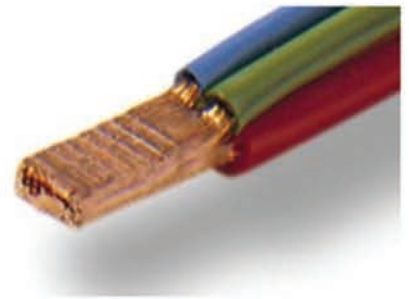
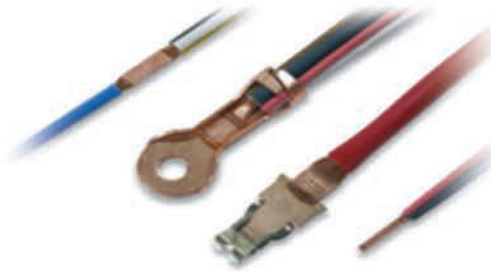
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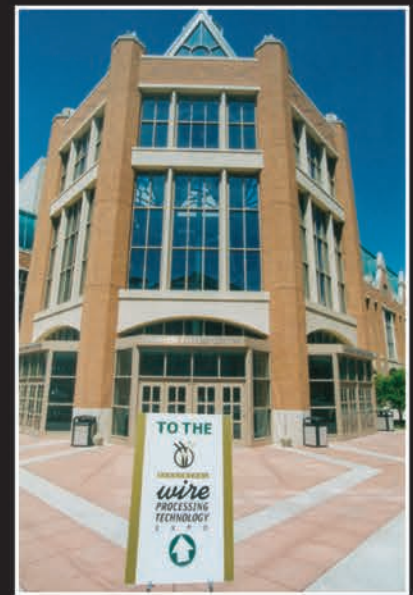
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Electrical Manufacturing & Coil Winding Expo

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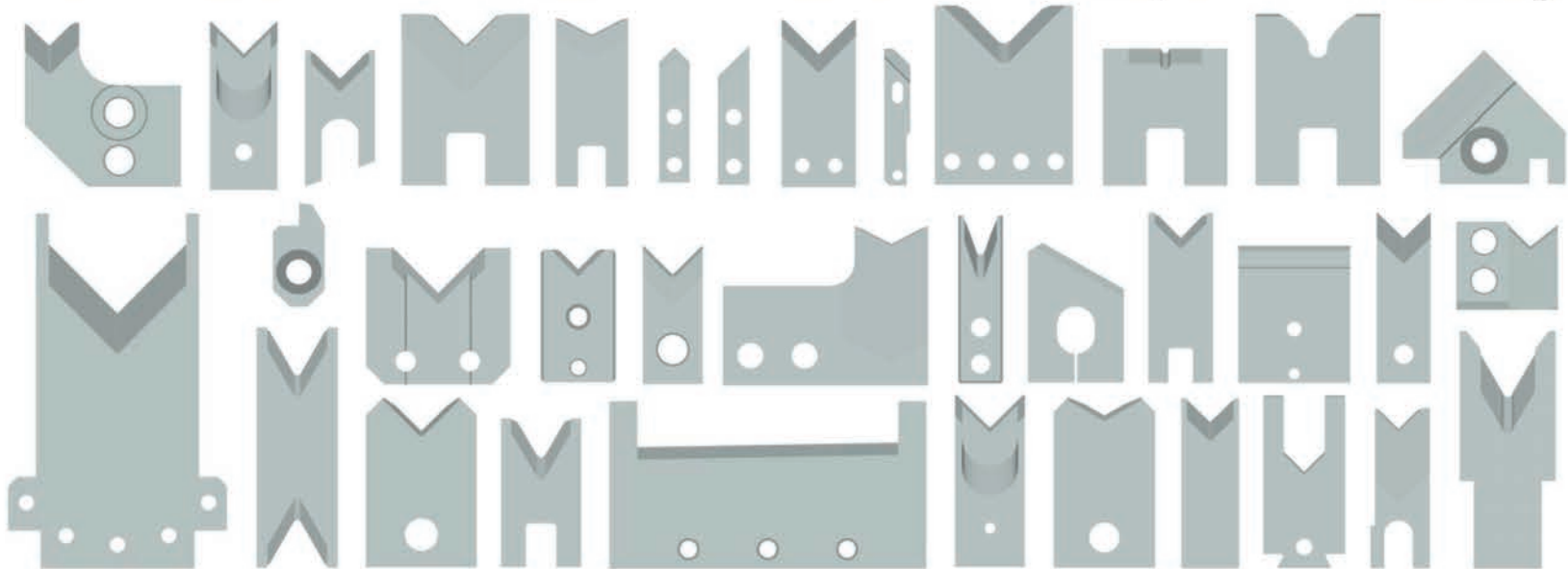
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Guideline for the Design and Selection of Powered and Non-powered Hand Tools

Continued from page 31

mechanism. Suitable load-reducing devices include arm rests, arm slings, tension reels and weight balancers.

For good stability of grip, the center of gravity for both powered and non-powered tools should be as close to the center of the hand grip as possible.

Trigger (Powered Hand Tools)

Since the thumb is the primary source of the stabilization in a hand grip, thumb triggers should be used only when necessary. It is preferable to have a strip finger trigger allowing for multiple finger actuation, rather than a single finger trigger.

Length - The trigger length should be at least 1 inch.

Span - The distance from back of hand to mid-trigger should be between 2.0 - 3.5 inches.

Force - Trigger forces should be high enough to avoid accidental activation, but low enough to avoid fatigue and stress. A suitable range is between 2.4 and 4.0 lbf.

Some Concluding Remarks on Handles

Generally speaking, with respect to handles and grips, a good indication of a functional tool is where the user can forget about the tool and concentrate on the job at hand. In this sense the tool should become "invisible". By a simple grasp, the user should have a good sense of the spatial orientation of the tool.

Tool Maintenance

It cannot be overemphasized that proper tool maintenance and adherence to recommended calibrations cycles is crucial to ensuring any tool is providing the optimum mechanical advantage.

3. Ergonomics, Aesthetics, and the Perception of Usability

The attributes outlined in previous sections can be reasonably measured to provide a fairly comprehensive quantitative analysis of any particular tool. But if ergonomics is just postulated as the anthropometric fit, half the issue is lost. Things like comfort,

tactile discrimination, and familiarity affect the overall perception of usability for any given tool. These attributes do not always correlate to the physical attributes. Some slight mechanical deficiencies might be subconsciously overlooked in favor of more subjective attributes like feel and sleekness. This "halo" effect is a very real phenomenon noted by many scholars of ergonomic theory. Entire dossiers have been compiled on the subject alone.

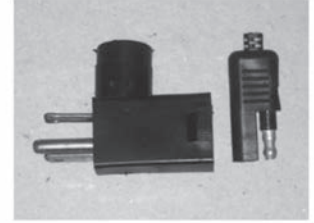
This is not to imply that aesthetics should override the physical

attributes. Reckless or trendy application of ergonomics can actually increase hand and wrist movement, and increase the possibility of repetitive injuries. Rather, aesthetics should be optimized in conjunction with the physical performance attributes of the tool to improve overall usability. Put simply, if it looks good, and feels good in the hand, the user will tend to have a better overall interaction.

To request a complete list of works cited for this report, please email me at joetito33@gmail.com.

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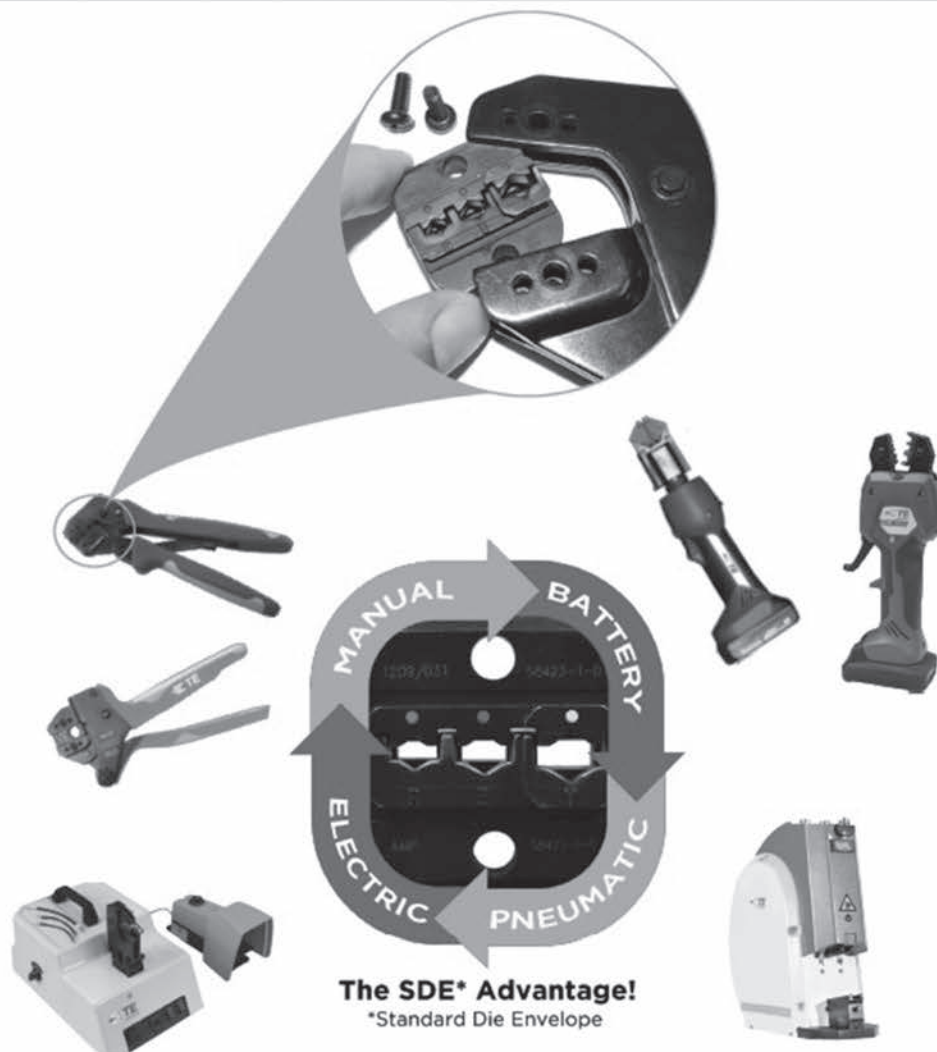
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NEWS PLUGS continued



Continued from page 18

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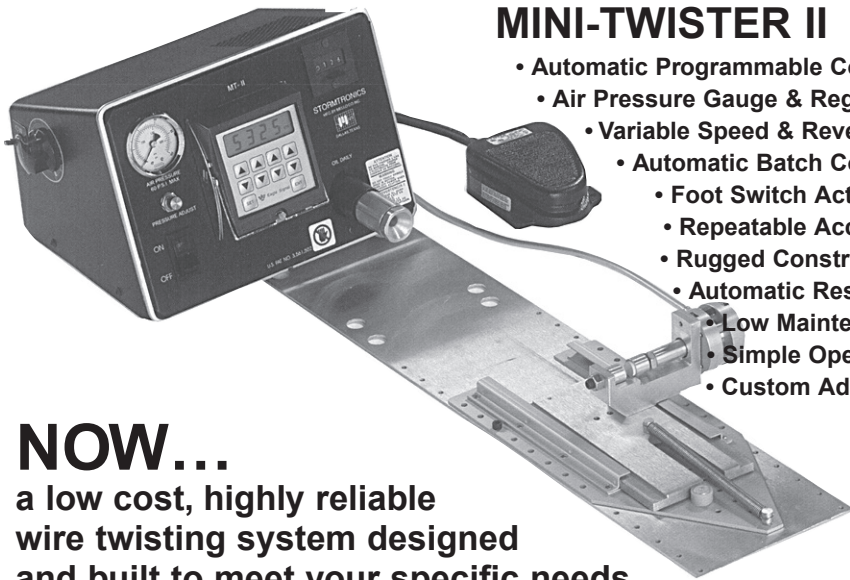
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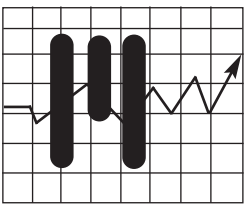
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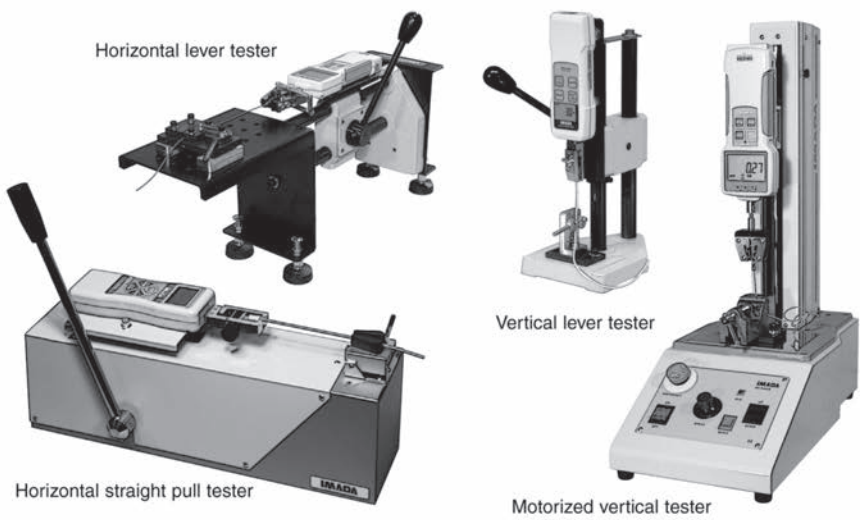
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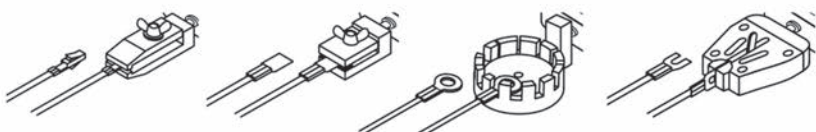
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Mando Can Do.



When Armando Zacarias goes out on a Eubanks service call, unusual things happen.

“Once I helped round up a cow that got loose in a customer’s plant.

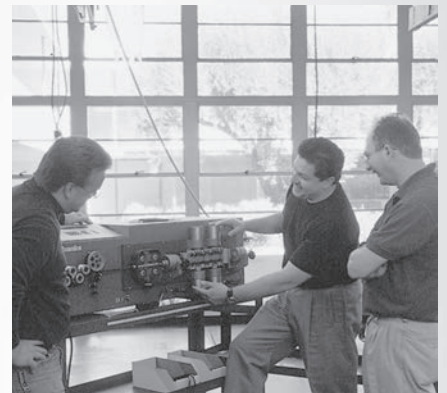
“Another time, while driving to a customer’s site, our rep’s car caught fire. We eventually arrived there that night and finished the job in time for the morning shift,” Mando reports.

Customers report something unusual too: Mando’s “can-do” attitude.

George Price, vice president of J&M Products, for example, writes how Mando takes time to answer questions, explain machine operation and even gave “tips on stripping some shielded cable that others said could not be done.”

“Can’t be done” is not in Mando’s vocabulary—either English or Spanish. On his own initiative, he solves problems, leads training classes, helps boost plant efficiencies, and makes lasting friendships while doing it.

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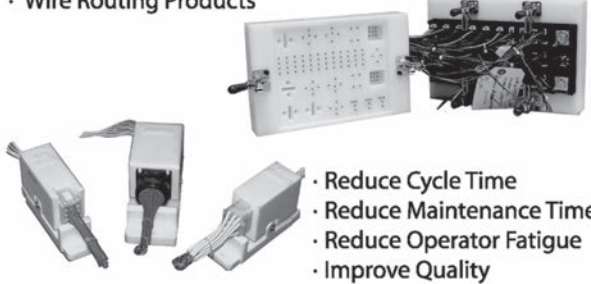
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NEWS PLUGS continued



Heilind Expands in Sensor Market with Addition of New Role

Heilind Electronics, one of the world's leading distributors of electronics components, has expanded its presence in the sensor market with the addition of Glen MacGibbon as Vice President of Business Development - Sensors.

As part of its ongoing evolution in the sensor business, leading electronics distributor Heilind Electronics has announced the hiring of Glen MacGibbon in the newly created position of Vice President of Business Development - Sensors.

Glen comes to Heilind with 27+ years in sensors, most recently as VP of Sales driving both the Industrial



Glen MacGibbon
Vice President of Business Development - Sensors

and Channel Markets for TE Connectivity -- where he was responsible for developing and growing TE Sensor Solutions. Prior to TE, he was Executive Vice President of Sales and Marketing with Measurement Specialties (before it was acquired by TE in October 2014). Glen also obtained

valuable experience through his prior positions at AMP, Pennwalt, and DuPont Electronics, and holds both a BS in Mechanical Engineering and an MBA.

In his new role, MacGibbon will report to Heilind Vice President Alan Clapp. "Glen's expertise and proven track record make him the perfect candidate to drive Heilind's sensor business. This is the next-generation connectivity that will fuel an increasing number of applications. With Glen's direction, I look forward to making Heilind the go-to distributor for sensors and other smart technology."

The addition of this new position will not only give Heilind Electronics an advantage in the growing sensor marketplace, but will also facilitate the company's overall growth and product diversity.

Founded in 1974, Heilind Electronics, Inc. (www.heilind.com/<http://www.heilindasia.com>) is one of the world's leading distributors of connectors, relays, sensors, switches, thermal management and circuit protection products, terminal blocks, wire and cable, wiring accessories, and insulation and identification products. Heilind has locations throughout the U.S., Canada, Mexico, Brazil, Germany, Singapore, Hong Kong, and China. Follow Heilind on Facebook at [facebook.com/Heilind](https://www.facebook.com/Heilind) and on Twitter at twitter.com/Heilind.

Rick Hoffman Joins MicroCare

MicroCare Corp. is pleased to announce that Mr. Rick Hoffman has joined the MicroCare team as the Eastern Regional Sales Manager. With over 30 years of industrial sales experience, he understands the cleaning needs of many industries, including wafer fab, aerospace, electronics assembly, telecommunications and medical device makers.



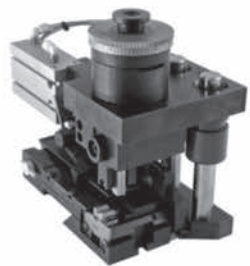
Mr. Rick Hoffman, Eastern Regional Sales Manager for MicroCare Corp

With detailed knowledge of chemical processes, vapor degreasing, coating/dispensing and water purification, Rick will use his expertise to help customers with their critical cleaning applications across the eastern portion of the USA.

APPLICATORS / CRIMPING PRESSES / TOOLING



Mini
 Left to Right



Mini (2 Post) Air
 Left to Right



Heavy Duty Slide
 Quick Change Tool Pack



NEW Mini (Power Drive Gen II)



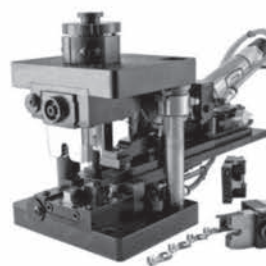
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Mini
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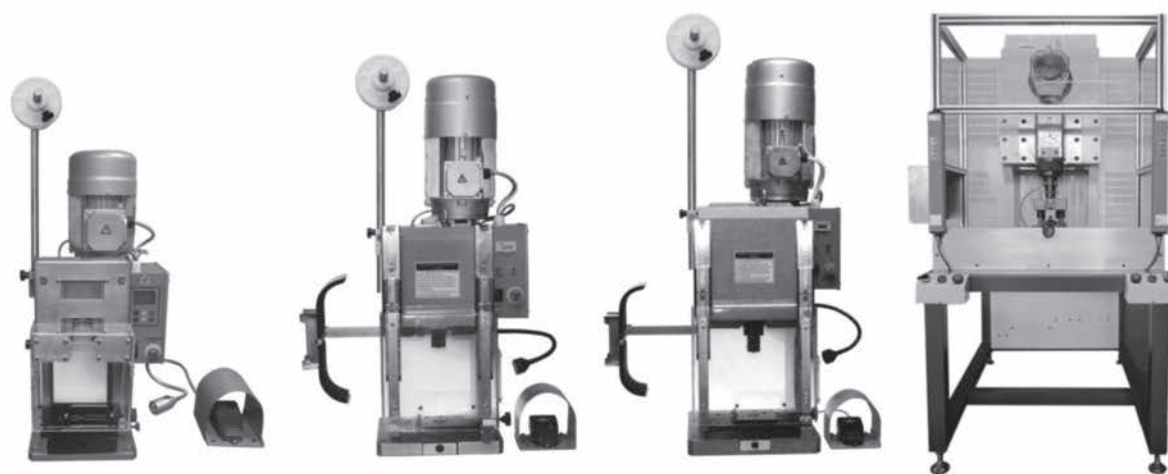


Med. Duty Air
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 Quick Change Tool Pack



Med. Duty Slide
 Quick Change Tool Pack

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Rick said; "I am truly excited to be a part of the MicroCare team and its wide market reach. It's a perfect fit with my experience, and it'll be great to help customers learn about today's best cleaning practices. I'm eager to step in and blessed to be part of a great organization."

Graduating from Bentley University (near Boston) in 1985, Rick is married and lives in the Boston area.

Specialist Harness Manufacturer Switches to Cadonix

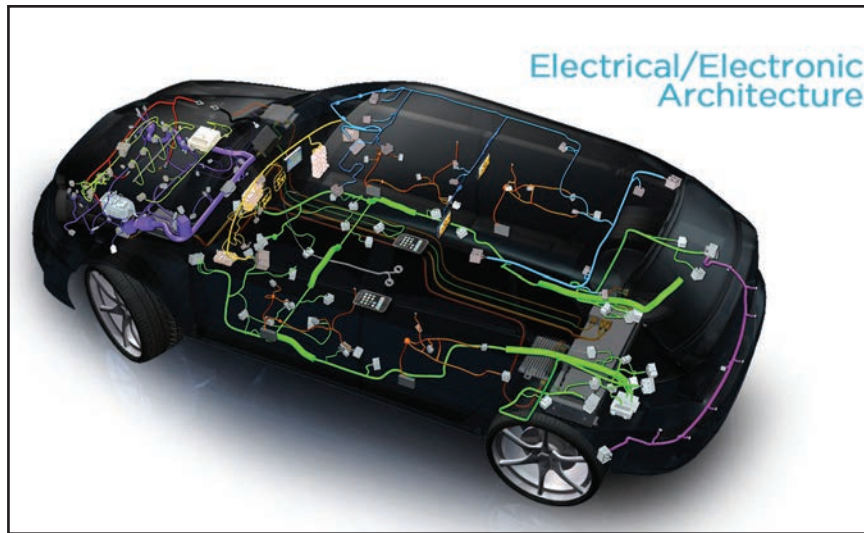
Cadonix Ltd, the cloud based automotive harness CAD specialist, named vehicle wiring harness specialist Raffenday as the latest industry leader to migrate to the Arcadia design environment.

Raffenday's Technical Director Nick Carter stated, "We've been manufacturing high quality, competitively priced wiring harnesses for over 25 years, supplying the automotive, marine and industrial markets. Having the right software tools is a major factor in our competitiveness and success. Several years ago it became clear that our existing harness design and development software package was not keeping up with fast-changing design and manufacturing techniques. Arcadia is more responsive, and its tight integration of design and manufacture enables us to work more closely with our customers."

Jon Collins, responsible for business development at Cadonix, added, "For companies like Raffenday, Arcadia offers flexibility, ease of use and compatibility with other design environments used by their customers. The feedback and cooperation we get from supportive customers like these has been crucial to Arcadia's success."

Raffenday has facilities in the UK and Slovakia. Arcadia's collaboration features are invaluable in helping them work together effectively across multiple sites. The company has adopted a local server licence, essentially giving them a private cloud solution that can be shared with customers performing their own design. Typical wiring applications go into short-run marine craft and specialist vehicles. There are frequent changes, often late in the day, and Arcadia allows Raffenday to respond quickly.

Arcadia CAD is an easy to use and innovative design environment offering schematic design, animated circuit simulation and analysis, electrical networking, harness design and full



Vehicle wiring harness specialist Raffenday is the latest industry leader to migrate to the Cardonix Arcadia design environment.

design rule checking for wire harness layout and manufacture. Using the integrated simulation capabilities, engineers can be assured that their design intent is carried through into the physical implementation. Arcadia

interfaces with the most popular 3D MCAD and enterprise wide PLM and ERP tools, allowing projects to transition easily and smoothly into manu-

Continued on page 44

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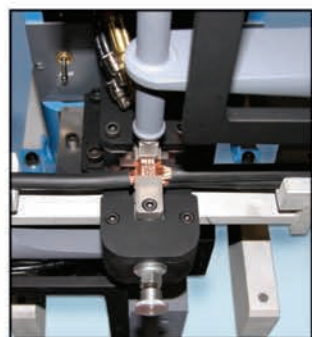
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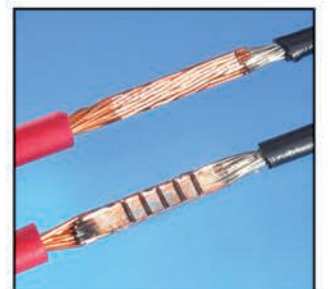
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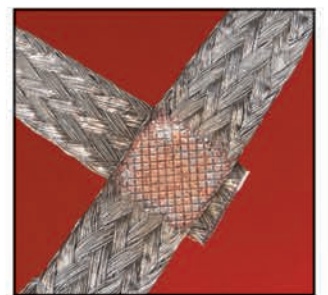
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NEWS PLUGS continued



Continued from page 43

facture. Customers can quickly import databases and designs from many legacy systems.

For further information please visit www.cadonix.com.

TLC Announces New Marketing Specialist

TLC Electronics, Inc. is pleased to announce that Chris Humting has accepted TLC Electronics' newly created position of Marketing Specialist. His new role will be effective February 1, 2016. Humting has over ten years of experience in the electronic component distribution industry specializing in product management of electronic components, most recently as a product manager for TLC.

"Chris is a seasoned product marketing professional with in-depth knowledge of digital marketing, SEO and analytics. His experience will be a welcome addition to TLC's sales and marketing efforts to strengthen the prospecting and communication efforts as we continue our aggressive growth initiatives," said Steven Olson, sales and marketing director of TLC Electronics.

Prior to TLC Electronics, Humting was a product manager for Arrow Electronics, a leading distributor of semiconductor, passive, electromechanical and interconnect



Chris Humting, TLC Electronics' Marketing Specialist

products based in Englewood, CO.

TLC Electronics, Inc., based in St. Paul, MN is one of the Midwest's largest regional value-added distributors of passive and electromechanical components and sub-assemblies for the electronics industry.

Chris can be reached at 651-558-2597 or c.humting@tlcelectronics.com.

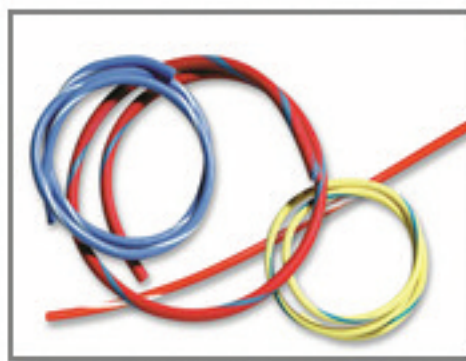
USB 3.1 and Type C: The Next Evolution of USB Cable Assemblies

Qualtek, a leading manufacturer of cable assemblies, introduces the next evolution of USB Cable Assemblies and they're a game changer. Qualtek's USB 3.1 cables along with the Type C connector allows you to charge and power your USB-C enabled device, sync and transfer data quickly and safely. With a sleek and low profile connector, this cable's minimal

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design harnesses the incredible power within. Experience up to 10 Gbps transfer speeds, up to 20X faster than USB 2.0 (480Mbps), 12x faster than FireWire 800, and 2X faster than USB 3.0 (5Gbps).

The introduction of the new symmetrical/reversible Type C to Type C cable assembly provides a user-friendly reversible design which allows the cable to be inserted into your device in either orientation or direction. The new connector is only slightly larger than the older mini and micro Type B connectors, which means that it can be used on mobile devices, replacing the existing use of mini or micro connectors.

USB 3.1 SuperSpeed+ offers a whole new level of connectivity. Advantages include:

Speed – increased data transfer rates to 10GBps, which is fast enough to carry full HD video and multichannel, uncompressed audio

Power - increased power handling capabilities to 100 watts, which means that USB C will replace existing power, video, networking, and data cables.

Connectors – USB 3.1 uses the same connector configurations as USB 3.0, plus the new reversible Type C connector, which plugs in the first time, every time!

For further information visit <http://qualtekusa.com>

Southwest Microwave Expands High-Performance Adapter Line

Southwest Microwave, Inc., a leading global supplier of high performance interconnect solutions, has added several new high-performance products to their line of precision adapters.

Additions include high-frequency within-series adapters for Southwest Microwave's 110 GHz 1.0 mm (W) connectors and 67 GHz 0.9 mm SuperMini ultra-miniature threaded coupling coaxial assemblies. Several between-series adapters have also been introduced for interface between 2.92 mm (K) and 1.85 mm (V) connectors, and between 0.9 mm SuperMini and 1.0 mm connectors.

Southwest Microwave offers a full range of commercially-priced within-series and between-series adapters with near-metrology grade performance. Produced and tested to the same criteria as adapters for calibration kits, they provide a cost-effective solution for applications that do not

specify phase matching, where previously only expensive metrology-grade adapters were used.

Designed to successfully and economically address critical production and test requirements, these adapters are ideal for use as connector savers without compromising measurement accuracy, and are approved for demanding environ-



Precision Adapters

ments such as Space or other Hi-Rel applications.

"Like all of Southwest Microwave's precision adapters, our newest offerings are designed based on transmission line principles, which enables us to deliver the superior interconnect performance that the RF and digital design communities have come to expect from our technologies," explained Holger Stuehmann, Southwest Microwave's Director of Sales.

"Expanding our adapters array to include broader interface options and to address higher frequencies means we can now satisfy an even wider scope of critical production and test applications at competitive prices."

For more information, visit www.southwestmicrowave.com

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Schleuniger Wins the 2015 Innovation Award



Receiving the 2015 Productronica Innovation Award for Schleuniger (left to right) Christoph Schüpbach, Michael Jost, Markus Walser and Beat Locher.

The CoaxCenter 6000 received the Productronica Innovation Award 2015. It is the first machine system that processes micro-coaxial cables fully-automatically and with high precision.

The Swiss Schleuniger Group celebrated a great success at the productronica 2015 trade fair in Munich, Germany. The company's CoaxCenter 6000 won the productronica Innovation Award in Cables, Coils and Hybrids Cluster prevailing against renowned competitors. The CoaxCenter 6000 is the world's first and currently the only machine system that enables micro-coaxial cables to be processed fully-automatically and with high precision. On behalf of the award panel, Christian Stoppok from the German Electrical and Electronic Manufacturers' Association (ZVEI) emphasized that the panel was particularly convinced by the innovative

combination of a maximum degree of precision, the quality monitoring, and the processing volume. Schleuniger CEO Christoph Schüpbach was extremely pleased about the prize and put this important award into a comprehensive context: "Our DNA drives us to perfect cable processing, to even better understand the current and future requirements of the industry, and respond with convincing solutions. Our CoaxCenter 6000 is just such a solution. It won the Productronica Innovation Award in representation for the entire range of Schleuniger innovations." Christoph Schüpbach is also pleased "that our employees were rewarded for their continuous and outstanding commitment."

The CoaxCenter 6000 was first presented to the public this spring at the

Continued on page 48



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Schleuniger Wins the 2015 Innovation Award

Continued from page 46

Internecon exhibition in Tokyo, where it attracted considerable interest amongst the visitors. The machine was designed to fulfill the modern communication society's increased data transfer demands in terms of data volume and data security and the resulting growing requirements on antenna components. As a result, assemblers of such cables are increasingly coming up against limits, because the required length tolerances can hardly be fulfilled using manual or semi-automatic tools. Hence, the cable ends must be checked systematically and without errors. In particular, it was important to exclude human sources of error, because even the slightest contact with the cable end can bend it and render the cable unusable.

The CoaxCenter 6000 systematically integrates and automates all the confection steps on a highly flexible machine platform. For the customer, this results in numerous benefits:

- The machine offers the highest degree of stripping accuracy of all the solutions that are currently available on the market
- Fully automatic monitoring of the stripping results using QCam 360
- Production protocol with all the relevant process parameters including 3D images

• Maximum degree of flexibility with regard to the integration of additional process steps, such as crimping, tinning, and window stripping

In addition to these technological and qualitative innovations, the CoaxCenter 6000 also achieves extremely high productivity: The output of this machine is at least three times higher than with manual and semi-automatic processes, and all this with considerably lower personnel and handling requirements and in perfect quality. The CoaxCenter 6000 will be released to the North America market in 2016.

This is the first year that the production Innovation Award was conferred. It is presented by the Productronica trade fair in cooperation with the Productronic Trade Journal. The independent award panel consisted of Professor Klaus-Dieter Lang from the Fraunhofer Institut IZM, Professor Mathias Nowotnick from the University of Rostock, Dr. Martin Oppermann from the Dresden University of Technology, Professor Lothar Pfitzner from the Fraunhofer Institut IISB, Dr. Eric Maiser from the German Engineering Federation (VDMA), and Christoph Stoppok from the Association of the Electrical Engineering and Electronics Industry (ZVEI).

More information can be found at www.schleuniger-na.com.



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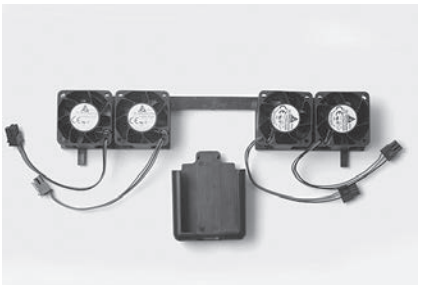
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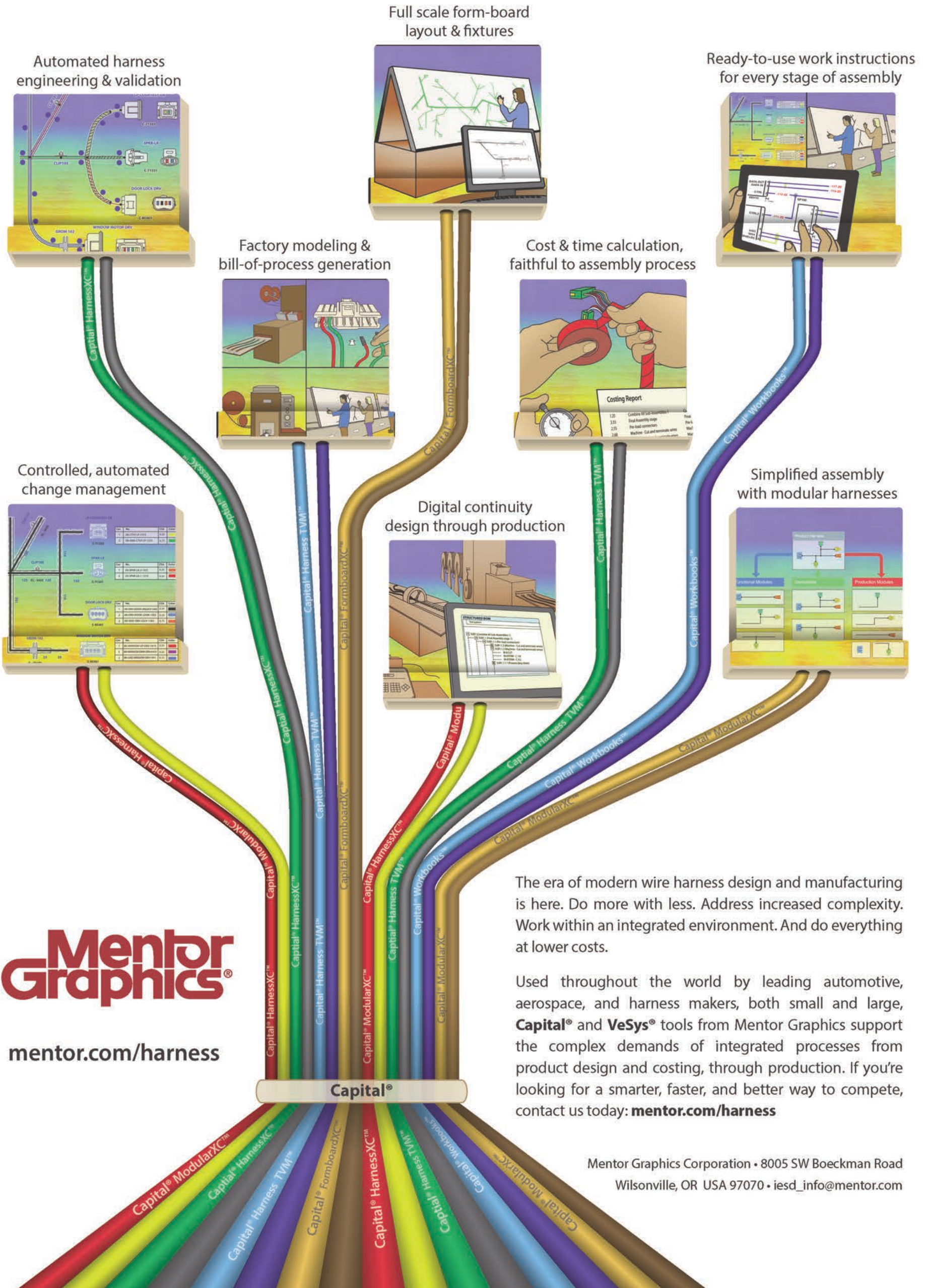
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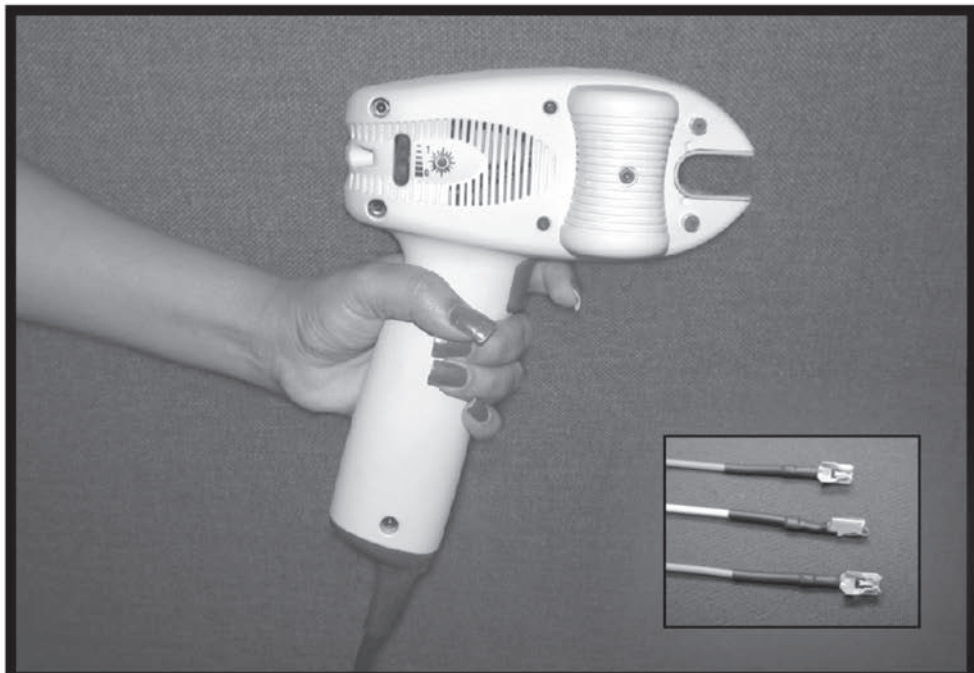


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Focus-Lite™ technology uses radiant energy to shrink heat-shrink tubing in a fraction of the time of traditional methods.

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

MINIMUM BEND RADIUS

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

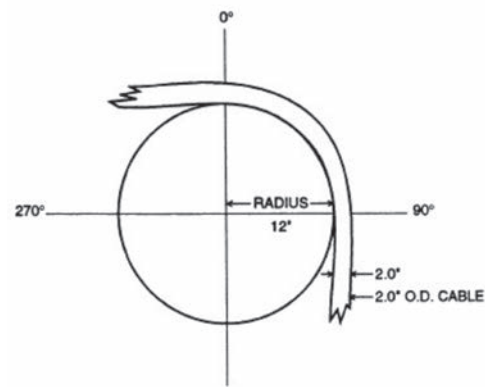


Figure 1: Minimum Bend Radius

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

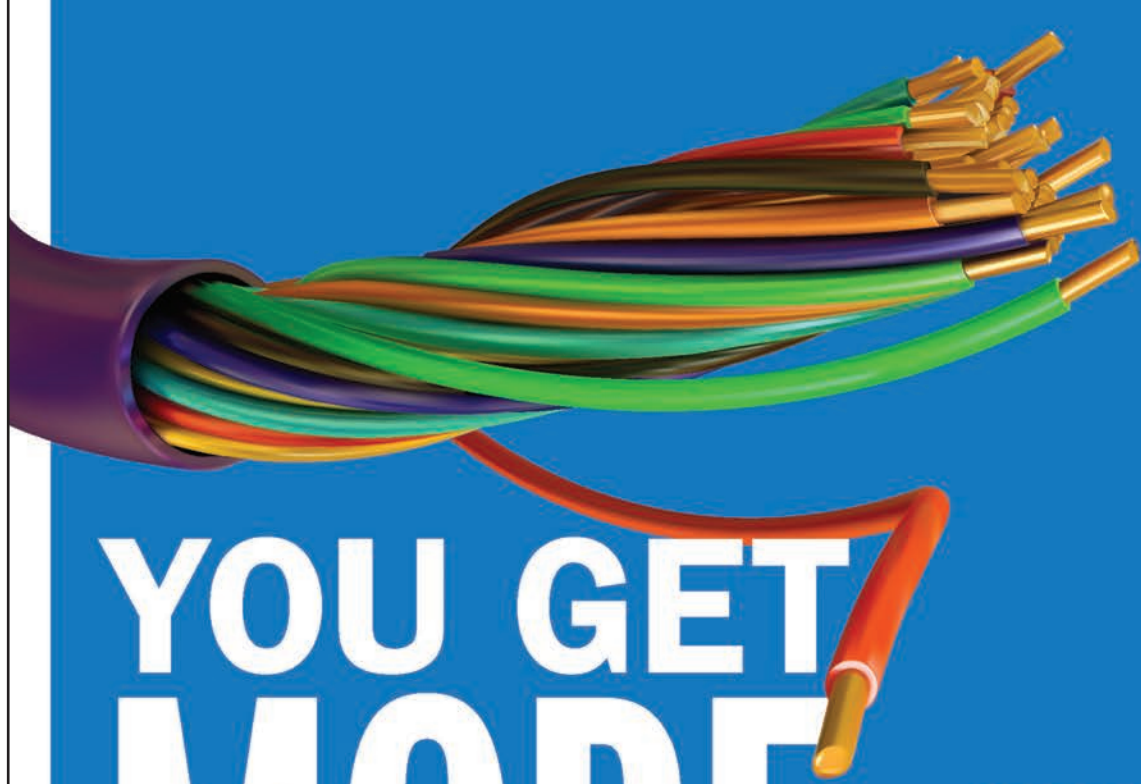
The minimum bend radius is the smallest allowed radius the cable is allowed to be bent around. Figure 1 shows a cable with an outer diameter of 2 inches being bent around a radius of 12 inches.

The minimum bend radius is based on the diameter of the cable and the type of cable. The following formula is used:

Minimum bend radius = cable outer diameter X cable multiplier

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

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Cable Type	Minimum Bend Radius as a Multiple of Overall Cable Diameter
Single or multiple conductor cables without metallic shielding, >1,000 V	Eight times the overall cable diameter ¹
Single conductor cables with shielding >1,000 V	12 times the overall cable diameter ¹
Multiconductor cables with individually shielded conductors >1,000 V	12 times the individual conductor diameter or seven times the overall cable diameter — whichever is greater ¹
Portable (mining) cables	Six times for cables rated 5000 volts or less, eight times for cables rated over 5,000 volt ²
Interlocked armor or corrugated sheath (Type MC) cables	Seven times overall cable diameter ³

¹ 2014 NEC Section 300.34 Conductor Bend Radius
² ICEA S-75-381 Portable and Power Feeder Cables for Use in Mines and Similar Applications
³ 2014 NEC Section 330.24 Bending Radius

Table 1: Cable Multipliers for Minimum Bend Radius

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

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

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

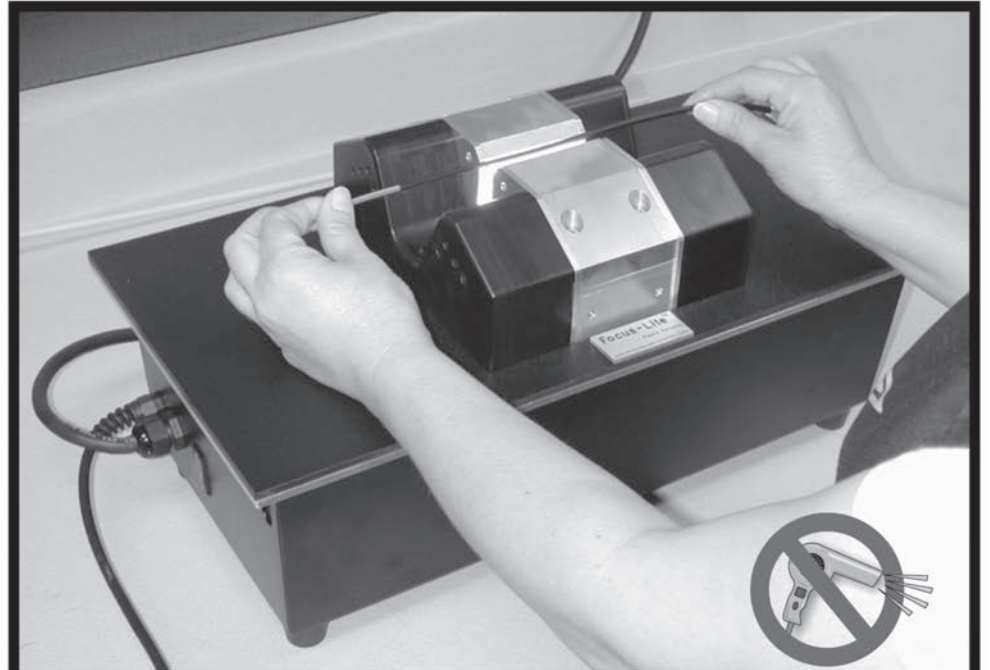


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Focus-Lite™ technology uses radiant energy to shrink heat-shrink tubing in a fraction of the time of traditional methods.

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Mentor Introduces Multi-Discipline Systems Engineering Tools For Cost & Weight Optimization in Automotive and Aerospace Markets

Mentor Graphics Corporation has announced the availability of new tools delivering integrated electrical/electronic/software systems engineering capability for the transportation market. The new Capital Systems™ tools allow implementations to be optimized for key parameters such as cost and weight. Unlike other approaches, engineers within the various disciplines do not need to understand one another's detailed syntax. This makes the new tools easy to deploy, leaving staff free to concentrate on design innovation.

Transportation platforms such as automobiles and aircraft are largely defined by their electrical/electronic systems, including embedded software. But implementation decisions, such as choosing the best processing resource for a software component, are hard to optimize because cross-discipline impacts are difficult to assess. For example, re-locating a software component may affect not only processor characteristics but also databus communications and wiring implementations. Given the scale of electrical/electronic content in modern vehicles, poor decisions can have significant impacts.

The problem can be solved by focusing on vehicle functions that will later be implemented as software, hardware, data communications, or electrical interconnect, and then assessing the impact of alternative implementations. The Capital Systems tools support functional connectivity capture, platform-level integration of those functions, and instant measurement of consequential impacts. Together they provide a complete environment to guide engineers to optimum decisions.

Luciano Lavagno, Professor of

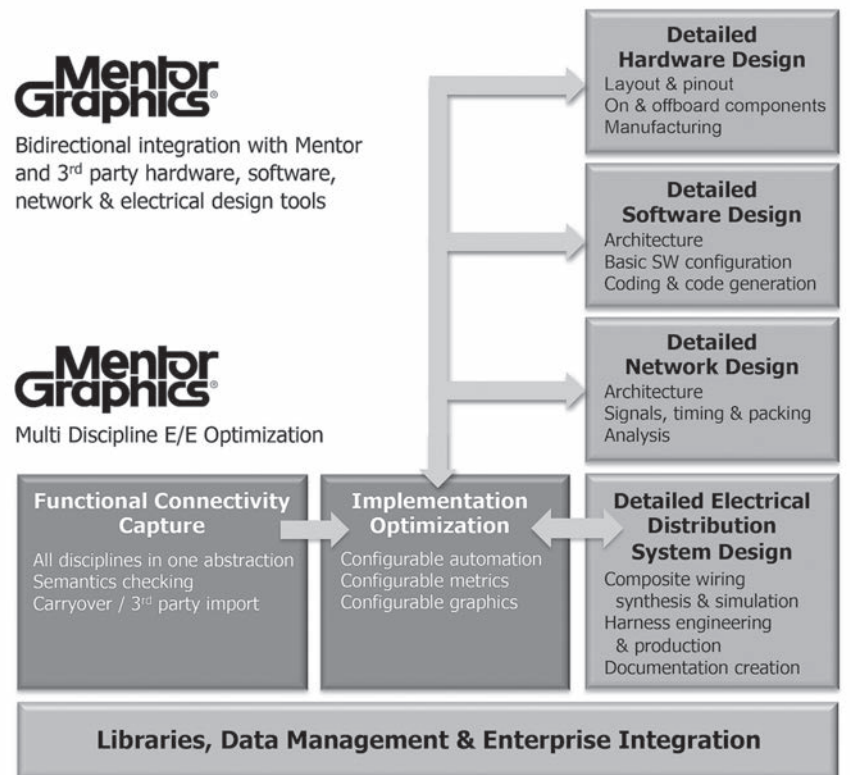
Electronics at Politecnico di Torino (Polytechnic University of Turin), who has a special research interest in hardware/software co-design, commented, "These tools are unique because they capture all high-level functionality aspects at a single abstraction level. This information is projected onto a representation of the host platform, which could be a car, an aircraft, or indeed a distributed system-of-systems. Real-time metrics immediately show engineers the effect of their decisions, allowing rapid optimization. No complex internal data mappings are needed, so the tools are ideal for fast adoption by staff responsible for system implementation decisions."

In practice new designs almost always build on data derived from previous projects. Moreover, the data describing implementation architectures must flow directly to detailed design processes within the various disciplines. For this reason the Capital Systems products provide extensive data connectivity.

Martin O'Brien, general manager of Mentor's Integrated Electrical Systems Division, said, "These tools are seamlessly integrated with Mentor's Capital electrical and Volcano network/embedded software design flows. They also support data exchange with other vendors' tools, including adjacencies such as SysML systems modeling and 3D mechanical modeling."

The Capital Systems tools are part of the successful Capital® suite, an advanced software suite for the electrical systems and wire harness domain. Used by leading automotive and aerospace OEMs and suppliers worldwide, the Capital tool is built to support the complex demands of integrated processes from initial product definition through electrical system design, harness manufacture and vehicle maintenance.

For further information contact Mentor Graphics, 8005 S.W. Boeckman Rd, Wilsonville, Oregon 97070-7777. Visit www.mentor.com



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CableEye® Quick-Change, Shielded RJ45 Adapter Board, CB18C

CAMI Research Inc. announces a new connector board for its CableEye cable and harness testing systems. Populated with eight, shielded RJ45 connectors, the boards may be used to test shielded or unshielded cables. Hipot rated to 500 Vdc/ 350 Vac, the CB18C may be used on all CableEye models.

CAMI offers the CableEye suite of Low and High Voltage products complete with accessories including connector boards. The selection of boards is constantly growing and is currently numbering over 60 – most of which are populated with ‘families’ of connectors.

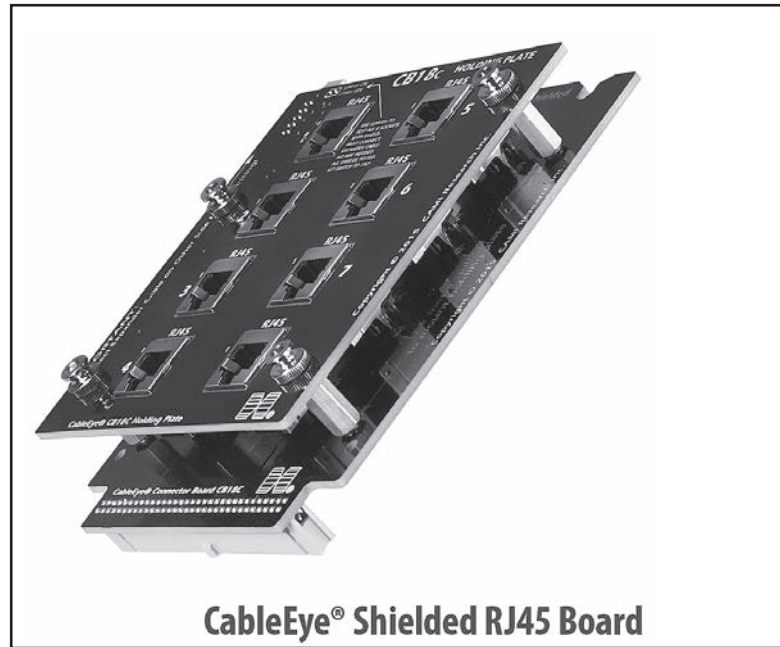
Sold as a set of two boards with expander cable, each CB18C accepts eight shielded RJ45 connectors via quick-change, press-fit connectors. The top deck provides both mechanical support and electrical connection (to the shields). The board may be used to test shielded or unshielded cables, and may be paired with other CableEye adapter boards to accommodate any combination of connectors.

The CB18C is best suited to high test-volume situations i.e. >500 cables/week. Under these conditions, the connector insertion count is high enough to quickly wear out the RJ45 mating sockets. The CB18C allows for rapid, in-house, RJ45 socket replacement, minimizing downtime, and significantly improving longevity of the test board itself. For lower production volumes, the CB18 or CB18A may be preferred.

Connector boards come with CAMI's standard, one-year warranty, renewable yearly with that of the tester for which it was purchased. The CB18C includes a kit of 16 spare industry-standard RJ45 sockets. Additional socket kits may be purchased from CAMI Research or a local distributor.

CAMI Research produces expandable and upgradable diagnostic Cable & Harness Test Systems for assembly, prototyping, production, and QC of standard or custom cables. CableEye® Testers display, and document basic electrical properties such as continuity, resistance, dielectric breakdown, insulation resistance, miswires, and intermittent defects.

For further information visit camiresearch.com



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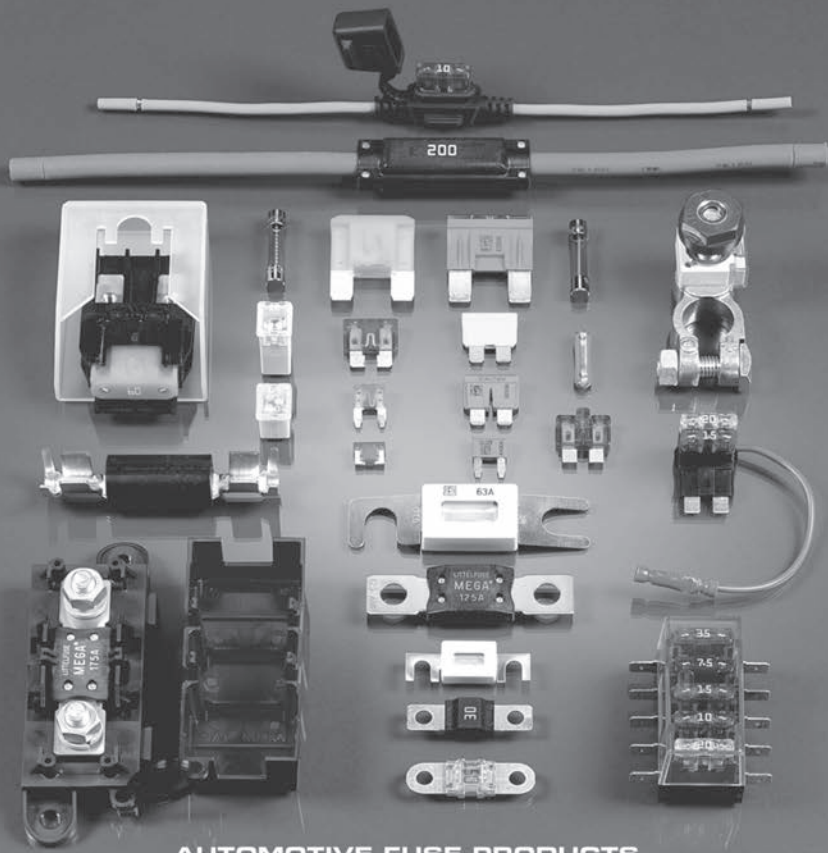
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NEWS PLUGS continued



Newly Appointed Branson Ultrasonics Vice President & General Manager Americas

Branson Ultrasonics Corporation, a business of Emerson, recently announced the appointment of Mr. Dan Douglass to Vice President & General Manager, Americas. In his new role, Mr. Douglass will have responsibility for overseeing the America's operations of Branson Ultrasonics, a global leader in customer focused solutions for plastic joining, ultrasonic metal joining and precision processing.

Dan Douglass will be replacing Bob Tibbetts who will be retiring effective



Dan Douglass to Vice President & General Manager, Americas

March 31, 2016, after more than 26 years of distinguished service with Emerson.

Joe Dillon, President of Branson states, "Branson has been extremely successful under the leadership of Bob Tibbetts and he has contributed to over a decade of the America's success. We are appreciative to Bob for his many years of dedicated service. Under Dan's leadership Branson will be positioned to support our customers, where ever they operate, with our industry leading expertise. I am confident that Dan is the correct person to lead the America's team moving forward."

Dan joined Emerson, St. Louis in 2004 in the Supply Chain Group. He later relocated to the Appleton Group as a part of the Marketing and Business Development team. Most recently he held the position of Vice President of Business Development and was responsible for Appleton's global growth initiatives.

Commenting about his new responsibilities, Mr. Douglass states, "This is a great business and I am excited to have the opportunity to help Branson to continue to grow in the Americas. The Branson team has a relentless drive for customer satisfaction and product innovation; because of this we have been able to maintain the leadership position in the markets we serve. In short, we will continue to provide customers with the same value, quality and innovation that they have become accustomed to from Branson."

For further information visit www.BransonUltrasonics.com

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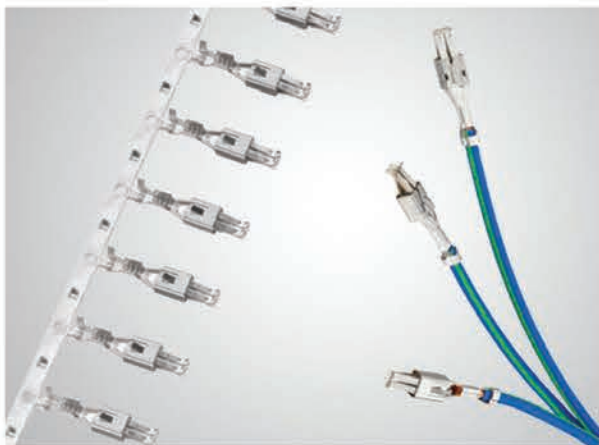
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NEWS PLUGS **continued**
Schleuniger, Inc. to Demonstrate Latest Cut & Strip Machine at IPC APEX Expo

Schleuniger, Inc., a leading international manufacturer of high-precision wire processing machines, will demonstrate select equipment from its comprehensive line of wire processing products at the 2016 IPC APEX EXPO.

The conference and exhibition will be held at the Las Vegas Convention Center in Las Vegas, NV on March 13 -17, 2016 and will include over 400 exhibitors showing advanced and emerging technologies in printed board design and manufacturing, printed electronics and electronics assembly, test and inspection. Schleuniger will be at booth #1157 providing hands-on demonstrations of innovative wire processing solutions.

At the exhibition, Schleuniger will debut its newest cut and strip machine, the EcoStrip 9380. The EcoStrip 9380 offers the most complete feature set at an economical price point. This flexible machine provides expanded capabilities due to its quick change transport unit for belts, rollers and shortmode and is compatible with a wide range of accessories, including prefeeding, marking, stacking and coiling. The intuitive color touchscreen user interface minimizes training and set-up times and with optional Schleuniger software, the EcoStrip 9380 can easily be integrated into various networks.

Also new this year, Schleuniger will demonstrate the new economical UniCrimp 100 crimping press. The UniCrimp 100 is a benchtop crimping machine that delivers up to two tons of force. The safety guards can be completely opened to allow easy access to the working area along with simple, fast changeover, adjustment and set-up times. The UniCrimp 100 accepts most applicators on the market and provides quality crimping for wires up to 6 mm² (10 AWG).

Schleuniger will also showcase the new ShieldCut 8100. The ShieldCut 8100 can safely and quickly cut and remove the braided shield layer from most shielded cables, eliminating countless hours of manual labor. As the only machine of its kind, the ShieldCut 8100 fills a current market need for efficient processing of shielded cables.

Once again, Schleuniger will provide demonstrations of the versatile MultiStrip 9480 cut and strip machine. Schleuniger debuted this machine at the 2015 IPC APEX Expo receiving high interest from attendees. The machine's high resolution indexing cutter head and programmable rotary incision capability set the benchmark for high precision processing of coaxial and other shielded cables. The MultiStrip 9480 family offers five machine versions to meet your specific production needs. With many additional options and accessories, the MultiStrip 9480 can handle a nearly endless range of applications.

Other popular machines that will be part of the exhibition include the UniStrip 2300, UniStrip 2550, UniStrip 2600 and RotaryStrip 2400 programmable wire strip-



MultiStrip 9480 Cut & Strip Machine

ping machines and the CoaxStrip 5200 coaxial cable stripping machine. As always Schleuniger's wire processing experts will be on hand to review your wire samples and help you find the right equipment for your specific applications.

In addition to participating in the exhibition, Schleuniger's Senior Product Manager, Rob Boyd, will participate in a Buzz Session Panel on the IPC/WHMA-A-620 Cable and Wire Harness workmanship standard.

This session will overview changes for Revision C of IPC/WHMA 620 (Requirements and Acceptance for Cable and

Wire Harness Assemblies) which is due to be released shortly. It will discuss the reasons to use this standard and how wire harness process equipment companies are incorporating this standard into the function of their equipment in order to meet the standard requirements. The session will be held Thursday, March 17, 2016 from 10:30 a.m. – 12:00 p.m. and is free to all APEX attendees.

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

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Newark element14 to Distribute Autodesk MCAD Software Solutions

Newark element14 announces the launch of a new partnership with Autodesk. This will expand the company's product offering to include mechanical design software in addition to its robust portfolio of embedded, test and EDA design software. The partnership will initially focus on six product lines, including Autodesk Fusion 360, AutoCAD LT and more. In addition, through technology collaboration formed between CadSoft, developers of the EAGLE PCB design software, and Autodesk, Newark element14 will also offer an integrated and comprehensive ECAD-MCAD Design Suite.

Autodesk Fusion 360 brings CAD, CAE and CAM together in the cloud. The integrated, connected and accessible platform allows users to take a design from concept to physical product. In addition, Autodesk has collaborated with CadSoft Computer to create a seamless electronic-to-mechanical integration between EAGLE and Fusion360, greatly simplifying the design work-flow from ECAD to MCAD. Newark element14 will offer Fusion360 an individual product and as part of an exclusive Product Design Suite, which also includes EAGLE Pro from CadSoft Computer and EAGLE's IDF-to-3D service.

"Our new partnership with Autodesk strengthens Newark element14's portfolio of professional engineering software and solidifies our position as the destination for engineering software for electronics and industrial engineers alike," said David Shen, Chief Technology Officer, Premier Farnell. "As one of the most trusted CAD tool providers in the world for all engineering disciplines, Autodesk's products complement Newark element14's existing capabilities and offerings and will also present new mechanical design opportunities for members of our element14 Community."

The full range of Autodesk products that will be available from Newark element14 include:

Fusion 360: Fusion 360 brings CAD, CAM and CAE together to provide an end-to-end product development process in a single cloud-based platform.

ECAD-MCAD Design Suite: 1 year of Fusion 360, EAGLE Pro from CadSoft Computer, and EAGLE's IDF-to-3D service integrated together to provide innovative designers a single, cohesive solution which greatly simplifies the design workflow.

AutoCAD LT: Autodesk's widely-used AutoCAD LT is a design platform technology that allows mechanical design engineers to create and share precise 2D drawings more efficiently.

AutoCAD Electrical: Part of Autodesk's Digital Prototyping solution, AutoCAD Electrical provides electrical engineers and electricians with electrical CAD design features in a familiar AutoCAD environment.

Autodesk Inventor: 3D CAD software for modeling and simulation of designs using freeform, direct and parametric modeling tools.

AutoCAD Inventor LT Suite: Bundles AutoCAD LT and Inventor to provide users with more design flexibility.

"Autodesk is teaming with Premier Farnell to deliver the software that designers and engineers need to adapt to the emerging future of making things," said Stephen Hooper, Autodesk's senior director for manufacturing industry strategy, Autodesk. "The growth of electronics embedded in end products continues to accelerate, with electronics and PCB design increasingly becoming pivotal within the broader product design workflow. The integration of EAGLE directly into Fusion 360 will give innovative designers a single, cohesive ECAD-MCAD product design solution which greatly simplifies the design workflow. Together, we are making these design solutions available to the broader engineering community and providing comprehensive support through Premier Farnell's sales channels and technical knowledge centers."

The range of Autodesk products will enhance Newark element14's portfolio of embedded, PCB and mechanical software available on the element14 Design Center. All of the main categories of design software are available through the element14 Design Center: integrated development environments & compilers, operating systems and middleware, EDA software, mechanical design software and test & simulation software. What's more, the Design Center provides customers with a streamlined software selection and purchasing experience with free software trials and multiple delivery options, including instantaneous eDelivery.

For more information, visit: <http://www.element14.com/community/docs/DOC-79277>

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NEWS PLUGS continued**Improving Gun Safety with Force Measurement**

In an effort to reduce the incidence of accidental gun discharge, The New York City Police Department (NYPD) has been modifying their standard, off-the-shelf firearms to require a greater amount of force to activate the trigger.

Following any shooting incident, the weapon is immediately sent to NYPD's Firearms Laboratory for a battery of tests. Among those tests, the trigger pull force was traditionally assessed by hanging a known weight from a gun trigger, while holding the gun body by hand in an upright orientation. If the trigger did not "click", the firearm was considered acceptable. Although simple, this method

was prone to inconsistencies and variations amongst the lab's personnel.

Mark-10 was called upon to develop a custom solution for this problem. Our engineers worked closely with the NYPD to design and produce a customized firearm test stand for NYPD's evaluation.

The test stand accommodates a variety of gun types and sizes, and measures trigger forces in a controlled manner. The test results are now more repeatable, can be transmitted to a PC for a more detailed view with statistics instead of a simple pass/fail indication.



Trigger Pull Force Stand

Through trigger pull force testing, an extra bit of gun safety is introduced into one of the world's busiest police departments, helping avoid unintended discharge, and saving lives in the process.

For further information contact Mark-10 Corporation, 11 Dixon Avenue, Copiague, NY 11726. Phone (631) 842-9200 or Fax (631) 842-9201. Visit www.mark-10.com or email info@mark10.com

Nordson ASYMTEK Receives 2015 Global Technology Award for Programmable Tilt + Rotate 5-Axis Fluid Dispenser

Nordson ASYMTEK, a Nordson company, a global leader in dispensing, jetting, and coating equipment and technologies, has been honored with the 2015 Global Technology Award in the dispensing category for its Programmable Tilt + Rotate 5-Axis Fluid Dispenser. The award was presented at the Productronica expo, in Munich, Germany on November 10, 2015.

Nordson ASYMTEK's innovative Tilt + Rotate dispenser enables precise jet dispensing with five axes of automated control instead of the usual three X, Y, and Z axes. The addition of tilt modes from a vertical position in either X or Y axis, enables jetting at varying angles, along all sides of a device, and up the side of a substrate. It has been tested in densely populated PCBs and semiconductor packages as well as 3D stacked die packages. Tilt + Rotate enables unprecedented speed, accuracy, and quality for precision underfilling of stacked die, delivering high throughput for volume production. The jet dispenses very thin lines, into tight corners and gaps, and around tall components, and using the tilt mode, the jet dispenses up to an industry-leading $\pm 30^\circ$ with 1° resolution.

According to Global SMT & Packaging editor-in-chief Trevor Galbraith, "It is a very big deal to receive such an honor, especially when this year we received more entries than in the past year for each category. Your entry was more than just one of the products entered, yours had one of the biggest impacts on the electronics industry in 2014-2015."

The award was open to equipment, materials, and EMS companies of all sizes. Entries were judged on innovation, speed/throughput improvements, quality contribution, cost benefits, environmental consideration, ease of use/implementation, and maintainability/repairability.

"It is very exciting and affirming to win this award,"



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Garrett Wong (left) accepts award from Trevor Galbraith.

said Garrett Wong, product manager for Nordson ASYMTEK. "The Tilt+Rotate is one of several new jetting features that Nordson ASYMTEK released this year that was shown at Productronica. We thank Global SMT & Packaging for this recognition."

The Global Technology Awards are sponsored by Global SMT & Packaging magazine, a Trafalgar publication, and judged by an independent panel of international industry experts. For information visit www.nordsonasymtek.com.

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



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NEWS PLUGS continued


CAMI Research Expands Distributorship Network

CAMI Research Inc. (Acton, MA) has appointed two new distributors for its CableEye cable and harness testing systems. Semicon (Poland & Eastern Europe), and LK Hitech (Korea) bring the number of global distributors to twenty.

A leader in development of PC-based Cable & Wire Harness Test Systems for over 20 years, CAMI offers the CableEye suite of Low and High Voltage (HiPot) products. Both Semicon and LK Hitech sought out their distributorships having been impressed with the quality, versatility, and ease of use of the testers.



CableEye® Cable & Harness Testers

CAMI is also seeking a distributor in Spain with experience in sales, promotion, & distribution of electronic test equipment.

For further information, please contact info@camiresearch.com or (978) 266-2655

BURNDY® Announces Expansion of UNIRAP™ Cable Tie Mounting Bases

BURNDY®, a leading manufacturer and provider of connector solutions to the industrial, energy, construction, telecommunication, petrochemical, data center, and transportation industries, announces the expansion of our nylon mounting bases.

Mounting bases are an effective, versatile, and durable wire management mounting product for routing and securing wires and cables in place. These

mounting bases are easy to install and are available in a variety of styles to attach to the mounting surface.

The mounting bases are square with rubber or acrylic adhesive, and/or 1, 2, or 4 screw holes for mounting depending on the design.

Acrylic adhesive is recommended for applications requiring more adhesive strength and in high temperature environments. Additionally, acrylic adhesive bases are more durable and suitable for mounting on plastics and metals producing a secure bond between oily and/or contaminated surfaces.

All the mounting bases are available in Natural or UV Black color.

Mounting bases are used in conjunction with cable ties to stabilize and secure wire bundles. The bases not only improve aesthetics, but are suitable for both indoor and outdoor applications.

Mounting bases provide a quick, economical, and dependable solution for supporting, routing, and protecting wires or cables.

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Wardwell Harness Braiding Machine



The Wardwell Harness Braider is the ideal machine for over braiding on harnesses. It works equally well with wire materials or with textile and synthetic threads. The improvements to this type of standard machine include: a motor driven capstan take-up for accurate coverage of the harness, a new tubular frame, a self lubricating horn gear, a new operator station and sound reduction, among many others.

Technical Features

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Applied DNA Sciences to Protect the Infrastructure of One of Europe's Leading Electricity Providers

Applied DNA Sciences, Inc. a provider of DNA-based supply-chain, anti-counterfeiting and anti-theft technology, product genotyping and product authentication solutions, announced that it has been awarded a contract to provide its increasingly popular metal marking product to one of Europe's leading electricity providers. The contract, which has recently been signed by one of the company's key distributors of security products, is for a period of two years with an option to extend for a third year and is estimated to be valued at between \$130,000 and \$260,000 per annum.

Applied DNA's technology can protect vital grid infrastructure from damage by copper thieves, a global concern to all managers of train and power distribution systems. The solution provided by Applied DNA and the key distributor combines the latest available technology to protect metal from theft with a very easy and quick application method to reduce costs for the client. A unique and permanent DNA mark is applied to the metal, which forever associates the specific copper directly to a specific crime. Use of the same product in similar industries has resulted in the reduction of security incidents by over 80%.

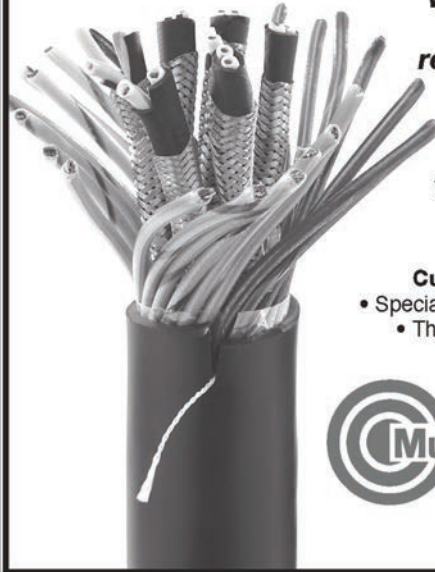
Commenting on the contract, Tony Benson, Managing Director for Applied DNA Sciences Europe, said, "As news of our products grows across Europe, I expect to be awarded more contracts in the future. This particular product is designed to make it easy and quick for clients to deploy saving them time and money, which is important for them. We believe they are using the very best technological solution available to them."

Applied DNA Sciences' Security and Asset Marking applications continue to gain momentum as a unique solution to combat crimes using innovative technologies and forensic authentication methods to convict criminals and deter the crime from occurring in the first place.

Applied DNA Sciences makes life real and safe by providing botanical-DNA based security and authentication solutions and services that can help protect products, brands, entire supply chains, and intellectual property of companies, governments and

consumers from theft, counterfeiting, fraud and diversion. SigNature® DNA describes the platform ingredient that is at the heart of all of our security and authentication solutions. SigNature DNA is at the core of a family of uncopyable products such as DNAnet®, our anti-theft product, SigNature® T, targeted toward textiles, and digitalDNA®, providing powerful track and trace. All provide a forensic chain of evidence and can be used to prosecute perpetrators. We are also engaged in the large-scale production of specific DNA sequences using the polymerase chain reaction. Applied DNA Sciences common stock is listed on NASDAQ under the symbol APDN, and its warrants are listed under the symbol APDNW.

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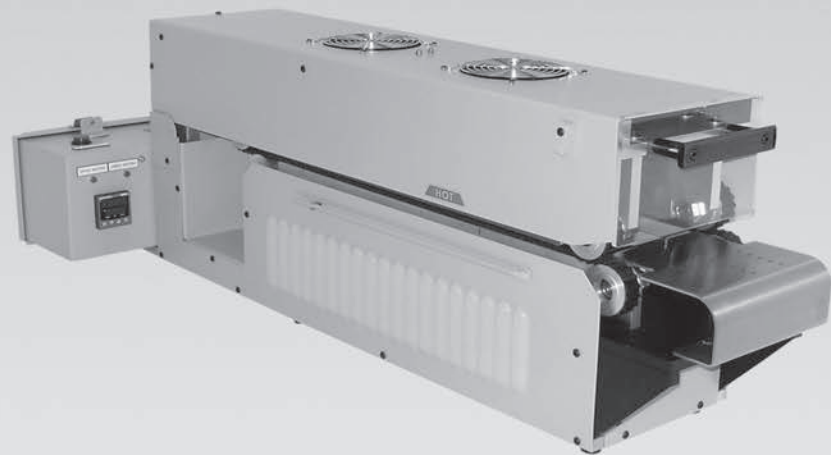
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Belt Heater for Heat-Shrinkable Tubing Products

Product Facts:

- Closed-loop speed and temperature control
- Continuous controlled process
- Adaptable for different applications
- Heater operation and over-temperature alarm lights
- Benchtop Design



RAYCHEM MODEL 16B TABLETOP BELT HEATER

Applications

The Model 16B is our smallest (tabletop) conveyor type processor which provides a controlled process for a wide variety of heat-shrinkable tubing products.

Double-sided timing belts on the top and bottom of the processing chamber draw the assemblies through a thermally controlled infrared heat zone and then through a fan-cooled cooling zone before depositing them into the unloading bin.

Controlled Heating Zone

The Model 16B processor has two stamped foil heating elements that are manufactured to a strict wattage specification. Consistent temperatures (ambient to 650° C) are controlled by a thermocouple embedded into the upper heating element connected to a closedloop temperature controller. An alarm light illuminates whenever the actual heating element temperature varies from the set point temperature.

Speed Control

The belt speed is selected using a 3-digit thumbwheel via a closed-loop motor controller and DC gear motor.

Minimal Skill Requirements

There are clearly marked guides for aligning the assembly as well as the tubing or device. The operator only has to center the assembly then the tubing and slide it into the belts. The belts carry the assembly through the heating and cooling zone, depositing them into the bin.

Labor costs are reduced significantly because once an operator loads an assembly, that operator can begin preparing another assembly. The throughput rate is usually limited by the rate at which the operator can load assemblies into the process.

Versatility

The processor is designed to process a broad range of heat-shrinkable products up to 19 mm [0.75"] in diameter and 90 mm [3.5"] in length. Heat output can be controlled to accommodate a wide variety of products and substrates.



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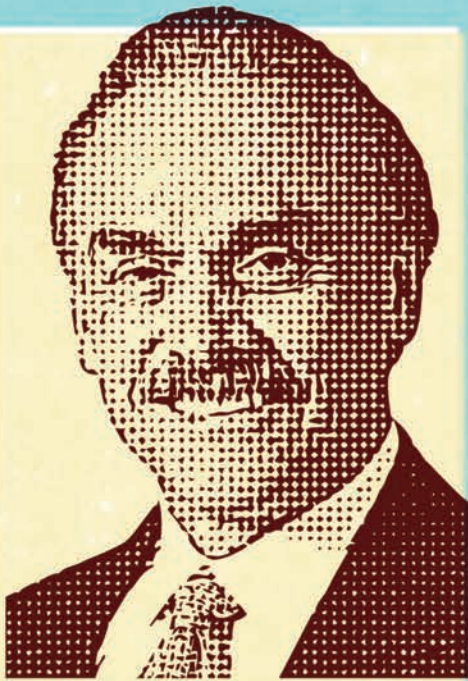
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