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Additive Manufacturing
with Better Build Plate
Resurfacing**

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We've taken a slightly different approach this month. We've got two guest writers who have penned incredibly interesting pieces on different, well, pieces of the manufacturing industry.

The first is an article written by Del Williams who has graced these pages in the past. This time around he's put the focus on metal additive manufacturing to aid in the advancement of improved build plate resurfacing. There's a combination of things at play here, and Del does a magnificent job of tying all the different variables together through the working guise of an actual case study. Don't miss out.

The second feature this month comes to us from Paul Critchley who reached out hoping to start a column in the Gateway Mag, and, if this first article is any indication of his storytelling prowess, we just need to oblige. Paul is a thought leader in the space of lean manufacturing, which is something we're all faced with, whether by design, or forced, in today's economy. We found his take on whether or not the principles of lean manufacturing belong or apply to job shops, which is, quite frankly, how a lot of us define our operations. Check out Paul's piece and let us know what you think.

Something we're running into while soliciting spotlight articles from our network is the regular feedback of, "sorry guys, we're just too busy with what work we do have and don't want to bring in any further leads into the mix." While we can appreciate that, it's never a bad thing to have folks knocking on the door. Job cycles are long across the board and some prospective customers just want to get their place in line. Keep that in mind. On the flipside, we're in need of topics to cover in the pages of the magazine, so if you have ideas of your own and would like to contribute, take this issue as an example of what you can do. The options are limitless, and, as always, we're all ears.

Kind regards,



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MAGAZINE

PUBLICATION MANAGER

Matthias Roberge

EDITORIAL DIRECTOR

Chris Hislop

ART DIRECTOR

Adam Kaufmann

SOCIAL MEDIA

Eileen Gillis

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STREAMLINING METAL
ADDITIVE MANUFACTURING
WITH BETTER BUILD PLATE
RESURFACING

Advanced rotary surface grinders enable efficient, precise resurfacing of the build plate, improving productivity and quality

This month's industry spotlight is brought to us by Del Williams, a technical writer based in Torrance, California. He submitted this interesting piece on surface grinding which we felt could be of interest to our readership. If you've got an interesting story that you'd like to share, please submit it for potential placement in the pages of the Gateway Magazine!

Industries like aerospace and automotive are increasingly relying on metal Additive Manufacturing (AM) to expeditiously create weight-saving components with complex geometries, different material properties, and minimal setup times. To construct each part, advanced 3D printers melt, or partially melt, ultra-fine layers of metal powder on build plates. After each metal part is finished, it is cut from the build plate.

However, one production bottleneck in AM is that any residual metal must be entirely removed before the build plate can be re-used. This requires precisely resurfacing the build plate so that is completely flat, level, and correctly textured prior to printing the next part. Unfortunately, traditional methods of accomplishing this task have significant drawbacks and have become a production bottleneck.

Enter advanced precision rotary surface grinders, which have long been used in metalworking and glass grinding to create perfectly flat, parallel surfaces. The equipment is ideally suited to the AM process and quickly and accurately removes any residual metal from the build plate surface, restoring it to precise dimensions.



The most advanced units even offer automation that allows minimally experienced operators to set them up and then attend to other tasks. This comprehensive approach is helping to exponentially speed build plate resurfacing, boost AM production, and improve quality.

“With advanced rotary surface grinders, our AM build plate resurfacing process is significantly more efficient, precise, and flexible. Incorporating the units in our process will help us handle high expected growth in the AM market,” says Doug Hedges, Chief Technology Officer of Deerfield Beach, FL based Beehive3D, Inc., an additive manufacturing provider for industries such as aerospace, defense, and turbine technologies. The AM contact manufacturer currently has five U.S. locations and is expanding nationally.

According to Hedges, it is critical in Beehive3D’s laser powder bed fusion process to resurface the build plate to precise process tolerances prior to re-use. “Not only do you have remnants of metal on the build plate, but also portions of the build plate can become bowed or distorted so it needs to be resurfaced after each use to keep it flat and parallel,” says Hedges.

Since the metal part is essentially “welded” to the build plate, it is typically cut off with electrical discharge machining (EDM) wire or a bandsaw. However, both approaches involve removing a thin layer of the build plate surface, gradually reducing its thickness until it is no longer usable. Most of the cuts are not entirely flat or level, either.

The alternative is to cut close to the part, but this leaves material that must be removed later. With EDM and bandsaws, the process can take hours and hard materials like Inconel tend to strain-harden, increasing the difficulty further. Some shops even address the issue with a CNC milling machine, but this can also take hours and limit the availability of the equipment for actual production. Exceptionally hard AM materials like Inconel and titanium further lengthen the required milling time.

A more efficient alternative utilizes advanced precision rotary surface grinders to remove unwanted residual material with a large rotary grinding wheel surface.

“The goal is to remove just the residual AM part material and as little of the building plate as possible while providing necessary resurfacing of the build plate,” says Erik Lawson, Engineering Manager at Winona, MN-based DCM Tech, a designer and builder of industrial rotary surface grinders.

Today, surface grinders are designed with much more advanced sensors and controls that automatically maintain very tight tolerances, removing material down to within one ten-thousandth of an inch of the final thickness. The equipment can achieve tighter dimensional tolerances, flatness, parallelism, and surface finish on build plates in much less time than other methods. The process eliminates variability among resurfaced build plates in addition to increasing production and quality, batch after batch.

More advanced units such as DCM Tech’s IG series offer variable speed grinding with automation and controls that allow virtually any operator to successfully manage a unit. These units can control

the initial contact between the abrasive wheel and the build plate, which in the past had to be finessed by the operator. Advanced sensor technology detects vibration and can automatically fine-tune not only the pressure of the spindle motor but how quickly it moves the wheel down onto the build plate. When the machine senses the abrasive wheel has contacted the build plate, it automatically begins the grind cycle.

The most advanced units offer simple controls including a touchscreen Human Machine Interface (HMI) that even unsophisticated operators can use to make any necessary adjustments without programming. The HMI controls allow operators to enter virtually any requirement into a touch screen. This capability enhances processing flexibility, so it is easy to adjust any grinding factor to prevent an issue from reoccurring.

For routine processes, the use of a variety of grind “recipes” with sets of parameters for different AM construction builds can further speed production, enhance quality, and aid in quick changeover.

“Different grind recipes can be set for different customers, material types, or construction builds so complex programming or data does not need to be entered at the start of each job. A new recipe can be





created for job variations, such as a different finish for a specific AM material,” explains Lawson.

One aspect that expedites production is the operator’s ability to accommodate grinding of extremely hard residual material like Inconel or titanium from build plates. This typically involves working with an expert vendor that can tailor the surface grinder’s abrasives to accommodate different types of metals and alloys, as well as the materials used for the build plate.

Beehive3D currently uses DCM Tech IG series rotary surface grinders at some of its locations and plans to add more in the future. Chief Technology Officer Hedges finds value in working with an expert vendor that can tailor the rotary surface grinder to Beehive3D’s specific needs.

“Using the proper abrasives and feed rates can reduce finishing time and facilitate an efficient, repeatable process. Working with an expert in abrasive use like DCM Tech

gives us the flexibility we need to efficiently remove a range of metal remnants such as aluminum, titanium, and Inconel from the build plates,” says Hedges.

Also important is the ability to alter the parameters through the grind cycle to handle both the printed metal or alloy and the material used for the build plate. The material characteristics of the printed part residue and the build plate are very different, so the rotary grinder must appropriately adjust to each on contact. Once the grinder cuts through the residual part material and reaches the actual plate, the grinding abrasive must work completely differently. The rotary grinders automatically make that transition.

The advanced unit’s grind recipes can also be set to accommodate required build plate textures. This eliminates the need to “roughen up” a build plate in a separate process so the AM part will properly adhere to the surface during buildout.

“Instead of trying to tailor a build plate finish by running it through a mill or an abrasive blaster, after grinding with an IG machine there is no reason to take it to a secondary operation,” says Hedges. “An operator can simply clean it with alcohol or a solvent, let it dry, and it is ready to use again in the AM process.”

According to Hedges, the automation provided by advanced rotary grinders allows operators to set up



the machine and then attend to other tasks. The machine does not need to be constantly monitored because it has built-in load monitoring.

“Unlike older style machines, the advanced rotary grinders do not need constant operator input or oversight. This allows the operator to multitask and minimizes the risk of error,” says Hedges.

Automation also eliminates the need for operators to manually dress abrasives on the grinding wheel to renew a good abrasive surface. Without automation, over time the wheel can become clogged with residue from the AM material.

When operators manually dress abrasives, on most machines they hold a tool under the grinding wheel abrasive. The tool applies abrasion and knocks off all used or clogged abrasives until the grinding wheel has a nice new abrasive surface. Operators frequently need to repeat the process, sometimes as often as every 10 minutes depending on the materials ground, which can be labor intensive and decrease productivity.

“Advanced rotary grinders with an auto dress option free operators from needing to do it manually, making operation easier and less time consuming,” says Hedges. “The option can be particularly helpful with hard materials like Inconel, which can require more frequent dressing of abrasives.”

As metal AM production ramps up, manufacturers that take advantage of sophisticated, automated rotary surface grinders to efficiently remove excess part materials and resurface build plates will outperform those using slower, less precise conventional methods.

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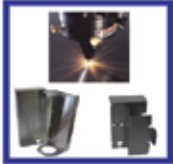
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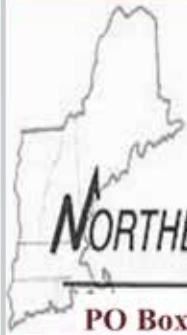
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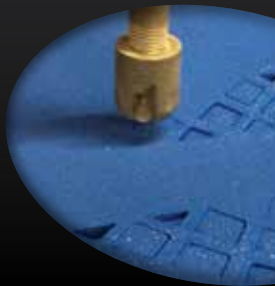
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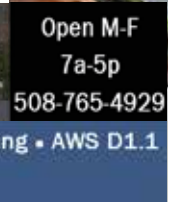
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DOES LEAN BELONG IN JOB SHOPS?



Written by Paul Critchley

While the core principles of Lean are generally agreed upon (delivering value to the customer, eliminating waste, showing respect for people), one of the places where opinions differ is the application of Lean in Job Shop environments. In Lean-speak, we call these places “High Mix – Low Volume” environments. Because of this inherent variety in part mix and complexity, it does become very difficult to see the benefit of implementing some of the tenets of Lean. Ideas like “1 piece flow”, for example, sometimes don’t convey in this kind of environment. Furthermore, the complexity of trying to figure out all the program cycle times, outside service or raw material lead times, and machine setup times of the coming week’s production is, a lot of times, simply more trouble than it’s worth. You’ve got a shop to run, after all, and if you’re anything like the job shops we visit, you don’t have the time to try and sort all of this out.

But that doesn’t mean that Lean is a wholesale failure within a job shop environment. In fact, I’d argue that it’s even more important to adopt in those cases...

High mix-low volume environments

In a high-mix, low-volume environment the flows of information and product are much harder to see than in a shop that consistently does the same operations day after day.

Because of this, there is usually a lot more waste present within the organization.

Disjointed operations, uneven processes and oddball customer requirements are all really easy ways to lose a lot of time while trying to get parts out the door.

I'll give you an example. One of our clients had a pretty bad throughput problem – parts were taking so long to get through production that the sales department was artificially increasing the order quantities before they were released to the shop floor. The thought process was that by the time the orders made it through production, the “extra” parts

made would probably have gotten ordered by another customer in the interim, so they could be sold without having to wait for yet another order to go through the shop. Conversely, if said extra parts didn't get ordered, they'd simply be put into finished goods. The former scenario would happen sometimes, but not as often as sales thought it did. And as a result, over time the warehouse gradually ran out of room as more and more “dead inventory” clogged up their finished goods racks.

In looking at their operations, it was pretty clear to see where there was waste and where there were bottlenecks. In one instance, a welder performed 20 minutes of rework on a single part (a 30% increase to his overall cycle time) as he struggled to meet the blueprint tolerance. In another, a machinist spent almost an hour setting up a mill just to put 4 holes into a part.



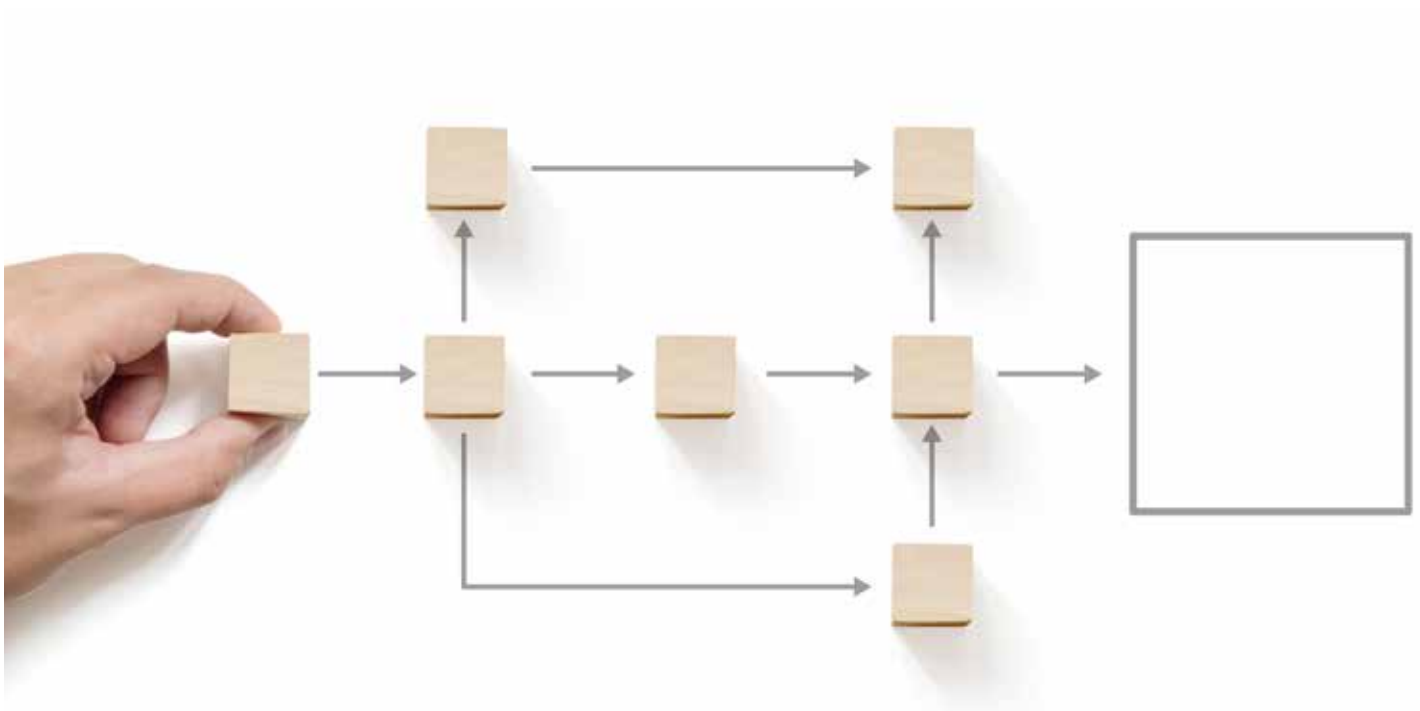
Get a clear view of what is happening – where it happens.

The first thing we did was map the process with the people who run them. There are lots of ways to do this, but ultimately, they all help us accomplish the same end goal; to graphically represent what is happening on the floor. In this particular case, we spent a lot of time walking the process. We asked a lot of questions of the people who were actually doing the work, then listened to their answers and ideas. This is called going to Gemba (“the actual place”) where work happens, and it’s the best way to experience for yourself how the work is getting done.

By doing this, we were able to see where things were getting jammed up – from unclear job assignments to bad upstream process quality. All of these were noted as opportunities for improvement on the map so that no idea was lost.

5S

Once we all had a clear understanding of what was happening, the team set about to make things better. The first step was instituting some good 5S practice. 5S is called this because, simply, it’s 5 words that start with the letter “S”: Sort, Set in order, Shine, Standardize and Sustain. 5S is a visual management system that helps get things



neat, clean and orderly, which in turn saves a lot of time because no longer do people have to stop what they're working on, go find whatever it is that they need, then get back to work. It puts what operators need where they need it and when they need it there. It sounds simple, but every day we lose untold production hours because someone has to stop working and go look for something or someone because they didn't have what they needed.

Setup reduction

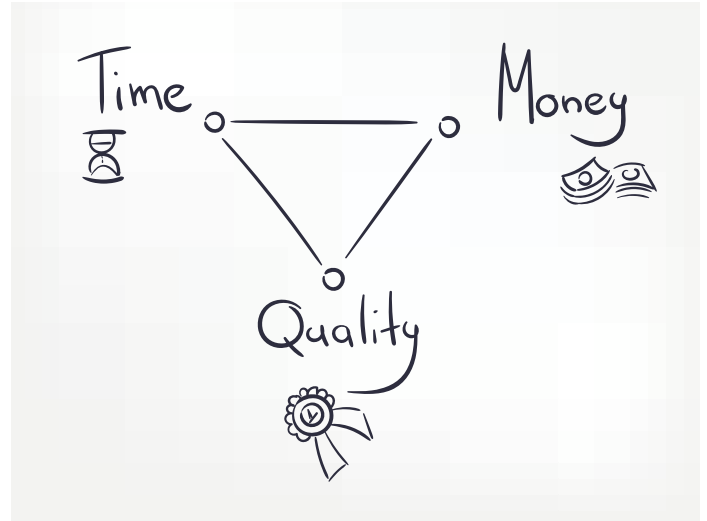
Another Lean tool we employed was that of Setup Reduction. For our Lean money, Setup Reduction has the best bang for the job shop buck because all of the time that gets taken out of a setup can go right toward production. It's one of the easiest and quickest ways to make sure that your time is being spent wisely – making parts that you can sell to your customers. When machines are down (for a setup or otherwise), they aren't making you any money. In this case, we focused on eliminating all the things that would prevent an operator from completing the setup – looking for tools, looking for a setup sheet, struggling with finicky fixtures... anything and everything that would stand in the way of getting the spindle turning again.

SORT
SET IN ORDER
SHINE
STANDARDIZE
SUSTAIN



So, what happened?

Flash forward a couple months, and the team had increased overall throughput by more than 100%. And no, that's not a typo; they had more than doubled their output. That tight print dimension that the welder was struggling with? Engineering revised the print to allow for a wider tolerance. This made the parts easier to weld and a lot faster to complete. That 1-hour setup time? The team got it down to about 7 minutes by putting needed tools and information at each machine (as opposed to having one central, shared toolbox), and making things easier to move, manipulate and fit. We also helped get the shop cleaned up – we got rid of old tools and fixtures that were either broken or out of service, as well as some equipment that had simply just been shoved into a corner. Overall, we freed up about 800 square feet of space. And finally, after some coaxing and Lean training, we got sales to stop artificially increasing order quantities, which helped free up associate's time, production time and finished good space.



My point is this: Lean doesn't have to be an all-or-nothing proposition. In truth, there are some aspects that just don't fit into certain situations, and that's okay. The whole point of Lean is to help you deliver better/faster/more value to your customers and employing Lean tools and techniques into your job shop environment can help you do this effectively and more profitably!

About Paul Critchley

Paul Critchley is a recognized thought leader on employee engagement and continuous improvement and has helped businesses around the world achieve greater levels of success through the application of Lean techniques. A frequent speaker, he has keynoted at numerous corporate events, as well as at international conventions such as AME's annual Lean conference and at OpEx Week. He's also the host of "The New England Lean Podcast", a weekly show that focuses on Lean leadership and New England-based businesses.

Paul is a former Board Member of the Northeast Region of AME, holds a B.S. in Mechanical Engineering, a M.S. degree in Management and a M.S. in Organizational Leadership.

He is passionate about Lean and creating organizational cultures that are sustainably engaged. He co-authored his first book - The Whole Professional, A Collection of Essays to Help You Achieve a Full and Satisfying Life to bring a fresh perspective on Work/Life Balance and how individuals and organizations can work together to achieve greater levels of attainment.

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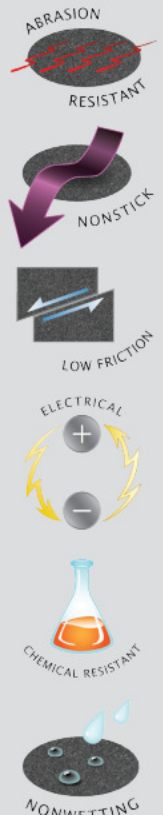
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Tyler Johnson, Douglas Johnson’s son, joined Marion Manufacturing Company in 2015. Tyler completed an extensive journeyman toolmaker program through a local Connecticut school. Since joining the team, Tyler has advanced to the title of Machining and Tooling. Tyler’s strong analytical and mathematical skills, along with attention to detail, has established his expertise in creating tools and designs.

It is with great pleasure we announce Tyler Johnson as Plant Manager at Marion Manufacturing Company starting January 17, 2022. His new job title will include overseeing the manufacturing process to ensure optimized production.

We are also pleased to announce Ashley Wells, Douglas Johnson’s daughter, as the new Marketing Director of Marion Manufacturing Company. Ashley has been an Elementary School Teacher the past thirteen years and joined the Marion family August 30, 2021.

Ashley brings her creative and innovative skills from teaching to this new marketing position, and we are excited to see where she will lead the company.

Please join us in congratulating Tyler on his promotion and welcoming Ashley to Marion Manufacturing.

For more information:

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HUTCHINSON, INC., HELPING TO ELECTRIFY THE COMMERCIAL ELECTRIC VEHICLE MARKET

Assists customer with a low-conductivity elastomer solution

HOPKINTON, Mass. – Hutchinson Aerospace & Industry, Inc., a manufacturing innovator and global leader in engineered shock, vibration and motion control solutions, helped a customer that provides innovative electrified powertrain solutions for commercial transportation by quickly developing a custom product that offers impressive electrical resistance. The customer, who had who previously worked with Hutchinson’s team to incorporate vibration isolators into their battery mounting design, requested an additional solution with a very low level of electrical conductivity—a solution that would improve system performance, reliability and operator safety.

“Our customer was very happy with our initial catalog offering but urgently required a vibration isolator with lower conductivity and unique specifications that did not exist at the time,” said Hutchinson EVP Bob Anderson. “So, we said, ‘give us two weeks.’ This customer originally chose us for vibration isolators because of our reputation as a solutions provider with extensive materials expertise and in-house testing capabilities. This was our time to show how we can perform under pressure.”

Hutchinson engineers considered an alternative option for electrical isolation at the mounting locations by introducing non-conductive insulating components between the vibration mounts and battery module. However, space constraints and assembly complexity precluded that option—meaning they would have to create a new compound to provide the necessary rubber electrical resistance. Neither party wanted a product with a significantly higher price point or lower quality, so the two worked together to define the specific.

“It was really something to see our team and our customer’s team working so closely to solve this problem within unbelievably tight time restrictions,” continued Anderson. “Ultimately, we formulated two different elastomer compounds and molded two different sets of low conductivity prototype isolators, in a unique shade of green, to identify them as high resistivity rubber mounts.”

The parts were installed on a development vehicle in the customer’s engineering lab and their performance

was evaluated through a series of tests. In the end, the electrical resistance was remarkable, exceeding the requirements by a substantial margin.

To learn more about Hutchinson's capabilities, including those within the electric vehicle marketplace or custom solutions in any industry, please visit hutchinsonai.com.

PLASTIC DESIGN, INC. ACQUIRES MILLENNIUM PLASTICS

Plastic Design, Inc. is pleased to announce the acquisition of Millennium Plastics out of Groveland Massachusetts! We are thrilled to welcome the skilled and talented team at Millennium into the PDI family. Coming together under the umbrella of our brand was a seamless transition and we look forward to the continued success and partnership.

While we are excited for the many benefits this will bring to our customers, we are particularly enthusiastic to be expanding our fulfillment capabilities, thereby improving our customer experience. Millennium Plastics has created customized plastic fabrications, turning customer's visions into reality for over 2 decades. Creating everything from custom kitchen hoods, to fishing pole racks or even COVID-19 testing booths, Millennium has the fabrication skills to do it all. This acquisition will add to the extensive list that Plastic Design, Inc. currently offers to our national customer base.

In 2019, Plastic Design, Inc. acquired Keller Products, an industrial filtration producer and manufacturer. Since then, they have expanded their product line and launched an e-commerce website with the goal of consistently delivering quality products to their growing users. Plastic Design, Inc. will also be launching an e-commerce site with our own line of products coming soon. Stay tuned to find out more.

For more information contact:

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A line of high-performance beryllium free copper-based alloy core pins for high volume, high-heat plastics molding applications has been introduced by Regal Components, Inc. of East Providence, Rhode Island.

Regal BFP Type High Conductivity Core Pins are made from C-18000 Beryllium Free copper-based alloy featuring 95-98 Rockwell B (20-25 Rockwell C) hardness. Providing 10X better heat conductivity than steel and 2X better conductivity than beryllium copper pins, they resist thermal stress, wear, and abrasion; making them ideal for high volume plastics injection molding.

Available in 16 standard pin diameters from 3/32" to 3/4" in 3", 6", 14", and 20" lengths, Regal BFP Type High Conductivity Core Pins are also offered as specials; machined to customer requirements. Uniform temperatures throughout these high-performance core pins and their low adhesion characteristics help reduce part damage during the part ejection process.

A catalog and complete price list is available upon request.

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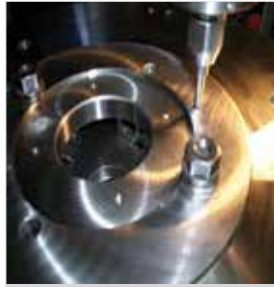


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