WHITE PAPER

Redefining Precision and Tight Tolerances: A 3D Printer That Can Finally Meet Your Specs

Introduction

Additive manufacturing has evolved from a quick way to prototype parts to a reliable alternative to traditional manufacturing methods, like machining and injection molding, offering a more efficient technique for product designers and engineers to take their parts from prototyping to production. The reality facing many product designers today is that miniaturization is creating an urgent need for technology that can quickly and cost effectively produce parts with micron-level precision and repeatability. The rise of miniaturization has made micro 3D printing even more appealing and, in some cases, the only suitable option to achieve the tight tolerances required of parts and products.

Even beyond this miniaturization movement, highly precise and accurate parts are essential for innovative applications across industries from medtech and life sciences to electronics, but not all 3D printing technology has the ability to hold high accuracy and precision. BMF's Projection Micro Stereolithography (PμSL) technology has a unique ability to hold micro-precision injection molded tolerance by utilizing ultra-high resolution 3D printing technology, software, specialty material and precision motion control to quickly produce parts requiring micron-level precision, achieving the tight tolerances needed every time.

This paper will discuss the importance of precision and the accuracy of the tolerances in 3D printed parts, which are required to efficiently move industries forward with innovative solutions to the world's toughest problems, down to the micron-level.

Did you know that you can print micro parts that are "true to CAD" with no post-secondary work?

Miniaturization is powering innovation across industries, but some manufacturing methods provide unreliable results when consistency is paramount. It's not uncommon to hear that companies expect to over-order printed parts and bake this extra time and cost into their manufacturing process with the expectation that a percentage will come back without the required specifications. But this does not have to be the status quo.

Design iteration is imperative for overall efficiency throughout the product development process, and BMF's PμSL technology can consistently produce single or batch products down to +/-10μm tolerance. This precision, especially when product specifications are down to the micron-level, makes the difference between a part or feature that fits perfectly into other components and one that needs to be refined with post-secondary work. With the latter, timelines are delayed, and more money spent on quality assurance. Consistently tight tolerances, high resolution, accuracy and precision are the defining factors for additive manufacturing solutions that can propel innovative solutions to the forefront of the marketplace.

Figure 1: A 3D printed micro nut and bolt with M0.3 threads

Did you know that additive manufacturing can create tight tolerances down to the micron-level?

For many years, creating molds for prototyping was the only solution for micro-precision parts, resulting in long lead times and high costs. Today, additive manufacturing can help optimize across the innovation funnel as a more cost-effective and time saving solution for industries who demand smaller parts, material compatibility for extended use cases, and the ability to rapidly prototype throughout the design process. Traditional manufacturing methods are no longer able to keep up with the requirements of today's parts and products. Specialized, ultra-high precision 3D printing that offers consistent results is extraordinarily valuable for companies who are developing miniaturized parts as it saves time, money and creates space for innovation.

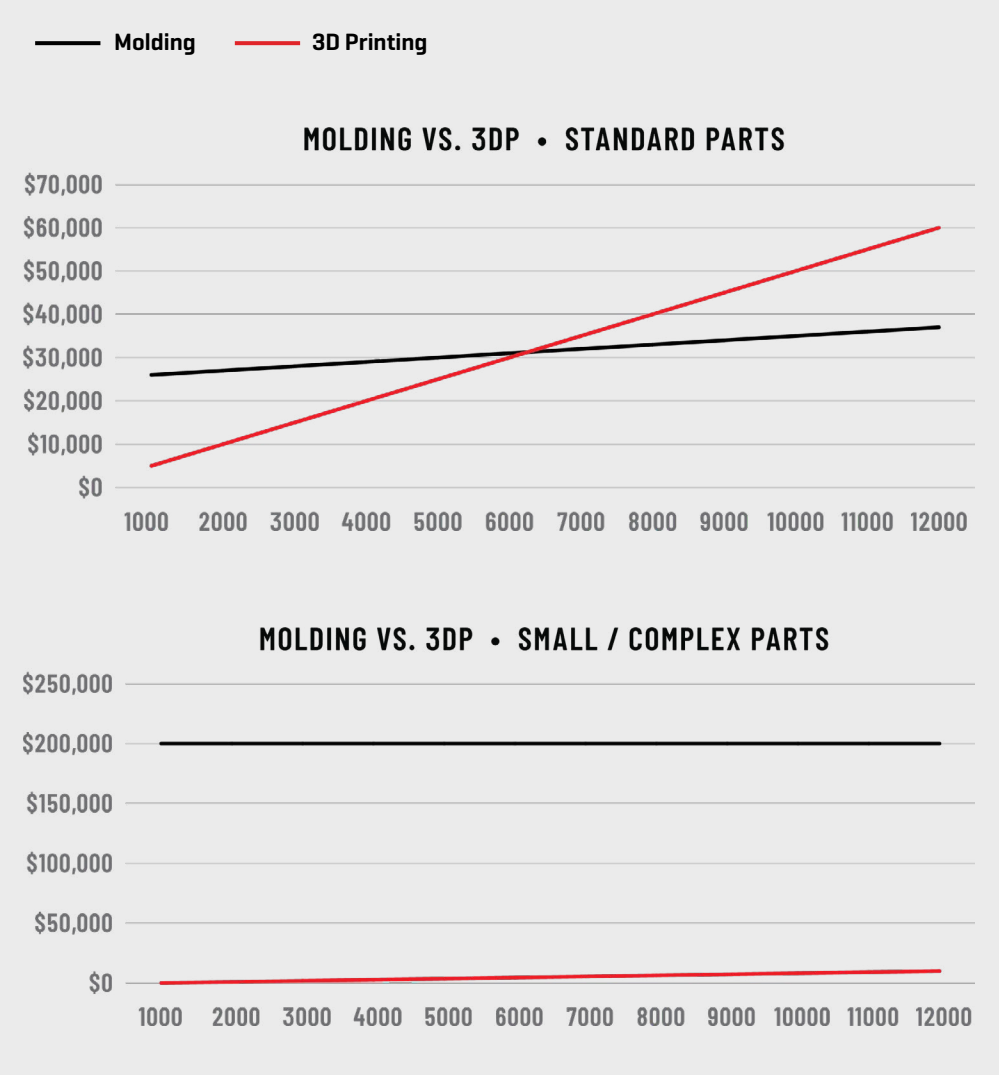


Figure 2: The line graphs illustrate the cost by quantity of manufacturing both standard and small, complex parts by either molding or 3D-printing

Industries propelled by ultra-high precision printing

Miniaturization in consumer goods

Think about the cell phone in your pocket today. Not only does it fit in the palm of your hand, but it's jam packed with capabilities from web browsing to social connectivity to business operations and more. It's more than a device – for many of us, it's our nucleus and north star. But remove the shiny glass and the platinum casing and you can see the power of precision and miniaturization in real time. The intricate chips, chip sockets and electronic wiring smaller than the width of a human hair are all possible because of technology that allows technology innovators that are designing consumer goods to go big by thinking small.

Cell phones, headphones and hearing aids are all examples of consumer products that are getting smaller with each iteration – and while the technology itself gets more advanced. Many of them utilize 3D printing to create micron-level parts with tight tolerances – and more often than not, the barrier to making things smaller is the packaging or housings that hold all the components together – which is where micro 3D printing comes in. Utilizing an open platform with the capability to use engineering-grade materials, the concept of using 3D printed parts in actual assemblies is starting to be a reality.

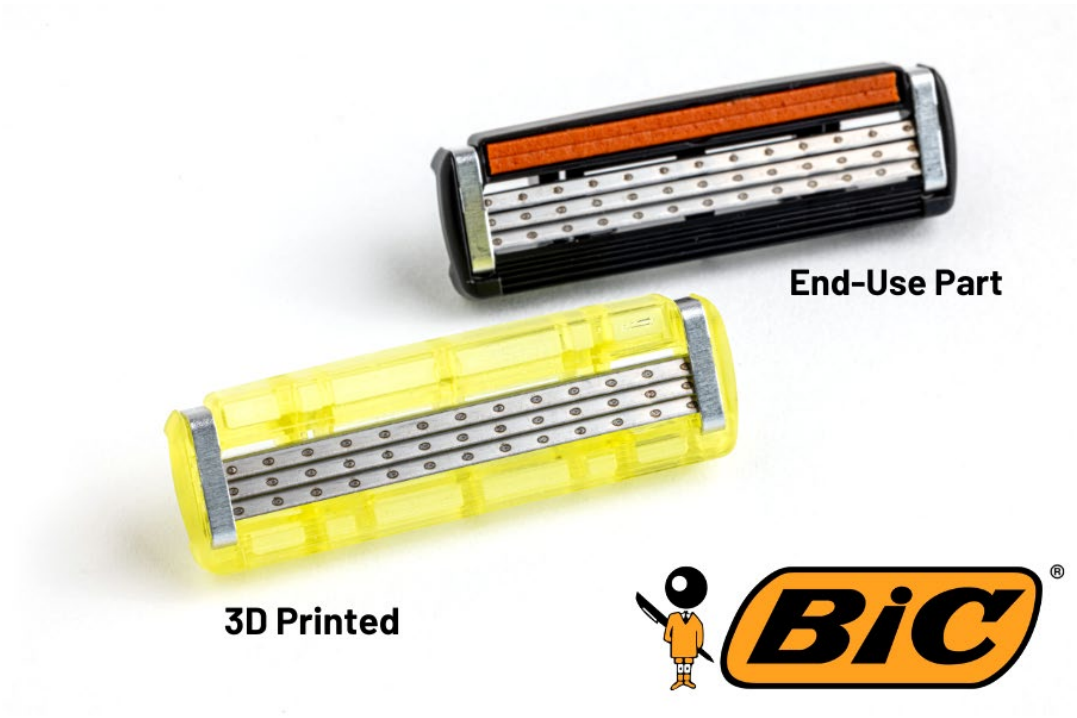


Figure 3: 3D printing was utilized in prototyping razor heads to test design changes

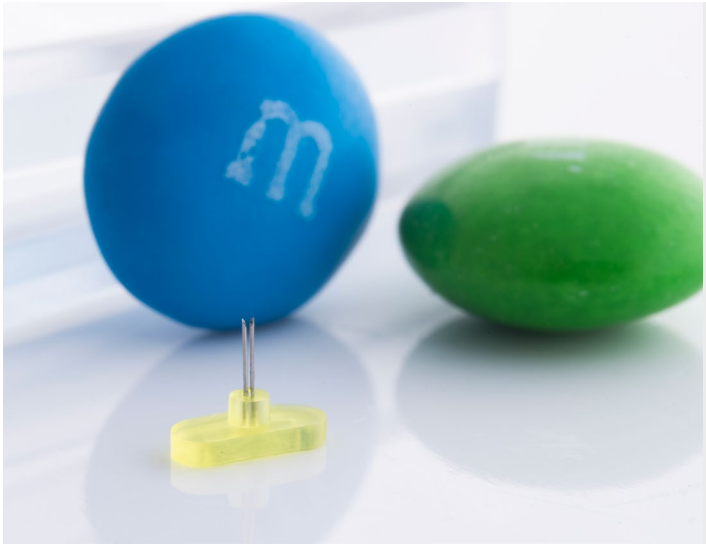
Micro-precision propelling healthcare

While miniaturization is a trend in healthcare, this highly regulated industry is also one in which high precision and accuracy are non-negotiable. From innovative drug delivery methods, such as micro-needle patches, to micro surgical devices that help to widen the availability of minimally invasive surgery, micro 3D printing is being used in a variety of medtech and medical device applications.

Consider one medical device company that needed a critical feature which measured -0/+0.0005 inches – a feature that is nearly impossible for most additive manufacturing technologies to resolve. For a long time, the company took a trial-and-error mentality toward sourcing these parts as it was historically the only option that would allow them to solve for the parts' micro specifications – even when their designers were providing drawings that pointed out the critical feature with specifications. However, during this time they often received parts that didn't fit their tolerance needs, were good enough after post-secondary work, but also parts that they had to scrap. They were wasting time, materials and money.

BMF answered the call. BMF's PμSL technology allowed the part to be printed to the exact specifications and the critical feature accommodated – every time. No more bulk ordering and scrapping parts. At BMF, every job and part produced goes through a crucial quality assurance process and is inspected by experts to ensure that it matches the requirements of the customer. This process is an integral part of collaborating with BMF and essential for many industries, but especially for healthcare.

There are also medical devices that require personalization or need to be made for single use. Additive manufacturing is an excellent solution for lower quantity orders that require high precision and accuracy. Another customer and its team of medical device engineers needed a three-millimeter distal tip for a novel single use scope for endourology which would allow for minimally invasive urology procedures. The distal tip houses key components such as a camera chip, light source and irrigation paths and has complex 3D geometry. The company switched to BMF from micro molding to solve for long wait times that prohibited innovative R&D and scalability.



IMcoMET is a medtech company pioneering a groundbreaking immunotherapy that has the potential to fundamentally change the way we treat skin cancer. Using BMF's technology, IMcoMET is able to rapidly prototype and produce small, precise parts for a patented device that collects interstitial fluid for a unique type of liquid biopsy.

Figure 4: IMcoMET's microneedle-Duo (M-Duo) Technology uses 3D printed components, specifically the caps and the lid that holds the needles in place.

A highly connected grid needs high precision

Another application that demands high precision printing is connectors for electronics. Take Z-Axis Connector Company, a corporation specializing in connector manufacturing, that produces innovative and cost-competitive connectors tailored to meet diverse requirements from high-volume consumer applications to micro-miniature connectors. Z-Axis specializes in finding solutions for customers when other available options won't work for their application, such as when ultra-high precision and the ability to withstand high heat are required. BMF's printers were able to accomplish significantly tighter tolerances than the next best option and use materials engineered to hold up against extreme temperatures, opening up new possibilities for compact, high-performance connectors and delivering solutions that surpassed industry standards.

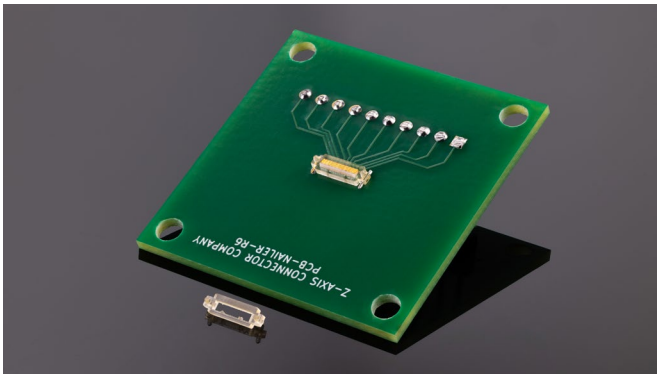
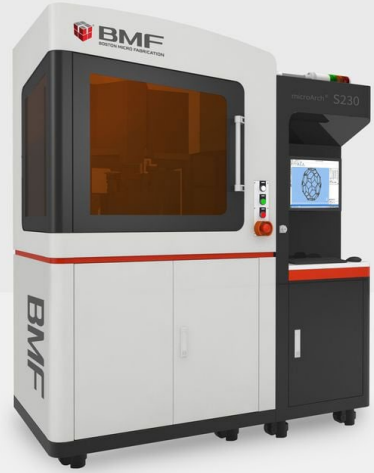


Figure 5: A Z-Axis connector that can withstand a reflow soldering oven by BMF's 3D printers

Specially tuned materials are ultra critical to achieve the best results when tight tolerances and micro features impact the quality and performance of your components and products. For medtech, biocompatibility is important. In microelectronics, it's important that parts are made with materials that meet end use requirements where products are typically exposed to high temperatures, require electrostatic dissipative (ESD) properties, or need V0 ratings or low dielectrics.



Samtec implemented the use of BMF's S230 3D printer platform, an advanced technology that allows for the speedy production of precise micro parts that could normally take weeks or months using conventional manufacturing methods. Samtec chose to use BMF's printer platform because it offered superior functionality, total control over production, and enabled the company to explore opportunities for growth and innovation.

Figure 6: BMF's S230 3D printer

A new way to solve life sciences' most challenging problems

Microfluidics, or fluid management, is propelling life sciences and cosmetic research. It's commonly found in lab-on-a-chip technology, which essentially allows labs to mimic the environment of how substances and therapeutics perform in the body. These miniaturized analytical devices are highly sensitive, quick to produce results and cost effective.

Historically, these small microfluidic devices were made through assembly of multiple parts. The parts were made via traditional manufacturing methods and then assembled in post-production, but this process was lengthy and costly. With BMF's PμSL technology, customers have been able to print the entire device at once, including the microscopic internal channels, removing any post-secondary work and streamlining the overall production process. In fact, The BMF San Diego Research Institute has been focused on developing advanced organ-on-a-chip platforms for enhanced recapitulation of physiologically relevant tissues by leveraging BMF's state of the art 3D printing technology, and they are looking to collaborate with researchers to understand the full implications of this technology to transform life science research.

Micro 3D printing has also been able to accommodate the micron-level nozzles required to make the delivery systems that control the pattern of the spray making it a holistically better options for advancing applications in the life sciences industry.

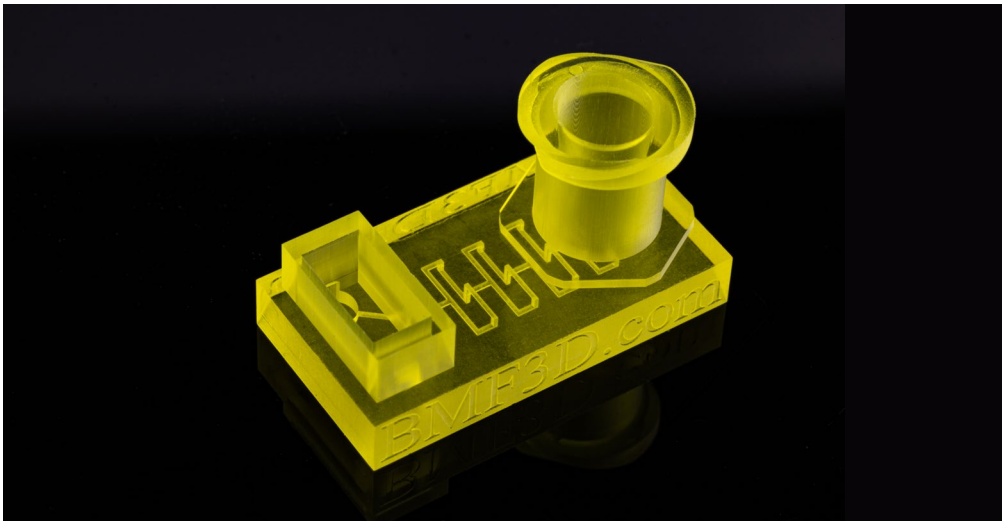


Figure 7: A microfluidic chip from BMF Biotechnology

Conclusion

With innovation that requires consistently accurate, micron-level precision with tight tolerances and granular design specifications, it's imperative that businesses choose technology that will help them achieve their goals today and tomorrow. The future of healthcare and life sciences, electronics and consumer goods depend on the highly specialized parts that will propel innovation across industries.

BMF's technology offers a unique and reliable solution to achieve the highest level of precision at the required sizes for its customers. To learn more about how our solutions could help increase the quality of your parts production or future innovation, please contact us now.