

Complex Metal 3D Printing and a Bridge to MIM with the Shop System™

Pennsylvania-based APG is at the forefront of metal part production with binder jet additive manufacturing





Tom Freemer, Plant Manager, MIM & Additive Manufacturing at APG, left, shows a local student group around the company's additive manufacturing facility. The Desktop Metal Studio System Bound Metal Deposition metal 3D printer is seen straight back and two Shop System binder jetting systems to the right.

Customer
Alpha Precision Group

Location
St. Marys, Pennsylvania

Industry
Powder metal part production
supporting industrial markets

Applications
Small, complex metal parts and
MIM development projects

Machines
Two Desktop Metal Shop Systems™ and
One Desktop Metal Studio System™

Materials
17-4 PH and 316L stainless steels

Website
www.alphaprecisionpm.com

3D printing as part of a full solutions portfolio

Alpha Precision Group (APG) is a global provider of metal formed products to a diverse customer base, from automotive and defense to aerospace and consumer products. The company specializes in press and sinter, metal injection molding (MIM), and additive manufacturing of components.

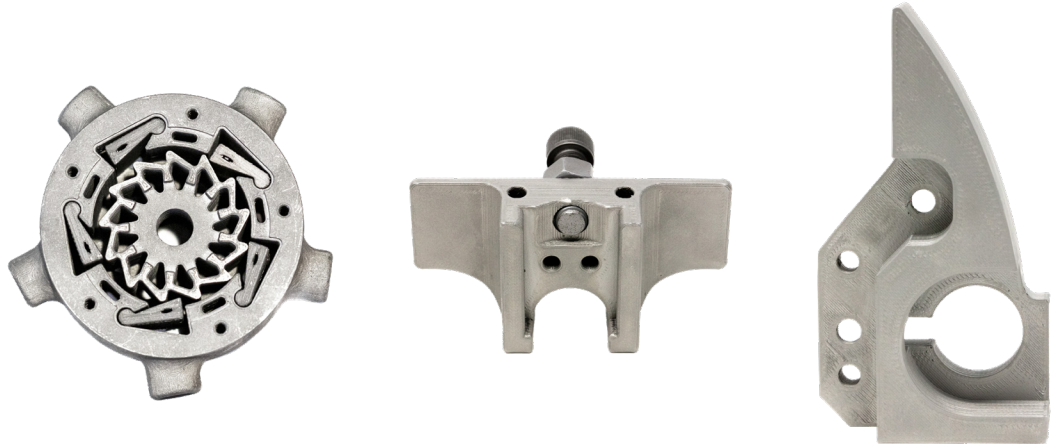
“We position ourselves as a metal parts producer, and that starts with being a full-service supplier to our customer base, and additive technology is another way to be a leader in that,” said Stephen Madill, Executive Vice President of Sales and Marketing for Nichols Portland Inc., who acquired APG in 2021. “We see 3D printing as a technology that we want to offer as part of our full portfolio of solutions for customers.”

APG first adopted metal 3D printing with the Desktop Metal Studio System – an office-friendly platform that extrudes pre-bound metal rods into complex shapes. “Right off the bat it helped us with internal production of our machining processes,” Madill said.

The team designed custom chuck jaws to perfectly match the profile of a part that needed an interior diameter machined. Despite having

less geometry capability, the traditional jaw would take longer to produce from tool steel in the machine shop. Using 3D printing, APG engineers were able to quickly iterate a design and deploy a solution to the manufacturing floor.

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From left to right, an assembly line screwdriver tool, coining fixture, and thread checker fixture were all 3D printed in 17-4 PH on the Studio System with fast turnarounds that minimize downtimes and at a cost savings over traditional methods.



With this initial success with Bound Metal Deposition technology on the Studio System, APG investigated binder jetting technology for its increased throughput and ability to scale production and lower part costs.

“We wanted to make sure we were at the forefront of that push, so we jumped into binder jetting and started winning certain jobs,” Tom Freemer, Plant Manager, MIM & Additive Manufacturing at APG, said. After installing its first Shop System in 2021, APG added a second Shop System in 2022 as well as additional additive manufacturing equipment to support customers.

Boasting a team experienced with industrial furnaces and sintering, APG was able to efficiently integrate the powder metallurgy of binder jetting into its solutions portfolio. The company utilizes batch vacuum furnaces to process 3D printed materials. To get the most out of the design freedom of additive manufacturing, APG also uses Live Sinter software to enhance the outcomes of its most difficult binder jetting designs. “Live Sinter excels at complex geometries,” Freemer said. “There are some part geometries that have sinter deformation challenges and it’s definitely helped with that.”

A playground for engineers

Today, APG's customer base is familiar with the metal injection molding technology, but Madill reflects on educating the market for binder jetting in the same way early MIM producers had to grow that market. "We saw this in the 80s and 90s in the conventional powder metal space; we had to educate all the engineers how a powder metal can work for them. Now, MIM is a steadfast technology used globally to help high volume production," he explained. "It's very similar with binder jetting. It's going to take time to build the expertise in the marketplace, but once we do, it will be a tool that many design companies will use, I'm sure."

To grow the marketplace for metal 3D printing, the company takes a three-pronged approach to utilizing binder jet technology:

1. Design iterations before tooling investment

While MIM may be the known production method for a future component because of the required volumes, binder jetting can be utilized to test and finalize a geometry before a customer has to invest in, or change, hard tooling.



The APG team operates powder-less metal 3D printing on the Studio System, far left, and increases throughput with binder jetting technology on the Shop System, left.

2. Early development for metal injection molding

While it typically takes eight to 10 weeks for a hard tool to be built, after winning a new MIM contract the company can quickly 3D print that product geometry with material properties similar to MIM to begin testing internal processes like sintering.

3. Production metal parts

Applications with lower volumes or higher complexity requirements are attracting customers for the life of manufacturing, with benefits like quick-turn first parts to production without a tooling investment and a minimum order of one.

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Stephen Madill, Executive Vice President of Sales and Marketing for Nichols Portland Inc.

The first customers to embrace the technology were those who loved the ability to iterate to optimize their MIM designs. “Binder jetting is a tremendous bridge for our customers to validate designs for high volume MIM products,” Madill said. “It’s kind of like a playground for engineers. They can take different ideas, throw them into one build box and test what works and what they like. We don’t have to make a hard tool, and customers love that.”

The competitive landscape also requires APG to respond to bids quickly and get parts out the door and into customers’ hands. Digital manufacturing allows APG to operate with fast turnarounds – printing metal parts directly from a digital design file without the need for hard tooling or complicated machining set ups. The company targets delivering prototypes or first parts in under two weeks – and sometimes delivers quick turn jobs in as little as five days.

Metal part production without the cost of tooling

A capo is a device used to change the pitch of a stringed musical instrument, such as a guitar or banjo. By clamping the strings across the neck, the capo allows musicians to raise the pitch of the instrument and play in different keys without changing finger positions of the chords.

From an existing relationship with a customer who produces for a six-string guitar using metal injection molding, APG was able to offer binder jet 3D printing as an ideal solution when the customer was looking to produce a lower-volume design targeting smaller instruments like banjos and ukuleles.

To avoid the cost of creating tooling for the MIM process, APG directly printed the capos in 17-4 PH stainless steel on the Desktop Metal Shop System. “The volume of this part didn’t justify investing in a MIM tool, but it’s an additive success story.” Freemer said. “We’ve shipped several production orders to date and the customer can continue to iterate the design.”

The 3D printed capo features an adjustable rod that is easily built into the component to attach the bar that holds down the strings. The top cross bar features a small counterbore structure that the team is adding an undercut feature to. Freemer notes how adding this type of design feature would be impossible using traditional MIM technology.

“That would be a problem with a MIM part, they wouldn’t be able to mold it. We wouldn’t be able to pull a tool, but we can print it. So it was an interesting solution for a problem today that we couldn’t solve on the MIM side.”

With flexible binder jetting technology, APG is able to build multiple designs simultaneously, enabling it to nest the small capo bars with other jobs to optimize production. Batches of as few as 12 to as many as 60 pieces have been shipped to the customer and they continue to optimize the design throughout production as needed. With 3D printing complete within a day followed by sintering and post-processing, designs go from powder to part within a week to keep the customer supplied with parts on-demand.

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This unique, lightweight capo design allows musicians to quickly attach and change frets with ease. APG directly 3D printed the yoke and straight bar in 17-4 PH stainless steel on the Shop System directly from a design file, seen on page above. The volume of this part didn’t justify investing in a MIM tool and without hard tooling the customer can continue to iterate the design.



About Alpha Precision Group

Alpha Precision Group aims to supply high-value, technically advanced powder metal, metal injection molding (MIM), additive manufacturing, and specialty valves to a diverse customer base through the passionate pursuit of customer satisfaction, a focus on safety, and a culture of continuous improvement. Formed in 2016 through the merger of several companies with over a half a century of experience in the powder metallurgy industry, the company was acquired by Nichols Portland, Inc. in 2022.



About Desktop Metal Inc.

Desktop Metal (NYSE:DM) is driving Additive Manufacturing 2.0, a new era of on-demand, digital mass production of industrial, medical, and consumer products. Our innovative 3D printers, materials, and software deliver the speed, cost, and part quality required for this transformation. We're the original inventors and world leaders of the 3D printing methods we believe will empower this shift, binder jetting and digital light processing. Today, our systems print metal, polymer, sand and other ceramics, as well as foam and recycled wood. Manufacturers use our technology worldwide to save time and money, reduce waste, increase flexibility, and produce designs that solve the world's toughest problems and enable once-impossible innovations. Learn more about Desktop Metal and our #TeamDM brands at www.desktopmetal.com