



 Desktop Metal.

[Case Study]

FreeFORM Technologies

www.desktopmetal.com



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Overview

Based in St. Mary's, Pennsylvania, FreeFORM Technologies provides world-class engineering and manufacturing services to customers across a wide range of industries, and is one of the first service bureaus to offer metal binder jet additive manufacturing. Founded to bring new levels of creativity and design to customers through the use of additive manufacturing, the company also offers FFF printing of both metal and plastic parts, as well as SLA contract manufacturing services.

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The Challenge

There are a host of reasons why companies might invest in additive manufacturing – from expanding options for customers to keeping up with competitors to working on the cutting edge of modern manufacturing.

For Nate Higgins and Chris Aiello, two of the founders of FreeFORM Technologies, it was a decision based on experience.

With decades of experience in metal injection molding (MIM) between them, they were intimately familiar with both the benefits and challenges that come with the process.

Though it's ideal for creating highly-complex, small- to medium-sized parts in huge quantities (even into the millions or billions,) and results in fully-dense, isotropic parts with excellent surface finishes, MIM also comes with challenges - most of which are tied to tooling.

Creating the molds used in MIM is both expensive and time-consuming - a single mold can cost upwards of \$40,000 and anywhere from eight to 12 weeks to fabricate.

The molds also impose limits on the geometry of MIM parts - features like undercuts, lattices, organic shapes and non-circular holes would be too expensive to justify, or would require expensive and time-consuming post-processing to create.

To address those challenges, FreeFORM turned to the binder jetting technology of the Desktop Metal P-1 Production System.

02 The Solution

Because it eliminates the need for tooling, the P-1 system has helped FreeFORM realize significant cost savings. More importantly, though, the system dramatically reduced lead times - rather than wait weeks for tooling, designs can be sent to the printer as soon as they're completed.

Using the system, the company was able to produce a medical "wrist" part, in quantities of 1,000 or more at a per-part cost of \$6.50, and deliver finished parts to customers in just over two weeks.

Producing the same part via MIM would result in slightly lower per-part costs, but would require an upfront investment in tooling of more than \$40,000 and as much as three months before a single part was produced.

Those savings, however, are just the start of the system's benefits.

The lack of tooling also means parts aren't locked into a single design, but can be fine-tuned and customized simply by updating CAD designs and sending them to the printer.

Additive manufacturing also allows FreeFORM to explore new design territory, incorporating features - like lattices, generative designs and undercuts - that would be too expensive to justify, or would require expensive and time-consuming post-processing to create.

The tooling-free nature of additive manufacturing means manufacturers are not locked into a particular design, but can make changes at any time by simply updating digital designs and uploading them to the printer.

Printing parts also allows FreeFORM to create parts with features - like lattices, generative designs, undercuts and more that would be difficult to justify, or outright impossible to create using traditional manufacturing.

Using the Production System P-1 printer, FreeFORM has printed parts for a wide variety of applications, from end effectors for other, traditional manufacturing technologies to medical devices to industrial hardware for locks and equipment to make containers for personal care products.

03 Why Desktop Metal?

While FreeFORM's founders have extensive experience with both extrusion and laser-based metal 3D printing, both technologies faced challenges - extrusion systems are too slow for higher-volume production and laser sintering is too costly.

With Desktop Metal's Production System P-1, we were able to print 100 parts in a single build in less than an hour and fulfill a 5,000-part order within two weeks.

With a throughput rate 20 times faster than competing systems, the P-1 is a game-changer for the flexible production of small, complex parts. Our P-1 offers incredible productivity, and we're looking forward to the release of the P-50.

—
Nate Higgins
President, FreeFORM Technologies

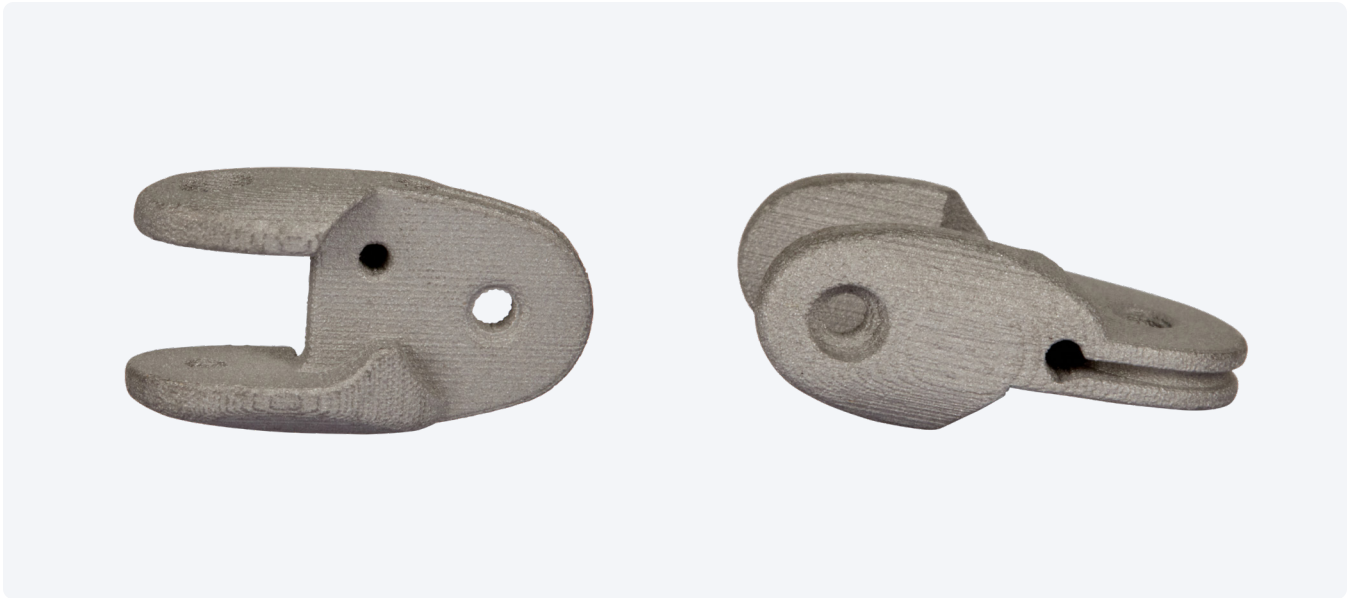
With the development of high speed, high capacity binder jet printers like the P-1, they felt the technology was ready for commercialization and production of end-use parts in volume.

Using the P-1, FreeFORM can be far more agile - parts can be produced quickly using a variety of materials and changed as needed.

With the ability to print a full build-box in 45 minutes to one hour, the company has run as many as five different prints in just a single day, and have thus far printed using 17-4 and 316L stainless steel, and has explored printing using S7 tool steel.



Part Fabrication & Comparison



Medical Component

A “wrist” component used to hold grippers during minimally invasive surgeries, this part would normally be created via MIM due to its small size (just 2 grams) and relatively complex geometry.

Using the P-1 system, however, FreeFORM was able to produce the part at a significant savings in both time and money.

The company’s initial pilot run - just 50 parts - was delivered to the customer in less than ten days, and ramping up to numbers as high as 1,000 pieces would take just 15 days.

Producing the part via MIM, by comparison, would require as much as 12 weeks lead time and more than \$40,000 for the fabrication of tooling, sampling and inspection, all before a single part is produced.

In addition to reducing cost and lead times, printing the parts helped simplify the process of sintering the parts early in their development.

Because the parts need support during sintering, FreeFORM would recommend the customer purchase ceramic sintering furniture when the parts go into production, rather than printing rafts which wind up as scrap.

Using the P-1 system, however, the company has the flexibility to print those rafts in the early stages of the part’s development, rather than spending thousands of dollars and waiting for weeks to create ceramic supports.

Part Fabrication & Comparison



Machinery Controls

These two parts are key components in a fine-tuning control for industrial machinery. A cam runs from the knob on the left through the slot on the right, giving an operator close control over the machinery's operation.

In the past, these parts had been machined. When the customer's machine shop supplier refused to lower their price as volumes increased, they turned to 3D printing, resulting in savings of approximately 15 percent.

The ability to print parts at volume means FreeFORM can produce approximately 300 knobs and up to 150 cam profilers per build.

Part Fabrication & Comparison



Alignment Jig

Used to align a blank key with the cutting tool in a key duplicating machine, this part in the past was created via MIM. As demand for the part fell, however, traditional manufacturing costs became difficult to justify, so the customer turned to metal 3D printing to help curb costs and reduce lead times.

Due to the relatively low demand for these parts, FreeFORM expects to print only about 500 per year.

In addition to helping cut costs and lower lead times for the jigs, printing eliminates the need for the customer to carry extensive inventory of parts and instead print the parts on demand as they're needed.



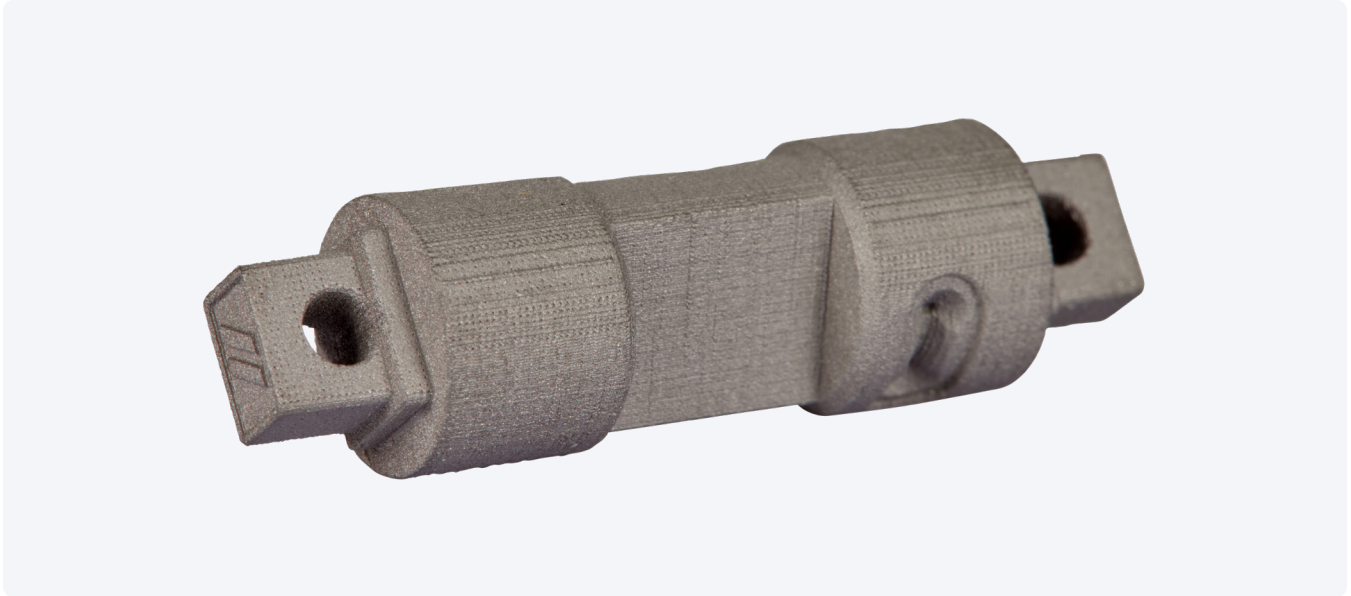
Hold Down Latch

While this hold-down latch could be machined, it is significantly cheaper for FreeFORM to print the parts using the P-1 system.

The 200-by-100-by-40 mm build box means nearly 500 of the parts can be printed in a single build, allowing the company to significantly reduce the per-part cost.

In addition, the tooling-free nature of 3D printing means FreeFORM can modify the latch's design easily without the delays and costs associated with producing new tooling, jigs or fixturing.

Part Fabrication & Comparison



Consumer Goods Prototype

Created for a customer interested in exploring the benefits of metal 3D printing, this prototype part features a unique design. After printing the part undergoes a machining operation, and the outside diameter is then ground to fit.

FreeFORM initially printed approximately 50 of the parts as a pilot run, and anticipates producing as many as 1,000 of the parts annually, at a cost of \$9.80 each.

While per part costs would be less with MIM, that cost does not include the lead time and expense of tooling, which can take as much as 12 weeks to produce and cost \$20,000 or more.

04 Evaluation

For FreeFORM, the P-1 system has proven to be a powerful tool, helping the company respond quickly to customer needs by filling orders for parts in a fraction of the time required for traditional manufacturing.

In addition, the system helped FreeFORM win new business by making it possible to produce parts in lower volumes, where the upfront cost of MIM tooling can't be justified.

With the ability to create highly complex parts, quickly and without the need for tooling, the system is helping FreeFORM take its place as a leader in additive manufacturing and a go-to provider for advanced manufacturing.

About Desktop Metal Inc.

Desktop Metal, Inc. is accelerating the transformation of manufacturing with end-to-end metal 3D printing solutions. Founded in 2015 by leaders in advanced manufacturing, metallurgy, and robotics, the company is addressing the unmet challenges of speed, cost, and quality to make metal 3D printing an essential tool for engineers and manufacturers around the world. In 2017, the company was selected as one of the world's 30 most promising Technology Pioneers by the World Economic Forum, and was recently named to MIT Technology Review's list of 50 Smartest Companies. For more information, visit www.desktopmetal.com.

About FreeFORM Technologies

Based in St. Mary's, Pennsylvania, FreeFORM Technologies was founded by engineers with years of experience in both traditional and additive manufacturing. Created to challenge conventional thinking in manufacturing, FreeFORM is driving additive technologies forward, bringing freedom of design to the customer, and providing world-class engineering and manufacturing services while providing low cost of ownership and speed to market.