Desktop Metal

CASE STUDY

Trusted Manufacturer Scaling Metal Binder Jetting for Serial Production

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Wisconsin-based DSB Technologies is reinventing the way powder metal parts are made

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Paul Hauck, Chief Operating Officer for DSB Technologies, explains why the company has adopted the entire line of Desktop Metal X-Series metal binder jetting 3D printers for production of metal parts.

Customer
DSB Technologies

Location
Janesville, Wisconsin

Industry
Powder metal part production supporting industrial markets

Machines
Desktop Metal X-Series
InventX™, X25Pro™, X160Pro™

Technology
Binder jetting with Triple Advanced Compaction Technology

Materials
316L and 17-4 PH stainless steels, 4140 low-alloy steel, and M2 tool steel with reactive materials such as aluminum in the strategic roadmap

Website
www.dsbtech.com

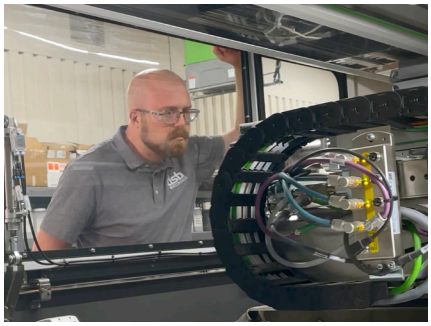
Scaling binder jetting for industrialized manufacturing

Processing over eight million pounds of metal powder each year – including over 7 million pounds of stainless steel materials, DSB Technologies (DSB) is a market leader in the mass production of powder metal components. This expertise in serial production using compaction and press technology and metal injection molding optimized for stainless steel affords the DSB team a deep understanding of the science of high-temperature sintering to obtain top-quality material properties. Its company mindset to collaborate, discover, and innovate together with customers led DSB Technologies to invest in transformative technologies like binder jet 3D printing to provide a wider range of metal solutions.

"Our high-temperature sintering capacity lends this business to technologies like PM press and sinter, metal injection molding and metal binder jetting," said Paul Hauck, Chief Operating Officer for DSB Technologies. "Our New Technology Center is bringing in new forming processes that leverage the high-temperature sintering that's been here for 40+ years."

With over 30 continuous high-temperature furnaces, some with proprietary customizations that optimize production, DSB Technologies believes it has the largest high-temperature sintering capacity in North America. It hopes to use this capacity to scale binder jetting to serial production.

"At DSB, we believe high-temperature sintering, specifically continuous sintering, is the key to taking metal binder jetting to an industrialized manufacturing process," said Neil Belanus, Senior Additive Manufacturing Engineer. "We're looking to use metal binder jetting as a means to create production components and continue a steady stream of parts going through our furnaces."



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Neil Belanus, Senior Additive Manufacturing Engineer at DSB Technologies, overlooks the binder jet 3D printing process on the X160Pro in the company's New Technology Center.

To get customers' applications ready for binder jet production, DSB Technologies is committed to application development and invested in the entire line of X-Series binder jet 3D printers. The X-Series platform leverages a specific approach to metal binder jetting with Triple Advanced Compaction Technology, which enhances its ability to work with a wide range of metal and ceramic powders.

First installed in 2021, the InnoventX lab-sized printer was the perfect jumping-off point for adopting binder jetting and today is used for material development and for testing initial sintering parameters. The X25Pro, installed in 2022, allows the team to scale those successful tests up to application development in a mid-size machine that is also capable of bridge production. The X160Pro, installed in 2023, offers the largest build volume to take applications to full production.

The ability to develop customer applications across one platform of machines was a key reason DSB Technologies chose the Desktop Metal X-Series binder jetting systems. "Having all three X-Series machines is helpful with scalability. We can do our material development, we can do small-scale prototypes and application development, as well as serial production of large parts, all within the same binder jetting platform," Belanus explained.

X-Series

As a full metallurgical solutions provider, DSB Technologies invested in three binder jetting systems to develop and scale applications. Neil Belanus, Senior Additive Manufacturing Engineer, comments on each of the machines in the New Technology Center.

InnoventX™

"The small build box is perfect for trials without using too much powder and allowing for quick changeovers. We like being able to do that study without having a huge investment in powder."

X25Pro™

"We've then been able to use our X25Pro to make a large prototypes or several parts for development to get to that final design, as well as small production runs."

X160Pro™

"Our X160Pro, with an 800 x 500 x 400 millimeter build box, really allows us to leverage that size to create true production volumes."

Complexity beyond what's possible with MIM

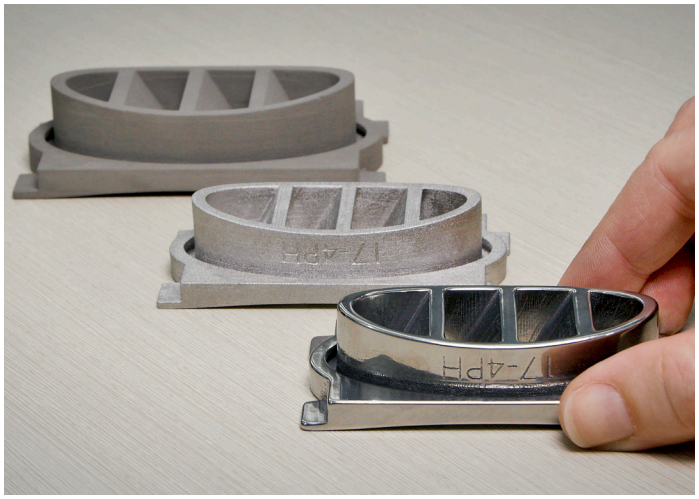
COO Hauck, who spent over three decades in the metal injection molding (MIM) industry before expanding his expertise into binder jetting, explains the similar, and often complementary, technologies. "Converting a printed part to a final sintered part requires high-temperature sintering of fine metal powders. Exactly what the MIM industry understands – they're very good at it. So, if you are successful at making MIM parts, you have a high likelihood of being successful making binder jet parts."

However, he emphasized the new possibilities additive manufacturing brings to applications. Binder jetting can take three-dimensional metal injection molding to a completely new level.

"Binder jetting really is a forming technology that gives us unlimited design potential," Hauck said. "We can go from a very simple shape to very complex things you can't produce in hard tooling, taking complexity beyond what's possible with metal injection molding."

Belanus agrees, noting the advanced design features the team is now able to develop with customers to optimize the performance of their products. "With metal binder jet, we can produce parts without being constrained by common conventional design limitations. We're seeing undercuts, internal cavities, lattices. Some unique lightweighting features that were previously impossible. We can add in threads, spirals, and a lot of other features that would be very difficult with conventional technologies. It allows us to really expand our portfolio of the parts and geometries we provide to our customers."

It's not just that the team can make parts they were never able to form before, but they are able to do it with no tooling, creating an extremely fast time to market. "The exciting part about binder jetting is the path from concept to part is all digital," Hauck said. "You're not sending a CAD file over to a tool shop that then creates a reverse image. So, you're taking as few as eight weeks, and maybe as many as 16 or 20 weeks out of that process."



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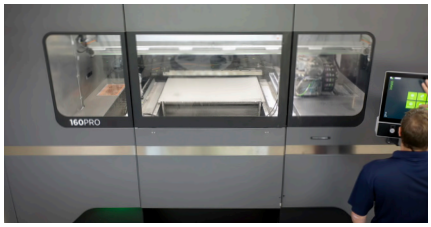
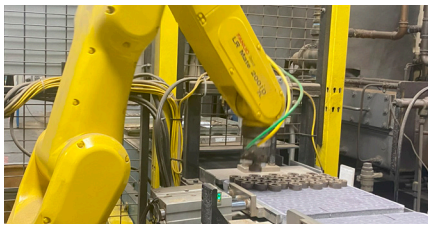
Binder jetting is also often compared to MIM because it is qualified to the same industry standards. Metal powder industry federation standard 35 properties are achieved through binder jetting – providing standard 35 level of performance. Left, the part at the top shows a "green" 17-4PH stainless steel part out of the printer, and the middle part shows the same part immediately after sintering in a furnace. The final part is shown polished.

Roadmap for production with the X160Pro





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Binder jet 3D printing stainless steel parts on the X160Pro, top. DSB aims to automate 3D printing on the X-Series to include robotics and integration into the company's high-temperature continuous sintering lines, both seen above working with press and sinter parts at the company's production facility.

Strategically investing to modernize its operations for the future, DSB Technologies has placed an emphasis on automation and digitalization to increase throughput and repeatability in production components. For example, robots help load CNC press parts into setters for automatic loading into sintering furnaces. The company has also fully automated its metal injection molding cell, serving as a model and roadmap for its binder jet 3D printing process.

"Our intention is to get to the point where we have a completely lights-out cell," Hauck said. "Print, manage material, place parts on setters for sintering — we really want to get to that stage."

Hauck is particularly excited about the X160Pro platform, calling it the foundation of the future for volume production. The X-Series line is rooted in Desktop Metal's 2021 acquisition of ExOne. DM continues to sell ExOne branded sand binder jetting systems to foundries, where the technology has become a trusted mainstay for serial metal casting production worldwide. Referencing the foundational work laid by sand binder jetting in metalcasting, Hauck said he believes metal binder jetting will follow a similar path toward production.

The size of the X160Pro also allows DSB Technologies to offer solutions at all-new scales, much larger than the often referenced "softball-sized" limitation of metal binder jetting. Pointing to a 24-lb (11 kg) stainless steel print in-process on the X160Pro, Hauck said, "It's a massive application, and we've already had a successful print run of it, and we're going at it again. That's exciting stuff; That could be a whole new world of metal part fabrication that we just haven't been able to get to with traditional MIM."

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Paul Hauck, Chief Operating Officer, DSB Technologies

Using the power of digitalization to improve results

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Simulation tools like Desktop Metal's Live Sinter software help reduce trial and error for successfully sintered powder metal parts

Metal binder jet 3D prints fuse together during the sintering process to form a dense metal part. In the furnace those parts shrink and experience significant forces that can lead to deformations. Desktop Metal Live Sinter™ software is helping the DSB Technologies team implement successful sintering strategies for complex 3D printed parts.

"We have found Live Sinter to be very effective in reducing the iterations from green to sintered part," Senior AM Engineer Belanus said. "Being able to cut initial development time through simulation has been very helpful." The predictive software tool aids the team in designing parts in a way that they get the outcome they want after sintering by providing a negative offset geometry that appears to be printed warped, so it sinters to the required specifications.

"That's not a trivial topic," Hauck said. The MIM industry long operated with trial and error, he explained, saying software solutions are changing the game. "We now have very useful scientific analytical tools that enable successful outcomes. It's helping us solve application problems, get successful outcomes, and get there faster."

Hauck remarked that although people were skeptical of the technology at first, no one today would think of making a mold without virtual simulation software tools. He sees sintering simulation tools like Live Sinter as no different – it's using the power of digitalization to improve results.

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> **Paul Hauck, Chief Operating Officer, DSB Technologies**

Diversification growth strategy with binder jetting

DSB Technologies is investing in disruptive forming technologies like binder jet 3D printing to drive the company for future growth. "We really see that being a bright spot in our future," Hauck said. "It's all about diversification, not only diversifying markets, but diversifying forming technologies. Binder jetting creates applications never produced before, and we want to be a leader in that."

The company, traditionally heavily invested in supporting the automotive industry, is using the introduction of technologies like metal injection molding and binder jetting to aggressively expand into new markets. "I think there's an opportunity for conversion of investment casting components to binder jetting, for example," Hauk said. The technology is also driving interest from new customers in markets like sporting equipment, medical devices, and industrial products.

Ultimately, Hauck returns to the DSB tagline of Collaborate. Discover. Innovate. "We really want to do that with customers," he said. The team tries to get its customers to think differently about their applications – think from an additive perspective. "When we receive a drawing, we're more inquisitive about the circumstance. What problem are you trying to solve? Why this geometry? We try to understand what their needs are." And the company is laying that groundwork today to scale applications to serial production.

"Desktop Metal and the X-Series is a big part of our future vision. We want to take everything that's happening in this technology center, grow it, and move it into our plant where we can run volume production," Hauck concluded.

Application example: Freedom of design and iteration

Near-net shape production was a key feature of binder jetting for DSB Technologies. Producing parts layer-by-layer allows complex design features to be formed with ease. "Being able to get that finished part out of a single box rather than having to go through multiple operations is very beneficial for our customers," Belanus said.

The team was able to iterate several designs at once to optimize this consolidated flange without a tooling investment. The ability to create complex designs with digital manufacturing is crucial, as Hauck noted. "The idea around consolidation of parts – for decades the MIM industry has done some of it. Binder jetting really takes that to a completely different level where large numbers of component consolidation can occur. You're really looking at *what do I need from the system* and *how do I design for that*?"

The optimized center flange below is printed with a taper and a uniform wall thickness as well as other features for lightweighting. It holds a multi-radius and step geometry on the top for a mounting surface while also integrating holes for mounting with ease. Multiple iterations were printed in the same process without the need to create tooling, allowing the team to quickly test designs to find the optimal geometry.

Belanus notes a dimensional stability of the binder jetting process out of sinter at approximately ± 1%, producing precise parts that limit the need for outside processing.

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Multiple iterations of a design can be 3D printed in one tooling-free process to test and finalize designs during application development before scaling to serial binder jetting production.

About DSB Technologies

With unmatched metallurgical expertise and a diverse technology portfolio, DSB Technologies has a proven history of finding new ways to design and manufacture functional powder metal components for mass production.

Its forming technology portfolio, which includes powder metallurgy press and sinter (PM), metal injection molding (MIM), and metal binder jetting (BJT), enables manufacturers to design complex powder metal components for high volume production through processes that had previously been economically impossible. Complementing its forming technology portfolio is a vast range of metallurgical expertise, from custom material development to a fleet of secondary machining centers. This knowledge, coupled with over four decades of experience, provides customers with an end-to-end manufacturing partner for the design and production of powder metal components.

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.