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3D PRINTING & ADDITIVE MANUFACTURING INTELLIGENCE

THE YEAR OF BINDER JET

WITH AN INFLUX OF NEW SYSTEMS EXPECTED, **EXONE** SAYS 2021 IS BINDER JET'S YEAR.

SUPPLY CHAIN
The opportunities & challenges for AM

SOFTWARE
A look at the industry's latest software developments

CREATIVE
Fine jewellery design & bespoke architecture

THE YEAR OF BINDER JET

At least five new production metal binder jet systems are expected this year from ExOne, HP, Desktop Metal and GE, with more likely to follow.

In the early years, few engineers thought it would be possible to simply inkjet binder onto powder and deliver high-density metal parts. For most of the two decades that followed the original 1993 binder jet patent from MIT, that conventional wisdom reigned.

The ExOne Company, which was the original licensee of MIT's binder jet patents for metal, went on to launch the first metal binder jet system in 1998 and continued to print metals on increasingly sophisticated machines without any direct competition for years. With as-printed part densities hovering at about 55-60%, binder jetting metal was viewed as a niche process with limited potential. ExOne had to infiltrate its printed metal parts with another metal to fill in the gaps.

That all changed in 2013, when ExOne finally cracked the code on binder jetting metals to high densities, or those greater than 97%, during a joint R&D project with an aerospace company. The team thought if they could just print the finest available powders, the particles would compact, or order themselves, more densely. The challenge with that, of course, is that these powders don't flow easily like grains of sand; they clump together like baking flour and are difficult to flow and spread evenly. But the project was successful, and the news spread quickly.

Even after ExOne filed patents on its invention, however, it took the company several years to get the first commercially viable high-density metal 3D printer — the Innovent — to market in 2016. One of the biggest challenges was figuring out how to automate dispensing, spreading and compacting the powders.

The year after the Innovent launch was a big one for binder jetting: Digital Metal, a subsidiary of Höganäs, launched production of the DM P2500. Desktop Metal announced plans for its Production System. GE announced it would produce its own binder jet system. In 2018, HP announced its Metal Jet Fusion binder jetting system.

While the Digital Metal printer has been available since then, this year – 2021 – is the year that all those other binder jet printers are slated to come to market.

What's more, ExOne also launches a new version of the system that jump-started the sector, with its

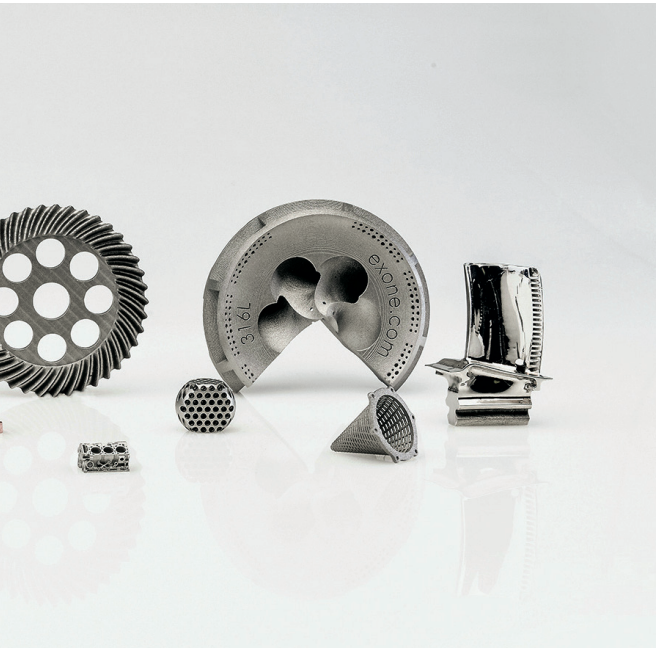
▲ **TOP:**
EXONE INNOVENTPRO

▲ **ABOVE:**
EXONE'S MATERIAL PORTFOLIO NOW OFFERS MORE THAN 20 MATERIALS

◀ **FROM THE COVER**
IN 2021, THE NEW EXONE METAL BINDER JET LINEUP WILL INCLUDE (LEFT TO RIGHT) THE X1 25PRO, ALREADY IN USE WORLDWIDE, THE INNOVENTPRO AND X1 160PRO

“Binder jet is well on its way to disrupting other manufacturing technologies.”

SHOWN:
PRODUCTION METAL BINDER JET PARTS



InnoventPro to be offered in a 3L and 5L size. Binder jetting is having such a moment, in fact, it wouldn’t be surprising if other companies jumped in.

“We really do believe this year is a turning point for binder jet 3D printing,” said John Hartner, ExOne’s CEO. “We see an increasing number of customers looking into how binder jet can help their business, whether it’s delivering lightweight parts, higher performance parts, or even decentralising their supply chain. It’s a truly exciting time, and we see the whole field growing.”

THE LURE OF BINDER JET

One of the reasons the lure of binder jetting has never really vanished, even though many doubted its ability to print high-density metal, is simple: speed.

In the complex field of additive manufacturing technologies, binder jetting is the most similar to paper printing and regarded as one of the fastest methods for volumetric output.

In binder jetting, an industrial printhead quickly inkjets binder (essentially a glue) onto a thin layer of powder particles – metal, sand or ceramic – creating a solid part one layer at a time. When printing metals, the final part must later be sintered in order to fuse the particles together.

When looking at metal 3D printing alone, almost every other method builds parts with a single point, either a laser or nozzle, that struggles to compete with a printhead. Multi-laser or multi-nozzle systems have grown increasingly common but, generally, adding those points isn’t as affordable as expanding a row of printheads.

“All technologies have their sweet spot, and binder jetting was really built for high throughput,” Hartner said. “Though we expect it to take time, binder jet is well on its way to disrupting other manufacturing technologies.”

INCREDIBLE MATERIAL FLEXIBILITY

Virtually any powder can be 3D printed in binder jetting so long as the right binder chemistry and sintering recipe can be developed and optimised to densify the printed part.

At ExOne, the company has printed everything from traditional MIM powders to concrete, trash and more. Creating bound powder designs is the easy part, with optimising recipes taking the most time.

Most of the new binder jetting systems that come to market in 2021 will arrive with stainless steel alloys, most often 316L and 17-4PH, but more materials are expected to follow. Digital Metal already offers at least six materials.

ExOne's material portfolio now offers more than 20 materials, including 11 single-alloy metals. That includes 17-4PH, 304L, 316L, M2 Tool Steel, Inconel 718, Cobalt Chrome, Copper, H13 Tool Steel, Inconel 625, Titanium and Tungsten Heavy Alloy. Aluminium, which is already qualified for R&D use on ExOne systems, has been fast-tracked for third-party qualification status, which indicates general market readiness. ExOne’s first aluminium alloys are expected to receive this status upgrade during 2021.

SUSTAINABILITY DRIVES BINDER JETTING

While most 3D printing technologies can call themselves green for their ability to deliver consolidated, lightweight parts and other benefits, binder jetting stands alone in one important respect: it can deliver a bigger impact.

The ability to produce high volumes of sustainable designs means that the technology can deliver sweeping benefits when it comes to lighter parts that can help decarbonise cars and other products. In fact, ExOne routinely delivers consolidated parts that are redesigned for up to 40% weight savings. What’s more, research has already shown that binder jetting has a material efficiency of up to 96%[1].

ExOne also recently joined the Additive Manufacturer Green Trade Association to support independent research into benefits like these so manufacturers can have data about the environmental impact of binder jetting. “Our team is confident about the broad sustainability benefits of binder jet,” Hartner said. “Whether it’s waste reduction, part consolidation, lightweighting or enabling decentralised manufacturing, we’re a company that is truly dedicated to our values and vision of Sustainable Manufacturing Without Limitations.”

REFERENCE

[1]Mirzababaei, S., Paul, B.K. & Pasebani, S. Metal Powder Recyclability in Binder Jet Additive Manufacturing. JOM 72, 3070–3079 (2020). https://doi.org/10.1007/s11837-020-04258-6