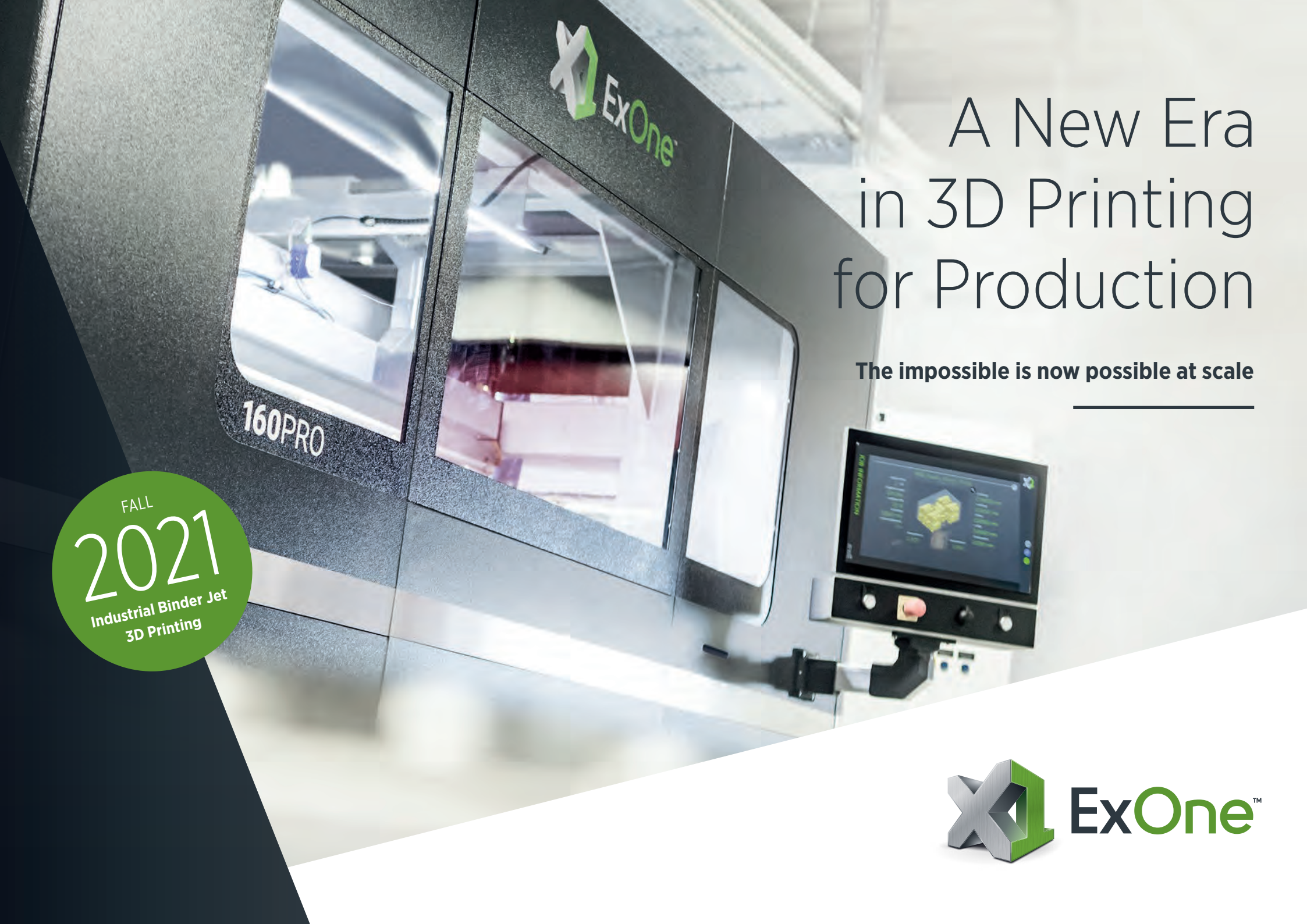


A New Era in 3D Printing for Production

The impossible is now possible at scale

FALL
2021
Industrial Binder Jet 3D Printing

ExOne™


ExOne
BINDER JETTING
Let's Solve
the Toughest
Problems.
And Change
the World.
PRODUCTION

OUR VISION

Sustainable Manufacturing Without Limitations

We're on a mission to deliver powerful 3D printers that solve the toughest problems and enable world-changing innovations.

Let’s Make It Right

The 3D future is built with powder, and it looks stronger than ever for binder jetting

ExOne and the field of binder jetting is stronger than ever.

I’m proud to say that we have a market-leading position in sand 3D printing, a breakout portfolio of new Pro-line metal 3D printers, such as the X1 160Pro™, and we’ve qualified a record number of binder jetting materials, such as aluminum 6061.

The advancements and interest in binder jetting comes at an important time for manufacturing and, really, the world at large. Sustainable parts and processes are desperately needed. Supply chains need decentralizing. These solutions are also needed in high volumes that can actually deliver a meaningful impact. Binder jetting checks all the boxes and then some.

But even more than our technology, I’m proud that ExOne is a solid team of world-class additive and materials experts who are friendly, collaborative, and passionate about achieving the impossible.

John Hartner
Director and Chief Executive Officer

We Are Pioneers.
And Global AM Leaders.

Our team is passionate about transforming manufacturing with fast, flexible binder jetting technology

Since 1995, we've been on a mission to deliver powerful 3D printers that solve the toughest problems and enable world-changing innovations.

Our industrial 3D printing systems quickly transform powder materials — including metals, sand, ceramics, or composites — into precision parts, metalcasting molds and cores, as well as innovative tooling solutions.

Industrial customers use our technology to:

- Save time and money
- Reduce waste
- Increase manufacturing flexibility
- Deliver designs and products that were once impossible

As home to the world's leading team of binder jetting experts, ExOne also provides specialized 3D printing services, including on-demand production of mission-critical parts, as well as engineering and design consulting.

We regularly work with clients to qualify a wide range of powders for specific applications and designs on which we collaborate to deliver the best results.

OUR 360° PRODUCTS & SERVICES

- Industrial binder jet 3D printers
- 3D printed parts and tooling on demand
- Installation, training, and support
- Design, engineering, and logistics

INDUSTRIES & SECTORS WE SERVE

- Aerospace
- Automotive
- Art
- Construction
- Defense
- Dental
- Energy
- Foundry
- Heavy Equipment
- Hydraulic
- Jewelry
- Medical
- Metal Injection Molding
- Oil & Gas
- Powder Metallurgy
- Pumps & Valves
- R&D

Learn more
exone.com/company
exone.com/partners

It Takes a Team

When you're working to solve the world's toughest problems with cutting-edge technologies, it truly takes a collaborative team that's open to the best ideas.

ExOne is proud to work with global experts and partners in academia and manufacturing to deliver the quality and repeatability necessary to bring a progressive manufacturing technology such as binder jetting from R&D and prototyping all the way to production.

At Formnext 2019 in Frankfurt, Germany, from left to right, Dr. Karsten Heuser, Siemens Digital Industries; Mathias Altmannshofer, Siemens; John Hartner, ExOne; Dr. Wolfgang Heuring, Siemens Motion Control; Andreas Nagy, ExOne; Marc Konrad, Siemens

SIEMENS
Altair
KENNAMETAL
GTP
OAK RIDGE National Laboratory
VDMA
Working Group Additive Manufactu
SANDVIK
ANSYS
ELNIK SYSTEMS

ExOne is Built on Values

As a leader in additive manufacturing for more than two decades, the ExOne team knows who we are and what we stand for—and what we don't.

We really listen. We tell it like it is. We don't spin. We care. We're in it for the long term. We want to make you successful. We want to partner with you to get there.

Most importantly, we really believe in making impossible projects possible through collaborative innovation.

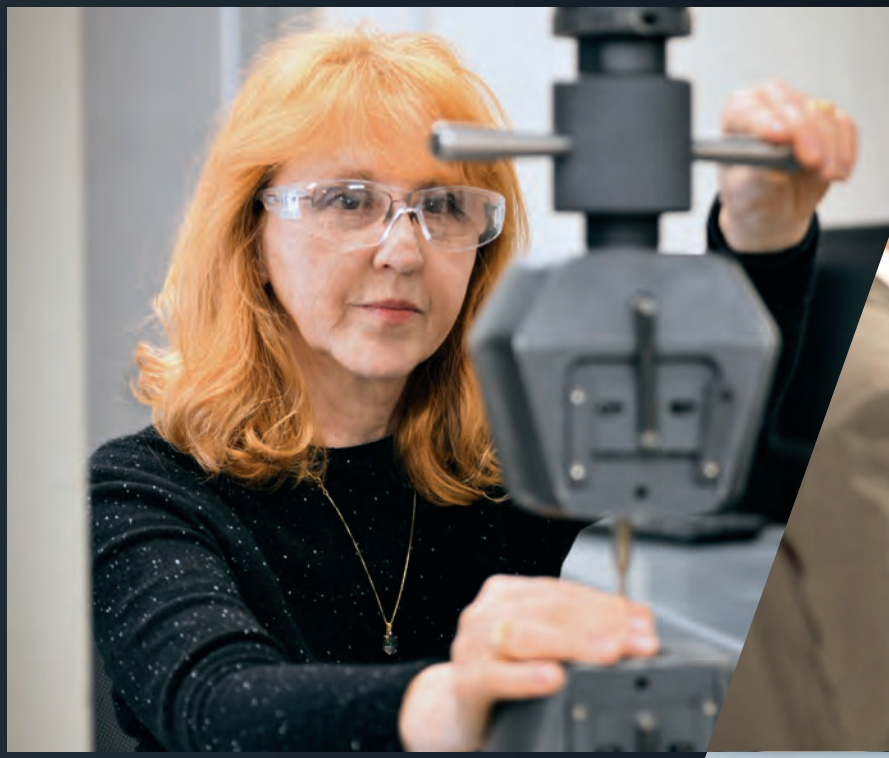
Learn more
exone.com/X1experts

INTEGRITY
In words and action.

POSITIVITY
We believe it's possible.

COLLABORATION
We build relationships.

INNOVATION
We deliver ideas that matter.



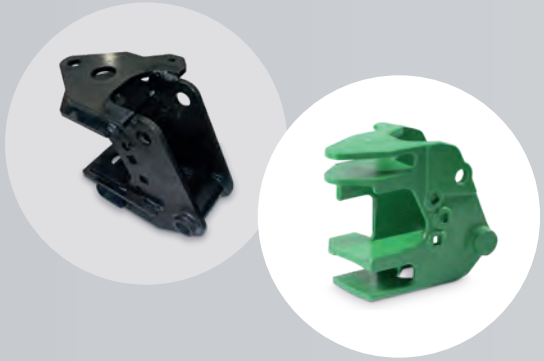
A dedicated team of world-class experts

At ExOne, We've Always Been Green

Binder jetting can deliver sustainability benefits at competitive costs and meaningful high volumes

From its inception as the 3D printing division of Extrude Hone in 1995, ExOne has always been focused on the sustainability benefits that binder jetting delivers. We might not have used the popular sustainability buzzword back then, but reducing the waste associated with traditional subtractive manufacturing and improving design freedom to make greener parts has driven us from the beginning.

That's why the ExOne logo has always been green, and it's why our R&D teams have been working so diligently for more than two decades to advance this technology.



2019 AFS Casting of the Year
This casting, enabled with ExOne sand 3D printing, consolidated 11 assembled part into one piece that reduced weight by 2.2 lbs and eliminated traditional tooling.

So, why is binder jetting so sustainable?

- Binder jetting fabricates metal, ceramic and composite parts with little to no waste. It offers a dramatic improvement over traditional manufacturing, which generates enormous volumes of debris, often toxic, that must be cleaned and recycled, or put into landfills
- Binder jetting enables all-new lightweight designs that were not previously manufacturable. That helps cars, planes and other heavy equipment consume less energy. Customers routinely reduce the weight of parts by 30–40% using our technology
- New designs enabled by binder jetting technology can deliver meaningful part consolidation that reduces waste and energy consumption along the supply chain by eliminating manufacturing process steps
- Binder jetting enables distributed manufacturing, closer to the point of use or assembly — reducing energy consumption for shipping and de-risking supply chains
- Our most popular binder, furan, is made from renewable sources, such as corn husks, rice hulls, sugar cane, and other biomaterials
- Our inorganic binder for sandcasting molds and cores uses a water-based geopolymer binder free of petroleum-based solvents and other volatile organic compounds (VOCs) — eliminating organic emissions during metalcasting

Yes, it's true that other 3D printing methods also reduce waste and offer similar design freedoms. So, here's what makes binder jetting truly unique:

> We can deliver all these benefits at speeds and volumes that are unmatched by other additive manufacturing technologies.

In other words, we can bring the benefits of 3D printing to a production environment at scale, delivering sweeping improvements that can truly make a difference. Bottom line: ExOne delivers sustainable parts made with sustainable technology in high volumes.

At ExOne, our entire global team is proud to offer a green, progressive manufacturing technology — because we believe technology has a role to play in solving the world's toughest problems.

We're delighted, too, that the world is getting more serious about getting green. Whether you print, pour or produce with ExOne's binder jetting technology, you can rest assured that you're 3D printing a better future.


FOUNDING
AMGTA
MEMBER

TECHNOLOGY

The Binder Jet Revolution is Here

Binder jet 3D printing is one of the seven primary branches of additive manufacturing recognized by ASTM.

Widely regarded as one of the fastest and most flexible methods of 3D printing, binder jetting can bind an entire layer of powderized material together quickly by scanning a print bed with a gantry of printheads dropping binder. Because our technology doesn't melt material together during printing, it's also extremely flexible in the types of powders it can print — from metals to ceramics, such as sand, to recycled materials, such as pulverized concrete and other types of refuse. Binder jet can also dial in porosity or density unlike any other AM method, 3D printing a range of output types from bonded and infiltrated to porous or highly dense.

Within the field of AM, we view binder jetting as the Swiss knife of AM — fast, flexible, and capable of solving a wide range of problems.

What is Binder Jetting?

Developed at MIT, first commercialized for metals by ExOne

Binder jetting is a method of 3D printing in which an industrial printhead quickly deposits a liquid bonding agent onto a thin layer of powdered particles, either metal, sand, ceramics, or composites.

The process is repeated layer by layer, using a map from a digital design file, until the object is complete.

Initially developed at the Massachusetts Institute of Technology in the early 1990s, ExOne obtained the exclusive license to this inkjet-in-powder-bed method of 3D printing in 1996.

Two years later, ExOne launched the market's first commercial binder jet 3D printer for metals, the Rapid Tooling System known as RTS-300. In 2002, ExOne launched its first sand 3D printer, the S15.

ExOne 3D printers have been used by industrial customers ever since.

Why Binder Jetting?

Fast and flexible, from materials to output types

With its wide, scalable gantry of printheads bonding a full layer together, binder jetting is regarded as one of the fastest forms of 3D printing for volumetric output. That helps manufacturers deliver sustainable, new, innovative designs with less waste at high volumes.

But that's just one part of the many reasons binder jetting is so incredibly attractive. When you're 3D printing powder at low temperatures without melting, as you do with binder jetting, you also have incredible flexibility in materials but also in product forms or, as we like to say, output types.

Binder jetting allows you not just to print a precise form, but to dial in the structure of that form in ways that few other forms of additive manufacturing, or even traditional manufacturing, can do.

ExOne has its long history in binder jetting development to thank for its understanding of these output types:

Bonded Parts are simply bound powder particles that require no further post-processing for their application. In sand 3D printing, this is a frequent ouput state for metalcasting when silica sand is bound with a binder such as furan.

Infiltrated Parts are bonded powder parts that have been infiltrated with another material. Infiltration is simply when another material is wicked into the printed form—similar to water being wicked into a sponge.

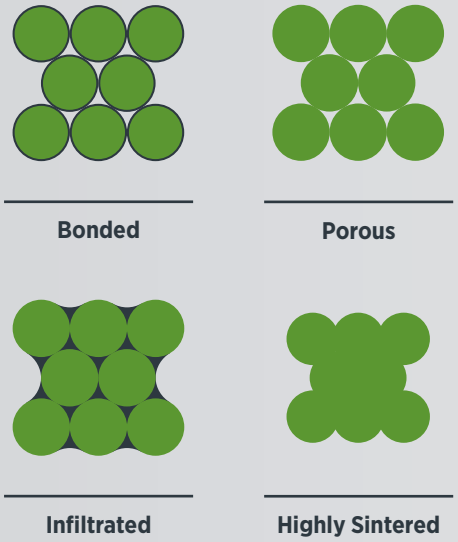
Infiltrated parts typically start off as 3D printed sand, ceramic, or metal. Then, they are infiltrated with resins, other metals, or even other materials, to create durable tooling, construction materials, and more.

For example, aluminum-infiltrated boron carbide (B_4C), which is used to make neutron imaging components, an be created this way. ExOne's affordable and durable 420i material is 420 stainless steel infiltrated with bronze. And some of our new tooling products start out as sand forms before they are infiltrated with resins that make them super durable. Also popular: 3D printed silicon carbide infiltrated with silicon (SiSiC) for optical mirrors.

Porous Parts are lightly or partially sintered metal or ceramic parts. Some applications, such as filters or medical devices, benefit from strong porous structures.

Finally, we move on to **High-Density Parts**. Today, ExOne can binder jet 3D print metal parts that are repeatably and reliably sintered to final densities of 97–99%. Depending on material, our metal parts are in line or better than traditional results from Metal Injection Molding (MIM) or gravity castings.

OVERVIEW OF OUTPUT MATERIAL STATES

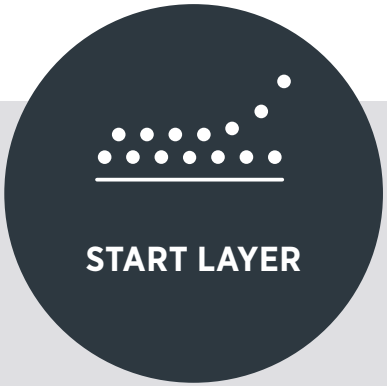


Binder Jetting Process: Simple & Flexible

DIGITAL FILE PREP

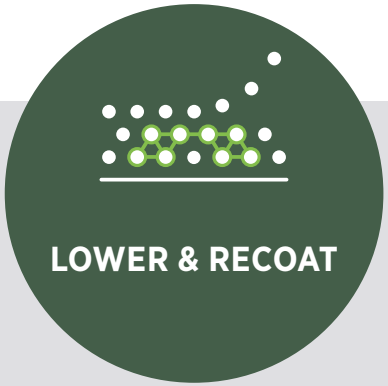
MACHINE & MATERIAL PREP

3D PRINTING



The recoater applies the first thin layers of powder — either sand, metal, or another material — in the print area or job box.

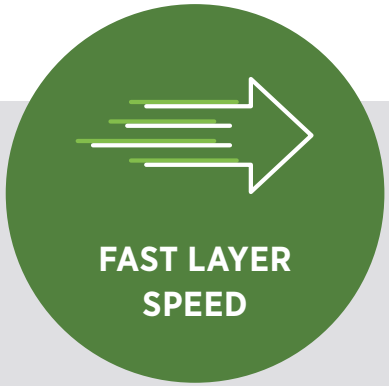
A gantry of industrial printheads selectively applies binder to the powder to bind particles together where desired. Different binders work with different materials to achieve desired results.



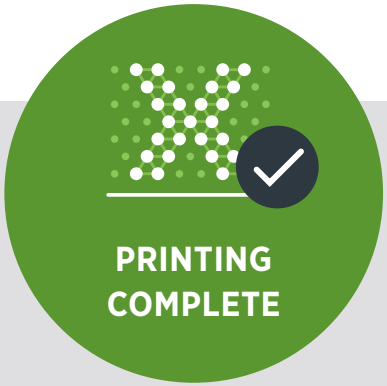
After each layer, the bed lowers for the next layer to be applied. Recoating is a critical step in binder jetting, as the consecutive powder layers must be precisely and compactly applied to deliver a high-quality precision part. Whether using coarse or fine particles, powder handling is a critical element of successful binder jetting.

Learn more
exone.com/bjt

Once the next powder layer has been applied to the print area, the stage has been set for the next layer of binder to be selectively deposited. This recoating-and-binding sequence is repeated until the part is complete.



With a full sweep of printheads, a binder jet 3D printer can complete a full layer very quickly. This is one of the core benefits of binder jetting compared to other additive manufacturing methods.



Once the print job has finished, parts can be removed from the print area or job box. Depending on the material and binder used, additional curing and post-processing steps may be necessary. For certain sand binders, parts should be cured in an oven or microwave. Metal parts typically require curing and sintering.

Next steps depend on application and specific materials

Sand Molds & Core (Page 30)	Tooling (Page 57)	Metal & Ceramics (Page 40)
CURING (Depending on binder)	DEPOWDER	CURING
DEPOWDER	COAT OR INFILTRATE	DEPOWDER
		DEBIND & SINTER

SUCCESS STORIES

Real Manufacturers, Real Binder Jet Solutions

Around the world, ExOne customers have been using our binder jet 3D printing technology to deliver meaningful solutions to their customers and their bottom line. Whether it's through the speed that gets prototypes and products to market faster, part consolidation that delivers meaningful weight savings, or innovative new designs that were once impossible — ExOne customers are pioneering their own future with the latest technology that challenges the status quo way of manufacturing.

On these pages, learn how ExOne users are transforming the future with our exclusive binder jet 3D printing technology. What could you do with an ExOne 3D printer?

EISENGIESSEREI MEZGER

Sand Binder Jetting Speeds Delivery, Improves Quality

CHALLENGE

As an iron foundry that specializes in small and medium production castings in a variety of industries, Mezger was in need of a solution to produce high-quality cores quickly and with minimal labor. Speed in production was a main issue for the company, which also specializes in prototype development, limited-run series, and replacement parts.

SOLUTION

Integrating the S-Max® Pro allowed the company to offer complex designs and hybrid mold castings — where a conventionally produced mold is paired with a monolithic core that has been 3D printed. The high level of integrated automation enables stable 24/7 operation with remote monitoring via the Scout App. The speed of the digital workflow and S-Max® Pro machine allows the company to deliver cast parts to customer in as little as three days.

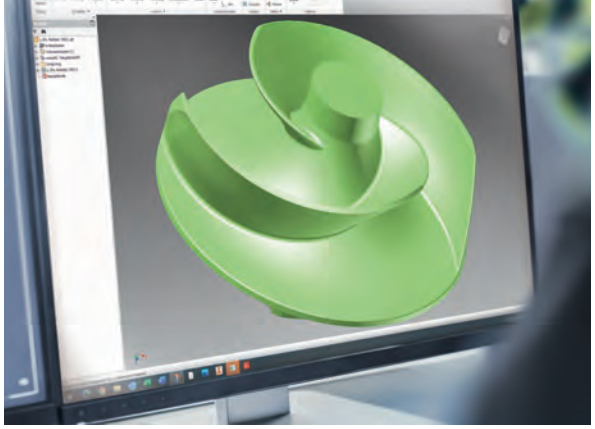
Valuing sustainability, the company utilizes the desanding station to recycle excess sand from the job box to minimize waste and disposal costs. By creating a semi-automated process, the furan desanding station allows the company to recover 95 % of the material with minimal labor and successfully integrate an 80 % recycled mixture into their production. Printing straight from CAD files has also reduced the number of models Mezger keeps in storage.

CUSTOMER ADDED VALUE

High-quality molds and cores are completed in just 12 hours, while a raw cast part is completed in around 3 days. Diverse geometries and projects can be flexibly taken from the CAD model for every printing process. In the interest of sustainability, the desanding station helps capture recycling sand during each printing process, which is then added to the fresh sand for the next process, thereby minimizing waste and disposal costs.

*"We wanted the ability to produce competitively with **high-quality in a high-wage country** and do so quickly."*

Dieter Diebold,
Foundry Manager Mezger AG



VIDEO
See ExOne technology at the Mezger foundry
exone.com/mezgervideo

EISENGIESSEREI MEZGER

INDUSTRY / PRODUCTS
Machine- and hand-molded cast parts, metal processing and installation

HEADQUARTERS
Kallnach, Switzerland

EMPLOYEES
45

CUSTOMER SPECTRUM
Mechanical engineering, gas and water supply, district heating supply, engine and tool manufacturing

WEBSITE
www.mezgergroup.com

Eisengiesserei Mezger AG

FEATURES EXONE S-MAX® PRO

NUMBER OF JOB BOXES
2

ADDITIONAL DESANDING STATION
Vacuum extraction unit with funnel system for quick and clean desanding at the push of a button

ADDITIONAL FLUIDMATIC SYSTEM
Central, automatic material supply for a seamless printing process

SIEMENS MINDSPHERE & EXONE SCOUT APP
The machine-monitoring app Scout is a key step in ExOne's strategy to surround its printers with a complete digital workflow.

TRADITIONAL PROCEDURE

The cores for the iron cast are procured from an external supplier. As such it was not possible to react to customer requests or last-minute changes.

MANUFACTURING TIME
10 days

EXONE SAND PRINTING PROCEDURE

Preparation and post-processing times are reduced and the casting molds can be flexibly adapted to all changes.

MANUFACTURING TIME
Approx. 12 hours

XYLEM WATER SOLUTIONS

Reduced Core Assembly Increases Yield at Lower Costs

CHALLENGE

Water pump impeller cores traditionally made with core shooters required four segments to be glued together with gum. This created a seven-day lead time and high scrap rates created by core gum gas or core drafts. Production was to be accelerated and the quality of the cores improved.

SOLUTION

Using the freedom of design of additive manufacturing, Xylem reduced the multi-part assembly to a single-piece. What was once four parts from the core shooter is now 3D printed as one monolithic core on the ExOne S-Max®, eliminating the need for assembly and the related defects from core gum gas pockets. Since the printer impeller cores have no drafts, the final castings require less post-processing, enabling streamlined operations. Production time was reduced from seven to two days, allowing Xylem to deliver impeller cores faster, at higher quality, and at a lower cost.

CUSTOMER ADDED VALUE

ExOne binder jetting cut lead times over 70 % and enables just-in-time production as up to 480 cores can be printed in one 24-hour process. “The quality of the impeller cores has improved significantly, at the same time, the production costs have decreased by around 30 %” said Torbjörn Andersson, 3D Technician at Xylem.

Impeller core printed as one piece | Conventionally manufactured impeller core

XYLEM WATER SOLUTIONS

INDUSTRY / PRODUCTS
Water treatment, pumps, filters, heat exchanger

HEADQUARTERS
Rye Brook, NY, USA

APPLICATION
Impeller cores for casting water pump impellers

WEBSITE
www.xylem.com

FEATURES EXONE

3D PRINTER
S-Max®

MATERIAL
Silica sand with CHP binder

PART SIZE
220 mm (8.7 in) diameter
60 mm (2.4 in) tall

“The quality of the impeller cores has improved significantly through the 3D printing process. At the same time, the ***production costs have decreased by around 30 %*** *for certain parts.”*

Torbjörn Andersson,
3D Technician at Xylem

DEEPTIME

Audio Startup Brings High-Fidelity Form and Function to Market

CHALLENGE
Standard PC speakers are compact, but generally offer poor sound performance while quality equipment is often large and expensive. Deeptime sought to produce compact speakers that were both high-quality and visually appealing without a hard tooling investment.

SOLUTION
Working with the ExOne Adoption Center to 3D print uniquely shaped sand forms directly from CAD files, Deeptime now receives raw speaker housings to their facility in just seven days without any tooling necessary. Despite the raw sand being porous, which is not ideal of acoustic applications, the economic and design advantages of binder jetting allowed Deeptime to develop a proprietary solution to infiltrate the porous sand structures. The outstanding sound properties of the final products exceeded even the high expectations of the developers.

CUSTOMER ADDED VALUE
Sand 3D printing was cheaper than plastic while providing more rigidity and allowing mass customization with no minimum order sizes. A study at Brno University of Technology showed Deeptime's speaker to be 86 % more rigid than MDF, leading to double the sound damping compared to a traditional speaker.

DEEPTIME

INDUSTRY / PRODUCTS
Innovative 3D printed speaker systems

HEADQUARTERS
Bustehrad, Czechia

APPLICATION
Sand 3D printed raw housing for sound system

WEBSITE
www.deeptime.limited

FEATURES EXONE

3D PRINTER
S-Max® Pro

MATERIAL
Silica sand with furan binder

PART SIZE
208 × 117 × 222 mm

*"A two-year study conducted at the **Brno University of Technology** verified the acoustic properties of the finished material; **the sand structure manufactured on ExOne 3D printers is 86 % more rigid than MDF.**"*

Ondrej Chotovinsky,
Founder of Deeptime

FREEFORM TECHNOLOGIES

Metal Binder Jetting Delivers Affordable, Durable, Lightweight Solution

CHALLENGE

Develop a strong, lightweight end of arm tooling (EOAT) attachment for a high-volume precision inspection application with varying weight requirements. The complex part enables two tools to sit at a 90-degree angle to each other on one arm.

SOLUTION

Generative software produced a lightweight design that could only be manufactured with 3D printing, yet carbon-reinforced plastic didn't offer the durability needed to inspect up to 500,000 parts annually with weights up to 2.5 pounds. Binder jetting was one-fourth the price of laser powder bed fusion and allowed the company to print in traditional MIM 17-4PH stainless steel powder for the required strength. Final materials met MPIF Standard 35 and customer requirements and the unique design reduced the overall payload on the robot.

CUSTOMER ADDED VALUE

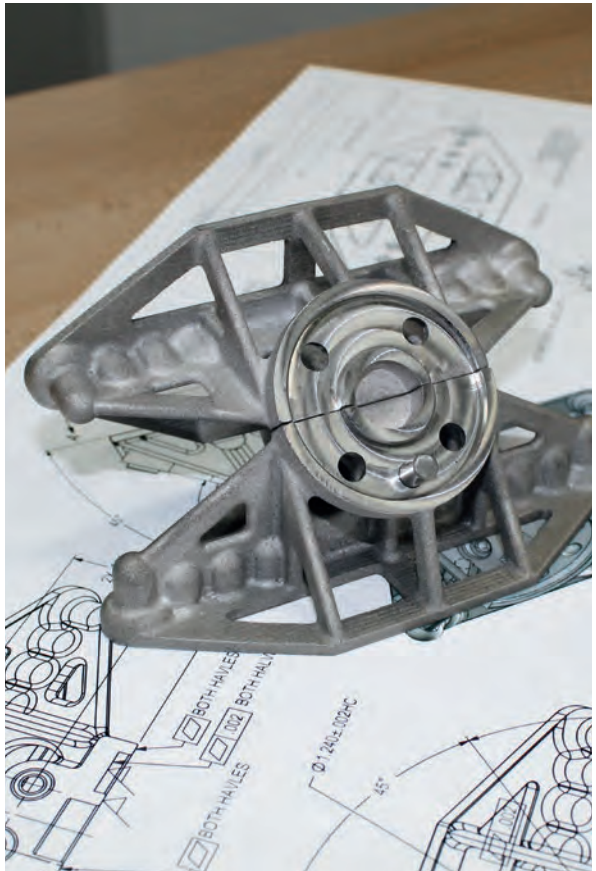
In less than a day of printing in standard MIM powder on the Innovent+®, the EOAT part delivered a final density of 98 % and hardness of HRC 27, eliminating the need for heat treatment. Machining the desired functionality, even in aluminum, would have been heavier to achieve the same strength as 17-4PH.

BENEFITS

Generative software produced a lightweight design that could not be manufactured outside of 3D printing. Binder jet 3D printing the part was one-fourth the price of laser powder bed fusion process. Final materials met MPIF Standard 35 and customer requirements.

*"Binder jet was **one-fourth the cost of DMLS,** and we did it in a strong material that reduced the payload on the robot."*

Chris Aiello, VP,
Business Development
FreeFORM Technologies



FREEFORM TECHNOLOGIES

INDUSTRY / PRODUCTS
Robotics — automotive parts manufacturing

HEADQUARTERS
Saint Marys, PA

APPLICATION
End of arm tooling

WEBSITE
www.freeformtech.com

FreeFORM technologies

FEATURES EXONE

3D PRINTER
Innovent+®

MATERIAL
17-4PH Stainless Steel (D90 of 22 µm)

PART SIZE
120 × 50 × 50 mm (4.5 × 2 × 2 in)

WEIGHT
95 grams (3.35 oz)

TECNALIA

Hard Metal and Tool Steels for Cutting Tools

CHALLENGE
Investigate binder jetting of tungsten carbide cobalt (WC-Co) and M2 high-speed steel materials which are widely used in the tooling industry. With very demanding requirements, the tools must withstand the harsh in-service environments. To obtain the final required properties comprehensive process development was needed from raw materials and 3D printing to post processing treatment.

SOLUTION
Binder jet additive manufacturing overcomes the limitations of the beam-based additive manufacturing processes since it does not use heat sources to melt material during printing, rather selectively deposits binder from a printhead onto the powder bed without thermal fluctuations. This eliminated the heating and cooling related defects, such as cracks and compound decomposition, often found when additively processing WC-Co and M2. The flexibility of the Innovent binder jetting machine allowed the TECNALIA team to print the challenging materials after exhaustive selection and powder conditioning optimized for the binder jetting process. New functional designs enabled by additive manufacturing allowed the team to embed cooling channels to reduce the tools' temperature during operation.

HIGHLIGHTS
Printing near net shapes reduced difficult and expensive machining and cut lead times by 75%, with tools produced in one week with ExOne binder jet technology compared to four weeks for conventional processes. This allowed the manufacturer to start production faster while running more efficiently since the integrated cooling channels allowed higher machining speeds that increased productivity and decreased coolant consumption.

TECNALIA

INDUSTRY / PRODUCTS
Research & Development for a variety of industrial customers

HEADQUARTERS
San Sebastián, Spain

APPLICATION
Cutting tools: inserts and drills

WEBSITE
www.tecnalia.com

FEATURES EXONE

3D PRINTER
Innovent®

MATERIAL
Hard Metal (WC-Co) and Tool Steel (M2)

*"After sintering, parts with **densities comparable to traditionally manufactured commercial parts** were obtained. In addition, the hardness and fracture toughness for the material was also comparable."*

Dr. Iñigo Agote,
Project Manager and Group Leader,
TECNALIA

MSA SAFETY

Speeding up Product Development

CHALLENGE

Long tooling lead times of traditional powder metal processes prevented MSA from being able to properly evaluate prototype performance before production. They set out to find a process that allowed their engineering team to quickly iterate metal parts through design concepts while saving time, costs, and shortening time to market.

SOLUTION

Using ExOne metal 3D printing service provided functional prototype parts for testing in the same material as the production pieces would eventually be produced in. The build volume of the X1 25Pro® enabled MSA to print a variety of designs at once and the quick turnaround times without hard tooling allowed them to continue to iterate designs for the optimal product.

HIGHLIGHTS

ExOne's fast production of prototype parts help speed up MSA's new product development. Traditional tooling required a four-month lead time with costs upwards of $10,000 for one design, while ExOne binder jetting allowed MSA to print 100 different prototypes in one build for testing without an up-front investment in tooling.

*"The primary driver is time. That's what makes the biggest difference for me. We are constantly **looking for ways to shorten our lead times,** and ExOne was able to deliver the parts to us in under two weeks."*

Matthew Jacob,
Mechanical Engineer, MSA

MSA SAFETY

INDUSTRY / PRODUCTS
Industrial Safety Equipment

HEADQUARTERS
Cranberry Township, PA

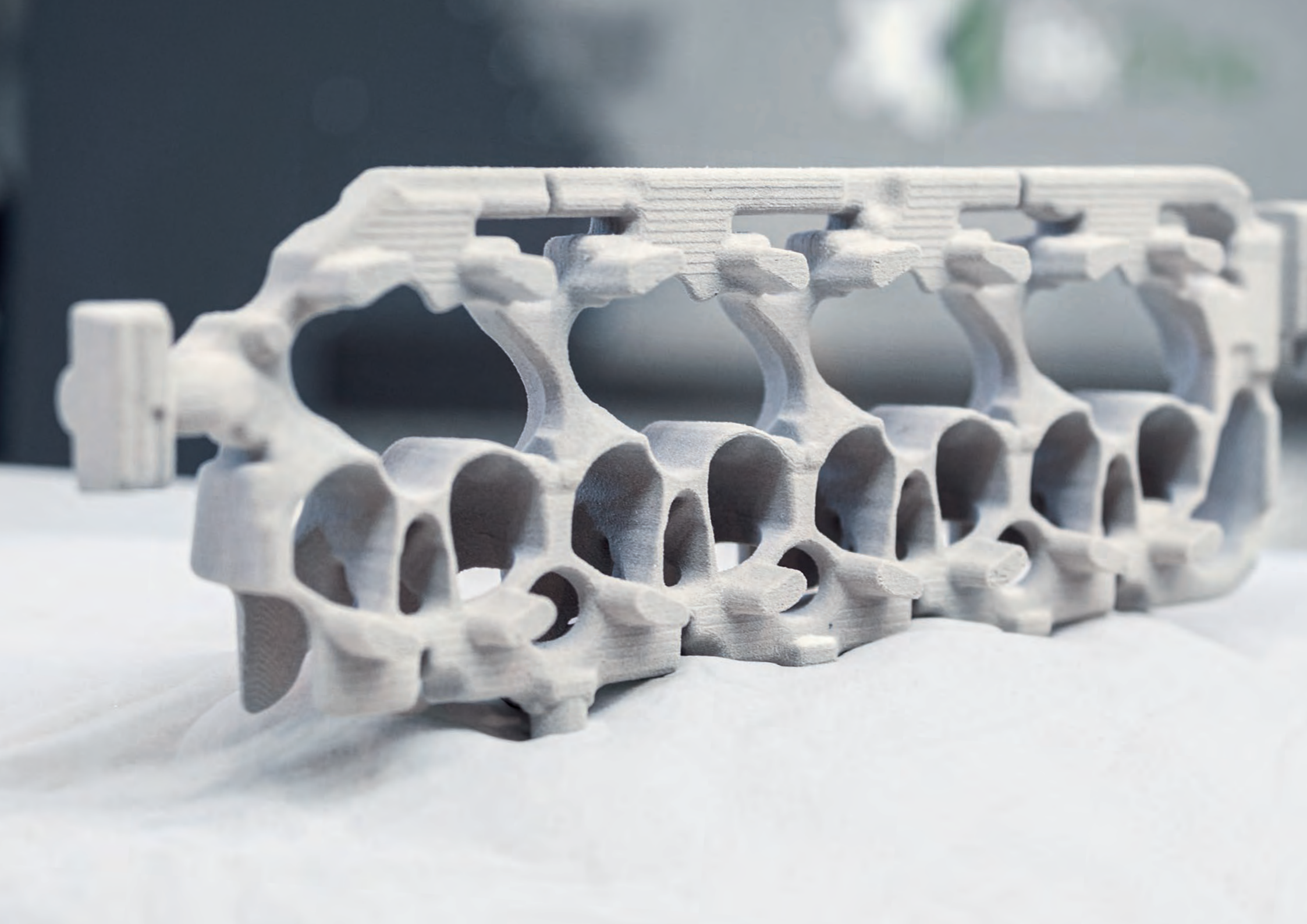
APPLICATION
Self-retracting lifeline device

WEBSITE
https://us.msasafety.com/

FEATURES EXONE

3D PRINTER
X1 25Pro®

MATERIAL
316L



SAND

The 3D Printing that Revolutionized Metalcasting

ExOne sand 3D printers are transforming the centuries-old method of sandcasting by eliminating the need for hard tooling. The digital workflow saves time and money on pattern production and storage while enabling rapid geometry iterations and exceptional design freedom.

Consolidate cores, incorporate previously impossible rigging features into molds, and lightweight parts through complex organic designs. At the same time, deliver casting in mere days using binder jetting to produce cores the way they were meant to be made.

- Consolidated and complex sand molds and cores
- Innovative 3D printed sand tooling
- Rigging design, virtual casting simulation, and sand 3D printing on demand
- Automated production accessories

Complexity is Simple

From complex prototypes to production in a few hours

Ultra-complex part geometries are at the heart of sand core and mold 3D printing. Whether producing previously impossible shapes, variable core geometries, or iterative design changes, most everything can now be done simultaneously in a single print. What's more, it can all be done in hours or days instead of weeks or months.

DIGITAL FILE PREP

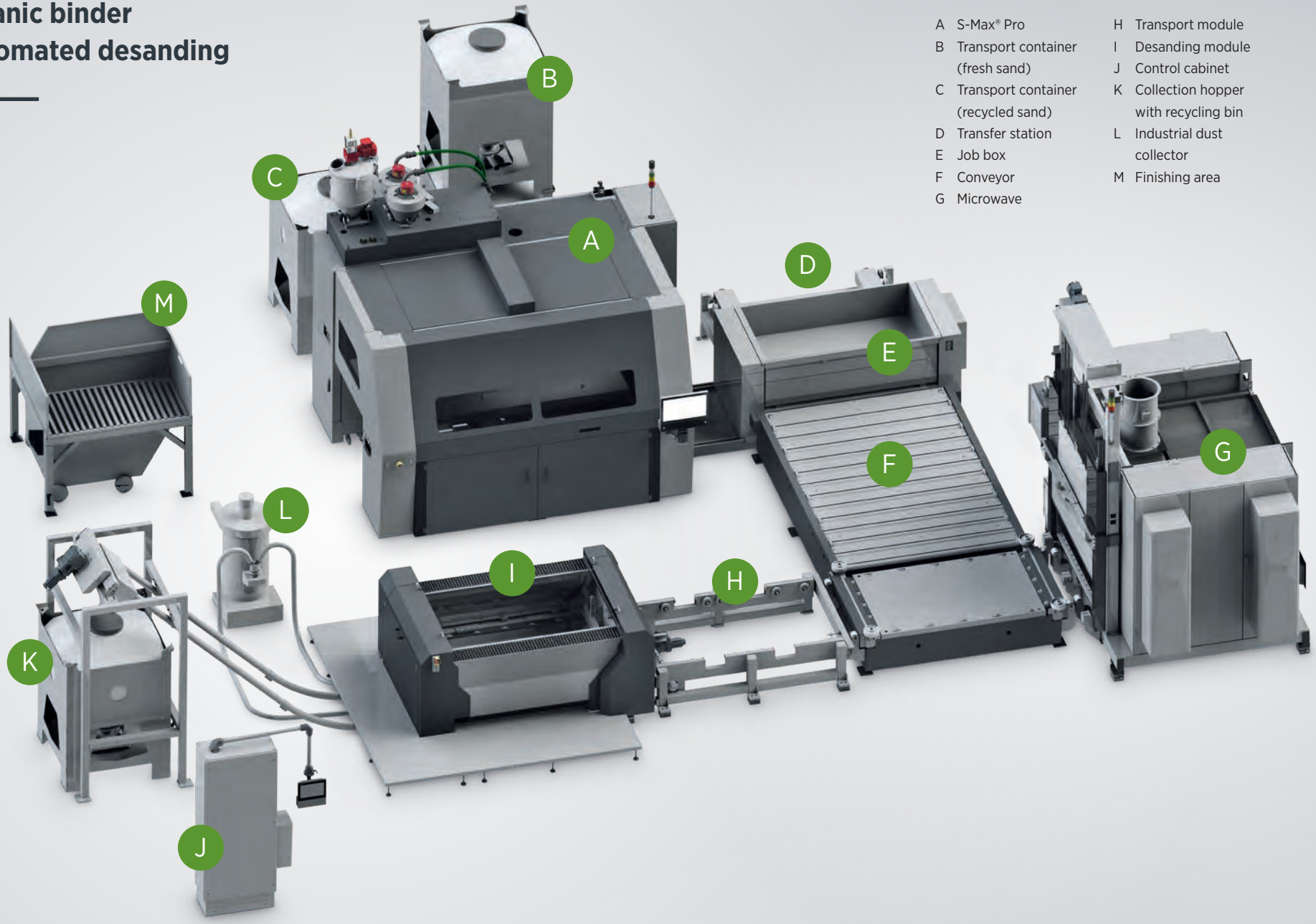
MACHINE & MATERIAL PREP

3D PRINTING

Next steps depend on application and specific materials

Furan	CHP	HHP	Inorganic
DEPOWDER	OVEN CURING	MICROWAVE CURING	MICROWAVE CURING
	DEPOWDER	DEPOWDER	DEPOWDER

Process using the example of inorganic binder with automated desanding



A S-Max® Pro
B Transport container (fresh sand)
C Transport container (recycled sand)
D Transfer station
E Job box
F Conveyor
G Microwave
H Transport module
I Desanding module
J Control cabinet
K Collection hopper with recycling bin
L Industrial dust collector
M Finishing area

Sand 3D Printing Machines

S-Print®

A fast, flexible, reliable and compact sand 3D printing machine. Delivering highly accurate complex parts from digital data since 2005.

- Prototyping
- Rapid product development
- Short-run production

APPLICATION
Binders: Furan, CHP, HHP, Inorganic

TECHNICAL DATA
Build box: L 800 × W 500 × H 400 mm (L 31.5 × W 19.7 × H 15.8 in)
Build volume: 160 l
Max build rate: up to 39 l/h layer height**: 0.26 – 0.38 mm
** Depending on material.

S-Max®

A large and robust sand 3D printer known for reliable performance. Double job box option. Printing cold-hardening binders since 2010.

- Prototyping
- Rapid product development
- Short-run production
- Continuous 24/7 production

APPLICATION
Binders: Furan, CHP

TECHNICAL DATA
Build box: L 1,800 × W 1,000 × H 700 mm (L 70.9 × W 39.4 × H 27.6 in)
Build volume: 1,260 l
Max build rate: up to 100 l/h layer height**: 0.26 – 0.38 mm
** Depending on material.

ExOne's family of sand 3D printers is the most popular in the world for digital manufacturing of sand cores and molds for metalcasting. With our trusted machines, you can go from design to metalcasting in hours or days instead of weeks and months.

No more patterns needed for sand molds. No more molds needed for blowing cores. No jigs or fixtures needed for core assembly. Print complex cores in one piece. This is how cores were meant to be made.

Learn more
exone.com/sandprinters

S-Max® Pro

Our fastest and smartest large sand 3D printer.
All-new automated printhead and recoater.
Innovative production features. Reliable since 2019.

- Prototyping
- Rapid product development
- Short-run production
- Continuous 24/7 production
- Serial production

APPLICATION
Binders: Furan, CHP, HHP, Inorganic

TECHNICAL DATA
Build size per box: L 1,800 × W 1,000 × H 700* mm (L 70.9 × W 39.4 × H 27.6 in)
Build volume: 1,260 l
Max build rate: up to 125*** l/h layer height**: 0.26 – 0.38 mm

* Available 400 mm option box-in-box system. ** Depending on material. *** Depending on layer height.

Specifications are subject to change without notice. Some data may be dependent on size and characteristics of powder being processed.

Sand 3D Printing Accessories

Desanding Station

The semi-automatic desanding station for your job box is a technological solution that significantly accelerates the desanding process. The desanding station can be installed and retrofitted efficiently on all S-Max® and S-Max® Pro models.

- Reduce time and costs spent harvesting parts
- Efficiently use your job box by keeping it ready for print
- Intuitive operation simplifies material recycling

For S-Max® and S-Max® Pro printers with furan or CHP binders

Video
exone.com/desanding

APPLICATION
FB001 (Furan) or FB201 (CHP) binders in combination with:
- Standard sand types FS001, FS003
- Cerabeads® sand types

TECHNICAL DATA
Dimension with platform: L 3,488 × W 3,337 × H 1,298 mm (L 137.3 × W 131.4 × H 51.1 in)
Dimension without platform: L 2,180 × W 1,767 × H 1,298 mm (L 85.8 × W 69.6 × H 51.1 in)
Piping standard: 5 m (196.8 in)

Automated Desanding Station

The pioneering automation technology in the ExOne desanding station can reduce job box material removal time by up to 95 %. A state-of-the-art PLC system and integrated sensors save labor costs and increase the speed of desanding cores printed using inorganic binders.

- Fully automated desanding of 3D printed cores
- Increased Overall Equipment Efficiency (OEE)
- Improved ergonomics and work safety

For S-Max® Pro printers with inorganic binder

Video
exone.com/autodesanding

APPLICATION
Inorganic binder (FB901) in combination with the box-in-box system for processing silica sand as a standard molding material.

TECHNICAL DATA
Dimensions: L 8,700 × W 3,300 × H 2,700 mm (L 342.5 × W 129.9 × H 106.3 in)
Total weight: ~ 3,000 kg
Supply voltage: 400 V, 50/60 Hz, 3-/N/PE
Pressurized air: 6 – 10 bar (dry and free of residual oil)

ExOne Scout

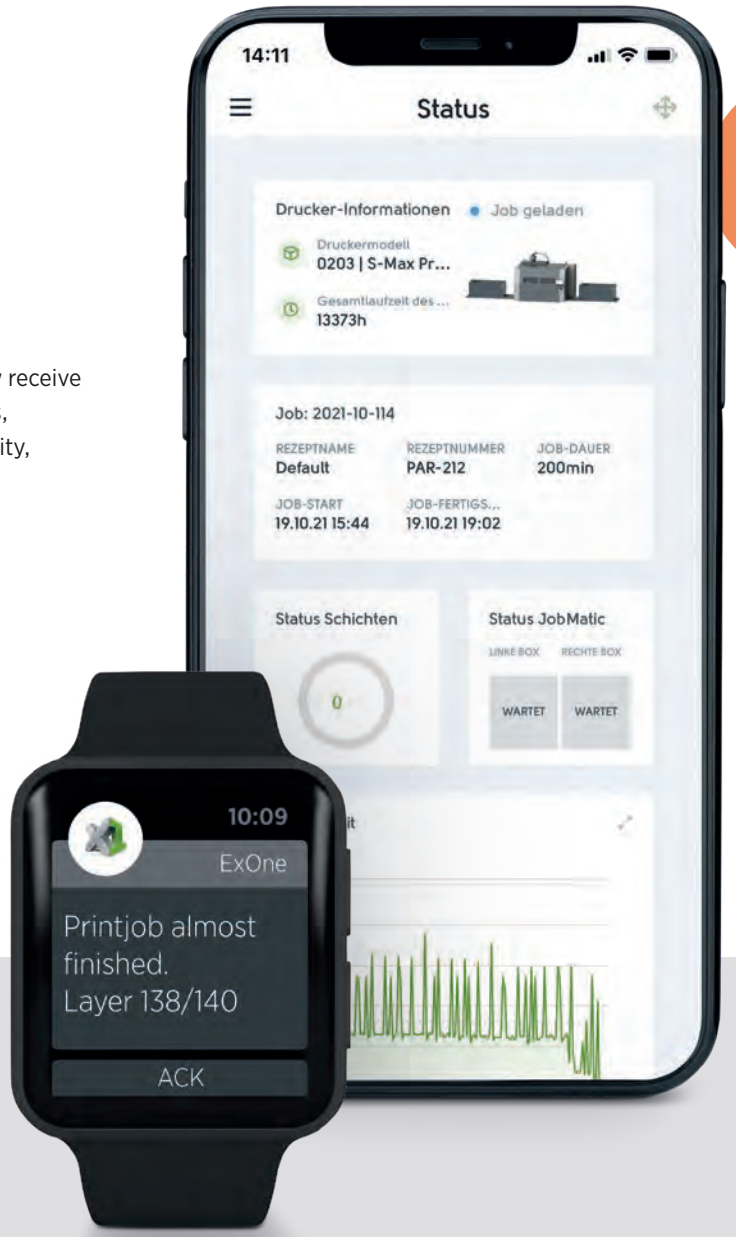
ExOne Scout is a secure Industry 4.0 app that provides real-time machine monitoring and analysis of ExOne production 3D printers on a wide range of digital devices, including smart phones and watches. ExOne Scout is now available for download in the Apple App Store and on Google Play. It's currently designed for use with sand and metal production 3D printers enabled by Siemens MindSphere, an Internet-of-Things operating system with multilayered security.

Users will now be able to connect ExOne 3D printers powered by Siemens MindSphere to Scout to simplify machine monitoring, receive real-time insights, and benefit from enhanced quality assurance and analysis.

What's more, smart phones and watches can now receive push notifications through Scout about job status, printhead speed, fluid levels, temperature, humidity, and other actionable manufacturing data.

APP HIGHLIGHTS

- Real-time machine monitoring
- Live insights and analysis
- Enhanced quality assurance
- Full reporting capabilities



Also available for metal printers page 42

AVAILABLE MACHINE INTEGRATIONS

- S-Max® Pro production sand 3D printers enabled with Siemens MindSphere
- Coming Soon: X1 160Pro™ production metal 3D printers enabled with Siemens MindSphere

Sand 3D Printing Materials

Furan

Cold-Hardening Binder System

CASTING MATERIAL
Steel, Iron, Non-Ferrous Metal

LOI
1.7–2.1%

CHARACTERISTICS*
Hot strength: 5–8**
Filigree character: 5–6
Strength: 7–8
Environmental impact: 3
Finishing: 3

MOLDING MATERIAL
Standard Process: Silica Sand
Alternative: Synthetic Sand

CHP

Cold-Hardening Binder System***

CASTING MATERIAL
Steel, Iron, Non-Ferrous Metal, Bronze

LOI
1.4–2.1%

CHARACTERISTICS*
Hot strength: 7–10
Filigree character: 10
Strength: 8–10
Environmental impact: 6
Finishing: 10

MOLDING MATERIAL
Standard Process: Silica Sand
Alternative: Synthetic Sand

HHP

Hot-Hardening Binder System

CASTING MATERIAL
Steel, Iron, Non-Ferrous Metal, Bronze

LOI
1.5–2.1%

CHARACTERISTICS*
Hot strength: 9–10
Filigree character: 7–8
Strength: 9–10
Environmental impact: 5
Finishing: 7–8

MOLDING MATERIAL
Standard Process: Synthetic Sand

Inorganic

Inorganic Binder System

CASTING MATERIAL
Non-Ferrous Metal, Light Metal

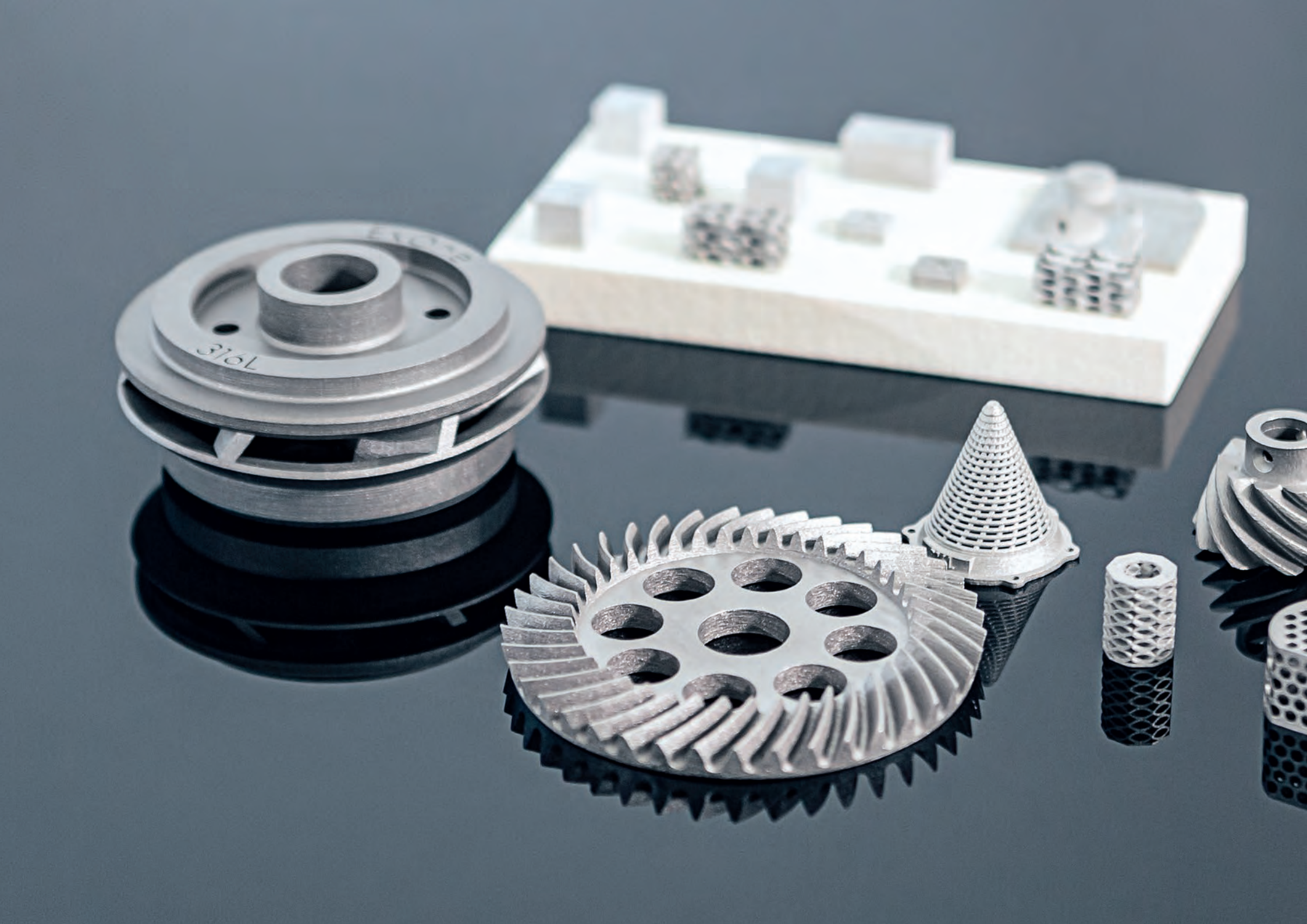
LOI
–

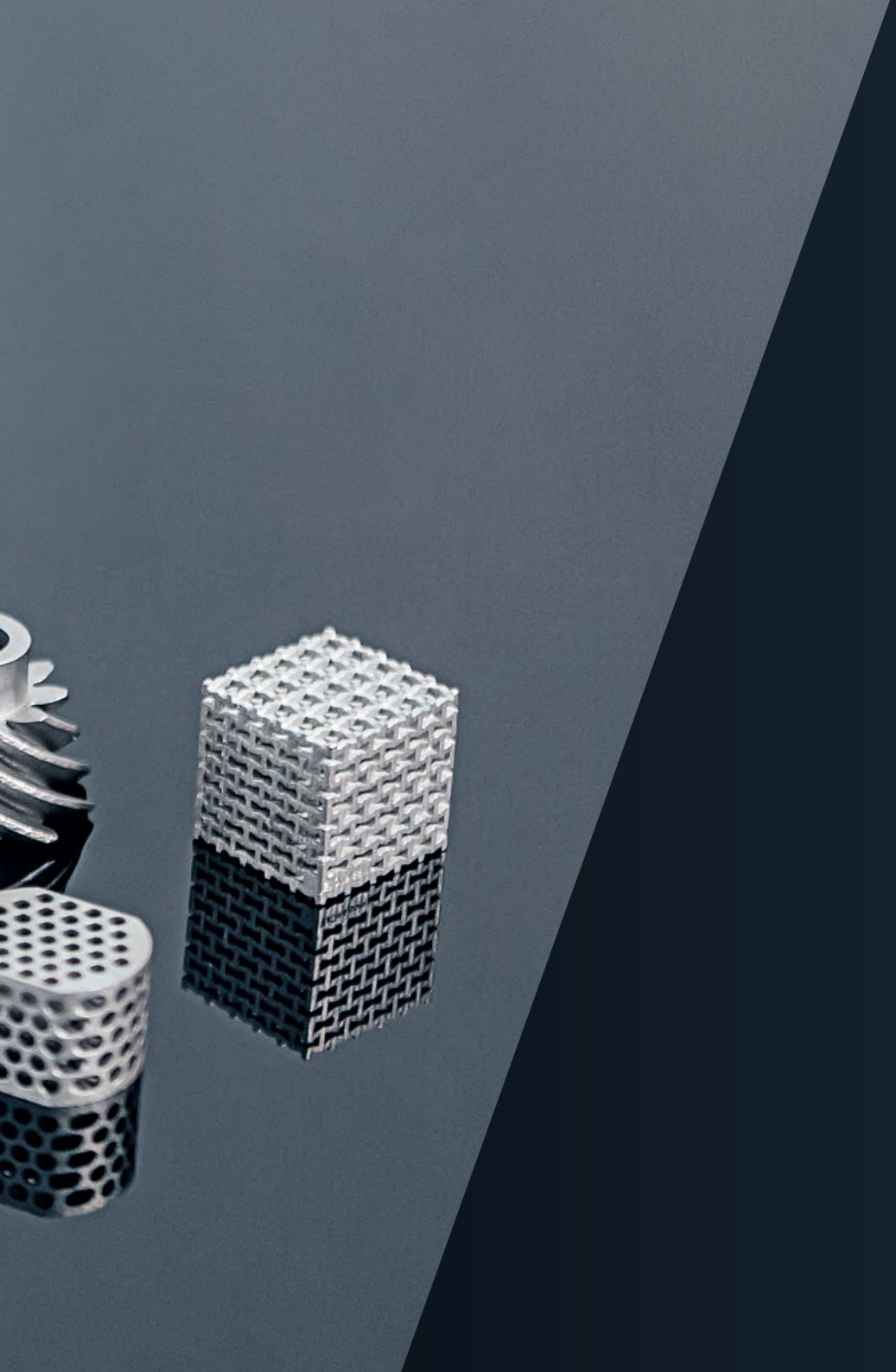
CHARACTERISTICS*
Hot strength: 3–4
Filigree character: 8–9
Strength: 5–6
Environmental impact: 10
Finishing: 9

MOLDING MATERIAL
Standard Process: Silica Sand
Alternative: Synthetic Sand or Combination

* Characteristics dependent on precise sand and binder combination. Scale is 1 – 10, with 10 indicating most ideal conditions. ** With additive. *** Green strength.


BINDER


316L



METAL

A New Era in Metal 3D Printing

ExOne metal binder jetting systems are the culmination of more than 20 years of development into metal binder jetting, starting with the RTS-300 in 1998. Today's systems, of course, are much more advanced than those early printers. Importantly, ExOne's exclusive and proprietary Triple ACT advanced compaction technology for dispensing, spreading, and compacting ultra-fine MIM powders to perfection has been a game changer. Originally proven out on the Innovent+®, it's now offered on all new Pro-line metal binder jet systems. It's the technology that changed the playing field for metal binder jetting, and we're proud of all the excitement it's brought to binder jetting.

Today, our team is hard at work delivering the best scalable portfolio of metal binder jetting systems in the market.

- Directly 3D print metal tooling and end-use parts
- Consolidate and lightweight parts
- A scalable system of printers that go from R&D to production
- A wide range of qualified materials with more on the way
- Meet the all-new Metal Designlab™ entry-level bound metal extrusion printer

Complete Systems for Metal 3D Printing

Binder jet complex, consolidated, lightweighted metal parts

A new era in metal binder jetting is upon us. With our complete metal printing systems, you can directly print end-use parts or tooling in a wide range of metals.

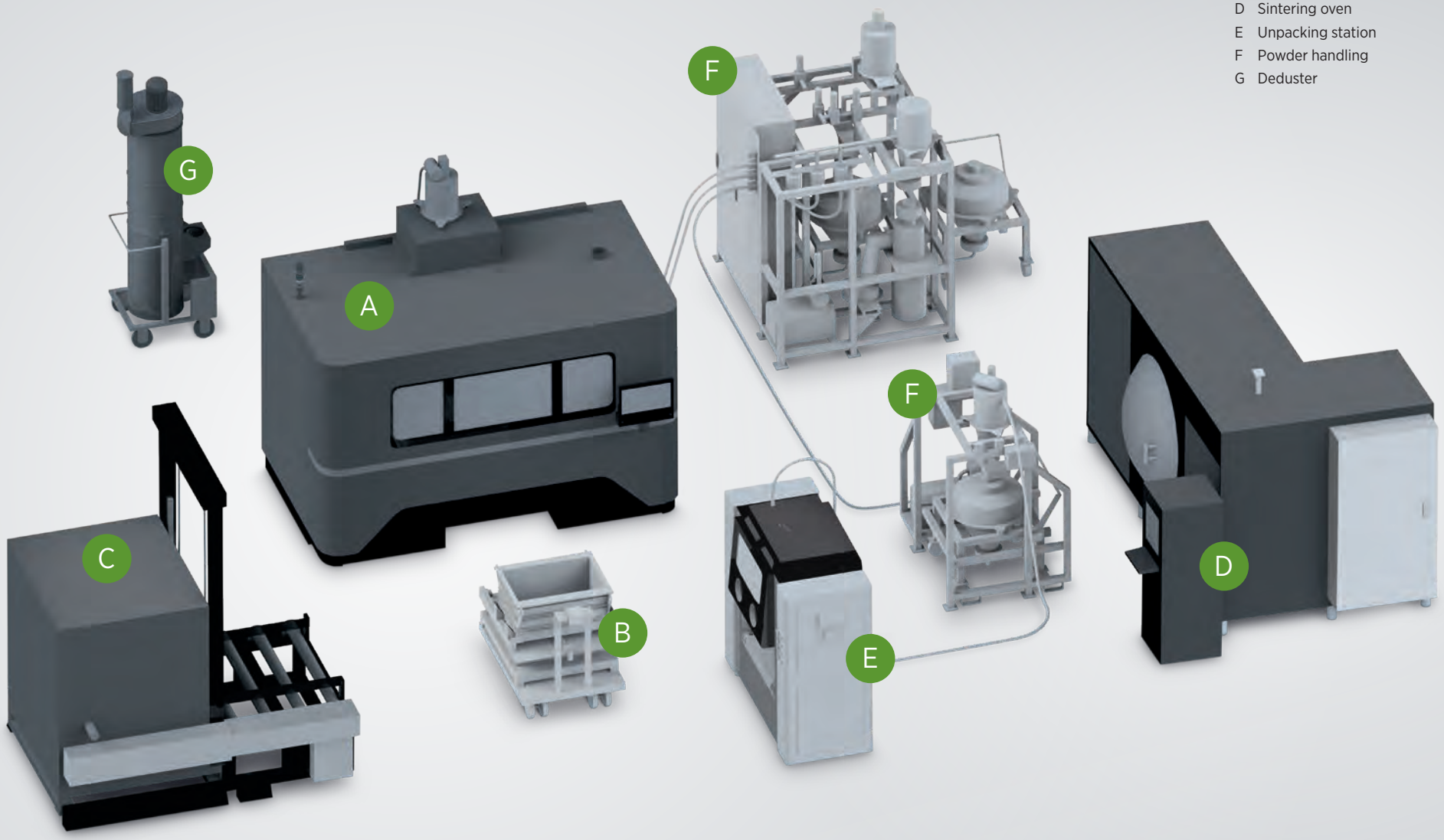
Complex part geometries that were once impossible are now possible. What's more, they can be made in desirable materials, such as aluminum 6061, copper, or tool steels.

Metal parts can now be consolidated and lightweighted like never before. Our customers routinely reduce the weight of parts by 30–40% when they redesign for binder jetting. Design iterations of metal parts are now affordable and easy.

	CleanFuse™	FluidFuse™	AquaFuse™	PhenolFuse™	NanoFuse™
DIGITAL FILE PREP					
MACHINE & MATERIAL PREP					
3D PRINTING					
CURING					
DEPOWDER					
DEBIND & SINTER					■

Process using the example of CleanFuse™

A X1 160Pro™
B Transfer cart
C Curing oven
D Sintering oven
E Unpacking station
F Powder handling
G Deduster



Metal 3D Printing Machines

InnoventPro™

The InnoventPro™ will be the world's most advanced entry-level model for metal binder jetting.

- Research
- Prototyping
- Rapid product development
- Short-run production

Smart powder control with dust collection

Easy fluid handling

TECHNICAL DATA

Build box: L 125 × W 220 × H 100 / 200 mm
(L 4.9 × W 8.7 × H 3.9 / 7.9 in)
Build volume: 3-liter and 5-liter options
Max build rate: 700+ cc/hour
Layer height: 30 – 200 µm

X1 25Pro®

A large, smart 3D printer for high-quality production of metal, ceramic, or composite parts.
Launched in 2019.

- Research
- Prototyping
- Rapid product development
- Short-run production
- Serial production
- Continuous 24/7 production

User-friendly touchscreen control

Advanced dust-control for safety and cleanliness

TECHNICAL DATA

Build box: L 400 × W 250 × H 250 mm
(L 15.75 × W 9.84 × H 9.84 in)
Build volume: 25 l
Max build rate: 3,600 cc/hr
Layer height: 30 – 200 µm
Min powder size: 5 µm (D50)

Specifications are subject to change without notice. Some data may be dependent on size and characteristics of powder being processed.

ExOne's family of metal 3D printers can confidently take your company from R&D and prototyping to production. These flexible, sustainable machine tools deliver incredible design freedom packaged in 20+ years of metal binder jetting experience.

ExOne metal printers feature our patented Triple ACT (advanced compaction technology) for dispensing, spreading, and compacting fine powders. Triple ACT delivers high density and repeatability for functional, precision parts.

Learn more
exone.com/metalprinters
exone.com/tripleact

New conveyance system for continuous serial production

New production options: Siemens MindSphere

X1 160Pro™

ExOne's 10th Metal 3D Printer is a Big One.
The largest and most advanced 3D printer for production of metal, ceramic, or composite parts. Launched in 2020.

- Research
- Prototyping
- Rapid product development
- Short-run production
- Serial production
- Continuous 24/7 production

TECHNICAL DATA
Build box: L 800 × W 500 × H 400 mm
(L 31.5 × W 19.7 × H 15.8 in)
Build volume: 160 l
Est. build rate: 10,000+ cc/hr
Est. layer height: 30 – 200 µm
Est. min powder size: 5 µm (D50)

The Innovent+® with Triple ACT

Innovent+®

An affordable, compact, and reliable 3D printer. Processes over 20 metal, ceramic, and composite materials. Prints fine features and surface-finishes. The world's best-selling and most-researched binder jetting system.

- Research
- Prototyping
- Rapid product development
- Short-run production

Easy-access fluid storage cabinet

Learn more
exone.com/innovent3D

TECHNICAL DATA
Build box: L 160 × W 65 × H 65 mm (L 6.3 × W 2.5 × H 2.5 in)
Volume: 676 cc
Max build rate: 166 cc/hr
Min layer height: 30 – 200 µm
Min powder size: 2 µm (d50)
Print resolution: > 30 µm voxels
Binder systems: AquaFuse™, CleanFuse™, FluidFuse™, PhenolFuse™

The Machine that Earned its Name

This is the original 3D printer and patented technology that reinvigorated the metal binder jetting movement by 3D printing high-density metal parts with standard MIM powders

Launched at RAPID 2018, ExOne's Innovent+® was an upgraded version of the original 2016 Innovent, a compact and budget-friendly binder jet 3D printer for researchers and small-part production.

But it featured something new and special for the history of binder jetting: a new technology — Triple ACT — that was critical for dispensing, spreading, and compacting ultra-fine MIM powders for high-density sintered parts.

Since then, the Innovent+® has become one of the most popular and researched binder jetting systems, with machines installed worldwide at some of the world's best-known universities and industrial brands.

In fact, the R&D done by ExOne users and partners on this machine has helped to advance the very important field of sustainable binder jet 3D printing, which additive manufacturing experts know will be the production metal 3D printing technology of the future. What makes Innovent+® such a powerhouse?

COMPACT AND AFFORDABLE

It's easy to get into an Innovent+®, and it's even easier to manage. With build dimensions of 160 × 65 × 65 mm (6.3 × 2.5 × 2.5 in), it only takes a 10-pound bag of standard MIM powder to get started. We've had users tell us: "It's the perfect size."

AMAZING QUALITY AND SURFACE FINISH

By printing ultra-fine MIM powders, you can achieve fine features and surface-finish results that impress and routinely meet final post-sintering dimensional tolerances of +/– 2.5%.

A MULTI-MATERIAL GENIUS

The Innovent+® was built for material changeovers. Try your hand at more than two dozen metal, ceramic, and composite materials. All you need is a new bag of material to get started.

EASY TO USE

Intuitive software. Simple to load powder. Easy-to-move boxes. Perfect for educating students, use in a lab or getting started with binder jet 3D printing (before you scale up to one of our bigger machines.) And if you manufacture small MIM-style parts or machine them in your shop, this may be the only metal 3D printer you'll ever need. It's so affordable, some customers get two.

FEATURES TRIPLE ACT

ExOne's exclusive and patented Advanced Compaction Technology dispensing, spreading, and compacting ultra-fine powders with precision — delivering industry-leading part density and repeatability. Learn more in this white paper: www.exone.com/tripleact

THE SMARTEST KID ON THE BINDER JET BLOCK

Did we mention that more binder jet 3D printing research has been done on the Innovent than any competing binder jet model? With an open control system and various printhead sizes (80, 30, or 10 picoliters), you're in full control of the ouput. Read more about the metals, ceramics and composite research done at ScienceDirect.

SAFETY AND HEALTH FEATURES

Innovent+® comes equipped with master-level powder handling. Aside from Triple ACT, it includes critical dust control features that allow the compact machine to comfortably run in a wide range of environments.

Metal 3D Printing Materials

More than 20 metals, ceramics, and composites are now qualified for use on ExOne metal systems, which deliver high-density, precision results

ExOne metal 3D printer systems transform more than 20 metal and ceramic powders into precision end-use parts for automotive, aerospace, defense, energy, and consumer applications.

Not every application is the same. So our comprehensive qualification process helps to ensure customers will have reliable, repeatable, and predictable parts from 3D printing through final sintering for their application.

ExOne continuously works to qualify new materials for use in our machines, as shown in the list of materials.

What's more, we routinely partner with companies to develop specific materials for binder jet 3D printing with our technology.

Third-Party

Have passed rigorous ExOne tests over multiple builds and have verified material property data from an independent third party.

METALS
17-4PH, 304L, 316L, M2 Tool Steel, Inconel 718

METAL COMPOSITES
X1 Metal 316i™, X1 Metal 420i™, and Tungsten i/w Bronze

Customer

Have been qualified by ExOne customers with their own standards and are being successfully printed today for their own applications.

METALS
17-4PH SS, 304L SS, 316L SS, Aluminum 6061, Cobalt Chrome, Copper, H13 Tool Steel, Inconel 625, Titanium, Tungsten Heavy Alloy

CERAMICS
Alumina, Carbon, Natural Sands, Synthetic Sands, Silicon Carbide, and Tungsten Carbide Cobalt

CERAMIC-METAL COMPOSITES
Boron Carbide i/w Aluminum and Silicon Carbide i/w Silicon

METAL COMPOSITES
X1 Metal 316i™, X1 Metal 420i™, and Tungsten i/w Bronze

R&D

Have passed a preliminary qualification phase by ExOne and are deemed printable, supported by ongoing development.

METALS
17-4PH SS, 304L SS, 316L SS, 4140, 420, 4340, 4605, Aluminum 6061, Bronze, Cobalt Chrome, Copper, H11 Tool Steel, H13 Tool Steel, Hastelloy, Haynes 230, Inconel 625, Inconel 718, Iron-Chrome-Aluminum, M2 Tool Steel, Panacea, Titanium, Tungsten (bonded or green), Tungsten Heavy Alloy, TZM Molybdenum

CERAMICS
Alumina, Aluminum Nitride, Barium Titanate, Boron Carbide, Carbon, Glass, Lead Zirconate Titanate (PZT), Natural Sands, Silicon Carbide, Silicon Nitride, Synthetic Sands, Tungsten Carbide, Tungsten Carbide-Cobalt, Zirconia, and Zirconium Carbide

CERAMIC-METAL COMPOSITES
Boron Carbide i/w Aluminum and Silicon Carbide i/w Silicon

METAL COMPOSITES
X1 Metal 316i™, X1 Metal 420i™, Iron i/w Bronze, Tungsten i/w Bronze, Tungsten i/w Copper, and Tungsten i/w Invar

A-to-Z

17-4PH SS
304L SS
316L SS
4140
420
4340
4605
Alumina
Aluminum 6061
Aluminum Nitride
Barium Titanate
Boron Carbide
Boron Carbide i/w Aluminum
Bronze
Carbon
Cobalt Chrome
Copper
Glass
H11 Tool Steel
H13 Tool Steel
Hastelloy
Haynes 230
Inconel 625
Inconel 718
Iron-Chrome-Aluminum
Iron i/w Bronze
Lead Zirconate Titanate (PZT)
M2 Tool Steel
Natural Sands
Panacea
Silicon Carbide
Silicon Carbide i/w Silicon
Silicon Nitride
Synthetic Sands
Titanium
Tungsten (bonded or green)
Tungsten Carbide
Tungsten Carbide-Cobalt
Tungsten Heavy Alloy
Tungsten i/w Bronze
Tungsten i/w Copper
Tungsten i/w Invar
TZM Molybdenum
X1 Metal 316i™
X1 Metal 420i™
Zirconia
Zirconium Carbide

Our qualified material list frequently changes. Please see the latest materials online at exone.com/metalmaterials.

ExOne Fuse™ Binders

Learn more
exone.com/materials
exone.com/FordAl6061

Key to our diversity of materials

One of the reasons ExOne metal binder jet systems can print such a diversity of powdered materials is our portfolio of specialty Fuse™ binders, which deliver unique benefits for the material being 3D printed.

Binders must deliver certain characteristics that work harmoniously with the powder material being printed. Considerations include viscosity, saturation, bleeding in X and Y, as well as debinding characteristics.

ExOne binders continue to be optimized to provide improved green strengths and other beneficial properties based on the material being printed.

CleanFuse™
A premium, clean-burning binder that leaves behind no carbon residue and works well with metallic materials negatively affected by carbon, such as Inconel powders.

FluidFuse™
A versatile solvent-based binder with low viscosity that works well with a variety of metallic and non-metallic materials, including ceramics.

AquaFuse™
A water-based binder that works well with a variety of metallic material.

PhenolFuse™
A phenolic binder best suited for printing high-temperature materials, including non-metallics such as carbon, tungsten carbide (WC), silicon carbide (SiC), and other ceramics.

NanoFuse™
A new line of groundbreaking binders featuring suspended nanoparticles to improve the quality of binder jetting results with certain materials, such as copper and aluminum.

Print Today, Parts Tomorrow™

X1 Metal Designlab™

The X1 Metal Designlab™ by Rapidia 3D prints bound metal parts for direct sintering without debinding. The original two-step process is made possible with HydroFuse™ build material, an innovative water-based paste containing metal or ceramic powders. Together with the X1F furnace, the X1 Metal Designlab™ is a truly office-safe and office-friendly metal 3D printing system that is easy to operate. For research and prototyping as well as rapid product development and short-run production.

- Print isotropic, solid metal without infill
- Create internal structures and intricate assemblies
- User-friendly design and operation for office environments

Learn more
exone.com/designlab

TECHNICAL DATA

Job box: L 200 × W 280 × H 150 mm (L 7.75 × W 11 × H 6 in)
Volume: 8,400 cm^3 (511 in^3)
Materials: 316L, 17-4PH, more to come
External dimensions: L 780 × W 700 × H 1,570 mm (L 31 × W 27.5 × H 62 in)
Max build rate: 40cc/h (2.4in^3/hr)
Print accuracy: ± 1% dimensional tolerance
Power: 110 – 125 VAC, 50/60 Hz, 12 A max

X1 25PRO® BRACKET

316L Bracket in Under 24 Hours

Looking to make a value-add customization to a customer's binder jetting machine without the costs or lead time of tooling, the ExOne team turned to the Metal Designlab™ for a fast and functional solution. A stainless steel bracket to withstand cyclic heating and cooling was produced on the X1 Metal Designlab™ 3D printer before going directly to sintering on the X1F furnace.

- 90% faster at 10% of the cost of CNC machining
- Printed and sintered in 16 hours
- Printed-right the first time, tapped, mounted

"As easy as using any plastic printer."

Alex Paterson,
Process Development
Engineer at ExOne

Case Studies available online **exone.com/designlab**

APPLICATION
Bracket to customize an X1 25Pro® binder jetting machine

MATERIAL
316L Stainless Steel

PRINT AND SINTER TIME
4 and 12 Hours

UNIVERSITY OF BRITISH COLUMBIA

Office-Friendly Metal 3D Printing Innovation

The mechanical engineering department at the University of British Columbia uses the X1 Metal Designlab™ and X1F furnace to advance research of the physical and mechanical properties of metal printed parts in an educational environment. Dr. Ahmad Mohammadpanah and his students assist the industry in creating standards and approved processes with metal 3D printing and the X1 Metal Designlab™ enables an entire class submission of models to be available for review within 48 hours.

- 17-4PH stainless steel and evaporative supports
- Two-step process without debinding, additional equipment, complicated exhaust systems, or other special facility considerations
- 0.4 mm nozzle with good accuracy

"It's super easy to use, especially in an educational environment. The learning curve is just a few hours for somebody already familiar with plastic printing."

Dr. Ahmad Mohammadpanah,
Department of Mechanical Engineer,
University of British Columbia

APPLICATION
Research of intelligent manufacturing, DfAM, spherical parallel mechanisms, non-linear dynamics and vibrations

MATERIAL
17-4PH Stainless Steel

INDUSTRY / PRODUCTS
Academia / Education


ExOne
Job information

SERVICES & SUPPORT

360° Products & Services

ExOne offers a comprehensive suite of services to successfully assist companies of all sizes in making a successful and low-risk transition from traditional to digital manufacturing.

Whether you want to simply order binder jetted parts or tooling as a service, explore new designs only possible with binder jetting or work towards adoption of binder jetting for high-volume production of unique materials, our world-class team of ExOne Experts can get you there.

We routinely tailor programs to meet the specialized needs of manufacturers in industries such as aerospace, automotive, energy, medical, agriculture, food and beverage, and more. We're confident we can support your goals, too.

- Industrial binder jet 3D printers
- 3D printed parts and tooling on demand
- Installation, training, and support
- Design, engineering, and logistics

Delivering Starts with Listening

KEY CONTACT

Rick Lucas
Chief Technology Officer
and VP of New Markets

- Material Development
- 3D Part Qualification
- Design, Engineering & Process Support
- OneCast Services
- 3D Program Design

COMPREHENSIVE AM SERVICES

Before you even buy a 3D printer, ExOne can help you evaluate whether binder jet 3D printing is right for your parts or business. Whether that's 3D printing parts for evaluation, developing specific materials, or a comprehensive project to design, engineer, and qualify a new part program for high-volume production, our world-class team of binder jetting experts is ready to go the extra mile.

PRODUCTION ADOPTION SERVICE

Our team has a low-risk method of helping customers make the move to high-volume production with 3D printing. Ask us about our customizable, step-by-step process to ensure your transition is a success.

ONECAST METALCASTING SERVICES

What's more, our specialized OneCast service team has exceptional knowledge of metalcasting designs and processes for both traditional and 3D printing-enhanced operations. We can help develop your design and sandcasting package to take full advantage of our technology's benefits. Our team specializes in done-in-one complex castings—saving you time and money.

Learn more
exone.com/services

Industrial Binder Jet 3D Printers

As the global leader in binder jet 3D printers, ExOne sand and metal printing systems are used and trusted by major manufacturers worldwide for mission-critical applications. Our machines are known for accuracy, reliability, and ease of use.

3D Printed Parts and Tooling on Demand

ExOne Adoption Centers (EAC) are premium 3D printing service bureaus, strategically placed in the United States, Asia and Europe. Our EACs can binder jet your mission-critical sand molds and cores, washout tooling, and metal, ceramic, or composite parts.

Installation, Training & Support

Installing machines and training customers on how to successfully use an emerging, breakthrough technology isn't new to us. Our goal is to make you successful with our technology, providing all the information, hands-on training and support you need — so you can untap new value. Our machines are known for accuracy, reliability, and ease of use.

Design, Engineering & Logistics

As world leaders in binder jetting, our expert teams can help you evaluate, design and qualify a part for 3D printing. Our comprehensive process includes material development, process planning, and quality control. We also offer a full suite of OneCast metalcasting support services.

Low-Risk Production Adoption Model

Customers are using this model to successfully implement direct metal 3D printing production for end-use parts

At ExOne, we know that adopting a transformative, game-changing technology can feel risky compared to just doing it the same old traditional way. So we've worked hard to develop a process that ensures your success. Our five-step process can help you decide if binder jet 3D printing is right for your application, from both a technical and business perspective, and we partner with you for the whole journey.

Evaluation if part is right

- Design & Geometry
- Metallurgy
- Accuracy
- Functionality

Process optimization for your parts

Our expert BJT team optimizes our binder jetting process for your part requirements, providing key details on timing, materials, recipe settings, etc. Complete testing for requirements.

Learn more
exone.com/metaladoption

Comprehensive executive report

A complete executive report and timeline is provided with details needed to validate both the technical and business case to proceed.

Production option selected, begins

We provide options:

- We can produce your parts long-term
- Or, proceed with purchase of binder jetting machines and customized work cells. We can print your parts until installation.

Installation of complete system

In line with final agreement, we install complete systems and execute first test runs. After acceptance is complete, we continue to support your operations and success.

Metal & Sand 3D Printing Services

Learn more
exone.com/MetalServices
exone.com/SandServices

End-to-end engineering services for direct-metal and sand binder jet 3D printing

Now available in Europe and the United States, ExOne can now provide metal 3D printing services in a wide variety of materials to customers who want to benchmark binder jetting for their application. Available services include:

- Engineering consultation and support from design to 3D printing
- Application and material development partnership
- Fast, flexible, local production of benchmarks and sample parts
- Low-volume production is available depending on material and location

Our sand 3D printing services bureaus and network of sand 3D printer owners is extensive. Together, we can help provide the sand molds and cores you need, or the castings, with fast turnaround times. Our OneCast services can also optimize your sandcasting designs for done-in-one pours using cutting-edge simulation and design software. Our sand 3D printing services include:

- Fast, flexible, local production of sand molds, cores, and other forms
- Sandcasting design assistance to leverage done-in-one pours
- We can connect you to foundries with our printers that can pour your desired material

X1 Tooling

Learn more
exone.com/X1tooling

The 3D printing industry's broadest portfolio of tooling options for the final production of plastic, composite, or metal parts

ExOne binder jet technology provides the speed of on-demand production with the nimbleness of local, digital tooling. Shorten lead times, lower tooling costs, and improve design flexibility with a range of 3D printed solutions for virtually any challenge.

X1 MetalTool
Binder jet metal 3D printing can replace machined metal molds for plastic injection molding, blow molding, foam molding, and more without the long lead times and high machining costs of traditional tools and can often cut cycle times by 30–50%.

X1 SandCast
ExOne's market-leading sand 3D printers quickly and accurately produce even the most complex sandcasting molds and cores. Trusted for more than 20 years, ExOne premium machine tools deliver innovative designs faster with organic geometries and consolidated assemblies that improve the quality and increase the complexity of cast products.

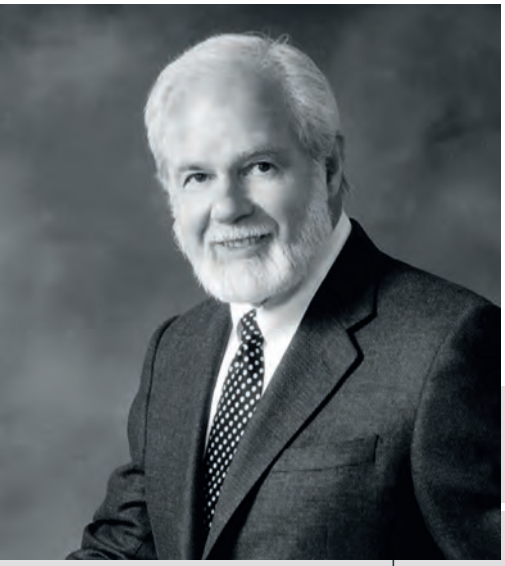
X1 ThermoForm
On-demand tooling for thermoforming, vacuum forming, or other compression tooling applications delivers tools more durable than other low-cost options that are able to withstand high temperatures, multiple hits, or even allow for full vacuum to be pulled in the forming process, all without delamination or failure.

X1 Layup
Get to composite layup faster with our patented infiltrated sand solutions. Whether low-cost prototyping or premium production tools, X1 Layup molds delivers complex geometries durable enough to withstand the temperatures and pressures of autoclave with a CTE comparable to aluminum and fast turnaround times.

X1 Washout
Eliminate the expense, lead time, and manufacturing challenges associated with production of composite parts with trapped geometries. X1 Washout creates a sacrificial 3D printed sand core for hollow objects that washes away with tap water after standard layup and autoclaving.

X1 DieMold
Still in development with global manufacturing customers, ExOne metal binder jetting systems 3D printing rugged die molds in H13 Tool Steel that are comparable to traditional die molds for shaping molten metal.

ExOne Milestones



1995

The Vision

Extrude Hone creates a “ProMetal” division to develop 3D printing. Company founder Larry Rhoades sees the potential of the new technology.

1996

The Patent

Extrude Hone obtains exclusive field-of-use license for patented 3D printing processes developed at the Massachusetts Institute of Technology (MIT).

1998

The Pioneer

Launch of the ProMetal RTS-300, the first metal 3D printer using binder jetting technology and the commercial realization of MIT’s invention.

2002

Entry Into Sand

Extrude Hone launches the S15 sand printer using binder jet technology.

2003

A Metal Workhorse

Extrude Hone launches the ProMetal R2, one of the company’s most robust and successful direct metal 3D printers using binder jet technology.

2005

ExOne Spins Off

Extrude Hone launches two new printers, the S-Print® sand and X1 Lab metal printer, and is sold to Kennametal. The 3D printing division is spun off as “The Ex One Company.”

2007

A New Change

After Rhoades dies unexpectedly, ExOne is purchased by a company owned by S. Kent Rockwell, who has led the company since as Chairman of the Board of Directors.

2010 – 2013

The Printers

Launch of four printers: the S-Max®, a new version of the S-Print®, now a staple portfolio product, and the M-Print and M-Flex® metal printers.

2013

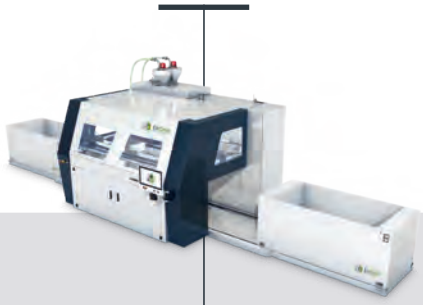
A Record Year

ExOne successfully completes its Initial Public Offering on Nasdaq, one of the most successful IPOs of the year. Shares of XONE begin trading.

2014

Waves Of Sand

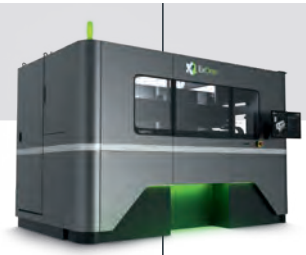
ExOne launches three new sand printers, including a new S-Max® and S-Print® models, continuing its market share gains in sand 3D printing.



2018

A New Metal Era

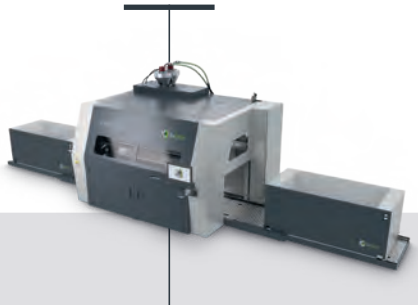
ExOne launches the Innovent+®, the X1 25Pro®, and the X1 160Pro™, a full family of metal 3D printers for processing MIM powders into dense parts without infiltration.



2019

High-Volume Production

ExOne launches the S-Max® Pro production sand 3D printer and the X1 160Pro™, the company's tenth metal printer and the industry's largest commercially available metal binder jetting system.



2020

The Next Generation

ExOne ships X1 25Pro® metal 3D printer and launches the new InnoventPro™ entry-level metal binder jetting System.

2021

The Future

ExOne showcases the InnoventPro™, the world's most advanced metal binder jetting system, at Formnext 2021.

ExOne™

ExOne has facilities and representatives around the world.
To reach us, feel free to call or email us at the locations below,
or visit us at exone.com/locations.

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