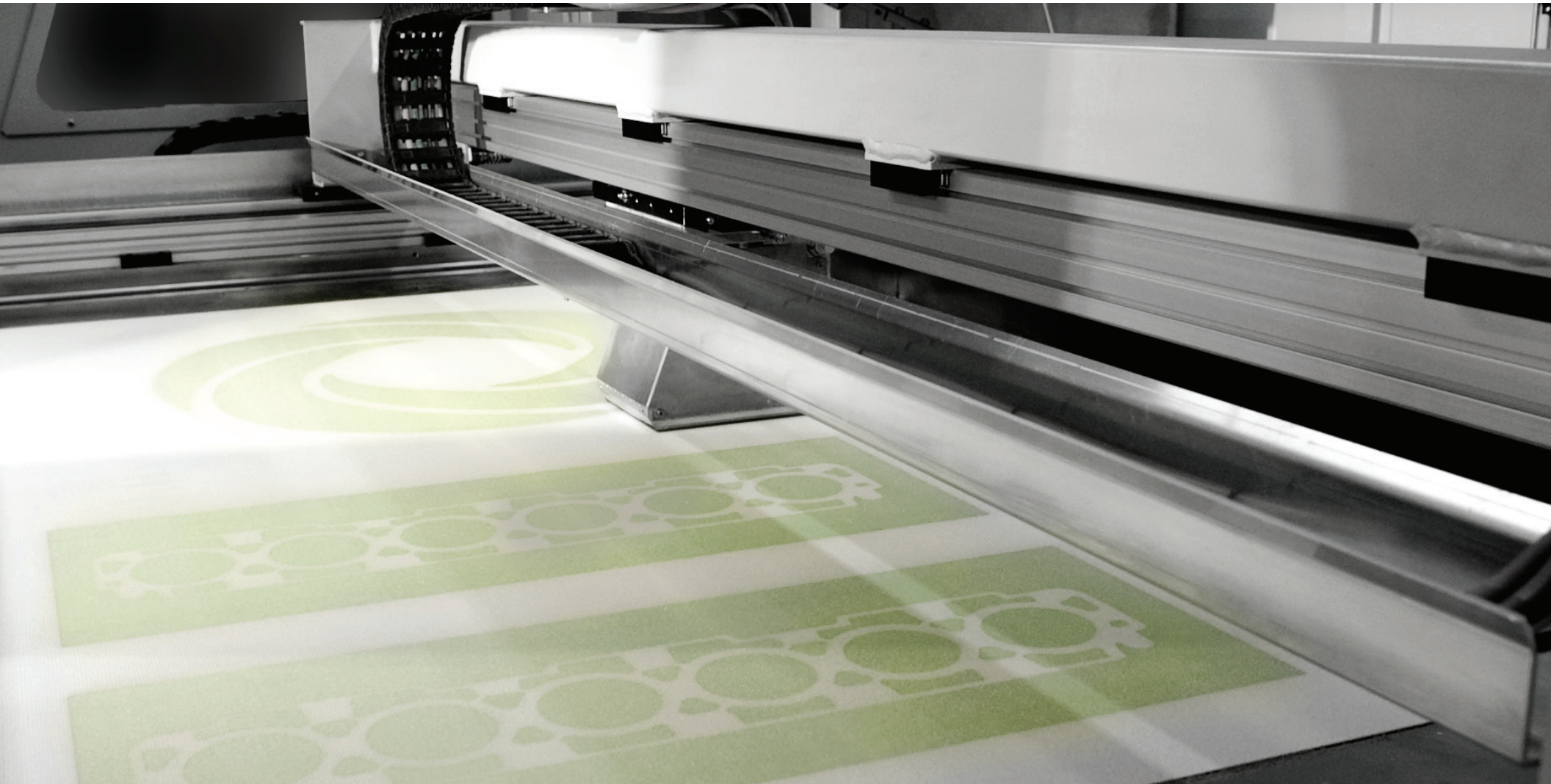
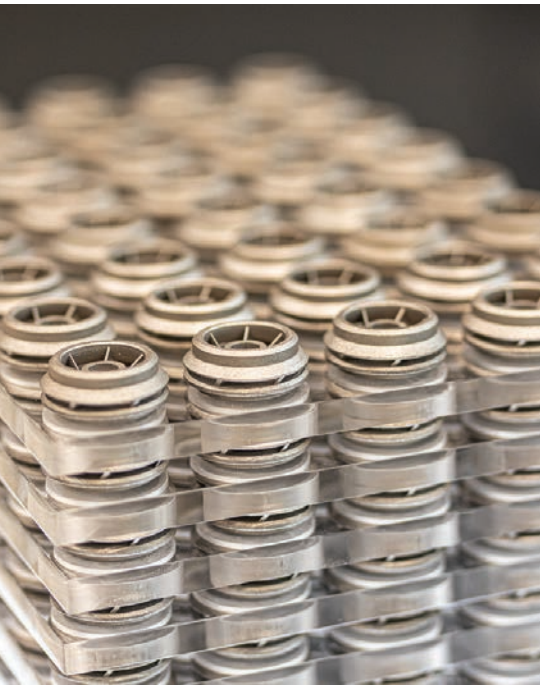
ExOne™

Collaborate. Innovate. Accelerate.

2020
INDUSTRIAL BINDER JET 3D PRINTING





3D PRINTED METAL

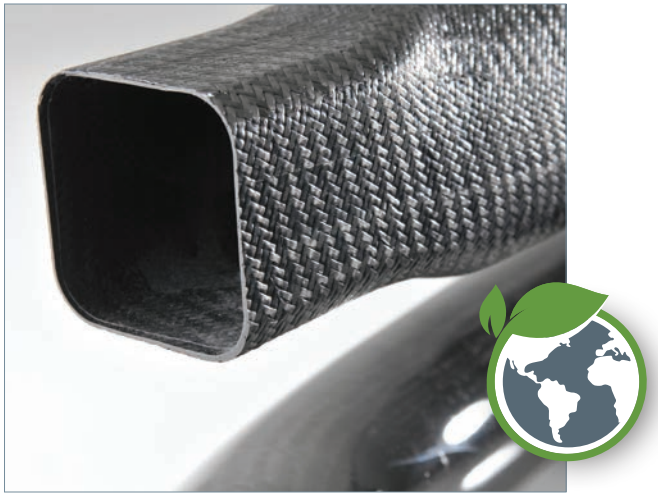
OUR VISION

SUSTAINABLE MANUFACTURING WITHOUT LIMITATIONS

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

SANDCASTING MOLDS & CORES

WATER-WASHOUT SUSTAINABLE TOOLING



HIGH DETAIL ACCURACY & FINISH

S-Max Pro

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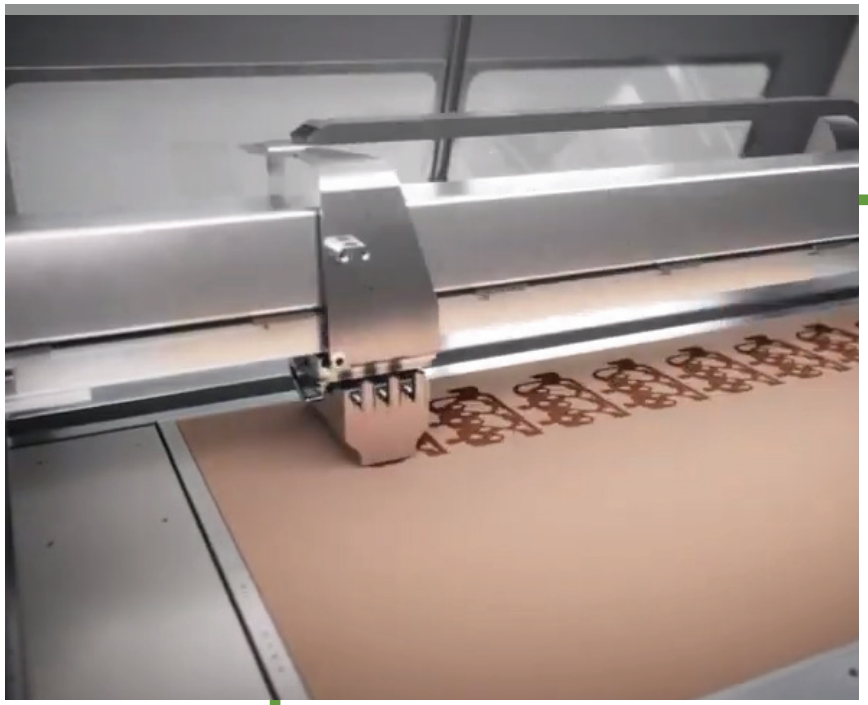


ABOUT US

The ExOne Company

ExOne is the pioneer and global leader in binder jet 3D printing 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, and
- 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.

What is Binder Jetting?

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.

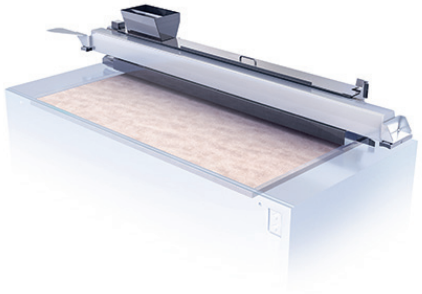
The process is repeated layer by layer, using a map from a digital design file, until the object is complete.

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 RTS-300. In 2002, ExOne launched its first sand 3D printer, the S15.

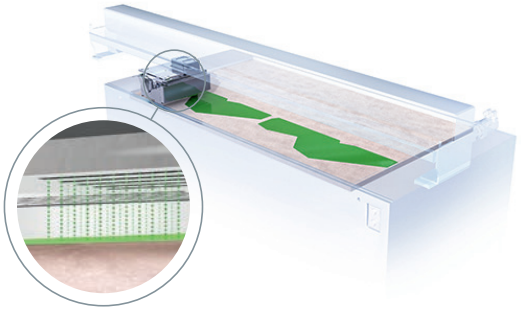
ExOne 3D printers have been used by industrial customers ever since.

The Binder Jetting Process



START LAYER

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



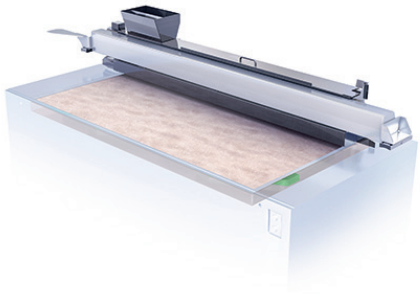
INKJET BINDER

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

FAST LAYER SPEEDS

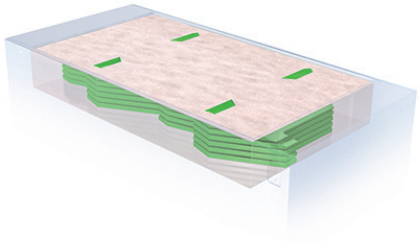
With a full sweep of print heads, a binder jet 3D printer can complete a full layer very quickly. This is one of the core benefits of binder jetting compared to other additive manufacturing methods. After each layer, the bed lowers for the next layer to be applied.

Simple & Flexible



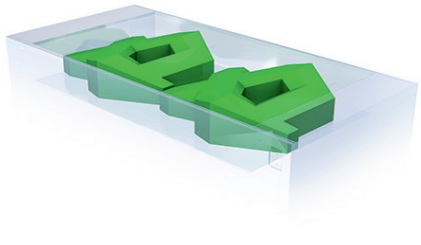
RECOATING

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.



RINSE & REPEAT

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.



PRINTING COMPLETE

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.

INDUSTRIES AND SECTORS WE SERVE

- Aerospace
- Automotive
- Art
- Construction
- Defense
- Dental
- Energy
- Foundries
- Heavy Equipment
- Hydraulics
- Jewelry
- Medical
- MIM (Metal Injection Molding)
- Oil & Gas
- Pumps
- R&D

360° Product & 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-critcial applications. Our machines are known for accuracy, reliability, and ease of use.

3D Printed Parts on Demand

ExOne Adoption Centers are premium 3D printing service bureaus, strategically placed in the United States and Europe. Our EACs can binder jet your mission-critcal 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.

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.

Our Partners

More than twenty years into our additive manufacturing journey, we've learned: it takes a team. ExOne is proud to work with global experts and partners 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.

IT TAKES A TEAM

Left to right: Dr. Karsten Heuser, VP Additive Manufacturing, Siemens Digital Industries; Mathias Altmannshofer, Senior Sales Representative, Siemens; John Hartner, CEO, ExOne; Dr. Wolfgang Heuring, CEO, Siemens Motion Control; Andreas Nagy, General Manager, Business Unit Indirect, ExOne; and Marc Konrad, Head of Business Unit Motion Control Germany, Siemens.

Altair

ANSYS

ELNIK SYSTEMS

GTP

KENNAMETAL

OAK RIDGE National Laboratory

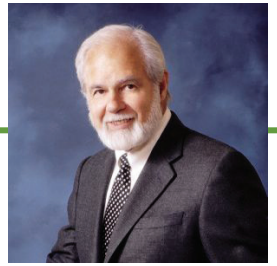
SIEMENS

SANDVIK

VDMA

Our History

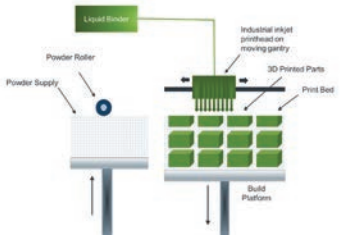
1995



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.

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

Breakthrough R&D

ExOne begins 3D printing full-density single-alloy metals without infiltration, a game-changing breakthrough

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.

A New Era

2002

ENTRY INTO SAND

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

2003

A METAL WORKHORSE

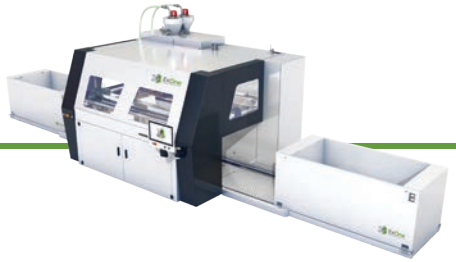
Extrude Hone launches the ProMetal R2, one of the company's most robust and successful direct metal 3D printers using binder jet technology.

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."

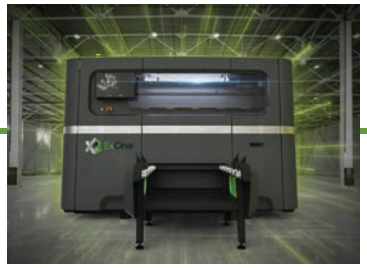
2014



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.

2018-2020



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.

At GIFA 2019, ExOne launched the S-Max Pro, a smart production sand 3D printer that enables high-speed throughput of sand molds and cores.

At ExOne, We've Always Been Green

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 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.

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
- The new designs enabled by binder jetting technology can also deliver meaningful part consolidation that reduces waste and energy consumption along the supply chain
- Binder jetting enables distributed manufacturing, closer to the point of use – 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.

John F. Hartner
Chief Executive Officer


Let's Solve
the Toughest
Problems.
And Change
the World.
ExOne
Collaborate. Innovate. Accelerate.
JETTING
PRODUCTION
READY
NOW

ExOne sand 3D printers have been used for metalcasting molds and cores since 2002 – to save time and eliminate the cost associated with hard tooling and storage. Even bigger benefits are delivered by enabling rapid design iterations and exceptional design freedom. Now, ExOne sand printers are also printing large, durable and sustainable sand tooling.

SAND 3D PRINTING

- Metalcasting sand molds and cores
- Consolidated complex cores
- Innovative 3D printed sand tooling

Sand 3D Printing Machine Tools

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.

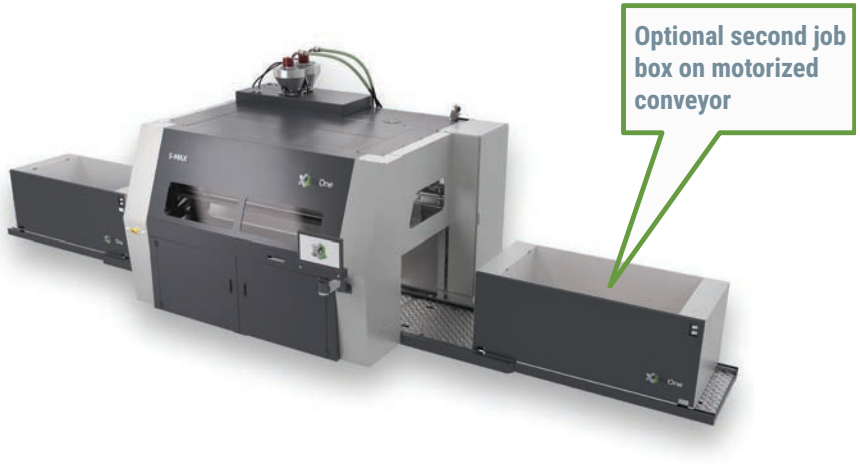
No more patterns needed for sand molds. No more molds needed for blowing cores. No jigs or fixtures needed for core assembly. Print complex cores in one piece. This is how cores were meant to be made. Learn more at exone.com/case-studies

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**

Build envelope:
800 × 500 × 400 mm
Volume: 160 L
Max Build Rate: 36 liters/hour
Min layer height**: 0.24 – 0.38 mm
Binders: Furan, CHP, HHP, Inorganic

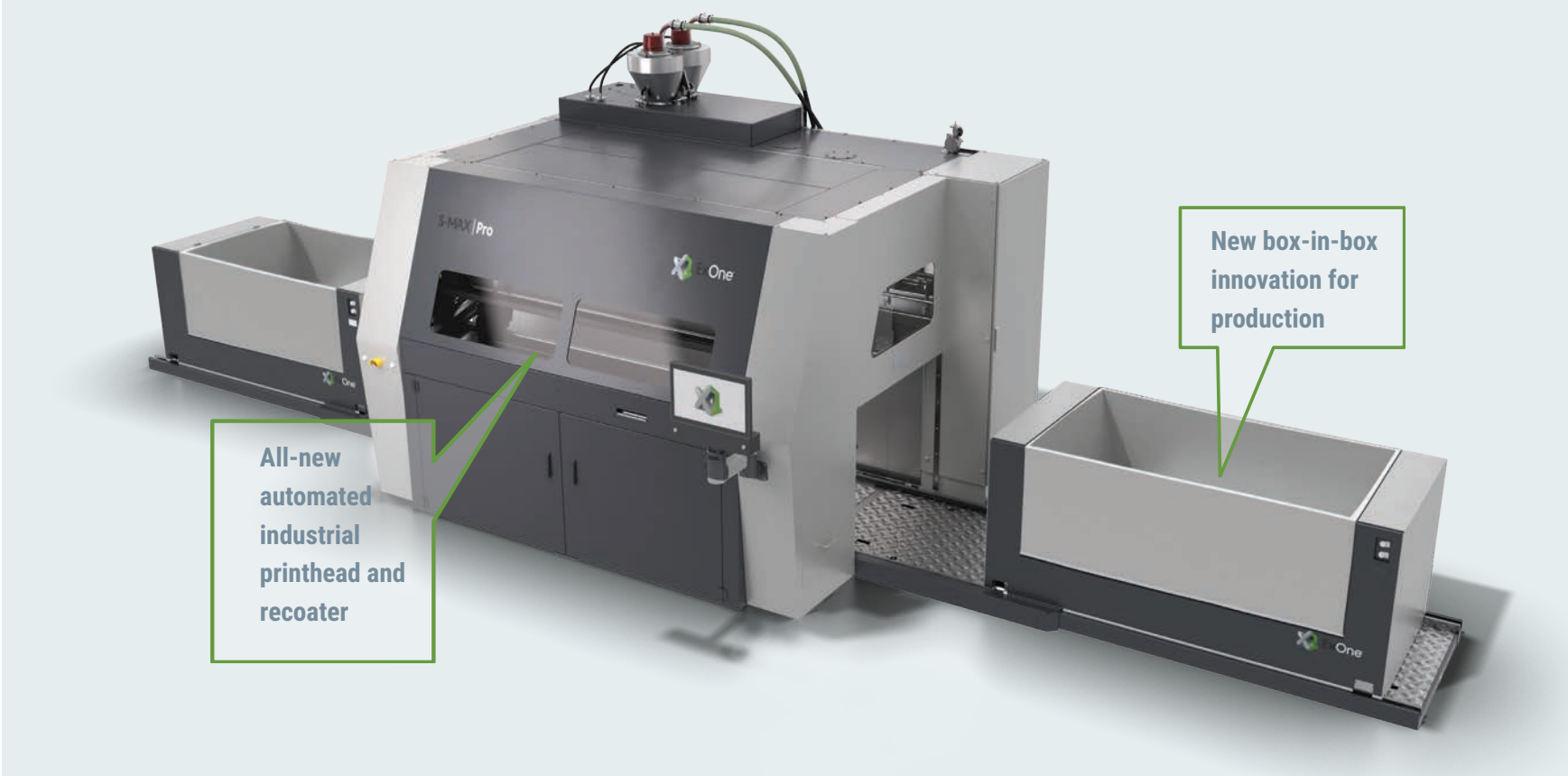


S-Max

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**

Build envelope:
1800 × 1000 × 700 mm
Volume: 1260 L
Max Build Rate: 105 liters/hour
Min layer height**: 0.26 – 0.38 m
Binders: Furan, CHP



How Complex Cores Were Meant to be Made

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

Build envelope per box:
1800 X 1000 X 700* mm
Volume: 1260 L
Max Build Rate: 100 – 135*** liters/hour
Min layer height**: 0.26 – 0.38 mm
Binders: Furan, CHP, HHP, Inorganic

**Available 400mm option. **Depending on material. ***Depending on layer height*

The S-Max Pro

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

Sand 3D Printing Materials

BINDERS & POWDERS

FURAN
Cold-Hardening Binder System

Casting Material
Steel, iron, non-ferrous metal, aluminum

*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

Thermal Post-Processing
None

CHP
Cold-Hardening Binder System

Casting Material
Steel, iron, non-ferrous metal, aluminum, bronze

*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

Thermal Post-Processing
Oven curing

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

BINDERS

HHP
Hot-Hardening Binder System

Casting Material
Steel, iron, non-ferrous metal, aluminum, bronze

*Characteristics**
Hot strength, 9-10
Filigree character, 7-8
Strength, 9-10
Environmental impact, 5
Finishing, 7-8

Molding Material
Standard Process: Synthetic Sand

Thermal Post-Processing
Microwave

INORGANIC
Inorganic Binder System

Casting Material
Aluminum

*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

Thermal Post-Processing
Microwave

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.

EXCEPTIONAL ACCURACY & FINISH

COMPREHENSIVE BENEFITS

FASTER TIME TO MARKET
- Days versus weeks and months

COST ELIMINATION
- No patterns needed for sand molds
- No wood, plastic or metal molds needed for blown cores
- No jigs or fixtures needed for core assembly

COST REDUCTION
- No core assembly
- Reduced Labor
- Reduce or eliminate core repair
- Reduce or eliminate scrap from failed cores
- No inventory of patterns or molds
- No re-assessment of patterns, molds for reuse
- No lost patterns or molds

NEW SERVICE OFFERINGS
- New sandcasting mold and core designs
- Consolidated mold and core designs
- More done-in-one, high-quality pours
- More complex designs now possible, affordable

Case Studies: Sand 3D Printing Customers

Original 11-piece weldment

NEENAH FOUNDRY

3D Printed Complex Core Saves Thousands in Tooling Costs, Reduces Lead Time by Weeks

2019 Casting of the Year, American Foundry Society

Weldment replaced by the cast swing frame

CHALLENGE: Amerequip Corporation wanted to consolidate parts on an 11-piece, laser-cut welded assembly swing frame to reduce weight, improve quality, and minimize cost through improved production efficiencies with a one-piece design.

SOLUTION: To accommodate the short lead time for rapid product development samples, Neenah used 3D printed cores produced at Hoosier Pattern using an ExOne S-Max printer.

CONCLUSION: The collaboration resulted in an improvement of quality, efficiency, and cost savings for Amerequip, and also brought a new customer to Neenah.

SPECIFICATIONS

PART: Swing frame, a compact utility tractor component

MATERIAL: Ductile iron

TRADITONAL METHOD: Manufactured core box tooling

LEAD TIME: 6 weeks

EXONE SAND 3D PRINTING

PRINT MEDIA: Silica Sand/Furan Binder

LEAD TIME: completed less than 2 weeks

CORE BOX MODIFICATION COST SAVINGS: $5,000

WEIGHT REDUCTION: 2.2 lbs

GERMAN AUTOMAKER

CHALLENGE: Automotive manufacturer needed a way to quickly and economically produce complex prototypes.

SOLUTION: ExOne's sand 3D printing process offered significant time and cost advantages over both traditional and other additive manufacturing technologies for delivering sand molds and cores for metal castings.

SPECIFICATIONS

PART: Formula 1 transmission housing

BATCH SIZE: 5 pieces

MATERIAL CAST: Aluminum Alloy 356

MATERIAL PRINTED: Silica sand with furan

PRINTED VOLUME: 200 L for complete mold package

TRADITONAL METHOD:

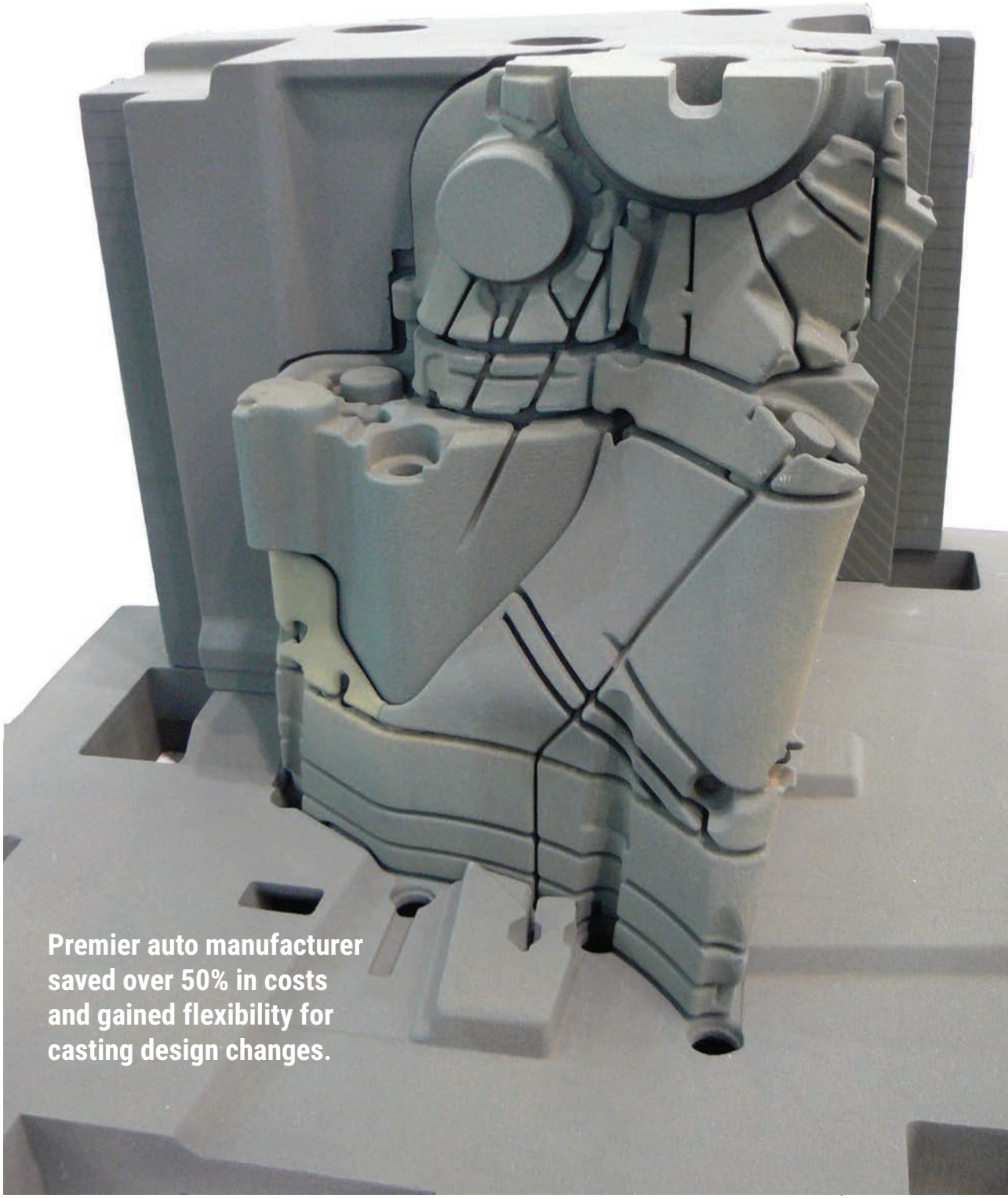
Patterns and tools for sand core forming, lost foam model parts

COST PER LOT: 15,000-20,000 €

EXONE SAND 3D PRINTING:

PRODUCTION TIME: 4 HOURS

COST PER PART: 1,500 €



Premier auto manufacturer saved over 50% in costs and gained flexibility for casting design changes.

All-New Tooling Solutions
Large, Complex Sustainable Toolmaking

With its ability to precisely bind powdered materials together quickly across large surface areas, binder jet 3D printing is known for high volumetric output at quick speeds. But that's just one of the reasons the technology is ideal for toolmaking.

Binder jetting can also be scaled up to produce very large parts with intricate and complex designs – without losing dimensional accuracy.

Currently, ExOne sand machines can print in a build envelope up to 1800 x 1000 x 700 mm (70.9 x 39.4 x 27.6 in).

But one of the most compelling reasons for binder jetted tooling is that large forms can be created in a broad range of cheap raw materials that can be infiltrated with substances to deliver desired tooling properties.

Washout Sacrificial Tooling

For example, with ExOne's washout tooling for composite layup, ExOne can 3D print a form in silica sand or ceramic sand with a binder that remains water soluble up to 180° Celsius or 356° Fahrenheit throughout the process.

Each of those sand media has its own coefficient of thermal expansion. The CTE for silica sand is 20 ppm/°C (11 ppm/°F), which works for certain materials. If a lower CTE is desired, ceramic sand delivers a CTE of 3 ppm/°C (2 ppm/°F).

Additionally, the expansion is driven by the media, not the binder, which makes the expansion isotropic (XYZ), resulting in controllable, high-quality results.

After the sand tool shape is created, the part is coated with a surface to prevent resin migration into the porous tool form during composite layup. The chosen coating also can deliver desired temperature or surface quality characteristics.

ExOne offers two forms of proprietary spray coatings for its washout tooling,

in addition to Teflon tape wrapping. Our blue coating remains water soluble up to 180° Celsius or 356° Fahrenheit while our green coating remains water soluble up to 132° Celsius or 270° Fahrenheit.

After autoclaving, removal of the tool is as simple as it sounds: it's simply washed out with tap water. No chemicals, breakout, break-down or deflating is necessary.

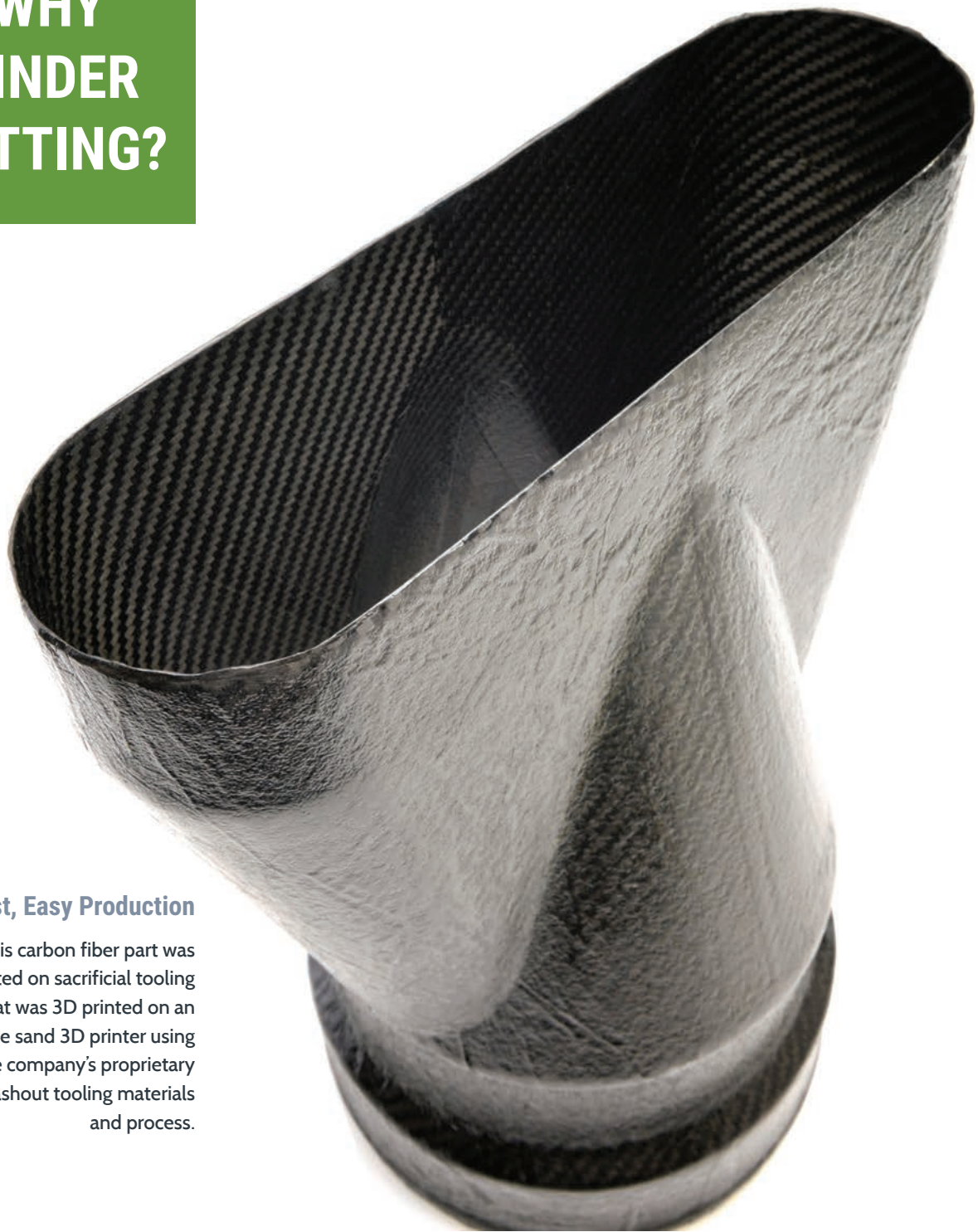
Even better: All the sand can be reclaimed and recycled for sustainable reuse.

Vacuum- and Hydro-form Tooling

Using this same approach, ExOne creates large tools that are now being used for vacuum- and hydro-forming. The porous sand part is infiltrated with resins that make the form incredibly durable and capable of withstanding high temperatures, pressures and other conditions.

At ExOne, we even use this tooling to build body panels on some of our industrial printers.

WHY BINDER JETTING?



Fast, Easy Production

This carbon fiber part was created on sacrificial tooling that was 3D printed on an ExOne sand 3D printer using the company's proprietary washout tooling materials and process.

Direct Metal 3D Printing

After 20 years of development, ExOne metal 3D printing is ready for prime time – with a full family of metal 3D printers to transform MIM powders into high-density, precision parts. No infiltration required for full density. ExOne can take you from R&D to design and prototyping to full production.

KEY USES

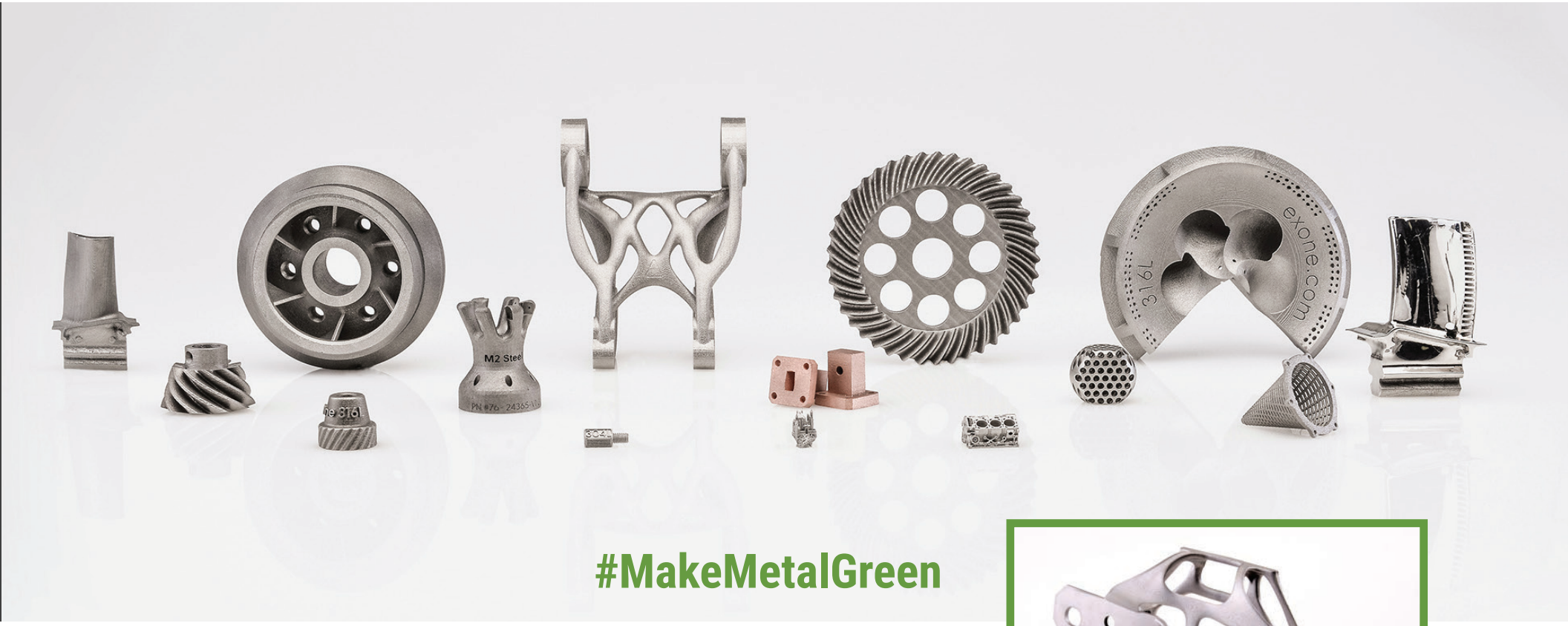
- Research & Development
- Prototyping
- Rapid product development
- Short-run production
- Serial production
- Continuous 24/7 production

BENEFITS

- Flexibility: Print 20+ metals, ceramics and composites
- Sustainable manufacturing
  - Eliminate waste
  - Consolidate parts
- All-New Metal Design Freedom

LIGHTWEIGHT WITH FREEDOM

CONSOLIDATE PARTS AND PROCESSES



#MakeMetalGreen

REDESIGNED AND 3D PRINTED: ExOne binder jet 3D printed this part (right) in 316L for a global automotive manufacturer in partnership with Altair. The new part was 45% lighter than the original part designed for traditional manufacturing. Making the new part also required fewer manufacturing operations and less welding to assemble it into the vehicle.

Metal 3D Printing Machine Tools

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.

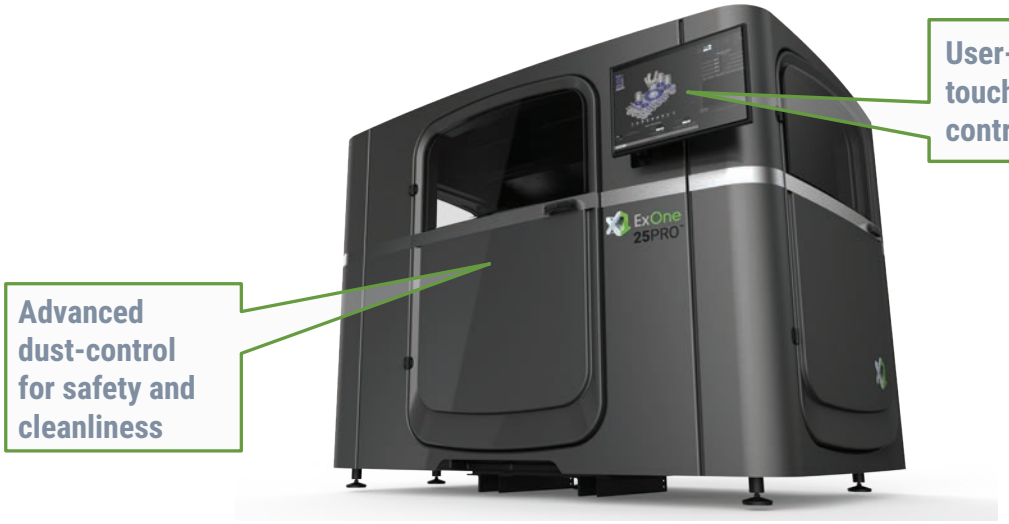
ExOne metal printers feature our patented Triple ACT (advanced compaction technology) for dispensing, spreading and compacting fine powders. Triple ACT delivers high density and repeatability for functional, precision parts. Learn more at exone.com/tripleact

Innovent+

An affordable, compact and reliable 3D printer for metal, ceramic or composites. Since 2018.

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

Build envelope: 160 x 65 x 65 mm (6.3 x 2.5 x 2.5 in)
Volume: 0.676L
Max throughput: 166 cc/hr
Min layer height: 30-200 µm
Min powder size: 2 µm (D50)

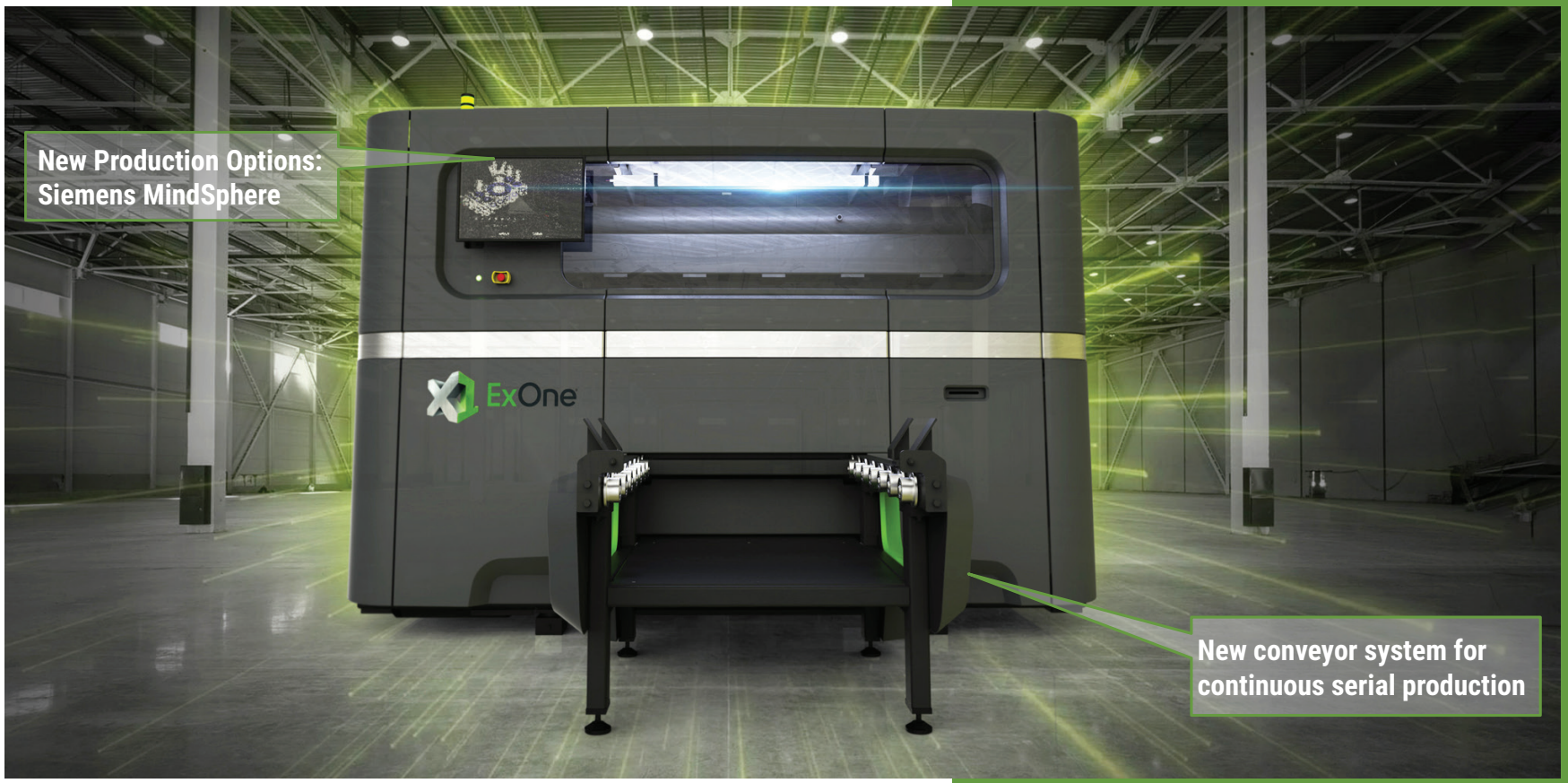


X1 25Pro

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**

Build envelope: 400 x 250 x 250 mm (15.75 x 9.84 x 9.84 in)
Volume: 25 L
Max throughput: 3,600 cc/hr
Min layer height: 30-200 µm
Min powder size: 5 µm (D50)



ExOne's 10th Metal 3D Printer is a Big One

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

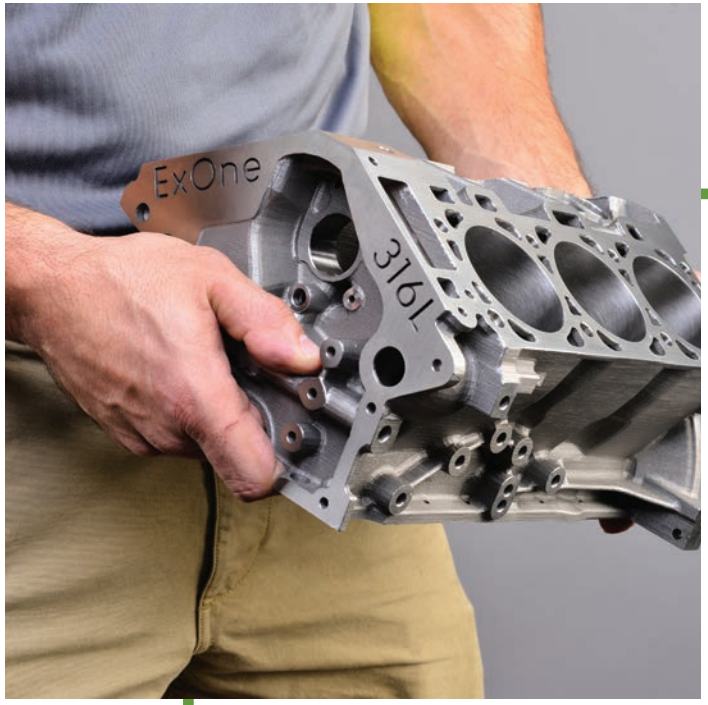
Build envelope: 800 x 500 x 400 mm
(31.5 x 19.7 x 15.8 in)
Volume: 160 L
Est. throughput: 10,000+ cc/hr
Est. layer height: 30-200 µm
Est. min powder size: 5 µm (D50)

The X1 160Pro

The largest and most advanced 3D printer for production of metal, ceramic or composite parts. Launches in 2020.

Metal 3D Printer Materials

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



POWDER-TO-PART

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.

Our comprehensive qualification process helps to ensure customers will have reliable, repeatable and predictable parts from 3D printing through final sintering.

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

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

Third-Party Qualified Materials

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
- Ceramics: silica sand and ceramic sand
- Metal Composites: 316 with bronze, 420 with bronze, and tungsten with bronze

Customer-Qualified Materials

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

- Metals: cobalt chrome, copper, H13 tool steel, Inconel 625, titanium, tungsten heavy alloy
- Ceramics: alumina, carbon, and tungsten carbide-cobalt
- Ceramic-metal composites: boron-carbide aluminum and silicon carbide

R&D Qualified Materials

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

- Metals: 4140, 420, 4340, 4605, aluminum, bronze, H11 tool steel, Hastelloy, Haynes 230, Inconel 718, iron-chrome-aluminum, Panacea, tungsten, TZM Molybdenum
- Ceramics: boron carbide, glass, silicon nitride, tungsten carbide and zirconia
- Metal composites: iron with bronze, and tungsten with copper

A-to-Z MATERIALS
(qualification category)

17-4PH (third-party)
304L (third-party)
316 i/w bronze (third-party)
316L (third-party)
4140 (R&D)
420 (R&D)
420 i/w bronze (third-party)
4340 (R&D)
4605 (R&D)
Alumina (Customer-qualified)
Aluminum (R&D)
Aluminum Nitride (R&D)
Barium Titanate (R&D)
Boron Carbide (R&D)
Boron-Carbide i/w Aluminum (Customer)
Bronze (R&D)
Carbon (Customer)
Ceramic Sand (Customer)
Cobalt chrome (Customer)
Copper (Customer)
Glass (R&D)
H11 Tool Steel (R&D)
H13 Tool Steel (Customer)
Hastelloy (R&D)
Haynes 230 (R&D)
Inconel 625 (Customer)
Inconel 718 (R&D)
Iron i/w Bronze (R&D)
Iron-Chrome Aluminum (R&D)
M2 Tool Steel (third-party)
Panacea (R&D)
Silica Sand (Customer)
Silicon Carbide (Customer)
Silicon Carbide i/w Silicon (Customer)
Silicon Nitride (R&D)
Titanium (Customer)
Tungsten (R&D)
Tungsten Carbide (R&D)
Tungsten Carbide-Cobalt (Customer)
Tungsten Heavy Alloy (Customer)
Tungsten i/w Bronze (third-party)
Tungsten i/w Copper (R&D)
Tungsten i/w/ Invar (R&D)
TZM Molybdenum (R&D)
Zirconia (R&D)
Zirconium Carbide (R&D)
Zirconate Titanate (R&D)

ExOne Fuse Binders

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, silicon carbide (SiC), and other ceramics

Case Studies: Direct Metal Customers

Production Time Comparison

Innovent+
One week

Traditional MIM
10-14 weeks

Metal Injection Molding (MIM) was chosen as the manufacturing technology for the serial production of fasteners for building hardware for customer evaluation.

Because the mold tooling for MIM is traditionally expensive and the lead time is usually 10 - 14 weeks, the new product was 3D printed using the Innovent+ printer. By doing so, MiMtechnik was able to present its customer with samples one week after receiving the request.

By using the same powder for the binder jetted parts and the MIM serial parts, MiMtechnik could use its current sintering process.

The delivered final part properties matched what the customer could expect with MIM parts.

MATERIAL: 316L High Density Single Alloy
PARTS: Fasteners for building hardware

TRADITONAL METHOD: Metal Injection Molding (MIM)
Total time: 10 - 14 weeks
Tooling costs: € 10,000 - 20,000

NEW 3D PRINTING METHOD: ExOne Innovent+
TOTAL TIME: 1 week
TOOLING COSTS: € 0

ideas2cycles

ideas2cycles is a non-profit organization for designing, engineering and prototyping concept bicycles, as well as other designs. Being a non-profit, ideas2cycles was looking for a way to lower the cost of producing personalized bike components.

ExOne binder jetting technology let ideas2cycles focus on creating unique parts without having to consider the limitiations of traditional manufacturing. ideas2cycles provided its customers with custom parts for half the cost with significantly reduced lead times compared to other manufacturing methods.

MATERIAL: 420 Stainless Steel/Bronze Matrix
PARTS: bicycle lugs, brackets, dropouts, fork crowns
TRADITIONAL COSTS: $1,000 (with labor) per assembly
EXONE COSTS: $425 per assembly
TRADITIONAL PRODUCTION TIME: 3-4 weeks
EXONE PRODUCTION TIME: 4 days

Custom bicycle frame builder ideas2cycles saved weeks in labor with metal parts binder jetted by ExOne.

ExOne Adoption Centers

Our EACs are premium binder jetting service bureaus, located in the United States (Pittsburgh and Detroit) and Europe (Gersthofen, Germany). Our EAC can 3D print your mission-critcal sand molds and cores, washout tooling, and metal, ceramic or composite parts.

Design, Engineering & Logistics

As world leaders in binder jetting technology, our expert teams can help you evaluate, design and qualify a part for 3D printing production. Our comprehensive process includes material development, process planning, and quality control.

Services & Support

- 3D Printed Parts on Demand
- Design, Engineering & Logistics Services
- Installation & Training Services
- Premium Maintenance & Support Services

About ExOne Services

ExOne offers comprehensive services to successfully assist companies of all sizes in making a successful transition from traditional to digital manufacturing. We're here to help you extract new value from the benefits that only binder jet 3D printing can deliver.

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.

OneCast Metal Casting Services

What's more, our specialized OneCast service team has exceptional knowledge of metal casting 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.

KEY CONTACT

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

Rick Lucas

Chief Technology Officer

KEY CONTACT

- On-Demand Production Services
- Machine Sales
- Machine Installation and Training
- Service & Support

Charlie Grace

Chief Customer Officer

360° Products & 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-critcial applications. Our machines are known for accuracy, reliability, and ease of use.

3D Printed Parts on Demand

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

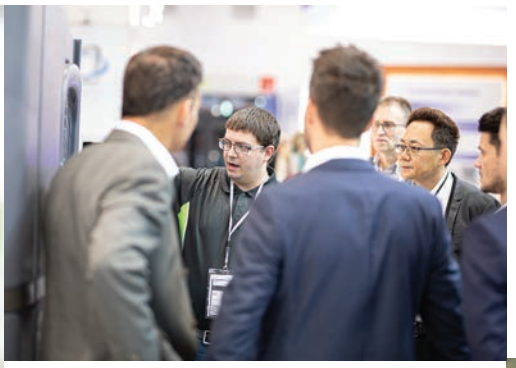
Installation, Training & Support

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.

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.

ExOne is Built on Values



COLLABORATION
We build relationships.

INTEGRITY
In words and action.

POSITIVITY
We believe it's possible.

INNOVATION
We deliver ideas that matters.

A DEDICATED TEAM OF WORLD-CLASS EXPERTS

ExOne Guides & Resources

Learn more online about binder jetting technology and how it has reshaped other businesses

THE BASICS: METAL BINDER JETTING
Compare metal binder jetting to other metal 3D printing processes

www.exone.com/binderjetting

THE EXONE TRIPLE ACT
A superior recoater for industry-leading density and repeatabilty

www.exone.com/tripleact

HOW 3D PRINTING RECAST HUMTOWN
Read how ExOne sand 3D printers transformed one manufacturing company

www.exone.com/humtown

METAL MATERIALS Q1 2020 UPDATE
Download ExOne's guide to metal materials, which includes 10 single-alloy metals, six ceramics and five composites, plus even more R&D materials.

www.exone.com/metalmaterials

News & Research

About ExOne Binder Jetting

It may not be an important distinction to every 3D printer manufacturer. But at ExOne, we're proud to say our binder jetting systems are cited in about 100 peer-reviewed technical and scientific articles.

The team at ExOne has worked closely with the R&D communities of universities, colleges and research institutions, such as Oak Ridge National Laboratory, since the company was founded as the ProMetal division of Extrude Hone in 1995.

Find the most up-to-date research papers at ScienceDirect.com and search "ExOne and binder jetting"

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Our YouTube channel also features fun, instructional content. Subscribe!

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LET'S SOLVE THE TOUGHEST PROBLEMS.

AND CHANGE THE WORLD.

ExOne™

Collaborate. Innovate. Accelerate.

About Us

1-877-773-9663

ExOne is the pioneer and global leader in binder jet 3D printing technology. Since 1995, we've been on a mission to deliver powerful 3D printers that solve our customers' toughest problems and enable world-changing innovations. Our 3D printing systems quickly transform powder materials — including metals, sand, ceramics, and composites — into precision parts, metalcasting molds and cores, and innovative tooling solutions.

Industrial customers use our technology to save time and money, reduce waste, increase their manufacturing flexibility, and 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.