



CASE STUDY

# Looking Ahead to the Next 150 Years with 3D Printing

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Waupaca Foundry fuses tradition and technology by bringing binder jet sand 3D printing in-house



*If you aren't looking ahead,  
you're already behind*

Waupaca Foundry

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**CUSTOMER**

Waupaca Foundry

**LOCATION**

Waupaca, Wisconsin

**APPLICATIONS**

High-quality raw, machined, painted, and assembled iron castings

**3D PRINTERS**

S-Max® Pro

**MATERIALS**

Silica sand with furan binder

**ALLOYS POURED**

Gray, ductile, and austempered ductile iron

**WEBSITE**

[www.waupacafoundry.com](http://www.waupacafoundry.com)

## Looking ahead with 3D printing

With a history dating back to 1871, Waupaca Foundry has established a legacy of producing high quality gray iron, ductile iron, and austempered ductile iron castings. Today, the company has an annual capacity of 1.4 million tons and employs more than 4,000 at plants located throughout the United States. To continue growing for the next 150 years, Waupaca Foundry keeps innovation as a top priority because, “if you aren’t looking ahead, you’re already behind.”

And to stay ahead of the curve, Waupaca Foundry has used additive manufacturing to deliver more value to its customers, solving quality issues and eliminating supply chain instability in iron casting manufacturing. First utilizing the technology through services offered at leading pattern shops, Waupaca installed its first sand 3D printer at Plant 1 in 2022. With an in-house S-Max Pro from the leader in sand 3D printing solutions, ExOne, the foundry is able to automate the core production process and create complex core assemblies as single pieces.

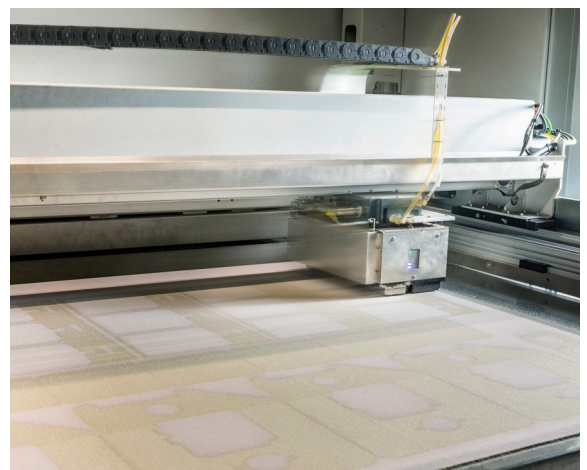
## Cultivating new opportunities

Adding 3D printing to Waupaca’s capabilities allows the team to provide flexible, local solutions to its customers’ unique challenges.

The foundry is currently building its expertise with binder jetting to aid in design development and program launch through rapid prototyping work. “Customers are able to do R&D on products without needing to cut a new tool,” said Nick Bonikowske, Sample and Process Analyst at Waupaca Foundry. With 3D printing, the team is able to



Waupaca Foundry’s history dates back to 1871



Digital sand 3D printing allows Waupaca to eliminate the cost and lead time of hard tooling, as well as optimize complex castings

*“The changes that we need to make to a design we can do on the fly and provide a new sample within a day instead of weeks.”*

Nick Bonikowske, Sample and Process Analyst, Waupaca Foundry



produce a proof-of-concept casting with digitally produced molds and cores without the cost of tooling, or the 6-10 week turnaround time to get it. Customers can thus mitigate risks by testing and verifying part performance before a casting goes into production. “The changes that we need to make to a design we can do on the fly and provide a new sample within a day instead of weeks,” Bonikowske emphasized.

In addition to streamlined product launches, additive manufacturing is helping Waupaca Foundry expand its business, taking on pours typically not cost effective with the cost of hard tooling. “We’re bringing in jobs that are low volume, so we don’t want customers to pay for tooling,” said Halden Collins, Process Engineer Manager at Waupaca Foundry. Eliminating the need for core box tooling by directly 3D printing sand designs, the foundry is able to flexibly produce jobs of any quantity. Unique or low-volume cores can be nested into the build volume of the 3D printer among a variety of other jobs and 3D printed all at once, streamlining production and making jobs of any size profitable for the foundry.

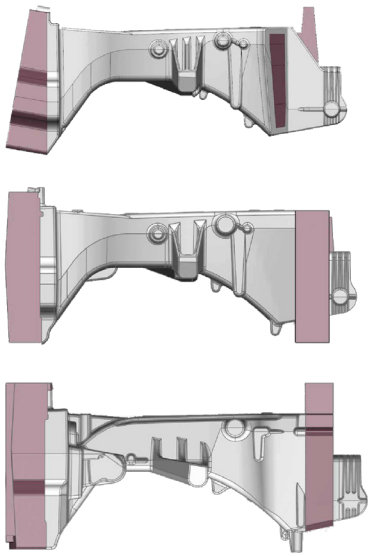
Going digital not only eliminates the cost and lead time of hard tooling, but also allows Waupaca to use the design freedoms of additive manufacturing. The team is optimizing gating in R&D projects and casting designs that weren’t previously possible with hard tooling and multi-piece cores.

3D printing is also helping improve quality in complex iron castings. Collins recalls a turbo housing for a diesel engine, cast with a three-piece core assembly, and “an absolute nightmare for scrap,” because manual assembly of the cores created a mess of seams and glue. Since Waupaca switched to 3D printing the turbo housing core as a single piece on the S-Max Pro, Collins says it’s been “smooth sailing.”



The ExOne S-Max Pro sand 3D printer, installed at Waupaca Foundry Plant, allows production of complex core assemblies as a single, consolidated piece and creates the ability to produce rapid prototype castings.

## 3D printing delivers tangible benefits



The initial design of the tractor steering column support, top, was iterated quickly to the final design, bottom, with sand 3D printing, eliminating the cost of tooling

### Risk avoidance and fast turnaround

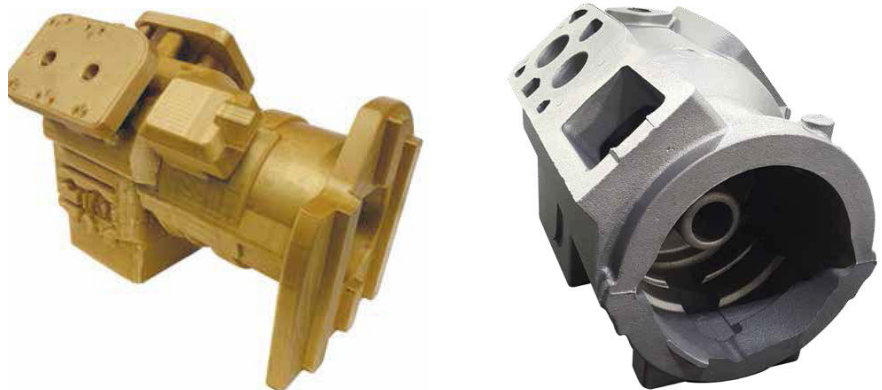
A global agricultural equipment OEM initiated a redesign of a tractor steering column support that required a fast turnaround. The 111-pound gray-iron casting featured a three-piece, 79 lb core assembly with complex airflow features. To avoid missing the tight deadline while waiting for hard tooling to be created, 3D printing was used to produce the cores.

Building cores in sand layer-by-layer directly from a CAD file not only allowed the customer to avoid the cost of core box tooling, but digital production allowed multiple geometry iterations to be produced simultaneously testing without the risk of high-cost modifications. The customer saved 20% on the project by eliminating tooling and the 3D printed cores were delivered in eight days, saving 2-3 weeks on the project lead time.

### Innovation mitigates supply chain risk

Despite dual-sourcing a casting, a global manufacturer that provides commercial refrigeration innovations for large grocers and supermarkets continuously experienced quality issues resulting in downtime. In the face of these supply chain disruptions, the company was forced to investigate new suppliers and manufacturing methods for an already-in-production compressor body.

Using simulation software to explore various solutions to improve the 202 lb gray iron compressor housing casting, Waupaca created a complex core package design to more easily produce without hard tooling. Providing a prototype by using a quick-turn 3D printed core gave the customer the confidence to switch suppliers knowing the improved core package design and core process change reduced internal scrap and eliminated recurring downtime.



The complex 3D printed core package, left, was produced without hard tooling and the final casting, right, helped reduce internal scrap while eliminating recurring downtime.

With advanced technologies like binder jet sand 3D printing, Waupaca Foundry making an investment in the future of its business by producing complex castings with short lead times and high accuracy using sustainable and cost-effective methods.

## Fusion of tradition and technology

Proud of its heritage and committed to the future, Waupaca Foundry is dedicated to improving the casting process for its customers, team members, and the environment. With a decades-long history of prioritizing sustainable practices, the foundry is proud to hold the distinction as the only metalcaster to be included within the inaugural membership of both the U.S. DOE Better Plants program in 2010 and the Better Climate Challenge in 2022.

And along with helping the business grow with innovation, sand 3D printing aligns with Waupaca's goal of finding smarter ways to use and preserve the plant's resources. Digital castings eliminate wooden core boxes and the storage footprint they create, reduce the logistics of finished parts produced locally, and can help play a role in improving dimensional accuracy to reduce scrap rates. What's more, the advanced and innovative designs enabled by additive manufacturing are often used to create more complex components that aid goals such as lightweighting and increased fuel efficiency.

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### Americas Headquarters

ExOne Operating, LLC  
Pennsylvania, USA  
americas@exone.com  
+1 877 773 9663

### European Headquarters

ExOne GmbH  
Gersthofen, Germany  
europe@exone.com  
+49 821 65063-0

### Asian Headquarters

ExOne KK  
Kanagawa, Japan  
asia@exone.com  
+81 465 44 1303

[www.exone.com](http://www.exone.com)

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### ABOUT WAUPACA

Waupaca Foundry is the largest producer of gray, ductile, austempered ductile, and compacted graphite iron in the world, melting more than 9,500 tons a day. Its castings are produced using a vertical green sand molding process and created by a workforce that puts generations of iron casting expertise to work for customers every day. Those customers trust Waupaca Foundry for high quality iron castings that are consistently the most durable, reliable, and innovative products on the market.

### ABOUT EXONE

ExOne is now part of Desktop Metal's group of #TeamDM brands, which exist to make Additive Manufacturing 2.0 a reality so we can unlock the vast benefits of 3D printing at meaningful production volumes. Our 3D printing systems quickly transform powder materials – including metals, ceramics, composites and sand – into precision parts, metalcasting molds and cores, and innovative tooling solutions. Industrial customers use our technology to save time and money, reduce waste, improve their manufacturing flexibility, and deliver designs and products that were once impossible. As home to the world's leading team of sand binder jetting experts, ExOne also provides specialized 3D printing services, engineering, and design consulting.

