Desktop Metal

CASE STUDY

Ultralight and High-Performance Racing Bicycle Components

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Tamau Italia and Stelbel leverage metal binder jetting to overcome the limitations of conventional manufacturing methods

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3D Printing Service Bureau
Tamau Italia

Location
Megliadino San Fidenzio, Italy

Scope of Service
Manufacturing of mechanical metal components

Machine
Shop System™

Website
www.tamau.it

Customer
Stelbel

Location
Bergamo, Italy

Application
Rear dropouts for racing bicycle frames

Material
Stainless steel 17-4-PH

Website
www.stelbel.it

Rigorous criteria for racing bicycles

The Bergamo region in Italy has a deep cycling tradition. It is also the headquarters of Stelbel, a registered trademark of Cicli Corsa and a leading manufacturer of high-end racing bicycles, components, and accessories, famous for its Stelbel™ frame brand. Stelbel strives to continuously produce innovative and high performance racing bicycles with the best available technology to meet cyclists' specific needs.

Stelbel understands that bikers' needs differ between casual and racing bikes in several key areas such as speed, efficiency, and performance. Unlike casual cyclists who often ride shorter distances at a relaxed pace, racing bikers ride long distances at high speeds and train extensively with their bicycles. As a result, Stelbel's racing bikes must meet stringent criteria, including:

- Lightweight frames
- High aerodynamic performance to reduce air drag
- Geometry that allows for sharp turns and rapid acceleration
- Durability as high-performance parts wear out faster
- Highly customizable to match the rider's performance goals, unique body mechanics, and riding style

However, these factors make racing bicycles very difficult, lengthy, and expensive to produce, especially with traditional manufacturing methods such as CNC, investment casting, and metal injection molding (MIM). The geometric

limitations of these methods make it difficult to produce complex shapes and with these manufacturing processes, small batches and custom production are very expensive. Importantly for bicycles, these factors create limitations in balancing the weight and mechanical strength of the components.

To overcome the challenges of traditional production methods for its cycling products, Stelbel collaborated with Tamau Italia, a manufacturing company specialized in the production of high-performance metal parts using advanced technologies such as binder jet 3D printing from Desktop Metal. The partnership's main objective was to improve the aerodynamic performance, reduce the weight, and increase the customization possibilities of Stelbel cycling products. The cycling company also sought to reduce the production time and cost of its custom products while enhancing the durability of advanced designs.

The collaboration with Tamau Italia demonstrated how metal 3D printing with binder jet technology successfully improved the performance and design of racing bicycle parts and even created innovations. Metal binder jetting also significantly reduced production time and cost compared to CNC.

The advantages of 3D printing racing bike parts with binder jet technology

Although Tamau Italia has several manufacturing technologies in-house, the company was convinced from the beginning of the project that binder 3D printing was the solution. Building complex designs layer-by-layer based on a software-generated digital model, the team overcame the following limitations of conventional manufacturing processes in the production of high-performance road bike components:

1. **Design freedom:** Binder jet technology is well known for its ability to realize intricate, specialized geometries that are not possible with traditional methods.
    - A lattice structure could be designed inside the part to distribute mechanical stresses more efficiently, improve fatigue strength by reducing stress concentrations, ensure stability during sintering, and prevent distortion. **This design is not possible with any conventional technology.**
2. **Strength-to-Weight-Ratio:** Printed components have an optimized design, resulting in parts with minimal material usage while maintaining structural integrity and strength.
3. **Advanced customization:** Binder jet technology allows component designs to be easily tailored to specific functional requirements or to meet the specific needs of its users, a great benefit for both professional and amateur cyclists.

"It's very important to us to be able to customize each part of our bikes," said a representative of Stelbel. "On one hand, we can adjust the weight and resistance ratio of each bike based on what the customer needs. On the other hand, we can also make small improvements or changes quickly, if needed. This means we can respond quickly to a customer's requests or to

new technical standards without having to produce a lot of inventory that requires a lot of money and time."

4. **Efficient production:** Parts can be printed with binder jetting in a matter of hours or days, significantly reducing production time compared to conventional manufacturing methods, especially for small batches such as premium racing bicycles.

Tamau Italia and Stelbel developed a pair of rear dropouts for a racing bicycle frame, components that secure the rear wheel to the frame, using the Desktop Metal Shop System binder jetting platform. Previously, the machined parts were welded together, often resulting in inaccurate alignment due to heat deformation during welding. So, consolidating fabrication with 3D printing was chosen over CNC, casting, or MIM to avoid this problem, as a representative from Stelbel mentioned: "The 3D printed design of the complex parts, with our desired aesthetic and technical aspects, ensured that the necessary welds, and consequently the deformations, could be reduced."

At Tamau Italia, the manufacturing process of rear dropouts began with digital design and finite element method (FEM) simulations, where engineers optimized the component's structure using state-of-the-art software. This stage ensured that the dropouts were not only lightweight but also strong enough to handle the demands of high-performance racing bicycles.

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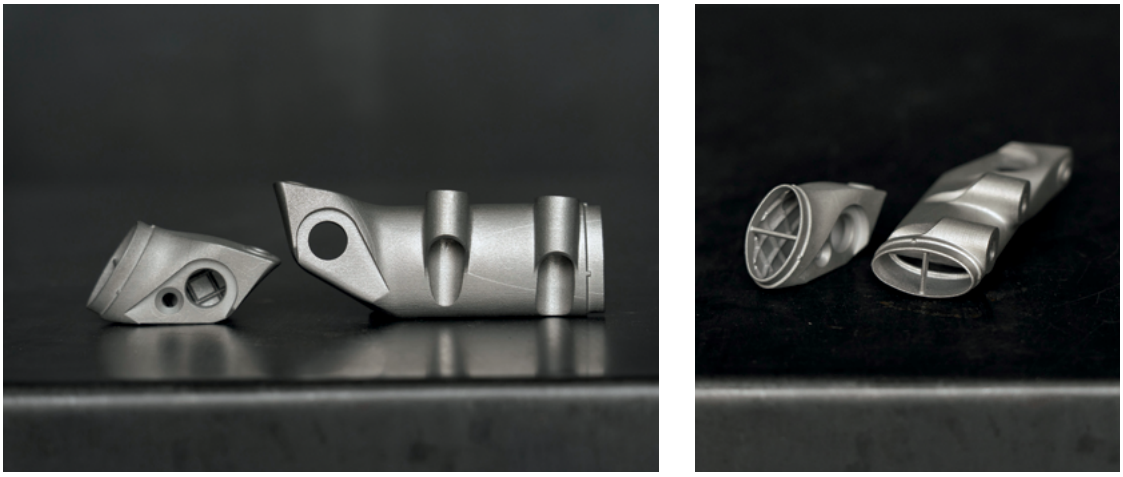
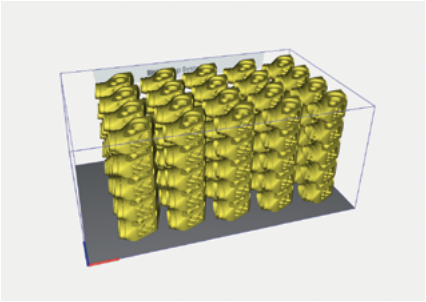
A pair of rear dropouts for a racing bicycle frame 3D printed on the Shop System from Desktop Metal



The dropouts were then 3D printed using the Shop System, a state-of-the-art binder jet system from Desktop Metal. Building the components layer-by-layer in a bed of metal powder, the process results in complex geometries that traditional manufacturing methods cannot easily replicate.

Finally, the rear dropouts underwent post-processing including sintering, surface finishing, and rigorous quality control. These steps enhanced the precision, durability, and overall strength of the final product, ensuring that each rear dropout met the high-performance standards required for competitive cycling.

Using binder jetting in this precision-driven approach, Tamau Italia successfully produced lightweight, strong, and reliable rear dropouts for racing bicycle frames.



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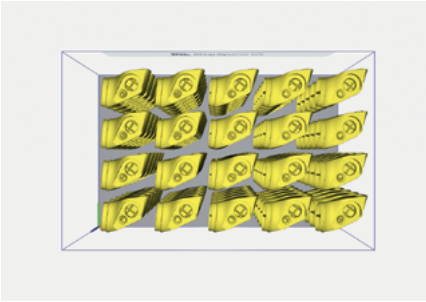
100 parts of Model 1 can be printed in a single build cycle on the Desktop Metal Shop System without the need for support structures



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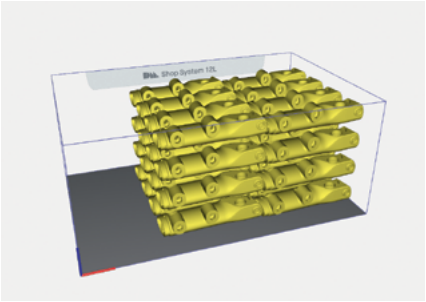
Estimated print time: 13h 1m – 15h 16m
Total used volume: 830.8 cc
Powder required: 131.1 kg



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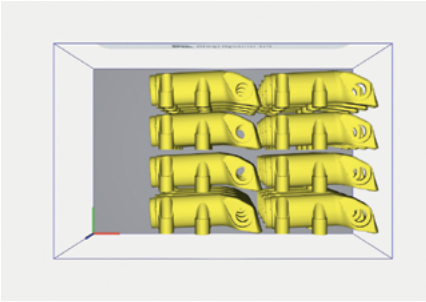
32 parts of Model 2 can be printed in a single build cycle on the Desktop Metal Shop System without the need for support structures



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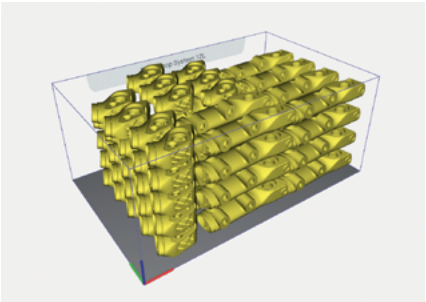
Estimated print time: 12h 39m – 14h 49m
Total used volume: 839.5 cc
Powder required: 127.3 kg



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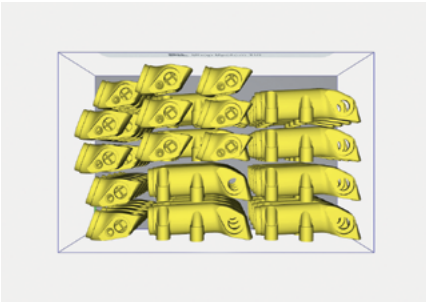
60 mixed parts from both models can also be printed in a single build cycle



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Estimated print time: 13h 1m – 15h 16m
Total used volume: 1036.3 cc
Powder required: 131.1 kg

3D printing material

In terms of 3D printing material, Tamau Italia and Stelbel decided to choose stainless steel 17-4-PH:

Key mechanical properties of stainless steel and its benefits for rear dropouts*

	Stainless steel rear dropouts
Tensile strength	High (~500–800 MPa) → Can handle high forces from pedaling and impacts
Density	~7.8 g/cm^3
Hardness and/or stiffness	High hardness (~150–200 HB) -> Reduces wear from axle and quick-release skewer pressure
Corrosion resistance	Good (ideal for all-weather racing)
Fatigue resistance	Good (withstands repeated stress over long rides)
Durability	Extremely durable and long lasting

*This evaluation was made by Tamau Italia and Stelbel

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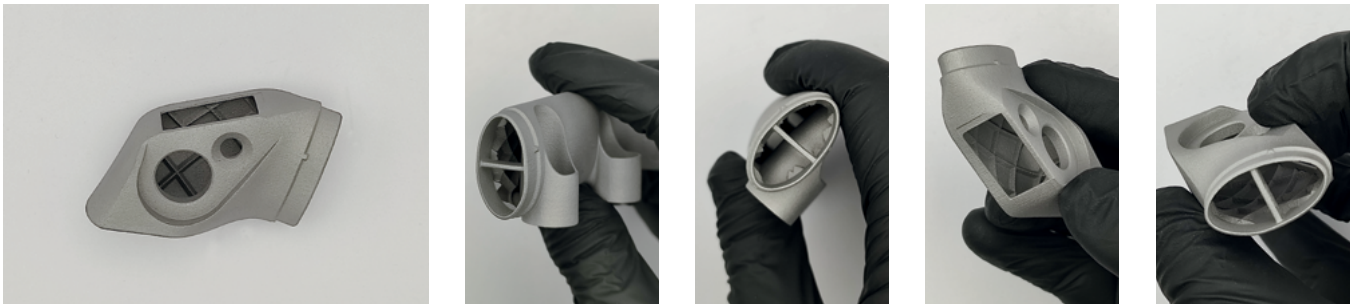
3D printed parts for rear dropouts prior to assembly



Tests and results

A comprehensive evaluation of the 3D-printed components' performance was conducted using both mechanical and real-word tests. The mechanical test encompassed the following aspects:

- Tensile, compression, and fatigue strength. The fatigue strength was evaluated according to the ISO 4210-6 standard
- Vibration and modal analysis

The collected comparative data concluded that the binder jet 3D printed rear dropouts were superior to the conventionally manufactured parts in terms of:

- Reduced component weight by 30 % (final weight: 125.5 gr)
- Enabled design complexity (lattice structure). This results in significant advantages:
  - Increased mechanical strength (more efficient distribution of mechanical stress)
  - Improved fatigue resistance due to reduced stress concentrations
  - Stability during sintering, which prevents distortion

"We were happy to see that using binder jetting made the component kit 30 % lighter. The fatigue resistance was superior and the assembly stiffness has increased. We know there's more we can do to improve it, and we plan to study how to do that," said Stelbel's representative.

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Rear dropouts installed on a Stelbel racing bicycle. Copyright: Stelbel

To ensure that the new parts meet industry standards, Stelbel participated in and successfully passed several tests.

In addition to the mechanical testing, bikes with the newly developed rear dropouts were tested on the road and in real-world competitions. These tests were conducted without the use of measuring instruments, relying instead on the direct feedback of the cyclists involved. The results were positive, with cyclists praising the significant improvements in performance and durability, while the athletes highlighted the component's lightness, stiffness, and responsiveness as key advantages.

For Stelbel, 3D printing the parts has also reduced the production time by over 80 % compared to CNC, as shown in the table below, allowing large batches to be produced in a single print without complex manual operations.

Bicycle component production time comparison between CNC and binder jetting*

Product Method	Production Time per Part	Production Time per Batch 50 Parts
CNC	4-6 hours	200-300 hours
Binder Jetting	30-60 minutes	10-15 hours

*This calculation was provided by Tamau Italia

In addition to reduced production time, additive manufacturing of bicycle components with metal binder jetting has reduced production costs by 50-60 % compared to CNC due to reduced manual labor and optimized material usage, as shown in the table below.

Bicycle component production cost comparison between CNC and binder jetting*

Cost Factor	CNC	Binder Jetting	Savings (%)
Material	High (up to 70 % waste)	Optimized (minimal waste)	~40 %
Machine Time	High (hours per part)	Reduced (minutes per part)	~80 %
Labor	High (set up, tool changes)	Minimal (automated process)	~70 %
Total cost per part	100 % (reference)	40-50 % of CNC cost	~50-60 %

*This calculation was provided by Tamau Italia

Future binder jetting projects

Tamau Italia and Stelbel were pleased with the outcome of their collaboration, as it demonstrated how 3D printing racing bicycle components with binder jet technology from Desktop Metal could improve several key aspects, including design complexity, performance and customization. In light of this outcome, Stelbel prepared to create more innovations. “We work in an industry that is very focused on weight, so we can expect steps in that direction. I would also

add that we see a series of new standards being introduced. Thanks to 3D printing, adapting to the new features introduced is very fast and simple," said Stelbel's representative.

As a result, the companies plan to continue their collaboration by additively manufacturing additional bicycle components and materials, including Ti64. They also plan to explore the potential for mass customization of 3D printed parts tailored to each cyclist.

"We're developing more components to improve the final product because of the results we've seen. It's important to balance craftsmanship and new technologies. So far, we've seen an increase in performance and kept up with our brand guidelines," he emphasized.

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Rear dropouts assembled on a Stelbel racing bicycle
Copyright: Stelbel

About Tamau Italia

TAMAU Italia, a market leader in MIM and precision investment casting, is the go-to service bureau for binder jetting, offering high-quality metal additive manufacturing solutions for prototyping, serial production, and advanced component validation. With over 25 years of experience, TAMAU HUB is at the forefront of industrial additive manufacturing, specializing in:

- Binder Jetting (BJ) – its core technology for high-precision metal AM
- Metal Injection Molding (MIM)
- Precision Investment Casting

As a leading binder jetting service provider, Tamau Italia delivers cost-effective, scalable, and production-ready metal parts, ensuring customized solutions for industries such as aerospace, automotive, biomedical, and industrial manufacturing. Tamau Italia's mission is to transform metal manufacturing through binder jetting, reducing costs and lead times while enhancing mechanical performance and maintaining rigorous quality control at every stage of production.

Learn more: www.tamau.it

About Stelbel

Based in Bergamo, Italy, Stelbel is a manufacturer of premium racing bicycles, components and accessories that uses the best available technology and highly skilled craftsmanship to create innovative, superior and highly customized products for cyclists and athletes around the world. Founded in the 1970s by cycling enthusiast Stelio Belletti, Stelbel is known for its unique and innovative frames. Stelbel was also one of the first to introduce vertical rear dropouts in 1977. Stelbel is a registered trademark of Cicli Corsa, an international seller of premium road bikes.

Learn more: www.stelbel.it

About Desktop Metal Inc.

Desktop Metal is driving Additive Manufacturing 2.0, a new era of on-demand, digital mass production of industrial, medical, and consumer products. Our innovative 3D printers, materials, and software deliver the speed, cost, and part quality required for this transformation. We're the original inventors and world leaders of the 3D printing methods we believe will empower this shift, binder jetting and digital light processing. Today, our systems print metal, polymer, sand and other ceramics, as well as foam and recycled wood. Manufacturers use our technology worldwide to save time and money, reduce waste, increase flexibility, and produce designs that solve the world's toughest problems and enable once-impossible innovations.

Learn more about Desktop Metal and our #TeamDM brands at www.desktopmetal.com