Desktop Metal

CASE STUDY

3D Printing For the Win in Clean Snowmobile Challenge

Clarkson University students use additive manufacturing to gain competitive advantage

Partner
Clarkson University

Location
Potsdam, New York

Industry
Education -
Race vehicle development

Application
Snowmobile exhaust manifold

Machines
Desktop Metal Shop System™

Material
17-4 PH Stainless Steel

Student innovations for mobility challenges

Every year, students at Clarkson University work together to compete in SAE International Clean Snowmobile Challenge (CSC). Similar to Formula SAE, the competition gathers student teams to reengineer a snowmobile to reduce emissions and noise while students apply engineering and project management skills.

The Clarkson University team participates in the diesel class focusing on utility style snowmobiles used by consumers such as ski resorts and national parks.

The team determined that a turbocharger would need to be added to the engine in order for the snowmobile to make enough power to hit the speed minimum requirement for the competition. Students are encouraged to reuse parts from previous competitions to meet budget requirements, so the team decided to reuse an existing GT12 turbocharger for the new engine.

With the defined goals for the competition, the team set out to develop a more innovative design than previous years that would increase speed, reduce weight and noise, as well as package into a compact, organized system for the judges.

Additive manufacturing solutions

The Clarkson SAE Diesel Snowmobile Team needed a part with a very complex geometry that was dimensionally accurate and that could withstand a cantilevered load and aggressive vibrations, all at 1250°F. The exhaust manifold was redesigned with the following requirements:

- Decrease losses with increased flow path design
- Easy installation fit to existing turbocharger flange
- Minimize space used in total assembly
- Reduce manufacturing cost compared to traditionally machined version

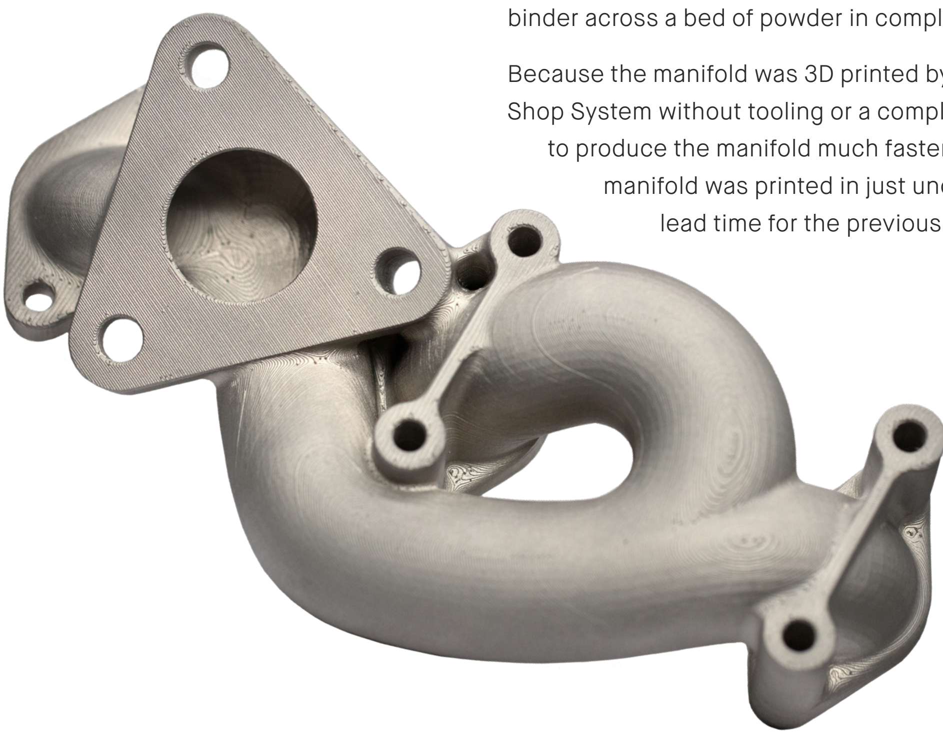
More than anything else, the addition of a turbocharger to the snowmobile added a huge packaging problem within the engine bay because of the limited space.

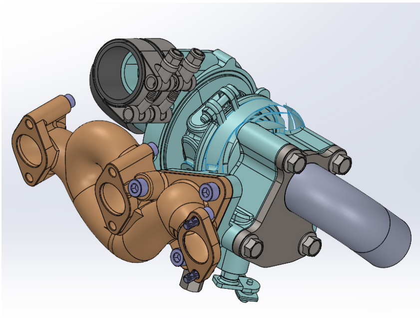
For previous competitions, the team designed a more simplistic billet manifold because of the ease of manufacturing. In order to develop a design that would fit into the allotted space, a new manifold with a very complex geometry with a series of runners to effectively collect exiting exhaust gasses was designed with 3D printing production in mind.

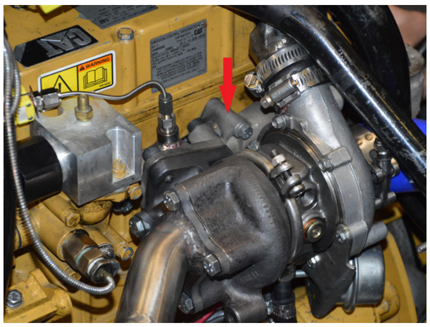
Additive manufacturing would allow the students to develop their unique design using a digital prouduction technology to meet their efficiency requirements. They turned to Desktop Metal's portfolio of easy-to-adopt metal 3D printing technologies to manufacture the complex exhaust manifold to the performance and space requirements.

For the end-use manifold, the team turned to the Desktop Metal Shop System. Binder jetting technology, similar to printing ink on a sheet of paper, deposits binder across a bed of powder in complex shapes, building parts layer by layer.

Because the manifold was 3D printed by directly sending a design file to the Shop System without tooling or a complex machining setup, the team was able to produce the manifold much faster than with traditional technologies. The manifold was printed in just under five hours, compared to a two-week lead time for the previous model.







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This complex mainfold was developed from CAD to functioning 3D printed piece by the Clarkson Diesel Snowmobile SAE team`

First-time success to get to the starting line

Because of the tight schedule of the competition, the team only had time to manufacture one component for end-use, making a successful 3D print and sinter run essential.

To eliminate any trial and error with the sintering furnace, often the crux of binder jet 3D printing, even for industry professionals, the students turned to Desktop Metal Live Sinter™. Capable of simulating the complex forces and part behavior in the furnace, Live Sinter automatically compensates for distortion and helped guide the students to 3D print and sinter the manifold successfully.

In just minutes Live Sinter generated "negative offset" geometry that sintered into a straight, defect-free part out of the furnace on the first try.

Delivered to the students the same day it came out of the furnace, the manifold was installed on the Clarkson Diesel Sled the day before leaving for the competition.

Record-holding snowmobile for Clarkson

The innovative 3D printed manifold design developed by the Clarkson SAE Diesel Snowmobile Team helped them place first overall in the competition. The stainless steel part performed perfectly in the sled, withstanding everything the team threw at it. The team was also presented with awards for "Best Technical Design" and "Lowest Emissions".

"Without the Desktop Metal Shop System printing this part, the team would have had to run sub-optimal engine components, hurting both the performance and emissions output," said Gregory Melone, Clarkson Diesel Snowmobile SAE team President. "This level of performance would not have been achievable by any means if not for 3D printing the manifold with Desktop Metal technology."

Brian Helenbrook, Paynter-Krigman Endowed Professor in Engineering Science Simulation at Clarkson University, praised the project. "This was a great collaboration between the Clarkson Clean Snowmobile team and Desktop Metal. The combination of Desktop Metal's technology and the Clarkson student's innovative ideas led to a truly unique and effective solution."

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> **Gregory Melone, President, Clarkson Diesel Snowmobile SAE**

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About Desktop Metal Inc.

Desktop Metal (NYSE:DM) 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