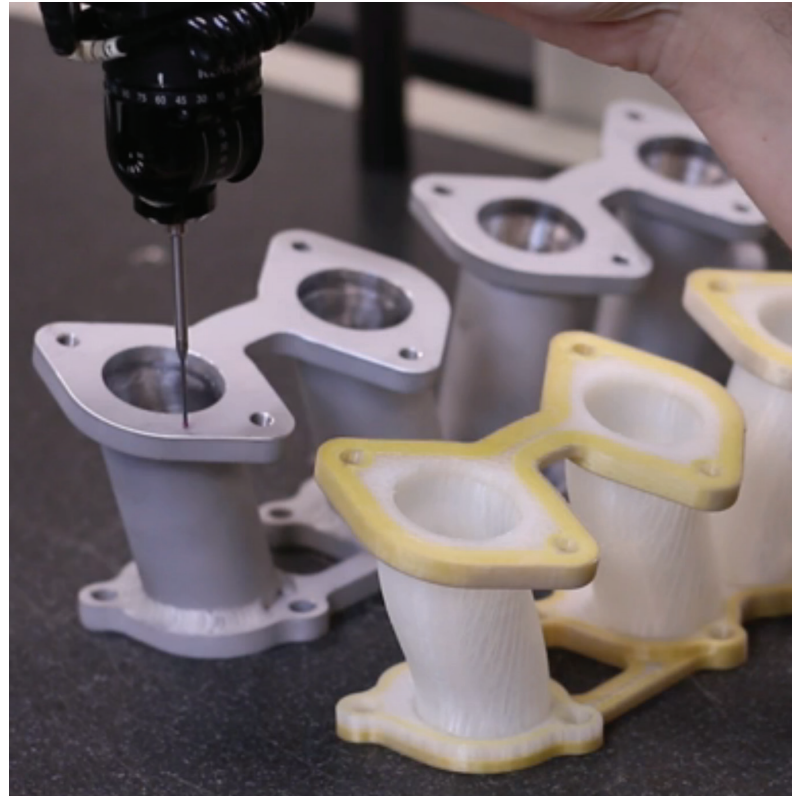


Driving Prices Down with the Markforged Industrial Strength 3D Printer



Comparing the Numbers

	Cost	Time
Markforged Part	\$63.85(material)	60 hours
Machine Shop - Aluminum	\$3,101.91	72-120 hours + shipping time

The printer paid for itself in less than three prototypes

The Need for Speed

For over 40 years, Turret Lathe Specialists, Inc has been churning out customer parts, be they one-off prototypes or larger production runs by leveraging their wide range of capabilities from high quality manual machining to CNC precision operations. Juggling orders and batch lead times, Quality Manager Daniel Shepherd is always under pressure to design and implement more efficient solutions: "The capabilities we have — with the conventional milling and turning we can offer — allow us to do short production runs. Because that's something we excel at, our customers started giving us some of their one to two piece rapid prototyping jobs." The company needed to find a way to fulfill these orders without burdening their larger production runs.

Investigate

Daniel Shepherd, Quality Manager at manufacturing company Turret Lathe Specialists Inc., has been searching for ways to keep job lead times short

Iterate

After discovering Markforged, Shepherd realized how a desktop 3D printer capable of printing metal-strength parts could cut down on time and costs while simplifying production runs

Improve

Using the Markforged 3D Printer to make prototypes and templates just as strong as their metal counterparts, Shepherd cut the manufacturing price of an engine manifold from \$2000 down to \$117

One of Shepherd's recent projects has involved fitting a carburetor on a 2.0L four cylinder engine and putting it all into a 1978 Volkswagen Rabbit, a car usually used for period-accurate racing. Shepherd needed a manifold to connect the engine to the carburetor, but the manifold he needed was impossible to get new. "Any versions of that part you would find today, the casting was one of the last made, you could tell the mold was blown out, and it probably shouldn't be turning out parts anymore," as Shepherd described. He challenged himself to make "not only an available manifold, but one that was lighter weight, more effective in terms of flow and fit, and simply one that's more affordable." After some initial design and prototyping, the design proved to be prohibitively expensive to manufacture. With runners in the manifold machined from solid aluminum, the manufacturing price was nearing \$2000, ten times the price for used manifolds on the market.

Shifting Gears

Since they had started receiving smaller orders, Turret Lathe Specialists faced some challenges meeting their customers' lead times. "Trying to fit [one piece orders] in between other jobs on the schedule was proving to be a nightmare, to say the least," Shepherd described. When Shepherd and his boss discussed how 3D printing could complement the machine shop, they realized how it could speed up their production runs: "The thing that really drove home the capability of 3D printing and how it could work in our work flow at the shop really had to do with our time management... to essentially have a robot working on a part when all of our valuable machinists are busy plugging away on more important work out in the shop."



"From the time of the first phone call, the first emails, to the time when the printer showed up and started turning out parts, the experience couldn't have been easier, and still here a year later, still printing out perfect parts every day."

-Daniel Shepherd
Quality Manager
Turret Lathe Specialists Inc.



Then it was just a matter of selecting a printer. “What we needed in a printer was something that fit on a desk, that didn’t cost as much as a huge industrial machine, and that turned out precision parts...Markforged was able to deliver on that,” Shepherd explained. The fiber-reinforced capabilities of the Markforged 3D Printer only solidified the deal: “The realization that we could turn out a part made of nylon with a few layers of composite fiber in between, and have it stand up to the same needs and abuses that we’d put aluminum parts through was really the thing that sealed the deal with top management for our Markforged printer.” Turret Lathe no longer needed to interrupt long product runs to make single parts; the Markforged could match the strength and precision of their best machines.

Pedal to the Metal

With Turret Lathe’s recently purchased Markforged 3D Printer, Shepherd could prototype and iterate upon his manifold design without needing to expend manufacturing cost and time at the company: “I began with my initial design in Solidworks and made it exactly as I wanted it — each stage was printed easily and accurately overnight during dead time between other jobs. It meets the needs of a fit prototype perfectly.” While he wanted the final part to be fabricated out of metal, the initial prototype exposed necessary revisions. He cut out the complex, 3D curvature of the runners to make them out of straight stock tubing, using the The Mark One once again, this time used to make cutting templates for the

“The only
shortcoming
I can think of is
that we don’t
have more
desk space for
a Mark Two.”

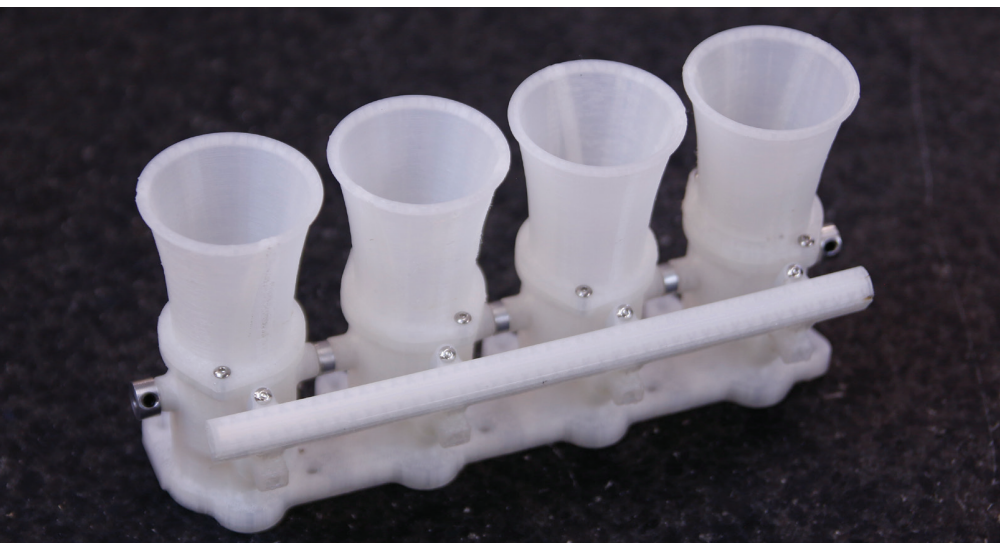
-Daniel Shepherd
Quality Manager
Turret Lathe Specialists Inc.

runners: "These templates allowed me to quickly and accurately cut the runners to size without having to spend time setting up a machine," he described. With no machinery capable of cutting the necessary angles without an arduous tooling setup, the Mark One allowed Shepherd to iterate upon his designs easily and bring the fabrication cost down to \$117. "It was really easy to make a prototype based on the old manifold...the design cleaned up and optimized for weight, for performance, for ease of manufacturing," Shepherd explained. "The runners came out beautifully. Most importantly, the templates kept them flat and as-designed. All that's left is to configure a jig and the finished product will be welded and finished."

The printer's success has expanded to other projects at the company as well, vastly simplifying manufacturing processes left and right. "A lot of the template and fitting tools that we used to make out of aluminum, that we can now make out of nylon and Kevlar, nylon and carbon fiber on the Markforged printer, they match the quality of the old aluminum tools with no question," Shepherd elaborated. "Knowing that we're saving on time and money, that just sweetens the deal." The production efficiency at Turret Lathe Inc. has vastly increased with the Mark One, and Shepherd is interested to see how it could improve the company's workflow even more: "I continue to be impressed with every part that comes off the Markforged printer. Having a tool like this allows us to solve problems in ways we never thought possible...Once we all catch up and learn how to implement the Markforged printer to its full potential, I don't doubt that our shop will be happily reaping the countless benefits it offers."

"With the Markforged, it was really easy to make a prototype based on the old manifold, and have it freshened up, the design cleaned up and optimized for weight, for performance, for ease of manufacturing."

-Daniel Shepherd
Quality Manager
Turret Lathe Specialists Inc.



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Markforged's mission is to bring high strength 3D printing to everyday engineering. Offering the world's only 3D printing systems capable of automatically reinforcing engineering plastics to aluminum levels of performance and beyond, Markforged enables every business to easily manufacture parts with structural strength right on the desktop. The Mark Two Industrial Strength 3D Printer empowers professional users to affordably create workhorse 3D parts that solve real problems, as well as realize reinforced structures never before possible. Markforged technologies are delivered with thoughtful, powerful software designed for collaboration, sharing, and scaling.

For more information, visit <https://www.markforged.com>