ADDITIVE X

APPLICATION SPOTLIGHTS

Tooling & Fixtures

Additive manufacturing is not only useful as a production method for end-use parts, but also as a complement to other manufacturing methods in the machine shop. Industrial 3D printers produce high-strength parts tough enough to withstand manufacturing floor environments, where printed parts are put to use as tools, jigs, and fixtures. This spotlight series highlights how Markforged users have reduced costs and optimized production floor uptime in their everyday manufacturing operations.

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APPLICATION SPOTLIGHT

CMM Fixtures

Quality assurance (QA) for most parts requires custom workholding. Inspection setups must be geometrically accurate, repeatable, and strong, which are all factors that contribute to significant time and cost investment. QA is thus often reserved for high-volume and high-precision parts. The lower cost and shorter lead time provided by additive manufacturing, enhanced by the material strength and precision of Markforged printers, help manufacturers use coordinate measuring machines (CMMs) to certify more parts more consistently and efficiently.

Precision Alignment
Markforged printers offer 50 micron precision to enable accurate locating features for exact measurements

Robust Construction
Reinforcing fibers prevent parts from deforming or deflecting under load, ensuring a dimensionally stable setup

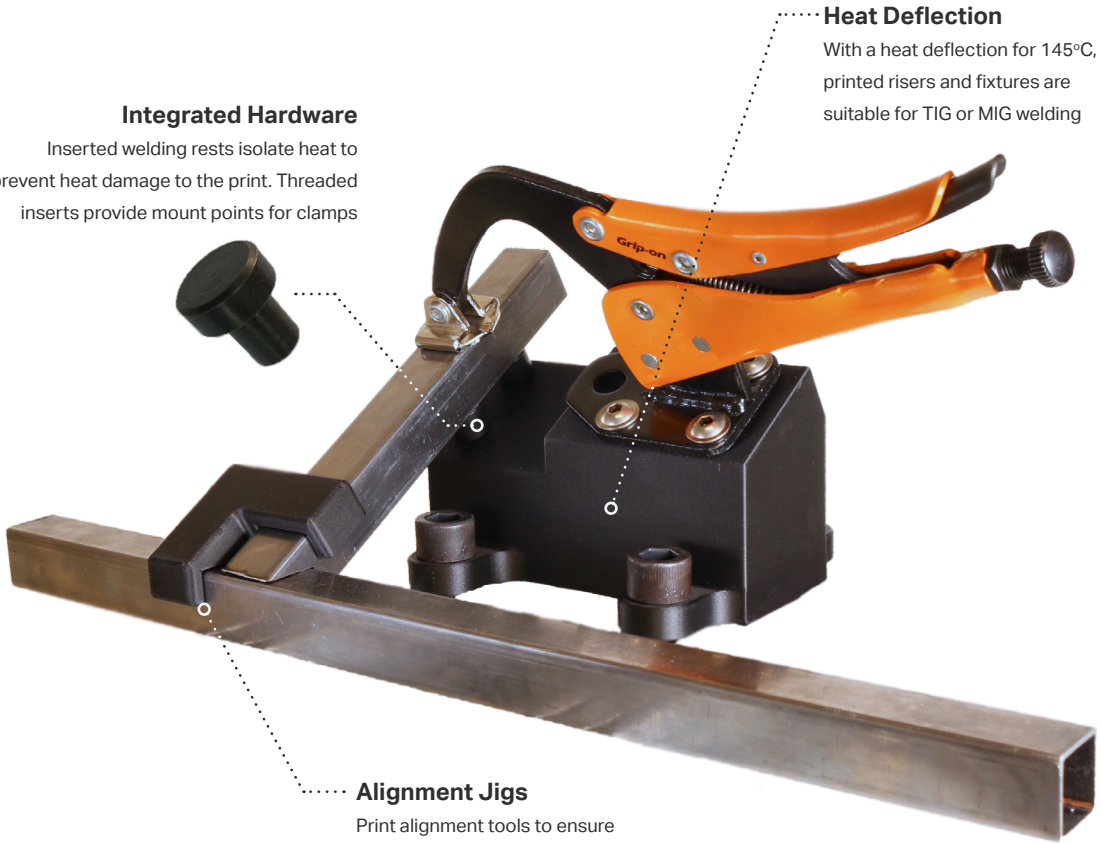
Minimal Setup
Standalone workholding fixtures eliminate the extensive setup time inherent to inspection jobs

	Generic	Machined	Markforged
Fabrication Time	—	↑ ↑	↓
Fabrication Cost	—	↑ ↑	↓

APPLICATION SPOTLIGHT

Welding Fixtures

Welding jobs often have high associated setup times due to generic and multi-purpose fixturing tools that may not be suitable for challenging structural geometries. Poor fixturing may lead to crooked tacking, inconsistency, and propagation of human error. Additive manufacturing enables design and fabrication of specialized alignment jigs, custom mounts, and fixtures that require drastically shorter setup times and improve the precision of welding operations.



	Modular	Machined	Markforged
Setup Time	—	↓ ↓	↓ ↓
Fabrication Time	—	↑ ↑	—
Fabrication Cost	—	↑	↓

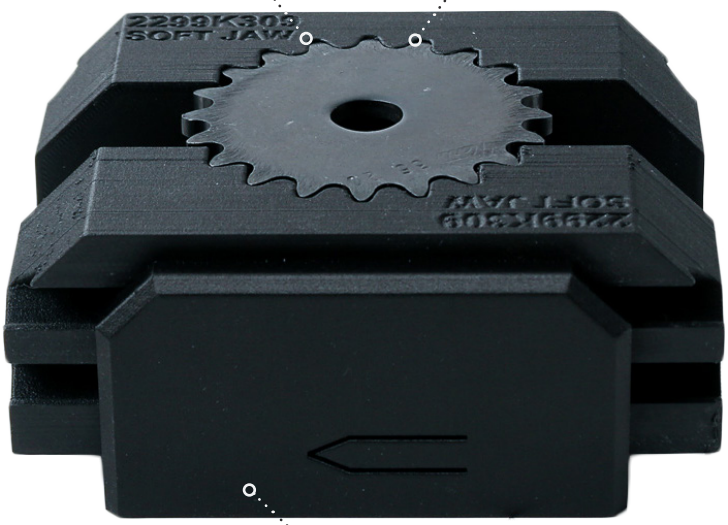
APPLICATION SPOTLIGHT

Soft Jaws

Soft jaws are a common solution for holding custom parts during machining. They are typically machined out of malleable metals, but machinists can free up machine bandwidth by 3D printing their soft jaws instead. Using reinforced composite materials that are strong enough to withstand the high forces exerted by heavy duty machining operations results in soft jaws that can be used hundreds of times without requiring calibration or marring a single part.

Custom Profile
Printed soft jaws can accomodate irregular profiles, allowing a wider range of complex parts to fit on mills and lathes for machining

Non-Marring Grip
Onyx soft jaws hold end use-parts securely without damaging or biting into them, thus preserving excellent surface finish



Resilient
Composite reinforcements provide the stiffness and strength that soft jaws need to not bend or break under significant clamping forces

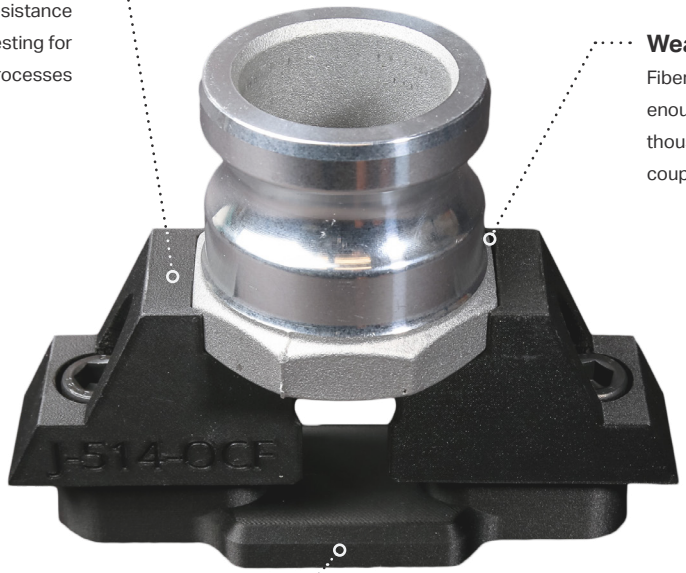
	Generic	Machined	Markforged
Fabrication Time	—	↑ ↑	↓
Fabrication Cost	—	↑ ↑	↓

APPLICATION SPOTLIGHT

End Effectors

Additively manufactured parts defy the design constraints of machining, and thus use much less material in a product of identical size and strength. Lighter end effectors decrease cantilevered weight on the robot arms to which they are attached, which improves motion control during operation. 3D printing significantly decreases lead time and cost while increasing payload capacity, so custom parts can be fabricated the same day for new applications, empowering development of a whole library of specialized end effectors.

Chemical Resistance
Onyx has successfully endured rigorous chemical resistance qualification testing for manufacturing processes



Wear Resistance
Fiber-reinforced jaws are robust enough to grip and move thousands of stainless steel pipe couplings without wearing down

Weight Reduction
Printed Onyx offers the strength of traditional end effectors in a lightweight package that reduces end-of-arm loads during use

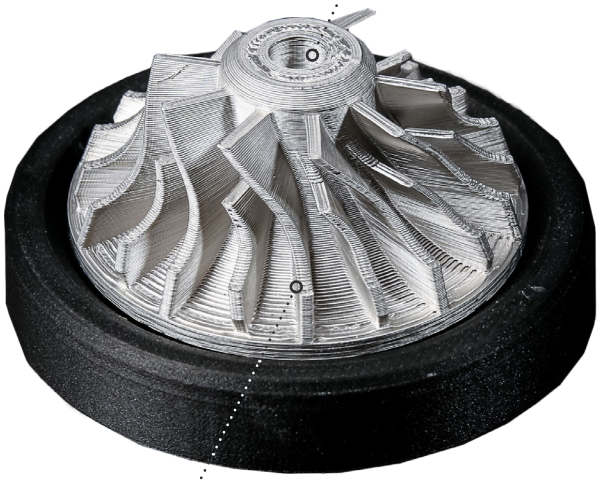
	Generic	Machined	Markforged
Fabrication Time	—	↑	↓ ↓
Fabrication Cost	—	↑	↓ ↓

APPLICATION SPOTLIGHT

Intricate Parts

Iterative design processes can be prohibitively time- and cost-intensive, such that manufacturers may stop the process once a part performs at a barely acceptable level rather than an optimal level. With traditional casting and machining methods, new molds and tooling need to be created with every iteration. Additive manufacturing eliminates this extra cost, time, and labor, and accelerates the iteration process that fundamentally matters.

End-Use Quality
Stainless steel augments the high quality and strength of Markforged 3D printed parts with the corrosion resistance to endure when exposed to a range of environmental conditions



Intricate Geometries
When tiny errors in geometry make huge differences in performance, fabrication constraints should not force you to compromise

	Generic	Investment Cast	Markforged
Fabrication Time	—	↑	↓ ↓
Fabrication Cost	—	↑	↓ ↓

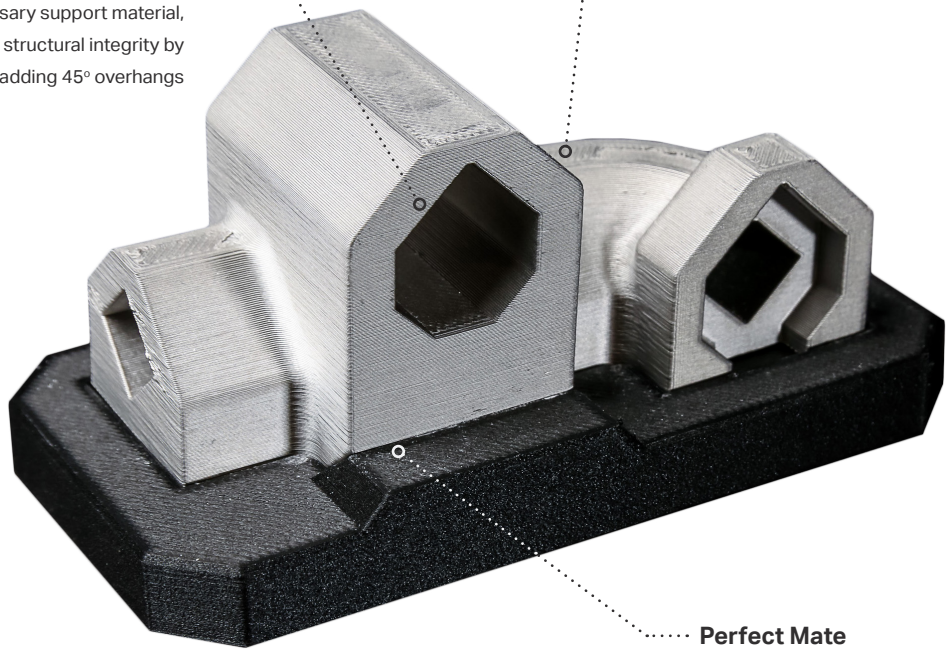
APPLICATION SPOTLIGHT

Internal Features

Parts with complex internal features are often impossible to fabricate using conventional subtractive machining methods, without segmenting into multiple components. These components may even require unique fabrication methods. Additive manufacturing unlocks the ability to produce functional internal features such as channels inside a single, seamless part. Good design for assembly demands minimizing the number of parts, which eliminates potential sources of error, reduces the need for fasteners, and decreases production time and cost down the line.

Streamline Assemblies
Free from the physical limitations of end mills and other machine tools, 3D printing can eliminate the need to break parts into multiple components

Reduce Waste
By specifically designing for additive manufacturing, users can avoid using unnecessary support material, and preserve structural integrity by adding 45° overhangs



Perfect Mate
Markforged machines achieve tight tolerances, meaning your parts mate without gaps or guesswork

	Generic	Machined	Markforged
Fabrication Time	—	↑	↓ ↓
Fabrication Cost	—	↑	↓ ↓

Manufacturing Reinvented

ADDITIVE X

From custom soft jaws for difficult machining operations to alignment jigs for welding, an industrial 3D printer can improve many of the behind-the-scenes tasks associated with manufacturing and fabrication. Complement your manufacturing floor with a Markforged printer and experience shorter lead times, increased machine bandwidth, and reduced manufacturing costs.

At Markforged, we are on a mission to unlock the next 10x innovation in design and manufacturing. We have built an Industrial 3D Printing Platform to liberate designers and engineers from decades-old, slow processes. NASA, Google, Ford, Amazon, General Electric and thousands of companies in 50 countries use Markforged to print same-day prototypes and produce stronger end-use parts than they did before. With Markforged, they're able to ship 50x faster, spend 20x less, and build 23x stronger products.

READY TO GET STARTED?

See how Markforged can impact your business with our return on investment calculator.

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