Additive Manufacturing for the Automotive Industry



goengineer

Markforged®

Introduction

The automotive industry and its partners leverage additive manufacturing to mitigate the risk of rapidly shifting supply chains and maintain a competitive edge. Through high-end shops like Graham Rahal Performance, the Markforged FX10 printer is used with Onyx and metal to produce custom 316L stainless steel exhaust components and strong assembly fixtures. 3D printing improves shop floor logistics by allowing engineers to create rapid prototypes and on-demand custom parts, while also pushing technological boundaries by lightweighting complex geometries for high-performance vehicles.

With material traceability and an expanding portfolio of materials, you can print a wide variety of critical parts at the point of need. For example, mobility suppliers like Dana Incorporated utilize Markforged systems, such as the Metal X, to rapidly create cost-effective metal replacements for specialized tooling.

Markforged components withstand demanding operational conditions with high strength and durability. Furthermore, exceptional printer reliability and repeatability guarantee that parts are created with precision and efficiency every time. This reliability allows manufacturers like Subaru of Indiana to keep their assembly lines moving by printing strong, color-coded placement and assembly jigs in Onyx GF that prevent tool mix-ups and eliminate costly downtime.

Combined with best-in-class software, training, and support, The Digital Forge platform makes it easy to train new engineers at scale and ensure you always have the parts you need when you need them.

Please review the key applications below and contact your rep to learn more!



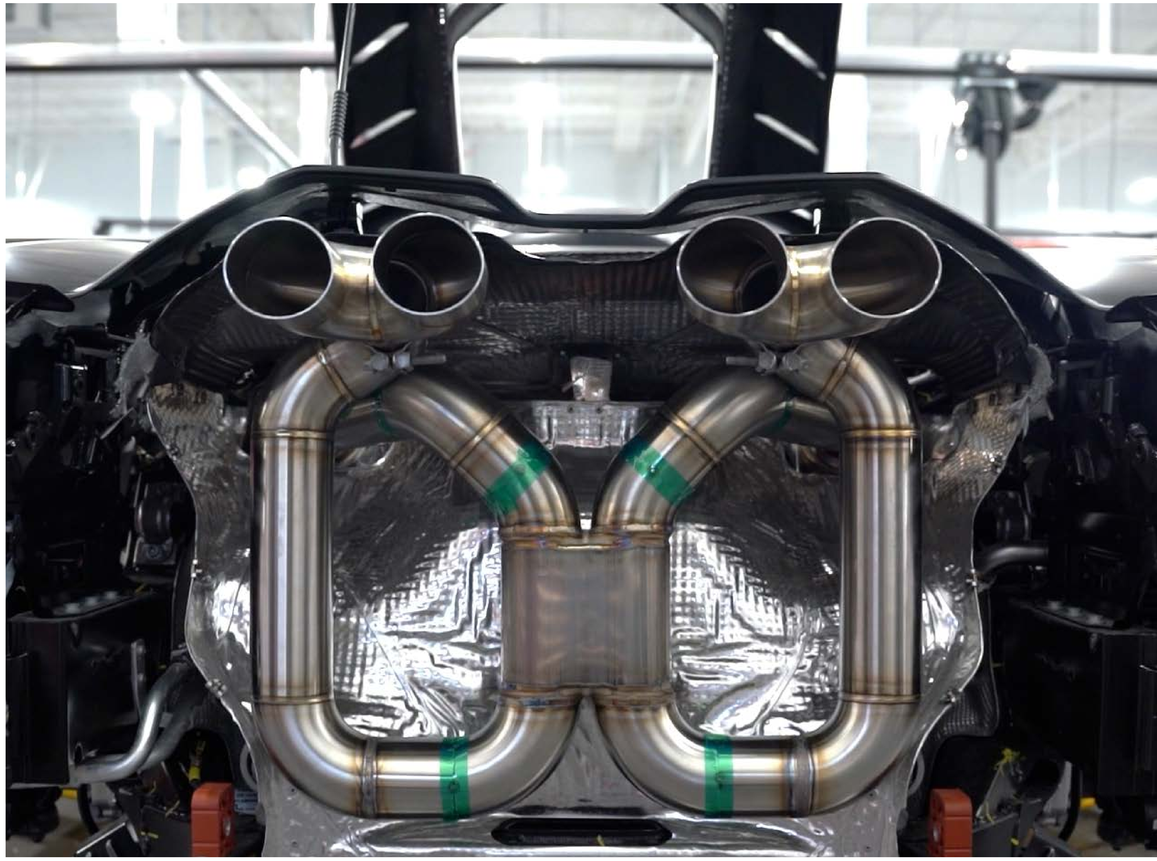
Accelerate High-End Fabrication

Graham Rahal Performance

Graham Rahal Performance (GRP) is known for building, tuning, and customizing some of the most exclusive supercars and hypercars in the world, including rare models from Ferrari, McLaren, and Lamborghini. In high-end custom fabrication, precision, repeatability, and finish quality are non-negotiable. Traditional fabrication workflows often introduce severe bottlenecks, requiring master fabricators to spend 20 to 40 hours hand-building, cutting, shaping, and welding custom jigs, brackets, and exhaust components.

To streamline shop operations and eliminate fabrication delays, GRP integrated the Markforged FX10 industrial 3D printer into its workflow. Utilizing continuous fiber reinforcement alongside Onyx and industrial metals, the team replaced labor-intensive manual methods with digital, on-demand fabrication. GRP now produces high-performance tooling overnight—such as non-marring suspension shock clamps, protective waterjet toe clamps, and rigid assembly jigs—delivering aluminum-level strength while completely bypassing outside machining.

When developing a custom X-pipe exhaust system for a 1,000-horsepower hybrid Lamborghini Revuelto, GRP used the FX10 to print custom flanges in 316L Stainless Steel. The printed metal flanges incorporated lightweight internal geometries, fit precisely off the print bed with virtually no post-processing or deburring, and welded cleanly with zero contamination. By moving from days of manual fabrication to single overnight print cycles, GRP dramatically accelerates project turnarounds and frees technicians to focus on elite engineering.



Further Reading: Graham Rahal Performance

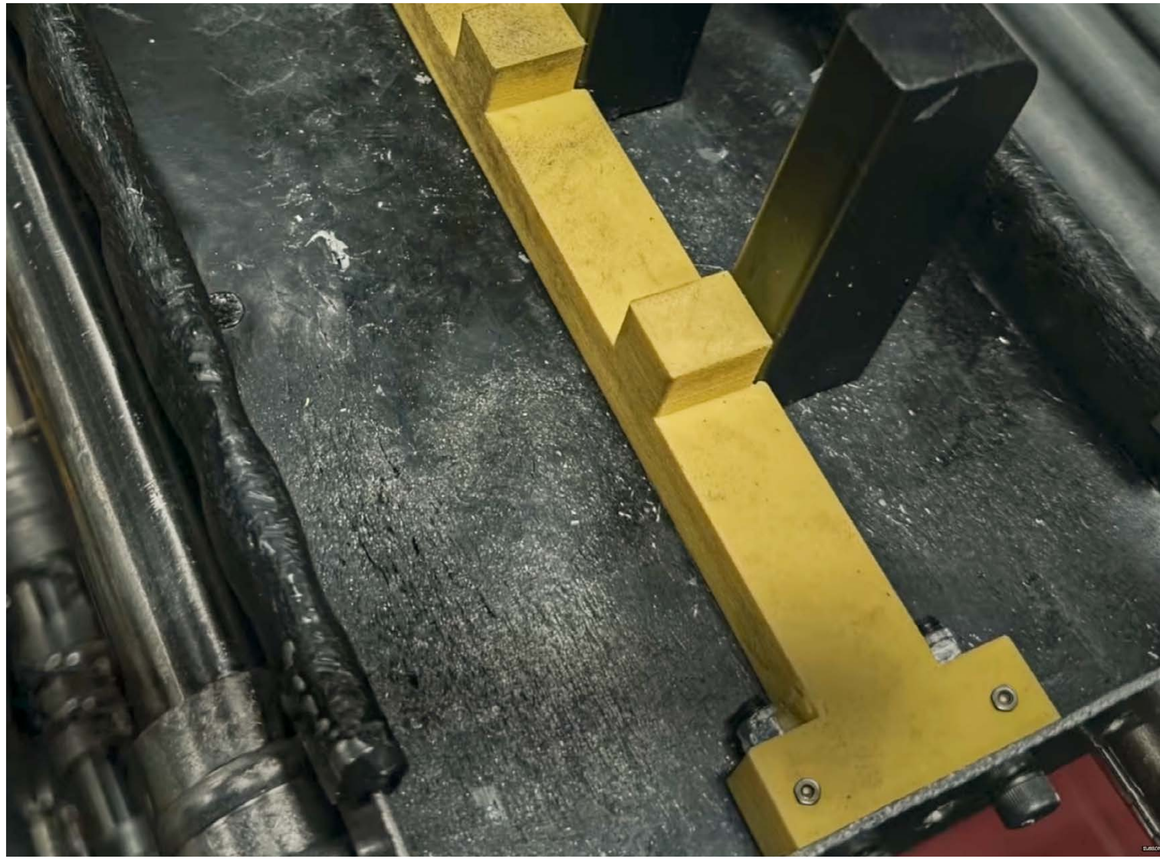
Eliminate Assembly Line Downtime

Subaru of Indiana

Subaru of Indiana Automotive (SIA) operates a high-volume manufacturing plant where associates assemble multiple vehicle models and trim variations simultaneously on the same line. In automotive mass production, speed and accuracy are paramount to protect line uptime. Because assembly fixtures can vary by just a few millimeters between vehicle variants, line operators need instant visual cues to select the right tool without losing pace.

While commodity 3D printed ABS initially allowed SIA to experiment with color-coded tooling, the material could not endure the mechanical stresses of a high-volume factory floor and repeatedly cracked in service. To achieve high-visibility color coding combined with industrial durability, Subaru adopted Markforged Onyx GF (glass fiber-reinforced nylon). The composite material provides the impact resistance and fatigue life needed for heavy daily use, while seamlessly integrating with SIA's existing Markforged fleet.

SIA deployed Onyx GF to manufacture critical bumper check jigs that index off exterior bumper contours to position QR paint-tracking labels to within a 0.1 mm tolerance. Printing each jig in a distinct color corresponding to a specific model variant prevents overhead scanner errors that previously halted the paint line. Alongside crack-resistant cradle jigs for engine cam cap sub-assemblies, Onyx GF tooling allows Subaru operators to grab the right tool on the first pass and keep the production line moving.



Further Reading: Subaru of Indiana Automotive

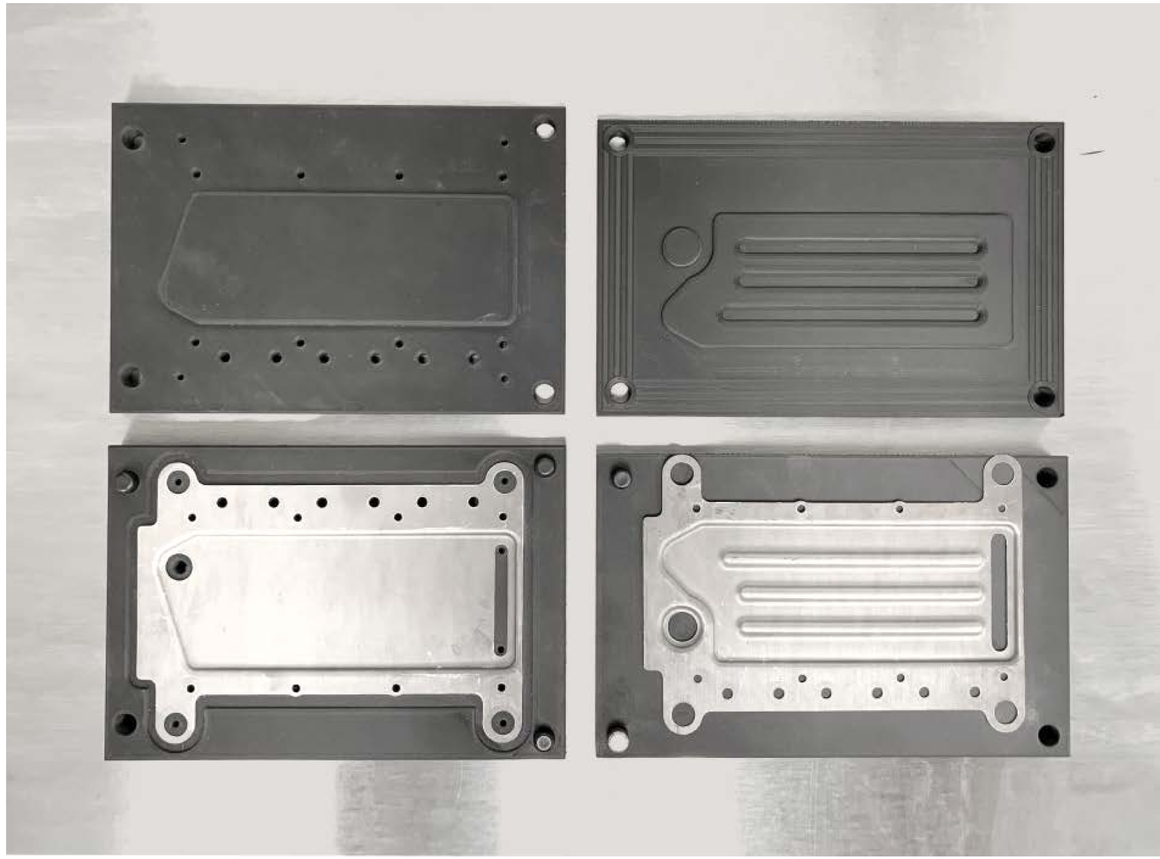
Produce Heavy-Duty Production

Dana Incorporated

Dana Incorporated is a Fortune 500 mobility supplier with more than a century of experience equipping light, commercial, and off-highway vehicle manufacturers with advanced drive, motion, sealing, and thermal systems. Operating across 33 countries, Dana continuously seeks methods to accelerate development and support manufacturing operations without relying on lengthy vendor lead times for specialized machine tooling and proof-of-concept parts.

Dana partnered with Markforged to establish a distributed additive manufacturing network, deploying industrial composite X7 printers and Metal X systems across facilities in seven countries, including the United States, Italy, Germany, and Canada. Coordinated globally via the cloud-based Eiger platform, Dana engineers share CAD designs, print parameters, and production telemetry across international engineering hubs, enabling facilities to print tools, fixtures, and metal components on demand.

At Dana's Off-Highway engineering facility in Rovereto, Italy, the engineering team printed custom workholding gears used to secure drive components during machining operations. The 3D printed composite fixtures operated on the production line for over a year without failure, cutting fixture costs by 70% and slashing lead times by 90%. From functional sheet metal stamping dies in Canada to specialized line tooling globally, Dana leverages Markforged additive manufacturing to stay agile, reduce costs, and accelerate innovation.



Further Reading: Dana Incorporated

Performance Critical. The Digital Forge. If it has to work, it starts here.

The Digital Forge is the reliable, easy-to-use and intelligent Additive Platform.



Software

Easy-to-use software and advanced SaaS modules increase additive adoption at scale. Gets smarter with every print.

The Digital Forge

Metal & Composite Printers

11 printers and sintering furnaces, which build strong end-use parts at the point of need



Materials



Wide range of applications across 21 proprietary metals and composites to answer plant critical manufacturing applications.

Automotive Printer Lineup



X7

ADVANCED COMPOSITES

Prints with Continuous Fiber Reinforcement for the strength manufacturers require.



FX20

HIGH-TEMP COMPOSITES

Large scale printer for strong, durable parts that withstand the most demanding automotive environments.



FX10

ADVANCED COMPOSITES & METALS

The world's first industrial metal & composite 3D printer. Reliable, low-touch user experience that mitigates the need for dedicated operators.



FX10™

FX10 is the first industrial metal and composite 3D printer — the product of years of engineering innovation and technological advancement. Built on the success of the Markforged X7 and Metal X, FX10 quickly delivers strong, accurate tools and fixtures for your operation.

FX10 features a modular print system that enables users to swap between metal and composite print engines quickly. All FX10s have composite and Continuous Fiber Reinforcement (CFR) technology, with metal capability as a purchasable add-on. Printhead-mounted optical sensors can verify the dimensional accuracy of parts and assess device health and performance. FX10 utilizes automatic calibration and material changeover, yielding a simple, low-touch user experience that mitigates the need for dedicated operators.

FX10 Details

Unlock strong parts on demand

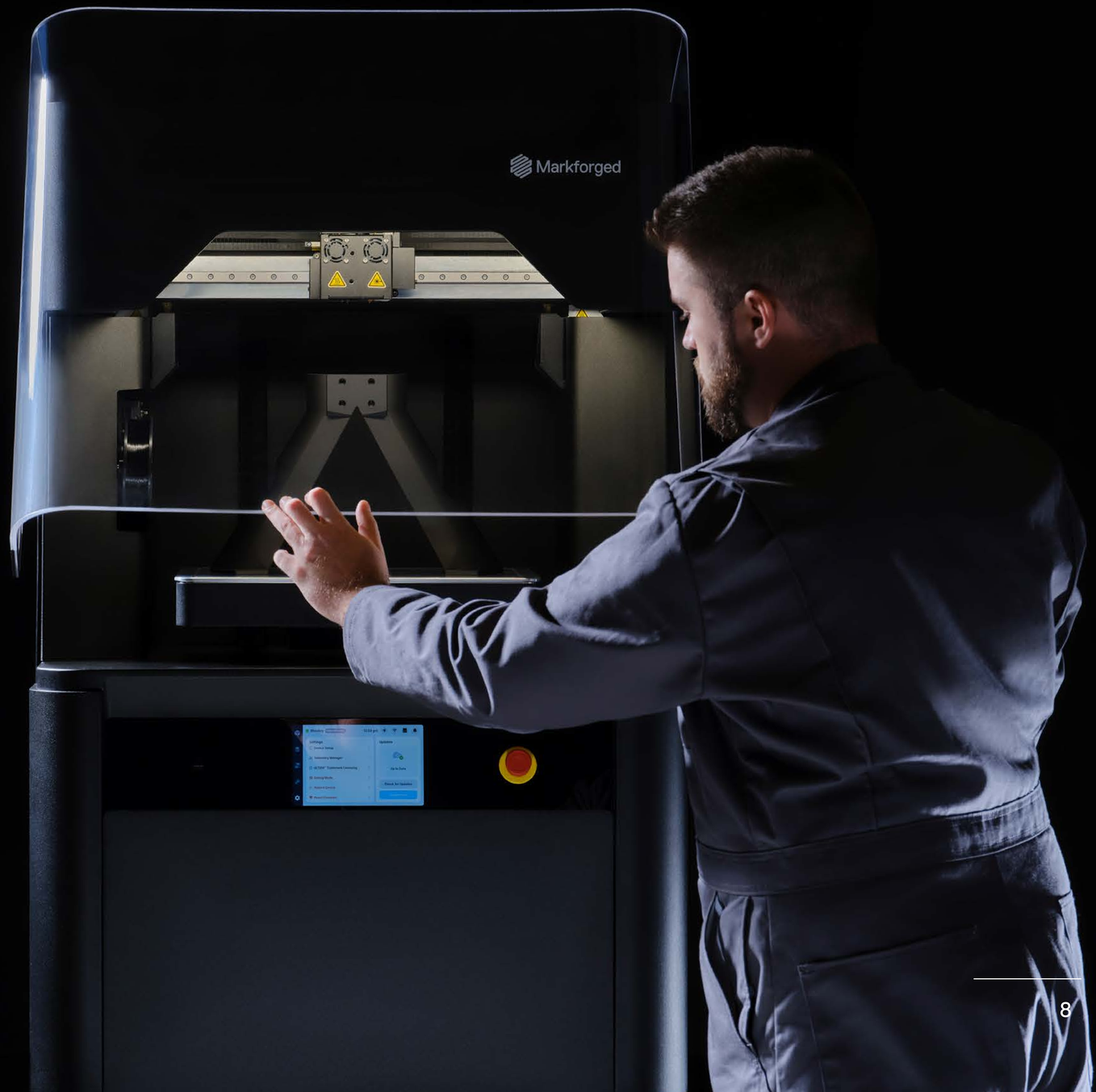
FX10 prints both metal and continuous carbon fiber reinforced parts for a wide range of automotive applications — helping users get essential parts faster, reducing the cost of replacement parts from manufacturers and de-risking downtime events.

Print the right part every time

We designed every aspect of FX10 — from its motion system to the software that powers it — around delivering accurate, strong parts, reliably. It's a printer you count on when it matters most.

Drive usage fast, then scale

FX10 operates on the Digital Forge: Markforged's additive platform that features intuitive device and desktop software, training, and built-in cost calculation. Line managers can adopt quickly, and effortlessly scale machines to more units and bases.



FX20™

FX20 is a high-temperature, large format 3D printer that brings The Digital Forge platform and Continuous Fiber Reinforcement (CFR) technology to a new realm of parts, problems, and industries. Designed to thrive in the most demanding manufacturing and automotive environments, FX20 prints bigger, faster, and hotter than any other Markforged 3D printer. Whether your needs are tooling or production parts, FX20 can deliver quality, high performance solutions.



FX20 Details

Massive Builds, Fast

The FX20 pairs size and throughput to print huge builds at incredible speeds, enabling users to get large, functional parts in hand next day.

Functional Parts for High-end Fabrication

Built for everything from performance tooling and fixtures to production parts, the FX20 can print with both high temperature materials and continuous fibers.

Production Ready Performance

A precision-designed, sensor-driven machine delivers breakthrough reliability and performance with a simple user experience.



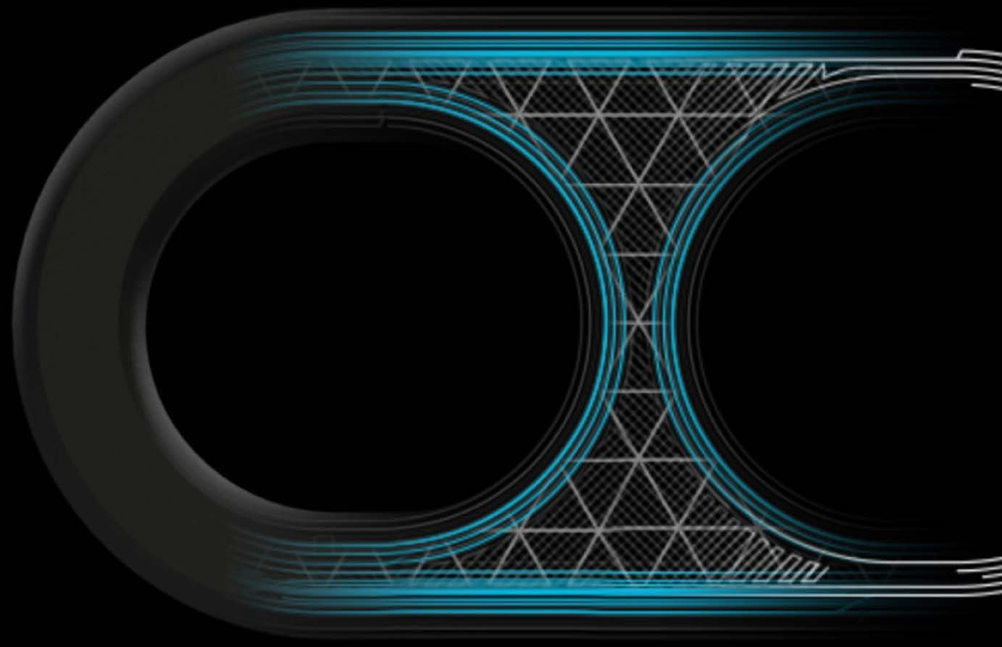
Automotive-Grade Parts, Made Possible by CFR

What is Continuous Fiber Reinforcement (CFR)?

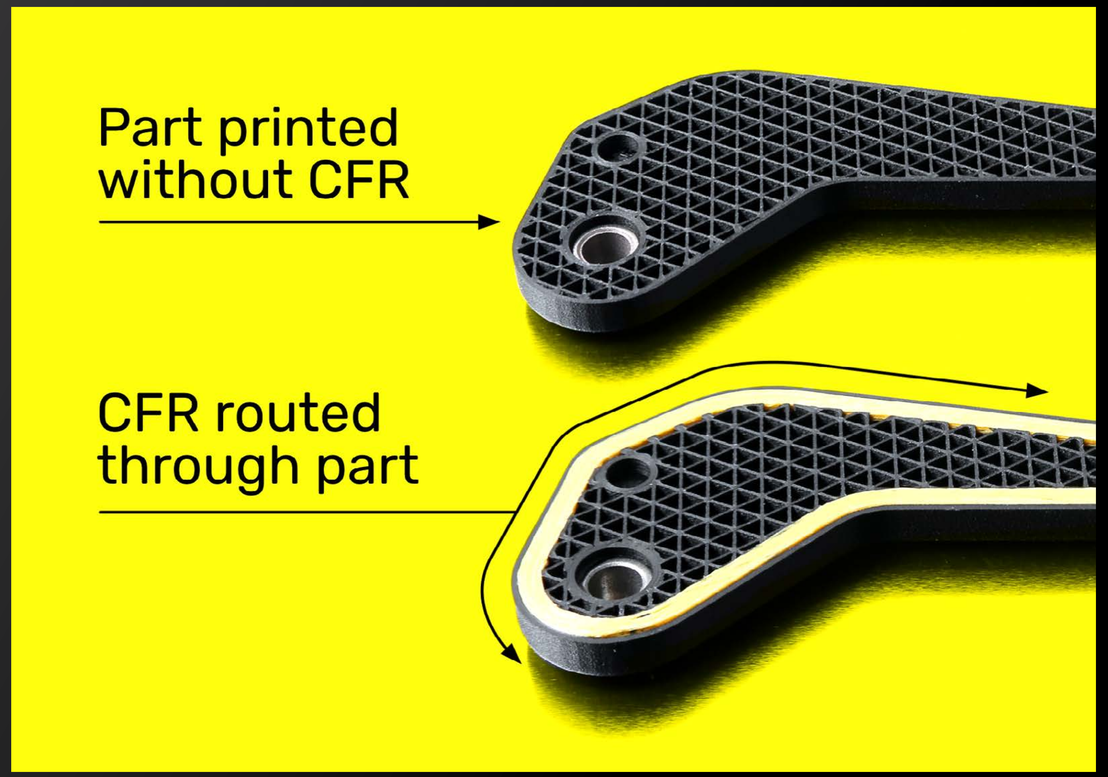
Continuous Fiber Reinforcement (CFR) is a proprietary Markforged process that enables 3D printers to reinforce Fused Filament Fabrication (FFF) parts with long-strand continuous fibers. A CFR-capable machine uses two extrusion systems: one for engineering base filament (such as Onyx) and a second dedicated nozzle for continuous fibers such as Carbon Fiber, Fiberglass, or Kevlar®.

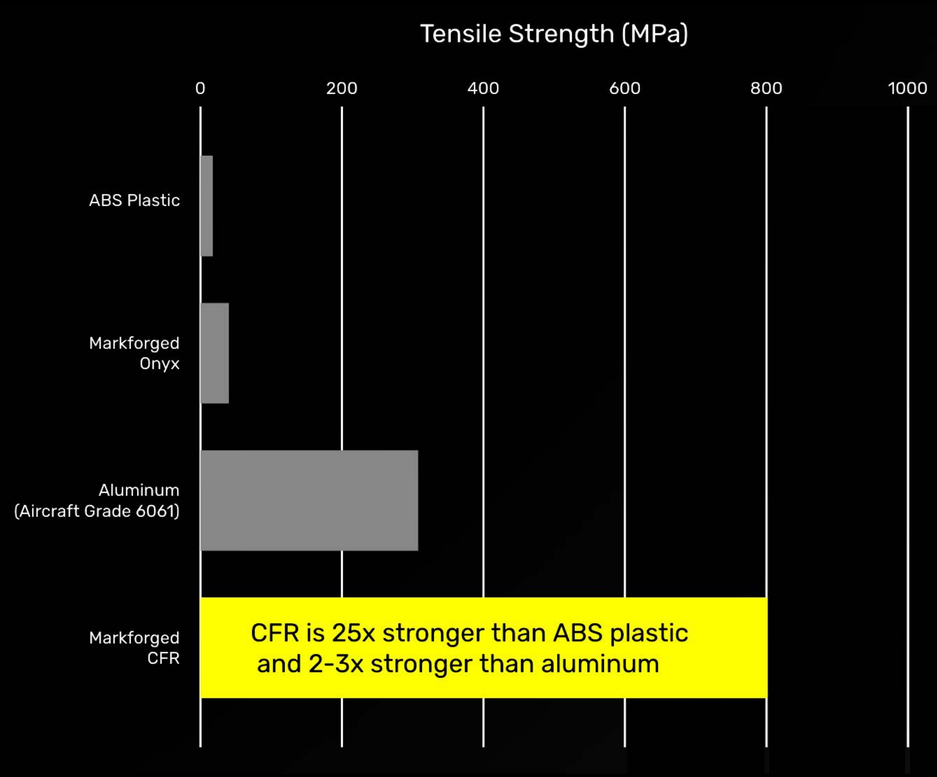
These continuous fibers are laid down in-layer, replacing standard infill to produce components that are up to 10 times stronger than standard FFF plastics and capable of directly replacing machined aluminum in high-stress applications.

Continuous fiber-reinforced parts boast extreme tensile strength and stiffness at a fraction of the weight of steel and aluminum. In the automotive industry—where production line uptime, cycle speed, and operational agility are critical—CFR delivers the mechanical reliability required for demanding manufacturing environments, custom vehicle fabrication, and high-performance motorsports.



Patented Continuous Fiber Reinforcement (CFR) technology enables users to replace metal with our solution.





Benefits of Continuous Fiber Reinforcement

Metal-Strength Replacement

CFR allows automotive engineers to dynamically route reinforcement exactly where mechanical loads require it, bridging the gap between plastic flexibility and aluminum strength. This enables facilities to 3D print functional stamping dies, robust alignment jigs, and structural mounting brackets that withstand heavy cyclic loads without the lead times or expense of CNC machining.

Factory-Floor Durability and Wear Resistance

Automotive tooling must endure repeated, high-frequency use across multiple shifts without failing or deforming. Combining continuous fiber reinforcement with micro-carbon fiber filled matrices creates parts with superior impact resistance, stiffness, and fatigue life—ensuring assembly cradles, shock clamps, and workholding fixtures perform reliably on the line.

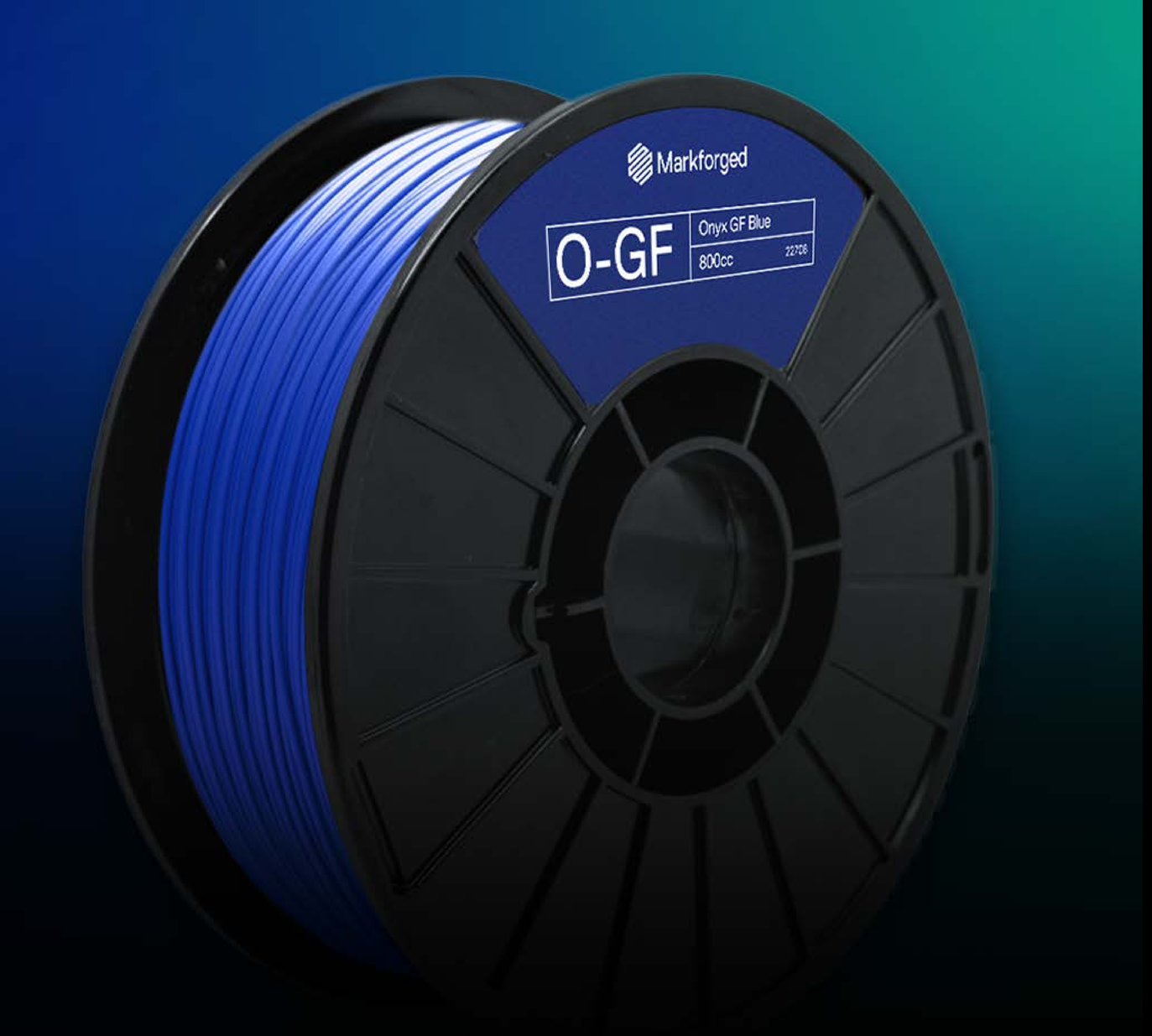


Resistance to Heat, Chemicals and Automotive Fluids

CFR composite components resist ambient operational heat and maintain dimensional stability in harsh plant and engine-bay conditions. Reinforced with short-fiber composite base filaments, parts exhibit high resistance to cutting fluids, motor oils, solvents, and lubricants commonly encountered on the factory floor.

Lightweighting and Line Ergonomics

By delivering aluminum-level tensile performance at a dramatically lower relative density, CFR allows plants to lightweight end-of-arm robotic tooling (EOAT) to reduce motor wear and accelerate cycle times. For manual assembly lines, lightweighting heavy hand tools and alignment fixtures reduces technician fatigue and minimizes the risk of workplace strain.



Color That Works for your Factory Floor

Onyx GF™ expands the Onyx material family in seven functional colors without sacrificing strength or stiffness. Built on the same trusted foundation as Onyx, it's a chopped glass fiber-filled nylon engineered for the daily demands of manufacturing.

Workplace Safety

Protect line operators with high-visibility red and yellow 3D-printed guards and brackets near hazardous machinery or confined spaces.

Line Differentiation

Easily distinguish between tools meant for Line A versus Line B.

Revision Control

If a part design changes, printing the new fixture in a different color ensures operators immediately phase out the legacy tooling.

Tool Organization

A glance at a shadow board immediately reveals if a tool is missing or misplaced based on a color mismatch.

High Temperature Material Properties

Physical Properties	Unit	Test	Ultem 9085™ Filament XZ Orientation	Test (ASTM)	Vega XZ Orientation	Test	Carbon Fiber HT-A
Tensile Strength	MPa (ksi)	D638	68 (9.9)	D638	88 (13)	D3039	800 (116)
Tensile Modulus	GPa (ksi)	D638	2.52 (365)	D638	5.2 (725)	D3039	69 (10,005)
Elongation at Break	%	D638	5.5	D638	3	D3039	1.6
Flexural Strength	MPa (ksi)	D790	105 (15.2)	D790	140 (20)	D790	529.7 (76.8)
Flexural Modulus	GPa (ksi)	D790	2.45 (355)	D790	4.7 (681)	D790	53.3 (7,730.5)
Flexural Extension at Break	%	D790	—	D790	5.2	D790	1.1
Compressive Strength	MPa	D695	—	D695	221	D695	300 (43.5)
Compressive Modulus	GPa	D695	—	D695	4.1	D695	59 (8,557)
Notched Izod Impact Resistance	J/m	D256-10 A	70 (1.3)	D256	48	D256	810 (15.2)
Density	g/cm^3	—	1.27	–	1.27	_	1.2
HDT (1.8 MPa)	deg C (deg F)	D648 B	175 (347)	D648	157 (315)	_	190 (374)
HDT (0.45 MPa)	deg C (Deg F)	D648 B	173 (346)	D648	164 (327)	_	190 (374)

FX10 Metals

316L Stainless Steel

316L is a low-carbon stainless steel widely used across manufacturing. Possessing good strength and toughness paired with excellent corrosion resistance, 316L requires almost no post-processing while remaining weld-ready . Markforged 316L is only available on FX10.

17-4 Stainless Steel

17-4PH Stainless Steel is a multipurpose steel used for specialized tooling, automotive vehicle parts, and tough fasteners. Heat-treatable to 36 HRC and possessing 95% wrought strength, Markforged 17-4PH enables you to print high-strength, robust metal parts for a wide variety of applications.

H13 Tool Steel

Harder than 17-4 PH Stainless Steel and capable of maintaining material properties at high temperatures, H13 tool steel is an extremely versatile material to work with. Markforged H13 can be heat treated to 45 HRC with a UTS of 1680 MPa, and is used by Markforged customers for tool bodies, brazing fixtures, and other parts where hardness or heat resistance are required.



Security Focus

ISO 27001 Certified

First AM vendor to achieve certification for ISO/IEC standards-based information security policies and practices backed by a dedicated security team to ensure customer data privacy, confidentiality, integrity and availability.

Strict Data Security

Encryption of customer part data at rest and in transit and encryption and tamper resistant protection of print files to prevent unauthorized access and changes to and printing of print files.

Secure Online or Offline Operation

Secure part slicing, storage and printing to connected printers using cloud-based Eiger or Offline Eiger software operating on private systems and networks without cloud connection.

STIG-Compliant OS

X7, Metal X, and Desktop Series printers feature a STIG-compliant operating system that adheres to strict government security guidelines for use in DoD and similar environments.

Markforged University

Markforged understands the importance of training. Markforged University is a comprehensive training program that accelerates mastery of Markforged Composite and Metal 3D printing technology, enabling you to realize the full potential of your technology investment and ensure successful adoption.

Maximize Impact

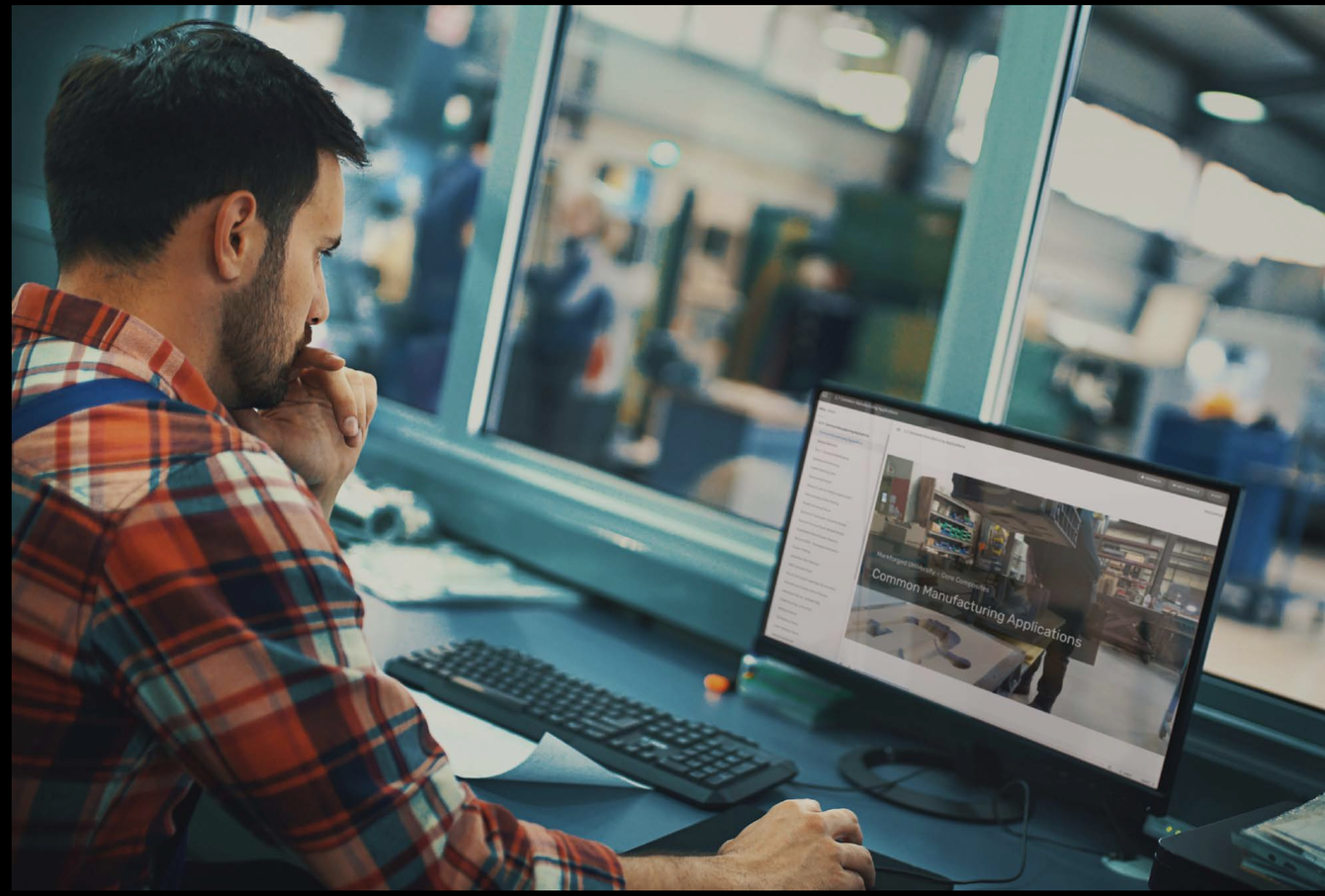
Learn how to identify which high risk parts can be printed to improve saftey and line efficiency.

Accelerate Additive Adoption

Realize the full potential of your investment faster and get line managers up and running quickly.

Built On Experience

Advanced design for additive manufacturing techniques based on field knowledge and proven workflows for best outcomes.

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