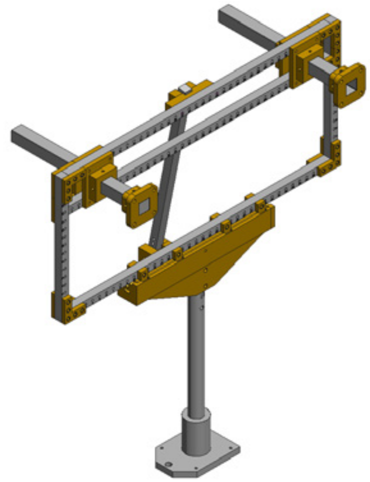
stratasys

Omega Tool Corp

Use Case – Paint Fixture



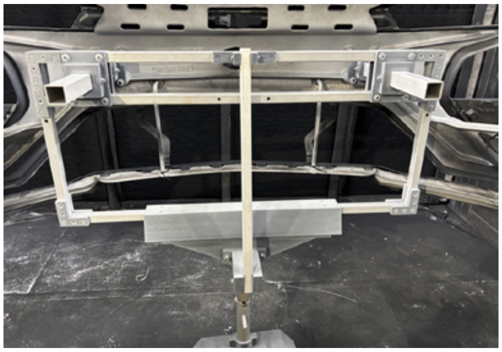
The yellow parts on this CAD render of the modular paint fixture show the parts printed with ULTEM™ 9085 resin.

Customer Profile

Founded in 1981, Omega Tool Corp is a global leader specializing in designing and manufacturing large, complex injection molds. In addition to mold making, the company excels in engineering, production, painting, and additive manufacturing, delivering comprehensive solutions to OEMs across the mobility, aerospace, and consumer sectors.

Challenge

To improve paint line efficiency and reduce tooling inventory, Omega Corp sought a modular fixture to hold parts during painting operations. Modular fixtures are adaptable to multiple parts and assemblies, reducing the tooling inventory. Omega's design requirements included holding a 30-pound part and high-temperature capability to withstand the painting environment. Although the fixtures could be made from machined metal components, this approach is costly, time-consuming, and increases tool weight.



This view shows the modular paint fixture with 3D printed elements holding a vehicle part mounted on the far side.

Solution

As an alternative to a conventional all-metal fixture, Omega incorporated 3D printed elements made from ULTEM™ 9085 resin material printed on a Stratasys F3300® production system. The 3D printed components replace some of the metal pieces while also providing adjustability for the fixture to hold different parts. ULTEM™ material can withstand high temperatures (HDT of 353 °F/178 °C @66 psi) and is resistant to various chemicals, making it compatible with the paint environment. The F3300 incorporates next-generation FDM® technology and can print at up to 3X the speed of legacy extrusion printers.

Impact

Using the 3D printed components allowed Omega to develop a more effective modular paint fixture compared to an all-metal tool and achieved the following design objectives:

- Modular, reconfigurable fixture
- Successfully supported a 30 lb. part through all phases of paint operation
- Maintained mechanical integrity of ULTEM™ parts with no deformation under heat and load
- Fast, repeatable fixture adjustment
- Fixture reusability demonstrated by successful operation through the full paint cycle

Additionally, incorporating 3D printed components reduces overall fixture weight compared to all-metal tools, and the modularity reduces the inventory of required paint fixtures. At a higher level, the F3300's speed and user-friendly operation give Omega Corp the simplicity and pace vital for fast production of additive solutions across departments.

Time Savings

Faster Configuration Adjustment

(vs. standard fixtures)

Weight Reduction

lbs.

Lighter Fixture Weight

stratasys

Automotive OEM

Use Case – Auto Production Tooling

Customer Profile

This global automotive manufacturer designs and builds a wide range of vehicles from gas-powered and electric cars to commercial trucks. With a strong presence in both consumer and fleet markets, the company continues to evolve its product lineup and production strategy with technology such as additive manufacturing to meet changing industry demands and customer expectations.

Challenge

This OEM uses FDM® technology for product development and tooling within its design and production operations. Although this technology produces durable and accurate parts, the print speed of legacy FDM printers is limited by their level of technology. To keep pace with ever-increasing production demands and schedules, the OEM sought new additive solutions capable of accelerating the production process.

Solution

To obtain the desired increase in additive capabilities, the OEM invested in the F3300® FDM production system. The F3300 embodies the latest developments in FDM technology and can more than double the print speed of legacy printers. Additionally, the F3300 employs a newly designed hot-end (extrusion tip) capable of applying custom toolpaths 50% wider than other printers, contributing to fewer voids and faster print speed. Another time-saving feature includes the F3300's auto-calibration capability, eliminating the time-consuming hands-on calibration required with legacy systems.

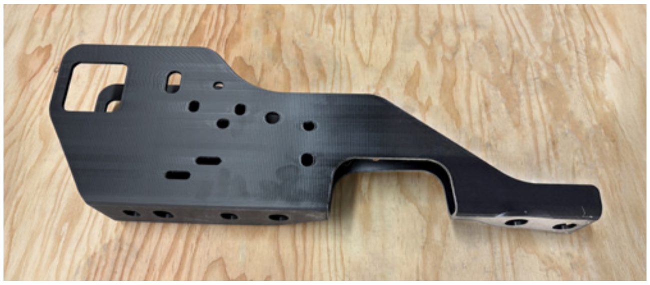
Impact

Adding the F3300 to its 3D printer lineup afforded the OEM multiple benefits. Most notable was a significant increase in print speed relative to other FDM printers (see table) – up to 72% faster compared to the F770 printer using custom toolpaths.

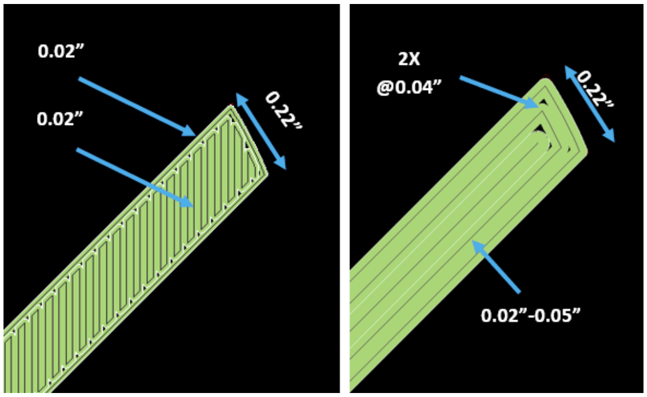
Additional benefits included:

- Ability to meet increased production demand for 3D printed parts
- Lower cost-per-part due to faster print speed, leading to increased throughput
- Stronger parts because of the increased bonding area resulting from wider extrusion paths and minimal voids
- Lower labor costs and enhanced productivity from auto-calibration

As a result of these benefits, the F3300 has become the OEM's flagship 3D printer, setting a new standard for the company's additive technology.



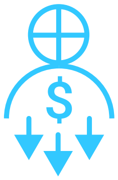
This large 27-inch (69 cm) long production tool was printed on the F3300.



A cross-section of the tool showing the increased extrusion width and fewer voids (right) that are possible with the F3300.

Lower Cost Per Part

Reduced Labor Cost



F3300 Print-Time Comparison With Other Stratasys FDM Printers

	F770	F900	F3300	F3300 using custom toolpath
Time (hrs)	46.5	37.75	25.5	13
ASA Model (ci/cc)	69/175	71/180	71/180	70/178
SR35 Support (ci/cc)	6.5/16.5	7/18	6/15	6/15

Radford Motors

Use Case – Custom Automotive Manufacturing

Customer Profile

Radford Motors builds exclusive luxury automobiles, focusing on high craftsmanship, limited-run production, customization and performance. The company traces its lineage back to the original Radford Motors, a British coachbuilder established in 1948 that built custom bodies for automakers such as Bentley, Aston Martin and Austin Mini Cooper.

Challenge

Radford Motors' first model run of only 62 units precludes the ability to use conventional manufacturing approaches that rely on mass production's economy of scale. Faster, more economical means of prototyping than the conventional method of CNC machining foam and clay are necessary. Costs and logistics to furnish a full complement of factory tooling are not viable with this highly customized, limited-production business model.

Solution

To prototype and build the Radford Lotus Type 62-2 production vehicle, the company relied on additive manufacturing to enable an agile development and production process. Radford uses large-format Stratasys F770™ and F900™ printers that offer 13 and 18 cubic feet of build volume, respectively. Thermoplastics such as ABS-CF10 (carbon fiber) and ASA offer the right strength-to-weight properties needed for making tooling and production parts.

Impact

The combination of printer capacity and strong but lightweight materials give Radford Motors the capability to design, iterate and build the tooling and components for each custom vehicle much faster and more economically than conventional production methods. The capabilities afforded by additive manufacturing help make Radford Motors' business model of low-volume, highly custom auto production economically viable.

Prototype wheel centers in the 3D printer made with black ASA material.

ASA heating/cooling duct production part ready for under-dash installation.

The 3D printed dashboard instrument panel will be covered with leather before installation.

stratasys

General Motors

Use Case – Comau Overhead Conveyor Hangers

A view of the overhead conveyor system.

Customer Profile

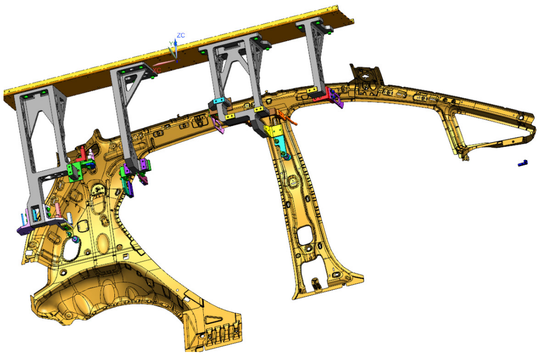
General Motors (GM) is a world leader in the development of transportation innovations that include electric cars and self-driving vehicle technology. Headquartered in Detroit, Michigan, GM serves six continents with 164,000 employees.

Challenge

The production of the Chevy Bolt electric car required a new overhead conveyor pallet design, made up of risers that support and position parts along the assembly line. The existing conveyor encountered infrequent but periodic downtime due to excess tooling weight on the automation equipment. Aluminum risers were considered because they offered a lighter alternative but that solution would also involve sending the conveyor pallets offsite for periodic maintenance and repair.

Solution

Instead of aluminum, GM 3D printed the risers out of FDM® Nylon 12CF (carbon fiber) material using an F900™ printer. This material offers excellent stiffness and strength while being lighter than aluminum. If spare parts are needed, they can be quickly produced on the 3D printer. This solution also avoided the special welding and maintenance requirements associated with making the risers out of aluminum.



Impact

The nylon 12 carbon fiber risers provided a 32% reduction in weight compared to aluminum and a 72% weight reduction compared to steel. Lead time to make the risers was also cut from an average of nine weeks for metal risers to two weeks for the 3D printed parts, a 75-80% time savings. Additionally, this solution cut cost by decreasing build and post-machining operations and reduced the frequency for periodic maintenance.

Weight Reduction	Lead Time Savings
32%	75-80%

stratasys

General Motors

Use Case – Sheet Metal Hemming Tool

The wheel arch hemmer tool (ivory) made from ASA thermoplastic.

Customer Profile

General Motors (GM) is a world leader in the development of transportation innovations that include electric cars and self-driving vehicle technology. Headquartered in Detroit, Michigan, GM serves six continents with 164,000 employees.

Challenge

The rear wheelhouse hemming tool used on the production Chevrolet Equinox is a large device used to join the inner and outer sheet metal fender panels. The tool is traditionally machined from aluminum and requires significant manufacturing lead time (>10 weeks), which doesn't afford any schedule flexibility in a preproduction environment. If tool changes are needed, significant delays could result. The tool is also heavy, requiring lift assistance to position it on the car. This opens the potential for damaging the sheet metal from hard contact with the tool because of its momentum when moving it into place.

Solution

As an alternative, GM opted to 3D print the tool with an F900™ printer using FDM® ASA thermoplastic material rather than machine it from an aluminum billet. 3D printing offers lighter materials, a much shorter lead time and faster iteration capability when tool design changes are needed.

Impact

The 3D printed hemming tool performed successfully and was produced in three weeks in contrast to the 10-13 week timeframe needed for an aluminum tool, a lead time savings of over 70%. In addition, weight was reduced from 75 pounds for the metal tool to 33 pounds, negating the need for lift assistance and significantly improving ergonomics of the assembly operation. Total cost was reduced 74%.

Weight Reduction	Lead Time Savings	Lower Cost
56%	70-77%	74%

Ford

Use Case – Ford Mustang Quarter Glass Alignment Fixture

Customer Profile

Ford Motor Company, founded by Henry Ford in 1903, is a leading American automobile manufacturer headquartered in Dearborn, Michigan. The Ford Mustang line has been produced since 1964, making it the longest-produced Ford car.

Challenge

The fixture used to accurately position and install the quarter glass in the Ford Mustang had several problems that needed optimization.

- Costly – manufacturing the tool required time-consuming CNC machining and welding
- Inefficient – the current configuration restricted sight lines, adding difficulty to the installation process; external pneumatic air lines added to the fixture's bulkiness
- Heavy – the complete metal fixture with air lines and locating fixtures was heavy, not ergonomic and difficult to use

Solution

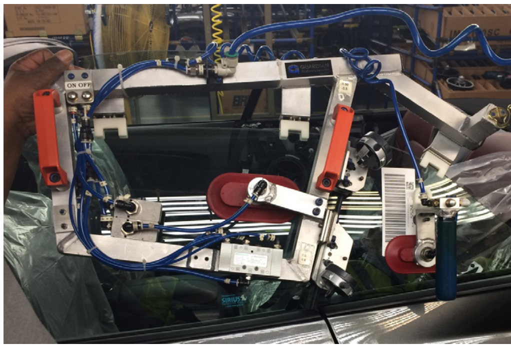
Making a new fixture using FDM additive manufacturing enabled several design improvements:

- A trigger-style on/off switch for improved ergonomics
- Reusing current fixture locator details, mounting brackets, and pneumatic controls
- Integrated pneumatic tubing retainers and optimized pneumatic valve and switch mounts
- Ergonomic handles
- Added material where strength is needed, and lower density where not needed

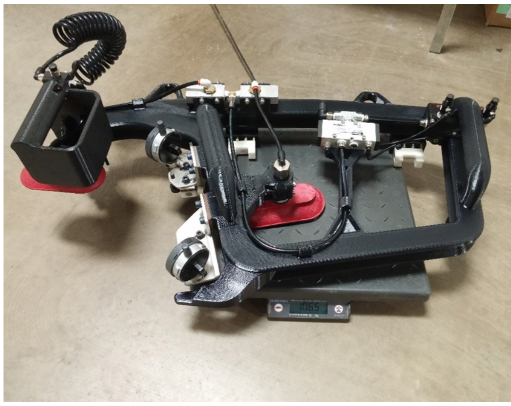
Impact

After producing the first design iteration, Ford was able to see additional improvements to be made. The line of sight to the window hanger details were blocked by the main frame's upper bar. In addition, deflection was found in the lateral direction when the main vacuum cup was activated. To address these, the upper rail was moved up and detail brackets were redesigned to provide better sight lines for production. An internal rib was also added to reinforce the frame and increase lateral stiffness without changing the external geometry. Nylon 12 Carbon Fiber was used for this fixture which reduced its weight, without compromising strength or rigidity.

The 3D printed alignment fixture was reduced to 10.65 lbs. fully assembled, easing the burden on its operators. Additive manufacturing enabled Ford to implement design improvements, test them out, and make additional changes, lower cost and faster than using CNC machining.

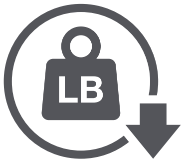


Alignment fixture before using additive manufacturing



Alignment fixture made using additive manufacturing

Weight Reduction



15%

Cost Savings vs. Traditional Manufacturing

70%

stratasys

Caterpillar

Customer Experience – Breather Port FDM Locating Fixture

Customer Profile

Since 1925, Caterpillar Inc. has been helping its customers build a better world – making sustainable progress possible and driving positive change on every continent. Caterpillar is the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives. Caterpillar is a leader and proudly has the largest global presence in the industries it serves.

Challenge

The breather outlet ports on a customer's medium density diesel and natural gas engine product must be assembled at a precise angular position to line up with tubes added at a later stage. However, there is no way for technicians to know if the outlets are positioned exactly per blueprint specifications since there's no precise physical reference to work from, and angular position is determined by eye. As a result, most outlet tubes are mislocated and have to be repositioned later in assembly, adding an hour of rework time per engine.

Solution

Caterpillar used FDM® technology to 3D print a fixture that physically locates the outlet tubes at the required position before they are clamped and bolted down. The fixture also has a built-in wheel with degree indications to verify the tube is at the blueprint angular orientation for proper alignment with connecting hardware.

Impact

Since incorporating the assembly fixture, Caterpillar has eliminated mispositioned outlet tubes. Given typical daily production levels, this saves three to five hours of rework each day.

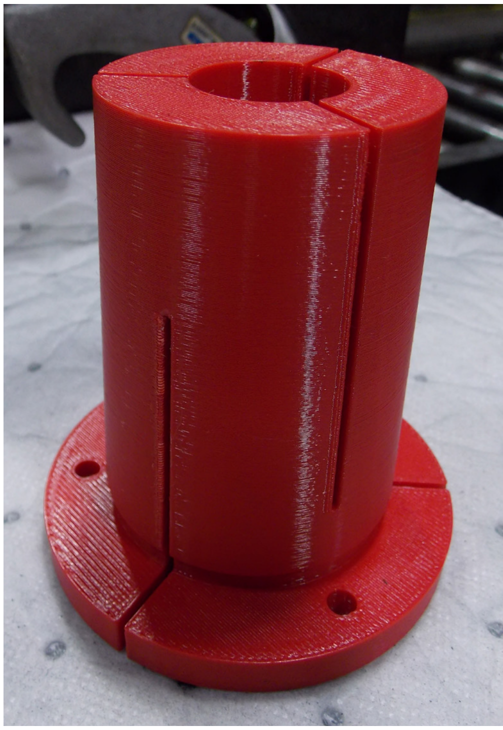
Cut Rework Time

3-5 Hrs/Day

The FDM locating fixture shown on top of the breather outlet port

Caterpillar

Customer Experience – Replacement Drill Collet



The 3D printed drill collet made with ABS-M30 thermoplastic.

Customer Profile

Since 1925, Caterpillar Inc. has been helping its customers build a better world – making sustainable progress possible and driving positive change on every continent. Caterpillar is the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives. Caterpillar is a leader and proudly has the largest global presence in the industries it serves.

Challenge

A drill collet used in the machining of the 3500-series engines is sometimes damaged during tool changes. The lead time to procure a replacement collet is four weeks and making one in-house requires three shifts and three working days. Although the cost to replace or machine a new part is $700 to $1000, the lost production time costs hundreds of thousands of dollars.

Solution

To minimize costly delays, Caterpillar engineers 3D printed a replacement collet using FDM® ABS-M30™ thermoplastic material. The 3D printed collet was made on a Fortus 450mc™ printer. Several 3D printed collets are now kept on-hand as replacements when needed.

Impact

3D printing a replacement drill collet took four hours and cost $60. This represents an 83% lead time savings over in-house machining and a 98% time savings compared to supplier-furnished replacement parts. Considering the cost of lost production time, the lead-time savings equates to approximately $150,000.

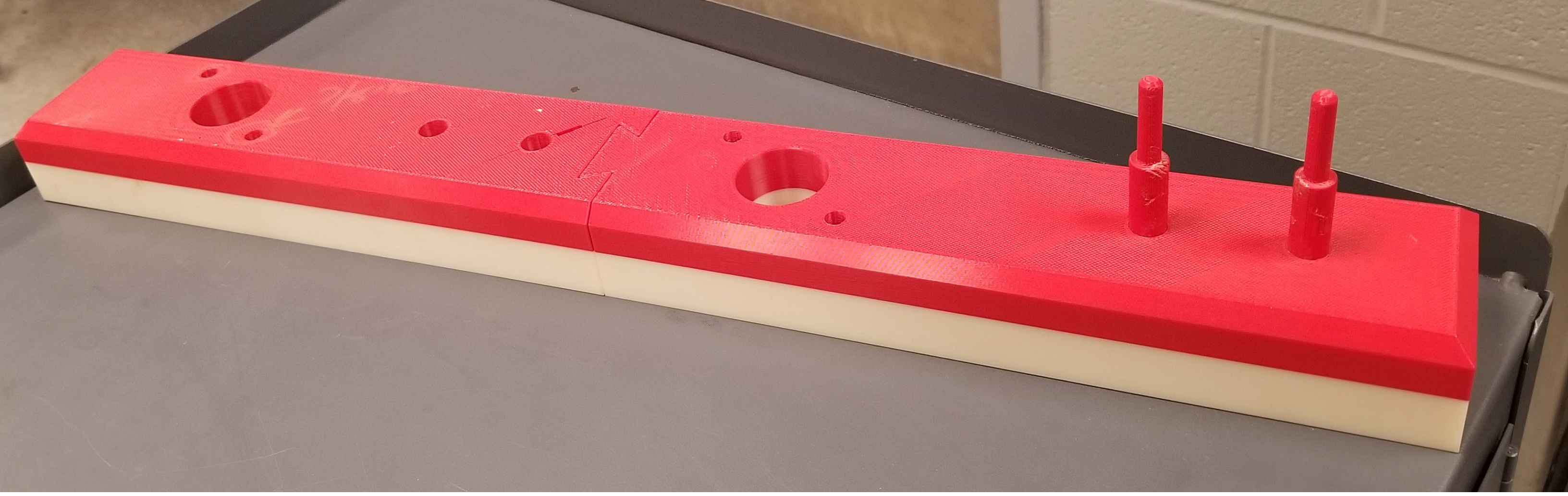
Lead Time Savings

83% to 98%

Cost Savings

$700-$1000 Replacement Cost
~$150K in Production Delays

stratasys



Caterpillar

Customer Experience – Assembly Rack

Customer Profile

Since 1925, Caterpillar Inc. has been helping its customers build a better world – making sustainable progress possible and driving positive change on every continent. Caterpillar is the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives. Caterpillar is a leader and proudly has the largest global presence in the industries it serves.

Challenge

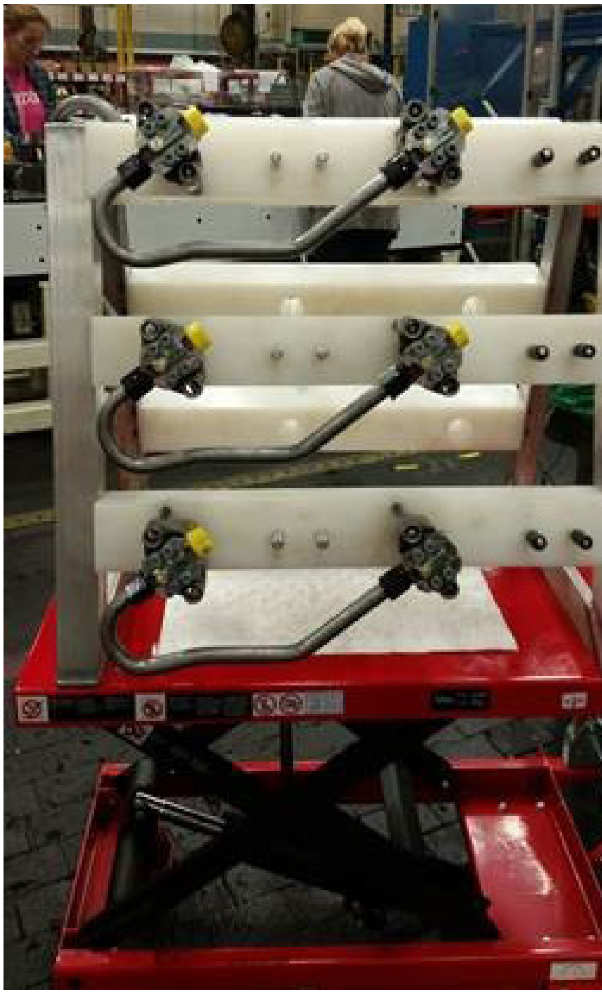
The introduction of a new engine model increased the number of assembly operations involving installation of some of the engine's fuel components. This doubled the cycle time for that in-station assembly step, resulting in a drag on the production line and the inability to meet the desired engine production rate.

Solution

Engineers developed a solution involving preassembling the fuel components separately (out-of-station) from the production line and placing them on an assembly holding rack so they could be installed later as a subassembly. To validate the concept, engineers 3D printed the assembly rack's parts using FDM® technology to prototype the fit and perform a trial run of the subassembly.

Impact

The assembly rack, quickly prototyped with 3D printed parts, helped validate the effectiveness of preassembling the fuel components out-of-station. This solution reduced the production line's in-station build time (where the preassembled fuel components are installed on the engine) by approximately 40%. 3D printing's fast turnaround also helped mitigate resistance to this solution because the assembly rack could be quickly built and tested for validation, which would not have been possible with traditional manufacturing due to its excessive lead time.



The assembly rack and one of the FDM 3D printed proof-of-concept rack components (top image).

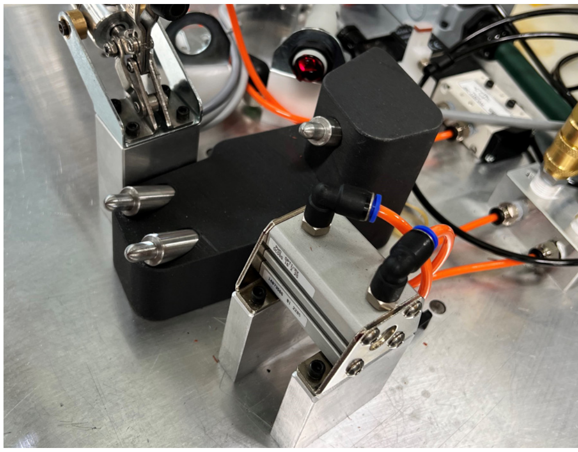
Cycle Time Reduction

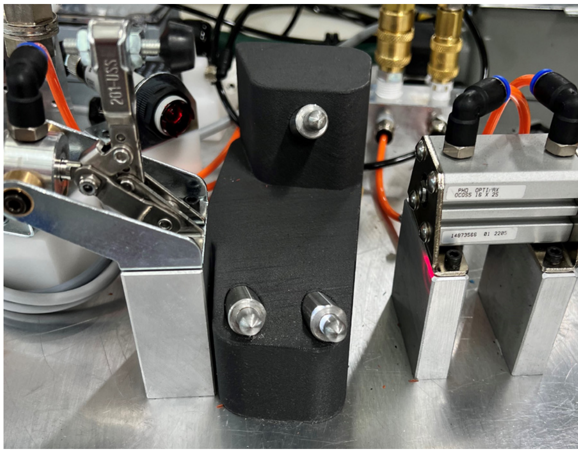
40%

stratasys

J.W. Speaker

Use Case – Leak Check Fixture





Customer Profile

Founded in 1935, J.W. Speaker Corporation makes high-performance lighting for automotive, powersports, transports, and industrial vehicles. The company specializes in developing innovative LED and emerging lighting technologies for OEM and aftermarket customers worldwide.

Challenge

The manufacture of a snowmobile light fixture required a leak test to validate its watertight capability. These tests employ fixtures that must withstand a 100-pound force as air is evacuated from the light housing to ensure a proper seal. Custom fixtures are typically machined from aluminum, but this involves procuring the raw stock and CNC machining the tool. Although this solution works, engineers desired a faster approach for manufacturing and deploying the device into production.

Solution

Instead of machining, J.W. Speaker tool designers 3D printed the fixture using FDM® Nylon-CF10 carbon fiber material, a nylon-based composite thermoplastic filled 10% with chopped carbon fiber. The result is a much stiffer and stronger material capable of more demanding applications. Nylon-CF10 is available on the F370®CR composite printer, which includes other composite materials and engineering-grade polymers.

Impact

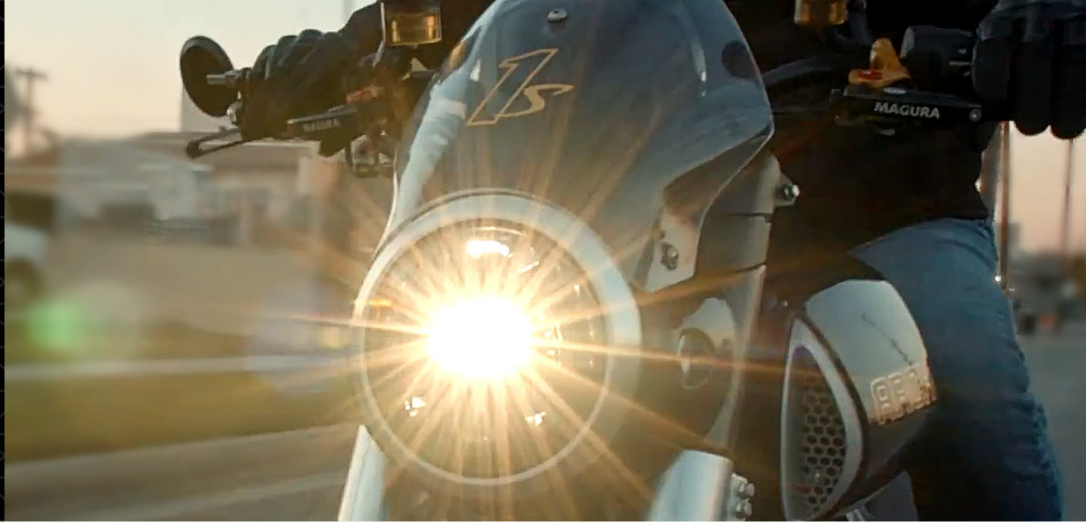
3D printing the tooling fixture allowed J.W. Speaker to reduce the tool production time by approximately 80%, from two days to 10 hours. The Nylon-CF10 and F370CR composite printing capabilities also enabled the freedom to design the tool as needed, without the constraints of traditional machining. This approach provides a more agile tool design process, allowing changes to be implemented quickly.

Time Savings

80%

2 days to 10 hours

stratasys



J.W. Speaker

Use Case – Manufacturing Fixtures

Customer Profile

Founded in 1935, J.W. Speaker Corporation makes high-performance lighting for automotive, powersports, transport, and industrial vehicles. The company specializes in developing innovative LED and emerging lighting technologies for OEM and aftermarket customers worldwide.

Challenge

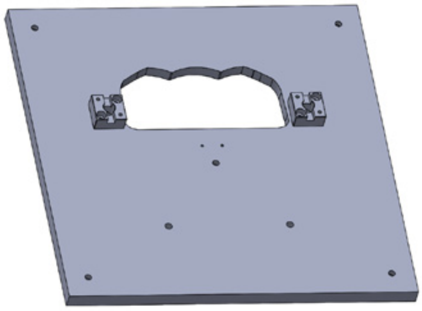
J.W. Speaker uses a variety of manufacturing tools to support its lighting production. Some tools, such as automation pallets and photometry fixtures, are relatively large and must be strong enough to handle heavier lighting products. These fixtures are typically machined from aluminum stock. However, with an annual requirement of 150 pallets, this approach is costly and time-consuming, relying on in-house or outsourced machining. J.W. Speaker engineers sought more control over production and a faster, more economical fabrication method.

Solution

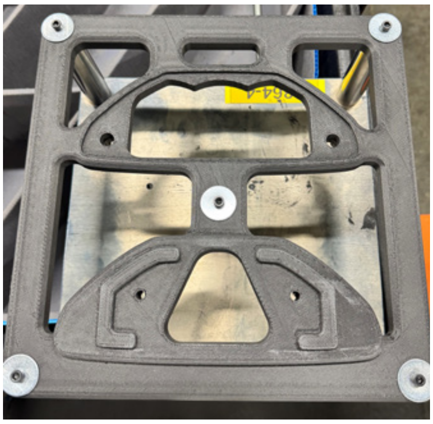
Instead of machining the fixtures, J.W. Speaker chose to 3D print them using a Stratasys F3300™ printer. The F3300 is a next-generation FDM® system that can print at twice the speed of legacy extrusion-based printers, enabling faster time-to-part. Its 10.2-cubic-foot build chamber is also able to accommodate the larger automation pallets, which measure 18 x 18 in. (46 x 46 cm). FDM® Nylon 12CF carbon fiber material provided the strength and rigidity necessary for the fixtures to handle the heavier parts.

Impact

3D printing the fixtures with the F3300 gave J.W. Speaker the design flexibility to produce optimized fixtures faster and for a lower cost than machining. The company realized $50,000 to $60,000 in cost savings on pallet production and $10,000 to $15,000 on photometry fixtures – savings that grow proportionally with annual fixture needs. J.W. Speaker also achieved a 78% time savings compared to in-house machining (9 hours vs. one week) and 89% compared to outsourcing (9 hours vs. two weeks), significantly reducing lead times.



A CAD rendering of the original pallet design.



The 3D printed pallet, built on the F3300 using Nylon 12CF.

Time Savings

78% to 89%

Cost Savings

$60k to $75k

Wolfpack Motorsports

Use Case – Sacrificial Tooling

Customer Profile

Wolfpack Motorsports is North Carolina State University's Formula SAE racing team. The team participates in a collegiate racing series where students get to design, build, test, and race their own quarter-scale formula style race car. The goal is to design the best overall race car – being given points based on static and dynamic events – and get a top-10 finish in competitions.

Challenge

One of the team's biggest projects was the development of a modular intake system for the car's engine to test its performance on a dynamometer. Testing multiple designs allows the team to optimize engine performance but this requires multiple intakes to be manufactured. Using traditional methods, the team would have to go through the process of making molds and laying up the intake in carbon fiber. However, there were several drawbacks to this process:

- Long lead time (1.5-2 months)
- Less time for design iterations resulting in fewer design tests

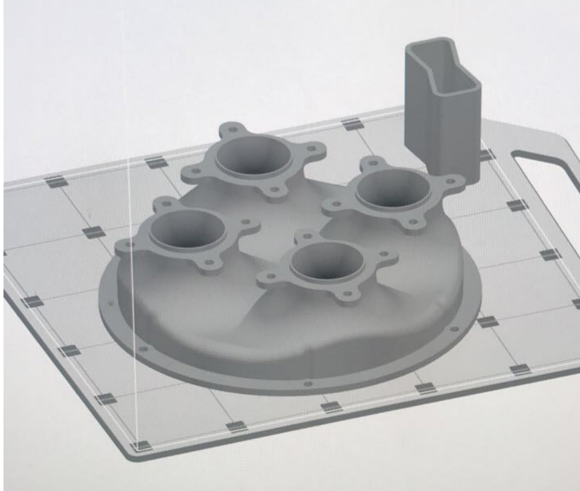
Solution

Instead of making traditional lay-up molds, Wolfpack Motorsports used additive manufacturing and their Stratasys F370™ printers to build the molds. They were printed using soluble QSR Support™ material and then wrapped in carbon fiber. The support material was then dissolved out, leaving a hollow intake system formed by the carbon fiber material. Multiple iterations were created and once enough data was gathered, the intake design was finalized. This solution provided a variety of benefits:

- Drastically reduced lead time
- Allowed for more design iterations
- Greater design freedom

Impact

FDM® additive manufacturing gave Wolfpack Motorsports the ability to produce 16 design iterations in a short amount of time to optimize the design. Traditional manufacturing would have allowed for one. Additionally, lead time for a single printed modular intake system amounted to 75 hours, instead of 1.5 to 2 months, an 80+% time savings. Additive manufacturing also gave students the opportunity to keep the process in-house for added student learning and hands-on experience.



Time Savings

80%

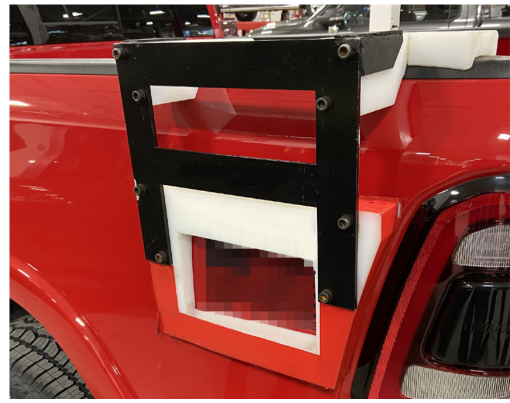
Design Iterations

16X more

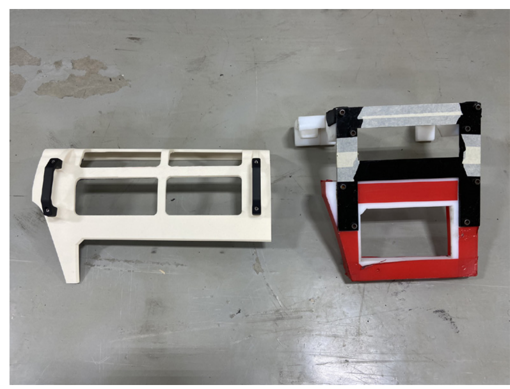
PREFIX
excellence is expected.

Prefix Corporation

Use Case – Decal Locating Fixture



The previous tool configuration shown on a vehicle.



The old multi-part tool on the right, the 3D printed tool on the left.

Customer Profile

Michigan-based Prefix Corporation is a leader in the development of prototype designs, mock-ups and concept validation for the automotive and aviation industries, as well as others. Prefix uses this expertise to help businesses assess the feasibiity of emerging technologies, gauge customer interest and prepare for production.

Challenge

A Prefix customer needed a tooling fixture used to apply automotive decals redesigned due to several problems inherent with the existing configuration. The original tool was a multi-piece assembly made up of machined aluminum and nylon, making it sub-optimal for several reasons:

- Considerable weight (15 – 20 lbs. depending on vehicle) causing operator fatigue
- Dimensional inaccuracies from tolerance stack-ups inherent with a multi-part assembly
- Vehicle damage due to difficulty in handling
- Excessive time to make and assemble

Solution

Prefix engineers redesigned the tool so it could be 3D printed, leveraging the technology's design freedom and lighter materials. The tool was printed using a Stratasys F770 large-format printer, taking advantage of its large 13 cubic-feet build volume. This provided the capability to make the bulk of the tool as a single part and use off-the-shelf handles, avoiding the need to make and assemble multiple pieces.

Impact

3D printing the redesigned tool using a Stratasys F770 provided several key benefits:

- Over 70% weight reduction affording much easier use
- Single-piece design with accommodation for stock handles, avoiding assembly
- Elimination of positioning inaccuracies from tolerance stack-ups
- Significantly reduced chances of vehicle damage
- Accurate decal placement from better tool positioning due to a more effective design
- 100% first time quality results achieved using the fixture on over 100 units

Weight Reduction

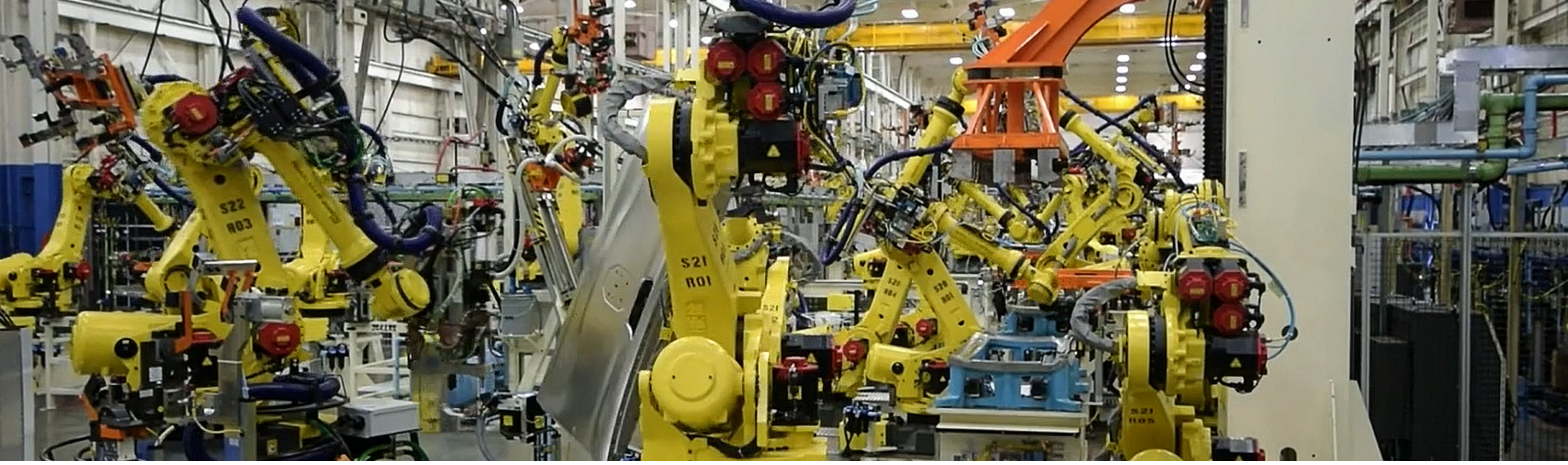
KG

73%

In-Use Quality Results

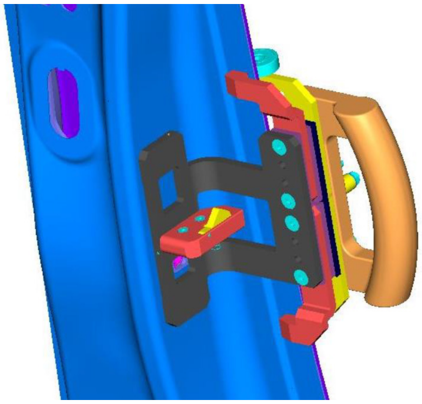
100% on over 100 Units

stratasys



Valiant TMS

Use Case – Auto A-Pillar Latch Tool Handle



A CAD rendering of the complete A-pillar tool with the handle shown in gold color.

Customer Profile

Valiant TMS develops intelligent production automation systems for automotive and aircraft manufacturing companies worldwide. Valiant TMS leverages current technologies, such as additive manufacturing, to meet its customer's requirements, and the Valiant TMS Additive Manufacturing Lab has multiple systems capable of printing polymer and metal.

Challenge

A new hand tool used to attach an auto A-pillar door latch required a combination of ergonomics, strength, and minimal weight. Engineers wanted to 3D print the tool since it would meet these requirements better than a machined metal alternative. However, an essential aspect of the ergonomic design was achieving a very smooth, no-defect surface finish in a material that would provide sufficient strength.

The 3D printed handle in Dura56 material.

Solution

The Valiant TMS Additive Manufacturing Lab chose to print the latch tool with the Origin One 3D printer using advanced digital light processing (DLP) P3 technology. The Origin One offered benefits on multiple fronts, including a broad range of materials and an injection mold-like surface finish. In addition, engineers used Dura56, a photopolymer material developed by Loctite® specifically for the Stratasys Origin One, for its quick print speed and high impact toughness. P3 technology on the Origin One is also more isotropic, offering higher strength than non-isotropic additive methods.

Impact

3D printing the tool with the Origin One resulted in a 78% cost reduction and 79% faster print time compared to other additive processes. Additionally, the combination of the Origin One and Dura56 material achieved a very smooth surface finish, which provides a comfortable grip for operators repetitively using the tool on the assembly line.

79%
Decrease in Print Time
Compared to Other Additive Processes

78%
Cost Savings
Compared to Other Additive Processes

stratasys

UC_P3_AU_Valiant TMS_0323a

Penske

Use Case – Daytime Running Lights

Customer Profile

Team Penske is one of the most successful organizations in motorsport racing as well as professional sports overall. To maintain its winning ways, the team draws on additive manufacturing to accelerate new ideas from concepts to 3D printed prototypes and end-use parts for their race vehicles.

Challenge

Daytime running lights for Team Penske's IMSA Acura sports cars are prone to impact damage during racing. Replacement costs are high, totaling $12,000 for six car sets, and the existing light configuration didn't meet Penske's needs. However, manufacturing a more optimal, less costly design posed several challenges:

- Creating a translucent cover and matching the texture of the original part
- Obtaining sufficient durability to hold up to the 24-hour race environment
- Meeting a one-week lead time target and reducing cost below replacement-part pricing

Solution

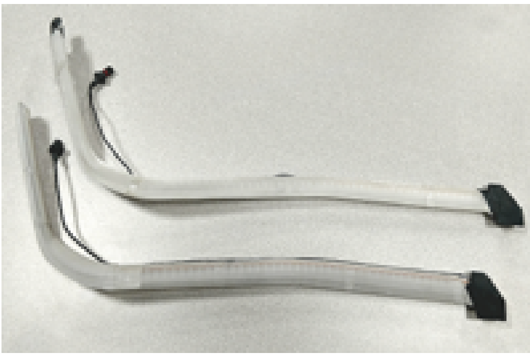
To create new, lower-cost lights, Team Penske used Stratasys® PolyJet™ 3D printing technology. PolyJet technology offered the following benefits:

- Multimaterial capability that included:
  - Translucent VeroClear™ material to reproduce the clear light components
  - Durable Digital ABS™ housing material to withstand operating temps
- Much lower cost than off-the-shelf replacement lights
- Faster production and implementation than what was possible with traditional manufacturing

PolyJet's multimaterial capability made it possible to print the transparent covers with clear material, incorporate a textured surface and make the housings with a rigid ABS-like material that can withstand the rigors of the race environment.

Impact

Team Penske exploited additive manufacturing's benefits to make the running light covers in five days and the housings in three days. Using other manufacturing methods would have taken two weeks each for both components. The total cost of the 3D printed solution amounted to $4,900 compared with a replacement cost of $12,000, a savings of $7,100.



Original light (top); 3D printed replacement (bottom).

3D printed light in operation.

60% Cost Savings

60% Lead Time Savings

stratasys

Roush Performance

Use Case – Auto Grill Camera Mount

The 3D printed camera mount bracket with retention clip shown behind.

The finished camera and 3D printed bracket shown mounted to the F-150 truck grill.

Customer Profile

Founded by motorsport legend Jack Roush, Roush Performance develops aftermarket style and performance improvements for OEM vehicles like the Ford Mustang and F-150 pickup truck and upgrade packages for other select vehicles.

Challenge

A late-stage design change for the front grill camera location became necessary on the Roush F-150 pickup truck due to an ADAS (Advanced Driver Assistance System) issue. The solution involved either redesigning the grill or the camera mount. Since the grill was already in production with finished units, a redesigned support offered a better alternative. However, that option required new injection mold tooling, jeopardizing the ability to meet the truck's production and delivery schedule.

Solution

Instead of injection molding, Roush engineers 3D printed the mounts with SAF™ (Selective Absorption Fusion™) technology using the H350™ printer. This powder-bed process provided sufficient throughput over several build cycles to make several thousand parts for the entire production run of F-150 vehicles. The SAF process also produces parts with nearly isotropic mechanical properties and the consistency needed to satisfy PPAP (production part approval process) quality specifications.

Impact

3D printing the camera mount resulted in at least a 50% cycle time reduction compared to injection molding, allowing Roush to meet its production schedule. The injection mold solution would have taken three to four months to get from the initial tool design to the final parts and cost approximately $30K. The cost to print the SAF parts was about $19.5K, for a 35% savings, and cycle time was cut to eight weeks. Additionally, a 3D printed prototype of the new mount design showed that it was not optimal. Roush was able to quickly 3D print a better design and print the final parts, avoiding additional delays and costs to rework a mold for the redesigned part.

Production Cycle Time Savings

50%

Cost Reduction

35%

Mercury Marine

Use Case – Custom Decal Application Fixture

Customer Profile

For over 80 years, Mercury Marine has been a leading producer of consumer and commercial marine propulsion systems. As an innovator, Mercury Marine pushes the boundaries of manufacturing, from developing its own corrosion-resistant aluminum alloy to employing state-of-the-art processes such as additive manufacturing.

Challenge

Custom-made “hats” – fixtures used to apply decals to engine cowls – typically take six months and $1250 to produce. In addition to the cost and long lead time, they present several additional challenges:

- Large hats are cumbersome and usually damaged in the production environment, requiring the manufacture of a replacement each year
- Matching the engine cowl’s curvature is difficult using conventional construction methods
- Fixtures need provision for a softer, non-marring surface to avoid scratching the painted cowl

Solution

To solve these challenges, Mercury Marine designers 3D printed the latest hat fixture using an F370®CR composite printer. The F370CR prints with high-strength carbon-fiber composite thermoplastics and other materials such as FDM® TPU-92A, a flexible thermoplastic polyurethane. The new fixture employed an outer framework made with FDM® Nylon-CF10 carbon fiber material, providing sufficient rigidity. The frame supported an inner liner printed separately with TPU-92A to provide a non-marring surface against the painted cowl. Combining the two materials resulted in an effective decal template that can withstand daily use on the factory floor.

Impact

The 3D printed fixture was designed and produced in one week compared to six months for a conventionally made tool. The total cost was $400 vs. $1250 for the previous version. The stronger tool means less breakage and fewer replacements, and its light weight makes it easier for operators to use. In addition, the versatility of the F370CR to use multiple thermoplastics with easy material changes provides time and resource-saving manufacturing capabilities.

3D printed emblem locating fixture with carbon fiber frame (gray) and TPU backing.

Fixture shown in place on the engine cowl.

Time Savings	Cost Reduction
96%	68%
1 week vs. 6 mos.	$400 vs. $1250

stratasys