GF Machining Solutions

DMP Factory 500

3D SYSTEMS

GF Machining Solutions: all about you

When all you need is everything, it's good to know that there is one company that you can count on to deliver complete solutions and services. From world-class electrical discharge machines (EDM), Laser texturing and Additive Manufacturing through to first-class Milling and Spindles, Tooling, Automation and software systems — all backed by unrivalled customer service and support — we, through our AgieCharmilles, Microlution, Mikron Mill, Liechti, Step-Tec and System 3R technologies, help you raise your game and increase your competitive edge.

Passion for Precision

3D Systems: making 3D production real

3D Systems is a global 3D solutions company focused on connecting our customers with the expertise and digital manufacturing workflow required to meet their business, design or engineering needs. From digitalization, design and simulation through manufacturing, inspection and management, our comprehensive portfolio of technologies provides a seamless, customizable workflow designed to optimize products and processes while accelerating outcomes. With advanced hardware, software and materials as well as on demand manufacturing services and a global team of experts, we are on a mission to transform businesses through manufacturing innovation.

Contents

Redefining the AM Factory

GF Machining Solutions, a leading global provider of complete solutions to the precision machining industry and manufacturers of precision components, and 3D Systems, a leading global provider of additive manufacturing solutions and the pioneer of 3D printing, have partnered to introduce new metal 3D printing solutions that empower manufacturers to develop their own dedicated Additive Manufacturing (AM) factories.

The DMP Factory 500 offers manufacturers in aerospace, automotive, motorsports and other high-tech industries increased productivity, part quality and process safety while significantly reducing Total Cost of Ownership (TCO) and facilitating seamless integration of metal AM technology into the entire manufacturing chain.

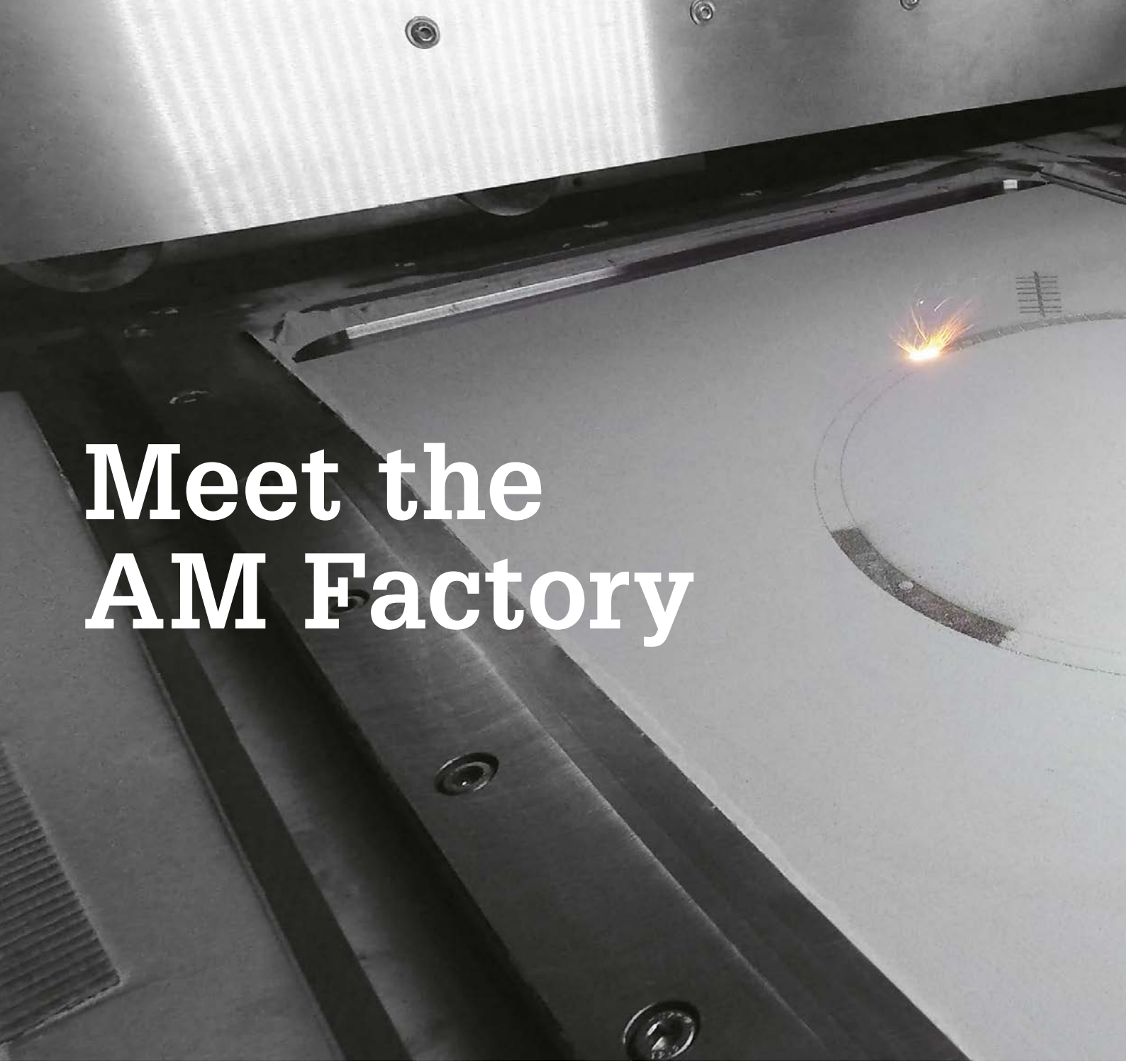
Natural match for aerospace needs

Metal AM today is poised to deliver significant production benefits to original equipment manufacturers (OEMs). Advances in additively-manufactured aerospace parts have proved how this technology can now be deployed to all metals manufacturers. By leveraging that experience, consequently, OEMs are now ready to fully deploy and experience the benefits of this game-changing technology.

Metal AM has delivered a natural evolution to the aerospace industry because it:

- Optimizes buy-to-fly ratios through reduced cost of waste material
- Optimizes geometry and design for functionality to reduce weight and increase performance
- Reduces product development and production times to better serve a fast-changing market

GF Machining Solutions, with its long history of relationships with OEMs, and 3D Systems, the global additive manufacturing solutions company, with the deepest expertise and broadest portfolio of 3D printers, are the ideal partners for developing factory-grade AM solutions that will fully address the challenge of mass production, with complete process traceability as required from the aerospace industry.

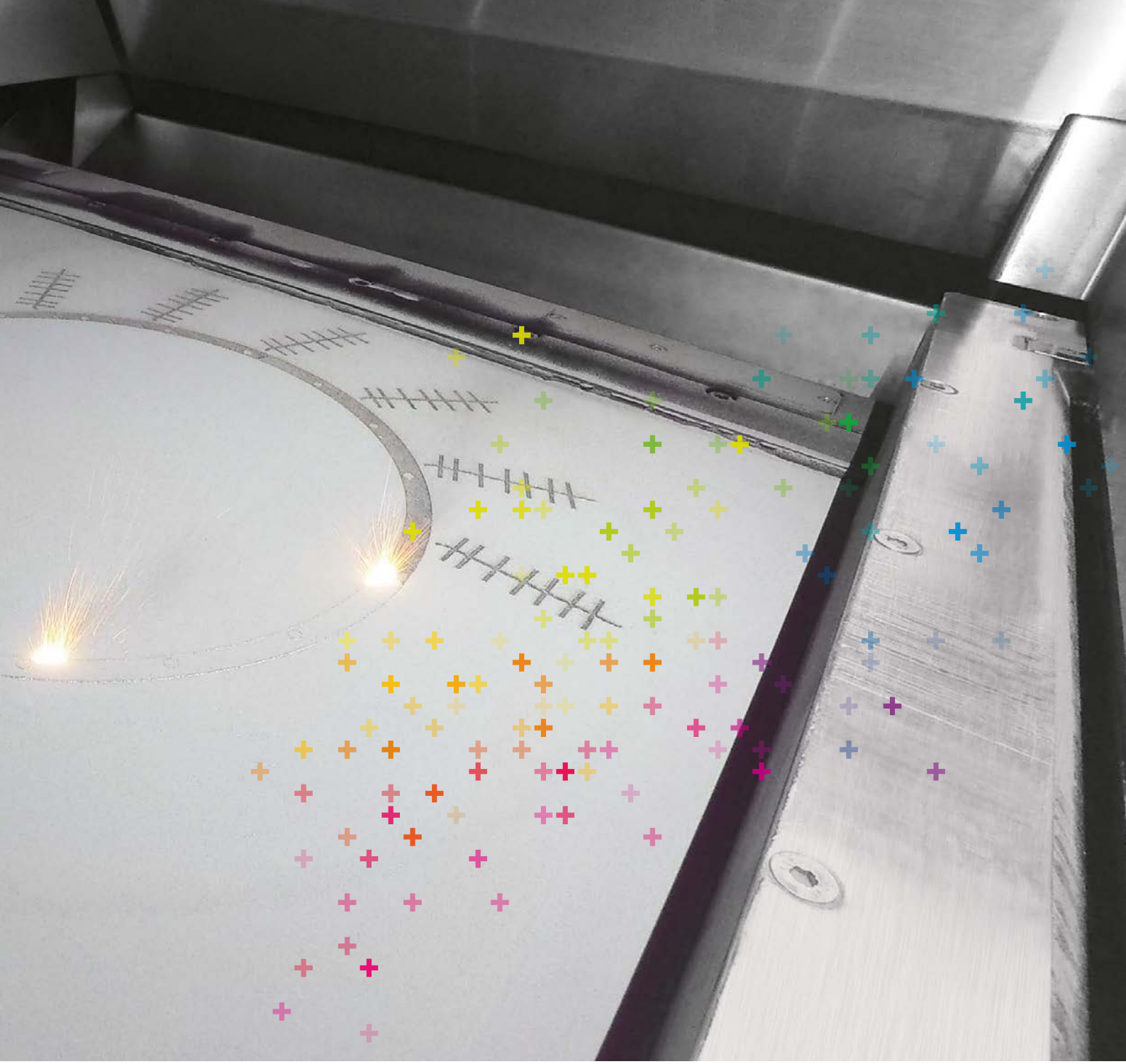


Meet the AM Factory

Scalable metal Additive Manufacturing for seamless large parts

The DMP Factory 500 is a workflow-optimized metal 3D printing solution for massive scalability, repeatable high-quality parts, high throughput and low TCO, producing parts of up to 500 x 500 x 500 mm in size.
Engineered using 3D Systems' proven precision metal additive technology, along with GF Machining Solutions' technical and industrial knowledge, and the precision System 3R clamping systems, the DMP Factory 500 solution is a fully-integrated, streamlined metal AM platform.

This advanced metal production system is powered by performant 3DXpert™ software, LaserForm® materials, workflow-optimized Direct Metal Printing (DMP) production modules and expert application support.



Companies that have identified a desirable metal AM application in an in-house laboratory setting will realize the complications of scaling with a stand-alone printer. Very often, the costs and human resources required make this an unrealistic approach for volume parts production. In order to arrive at a viable factory solution, it must be possible to control part quality, cost, workflows and to scale operations easily.

Our technicians produce more than 500,000 high quality metal AM parts in-house every year through our parts manufacturing services. Informed by their ongoing insights and experiences, our materials scientists and expert product development teams have developed the DMP Factory 500 as a modular factory solution that enables users to:

- Build higher quality large parts
- Lower TCO
- Simplify process workflows
- Scale in a factory environment

Modular concept for scalability

The DMP Factory 500 is a scalable manufacturing solution comprised of function-specific modules designed to maximize efficiency by optimizing utilization. Each module of the DMP Factory 500 is fully integrated with a vacuum-sealable Removable Print Module (RPM) that delivers a controlled print environment and is engineered to move between printer and powder modules for a continuous production workflow. Customers can configure a custom metal AM factory by choosing the right combination of modules to optimize their specific production application.

Printer Module (PTM)
Designed for the ongoing, 24/7 printing of parts

Powder Management Module (PMM)
Efficiently depowders parts on build platforms under inert conditions, automatically recycling unused powder materials and preparing the RPM for future print jobs

Removable Print Module (RPM)
Seals the build platform and powder from the atmosphere and is engineered to move between Printer and Powder Management Modules for a continuous production workflow

Transport Module (TRM)
Efficiently transports RPMs between printer and powder management modules using a precision positioning system to facilitate easy loading of RPMs into PTM and PMM modules

Parking Module (PAM)
Interim storage of RPMs in an inert environment until ready for further progression in the workflow (e.g., stores a fully prepared RPM for its next print job while the PTM is finishing the previous print job)

Parking Module

Printer Module

Powder Management Module

Removable Print Module

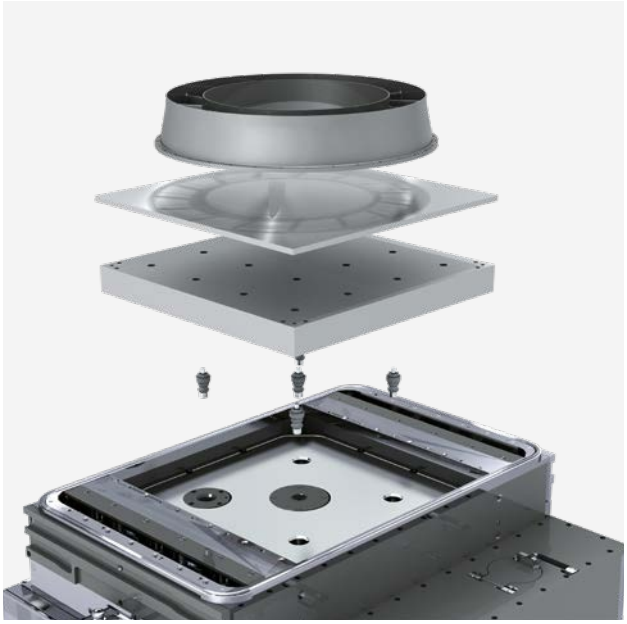
Transport Module

Integrating AM with traditional technologies

To underline our mutual commitment to providing innovative solutions to market leaders, GF Machining Solutions has filed a patent application for a new carrier concept. This flexible solution allows the user to position and locate build plates on the RPM and provides links to automated conventional machining processes. This concept contributes to a significant increase in automation possibilities and reduction of build plates costs.

Automation of the AM process is a top priority, but we are also keenly developing solutions to seamlessly integrate AM technology into the complete manufacturing process chain. The DMP Factory 500 drives efficient management of post-processing steps alongside your metal additive production process, such as wire-cutting electrical discharge machining (EDM) and milling.

- System 3R carrier concept for easier post-processing
- Integrated System 3R chucks

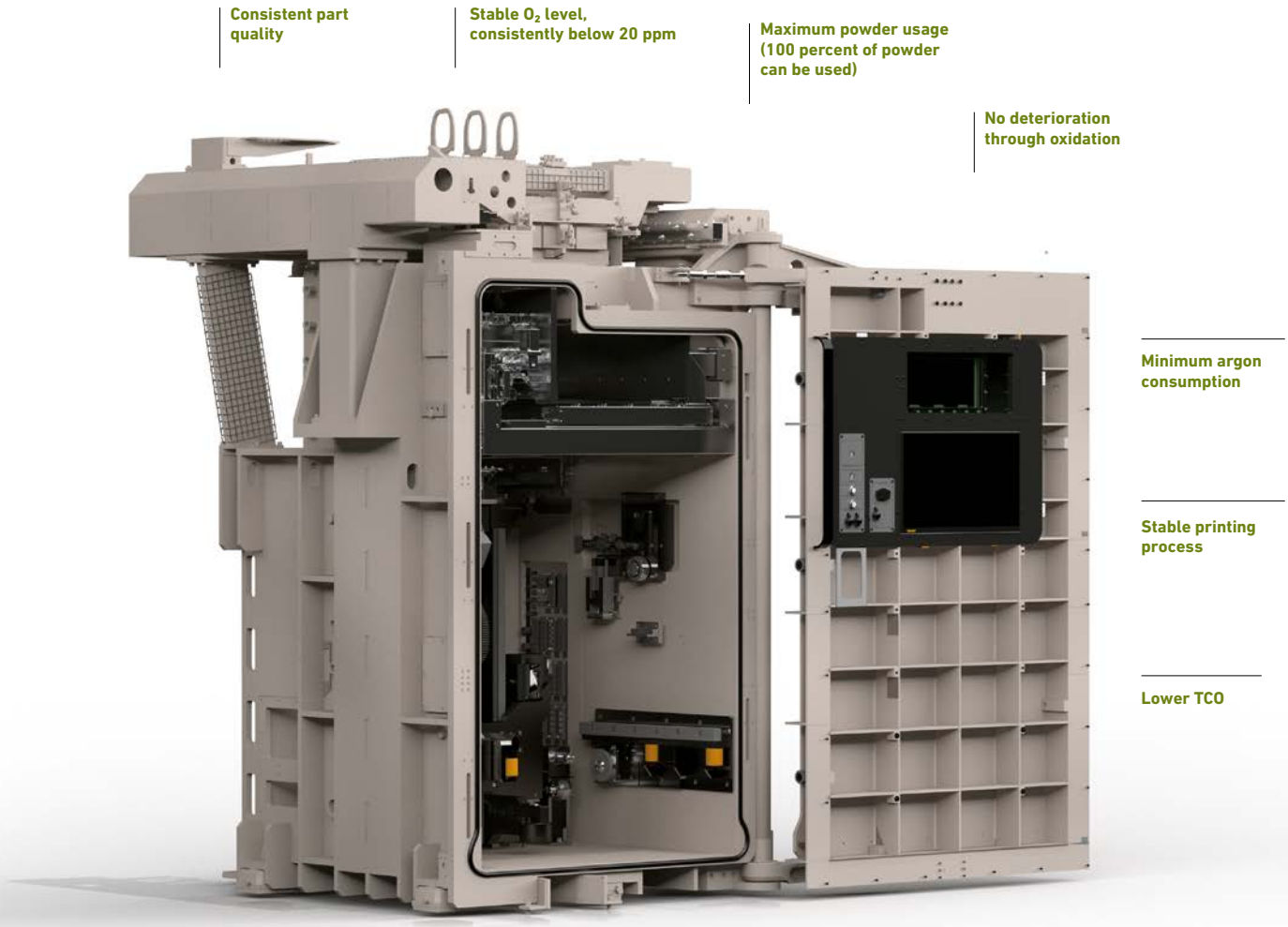


Carrier concept

The vacuum chamber concept

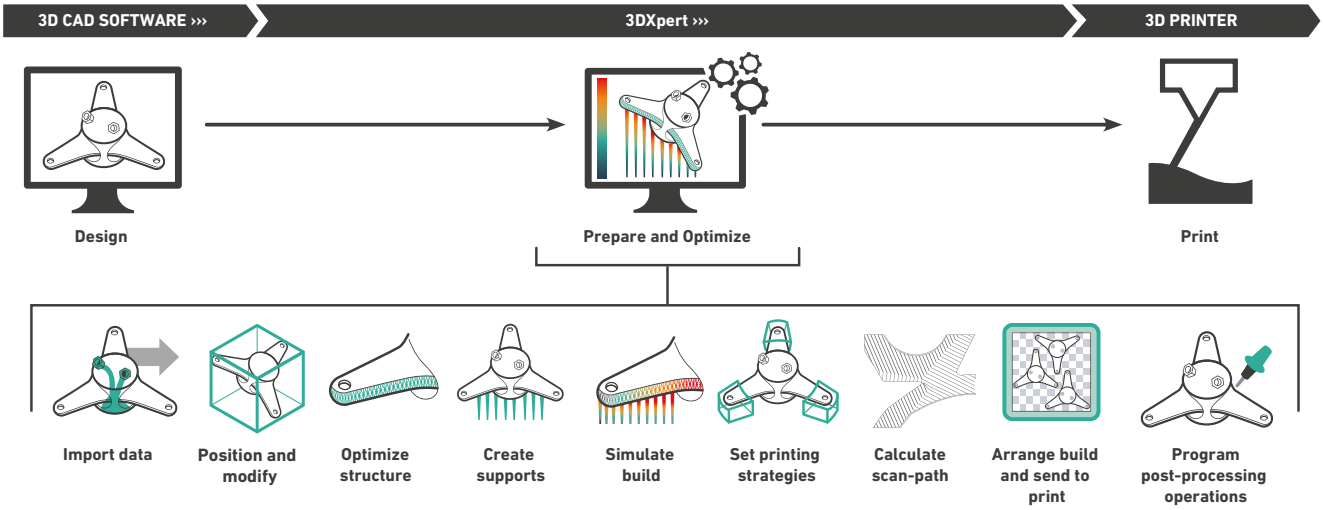
3D Systems has developed a unique vacuum chamber for the PTM to improve process efficiency and part quality and reduce overall manufacturing costs in metal AM. In order to consistently achieve these benefits throughout the workflow from printing to material recycling, the resulting inert environment is also present in other modules of the DMP Factory 500.

The lowest possible oxygen (O_2) content in the build chamber protects chemical composition and moisture content of the LaserForm® metal alloys during manufacturing. This means operating conditions do not affect material specification. Printing in a vacuum chamber eliminates material waste and directly reduces TCO by protecting powder from deterioration through oxygen exposure. By maximizing the utilization of consumables, the DMP Factory 500 solution offers shorter setup times and fewer material change-overs compared to competing products.



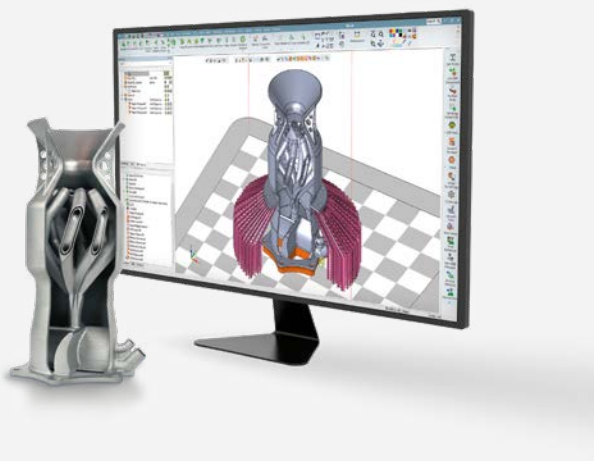
3DXpert™: from 3D CAD model to best-in-class prints

Empowering the DMP Factory 500, 3DXpert™ is an integrated software handling the entire spectrum of the AM workflow. 3DXpert™ allows you to leverage the full potential of AM with complete control over the preparation and manufacturing process. Supporting every step of the AM workflow from design to post-processing, 3DXpert™ streamlines your process to quickly and efficiently transition from a 3D model to successfully printed parts.



3DXpert™ auto-balancing control enables the best quality at minimum printing time for the multi-head DMP Factory 500. Intelligent multi-laser control ensures best utilization and balancing of multiple print heads for high throughput production of multiple parts or large parts, up to the size of the full build volume. 3DXpert™ also ensures there is a perfect merging of volumes printed by different print heads, from the inner layers to the outer surface. This results in seamless large prints with outstanding material properties and the highest surface quality for metal 3D printed parts.

- All-in-one integrated software for the entire AM workflow
- Hybrid CAD for greater agility, quality and speed
- History-based approach facilitates changes at any stage
- Controlled Automation with the ultimate combination of Automation and full user control
- Built-in simulation minimizes trial and error
- Optimize printing strategies to shorten print time and ensure quality



Build higher quality large parts

Metal 3D printing emerged as a technology best suited for producing small, intricate metal parts. As part sizes go up, achieving consistent, high quality parts becomes a challenge that requires deep expertise and clever engineering solutions.

Intelligent seamless scanning via unique 3DXpert™-enabled print strategies

3D Systems' metal printing specialists devised multiple software-enabled build techniques to eliminate seam lines and internal weak points, including overlapping and bricking. They also developed strategies to minimize splits by enabling specific print heads to be assigned to specific zones. One laser can also reach the entire platform and ensure the best quality for large part contours.

Thoroughly-developed and tested print settings

An expert team of material scientists and metal AM application specialists develop and test extensive databases of print parameters to enable users to consistently achieve the material properties specified by the LaserForm® material datasheets. The extensive print settings available can significantly shorten the time it takes to get the metal AM factory up and running.

Consistent, low O_2 environment

The consistently low O_2 environment of the vacuum chamber in the PTM and inert environments in the RPM and PMM guarantee consistent powder quality for high quality parts. The closed powder concept maintains material integrity and allows for printing of even very reactive alloys.

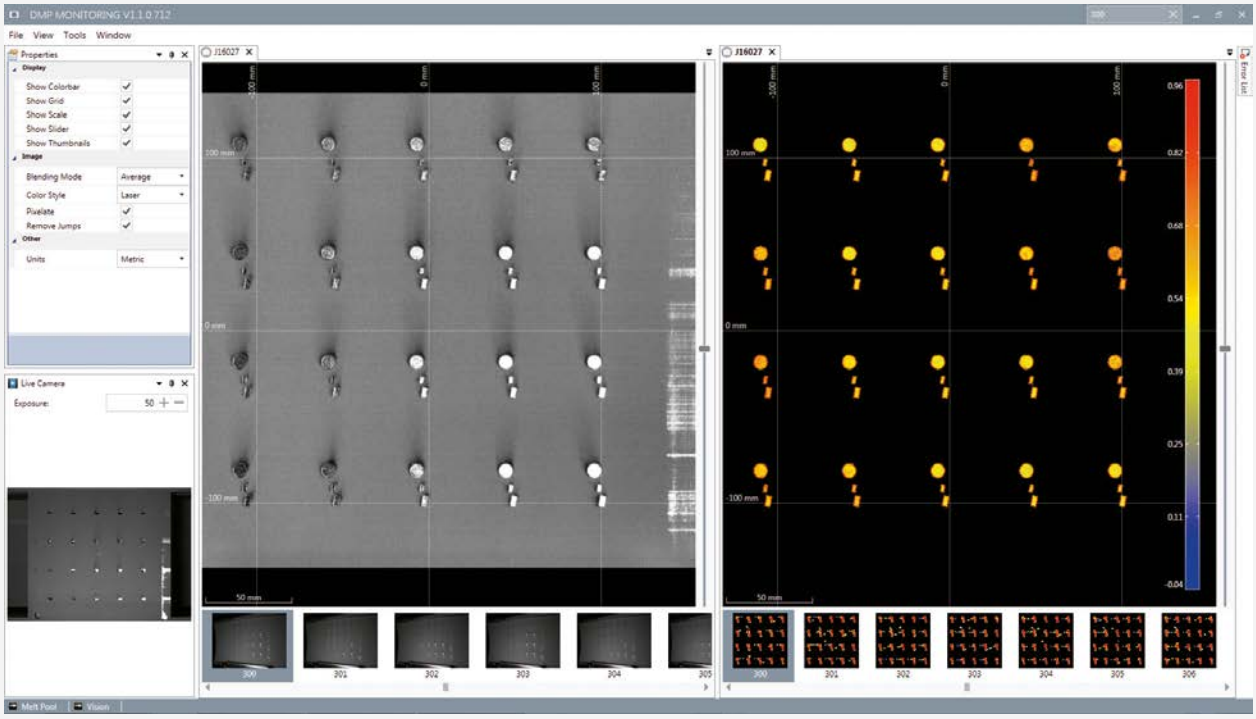
High precision laser quality, control and in-line verification capabilities

Tools for in-line scanner calibration checks allow users to control laser precision throughout the build process of large parts.

DMP Monitoring

DMP Monitoring allows users to see, analyze, understand and fine-tune their metal AM process with unprecedented capability. The DMP Monitoring toolset for enhanced quality control includes real-time process monitoring, synchronized images of the melt pool and powder bed, synchronized images of active and archived jobs for comparison, and a toolset for analyzing the magnitude of a subject area, enabling:

- Real-time, in-build data collection and visualization
- Post-build process analysis
- Build parameter optimization



Lower Total Cost of Ownership

TCO and final per-part costs are key factors. The modularity of the DMP Factory 500 solution allows manufacturers to define a factory setup that is tailored to their application and capacity requirements and maximizes the use of each module. This includes configuring an optimal workflow for machine operators with smooth integration of post-processing steps. The DMP Factory 500 enables the consistent-quality parts production and nearly eliminates waste and scrap, thereby optimizing part costs and TCO.

High printer utilization
With short setup times, a one-hour changeover from print job to print job is the standard. In addition, the modular configuration of the DMP Factory 500 solution ensures that the PTM can be used 24/7 to print high-quality parts, every time.

Optimized productivity of three high-precision lasers
Multiple lasers in a printer have to be carefully controlled to increase productivity and reduce cost. The intelligent print strategies enabled by 3DXpert™ allow for optimized productivity of the 3 lasers based on intelligent overlapping scan fields.

Powder traceability and control
Full traceability of powder down to the batch number and the powder recycling activity.

High powder recyclability
Unlike any other available systems, the vacuum chamber and inert environments of the RPM and PPM secure the LaserForm® powders against quality deterioration throughout printing, depowdering and powder recycling to enable effectively almost 100 percent powder recyclability.

Fast bidirectional recoating
A high-performance, bidirectional recoating system consistently and accurately deposits a fresh layer of powder at each pass. This increases productivity by reducing the time in which lasers are inactive.

Simplify process workflow

An efficient factory is streamlined from end to end. With extensive experience in the production environment, our engineers have packaged their production workflow expertise into functional modules that enable maximum uptime and efficiency. In metal 3D printing, workflow optimization relies on the integration of hardware and software. 3DXpert™ all-in-one software for metal AM supports every step of the AM workflow with complete control over preparation and manufacturing process.

CAD-based build setup with 3DXpert™

With CAD-based 3DXpert™ AM software, customers enjoy having all the design for additive tools available in a single solution, so that engineers do not have to revisit several software solutions to make edits solutions and can easily apply all required changes at any stage of the process.

Integrated System 3R referencing and clamping system

Integrated referencing and clamping system has been optimized for the use in Additive Manufacturing (PBF – Powder Bed Fusion) machinery. It facilitates the link to subsequent machining processes and results in a drastic reduction of setup and changeover time, thus enabling companies to produce at much greater scale and efficiency.

Modular design enables full automation

With its five function-specific modules, the DMP Factory 500 is ready to be tailored to customers' specific production requirements and manufacturing plant layouts. The modules allow for incrementally leveling-up automation to a complete factory system, depending on customer requirements.

Scale in a factory environment

Setting up an AM factory relies on scalable solutions to adjust to increased demand. DMP Factory 500 is designed to start and grow a factory setup, with the flexibility to configure the function-specific modules to your specific requirements. To intelligently deliver a true metal additive factory, we also deliver on Overall Equipment Efficiency (OEE), safety standards and data integration to meet customer needs.

Optimize mix of modules to meet production requirements and optimize individual equipment OEE

The architecture of the DMP Factory 500 solution with its function-specific modules delivers on two key conditions: flexibility to define an individual factory workflow based on specific applications, as well as productivity for the highest possible OEE to achieve manufacturing key performance indicators (KPIs).

Enable parallel workflows

The modularity of the DMP Factory 500 allows for increased throughput as key workflows occur in parallel: printing the parts, depowdering the parts, recycling the material, and preparing a new build. By comparison, non-modular systems are limited to each part of the workflow occurring in the same system, extending wait times and reducing production efficiencies.

Full powder management and containment

We defined our solution so that individual PMMs allow you to optimize your factory layout to match material flow. All powder is contained in the RPMs between prints, so no powder stays in the printer or in the PMM. For your documentation requirements, you can count on the intelligent powder use, traceability and batch control.

Highest safety standards for the equipment

The individual modules of the DMP Factory 500 solution comply with the highest safety standards. Powder handling throughout the workflow takes place in an inert atmosphere, which further increases safety. Filter changes, a potential safety risk in metal AM solutions, are complete with one, easy and safe operation.

Smooth data connectivity with all major enterprise resource planning (ERP) systems

Whichever ERP system you use, we provide you with easy access to data to feed it, whether it is data for job reports, user log on, log off, job execution status, parameter changes, and many more. You can count on it: Simplified traceability is a key building block of an effective factory solution.

Customer Services

The availability of equipment, productivity and continuous improvement are essential drivers for your business.
GF Machining Solutions Customer Services offers you a modular concept with three levels of support. Benefit from our services to answer your specific needs.

Operations Support: Solutions to boost your applications
Achieve optimum levels of performance and precision in your daily operations with certified consumables and original wear parts.

Machine Support: Securing your sustainable machining success
With Machine Support, GF Machining Solutions offers you original spare parts, technical support and preventive services to operate your equipment in perfect order and condition and optimize your uptime.

Open up new digital service possibilities
Thanks to the rConnect, you can stay connected with your production environment anywhere and at any time. Through innovative digital services, rConnect allows you to monitor your productivity and to improve your machine availability. With rConnect Live Remote Assistance (LRA), you can rely on our expert engineers to rapidly respond to your service requests. Our solution connects you to our experts for remote assistance in real time.

Business support: Realize the full potential of your DMP Factory 500
As your business evolves, so does its needs, and you can count on GF Machining Solutions for the individually tailored solutions to enhance your operational excellence. We help you keep pace with the continuously changing business and market environments and outperform your competitors. Our advanced support and consulting, including a variety of trainings as well as upgrades and application development, improve your performance, productivity and competitive edge.

Technical specifications

DMP Factory 500 Printer Module	
Specifications	
Laser power type	3 x 500 W / Fiber laser
Laser wavelength	1070 nm
Layer thickness, range, preset	Adjustable, min. 2 µm, max.200 µm, typ. 30-60-90 µm
Build envelope	500 x 500 x 500 mm (20 x 20 x 20 in)
Material deposition	Tube (Silicon)
Repeatability	x y z 20 µm (0.00079 in)
Minimum feature size	100 µm (0.0039 in)
Typical accuracy	± 0,1 - 0,2% with ± 50 µm minimum
Metal powders	
Available materials	Nickel Alloys, Titanium (others upon request)
Space requirements	
Dimensions uncrated (w x d x h)	3010 x 2290 x 2820 mm (118 x 90 x 111 in)
Floor space requirements (w x d)	2730 x 7250 mm (107 x 285 in) (including 4000 mm (157 in) in front – 900 mm (35 in) in back)
Weight uncrated + powder	Approx. 8000 kg (17636 lb)
Facility Requirements	
Electrical requirements	400 V AC 3 phase + N + PE - 50/60 Hz
Compressed Air requirements	4-8 bar (115 psi)
Argon requirements	8 bar (58 -115 psi)
Water Cooling	Chiller supplied with printer
Control System and Software	
Software tools	DMP Software Suite + 3DXpert
Control software	DMP Software Suite
Operating system	Windows 10 Pro, 64bit
Input data file formats	Native CAD files, STEP, IGES, ACIS Parasolid, STL...
Network type and protocol	Ethernet 1 Gbps, RJ-45 plug

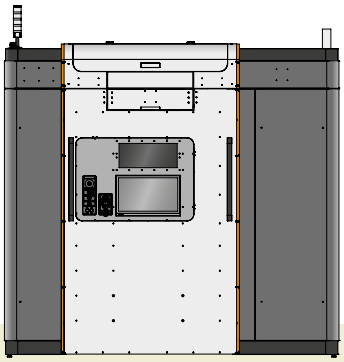
DMP Factory 500 Printer Module

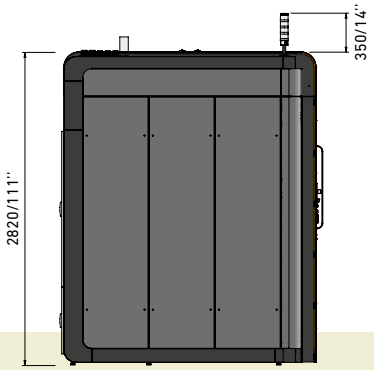
Handling	
Material loading	Manual or Semi-automatic
Interchangeable build modules	Yes
Accessories/peripherals	
Modules	Powder management module / Parking module / Transporter module / Removable Print Module

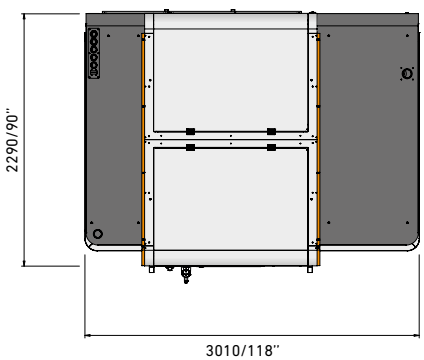
DMP Factory 500 Modules

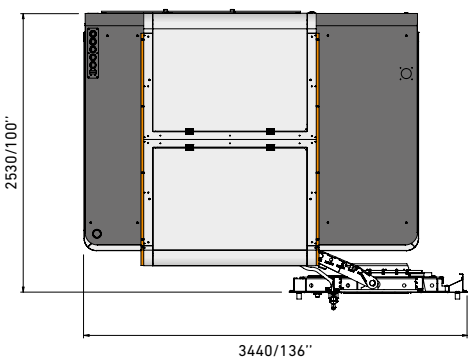
Powder Management Module	
Module footprint (w x d x h)	3000 x 2500 x 3000 mm (118 x 98 x 118 in)
Electrical requirements	400 V AC 3 phase + N + PE - 50/60 Hz electrical cable
Parking Module (PAM)	
Module footprint (w x d x h)	1450 x 1780 x 1850 mm (57 x 70 x 72 in)
Electrical requirements	400 V AC - 3 phase + N + PE - 50/60 Hz electrical cable
Removable Print Module (RPM)	
Module footprint (w x d x h)	1120 x 780 x 1400 mm (44 x 31 x 55 in)
Transport Module (TRM)	
Module footprint (w x d x h)	900 x 2100 x 1400 mm (37 x 83 x 55 in)
Electrical requirements	400 V AC 3 phase + N + PE - 50/60 Hz electrical cable

DMP Factory 500









GF Machining Solutions

EDM (electrical discharge machining)

AgieCharmilles wire-cutting, die-sinking and hole-drilling machines

For over 60 years we have been at the forefront of every EDM development: designing and refining the EDM process and building machine tools that deliver peerless part accuracies, surface finishes, cutting speeds and process reliability. Today, our AgieCharmilles wire-cutting, die-sinking and hole-drilling machines are recognized throughout the world as the best in the business. Our continuous research and development in digital generator technology, control systems and integrated Automation systems are evidence of our commitment to keeping your EDM operations on the leading edge of technology.

Laser

AgieCharmilles Laser texturing machines

Laser texturing is a fully-digitized surface engineering process that has huge potential. The technology enables precise 2D and 3D textures or engravings to be machined accurately and directly onto complex parts or molds to improve and alter their aesthetic appeal, functionality and performance. The process is infinitely repeatable and offers many distinct environmental and economic advantages over conventional texturing processes.

Laser Additive Manufacturing (AM)

GF Machining Solutions and 3D Systems, a leading global provider of additive manufacturing solutions and the pioneer of 3D printing, have partnered to introduce new metal 3D printing solutions that enable manufacturers to more efficiently produce complex metal parts.

Tooling and Automation

System 3R Tooling, Automation and software

Productivity is the key to manufacturing success, and automating a manufacturing process is a proven method of increasing its efficiency, effectiveness, quality and reliability. System 3R's integrated Tooling, Automation and software solutions ranging from simple workpiece pallet and electrode changers through to flexible manufacturing and robot handling systems are guaranteed to help you increase their competitive advantage.

Milling

Mikron MILL S (high-speed Milling), Mikron MILL P (high-performance Milling) and Mikron MILL E (high-efficiency Milling)

Customers operating in the mold, tool and die and precision component manufacturing sectors stake their reputations on being able to quickly and cost-competitively meet their customers' demands. That's why they invest in GF Mikron machines. Incorporating the latest and most advanced technologies and premium-performance components, Mikron MILL S, Mikron MILL P and Mikron MILL E machines help you increase your production capabilities and improve your productivity. Designed and built for speed, accuracy and reliability, the machines, like you, are proven performers.

Liechti dedicated aerospace and energy machining centers

Aerospace and power generation turbine manufacturers increasingly turn to Liechti dedicated five- and six-axis machining centers to machine complex, high-precision airfoils on blades, disks, blings, blisks/IBRs and impellers. It's easy to see why because these machines, with their specific profile machining technology, specialized CAD/CAM software and engineering competence for ultra-dynamic machining in titanium, Inconel, nimonic, titanium-aluminide and high-alloy steels, yield productivity gains as much as 30 percent, thanks to reduced machining times. In the globally competitive aerospace and power generation manufacturing sector, that's definitely worth shouting about.

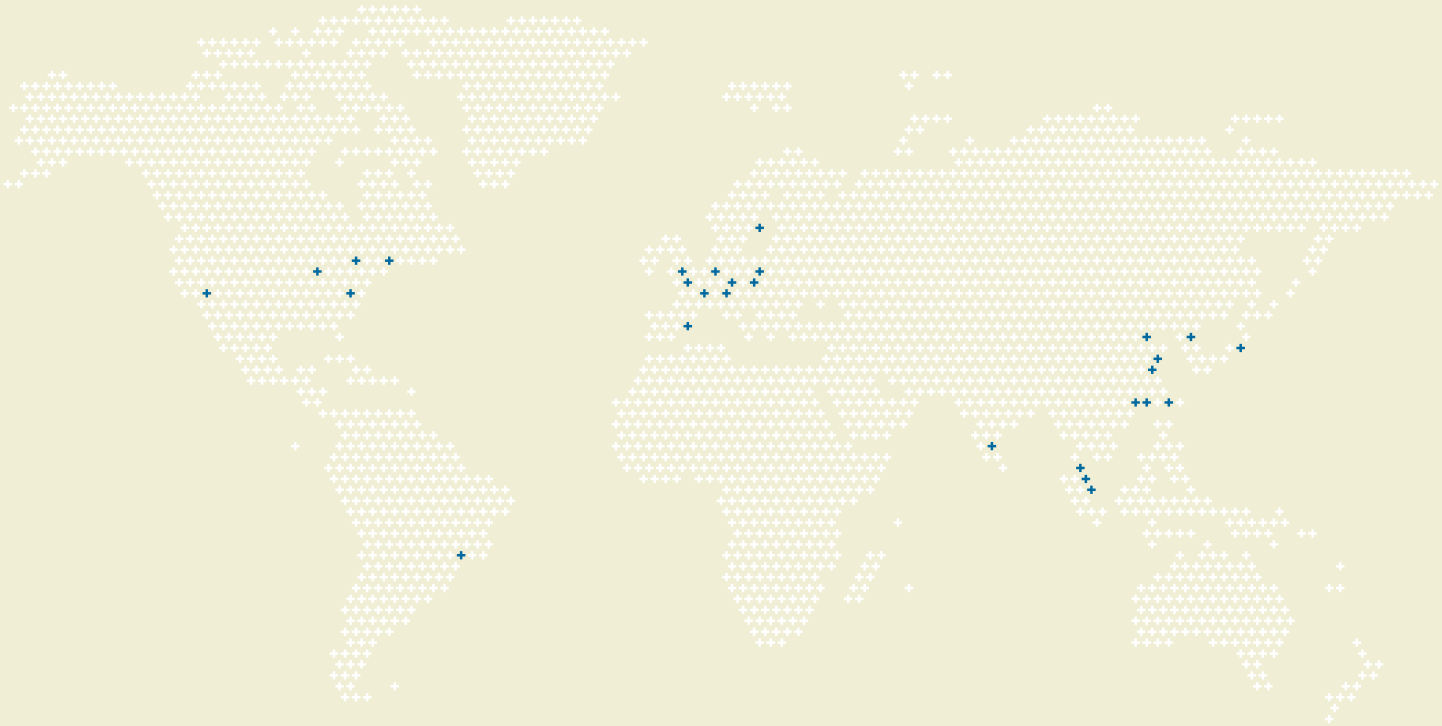
Step-Tec Spindles

At the heart of every GF Mikron machining center is high-performance Step-Tec Spindle. Step-Tec Spindles are essential core components of our machining centers. Highly accurate and thermally stable Step-Tec Spindles ensure that our machines can handle everything from heavy-duty roughing to fine-finishing operations.

Customer Services

Operations Support, Machine Support and Business Support

To help you get the most and the best from your machine tools and equipment, we offer three levels of support. Operations Support covers our range of original wear parts and certified consumables (EDM wires, filters, resins, electrodes etc.) to ensure that your machines are performing at the highest levels. Machine Support maximizes, through our best-in-class technical support, preventive services and quality spare parts, your machine tool uptime. Business Support is designed to help you make a real step-change in your productivity and performance with solutions tailored to your specific needs.



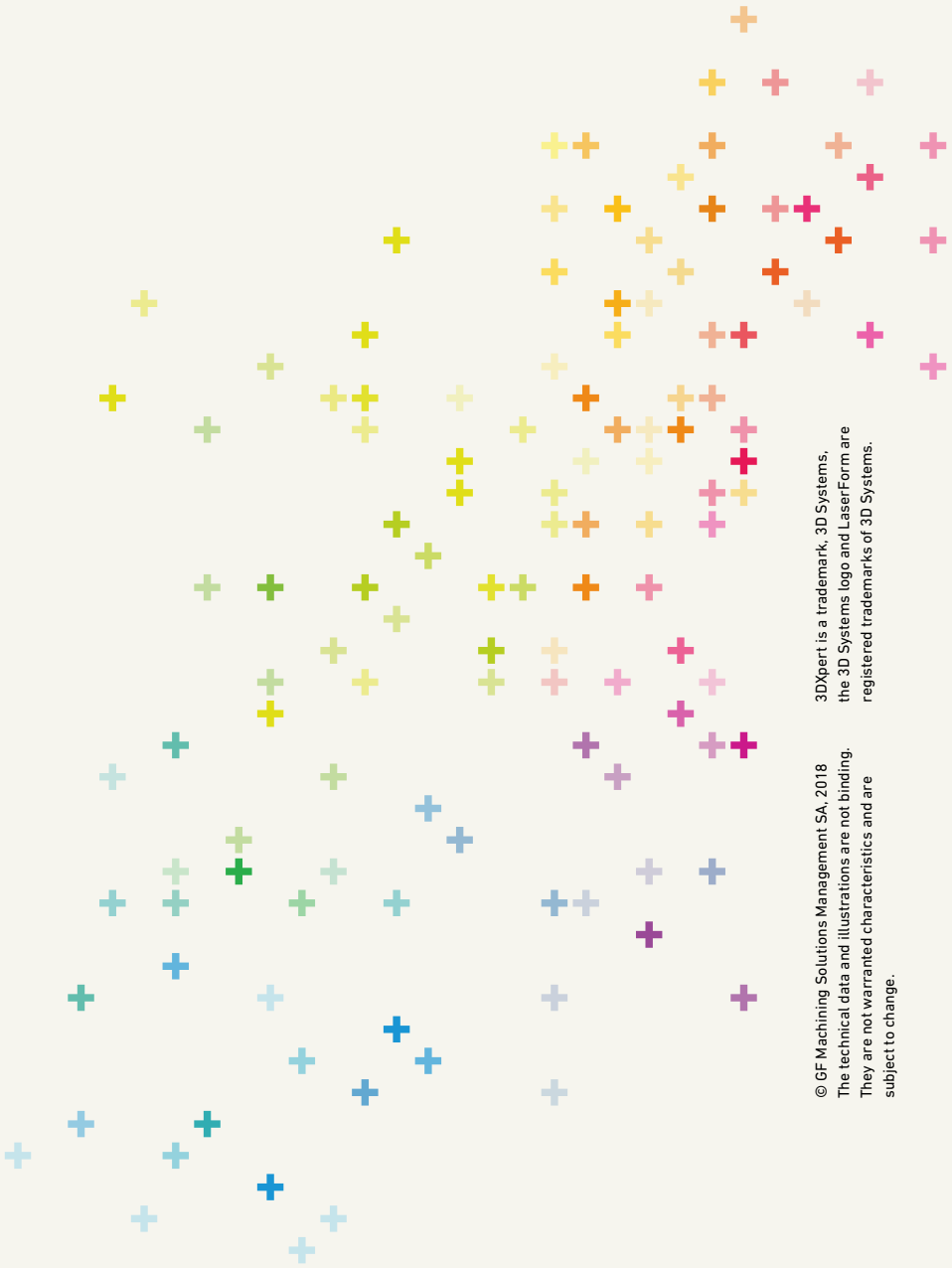
GF Machining Solutions

259.806.742–EN

At a glance

We enable our customers to run their businesses efficiently and effectively by offering innovative Milling, EDM, Laser, Additive Manufacturing, Spindle, Tooling and Automation solutions. A comprehensive package of Customer Services completes our proposition.

www.gfms.com



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