



DMP Factory 500

Scalable metal additive manufacturing
for seamless large parts



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.



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 and 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

Market introduction	4
Meet the AM factory	6
Modular concept for scalability	8
Integrating additive manufacturing with traditional technologies	9
The vacuum chamber concept	10
3DXpert™	11
Build higher quality large parts	12
Lower total cost of ownership	14
Simplify process workflow	15
Scale in a factory environment	16
Technical specifications	18
3D Systems	20
GF Machining Solutions	22



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 shown 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 with a build volume up to 500 x 500 x 500 mm, height inclusive of build plate.

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 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.

3D Systems' technicians produce more than 500,000 high quality metal AM parts in-house every year through its 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 sealed 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)



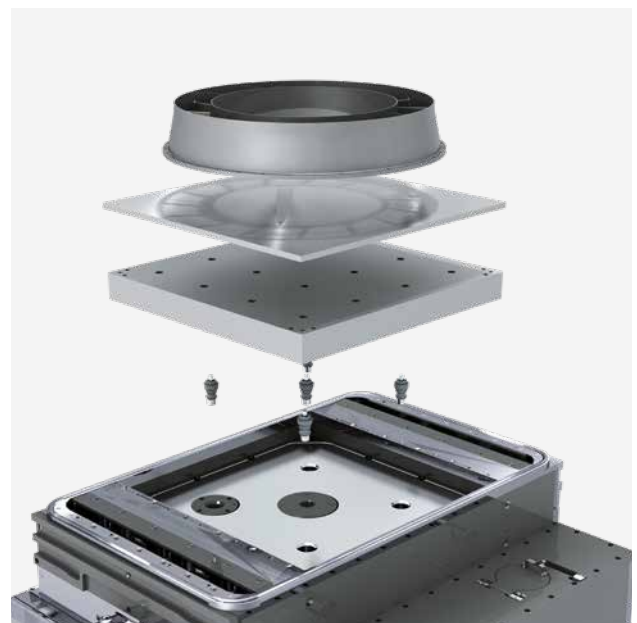
Integrating AM with traditional technologies



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



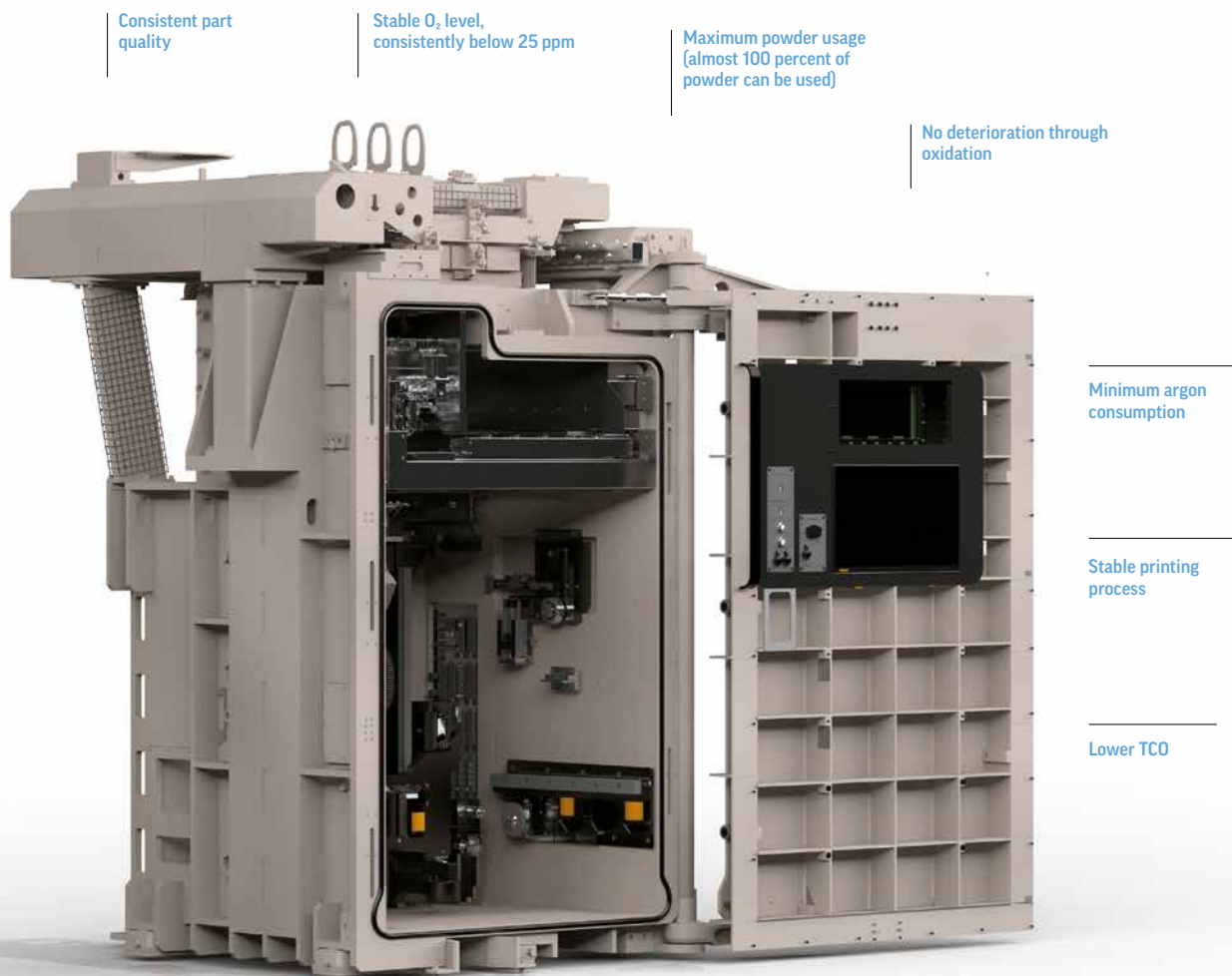
AM Carrier concept

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.

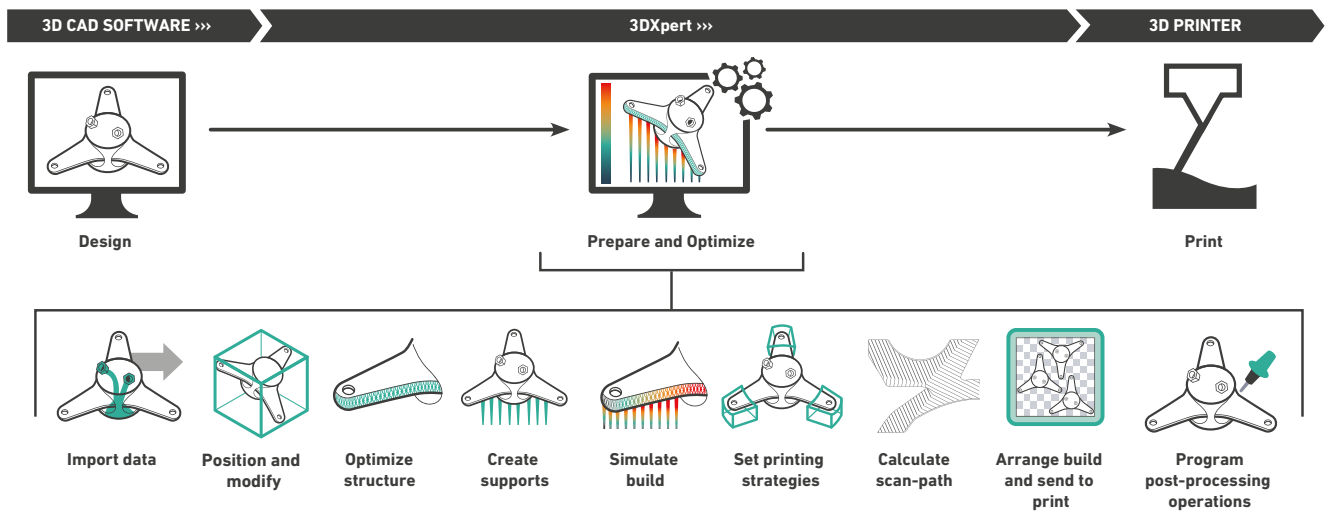
The lowest possible oxygen (O₂) content in the build chamber protects chemical composition and reduces moisture content of the LaserForm metal alloys during manufacturing. This ensures optimal operating conditions for consistent mechanical properties. Printing in a vacuum chamber eliminates material

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

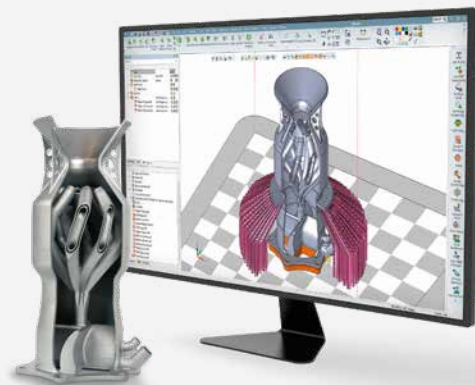
Empowering the DMP Factory 500, 3DXpert® is an integrated software handling the entire spectrum of the AM workflow. 3DXpert allows you to leverage the full potential of AM with complete control over the preparation and manufacturing process. Supporting every step of the AM workflow from design to post-processing, 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 O₂ environment

The consistently low O₂ 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

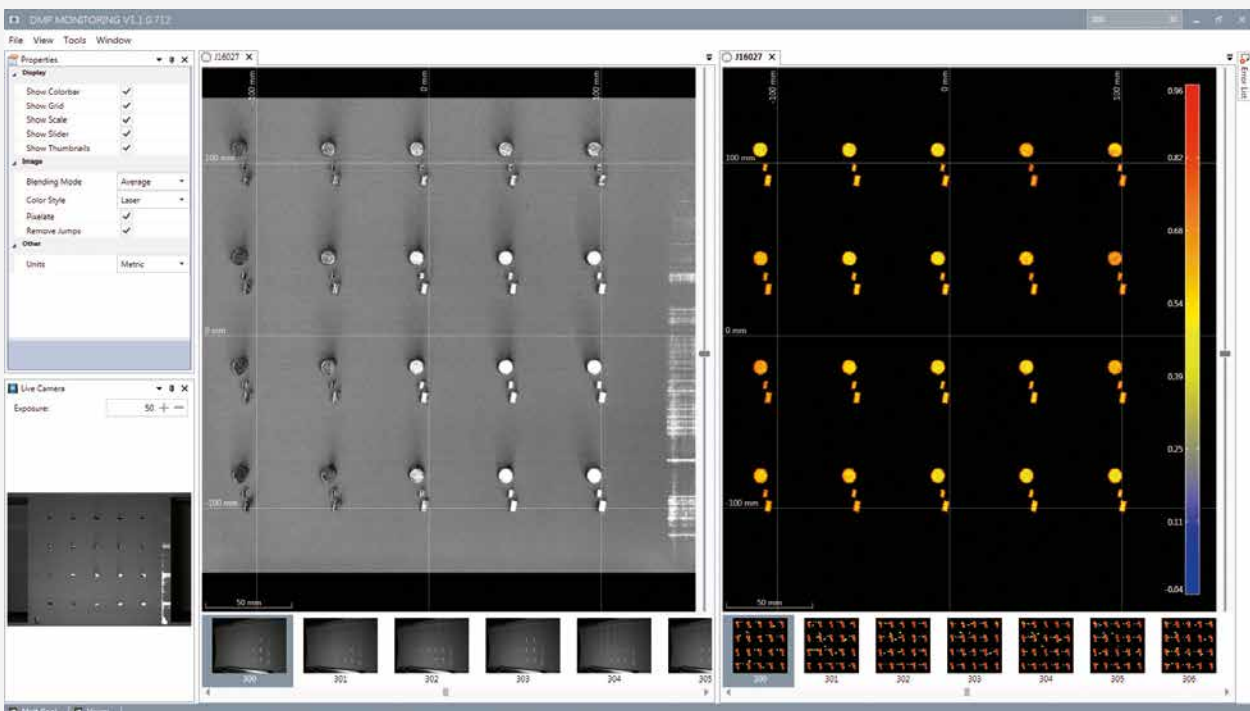
Tools for in-line scanner calibration checks allow users to control laser precision throughout the build process of large parts.

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 important 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 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 PTM 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 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 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 simplified traceability as a key building block of this effective factory solution.

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 μ m, max.200 μ m, typ. 30-60-90 μ m
Build volume (x x y x z)	500 x 500 x 500 mm (19.7 x 19.7 x 19.7 in), height inclusive of build plate
Material deposition	Tube (Silicon)
Repeatability	x,y,z = 20 μ m (0.00079 in)
Minimum feature size	100 μ m (0.0039 in)
Typical accuracy	\pm 0,1-0,2% with \pm 50 μ m minimum

Metal powders

Available materials	Nickel Alloys (others upon request)
---------------------	-------------------------------------

Space requirements

Dimensions uncrated (W x D x H)	3010 x 2290 x 2820 mm (118 x 90 x 111 in)
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)	4050 x 2450 x 3000 mm (160 x 97 x 118 in)
Electrical requirements	400 V AC 3 phase + N + PE - 50/60 Hz electrical cable

Parking Module (PAM)

Dimensions uncrated (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

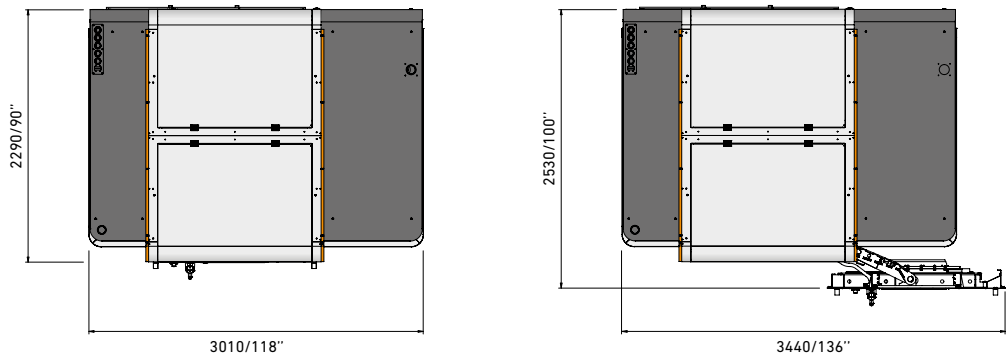
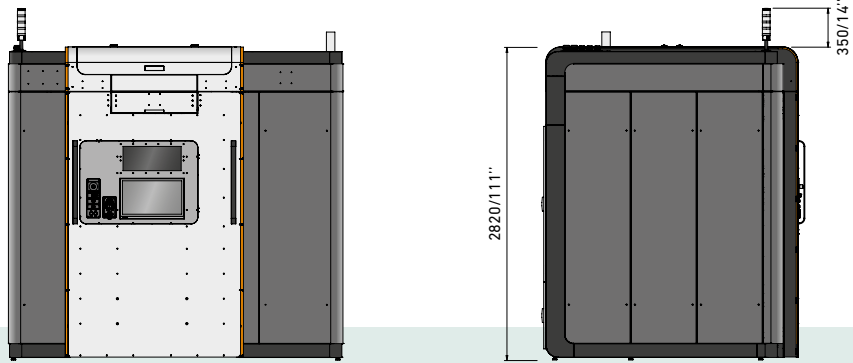
Removable Print Module (RPM)

Dimensions uncrated (W x D x H)	1120 x 850 x 1400 mm (44 x 33 x 55 in)
---------------------------------	--

Transport Module (TRM)

Dimensions uncrated (W x D x H)	850 x 1810 x 1400 mm (33 x 71 x 55 in)
Electrical requirements	400 V AC 3 phase + N + PE - 50/60 Hz electrical cable

DMP Factory 500



Additive Manufacturing Solutions

Metal

Direct Metal Printing (DMP): a metal additive manufacturing technology in which a high-powered laser scans over a bed of fine metal powder to micro-weld particles in the pattern prescribed by a cross-section of the CAD file. 3D Systems' precision metal manufacturing solutions integrate DMP with thoroughly tested print parameters for Laser-Form materials, 3DXpert all-in-one software, and expert application support.

Full Color

ColorJet Printing (CJP): a binder is selectively jetted from inkjet print heads onto a powdered core material, causing the core to solidify. The build platform lowers with each subsequent layer, and CMY or CMYK color is applied to the outermost surfaces resulting in a full-color 3D model.

3S Systems On Demand

3D Systems offers complete on demand parts manufacturing services, from 3D printed metal and plastic parts to CNC machining, injection molding, and cast urethane modeling. With instant online access to digital manufacturing tools, 3D Systems On Demand connects users with quality 3D printed parts and prototypes with some of the fastest and most reliable turnaround times in the industry. 3D Systems On Demand is able to meet the specific business needs of today's most advanced companies.

Plastic

Selective Laser Sintering (SLS): a high-powered laser selectively fuses powdered material, layer-by-layer. SLS machines are available in large build sizes and compatible with robust materials to enable durable, high-heat and chemically resistant applications.

Stereolithography (SLA): a UV laser scans over a layer of liquid photopolymer material to build up a part. SLA delivers the highest accuracy and smoothest surface finish of all 3D printed parts and is available in large build platforms with high resolution settings.

Figure 4 Technology: a projector images each layer of a build within a UVcurable, liquid material. Figure 4 offers precise, cost-efficient printing at fast throughput speeds, with six sigma repeatability.

Multijet Printing (MJP): a printing process that uses piezo printhead technology to deposit either photocurable plastic resin or wax casting materials, layer-by-layer. These high resolution printers are economical to own and post-processing is virtually hands-free, enabling delicate and complex features to be printed and cleaned without damage.

Software Solutions

Geomagic Design X™, Geomagic Wrap® and Geomagic for SOLIDWORKS® Scan-to-CAD Software

Reverse engineering with 3D scanning and can introduce dramatic time savings in product design and yield more accurate and customized final products.

Geomagic Freeform®, Cimatron®, 3DXpert for SOLIDWORKS, 3DXpert, 3D Sprint®, and GibbsCAM®

3D Systems' design products help accelerate and optimize designs across organic shapes, tooling design and dedicated solutions for Design for Additive Manufacturing (DfAM). Robust and diversified toolsets help users bring new and innovative ideas to life with application-specific tools to fast-track and fine-tune projects.

Geomagic Control X™ 3D Inspection Software 3D metrology and automated digital inspection tools verify design intent, ensure quality outcomes, and facilitate reporting in a streamlined process that can save significant time and money.

Healthcare & Dental Solutions

3D Systems partners with surgeons, healthcare professionals, medical device manufacturers, and medical teaching staff to offer a range of precision healthcare solutions, including virtual reality simulators, 3D printed anatomical models, VSP® (Virtual Surgical Planning), patient-specific surgical guides, instrumentation and implants. In the world of digital dentistry, 3D Systems offers a broad range of clinically validated technologies and materials that allow dental labs to access advanced digital workflows, driving speed, efficiency and precision of a range of indications delivered to patients.

Customer Support

With 66 locations worldwide, 3D Systems offers best-in-class end-to-end support and services across the globe. 3D Systems' highly trained application engineers and field service technicians are available to assist customers at any stage: from the design phase and technology selection, to machine installation and maintenance.



More information on www.3dsystems.com



Multi-technology solutions provider

Our commitment to you and your specific applications is proven by the value-adding intelligence, productivity and quality delivered by our multi-technology solutions. Your success is our chief motivator. That's why we are continuously advancing our legendary technical expertise. Wherever you are, whatever your market segment and whatever the size of your operation, we have the complete solutions and the customer-centric commitment to accelerate your success—today.

EDM (Electrical Discharge Machining)

Wire-cutting EDM

GF Machining Solutions' wire-cutting EDM is fast, precise and increasingly energy efficient. From ultraprecise machining of miniaturized components down to 0.02 mm to powerful solutions for demanding high-speed machining with respect to surface accuracy, our wire EDM solutions position you for success.

Die-sinking EDM

GF Machining Solutions is revolutionizing die-sinking EDM with features like iGAP technology to dramatically boost machining speed and reduce electrode wear. All of our die-sinking systems offer fast removal and deliver mirror finishes of Ra 0.1 µm (4 µin).

Hole-drilling EDM

GF Machining Solutions' robust hole-drilling EDM solutions enable you to drill holes in electrically conductive materials at a very high speed—and, with a five-axis configuration, at any angle on a workpiece with an inclined surface.

Tooling and Automation

Tooling

Our customers experience complete autonomy while maintaining extreme accuracy, thanks to our highly accurate System 3R reference systems for holding and positioning electrodes and work pieces. All types of machines can easily be linked, which reduces set-up times and enables a seamless transfer of workpieces between different operations.

Automation

Together with System 3R, we also provide scalable and cost-effective Automation solutions for simple, single machine cells or complex, multi-process cells, tailored to your needs.

Milling

Milling

Precision tool and mold manufacturers enjoy a competitive edge with our Mikron MILL S solutions' fast and precise machining. The Mikron MILL P machines achieve above-average productivity thanks to their high performance and Automation. Customers seeking fastest return on investment benefit from the affordable efficiency of our MILL E solutions.

High Performance Airfoil Machining

Our Liechti turnkey solutions enable the highly dynamic manufacturing of precision airfoils. Thanks to the unique performance and our expertise in airfoil machining, you increase productivity by producing at the lowest cost per part.

Spindles

As part of GF Machining Solutions, Step-Tec is engaged in the very first stage of each machining center development project. Compact design combined with excellent thermal and geometric repeatability ensure the perfect integration of this core component into the machine tool.

Software

Digitalization solutions

To drive its digital transformation, GF Machining Solutions acquired symmedia GmbH, a company specialized in software for machine connectivity. Together, we offer a complete range of Industry 4.0 solutions across all industries. The future requires the agility to adapt quickly to continual digital processes. Our intelligent manufacturing offers embedded expertise, optimized production processes, and workshop Automation: solutions for smart and connected machines.

Advanced manufacturing

Laser texturing

Aesthetic and functional texturing is easy and infinitely repeatable with our digitized Laser technology. Even complex 3D geometries, including precision parts, are textured, engraved, microstructured, marked and labeled.

Laser micromachining

GF Machining Solutions offers the industry's most complete line of Laser micromachining platforms optimized for small, high-precision features to meet the increasing need for smaller, smarter parts to support today's leading-edge products.

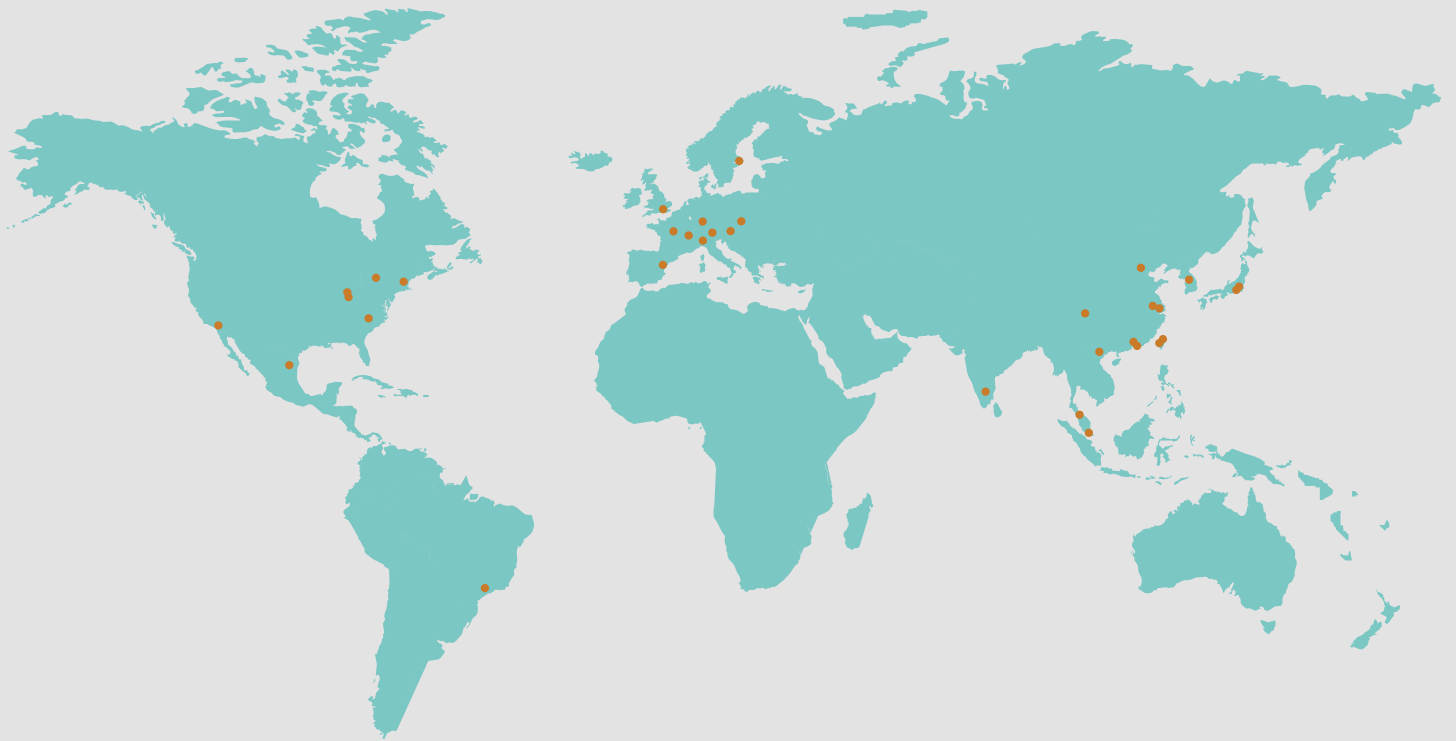
Laser Additive Manufacturing (AM)

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 produce complex metal parts more efficiently.

Customer Services

Worldwide for you

Ensuring the best performance throughout the lifetime of our customers' equipment is the goal of our three levels of support. Operations Support offers the complete range of original wear parts and certified consumables. Machine Support includes spare parts, technical support, and a range of preventive services to maximize machine uptime. Business Support offers customer-specific business solutions.



Find our locations on www.gfms.com/location



GF Machining Solutions

Roger-Federer-Allee 7
2504 Biel/Bienne
Switzerland
www.gfms.com

259.806.742-EN



3D Systems Corporation

333 Three D Systems Circle
Rock Hill, SC 29730
www.3dsystems.com

3DS-10204A

Warranty/Disclaimer: The performance characteristics of these products may vary according to product application, operating conditions, material combined with, or with end use. 3D Systems and GF Machining Solutions make no warranties of any type, express or implied, including, but not limited to, the warranties of merchantability or fitness for a particular use.

©2019 by 3D Systems and GF Machining Solutions, Inc. All rights reserved. Specifications subject to change without notice. 3D Systems, the 3D Systems logo, LaserForm, 3DXpert, Geomagic, Cimatron, GibbsCAM and 3D Sprint are registered trademarks of 3D Systems, Inc.