

Directed Energy
Deposition*



DMG MORI



Powder Bed Fusion*



EOS GmbH
Electro Optical Systems



Material Extrusion*



Stratasys, Ltd.



Jetting*



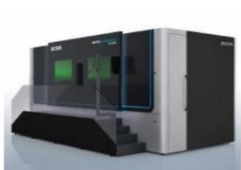
Vader Systems, LLC



GEFERTEC GmbH



ADIRA - Metal Forming
Solutions S.A.

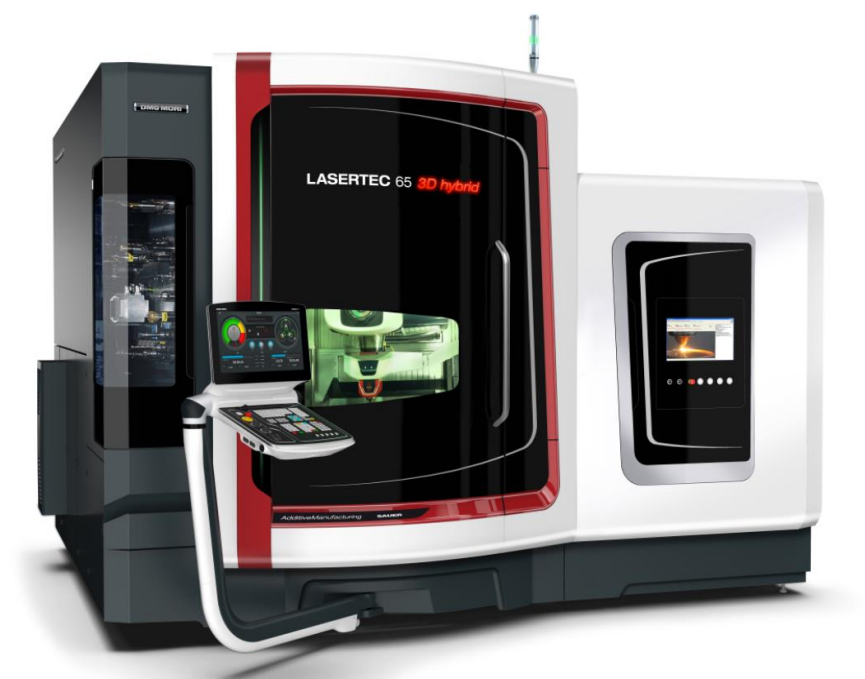


HAGE Sondermaschinenbau
GmbH & Co. KG



DMG MORI / SAUER GmbH / Advanced Technologies

LASERTEC 65 3D hybrid
Germany



[> Machine overview](#)

GEFERTEC GmbH

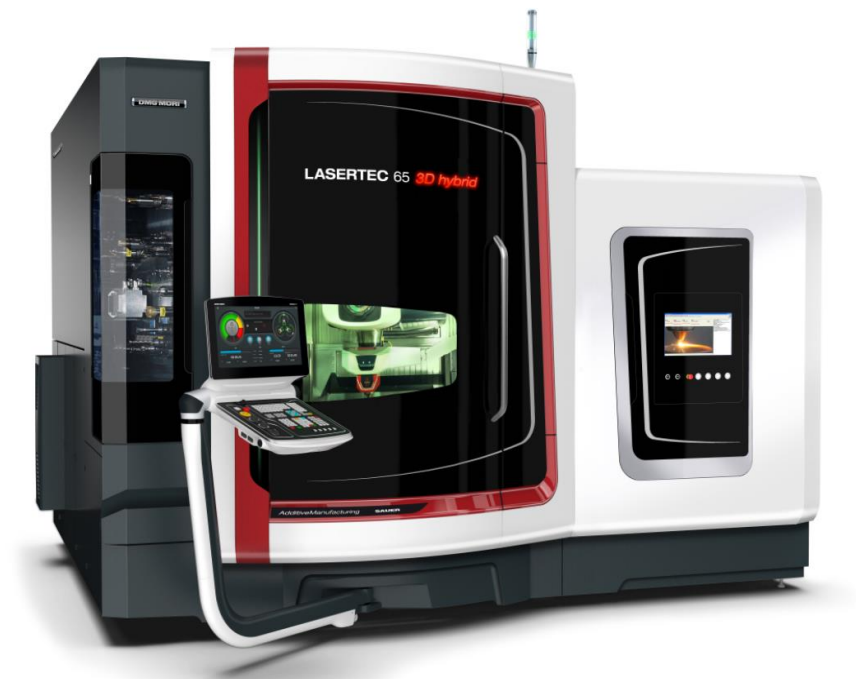
GTarc800-5
Germany



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LASERTEC 65 3D hybrid

Hybrid technology: Laser deposition welding and milling



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Highlights

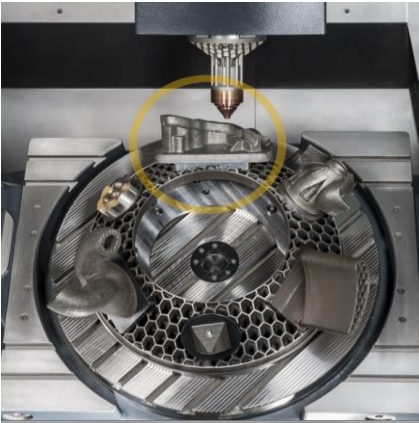
- The flexibility of the generative process combined with the precision of milling technology
- Laser generation of the workpiece with intermediate milling
- High build-up rates due to coaxial powder nozzle
- Large machining area for workpieces up to Ø500 mm × 400 mm height
- Allows the additive manufacture of parts without a processing chamber nor the need for a supporting structures
- High material efficiency
- Complete, hybrid CAD/CAM process chain (additive and subtractive)

LASERTEC 65 3D hybrid

Hybrid technology: Laser deposition welding and milling

Sample Parts

Cutting knife










Function	Automotive application
Material	Ferro 44 + HSS
Processing time	5,75h
Dimensions	120 x 100 x 80 mm

Manifold



Market	Automotive
Material	Stainless steel
Cycle time	15h
Dimensions	100 x 80 x 200 mm

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LASERTEC 65 3D hybrid

Hybrid technology: Laser deposition welding and milling

Technical data









Technology	<ul style="list-style-type: none">Laser deposition welding with a powder nozzle
Materials	<ul style="list-style-type: none">Stainless SteelNickel-Based Alloys (Inconel 625, 718)Tungsten Carbide Matrix MaterialsBronze and Brass AlloysChrome-Cobalt-Molybdenum AlloysStelliteTool Steel (weldable)
Max. Workpiece dimension	<ul style="list-style-type: none">ø500×400mm, 600kg
NC programming	<ul style="list-style-type: none">Hybrid CAD/CAM module for laser and milling process
Laser power	<ul style="list-style-type: none">Up to 3 kW
Metallurgy	<ul style="list-style-type: none">99.8% achievement of the density of the casting
Track width	<ul style="list-style-type: none">Possibility to change between ø1.6 mm and 3 mm
Laser Head Integration	<ul style="list-style-type: none">HSK Milling Taper








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LASERTEC 65 3D hybrid

Hybrid technology: Laser deposition welding and milling

Siemens content

	Controller	<ul style="list-style-type: none">SINUMERIK 840D sl
	HMI	<ul style="list-style-type: none">CELOS with SIEMENS 840D slOperate including 21.5" ERGOline control system
	IPC	<ul style="list-style-type: none">SIMATIC IPC 627D
	Industrial Communication	<ul style="list-style-type: none">PROFINET
	Drive Systems	<ul style="list-style-type: none">SINAMICS S120SIMOTICS 1FT7/1FK7 Servomotors
	Industrial Controls	<ul style="list-style-type: none">SIRIUS series
	Distributed IO	<ul style="list-style-type: none">SIMATIC ET 200SP
	Additional components	<ul style="list-style-type: none">NX Hybrid Additive Manufacturing (complete CAD/CAM software chain)

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LASERTEC 65 3D hybrid

Hybrid technology: Laser deposition welding and milling

Benefits of the Siemens solution

Motion control	<ul style="list-style-type: none">• High dynamic and continuous jerk-free toolpath movement• Control of high complex 5-axis synchronous movement
Technological feature	<ul style="list-style-type: none">• High speed control of Laser source
Data handling	<ul style="list-style-type: none">• All technological parameters are defined in G-code files
Machining process	<ul style="list-style-type: none">• Approved user cycles for machining, measurement and maintenance

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LASERTEC 65 3D hybrid

Hybrid technology: Laser deposition welding and milling

Customer Statement



Patrick Diederich

Managing Director

Sauer GmbH/Realizer GmbH

” Siemens NX, with its worldwide presence, particularly with OEMs, was the perfect development partner for the LASERTEC 65 3D powder nozzle hybrid and non hybrid machine tools. The process chain we jointly developed includes all additive and conventional manufacturing processes on one programming platform, allowing seamless transfer of information between different processes. With their global presence, but local footprint, Siemens is ideally placed to establish the end to end CAD/CAM process chain together with our customers around the world.

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GTarc800-5

3DMP® 3D Metal Print



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Highlights

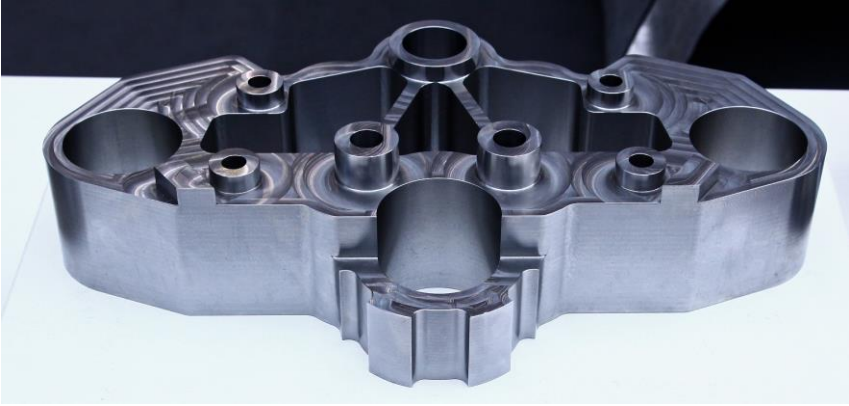
- Nearly 100% material utilisation
- Uncomplicated storage and easy handling due to use of wire instead of powder
- Based on technically mature and highly reliable arc welding method
- Low material costs
- High deposition rate
- Outstanding design freedom
- Economically efficient additive method for the production of metallic parts

GTarc800-5

3DMP® 3D Metal Print

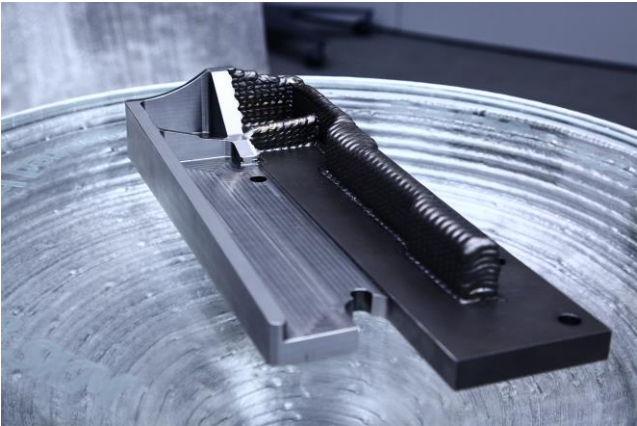
Sample Parts

Bearing block










Function	Bearing retainer
Material	Stainless steel 1.4316
Processing time	6,5h
Dimensions	452x245x100mm
Build-up rate	325 cm³/h

Bracket



Function	Structural component (aerospace)
Material	Ti6Al4V
Processing time	45 minutes
Volume	375 cm³
Build-up rate	500 cm³/h








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GTarc800-5

3DMP® 3D Metal Print

Technical data







Technology	<ul style="list-style-type: none">Arc welding with wire
Linear speed (X/Y/Z)	<ul style="list-style-type: none">20/10 /20 m/min
Max. Workpiece dimension	<ul style="list-style-type: none">Manufacturing of metal parts up to a volume of 0.8 m³ and a total weight of 500 kg
Maximum size of machined parts (ø - z) in mm	<ul style="list-style-type: none">900 - 1.100
Materials	<ul style="list-style-type: none">Tool steel (1.2...)Corrosion resistant steel (1.4...)Mild steel (1.5...)Ni based alloys like Alloy625 and Alloy 718Non-ferrous metals (cupper basis, MgSi, Ti6Al4V)








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GTarc800-5

3DMP® 3D Metal Print

Siemens content

	Controller	<ul style="list-style-type: none">SINUMERIK 840D sl
	HMI	<ul style="list-style-type: none">SINUMERIK TCU with OP015ASINUMERIK Operate MCP 483 PN machine operating panel
	Industrial Communication	<ul style="list-style-type: none">PROFINET
	Drive Systems	<ul style="list-style-type: none">SINAMICS S120 booksizeSIMOTICS 1FT7/1FK7 Servomotors
	Industrial Controls	<ul style="list-style-type: none">SIRIUS series
	Distributed IO	<ul style="list-style-type: none">SIMATIC ET 200SP

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3DMP® 3D Metal Print

Benefits of the Siemens solution

Motion control

- High dynamic and continuous jerk-free toolpath movement
- High speed control of arc welding power supply
- Control of high complex 3- and 5-axes synchronous movement

Overall benefits

- Future-proof CNC controller due to wide range of functions
- Flexibility and openness
- SINUMERIK Operate provides maximum operating convenience – established operator interface

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3DMP® 3D Metal Print

Customer Statement



Georg Fischer
CEO
GEFERTEC GmbH

” Siemens offers a scalable CNC system that can be easily extended to fulfil further functional requirements. We are able to offer an easy-to-use operating concept based on the Siemens HMI solution that is well established in the market.

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EOS GmbH Electro Optical Systems

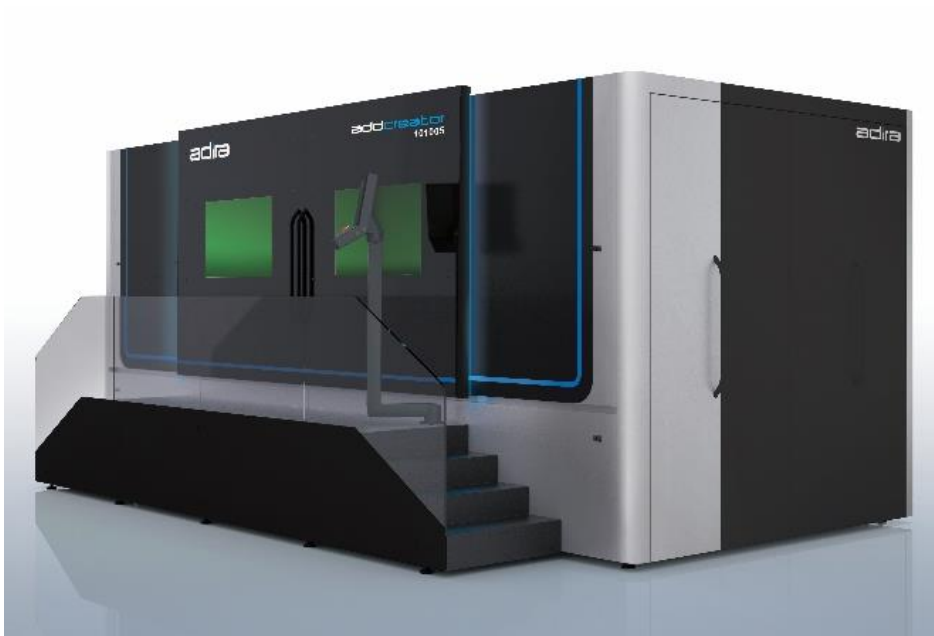
EOS P 500
Germany



> Machine overview

ADIRA – Metal Forming Solutions S.A.

ADIRA AC – AddCreator
Portugal



> Machine overview

EOS P 500

Laser Sintering



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Highlights

- Enabling mass production
- Highly productive system
- Enabling a new world of materials
- Lowest cost-per-part
- Reproducible part quality job to job and between machines
- Capable of delivering all kinds of data, and easy integration with existing manufacturing environments

EOS P 500








Laser Sintering

Process



Working principle

The system starts by applying a thin layer of the powder material to the building platform. A powerful laser beam then fuses the powder at exactly the points defined by the computer-generated component design data. The platform is then lowered and another layer of powder is applied. Once again the material is fused so as to bond with the layer below at the predefined points.

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EOS P 500

Laser Sintering

Technical data

Technology	<ul style="list-style-type: none">Two-laser system, CO2, 2 x 70 Watt
Materials	<ul style="list-style-type: none">PA 2200PEKK (Polyetherketoneketon)
Effective building volume	<ul style="list-style-type: none">500 x 330 x 400 mm
Building speed (depending on material)	<ul style="list-style-type: none">Up to 40 mm/h
Scan speed during building	<ul style="list-style-type: none">Up to 2 x 10m/s
Recoating speed	<ul style="list-style-type: none">600 mm/s
Building chamber temperature	<ul style="list-style-type: none">Up to 300 degrees Celsius








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EOS P 500

Laser Sintering

Siemens content

	Controller	<ul style="list-style-type: none">SIMATIC S7-1500Software Controller Failsafe
	IPC	<ul style="list-style-type: none">SIMATIC IPC 627D
	Industrial Communication	<ul style="list-style-type: none">SCALANCE SwitchesPROFINET/OPC UA
	Drive Systems	<ul style="list-style-type: none">SINAMICS S120 booksize compactSIMOTICS 1FK7/1F7 Servomotors
	Industrial Controls	<ul style="list-style-type: none">SIRIUS and SENTRON devicesSITOP PSU8600 with BUF8600
	Distributed IO	<ul style="list-style-type: none">SIMATIC ET 200SP
	Additional components	<ul style="list-style-type: none">Engineered with TIA Portal

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View into the P 500 control cabinet



EOS P 500

Laser Sintering

Benefits of the Siemens solution

Efficient engineering	<ul style="list-style-type: none">TIA Portal as an overarching engineering tool enables a drastic reduction in commissioning times for initial commissioning and changes
A control cabinet solution globally valid	<ul style="list-style-type: none">Siemens products can be used all over the world as they fulfil IEC-UL/CSA criteria and have the associated certification; Keyword "Global control cabinet"
Customer-supplier relationship	<ul style="list-style-type: none">The extensive portfolio of automation technology enables homogenization of control cabinet equipment and also enables the approach "everything from a single source"

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EOS P 500

Laser Sintering

Customer Statement



Alfons Eiterer

Head of System Engineering

EOS GmbH

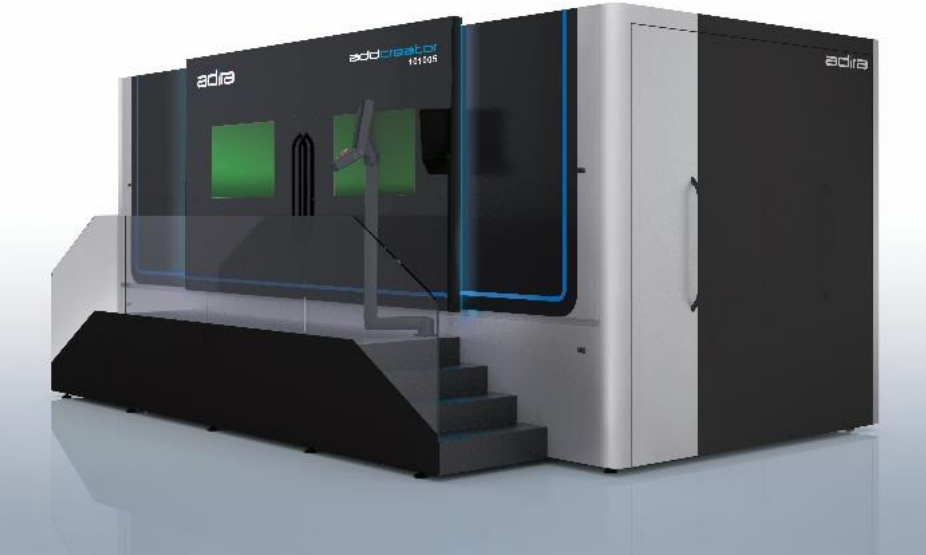
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EOS puts a strong focus on high quality and reliability in its new developments, while at the same time ensuring sustainability. This is the reason we chose Siemens control technology for the EOS P 500. With Siemens we can rely on proven technical components and are well prepared to handle future requirements. This helps us to handle the challenges of digitalization, increasing plant connectivity and the requirements of Industry 4.0.

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ADIRA AC – AddCreator

Tiled Laser Melting (TLM)



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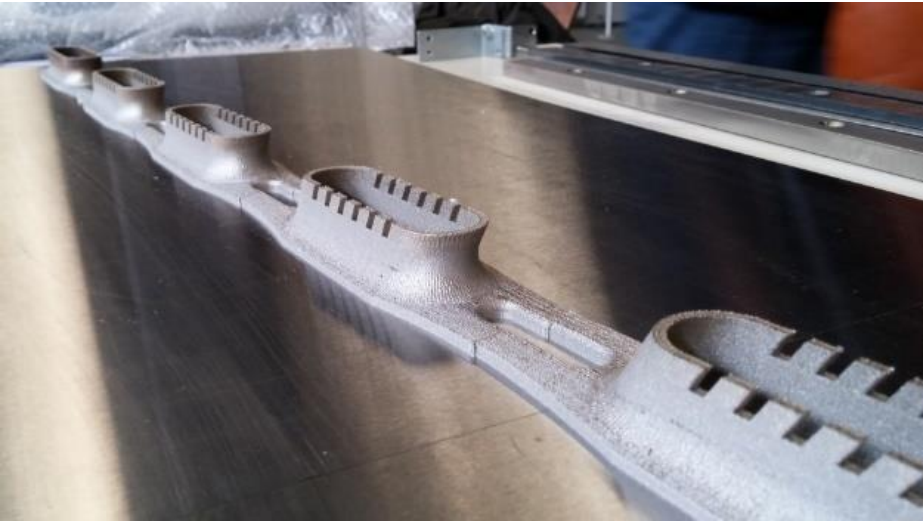
- Currently the sector’s largest working volume
- Larger part geometries can be printed with PBF technology which opens up new possibilities
- Automatic part handling and IoT integration
- Optimized scan strategies and multiple laser sources
- Improved traceability and handling procedures
- Local powder application
- Cleaning and preparation of the feeding device can be made in parallel

ADIRA AC – AddCreator








Tiled Laser Melting (TLM)

Sample Parts

Conceptual cooling structure



Material	316L stainless steel
Processing time	26 hours
Dimensions	900x40x20mm

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ADIRA AC – AddCreator

Tiled Laser Melting (TLM)

Technical data








Technology	<ul style="list-style-type: none">OptiFocus 3D Scanning combines the laser scanner motion with a defocusing capability
Max. build rate	<ul style="list-style-type: none">40 cm³/hour
Min. Layer Thickness	<ul style="list-style-type: none">25 µm
Max. Scan Speed	<ul style="list-style-type: none">9 m/sec
Laser	<ul style="list-style-type: none">400W fibre laser
Scalable concept	<ul style="list-style-type: none">Segmented build-up, dividing the workspace in different tiles, with local atmosphere control
Modular concept	<ul style="list-style-type: none">Movable chamber concept with a fully modular processing head
Building volume	<ul style="list-style-type: none">1000x1000x500mm
Building chamber size	<ul style="list-style-type: none">300x300mm
Material handling	<ul style="list-style-type: none">Detachable modular feeding system








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ADIRA AC – AddCreator

Tiled Laser Melting (TLM)

Siemens content

	Controller	<ul style="list-style-type: none">SINUMERIK 840D sl
	HMI	<ul style="list-style-type: none">SINUMERIK OP015 black
	IPC	<ul style="list-style-type: none">SINUMERIK PCU 50.5
	Drive Systems	<ul style="list-style-type: none">SINAMICS S120 booksizeSIMOTICS 1FK7 Servomotors
	Industrial Controls	<ul style="list-style-type: none">SIRIUS series
	Distributed IO	<ul style="list-style-type: none">SIMATIC ET 200SP
	Additional components	<ul style="list-style-type: none">ADIRA proprietary Software Embedded







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ADIRA AC – AddCreator

Tiled Laser Melting (TLM)

Benefits of the Siemens solution

Comprehensive product portfolio for TIA ...	<ul style="list-style-type: none">• makes engineering development easier and simple
High dynamics and reliability of the machine ...	<ul style="list-style-type: none">• due to high performance drive system
Customer-supplier relationship	<ul style="list-style-type: none">• The extensive portfolio of automation technology enables homogenization of control cabinet equipment and also enables the approach “everything from a single source”
Ready for future	<ul style="list-style-type: none">• Remote maintenance capability and IoT integration readiness

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ADIRA AC – AddCreator

Tiled Laser Melting (TLM)

Customer Statement



Tiago Brito e Faro

Technical Director

ADIRA Metal Forming Solutions S.A.

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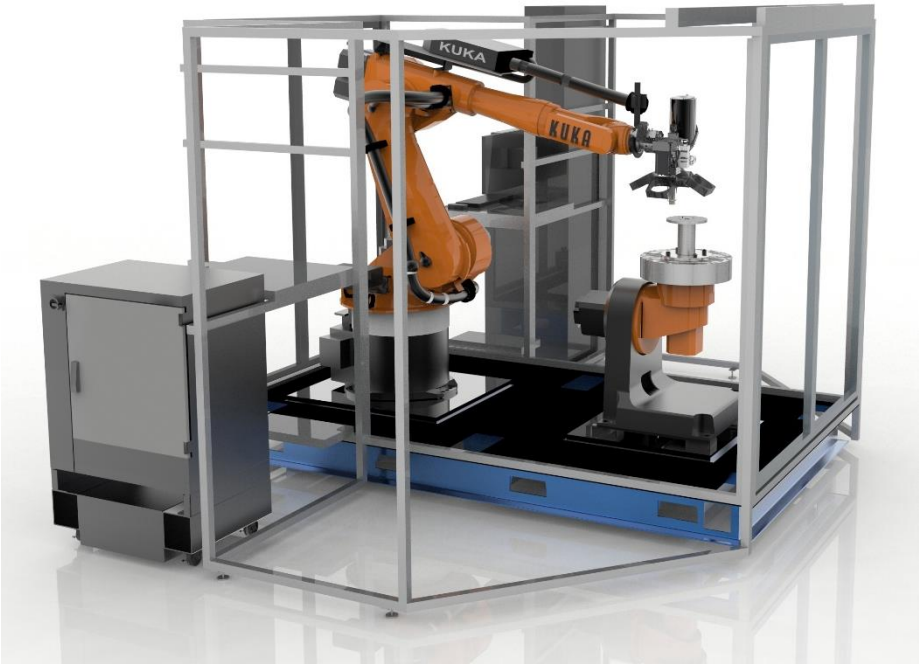
Siemens and ADIRA have had a close relationship for more than 15 years, largely based on a mutual trust and effort to reach new and improved solutions for industrial applications. Reliability and flexibility have been essential pillars of a long-lasting partnership which goes beyond a simple supplier-client relationship and now advances towards new solutions for Additive Manufacturing. We perceive Siemens not only as a provider of Ingenuity for Life, but also quite possibly as a main provider of Additive Solutions for Life. We hope to keep following a common path alongside an important partner, in our search for innovation and differentiating solutions for our industrial machines, which can only be achieved with the advanced expertise at hand.

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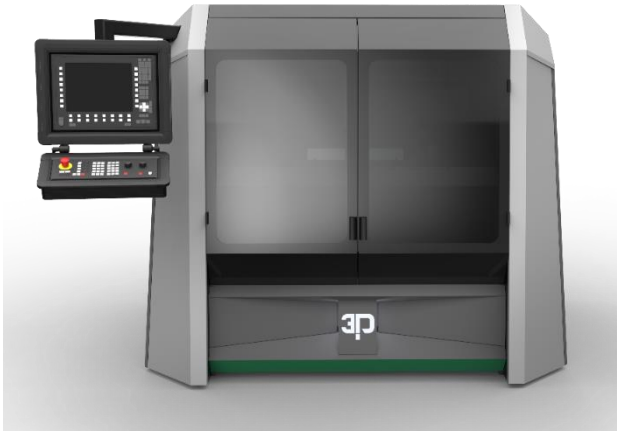


Stratasys, Ltd.

Robotic Composite 3D Demonstrator
USA



[> Machine overview](#)



**HAGE Sondermaschinenbau
GmbH & Co. KG**

HAGE3D 5 Axis printer Model 175X
Austria

[> Machine overview](#)



Vader Systems, LLC

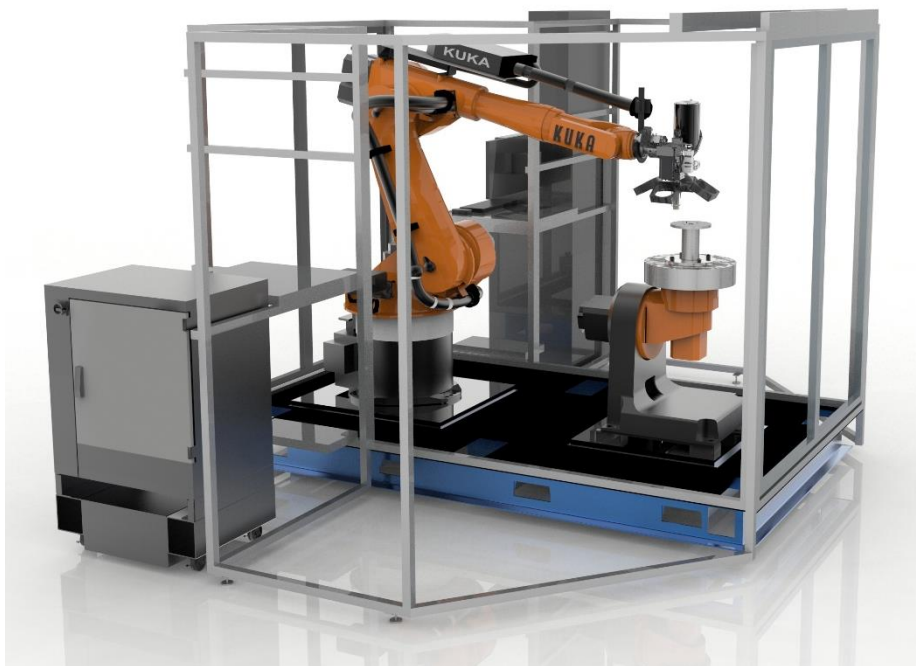
Mk1 (Liquid Metal 3D Printer)
USA

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Robotic Composite 3D Demonstrator

Fused Deposition Modeling (FDM)



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Highlights

- Highly scalable and configurable build environment capable of producing parts
- Ability to build complex composite structures in a fraction of the time as conventional methods
- Optimized parts with optimized force flow can be printed
- Significant time savings due to fast print process and minimized post-processing
- Fully contained and traceable end-to-end industrialized (CAD/CAE/CAM) workflow from design to simulation through all critical manufacturing processes
- Full directional control over fiber orientation permitting production of unique, lightweight, high performance composite structures



Robotic Composite 3D Demonstrator

Fused Deposition Modeling (FDM)

Sample Parts

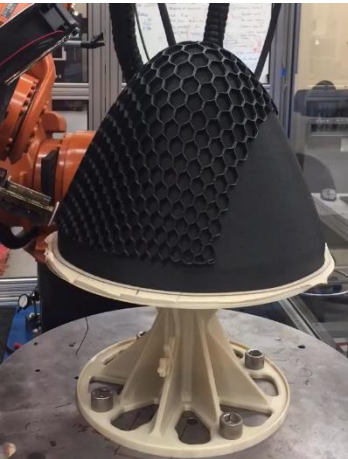
Ribbed dome



Processing time	90 min
Material amount used	148 cm ³
Support material	Not required
Material	FDM Nylon 12CF
Dimensions	B 190mm, T 190mm, H 205mm

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Half-scale radome based on the Eclipse 500 aircraft geometry



Processing time	5 h 30 min
Material amount used	459 cm ³
Support material	Not required
Material	FDM Nylon 12CF



Robotic Composite 3D Demonstrator

Fused Deposition Modeling (FDM)

Technical data

Materials

- Chopped Fiber
- Continuous Fiber composites
- Further industry-specific and highly tailored fiber reinforced thermoplastic composites and functional compounds in development, including fiber-reinforced PEKK for aerospace

Speed

- Build times up to 90% faster than traditional FDM for equivalent geometries

Builder chamber size








- Approx. 2.000 mm (spherical)

Target

- Aerospace

Markets

- Tooling
- Automotive
- Oil & Gas
- Industrial Manufacturing
- Medical Industry

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Robotic Composite 3D Demonstrator

Fused Deposition Modeling (FDM)

Siemens content



Controller

- SINUMERIK 840D sl



HMI

- SINUMERIK Operate



Industrial Communication

- PROFINET



Drive Systems

- SINAMICS S120 booksize



Distributed IO

- SIMATIC ET 200SP



Additional components

- SIEMENS NX multi-axis deposition module
- SINUMERIK Run MyRobot
- Seamless NX CAD/CAE/CAM software chain

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Robotic Composite 3D Demonstrator

Fused Deposition Modeling (FDM)

Benefits of the Siemens solution

Motion control	<ul style="list-style-type: none">• Proven capabilities for speed, accuracy and complex motion• Accurate control of multi-axis additive operation
Machine operation	<ul style="list-style-type: none">• A well understood and established user interface and machine controls environment
Industrial Standard	<ul style="list-style-type: none">• Plug and play factory communications and industry standard protocols
Software chain	<ul style="list-style-type: none">• All-in-one system with full CAD/CAM/CAE-integration• Create multi-axis robot toolpaths and perform multi-function machine programming with• Integrated verification and machine simulation in NX CAM• Fully integrated in product life cycle management process
Process Control	<ul style="list-style-type: none">• Effective robot control with SINUMERIK (G-code programming, SINUMERIK modes & cycles)

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Robotic Composite 3D Demonstrator

Fused Deposition Modeling (FDM)

Customer Statement



Scott Sevcik

VP, Head of Manufacturing Solutions
Stratasys, Ltd.

”

Siemens expertise in multi-axis robotic motion control and seamlessly integrated PLM solutions make them an ideal partner for Stratasys on the Robotic Composite 3D Demonstrator where we are pushing the boundaries of additive manufacturing into high performance composite materials.

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HAGE3D 5 Axis printer Model 175X

Fused Filament Fabrication (FFF)



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Highlights

- First commercially available 5-axis FFF printer
- Printing of complex parts largely without support structures due to optimal part orientation in relation to the print head
- Significant time savings due to fast print process and minimised post-processing
- Topologically optimized parts with optimized force flow can be printed
- Improved surface quality since the print head follows continuously the contour shape
- High material efficiency



HAGE3D 5 Axis printer Model 175X

Fused Filament Fabrication (FFF)

Sample Parts

Pipe bend



Material	PLA
Processing time	Approx. 30 minutes
Dimensions	170 mm x 170 mm; pipe diameter = 40 mm

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HAGE3D 5 Axis printer Model 175X

Fused Filament Fabrication (FFF)

Technical data

Technology	<ul style="list-style-type: none">Fused Filament Fabrication (FFF)
Materials	<ul style="list-style-type: none">ABS, ASA, PLA, PET-G, PMMACopolyster Elastom (TPC)Metal-polymer composites for printing of e.g. titanium alloys or stainless steel 316L
Builder chamber size	<ul style="list-style-type: none">500 x 500 x 450 mm
Traverse speed XY	<ul style="list-style-type: none">Up to 250 mm/s
Extrusion head	<ul style="list-style-type: none">HFFS (High Friction Feeding System) with Single Extruder
Extrusion head speed	<ul style="list-style-type: none">Up to 150 mm/s
Nozzle diameter	<ul style="list-style-type: none">0,4 mm
Building plate temperatur	<ul style="list-style-type: none">Up to 110°C

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HAGE3D 5 Axis printer Model 175X

Fused Filament Fabrication (FFF)

Siemens content

	Controller	<ul style="list-style-type: none">SINUMERIK 840D sl
	HMI	<ul style="list-style-type: none">SINUMERIK OP015A, Thin Client UnitSINUMERIK Operate
	Industrial Communication	<ul style="list-style-type: none">PROFINET
	Drive Systems	<ul style="list-style-type: none">SINAMICS S120 booksizeSIMOTICS 1FT7/1FK7 Servomotors
	Industrial Controls	<ul style="list-style-type: none">SIRIUS series
	Distributed IO	<ul style="list-style-type: none">SIMATIC ET 200SP
	Additional components	<ul style="list-style-type: none">SIEMENS NX multi-axis deposition module

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HAGE3D 5 Axis printer Model 175X

Fused Filament Fabrication (FFF)

Benefits of the Siemens solution

Motion control	<ul style="list-style-type: none">• High dynamic and continuous jerk-free print head movement• Control of high complex 5-axis synchronous movement
Technology upgrade	<ul style="list-style-type: none">• Well-established Siemens CNC technology enhances Material Extrusion
Seamless digital chain	<ul style="list-style-type: none">• Automation systems plus printing software from a single source
Siemens support	<ul style="list-style-type: none">• Siemens offers worldwide support as one pre-requisite for Hage’s global market approach

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HAGE3D 5 Axis printer Model 175X

Fused Filament Fabrication (FFF)

Customer Statement



Stefan Hampel
Executive Officer
Hage GmbH








” After the initial meetings it quickly became clear to Siemens and us that the development of the 5-axis printer would be an important joint project for both of us. And just like with our special plant for the automotive and aerospace industries where we implement new solutions with maximum precision and reliability, we wanted a partner who can support us to put our innovative ideas into practice efficiently and professionally. This is why we're relying on the proven Siemens Control SINUMERIK system and the newly developed multi-axis Deposition solution from the NX platform for our 175x model.

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Mk1 (Liquid Metal 3D Printer)

MagnetoJet technology



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Highlights

- Fully-dense (99.5+%) parts without typical residual stresses can be printed
- Higher speed compared to Powder Bed Fusion technology
- Significantly lower part costs compared to Powder Bed Fusion technology
- High material efficiency
- MagnetoJet will evolve to offer printing higher temperature metals

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Sample Parts

Vader logotype as demo part



Material	4043 Aluminum
Processing time	Approx. 30 minutes
Dimensions	L127 mm x W25 mm x H37mm

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Technical data





Materials	<ul style="list-style-type: none">Aluminum 4043, 6061, 7075
Material type	<ul style="list-style-type: none">Low cost commodity wire
Droplet range	<ul style="list-style-type: none">300 µm to 500 µm
Droplet rate	<ul style="list-style-type: none">1 kHz
Envelope	<ul style="list-style-type: none">300 mm x 300 mm x 300 mm
Deposition rate	<ul style="list-style-type: none">500g per hour based on 500 µm droplet size
Max. feed rate	<ul style="list-style-type: none">1.000 mm/sec
Printhead heating system	<ul style="list-style-type: none">900°C








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Siemens content

	<div>Controller</div> <div><ul style="list-style-type: none">SINUMERIK 840D sl</div>
	<div>HMI</div> <div><ul style="list-style-type: none">SINUMERIK OP019 blackMCP 483</div>
	<div>Drive Systems</div> <div><ul style="list-style-type: none">SINAMICS S120 booksizeSIMOTICS 1FK7 Servomotors</div>
	<div>Central IO</div> <div><ul style="list-style-type: none">SIMATIC ET 200M</div>
	<div>Additional components</div> <div><ul style="list-style-type: none">SINUMERIK 840D sl TMC 2040PNCompact I/O module for SINAMICS S120</div>

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Benefits of the Siemens solution

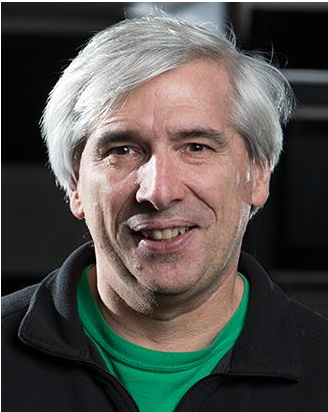
Motion control	<ul style="list-style-type: none">Ready for a future build platen on dual rotary kinematic allows additional part geometries
Highspeed process control	<ul style="list-style-type: none">TMC 2040PN handles output switching signals with microsecond accuracy
Strategical benefit	<ul style="list-style-type: none">SINUMERIK 840D sl is widely spread accepted in Aerospace industry (= main target market)

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Scott Vader
President
Vader Systems, LLC

” We chose Siemens 840D motion controllers for our system due to its high-performance and unique scalability, to support our technology as it grows. We also chose Siemens for their worldwide support and service.

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