ADDITIVE MANUFACTURING
Reinvent your Metal Production

Lasertec 12 SLM
Lasertec 30 SLM 2nd Gen.
Lasertec 65 3D
Lasertec 65 3D hybrid
Lasertec 4300 3D hybrid

First Time Right
The new OPTOMET software for parameter optimisation
LASERTEC **SLM**
Additive Manufacturing through Selective Laser Melting (SLM) in the powder bed

LASERTEC **3D**
Laser Deposition Welding with a coaxial powder nozzle

LASERTEC **3D hybrid**
Combination of technologies on one machine: Laser Deposition Welding with coaxial powder nozzle combined with 5-axis milling and turning for Additive Manufacturing in finished part quality
Global number 1 for Additive Manufacturing in metal!

157 sales and service locations, 14 production factories, as well as 5 Additive Manufacturing Excellence Centres worldwide for the best support of our customers.

+ **Unique**: Four process chains in Additive Manufacturing and finishing from a single source
+ **20 years experience** in laser and SLM technology
+ **End-to-end knowledge** in the field of additive metal machining
+ **Powder bed (SLM) and powder nozzle (LDW)** under one roof for all metallic materials and geometries
+ **LASERTEC 3D hybrid / LASERTEC 3D**: Success in the market with Laser Deposition Welding using the powder nozzle technique
+ **LASERTEC SLM**: Pioneer in powder bed technology
+ **Comprehensive consulting services and training** e.g. for design, material selection and the definition of process parameters

**NEW: OPTOMET – FIRST TIME RIGHT**
Software for parameter optimisation

5 Additive Manufacturing Excellence Centres worldwide:

- AMEC Bielefeld, Germany
- AMEC Pfaffenhofen, Germany
- AMEC Shanghai, China
- AMEC Tokyo, Japan
- AMEC Chicago, USA
ADDITIVE TECHNOLOGIES

Unique – Global full line of products for Additive Manufacturing with powder nozzle and powder bed from a single source

Laser Deposition Welding combined with milling

LASERTEC 65 3D hybrid
+ Additive Manufacturing with a powder nozzle and integrated 5-axis milling in finished part quality
+ Max. workpiece dimensions: ø 500 × 400 mm, 600 kg

Laser Deposition Welding combined with turning / milling

LASERTEC 4300 3D hybrid
+ Additive Manufacturing with a powder nozzle and integrated 6-sided turn & mill machining
+ Max. workpiece dimensions: ø 660 × 1,500 mm, 1,700 kg
Selective Laser Melting (SLM)

LASERTEC 12 SLM
LASERTEC 30 SLM 2nd Gen.

+ Additive Manufacturing in a powder bed with integrated powder recycling
+ Max. workpiece dimensions
  125 × 125 × 200 / 300 × 300 × 300 mm

Laser Deposition Welding

LASERTEC 65 3D

+ First special powder nozzle machine based on a CNC machine
+ Max. workpiece dimensions:
  ø 650 × 560 mm, 600 kg
GLOBAL FULL LINE OF PRODUCTS FOR ADDITIVE MANUFACTURING

Four process chains for end to end Additive Manufacture

Laser Deposition Welding

SIEMENS NX ADDITIVE / HYBRID

3D hybrid

ADDITIVE MANUFACTURING WITH POWDER NOZZLE
Component size max. ø 650 mm, height 560 mm

3D

Selective Laser Melting (SLM)

CELDS

SLM

ADDITIVE MANUFACTURING IN A POWDER BED
Component size max. 300 x 300 x 300 mm

SLM

METAL-CUTTING MACHINING
ADDITIVE MANUFACTURING WITH POWDER NOZZLE COMBINED WITH:

MILLING – LASERTEC 65 3D hybrid:
Component size max.: ø 500 mm, height 400 mm

TURN & MILL – LASERTEC 4300 3D hybrid:
Component size max.: ø 660 mm, length 1,500 mm

METAL-CUTTING MACHINING

ADDITIVE MANUFACTURING IN A POWDER BED
Component size max.: 300 x 300 x 300 mm
REALIZER GMBH

Pioneer of the powder bed process with more than 20 years application experience: Selective Laser Melting

FUNCTIONAL PRINCIPLE:
BUILDING A PART LAYER BY LAYER

1. Applying a layer of powder
2. Selectively melting the powder using laser light
3. After melting, the platform is lowered by the respective thickness of the layer
4. Applying a new powder layer

Dr. Matthias Fockele is co-founder of F & S Stereolithografietechnik GmbH, now REALIZER GmbH.

1990
- Dr. Matthias Fockele is co-founder of F & S Stereolithografietechnik GmbH, now REALIZER GmbH.

1995
- F & S begin developing SLM technology in cooperation with the Fraunhofer Institute for Laser Technology (ILT) in Aachen.

1997
- First patent applications for the SLM technology.

2004
- Dr. Matthias Fockele establishes REALIZER GmbH in Borchen, Germany.
HIGHLIGHTS

+ Highly complex components with functional integration
+ Internal conformal cooling channels
+ Topology-optimised components
+ Simultaneous build-up of different designs
+ Weight optimisation due to lattice and honeycomb structures
+ Functional prototypes made of common materials

Combustion chamber prototype

On 06/02/2017, DMG MORI takes over 50.1% of REALIZER and the LASERTEC 30 SLM celebrates its WORLD PREMIERE.

DMG MORI increases its stake in REALIZER to 75.1% and presents the second generation of the LASERTEC 30 SLM in the middle of 2018 and the LASERTEC 12 SLM in November 2018.

LASERTEC SLM SERIES

Highest process autonomy, maximum work safety and intuitive operation for top component quality and reproducible results.
Aerospace
Customised applications made from aluminium and titanium, e.g. blades with integrated cooling channels and high-efficiency heat exchangers.

Dental
Custom-fit dental implants such as ligaments, crowns or bridges made from cobalt chrome or titanium.

Medical
Implants such as joint or bone prostheses made from titanium. Customised, tailor-made implants. Complex lattice structures, e.g. for hip and knee implants.

Tool / mould making
Production of tooling inserts with conformal cooling channels. Manufacturing of prototypes and small batches.
New design freedom

**POWDER NOZZLE HOLDER**
**LASERTEC 65 3D hybrid**

1. **Rapid product development**
   - due to completely digital process chain

2. **Significant reduction of production costs**
   - due to tool-less production

3. **Functional integration**: Improved cooling due to larger cooling channels

4. **Complex geometries** almost without restrictions in design

5. **Work preparation**: Ideal optimisation of parameters and machine with the in-house developed RDesigner software

6. **Functional integration** of different features by avoiding seals and connectors used in conventional design

7. **Lightweight design**: Integrated honeycomb structures

8. **Integrated design**: Complex internal channels
LASERTEC SLM

High-precision Selective Laser Melting

LASERTEC 12 SLM

+ Powder bed with a build volume of 125 × 125 × 200 mm
+ 35 µm focus diameter for maximum precision
+ Application-specific fibre laser sources of 200 W as standard and up to 400 W optional

LARGEST BUILD VOLUME IN ITS CLASS
rePLUG POWDER MODULE

Use the same rePLUG and rePLUG reSEARCH on the LASERTEC 12 *SLM* and LASERTEC 30 *SLM 2nd Gen.* without any adaptation.

**LASERTEC 30 SLM 2nd Gen.**

- Powder bed with a build volume of $300 \times 300 \times 300 \text{ mm}$
- Dynamic adjustment of the focus diameter between 70 and 200 $\mu\text{m}$ for maximum productivity
- Application-specific fibre laser sources of 600 W as standard and up to 1,000 W optional
LASERTEC SLM

Additive Manufacturing with the powder bed process

HIGHLIGHTS

+ High-precision build-up of 3D components with layer thicknesses in the 20 – 100 µm range
+ Optimised gas flow guidance for highest component quality with minimum argon consumption
+ Maximum work safety thanks to closed material circulation and integrated powder recycling
+ Replaceable rePLUG powder module for material change without contamination < 2 hours
+ CELOS: Consistent software solution from CAM programming with the RDesigner through to machine control

Open system:
Individual adjustment of all machine settings and process parameters as well as unrestricted choice of material suppliers.
Expert knowledge at your fingertips: OPTOMET software enables the development of process parameters for new materials within minutes.
LASERTEC SLM

rePLUG – The powder module for fast material changeover

HIGHLIGHTS

+ Automated powder handling and powder storage under inert gas atmosphere
+ One material per rePLUG – expansion of the material range at will thanks to modular changeover system
+ Change between different materials without contamination in < 2 hours
+ Safe powder handling due to integrated periphery and closed material cycle
+ Increased efficiency thanks to integrated powder recycling
+ High process reliability thanks to efficient double filter system where the filter can be changed without interrupting the building process, and a large powder reservoir which means no manual refilling during the process either.

Optional: rePLUG reSEARCH
The additional powder module developed especially for material and process parameter development before series production.

1. Sieving unit
2. Buffer tank
3. Powder supply process area
4. Main tank
5. Powder return process area
6. Powder transport within the inert gas volume flow
FULLY COMPATIBLE

Use the same rePLUG and reSEARCH on the LASERTEC 12 SLM and LASERTEC 30 SLM 2nd Gen. without any adaptation.

WIDE RANGE OF AVAILABLE MATERIALS

+ Aluminium AlSi10Mg0.5
+ CoCrMo (ASTM F75)
+ Inconel® 625/718
+ Stainless steel 1.4404
+ Stainless steel 1.4828
+ Tool steel 1.2709
+ Titanium Ti6/6Al4V
CELOS ensures an efficient flow of information on the shop floor and provides the machine operator with all relevant job information in real time. Touchscreen and APPs ensure intuitive operation of the machine, while various monitoring tools enable a clear view of the current process at all times.

**CELOS APPS**

- **RDesigner**
  CAM programming

- **MATERIAL MANAGEMENT**
  Management of material data and parameter editor

- **MANUAL CONTROL**
  Machine setup for process preparation

- **JOB CONTROL**
  Machine control

- **JOB HISTORY**
  Job management

- **WATCHER**
  Camera-based process monitoring and documentation of each individual layer

- **STATUS MONITOR**
  Visualisation of the machine status in real time

- **MESSENGER**
  Live status on PC, tablet or smartphone for complete process monitoring

- **NETservice**
  Online error analysis and technical support directly on the machine control

- **SETTINGS**
  Machine settings
NEW: OPTOMET – FIRST TIME RIGHT

Software for parameter optimisation

+ Expert knowledge at your fingertips: Parameter development for new materials within minutes
+ Reduced material costs: Increased use of recycling powder with no compromise in quality
+ Comprehensively adaptable material properties and layer thicknesses

User-friendly – only two parameters to enter:
1. Select composition of the alloy  
2. Enter particle size distribution

70% shorter material development cycles

with OPTOMET
Ra 6 μm

without OPTOMET
Ra 11 μm
Software for parameter optimisation

**HIGHLIGHTS**

+ Automatic calculation of process parameters for new and existing materials within minutes
+ Advance calculation of mechanical properties for selected materials thanks to integrated material database
+ Adjustment of the process parameters to changed layer thicknesses, changed requirements (density, tensile strengths, etc.), new powder suppliers/powder properties, recycling powder
+ Optional: rePLUG reSEARCH – the additional powder module developed especially for material development with OPTOMET

**Automatic calculation of the process parameters laser power, scan speed and spacing for:**

+ Hatch
+ Up/down skin
+ Top skin
+ Outer-/inner contour

**Advance calculation of the material characteristics and mechanical properties for selected materials in the basic package:**

+ Density of the material
+ Surface hardness
+ Tensile strength
+ Yield point
+ Elongation at break
+ Impact strength

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**Self-optimising algorithm**

The integrated material database can be expanded to include the results of every material test, thus creating the basis for a self-learning machine that gets a bit better with every print job.
First time right – best component quality thanks to comprehensive, definable input variables:

+ Chemical composition (Basic: within the permitted tolerance values for selected materials)
+ Particle size distribution (PSD)
+ Flowability of the powder
+ Bulk density of the powder
+ Layer thickness for support and component
+ Focus diameter*
+ Build platform temperature*

* dependent on machine characteristics

Unrestricted choice of material supplier – without any additional R&D effort

No compromise in quality – reduced material costs through use of recycling powder

OPTOMET BASIC – MATERIALS

+ Aluminium AlSi10Mg0.5
+ Stainless steel 1.4404
+ Stainless steel 17-4 PH
+ Tool steel 1.2709
+ Titanium Ti64
+ Inconel® 625
+ Inconel® 718
+ Inconel® 738
+ CM 24 LC

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Your contact person
Florian Feucht
Head of Sales and Application
HIGHLIGHTS

+ Parameter development for completely new materials within minutes
+ Choice of alloy composition using the periodic system
+ Optimisation of the process parameters for existing alloys
+ Special module for crack prone alloys
+ OPTOMET Advanced and rePLUG reSEARCH: The combination for faster material development

rePLUG reSEARCH

+ Specifically for material development
+ Process parameter development with small amounts of material
+ Easy to clean
+ Advantage: Parameter development directly on the serial production system

Fully compatible with the LASERTEC 12 SLM and LASERTEC 30 SLM 2nd Gen.
Programming and control

RDesigner

CAM programming
+ Starts with a pure CAD model [STL]
+ Orientation/Positioning
+ Support
+ Slicing
+ Hatching
+ Copying
+ Generation Process Control File

Heat calculation
+ Advance calculation of mass distribution
+ Automatic adaptation of all laser parameters for top component quality
+ Integration in RDesigner

JOB CONTROL
+ At a glance: All relevant machine and job parameters
+ Camera-based check of the build-up and coating quality
+ Automatic machine stop at error detection
SLM PROCESS CHAIN

Process understanding from the drawing to the finished part, with end to end process knowledge of DMG MORI

Additive Manufacturing → Milling

Maximum component accuracy and top surfaces guaranteed – Post-processing on milling machines from DMG MORI

DMU 50 3rd Gen.

HIGHLIGHTS

+ 5-axis machining with up to 20,000 rpm
+ Swivel rotary table for 5-axis simultaneous machining
+ Tool magazine with 30 pockets as standard and optionally up to 120 magazine pockets
+ Integrated cooling concept for top long-term precision
+ Direct-driven ball screw drive for the best possible accuracy
+ Direct measuring system in all axis
CAD / CAM

MILLING ON DMU 50 3rd Gen.

ADDITIVE MANUFACTURING IN A POWDER BED MACHINE

FINISHED PART

**CELOS**

Due to the efficient information flow and the intuitive operation, CELOS stands for optimum process chains in pre- and post-processing of additively produced components.

**Milling → Additive Manufacturing**

**Full flexibility** – Milling of the base before the Additive Manufacturing process does away with the need for support structures and leads directly to the finished part!

**Application example:**

**Basic tibia plateau**

+ Material: Ti6Al4V
+ Machining time milling: 12 min./unit
+ Machining time additive manufacturing: 9 hours (9 parts)
+ Layer thickness: 50 µm
+ Dimensions: 75 × 57 × 53 mm

**DIRECTLY TO THE FINISHED PART!**

+ No post-processing
+ No support structures
Start now and use the full potential of the **SLM** technology!

The DMG MORI Academy supports companies with the introduction and use of Additive Manufacturing with a new comprehensive portfolio.

**OUR SERVICES**

+ Additive Manufacturing Quick Check for the identification of your specific Additive Manufacturing components
+ Redesign of your components for Additive Manufacturing
+ Engineering and design of new components and groups
+ Simulation and topology optimization
+ Production of prototypes and small series of your components
+ Courses and training for management, design and manufacturing departments
+ Consulting for the strategy from design optimisation, through to your Additive Manufacturing production
YOUR BENEFITS

+ Faster to market
+ Better products
+ Everything from a single source
+ Reduced obstacles to investment
+ Build-up of knowledge during entry in the technology

BEST PRACTICE COOLANT RING

Sector: Mechanical engineering
Material: Aluminium
Quantities: 20 p.a.

Challenges
+ Guidance of coolant
+ Interfering contours due to ULTRASONIC holder
+ Compact design

Added value
+ Targeted supply of coolant
+ Cooling efficiency significantly improved
+ Optimised chip removal

Serial component
ULTRASONIC 80 eVo
DMG MORI ACADEMY – CONSULTING

Quick check as the perfect start for your design

2-DAY ON-SITE WORKSHOP AT THE CUSTOMERS

Aim: Development of basic knowledge and identification of components with Additive Manufacturing potential.

**Basics**
- Technology overview
- Materials
- Opportunities and challenges
- Process chain from design to finishing

**Component selection**
- Best practices from the industry
- Methods for identification of components with AM potential
- Sighting of first component ideas from your company

**Component analysis**
- Analysis of the components
- Rating according to technical and economic viability
- Portfolio creation
- Concepts for redesign
- Roadmap development

**Technical suitability**

<table>
<thead>
<tr>
<th></th>
<th>high</th>
<th>medium</th>
<th>low</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>medium</td>
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<td></td>
<td></td>
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<tr>
<td>low</td>
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</tbody>
</table>

**Powder nozzle holder LASERTEC 65 3D after redesign for Additive Manufacturing**
- Functional integration
- Reduction of production costs
- Enhanced cooling efficiency
- 60% lighter
- 95% fewer components
QUICK CHECK KEY FACTS

Benefits
Customers receive practical knowledge in Additive Manufacturing based on many examples. The first components with Additive Manufacturing potential are also identified and analysed. Participants thus learn to identify the right components for Additive Manufacturing for the future.

Target group:
The Additive Manufacturing Quick Check is intended for developers and design engineers. Production planning and preparation are complimentary to this process.

Number of participants:
The Additive Manufacturing Quick Check is intended for groups of 4 – 10 people.
DMG MORI ACADEMY – CONSULTING

Design for Additive Manufacturing

Additive Manufacturing requires innovative thinking in design. We help your development team to the next level!

<table>
<thead>
<tr>
<th>Task</th>
<th>Traditional design</th>
<th>Additive design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lens holder for the LASERTEC 30 SLM</td>
<td>Technology-driven: Which material do I have to remove?</td>
<td>Function-driven: Which material do I have to add?</td>
</tr>
</tbody>
</table>

DESIGN TRAINING COURSES

1. Design for Additive Manufacturing **Basic**  
   knowledge: CAD Basics
2. Design for Additive Manufacturing **Advanced**  
   prior knowledge: Basic training
   
   - **Duration:** 4.5 days each
   - **Number of participants:** Max. 8 Persons
   - **Target group:** Specialists and managers in the field of development and design
   - **Course starting times:** On-going, several times a year

*We help you with the introduction of the technology!*
TRADITIONAL DESIGN
12 SEPARATE PARTS

ADDITIVE DESIGN
1 FINISHED PART

Functional integration

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BEST PRACTICE GRINDING NOZZLE

Sector: Mechanical engineering
Material: Aluminium
Quantities: 120 p. a.

Challenges
+ Guidance of coolant
+ Compact design

Added value
+ Supply of coolant over a large area
+ Optimised flow conditions

Serial component
DMU 80 P duoBLOCK

56 % LIGHTER
30 % FASTER PRINT
60 % CHEAPER

RETHINK DESIGN!
**Worldwide Service**

**NETservice – YOUR ACCESS TO THE DIGITAL SERVICE**

+ **Shorter waiting times** due to routing directly to the next free employee
+ **Higher resolution rate** due to access to CELOS, IPC and NC
+ **Maximum data security**
+ **Optional connection of the SERVICEcamera**: More efficient problem resolution due to livestream (video/audio/image) from the machine directly to the DMG MORI Hotline
+ **Recording of all service activities**
+ **Direct transfer of document updates**
+ **Multi-user conference**: Interconnection of different DMG MORI skilled workers for joint faster problem resolution
+ **Intuitive operation**
+ **Individual user profiles** and rights
+ **Also for existing machines** thanks to the Retrofit-Kit

**REMOTE SUPPORT WITH CAMERA AND MULTI-USER CONFERENCE**

The NETservice also enables several parties to be interconnected in the new multi-user process. Operators, hotliners, service technicians or other employees from the plants can then work together.

+ **Faster problem solving** due to communication network
+ **Expert know-how available immediately**
Your contact person

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SERVICEcamera-LIVESTREAM FOR THE NETservice

+ Plug-and-play connection without preconfiguration between SERVICEcamera and NETservice (IoTconnector)
+ Faster problem identification and resolution
+ A description of the problem by phone is often superfluous
+ Fast and secure 5G WiFi transmission
+ Integrated lighting and laser pointer
+ Photo and video storage on the camera and IoTconnector for subsequent use

CERTIFIED MACHINE PERIPHERALS AND ACCESSORIES

+ Everything from a single source
  Perfectly coordinated machines peripherals an innovative technology accessories for your DMG MORI machine
+ Certified interfaces
  Simple connectivity for all DMQP products via certified standard interfaces
+ Selected partners
  Our DMQP partners stand for the highest innovation and technology competence and maximum quality requirements

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DMQP – DMG MORI QUALIFIED PRODUCTS

+ Certified powder material for best component quality
+ Transport free of charge for all consumables – simply per mouse click
+ www.shop.dmgmori.com

NEW: WiFi CAMERA
LASERTEC SLM

Floor plans

Front view

Top view

Identical for LASERTEC 12 and LASERTEC 30 SLM 2nd Gen. / External cooler not needed for the LASERTEC 12 SLM
## LASERTEC SLM

### Technical data

#### Connections

<table>
<thead>
<tr>
<th>Description</th>
<th>LASERTEC 30 SLM 2nd Gen.</th>
<th>LASERTEC 12 SLM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical connection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mains connection</td>
<td>(3N / PE)</td>
<td>(3N / PE)</td>
</tr>
<tr>
<td>Nominal voltage V</td>
<td>400 V / 230 V ± 10 %</td>
<td>400 V / 230 V ± 10 %</td>
</tr>
<tr>
<td>Frequency Hz</td>
<td>50 / 60</td>
<td>50 / 60</td>
</tr>
<tr>
<td>Power consumption kVa</td>
<td>17.3</td>
<td>17.3</td>
</tr>
<tr>
<td>Required mains fuse A</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Required short-circuit power kVA</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td><strong>Inert gas connection</strong></td>
<td></td>
<td></td>
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<tr>
<td>Inert gas</td>
<td>Argon</td>
<td>Argon</td>
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<tr>
<td>Purity 4.6 or higher</td>
<td></td>
<td></td>
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<tr>
<td>Minimum consumption per build (floods and large parts) l</td>
<td>1,000</td>
<td>1,000</td>
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<tr>
<td>Average consumption l / h</td>
<td>72</td>
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<tr>
<td>Min. Pressure bar</td>
<td>6</td>
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<tr>
<td>Gas connection</td>
<td>Connector D 10 mm</td>
<td>Connector D 10 mm</td>
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<tr>
<td><strong>Network connection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection type RJ-45</td>
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<td>RJ-45</td>
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<tr>
<td><strong>Build data</strong></td>
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<tr>
<td>Build volume (X × Y × Z) mm</td>
<td>300 × 300 × 300</td>
<td>125 × 125 × 200</td>
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<tr>
<td>Layer thicknesses µm</td>
<td>20 – 100</td>
<td>20 – 100</td>
</tr>
<tr>
<td>Focus diameter µm</td>
<td>min. 70</td>
<td>min. 35</td>
</tr>
<tr>
<td>Laser type</td>
<td>Fibre laser</td>
<td>Fibre laser</td>
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<tr>
<td>Laser power (depending on version) W</td>
<td>600 – 1,000</td>
<td>200 – 400</td>
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<tr>
<td>Material</td>
<td>Tool steel, stainless steel, cobalt chrome alloys, titanium, aluminium</td>
<td>Tool steel, stainless steel, cobalt chrome alloys, titanium, aluminium</td>
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<tr>
<td>Software</td>
<td>CELOS / RDesigner</td>
<td>CELOS / RDesigner</td>
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<tr>
<td>Integrated powder extraction</td>
<td>Yes (in rePLUG powder module)</td>
<td>Yes (in rePLUG powder module)</td>
</tr>
<tr>
<td>Integrated sieving unit</td>
<td>Yes (in rePLUG powder module)</td>
<td>Yes (in rePLUG powder module)</td>
</tr>
<tr>
<td><strong>Machine weight</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine kg</td>
<td>1,200</td>
<td>1,200</td>
</tr>
<tr>
<td>rePLUG powder module (without powder) kg</td>
<td>540</td>
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</tbody>
</table>
Laser Deposition Welding – LASERTEC 3D and LASERTEC 3D hybrid

FUNCTIONAL PRINCIPLE: TRACK-FOR-TRACK BUILDING IN LAYERS

1. The powder is transported by an inert carrier gas to the coaxial powder nozzle
2. Laser melts the metal powder to a high-strength and high-density weld
3. Individual tracks become one layer
4. Layers become the 3D component

HIGHLIGHTS

+ 5-sided additive process
+ Addition of additive features to existing parts
+ Coating and repair of existing parts
+ Large honeycomb structures for weight reduction
+ Combination of multiple materials in one part
+ Building near-net semi-finished products
+ High-quality welding
PORTFOLIO OF POWDER NOZZLE MACHINES

<table>
<thead>
<tr>
<th>Applications</th>
<th>LASERTEC 65 3D</th>
<th>LASERTEC 65 3D hybrid</th>
<th>LASERTEC 4300 SLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build-up on semi-finished products</td>
<td>Build-up on semi-finished products</td>
<td>Build-up on semi-finished products</td>
<td></td>
</tr>
<tr>
<td>Repair and coating possible, multi-material and material mix</td>
<td>Repair and coating possible, multi-material and material mix</td>
<td>Repair and coating possible, multi-material and material mix</td>
<td></td>
</tr>
<tr>
<td>No reactive materials (e.g. Ti, Al)</td>
<td>No reactive materials (e.g. Ti, Al)</td>
<td>Titanium possible (Ti-6Al-4V)</td>
<td></td>
</tr>
<tr>
<td>High-strength materials up to 65 HRC</td>
<td>High-strength materials up to 65 HRC</td>
<td>Particle size 45 – 150 μm</td>
<td></td>
</tr>
<tr>
<td>Particle size 45 – 120 µm</td>
<td>Particle size 45 – 120 µm</td>
<td>Particle size 45 – 120 µm</td>
<td></td>
</tr>
<tr>
<td>The parts must be post-processed on a separate machine</td>
<td>Post-processing in a single setup on the same machine, based on 5-axis milling</td>
<td>Post-processing in a single setup on the machine, based on a lathe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hybrid machine milling, turning, ULTRASONIC machining</td>
<td>Hybrid machine 6-sided machining: Turning / milling</td>
<td></td>
</tr>
</tbody>
</table>

FROM PROTOTYPE TO SERIES PRODUCTION

World premiere of the LASERTEC 65 3D hybrid as a prototype.

Start of series production of the LASERTEC 65 3D hybrid.

World premiere of the LASERTEC 65 3D as a pure laser processing machine for Additive Manufacturing using a powder nozzle.
Lasers Deposition Welding – LASERTEC 3D and LASERTEC 3D hybrid

MATERIALS

+ Stainless steel (316L – X2CrNiMo17-12-2)
+ Tool steels (X35CrMoMn7-2-1, X20CrMoMn15-15-3)
+ High-speed steel (M2 – 56-5-2)
+ Nickel-based alloys (625, 718)
+ Cobalt alloys (6, 21)
+ Copper alloys (CuSn10, CuAl10)
+ MMC coating (WC in nickel-based matrix)

+ Density ≥ 99.8 %
+ Good mechanical properties

Typical Mechanical Properties

<table>
<thead>
<tr>
<th>Size</th>
<th>Unit</th>
<th>316L</th>
<th>Ni 625</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield point [R_p] Mpa</td>
<td>390</td>
<td>538</td>
<td></td>
</tr>
<tr>
<td>Tensile strength [R_m] Mpa</td>
<td>563</td>
<td>844</td>
<td></td>
</tr>
<tr>
<td>Elongation at break [A] %</td>
<td>36.6</td>
<td>28.9</td>
<td></td>
</tr>
<tr>
<td>Impact strength [J] J</td>
<td>105</td>
<td>52</td>
<td></td>
</tr>
</tbody>
</table>

1: Ni-718 cuboid  
2: Cross-section of a 316L cuboid  
3: 316L cylinder

MULTI-MATERIAL COMBINATION AND GRADED MATERIALS

The use of a twin powder conveyor allows the building of multi material parts or graded materials, by changing the ratio of two materials for each layer.
### Applications

#### PRODUCTION

<table>
<thead>
<tr>
<th>Images</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>PLANT ENGINEERING elbow</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>ENERGY blade</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>AEROSPACE casing</td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td>MOULD AND DIE injection mould</td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td>ENERGY impeller</td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /></td>
<td>MECHANICAL ENGINEERING nozzle</td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td>MARINE propeller</td>
</tr>
<tr>
<td><img src="image8.png" alt="Image" /></td>
<td>PROCESS ENGINEERING filter</td>
</tr>
</tbody>
</table>

#### REPAIR

<table>
<thead>
<tr>
<th>Images</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image9.png" alt="Image" /></td>
<td>AEROSPACE blisk</td>
</tr>
<tr>
<td><img src="image10.png" alt="Image" /></td>
<td>ENERGY impeller</td>
</tr>
</tbody>
</table>

#### COATING

<table>
<thead>
<tr>
<th>Images</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image11.png" alt="Image" /></td>
<td>TOOL MAKING cutting knife</td>
</tr>
<tr>
<td><img src="image12.png" alt="Image" /></td>
<td>PLANT ENGINEERING flange</td>
</tr>
</tbody>
</table>
LASERTEC 65 3D hybrid AND LASERTEC 4300 3D hybrid

Hybrid CAD/CAM module for additive and subtractive programming

1: Customer CAD/CAM data; CAD model separation into additive and subtractive areas; slicing of the individual workpiece sections

2: Generation of the NC paths for the laser process and milling; output by post processor; definition of programming order

3: 3D simulation for collision protection with consideration of the integrated laser head

4: Laser Deposition Welding and milling combined on the LASERTEC 65 3D hybrid/ LASERTEC 4300 3D hybrid (flexible changeover possible)

5: TURBINE CASING, AEROSPACE INCONEL® 718/Bronze ø 194 × 80 mm
Wall thickness: 6 mm

APPLICATION EXAMPLE

1: Basic build-up of the cylinder
2: Build-up of the flange
3: Machining the flange
4: Build-up of outer connections
5: Milling the upper contour
6: Milling of the plane surface

HIGHLIGHTS

+ One software package for the complete process (design, programming, simulation)
+ Unique SAUER LASERTEC build-up module – fully integrated into CAD/CAM software
+ The part can be programmed in several steps, while flexibly switching between Laser Deposition Welding and milling operations in only one programming set-up.
LASER DEPOSITION WELDING

Programming highlights

“Graded Materials”
+ Automatic interpolation between two parameter sets along a defined trajectory
+ Also usable for complex geometries
+ Fast programming possible with the NX material database

“Tube Additive Build-up”
+ Build-up of curved geometries (filled, thick or thin wall)
+ Automatic generation of the tool path based on the component curve
+ Increased flexibility in production

“Merge”
+ Simultaneous build-up of individually programmed operations
+ Prevention of collisions due to parallel setup of features
+ Combined setup of features with different parameters, materials or geometries

“3D Freeform”
+ Build-up on complex, existing surfaces
+ Coatings, thin walls and full components
+ Flexibility with regard to programming

“Build on parts”
+ This is based on an existing part (build-up by Additive Manufacturing or with an alternative production process)
+ “Flanging” of an additional 3D contour onto the existing part

“3D coating”
+ Deposition of partial or complete coatings for corrosion protection and wear resistance, “3D coating” on 3D parts as a material coating or a repair
LASERTEC 65 3D hybrid: ADDITIVE MANUFACTURING IN FINISHED PART QUALITY

Laser Deposition Welding with integrated milling

**Footprint**

Max. workpiece dimensions

<table>
<thead>
<tr>
<th>Model</th>
<th>Max. Ø</th>
<th>Max. H</th>
<th>Max. Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASERTEC 65 3D</td>
<td>650 mm</td>
<td>560 mm</td>
<td>600 kg</td>
</tr>
<tr>
<td>LASERTEC 65 3D hybrid</td>
<td>500 mm</td>
<td>400 mm</td>
<td>600 kg</td>
</tr>
<tr>
<td>LASERTEC 4300 3D hybrid</td>
<td>200 mm</td>
<td>300 mm</td>
<td>1,700 kg</td>
</tr>
</tbody>
</table>

**HIGHLIGHTS**

+ The flexibility of Additive Manufacturing combined with the precision of milling
+ Laser build-up of the workpiece with intermediate milling
+ High build-up rates due to coaxial powder nozzle
+ Coolant for machining is no problem
+ Building of parts without support geometries, due to 5-axis application
+ Reduced material usage due to building near-net parts
Unique technology integration

+ Intelligent combination of Laser Deposition Welding and 5-axis milling for highest surface quality and part precision

Laser Deposition Welding with a powder nozzle

+ Reliable high-quality welding by combining laser deposition welding with the precision of a CNC machine

Hybrid CAD/CAM module for laser and milling process

+ One universal solution for additive build-up and subtractive machining for design, programming and processing

Closed loop – in-process regulation, analysis and control

+ Continuous measuring and monitoring of the build-up process
+ Closed loop automatic adjustment of laser power in real time
+ Ensuring a uniform welding process
+ Process monitoring for maximum process reliability and homogeneous part quality

Flexible integration of the laser head via HSK interface

+ Automatic exchange of the laser head by the shuttle – without manual intervention
+ Protected against dust, chips and coolant during milling
+ Coaxial nozzle for uniform powder distribution, independent of the laser build direction
+ Integrated inert gas monitoring
+ Ideal powder volume supply

Additive Manufacturing material database for users

+ Basic parameters for users and hybrid CAD/CAM for a wide variety of materials
+ Development of process parameters for surfaces, ridges and 3D parts for a wide variety of materials
+ Customer-specific material developments in five Additive Manufacturing Excellence Centres worldwide
LASERTEC 65 3D hybrid

Floor plans

Front view

Top view

+ Also: Gas package argon or central client supply
## Technical data

<table>
<thead>
<tr>
<th>Work area / Drives</th>
<th>LASERTEC 65 3D hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel in X/Y/Z mm</td>
<td>735 / 650 / 560</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work table / workpieces</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (NC swivel / rotary table) mm</td>
<td>Ø 650</td>
</tr>
<tr>
<td>Max. Workpiece dimensions (Additive Manufacturing) mm</td>
<td>Ø 500 x 400</td>
</tr>
<tr>
<td>Max. Workpiece weight (NC swivel / rotary table) kg</td>
<td>600</td>
</tr>
<tr>
<td>Rotary axis [C-axis] degrees</td>
<td>360</td>
</tr>
<tr>
<td>Swivel range [A-axis] degrees</td>
<td>−120 to +120</td>
</tr>
<tr>
<td>( P_{\text{max}} ) under VDI / DGQ 3441 [C-axis / A-axis] Ws</td>
<td>7 / 9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Milling spindle</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Speed (standard / optional) rpm</td>
<td>14,000 / 20,000</td>
</tr>
<tr>
<td>Output 40% DC / 100% DC (standard) kW</td>
<td>19 / 35</td>
</tr>
<tr>
<td>Torque Nm</td>
<td>100 / 130</td>
</tr>
<tr>
<td>Tool holder Type</td>
<td>HSK-A63</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laser source</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibre laser diode (standard) Watt</td>
<td>2,500</td>
</tr>
<tr>
<td>Fibre laser diode (optional) Watt</td>
<td>3,000</td>
</tr>
<tr>
<td>Laser spot diameter 1 (standard) mm</td>
<td>3</td>
</tr>
<tr>
<td>Laser spot diameter 2 (optional) mm</td>
<td>1.6</td>
</tr>
<tr>
<td>Build-up rate (depending on material kg / h)</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Linear axes (X/Y/Z)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid traverse speed mm</td>
<td>40 / 40 / 40</td>
</tr>
<tr>
<td>Max. acceleration X/Y/Z m / sec²</td>
<td>6 / 6 / 6</td>
</tr>
<tr>
<td>( P_{\text{max}} ) under VDI / DGQ 3441 mm</td>
<td>0.008</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tool change system</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tools Standard / Option Number</td>
<td>60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Machine data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Width x depth x height (basic machine) mm</td>
<td>4,180 x 3,487 x 2,884</td>
</tr>
<tr>
<td>Machine weight kg</td>
<td>13,000</td>
</tr>
</tbody>
</table>

---

**SAUER LASERTEC EXCELLENCE CENTRE IN PFROanten**

- > 25 years of experience in precision laser machining
- > 700 LASERTEC machines installed worldwide
- Application expertise: training, customer support, complete turnkey solutions
- Regular LASERTEC technology seminars

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**Your contact person**

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Additive Manufacturing

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www.dmgmori.com
**LASERTEC 65 3D**

5-axis build-up of additive parts using powder nozzle without compromise

Max. workpiece dimensions

<table>
<thead>
<tr>
<th>Machine Type</th>
<th>ø</th>
<th>mm</th>
<th>Height</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASERTEC 65 3D</td>
<td>650</td>
<td>560</td>
<td>1,700</td>
<td>600 kg</td>
</tr>
<tr>
<td>LASERTEC 65 3D hybrid</td>
<td>500</td>
<td>500</td>
<td>660</td>
<td>600 kg</td>
</tr>
<tr>
<td>LASERTEC 4300 3D hybrid</td>
<td>200</td>
<td>250</td>
<td>660</td>
<td>1,700 kg</td>
</tr>
</tbody>
</table>

Footprint

- LASERTEC 65 3D: 6 m²
- LASERTEC 65 3D hybrid: 25 m²
- LASERTEC 4300 3D hybrid: 63 m²

**HIGHLIGHTS**

- Laser Deposition Welding based on a CNC controlled machine tool
- 5-Axis building of large additive 3D metal parts up to ø 650 mm, 560 mm in Z (max. 600 kg)
- Laser head integrated into the headstock
- Automatic change between different track widths [ø 1.8 – 3.6 mm]
- Complete hybrid CAD/CAM process chain with interface for subtractive post-processing
- Customised automation solutions available for best utilisation in production
## Technical data

### Work area/Drives

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel in X/Y/Z</td>
<td>735/650/560</td>
</tr>
</tbody>
</table>

### Work table/workpieces

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clamping surface rigid table</td>
<td>800 × 650</td>
</tr>
<tr>
<td>Dimensions INC swivel/rotary table</td>
<td>ø 650</td>
</tr>
<tr>
<td>Max. Workpiece dimensions</td>
<td>ø 650 × 560</td>
</tr>
<tr>
<td>Max. Workpiece weight INC swivel/rotary table</td>
<td>600</td>
</tr>
<tr>
<td>Rotary axis [C-axis]</td>
<td>360</td>
</tr>
<tr>
<td>Swivel range [A-axis]</td>
<td>−120 to +120</td>
</tr>
</tbody>
</table>

### P<sub>max</sub> under VDI / DGQ 3441 [C-axis / A-axis]

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 / 9</td>
</tr>
</tbody>
</table>

### Laser source

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibre laser diode (standard)</td>
<td>2,500</td>
</tr>
<tr>
<td>Fibre laser diode (optional)</td>
<td>3,000</td>
</tr>
<tr>
<td>Laser spot diameter 1 [standard]</td>
<td>3</td>
</tr>
<tr>
<td>Laser spot diameter 2 (optional)</td>
<td>1.2 - 3.6</td>
</tr>
<tr>
<td>Build-up rate (depending on material)</td>
<td>2</td>
</tr>
</tbody>
</table>

### Linear axes (X/Y/Z)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid traverse speed</td>
<td>40 / 40 / 40</td>
</tr>
<tr>
<td>Max. acceleration X/Y/Z</td>
<td>6 / 6 / 6</td>
</tr>
</tbody>
</table>

### P<sub>max</sub> under VDI / DGQ 3441

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.008</td>
</tr>
</tbody>
</table>

### Machine data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width × depth × height (basic machine)</td>
<td>2,614 × 3,825 × 2,912</td>
</tr>
<tr>
<td>Machine weight</td>
<td>11,000</td>
</tr>
</tbody>
</table>

---

### LASERTEC 65 3D

#### Floor Plan

![Floor Plan Diagram](image-url)
LASERTEC 4300 3D hybrid: ADDITIVE MANUFACTURING IN FINISHED PART QUALITY

Laser Deposition Welding with integrated 6 sided turning and milling

The LASERTEC 4300 3D hybrid expands the range of hybrid machines with a turn / mill machine for the ideal manufacture of rotational parts. The main and sub-spindles allow 6-sided machining of parts, including the welding of pipes by automated sub-spindle handling.

Max. workpiece dimensions

Footprint

HIGHLIGHTS

- Combined Laser Deposition Welding and turning/milling operations on the LASERTEC 4300 3D hybrid
- Large parts up to ø660 mm, 660 mm in Z (axial) or ø545 mm, 1500 mm in Z (rotational)
- Max. workpiece weight 1,700 kg
- Top surface quality and precision due to the integrated 6-axis turning machine
- Additive manufacturing of metals and reactive materials such as Ti-6Al-4V (optional)
- Complete hybrid CAD/CAM process chain
**Unique technology integration**
- Laser Deposition Welding and 6-sided 5-axis simultaneous machining
- Turning and milling combined

**Laser head**
- Laser power of up to 6kW
- Integrated cooling of head

**Flexible changeover of different Additive Manufacturing heads**
- Revolver with up to five additive manufacturing laser heads
- Automatic laser head changer

**Titanium package**
- Safe Additive Manufacturing with titanium powder
- Additional argon safety gas supply via specially designed nozzles
- Certified non-flammable titanium powder [Ti-6Al-4V]
- Safety cycle guarantees correct powder supply
- Wet extraction unit during additive operations
- Additional cleaning kit
- Safety package for machine operators

**Intelligent process monitoring and control**
- 2-colour pyrometer
- Closed control loop: Automatic regulation of laser output for constant melt pool temperatures
- Feedback from melt pool
- Conversion of brightness into corresponding temperatures
- Automatic adjustment of laser power to ensure a constant temperature is maintained in the melt pool

**Complete integration into CELOS**
- CELOS with SIEMENS 840D sl Operate including 21.5" ERGOline control system with multi-touchscreen
- 3D apps and Additive Manufacturing control
- Ready for Industry 4.0

**ADDITIVE AND SUBTRACTIVE MACHINING ON MAIN AND SUB-SPINDLE**
- Complete 6-sided machining of parts
- Build-up of parts on main and sub-spindle with subsequent welding of built-up parts
- Automated way to weld to separate parts together on the main and sub spindles
LASERTEC 4300 3D hybrid

Building space for Additive Manufacturing

Floor plan
### LASERTEC 4300 3D hybrid

#### Technical data

<table>
<thead>
<tr>
<th>General</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine weight (standard)</td>
<td>kg</td>
</tr>
<tr>
<td>Footprint</td>
<td>mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tool spindle (Turret 1)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear axes X/Y/Z</td>
<td>mm</td>
</tr>
<tr>
<td>Spindle angle (B-axis)</td>
<td>°</td>
</tr>
<tr>
<td>Rapid traverse (tool spindle)</td>
<td>m / min</td>
</tr>
<tr>
<td>Max. workpiece weight</td>
<td>kg</td>
</tr>
<tr>
<td>Tool spindle motor (10 min. / cont.)</td>
<td>kW</td>
</tr>
<tr>
<td>Max. spindle speed</td>
<td>rpm</td>
</tr>
<tr>
<td>Tool spindle torque (10 % DC / cont.)</td>
<td>Nm</td>
</tr>
<tr>
<td>Chuck Type</td>
<td>Capto C6 [BT 40] [HSK-A63] [CAT40]</td>
</tr>
<tr>
<td>Tools (optional)</td>
<td>#</td>
</tr>
<tr>
<td>Max. tool weight</td>
<td>kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Main spindle 1 + 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>max. turning diameter</td>
<td>mm</td>
</tr>
<tr>
<td>Rotary axis [C-axis]</td>
<td>360</td>
</tr>
<tr>
<td>Max. spindle speed/chuck (spindle 1 + 2)</td>
<td>rpm</td>
</tr>
<tr>
<td>Spindle motor power (30 min. / cont.)</td>
<td>kW</td>
</tr>
<tr>
<td>Spindle motor torque (30 min. / cont.)</td>
<td>Nm</td>
</tr>
<tr>
<td>Clamping diameter</td>
<td>mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Turret 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transversal axes X2 / Z2</td>
<td>mm</td>
</tr>
<tr>
<td>Rapid traverse (Turret 2)</td>
<td>m / min</td>
</tr>
<tr>
<td>No. of tools (Turret 2)</td>
<td>#</td>
</tr>
<tr>
<td>Max. milling spindle speed (Turret 2)</td>
<td>rpm</td>
</tr>
<tr>
<td>Turret 2 milling spindle motor power (5 min. / cont.)</td>
<td>kW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Powder build-up</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Stainless steel / maraging steel / inconel® 625 / 718 / Stellite® / copper / titanium</td>
</tr>
<tr>
<td>Build-up rate (depending on material)</td>
<td>kg / h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laser</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibre diode laser, coupled (optional)</td>
<td>Watt</td>
</tr>
<tr>
<td>Focal length (fixed)</td>
<td>mm</td>
</tr>
<tr>
<td>Laser spot</td>
<td>mm</td>
</tr>
<tr>
<td>Additive Manufacturing tool change</td>
<td>Automatic Additive Manufacturing tool changer and turret</td>
</tr>
<tr>
<td>Laser beam / powder nozzle rotation</td>
<td>Tangential guide</td>
</tr>
</tbody>
</table>

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**Your contact person**

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