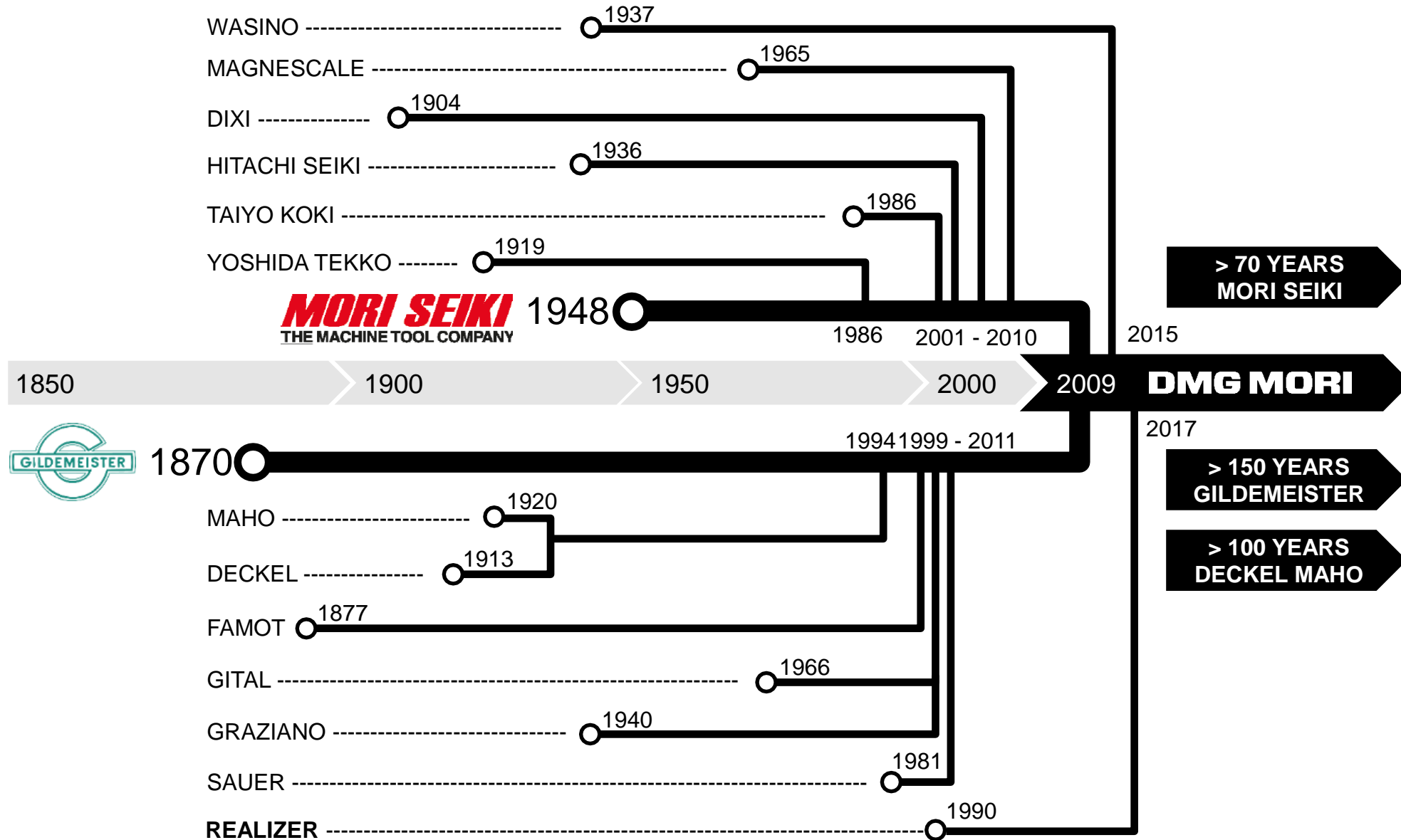
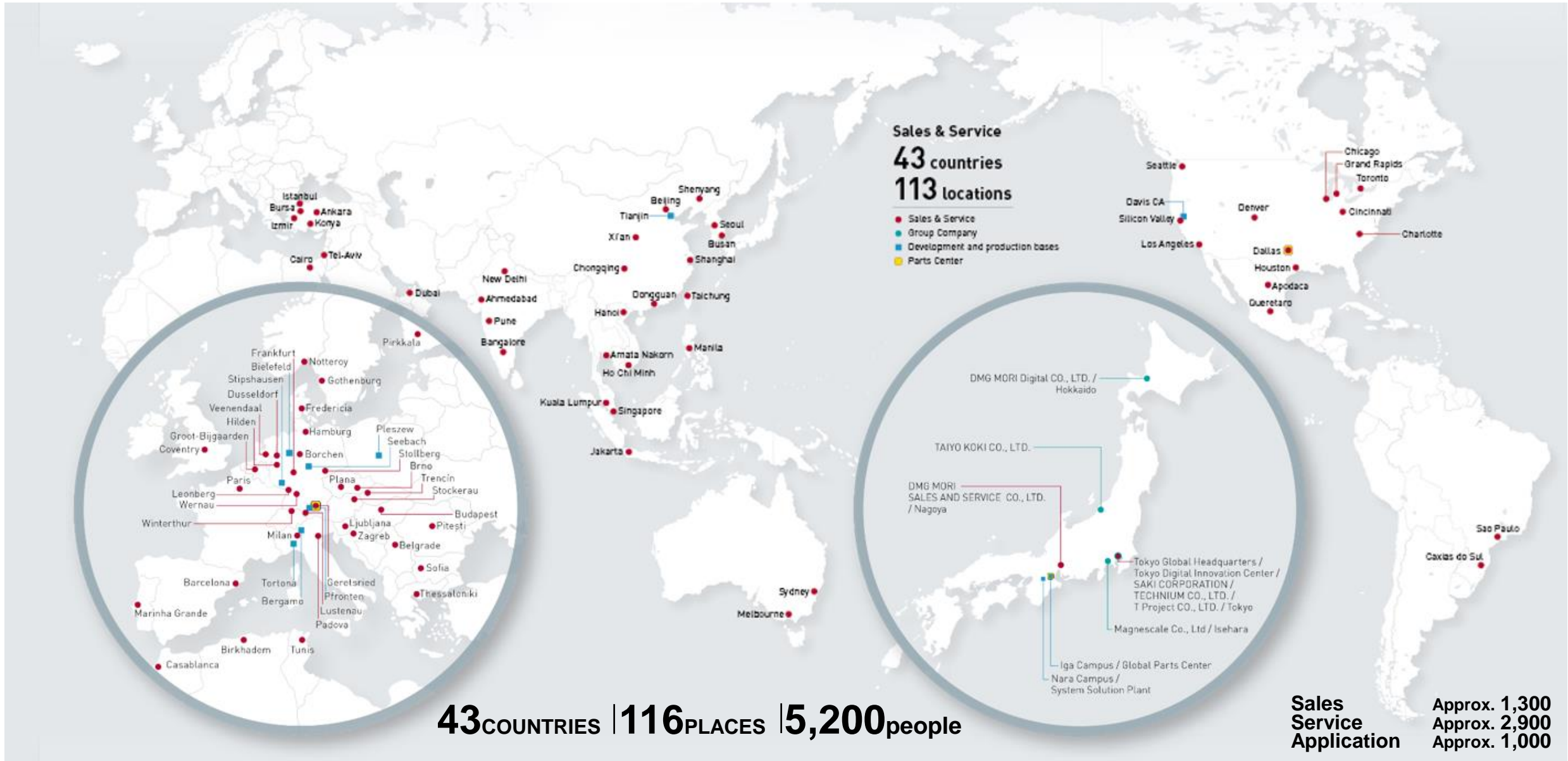


PREREQUISITES FOR COST-EFFECTIVE AM PRODUCTION MACHINE DESIGN AND CONTINUOUS PROCESS CHAIN

Manufacturing Technology Conference 2024

DMG MORI ADDITIVE





17 R&D AND PRODUCTION SITES



USA



3 LOS ANGELES



4 CHICAGO

Germany



1 BIELEFELD



2 PFRONTEN

Japan



5 TOKYO



6 IGA



7 NARA

GLOBAL PARTNER

- + Global Training Academy
- + Application Support, Technology and Material Development
- + Worldwide Service with more than 3,000 Experts

TURNING TECHNOLOGY



Drive shaft



Hydraulic component

MILLING TECHNOLOGY



Compressor disk



Landing gear

ULTRASONIC



Gyroscope

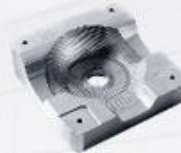


Watch case

LASERTEC

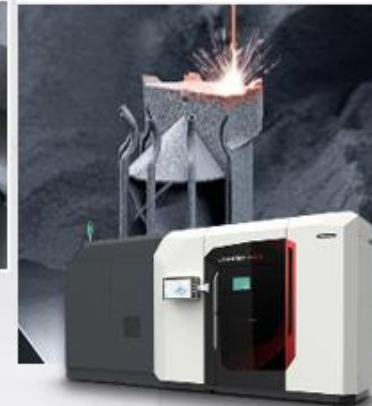


Turbine vane



Steering wheel cap mould

ADDITIVE MANUFACTURING



Blow mould



Heat exchanger

AUTOMATION



Robo2Go



AMR 2000

DIGITIZATION



TECHNOLOGY EXCELLENCE



TRAINING



SERVICE



MECHANICAL ENGINEERING



Turret Media Interface
Stainless Steel

PRECISION TOOLS



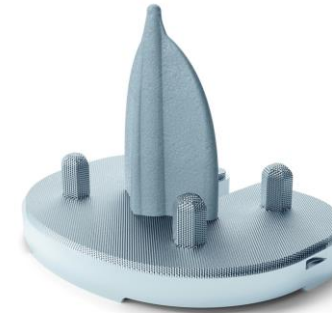
Stator Bore Tool
Aluminium

DIE & MOLD



Connector Tool Insert
Tool Steel

MEDICAL



Knee Implant
Titanium

SEMICONDUCTOR



Wafer Table
Stainless Steel

AUTOMOTIVE



Stator Housing
Aluminium

AEROSPACE



Heat Exchanger
Inconel 625

SPACE



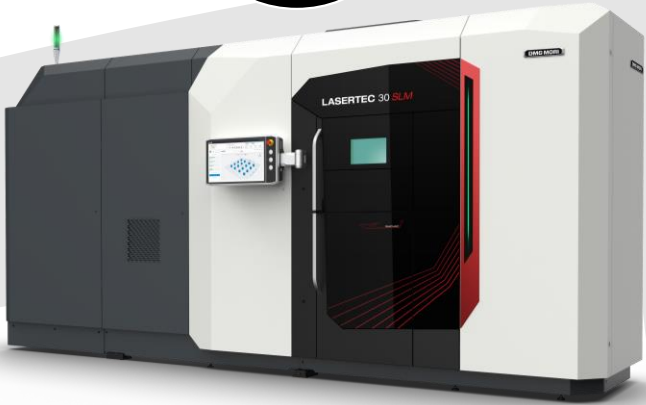
Rocket Nozzle
Copper

ADVANTAGES

- + Highly complex parts with functional integration
- + Inner cooling channels
- + Light weight design
- + Simultaneous build up of different designs
- + Functional prototypes made of common materials

EVOLUTION OF LASERTEC SLM MACHINES

2023



LASERTEC 30 SLM 3rd Gen.

2020



LASERTEC 30 DUAL SLM

2018



LASERTEC 30 SLM 2nd Gen.
LASERTEC 12 SLM

2017

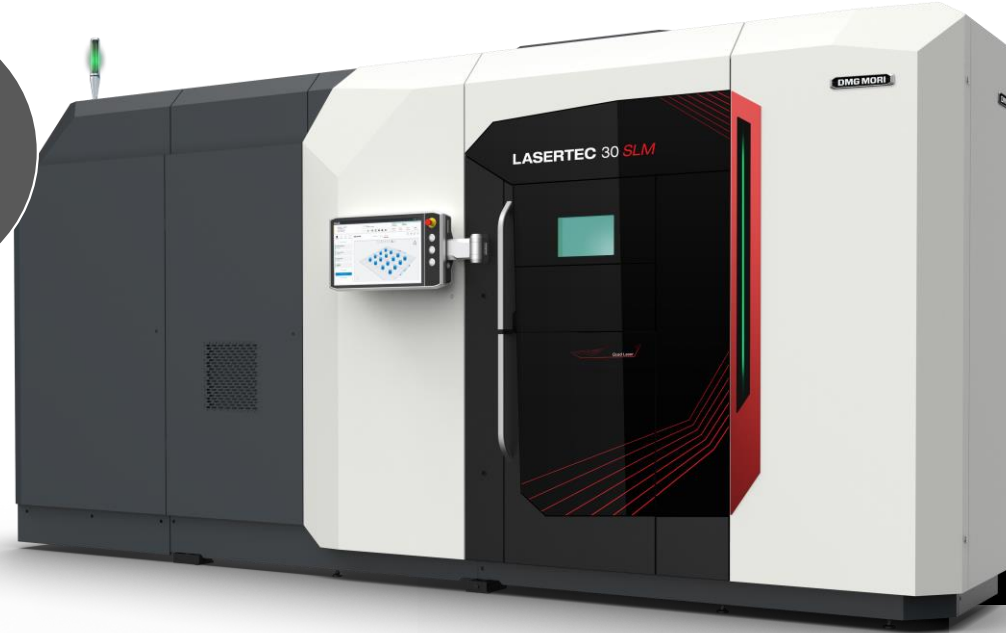


LASERTEC 30 SLM 1st Gen.



Assembly hall in Bielefeld

NEW



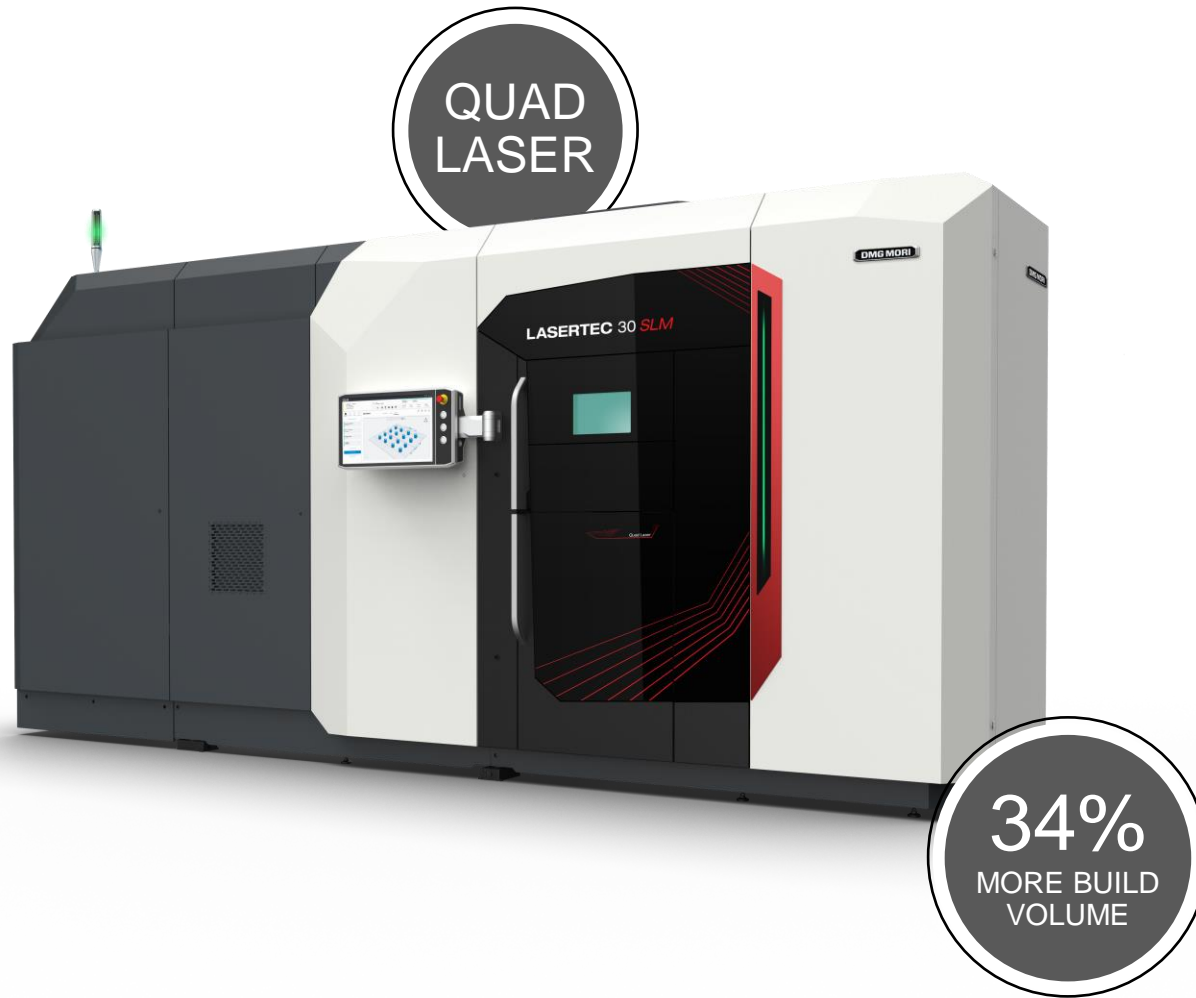
LASERTEC 30 SLM 3rd Gen.

- + Max. workpiece dimensions: 325 x 325 x 400 mm
- + Single, Dual or Quad Laser



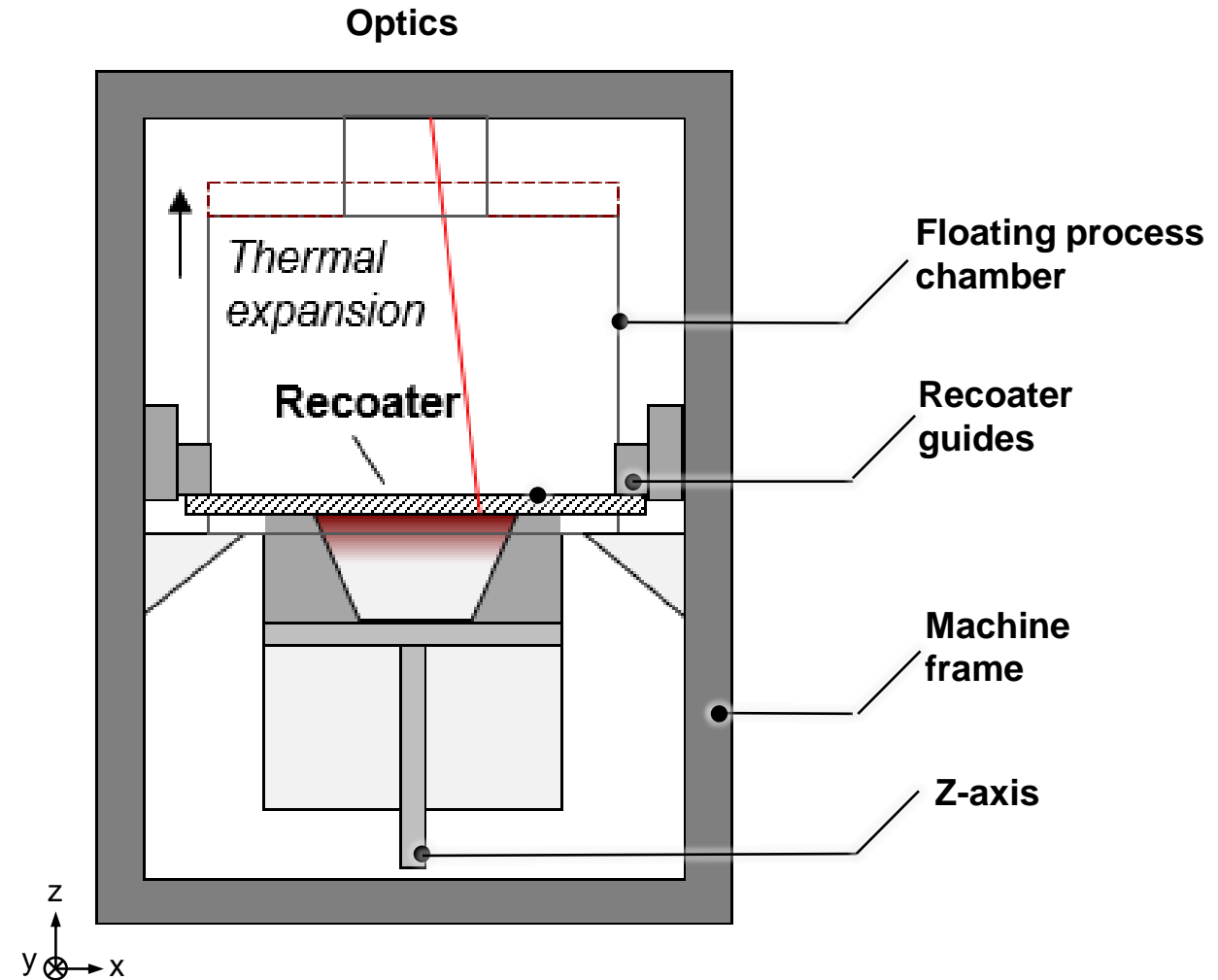
LASERTEC 12 SLM

- + Max. workpiece dimensions : 125 x 125 x 200 mm
- + Single Laser

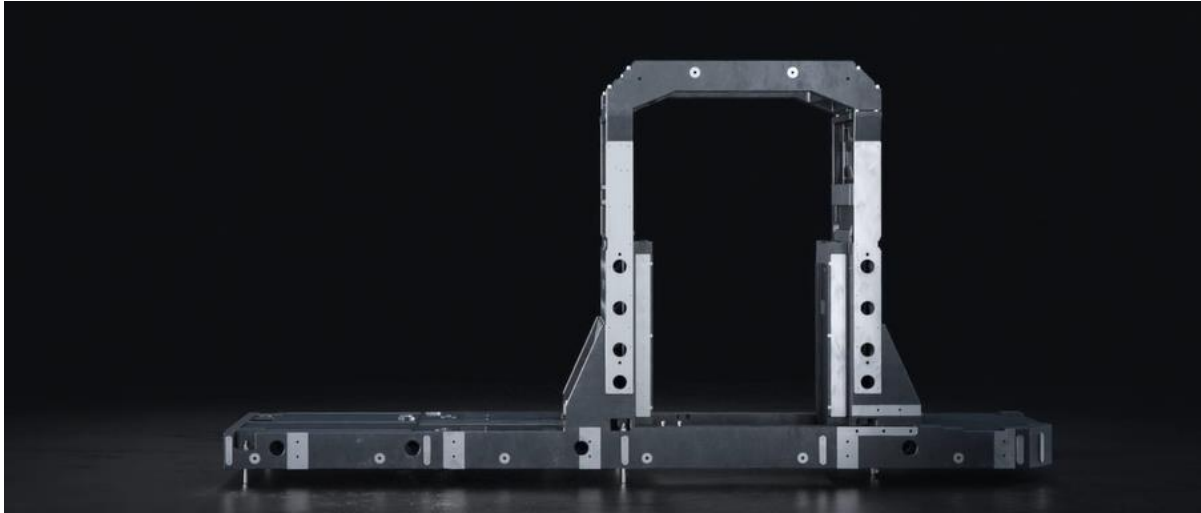


- + Build volume of 325 x 325 x 400 mm
- + Single-, Dual- or Quad-Laser with 600 W or 1.000 W
- + High-precision optics with 80 μm spot size and full overlap
- + rePLUG module for automated powder management under inert gas atmosphere
- + Thermosymmetric casting frame
- + Exchangeable build container
- + CELOS X with easyAM – guided workflows for easy machine operation and maintenance

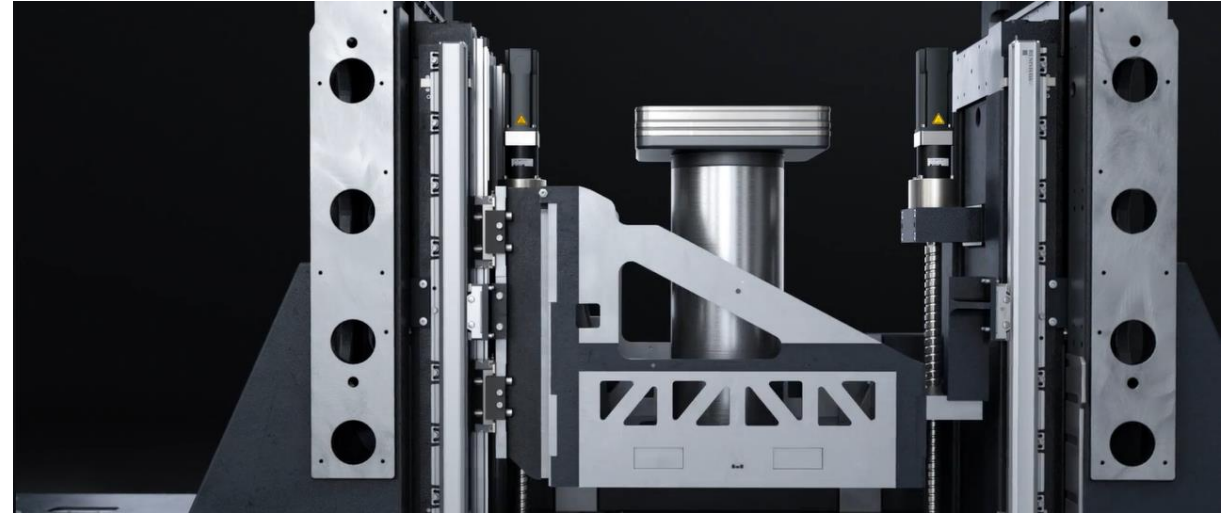
- + Floating process chamber for minimized thermal shifts
- + Thermosymmetric casting frame for highest rigidity
- + All accuracy relevant components mounted on casting frame
- + Constant accuracy independent from thermal fluctuations



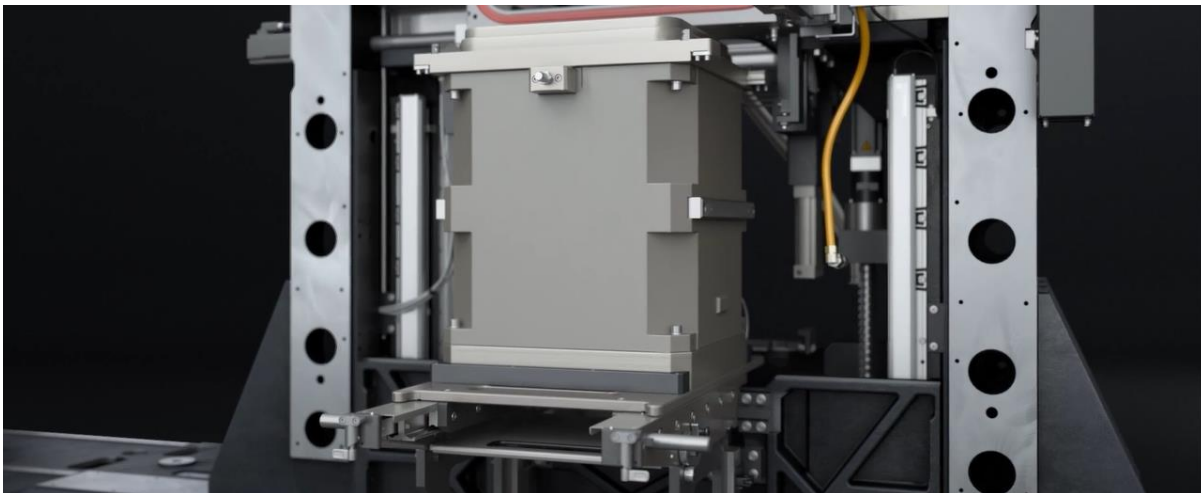
Casting Frame



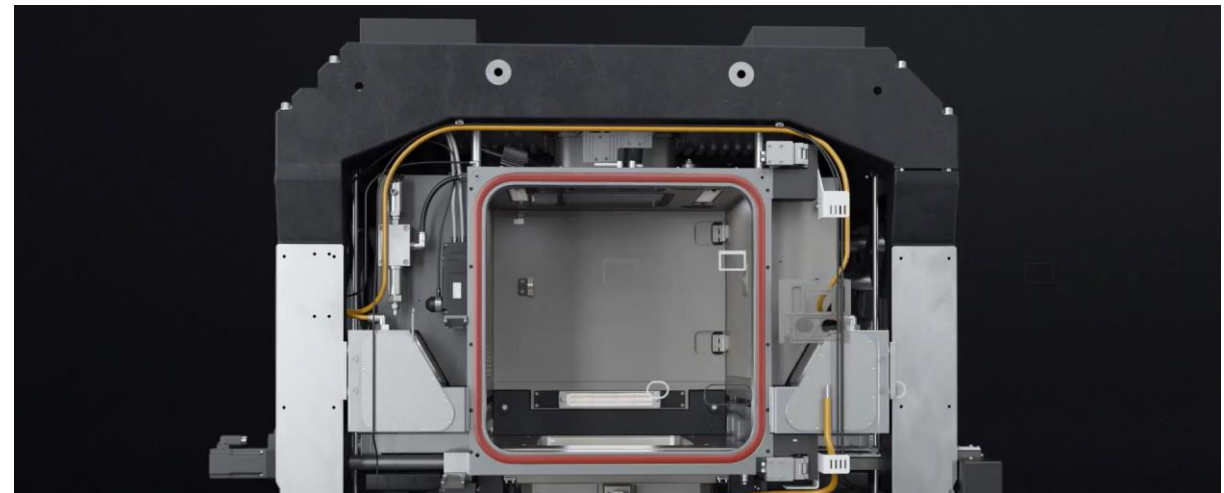
Gantry Concept



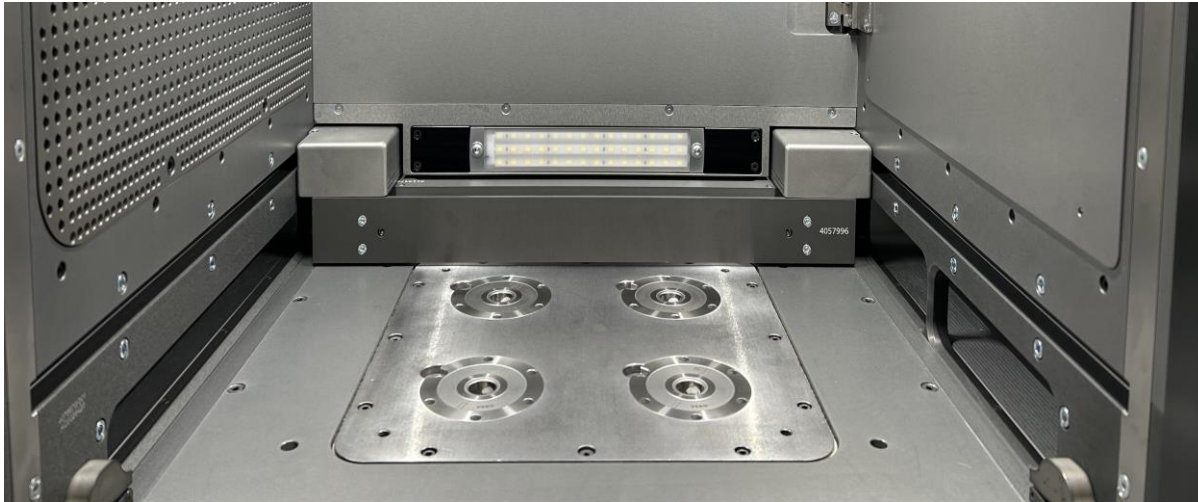
Pallet Change



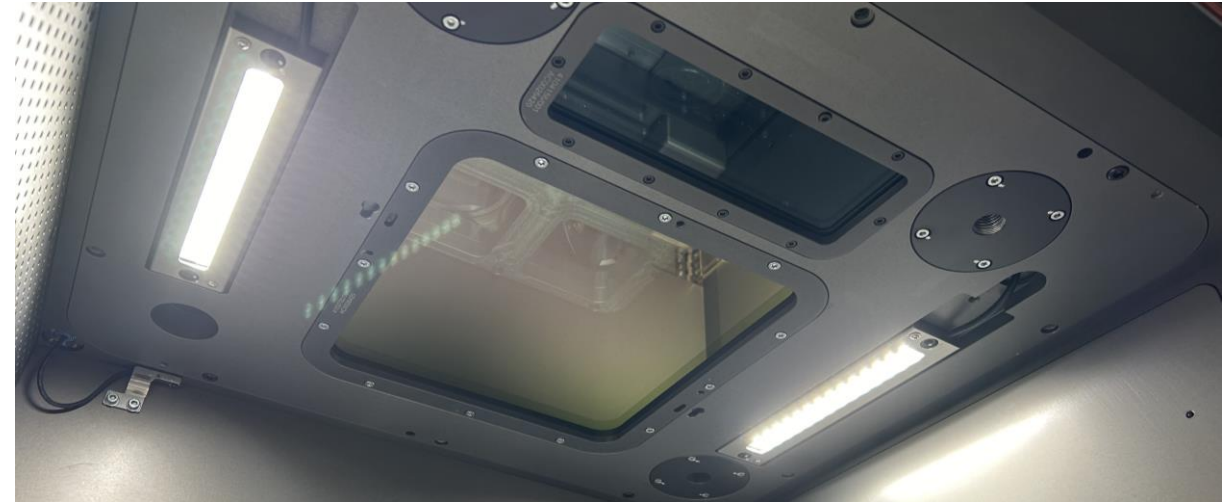
Floating Chamber



Collision Protection



Condition Monitoring

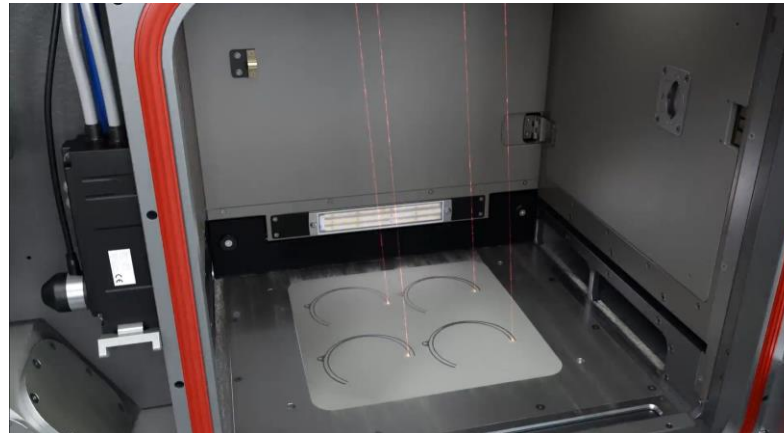


Temperature Compensation



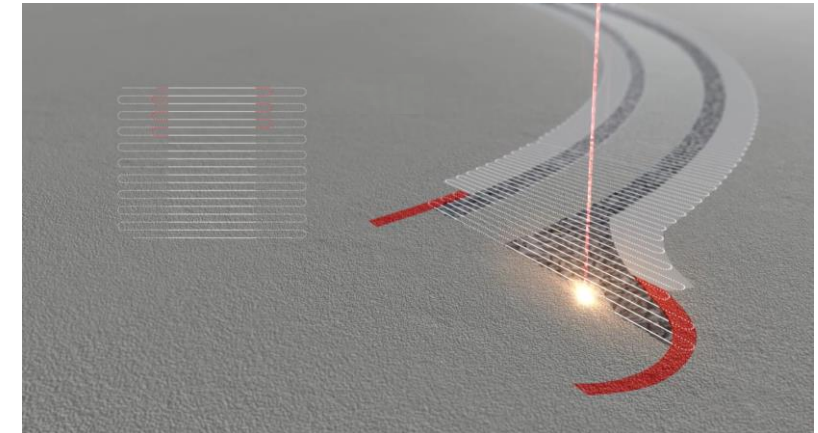
Up to 60 μm – 90 μm thermally induced expansion of piston

Reference Surface



Reference surface for recoater aligned with optics

Path Planning



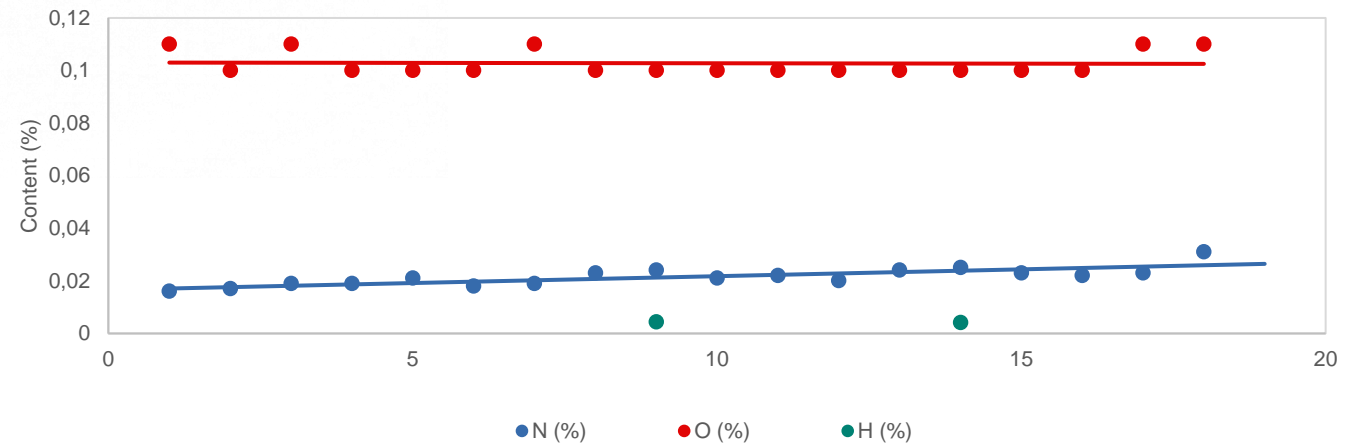
Up to 7% shorter build job times by shorter dark jumps

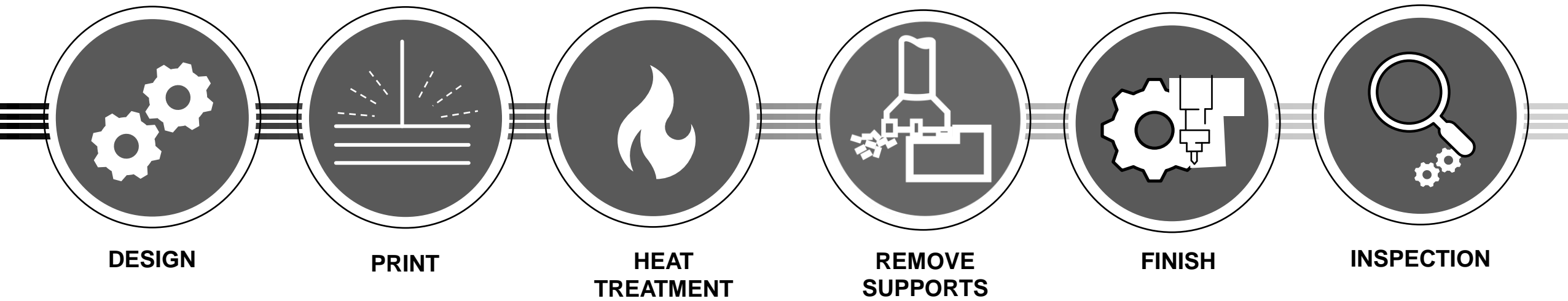


- + **Automated powder management** under inert gas atmosphere
- + Integrated **sieving unit**
- + **Highest operator safety** by closed material cycle
- + **Easy material changeover**
- + **Industrialized powder fill-in-interfaces**
- + **Powder weight detection** in main tank

NO increase of Nitrogen and Oxygen during **18** builds in rePLUG

Content of N, O



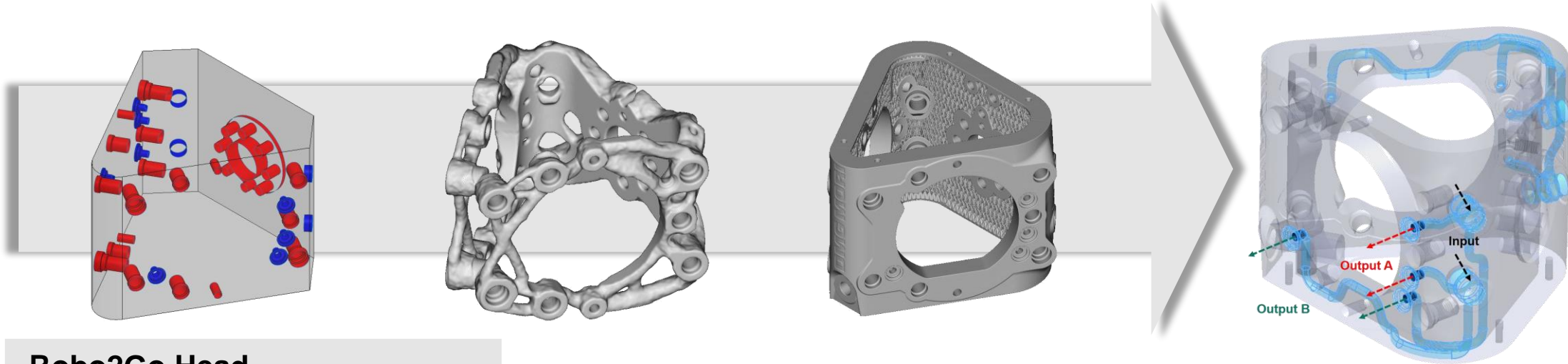


TASK

WEIGHT OPTIMIZATION

STRUCTURAL OPTIMIZATION

REDESIGNED FOR ADDITIVE MANUFACTURING



Robo2Go Head

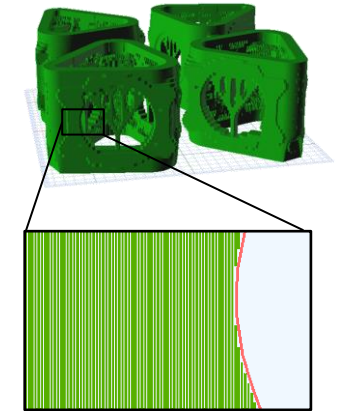
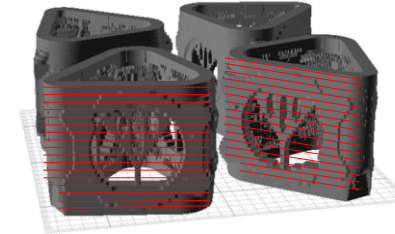
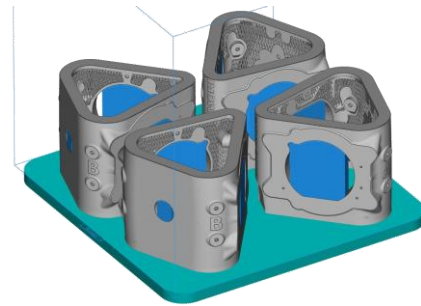
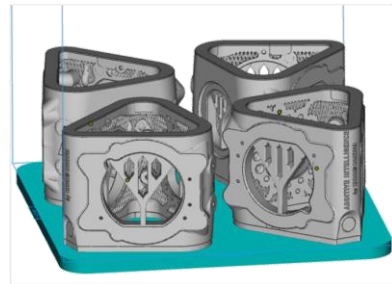
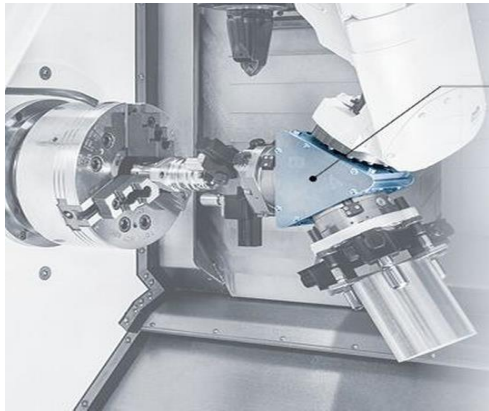
Printed in aluminum, series part for Robotic Automation

Facts

- + 64 % lighter
- + 45 % fewer seals
- + 59 % less Parts
- + 100 % traceability



“ADDITIVE MANUFACTURING requires a new mindset. Together, we refine your additive parts and develop the full potential.”



- + CAD data set is used for data preparation
- + No difference to subtractive manufacturing

- + Virtual workpiece is oriented on building platform
- + Orientation affects components building time and surface roughness

- + Support structures fixing the workpiece on the building platform
- + Support structures provides better heat dissipation

- + Cutting workpiece into virtually 2D layers

- + Adding process parameters for build job

SINGLE LASER



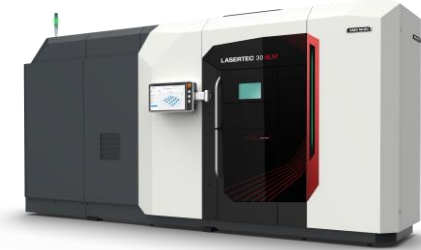
Build time: 73h

DUAL LASER



Build time: 39h

QUAD LASER



Build time: 17h

CUSTOMER BENEFITS

- + **64 %** Weight reduction and higher stiffness
- + **59 %** Less parts and optimized assembly
- + **45 %** Fewer seals and integrated components

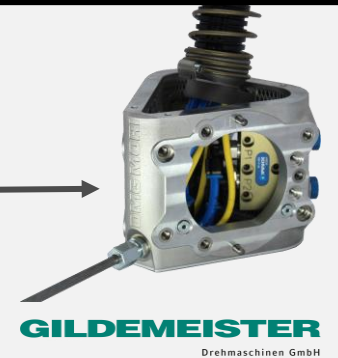
PROCESS DETAILS



+ **4 units** on one platform



+ Layer thickness: **50 µm**



+ Material: **Aluminum**

UNPACKING



- + Integrated vacuum system in process chamber itself
- + Powder removal under inert gas atmosphere
- + Highest operator safety

SEPARATION



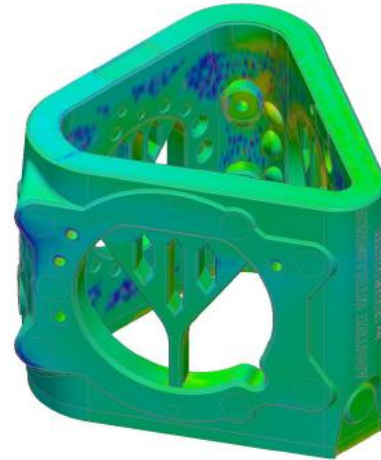
- + Parts separation from build plate
- + Cutting with Band Saw

BLASTING



- + Dustproof vacuum cabin blasting
- + Blasting with High-performance blast gun system, operation via foot pedal

- + Detection of shape errors and quality control
- + Analyze geometric tolerances to identify potential defects
- + Automate quality control with a PMI-driven process
- + Quality Workflow with TULIP



3D Scanned Model





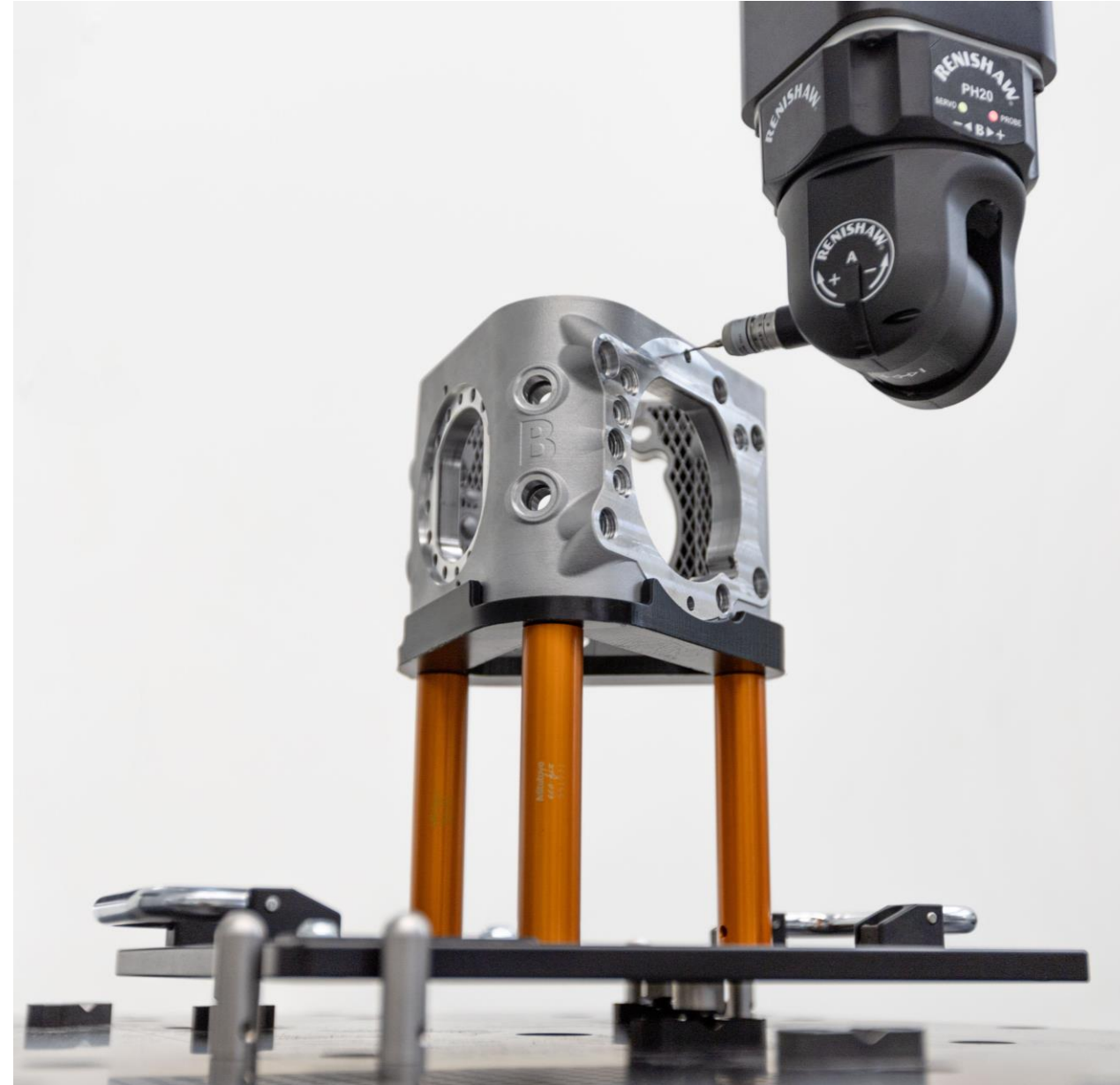
DMU 50 3rd Generation

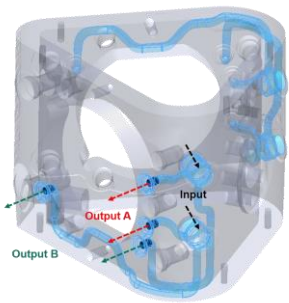
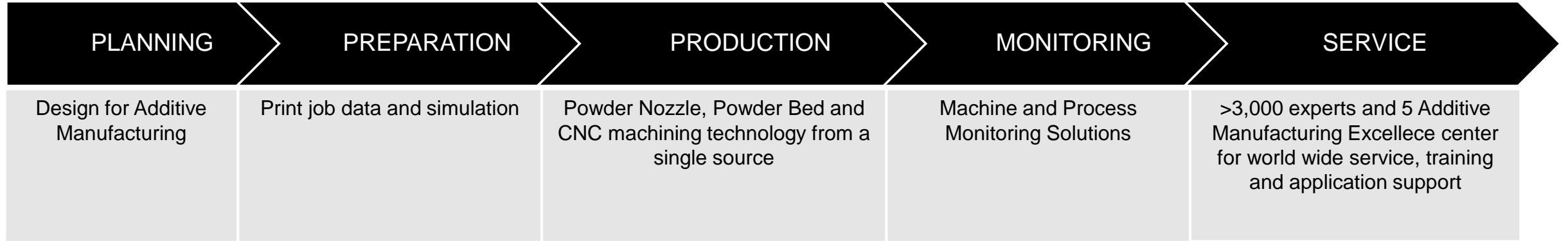
END-TO-END PROCESS KNOWLEDGE

- + Powder bed and CNC machining technology from a single source
- + Efficient process chains:
Machining in 25min per part

*As a leading global manufacturer of CNC-controlled Turning and Milling machines DMG MORI is your perfect partner for individual process chains with **154 different** machine types.*

- + High precision measurement capabilities
- + Robust statistical analysis tools for evaluating measurement data
- + Traceability by generating detailed inspection reports
- + Automate quality control with a PMI-driven process
- + Quality Workflow with TULIP



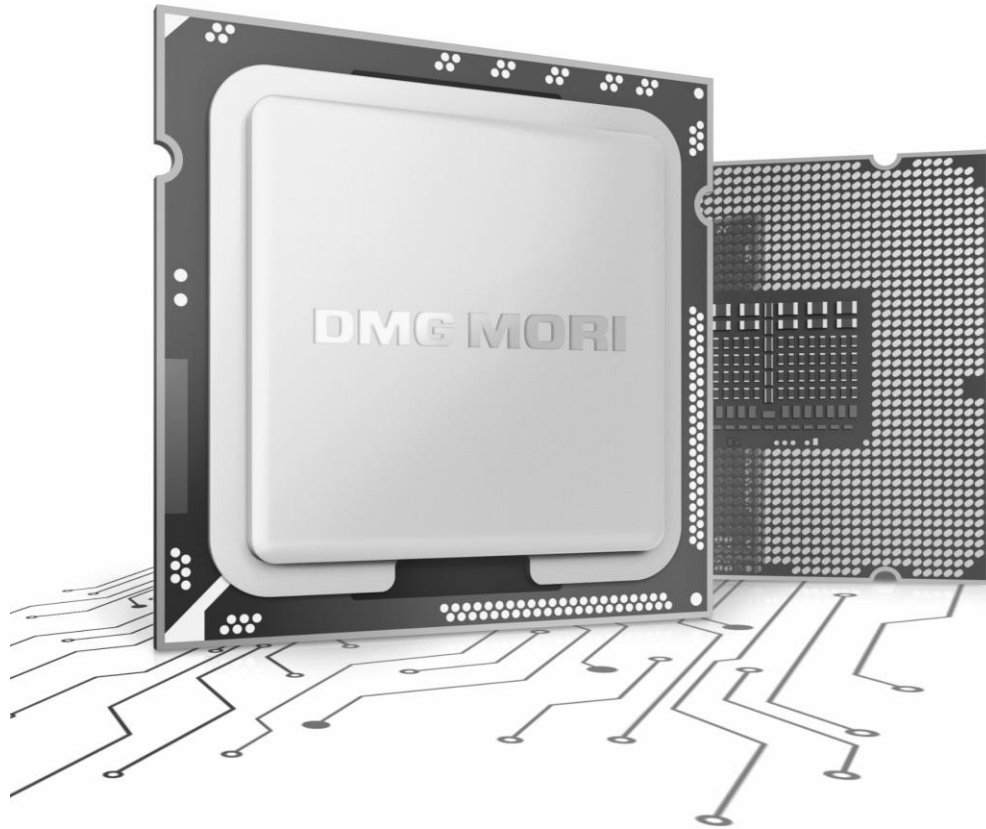


Functional Integration:
Pneumatic Channels



Robo2Go Head

Lightweight Design



ADDITIVE MANUFACTURING FOR SEMICONDUCTOR INDUSTRY

BEST PRACTICE: WAFER TABLE

Thermal Management

- + Optimized internal cooling channels and surface patterns

Fluid Flow Optimization

- + Complex fluid manifolds for reduced pressure drops

Accuracy

- + Parts produced with the additive/subtractive process chain can deliver high accuracy

Weight Reduction & Less Parts

- + Eliminates the need for brazing and multipart assembly elimination

Structural Optimization

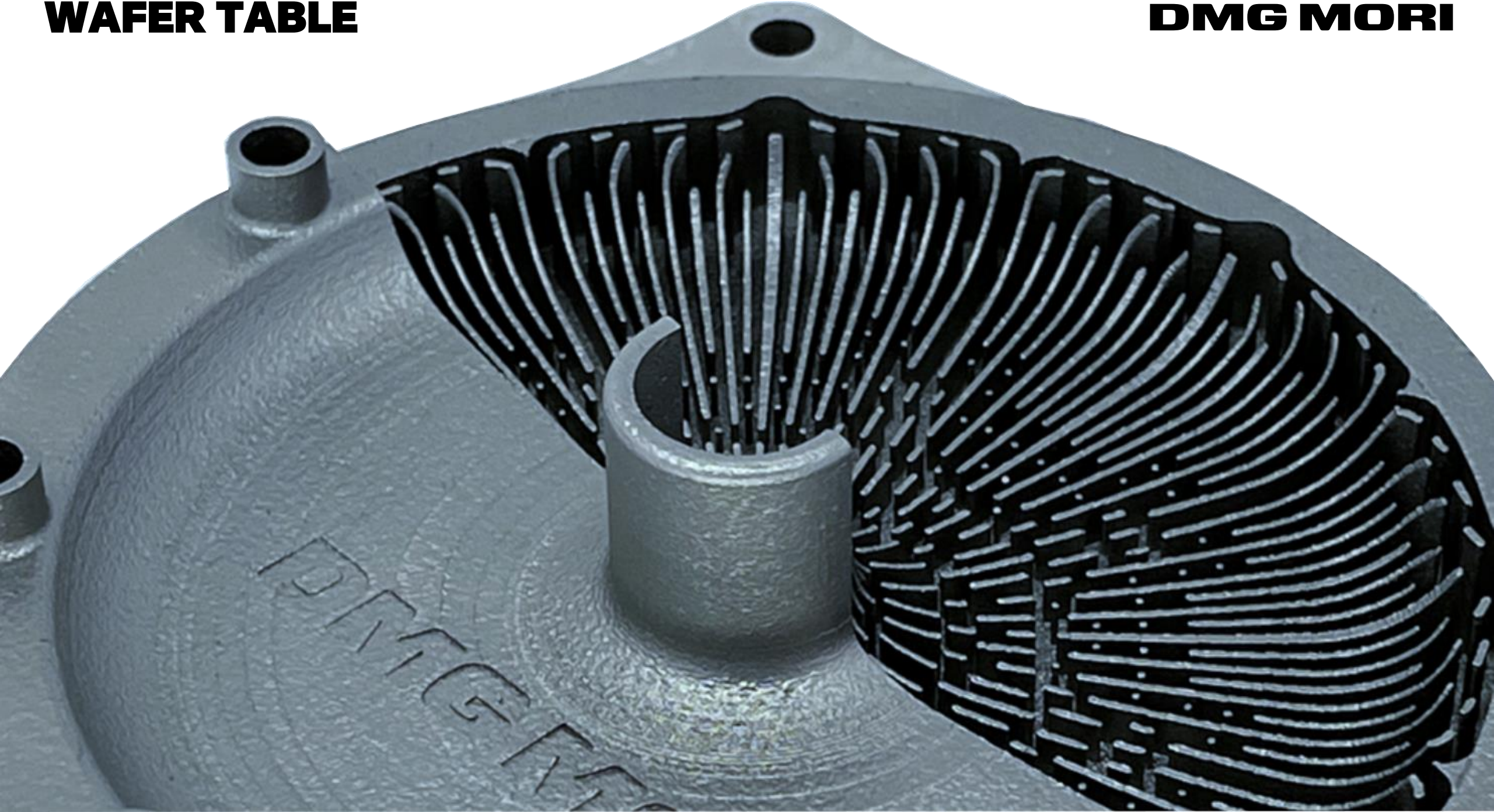
- + Lightweight, high-strength parts, improving performance and reducing system vibration

Significant cost savings

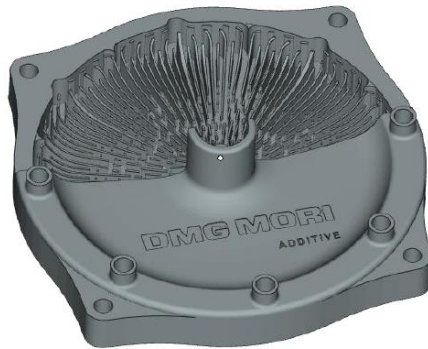
- + Reduced waste and use of less expensive materials for prototyping

WAFER TABLE

DMG MORI

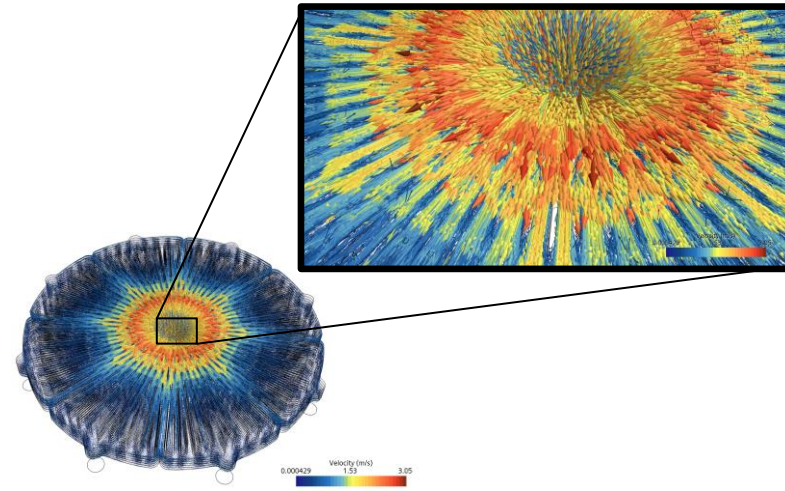


PART DESIGN



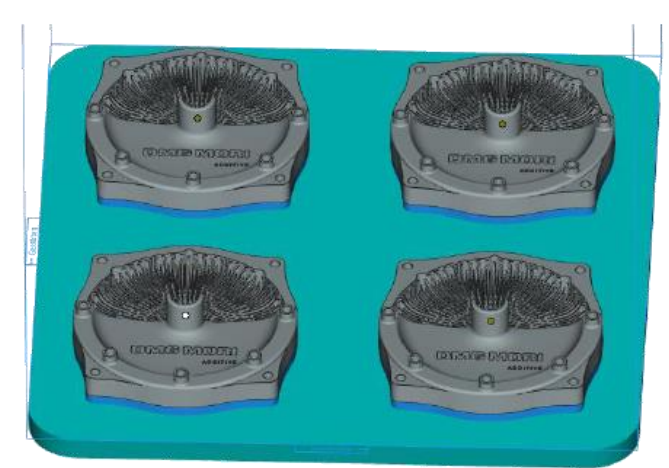
- + Optimized CAD design developed for weight optimization
- + Dimensions :110 x 110 x 26 mm

SIMULATION



- + Multiple iterations simulated of different CAD designs
- + Selection of best CAD Model for thermal management

ORIENTATION & SUPPORT

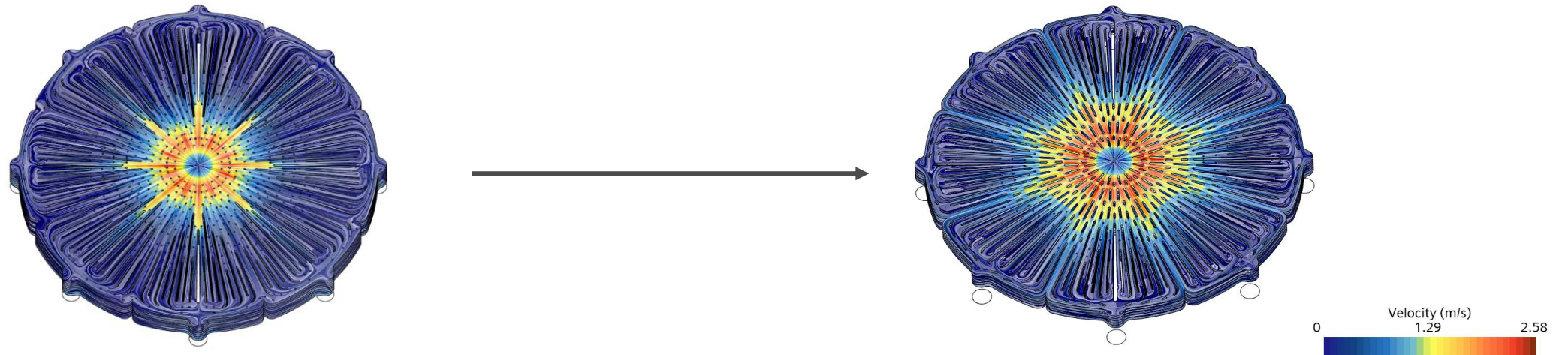


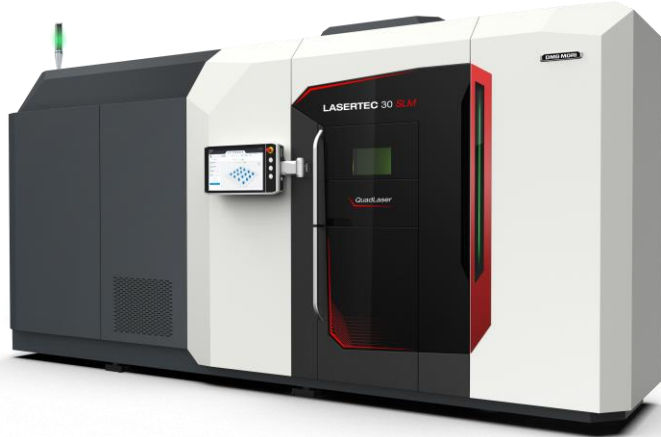
- + Virtual workpiece is oriented on building platform
- + Up to 4 part per platform

UNIFORM FLUID VELOCITY



FLUID FLOW TURBULANCE ELIMINATION





LASERTEC 30 SLM 3rd Generation



WAFER TABLES with build plate



Additive Manufactured WAFER TABLE

PROCESS DETAILS

- + Material: Stainless Steel
- + Layer thickness: 60 μ m
- + Build time: **17 h (4 Parts)**
- + Dimensions: 110 x 110 x 26 mm
- + Part per platform: 4
- + Laser : 2 x 600 W

CUSTOMER BENEFITS

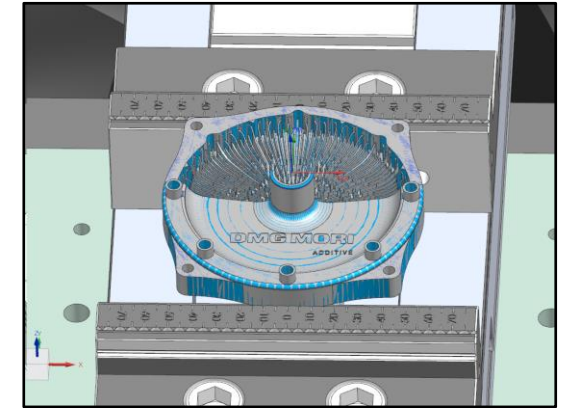
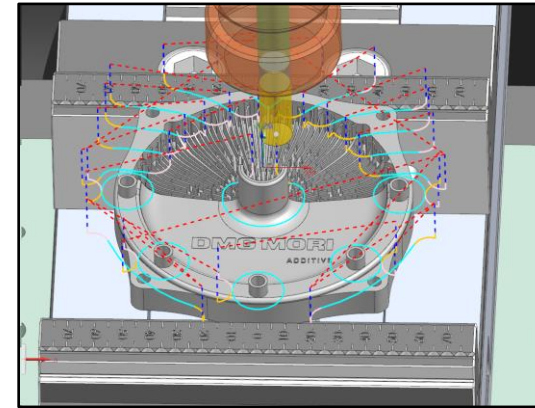
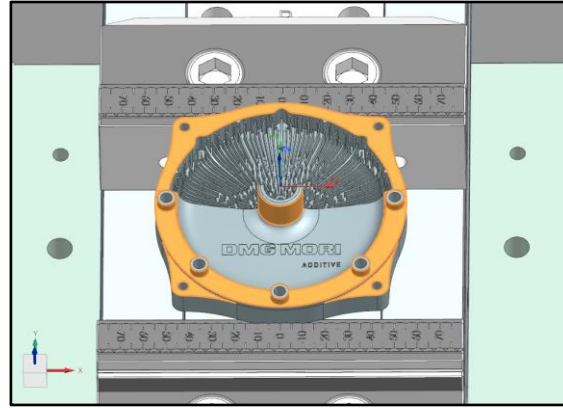
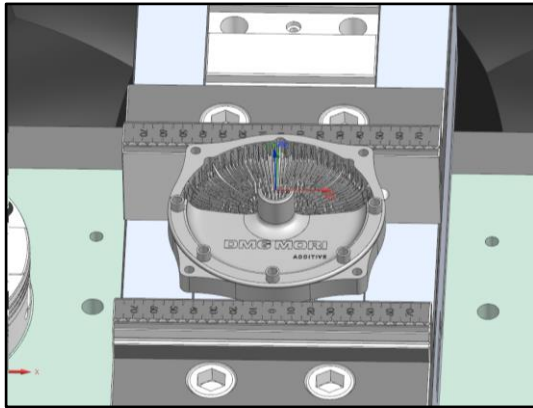
- + Optimized internal channels and surface patterns reduces temperature fluctuations
- + Reduced pressure drops and decreased disturbances
- + No multipart assemblies resulting in less assembly efforts
- + Less seals and reduced labor cost

CAD-FILES

OFFSET

MACHINING

RESULT



- + CAD-File imported in CAM Software
- + Orient the part in the Vice

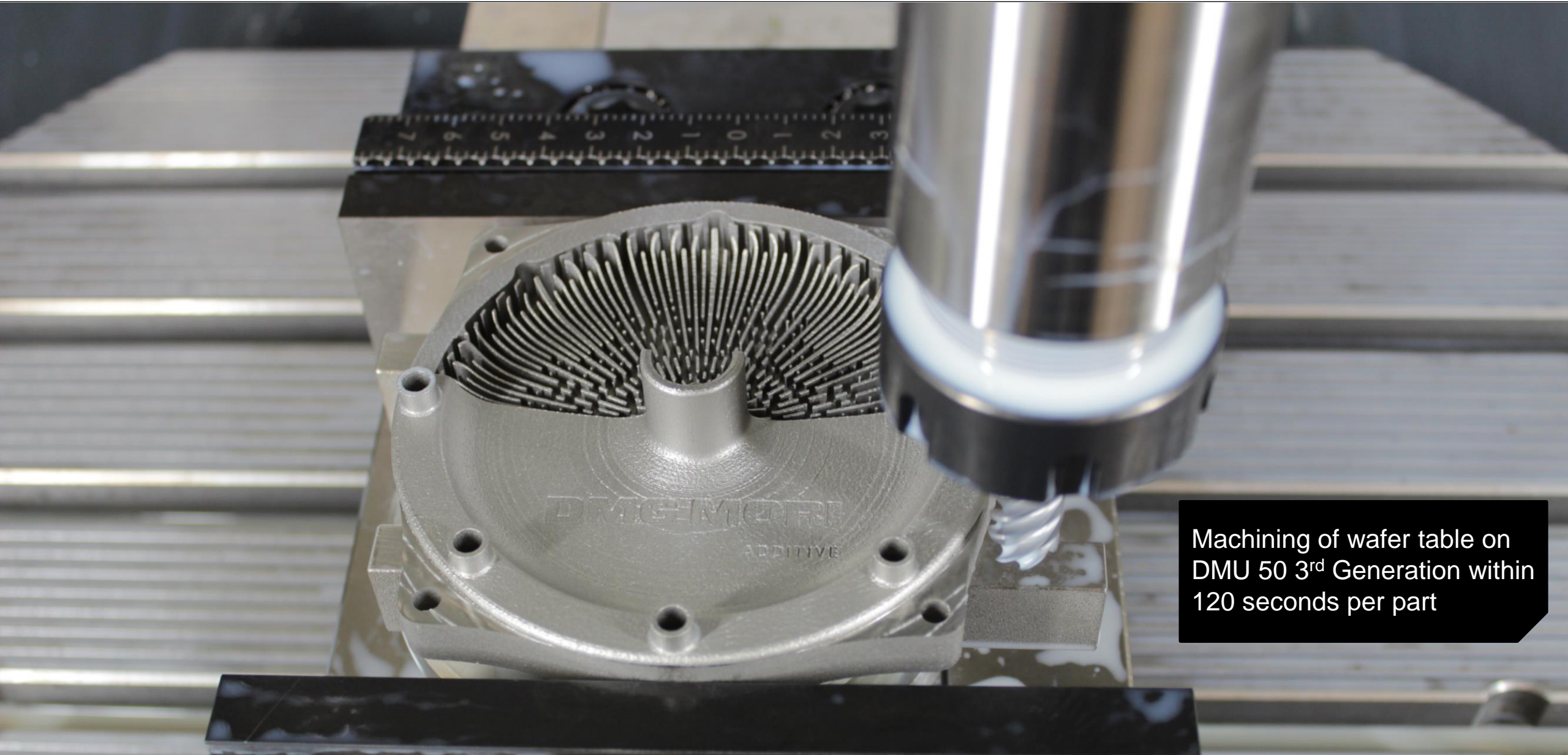
- + Set offset on the machining surfaces which need to be milled
- + Set the Zero reference point

- + Plan the machining path
- + Simulate the machining

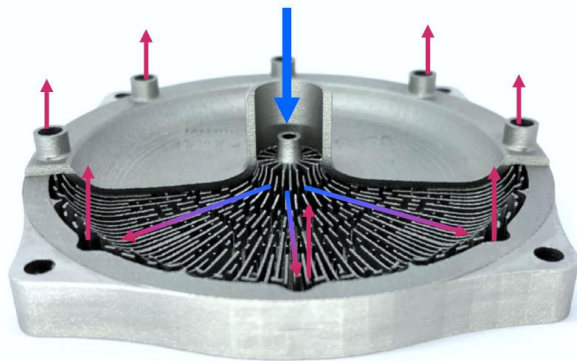
- + Virtual finished part



Machining with DMU 50 3rd Generation



Machining of wafer table on DMU 50 3rd Generation within 120 seconds per part



Fluid flow direction in wafer table



Additive manufactured and machined wafer table



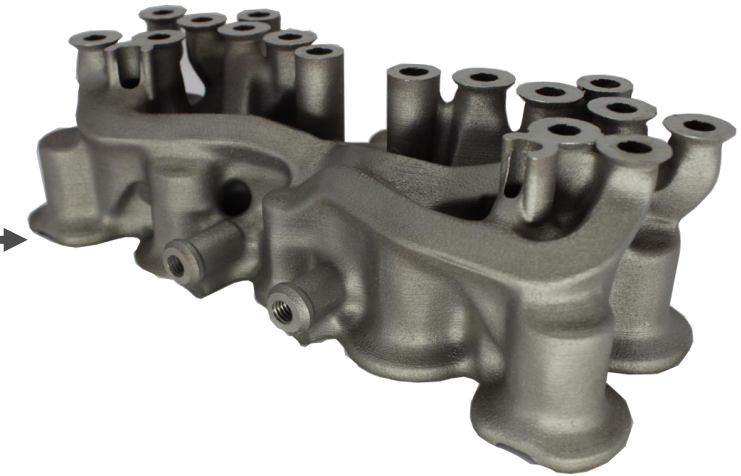
High quality surface finish for wafer production



LASERTEC 30 SLM 3rd Generation

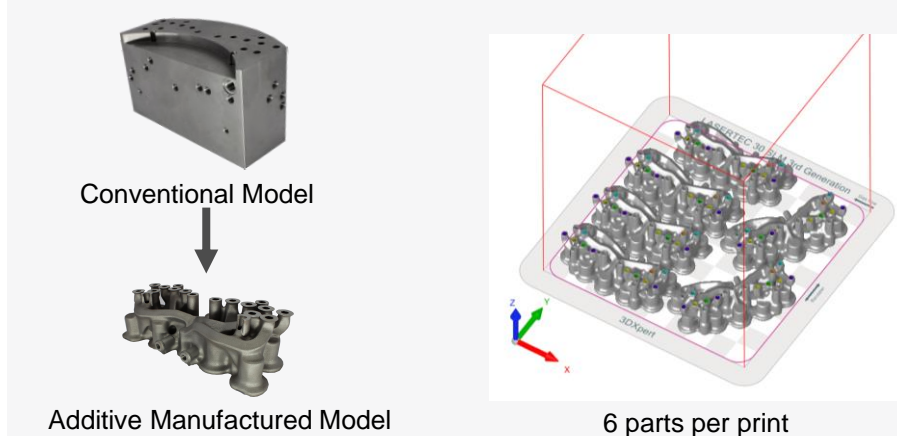


DMU 50 3rd Generation



Finished Part

PROCESS DETAILS



- + Material: ToolSteel_1.2709
- + Layer thickness: 50µm
- + Build time: **24 H (6 parts)**
- + Dimensions :173 x 81 x 50
- + Part per platform : 6
- + Laser : 4 x 600 W

CUSTOMER BENEFITS

- + **80 %** weight reduction with minimize material usage
- + Integrated channels for optimized fluid flow
- + No channels interference and milling pilot holes anymore
- + No seal points make assembly time shorter



ADDITIVELY MANUFACTURES PARTS



Sensor Block Holder



AKZ Holder



Robo2Go head



Drawbar



AKZ Adapter



Robot head



Turret Manifold



Powder Nozzle



Stealth Nozzle



Magnescale tool



NZi manifold



Powder sieve



Grinding Dresser Nozzle



SK Gripper

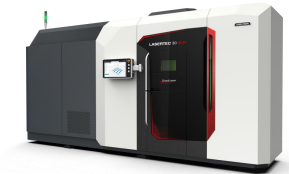


Flow Ring Nozzle

MACHINES USING AM PARTS



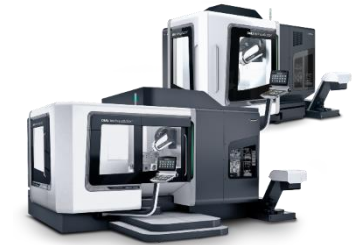
NHX series



LASERTEC SLM



Robo2Go



DMU series



NZi series Machine



WH cell



YOUR CONTACT PERSON

FRIEDEMANN LELL

MANAGING DIRECTOR

MOBILE: +49 171 6287442

FRIEDEMANN.LELL@DMGMORI.COM

**THANK YOU !
FOR YOUR ATTENTION**