Innovationen in der SLM-Technologie – Wie Multilaser-Systeme und supportfreie Bauprozesse die Produktivität steigern

Dr. Dieter Schwarze SLM Solutions Group AG

www.slm-solutions.com

Evolution of Multi-Laser SLM

F&S Realizer SLM®250
First machine with fiber laser technology

MCP Realizer
400 Watt technology

SLM®250HL

SLM®125HL &

SLM®280HL
Twin Laser

SLM®800

SLM®280 PS

Next Gen
Release 11/10/20

2002 | 2003 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2013 | 2016 | 2017 | 2018 | 2019 | 2020

F&S Realizer from 1998/99

SLM®100
MCP Realizer

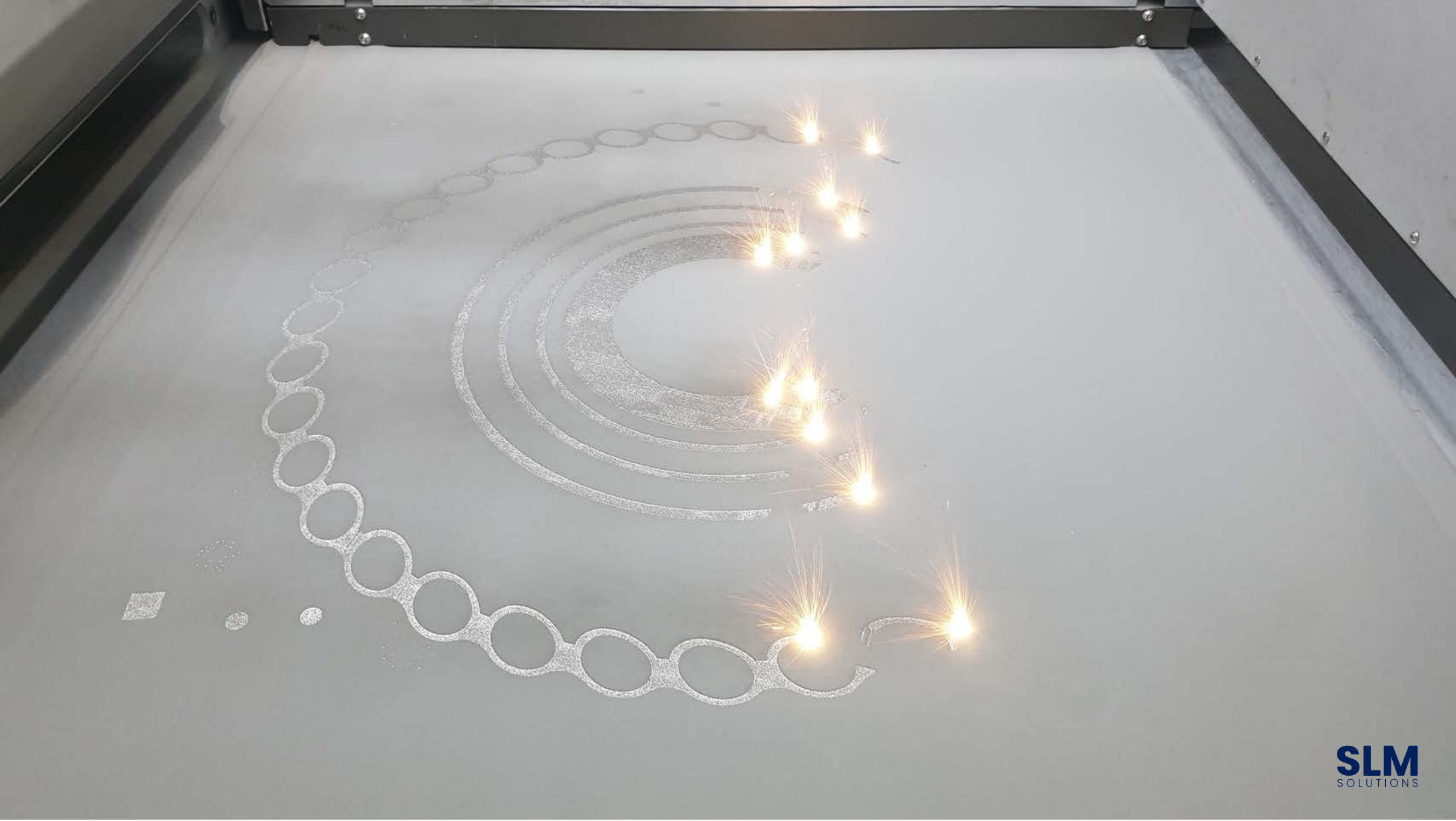
Splitting of MTT Technologies into:
- SLM Solutions GmbH
- Renishaw

SLM Solutions GmbH

SLM®500
Quad Laser

SLM®280 2.0
With patented Gas Flow Upgrade

SLM®800 HUB
Multi-Machines Setup



SLM
SOLUTIONS

Engine Mid Frame

Demonstration Application

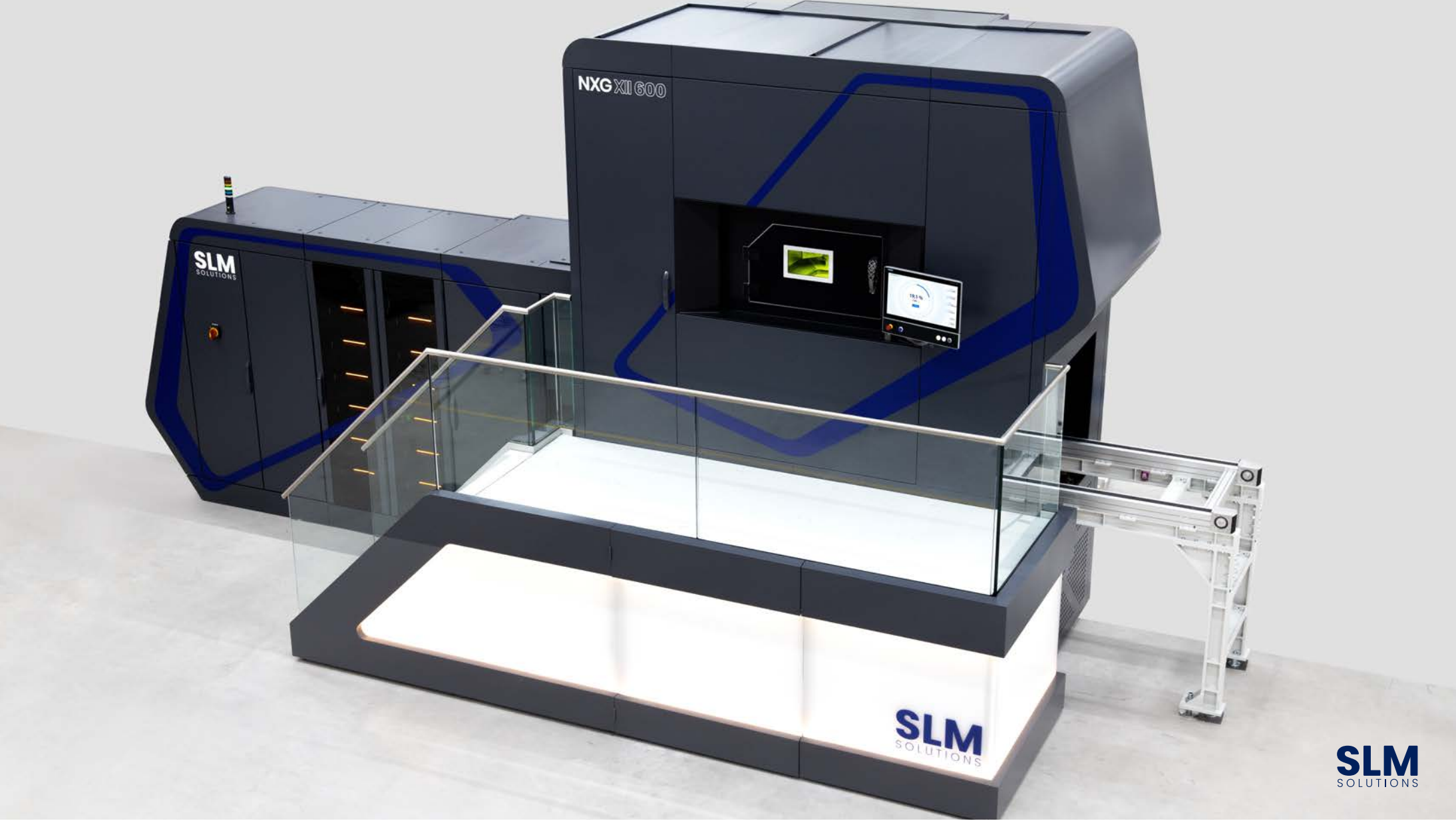
In this case standard high-quality parameters were applied on the NXG XII 600 from our qualified process for the SLM500. Specific high power parameters up to 900W are under development and will result, in combination with the zoom function and an AM re-design, in a massive increase of build-up rate by a factor of 2-3.

Part Specifications

- Material: IN718
- X,Y dimensions: 560 mm part diameter
- Height: 427,5 mm
- Total Parts Volume: 9,2 liters
  - Supports: 5,3 liters

Build parameters

- Laser Power: 350 W
- Layer thickness: 0,06 mm
- Build time: 69,9 h
- Build-up rate: 207,9 cm^3/h
- The part was not yet performance optimized. Supports and scan strategy will be improved. Supports to be removed by geometry adoption and Free Float utilization.



SLM
SOLUTIONS

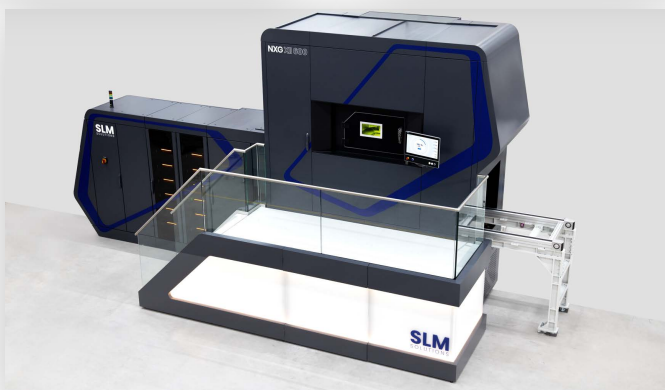
Key Product Features

Productivity

12x 1000W lasers sources | intelligent laser load balancing | variable spot size | bi-directional | 90/120µm recoating layers

Quality

80µm focus diameter | 30/60µm layers | automated calibration | 200°C pre-heating | gas flow | low ppm O2 atmosphere | job report



Safety

Machine and operator safety | cylinder lid mechanism for closed environment

Open architecture

Siemens PLC | OPC-UA interface | modularity | application-oriented periphery | quick installation tools

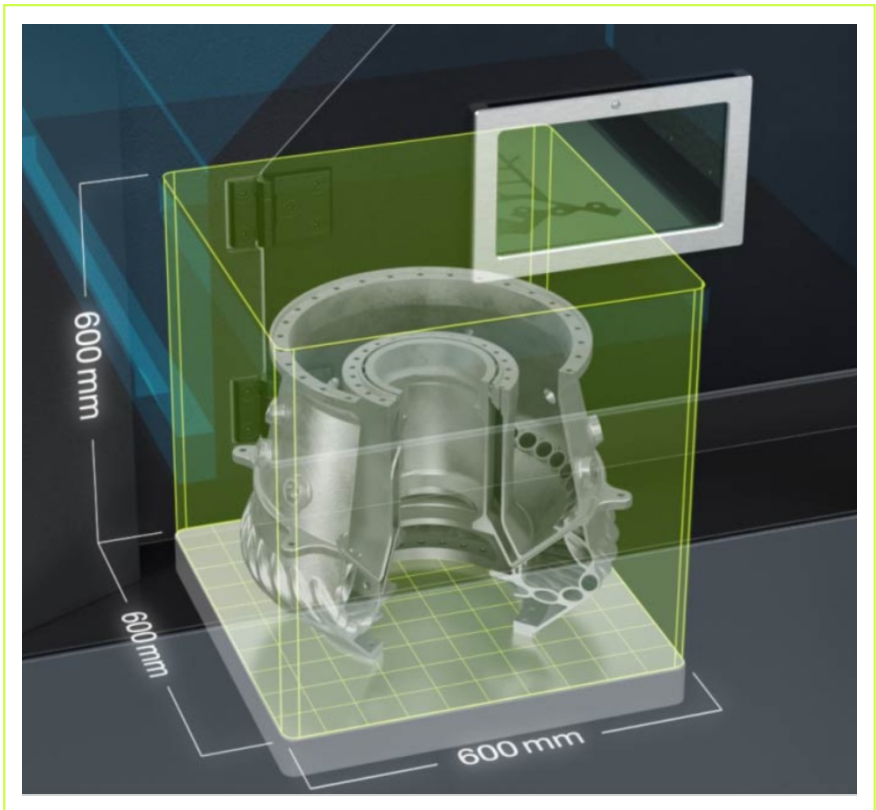
Build Envelope

Build Area
600 x 600
removed screws to increase field of use

Build Height
600 mm
considering a 60mm thick substrate plate

Build volume
216 L

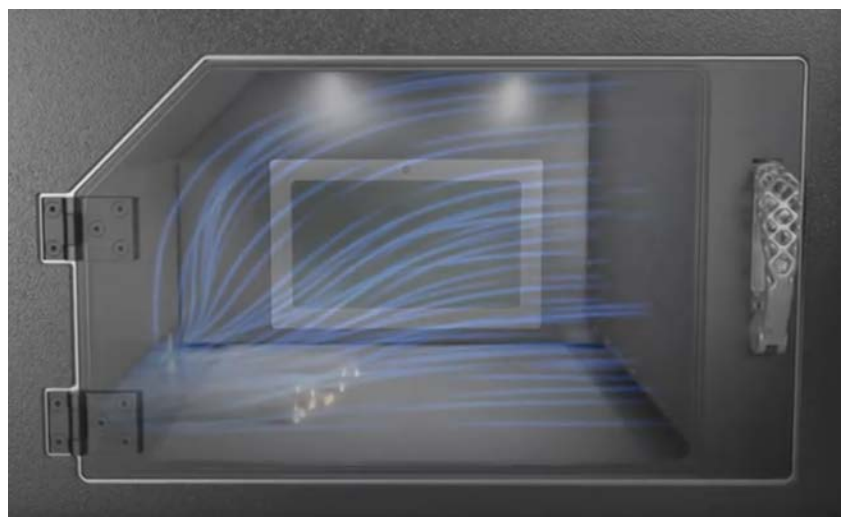
- Enabling large parts or huge quantity of parts to be produced



Gas Flow

- Consistent shielding gas flow over the whole build area
- Patented sintered wall technology

➢ Clean process chamber enables production of high-quality parts

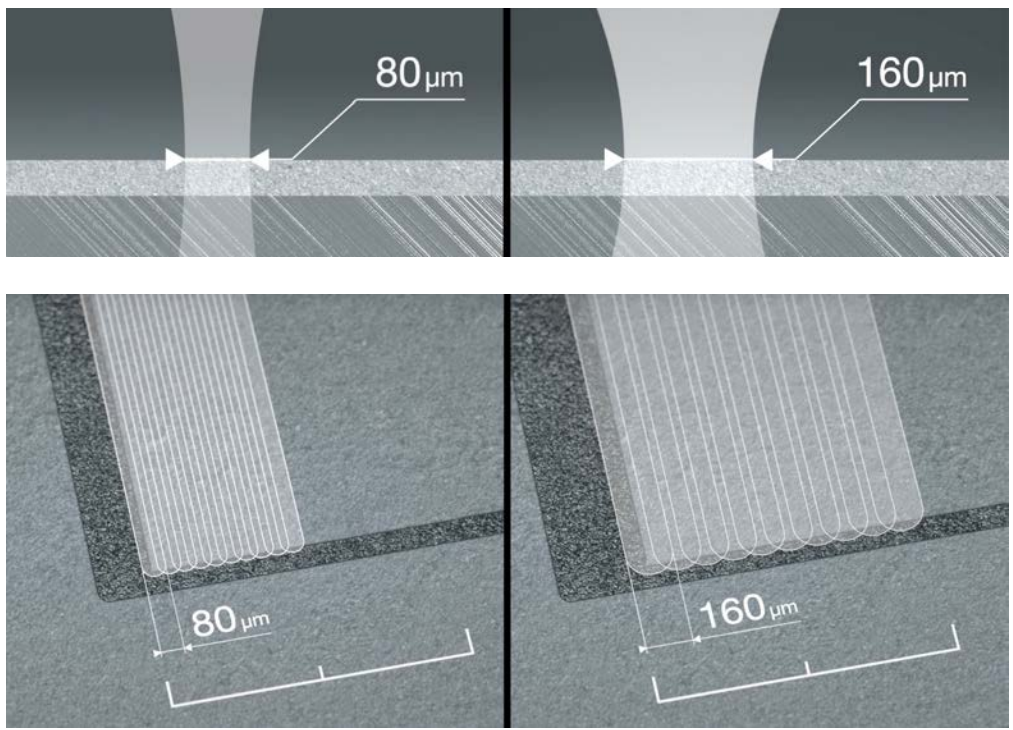


Zoom Function
variable spot size

The SLM® Optics Module allows shaping of the beam diameter from 80 to 160µm in the focus.

- Allowing to operate with more laser power in the SLM® process.
- Reduction scanning paths.
- Additional defocusing is still possible
- More stable melt pool

➢ Productivity boost to a new level



80µm process 160µm process

Success Story: 4 Cylinder Head

SLM® 500 Quad-700W – 90µm – 1 Part

Material Data Sheet

SLM SOLUTIONS

Al-Alloy AlSi10Mg[1]

90 µm / 700 W[9]			As-built
Build-up rate[10]	[cm³/h]		86.0 cm³/h
Component density[11]	[%]		≥ 99.0 %

Tensile test[12]			M	SD
Tensile strength	R_m [MPa]	H	398	5
		V	380	16
Offset yield strength	$R_{p0.2}$ [MPa]	H	230	3
		V	206	4
Elongation at break	A [%]	H	7	1
		V	5	1
Reduction of area	Z [%]	H	6	1
		V	4	2
Young's modulus	E [GPa]	H	67	8
		V	65	4

Hardness test[13]		M	SD
Vickers hardness	HV5	112	2

Roughness measurement[14]			As-built		Corundum blasted		Glass-bead blasted	
			M	SD	M	SD	M	SD
Roughness average	Ra	[µm]	13	1	9	1	7	1
Mean roughness depth	Rz	[µm]	76	7	47	4	37	4

Material: AlSi10Mg

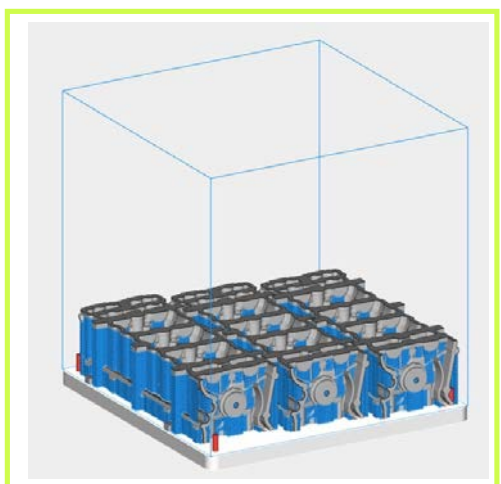
Part weight: 13,9 kg

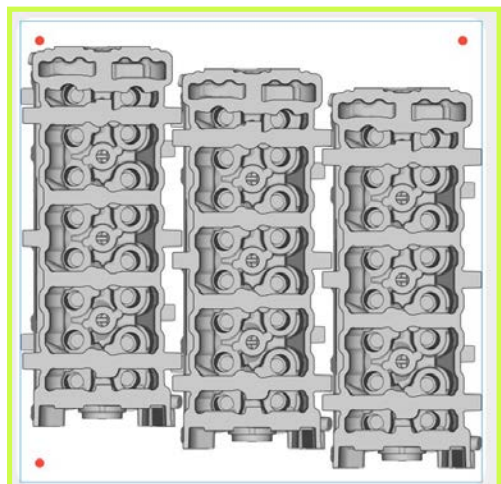
Layer thickness: 90 µm – **1 part build time: 27 h**

Build rate: 194 cm³/ h

Success Story: 4 Cylinder Head

NXG XII600 - 12x1000W – 90µm – 3 Parts





Material: AlSi10Mg

Parts weight: 13,9 kg x 3 = 41,7 kg

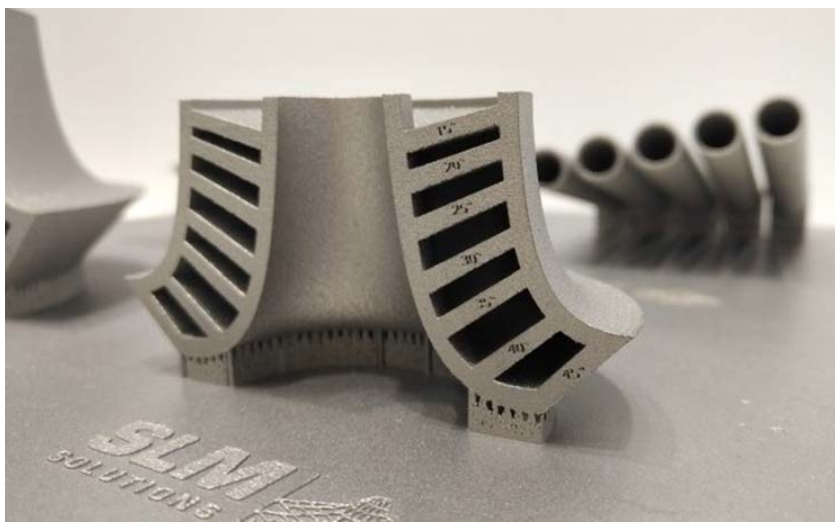
Layer thickness: 90 µm – **3 parts build time: 24,8 h**

Build Rate: 630 cm³/ h

Free Float

Formnext 2018

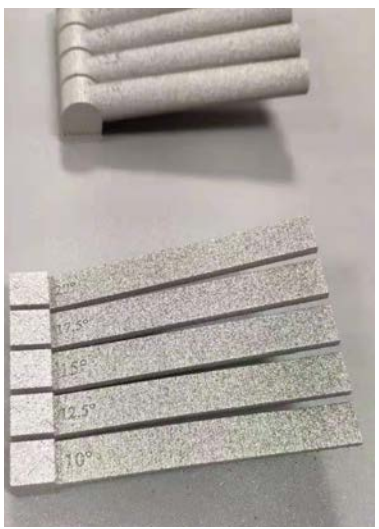
Free Float 2021

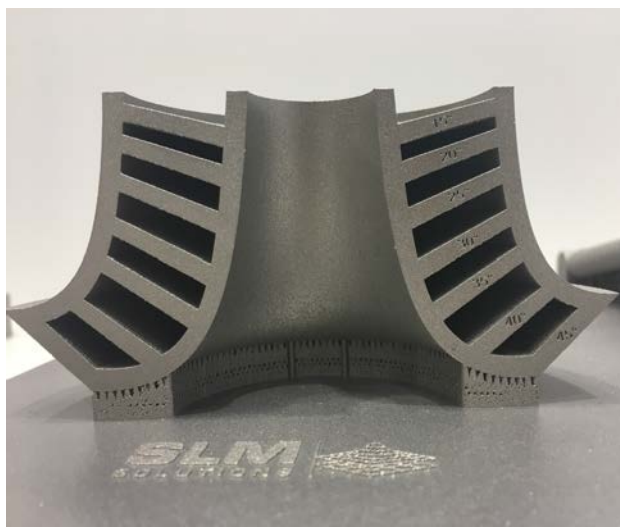


Free Float enables SLM® users to:

- drastically reduce or eliminate supports for less post-processing
- increase the diameter of internal cooling channels
- be more precise on thin-walled or sharply edged components
- improve surface finish
- reduce peel-up on complex geometry

Reduction of supports & low angles



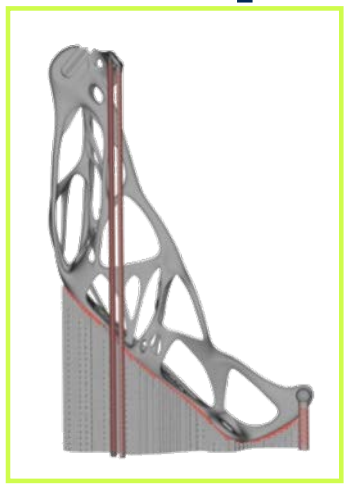


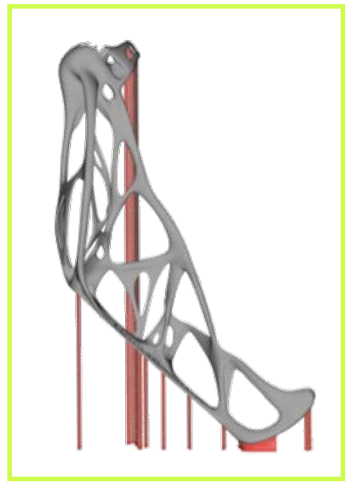
Free Float demonstrated potential:

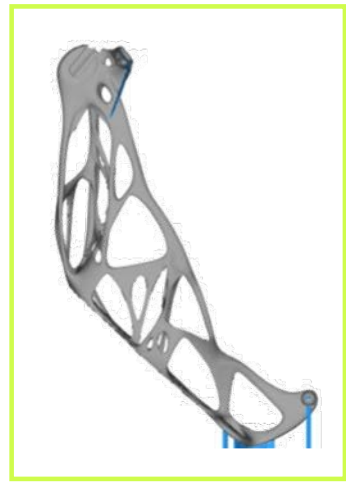
Long range geometry to 10°

Short range geometry to 5°

Free Float is productive



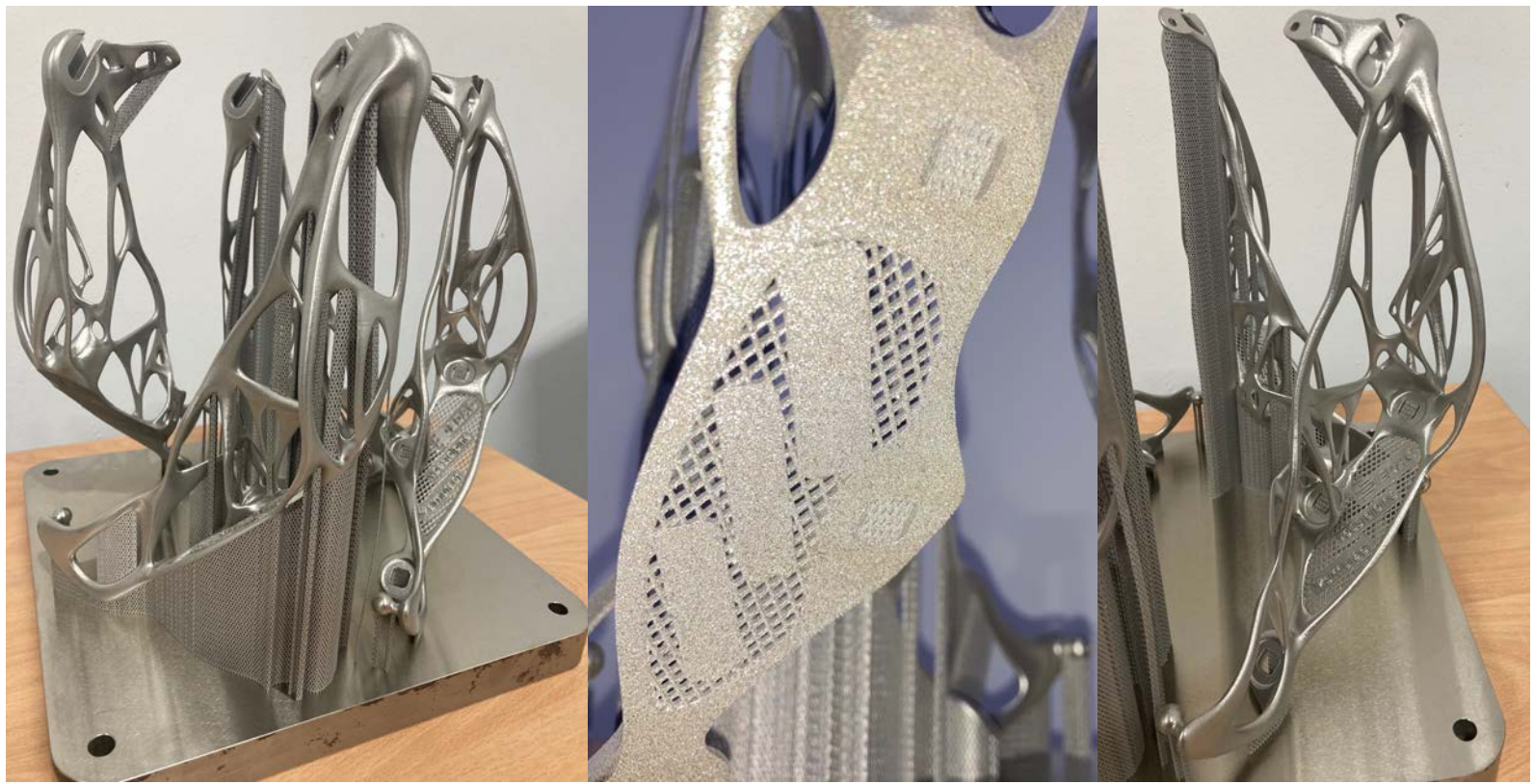




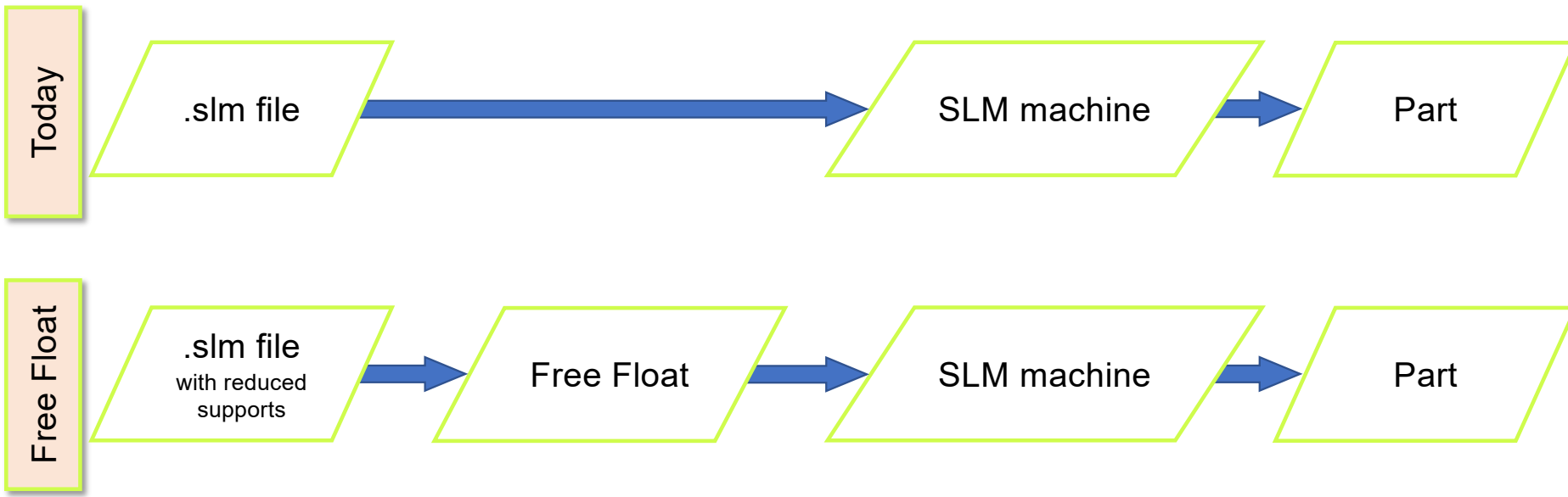
	Without **Free Float**	With **Free Float**	With **Free Float**
Material	IN718	IN718	IN718
Supports	Block Supports up to 45°	Supports up to 27.5°	Flat sections + connections
Support Volume	59588 mm³	2390 mm³ **-96%**	767 mm³ **-99%**
Build time (dd:hh:mm)	02:14:18	02:14:16	Comparable build time, but multiple parts on platform (see next slide)
Post Processing (hh:mm)	**01:30**	**00:15** **-83%**	**00:05** **-94%**

Free Float does not use an alternating scanning pattern with punctual melting, which allows us to be more productive than other solutions. Less supports automatically lead to largely reduced post processing and smoother surfaces directly after the build.
Part: Lighthinge (EDAG, voestalpine, simufact)

Free Float is productive

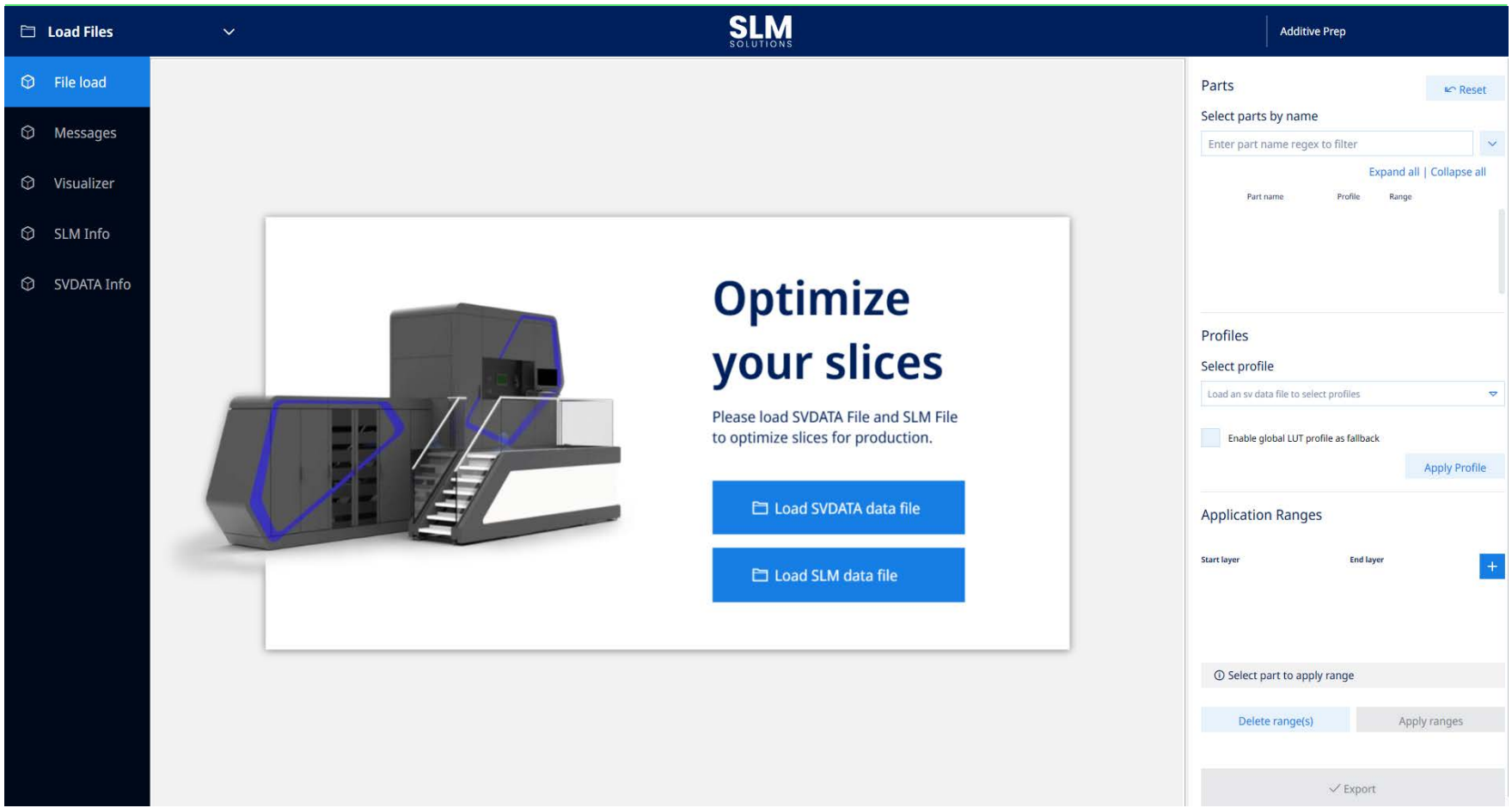


Free Float Workflow

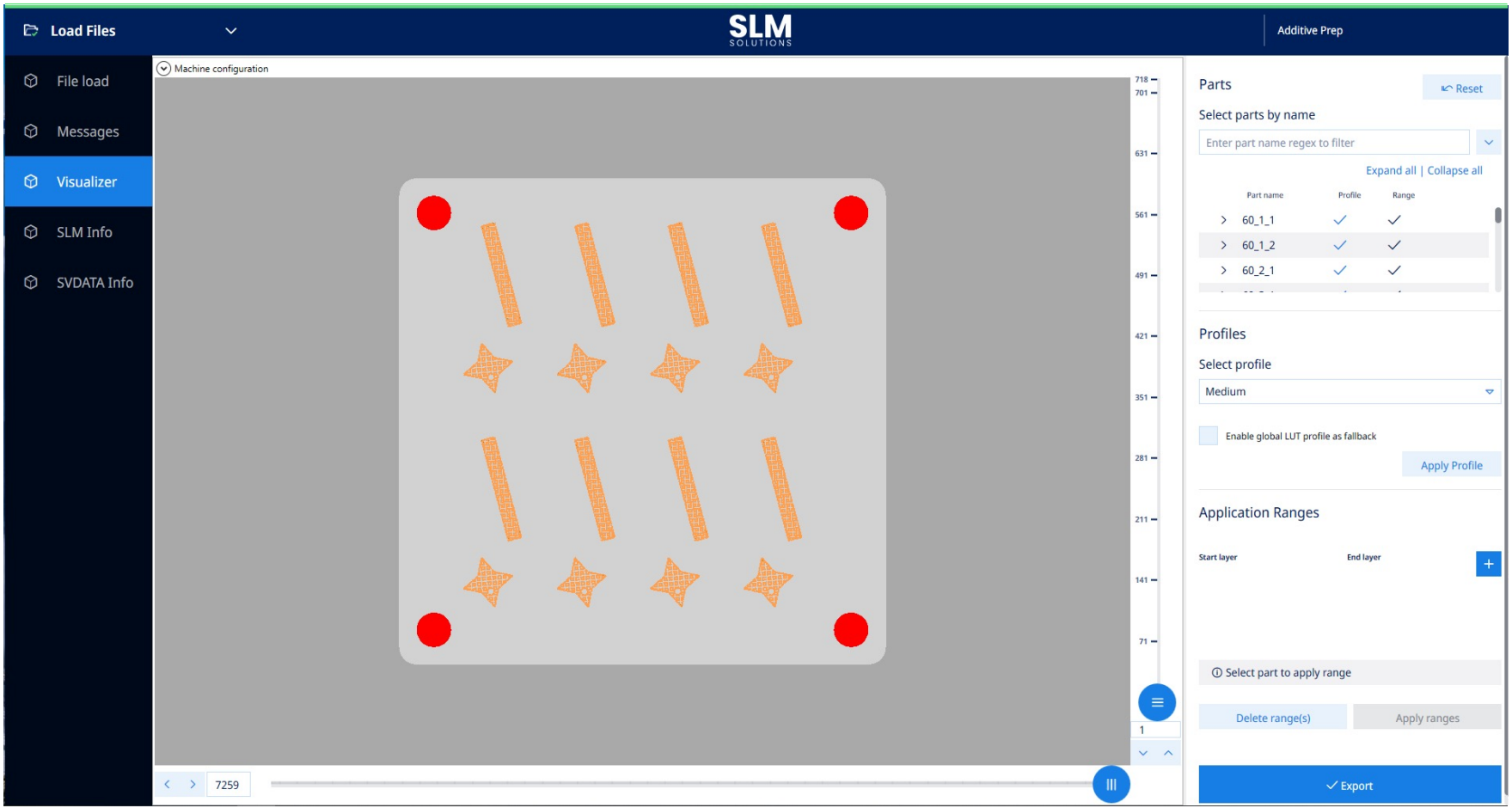


Free Float is an additional pre-process step and starts with a regular .slm file
Next, so-called profiles are added to the part
Profiles can be assigned partially or to a whole part/file
Finally, a new .slm file containing Free Float information is exported
This file is loaded into MCS

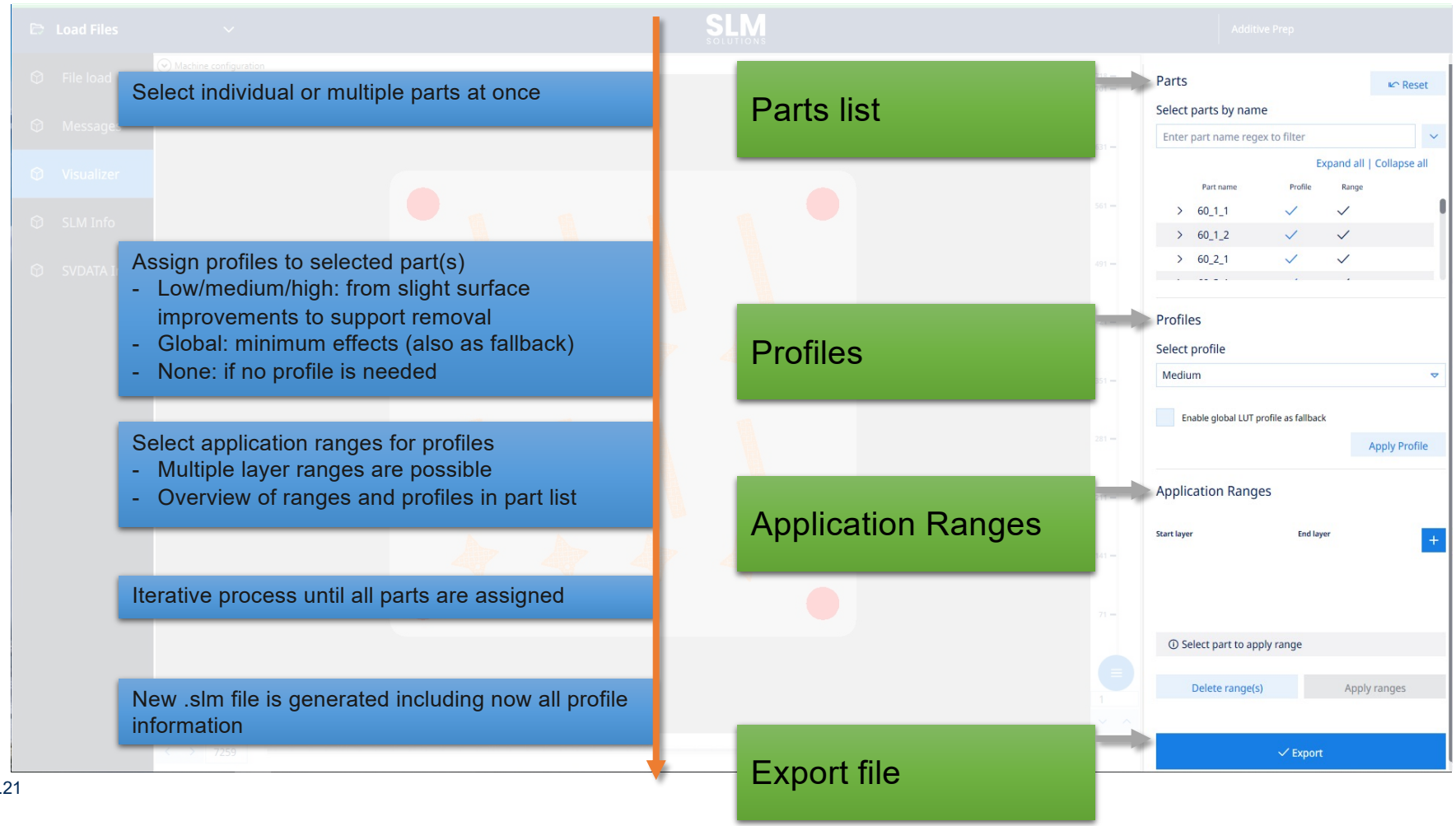
Free Float Workflow



Free Float Workflow



Free Float Workflow

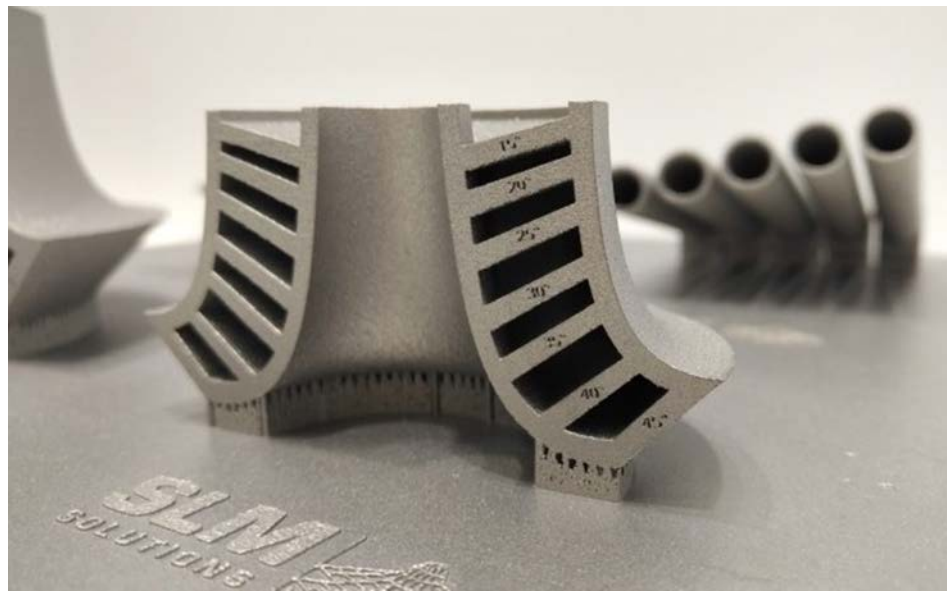


Product availability

- **Free Float** requirements:
  - SLM280, SLM500, SLM800 with
    - latest airflow (CE2 configuration)
    - MCS 2.6
    - Recoater brush
  - New desktop Software

Retrofittable to existing machines

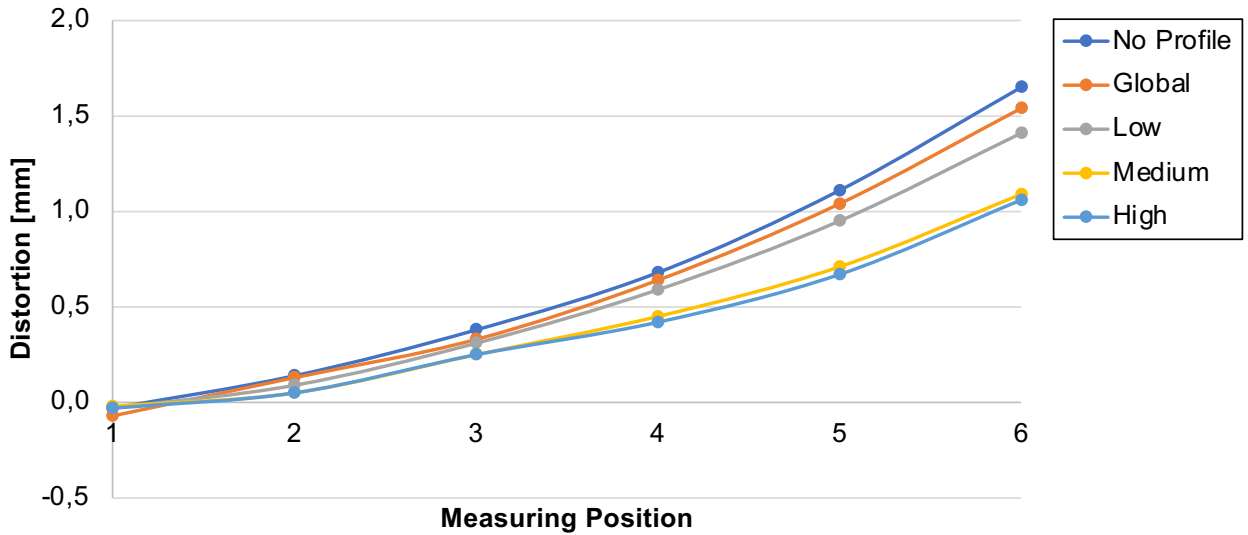
- **Free Float** will be launched with following materials:
  - IN718
  - TiAl6V4



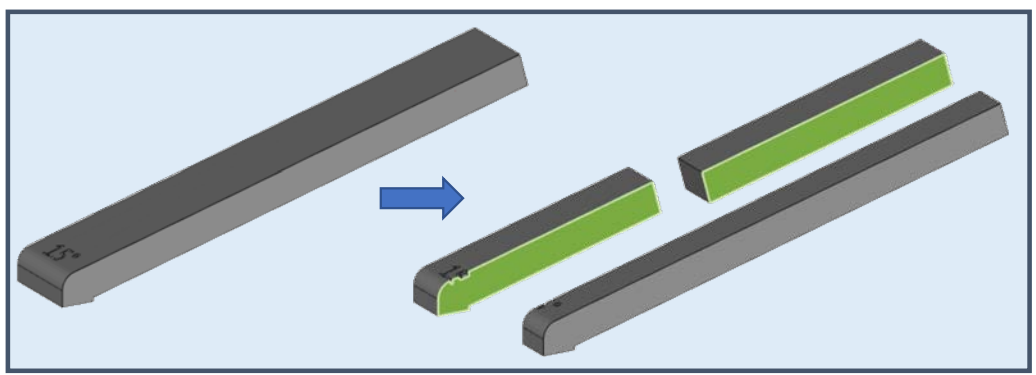
Official Announcement: June 2021 / Product Availability: 4Q21

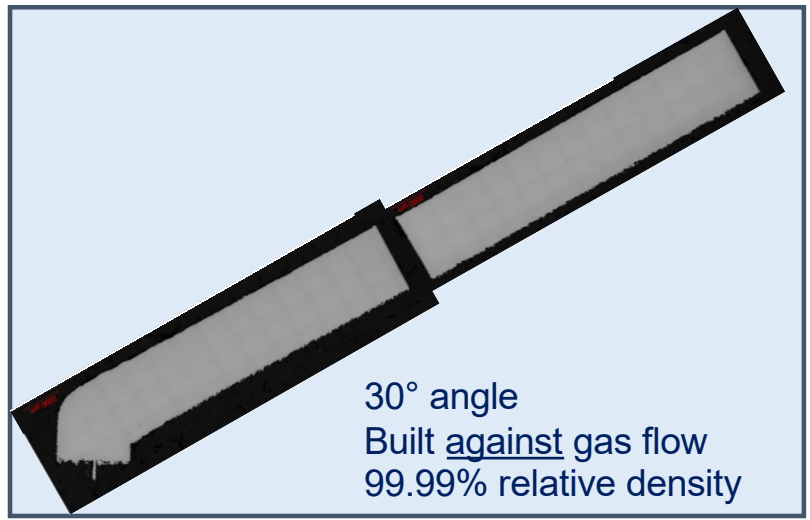
Ti6Al4V

Distortion of Cantilevers caused by residual stresses

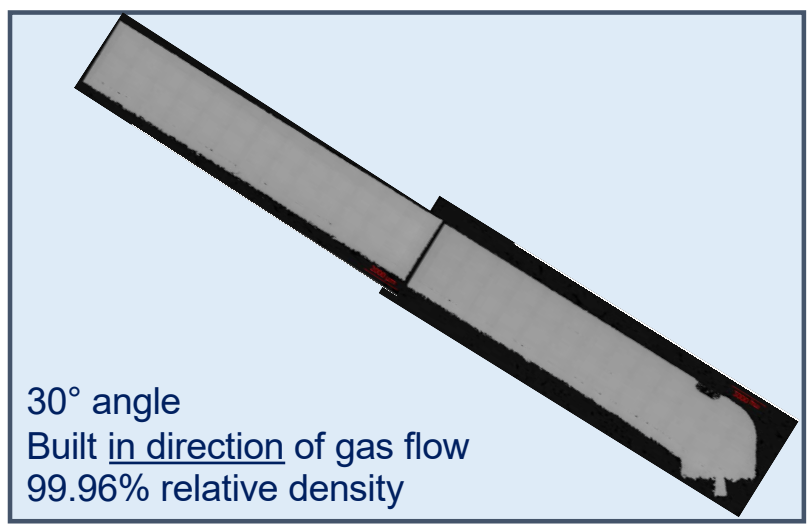


Ti6Al4V
Relative Density





30° angle
Built against gas flow
99.99% relative density



30° angle
Built in direction of gas flow
99.96% relative density

Thank you.