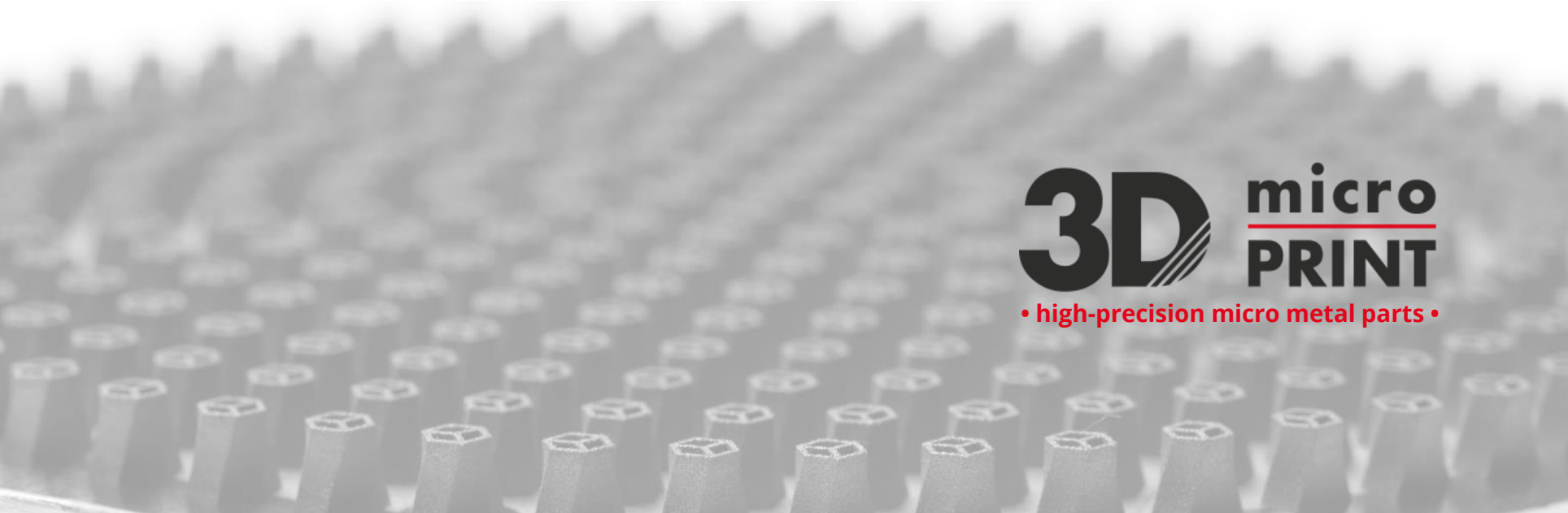


3D micro PRINT

• high-precision micro metal parts •

Micro Laser Sintern

3D MicroPrint GmbH 2024

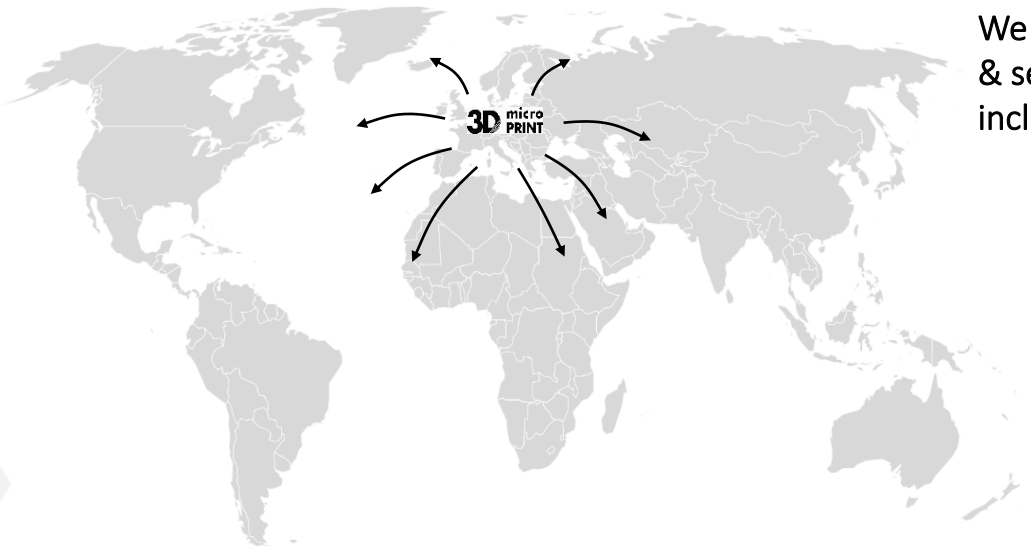
 Release: 04/2024

3D MicroPrint GmbH

- **Since 2006:** Technological development of laser beam sintering through cooperation between 3D-Micromac & EOS
- **2013:** foundation of the company 3D MicroPrint
- Business model:
  - Micro metal parts (prototypes to large serial production)
  - Engineering & design services for 3D printing
  - Micro Laser Sintering machines
- Certified according to **ISO 9001**
- Work according to **ISO EN 13485**

We specialise in the manufacture of high precision micro metal parts and micro laser sintering machine technology.

3D MicroPrint GmbH



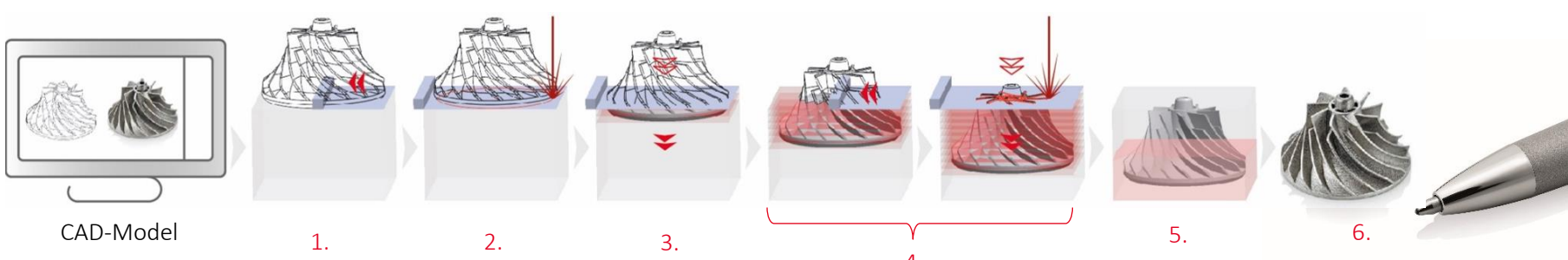
We have over 10 years of experience in technology & serial production for all types of industries, including:

- Medical & robotics industry
- Automotive & Aerospace
- Fluid engineering
- Energy technology
- Jewelry & watches

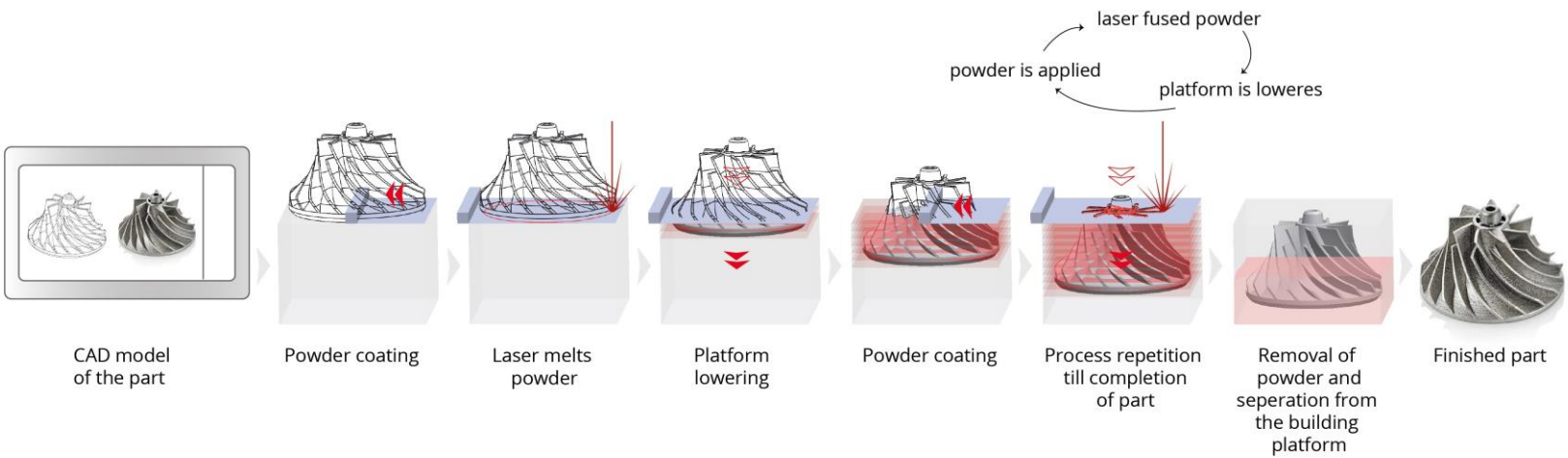
- Business model:
  - Technical Services > Prototyping > Serial Production
  - MLS-machines sales

MLS - Technology / Process description

1. A powder bed of **< 10 µm layer** of ultrafine metal powder less than **5 µm** thick is applied to the platform.
2. The laser spot smaller than **30 µm** melts the sliced structure of a three-dimensional micro-object.
3. The platform is lowered by the thickness of the **powder bed < 10 µm** to apply the next layer of powder.
4. The entire process of steps 1-3 of powder **coating, fusing & lowering** the platform is repeated until the desired target geometry is achieved by the full size of the part.
5. At the end of the building process, the platform is de-powdered, further cleaned by ultrasonic & the parts are cut from the platform by fine **wire EDM**.
6. If required, the **post-processing** can start.



MLS - Technology / Process description



- Powder particle size: D90 < 5 µm
- Minimum layer thickness: 1 - 10 µm
- Laser focus: < 30 µm
- Minimum wall thickness: 30 µm
- Component density: > 99 %
- Roughness (as built): Ra 2-3 µm

Key data & Materials

Key data for MLS:

- Prototype part accuracy: <5 µm
- Serial part accuracy: <25 µm
- Minimum wall thickness: <30 µm
- Minimum hole diameter: <30 µm
- Minimum gap width: <20 µm

- Powder handling & processing in purified **argon atmosphere** with < 20 ppm O2 & H2O
- Ability to print **complex 3D structures** & **moving mechanisms** in one piece with high accuracy & low clearance

Materials for MLS:

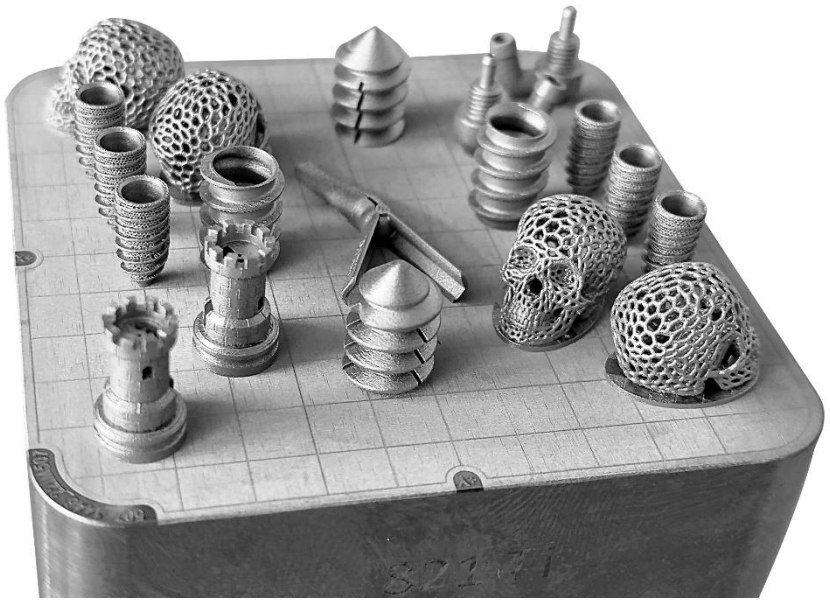
For prototypes / series productions:

- Stainless steel: 1.4404 (316L)
  1.4542 (17-4PH)
- Titanium (alloy): 3.7164 (Ti6Al4V)
  Grade 4/5/23
- Nickel-based alloys: Inconel 718
- Copper: CuCrZr, pure copper

Possible as development project:

- Precious metals (platinium, gold,…)
- Bronze, Tungsten, …
- Molybdenum, …

MLS - Technology



Building platform:

- Build area: 60 x 60 mm
- Build height: 40 mm

Post-processing:

- Wire EDM
- Microblasting (corundom & glas)
- Plasmapolishing

Machine - **DMP 73/74**

Technical specifications DMP 7X:

- Infrared fibre Laser: **50 Watt**
- Laser spot size Ø*: **≤ 30 µm**
- Building platform: **60 mm, max. build height 30/50 mm**
- Layer thickness: **1 µm to 5 µm**
- Powder particle size: **≤ 5 µm (D90)**
- Purified argon atmosphere: < 20 ppm H_20 & O_2
- Gas tight design & gas purification included, low cost of ownership
- Air locks & quick transfer ports
- Remote access for fast service
- Zero-point clamping system
- Processing of highly reactive materials
- Glove box for powder preparation
- Data preparation software & PC
- CE & UL compliance available (option)
- Pneumatic shock absorbers for harsh environments (option)
- Laser upgrade DMP 74: **200 W** infrared fibre laser (option), laser spot size Ø* **20µm**

** calculated diameter*

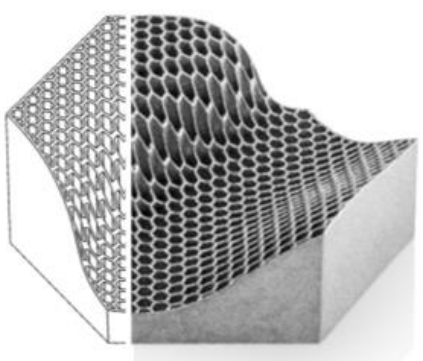
Applicationen MLS

Merger Tree

- Connection tube (Ø 7 mm) branched to 1.024 tubes (200 µm)
- Min. 80 µm wall thickness
- Support free production
- Material: titanium (Ti6Al4V)

Honeycomb

- Complex micro lattice structures
- Honeycomb size (inside) 250 µm
- 60 µm wall thickness
- Material: 1.4542 (17-4PH)



Extruder/ Mixer

- Internal spiraled structures in µ-range with high resolution
- > 150 µm inside wall thickness
- < 300 µm outside wall thickness
- Ra < 1,0 µm surface roughness
- Material: 1.4404 (316L)

Applicationen MLS

Mikrowave-Bandpassfilter 180GHz

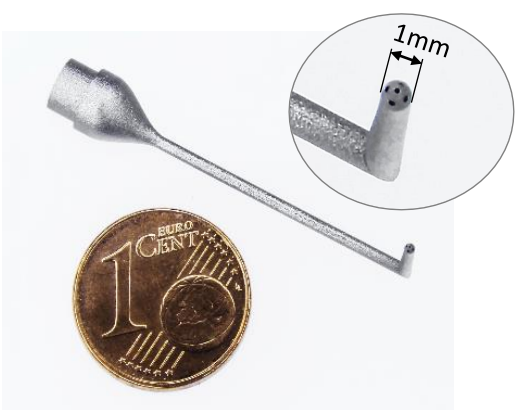
- 200 µm internal structure size
- Ra < 2 µm internal surface roughness
- Material stainless steel 1.4542
- Gold plating for end application
- Application University of Birmingham, UK

Jewellery „Skull“

- Complex 3D-grid structure
- Bar width 250 µm
- Support free production
- Material: gold 18k

5-hole flow sensor

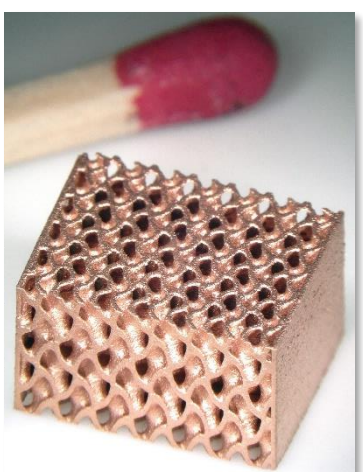
- 5 internal 150 µm channels
- 120 µm internal wall thickness
- Ra < 2,0 µm surface roughness
- Material: 1.4404 (316L)
- Application by Vectoflow GmbH, Germany



Applicationen MLS

Gyro grid structure

- 150 µm wall thickness
- Cell size 1.5 mm
- Material: copper alloy CuCr1Zr



Microwave Components

- Filter, diplexers, horn antennas & various other components
- Material: pure copper CU-OF

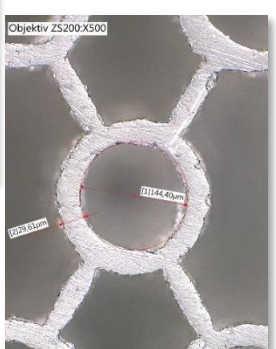
Inductor

- 150 µm internal cooling channels
- 500 µm wall thickness
- Material: CuCr1Zr copper alloy
- Heat treated to achieve conductivity up to 94 % IACS

Applicationen MLS

Heat Exchanger

- Complex micro-grid structure
- Tube inner-Ø 150 µm
- 35 µm wall thickness
- Material: 1.4404 (316L)



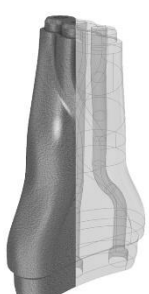
Satellite engine

- Complex structure of the inner channels
- Smallest channel 300µm
- Size: 48 x 40 x 39 mm
- High thermal stability (up to 700 °C)
- Material: 2.4668 (Inconel® 718)

Approved: DLR, Germany

Optical fiber guide

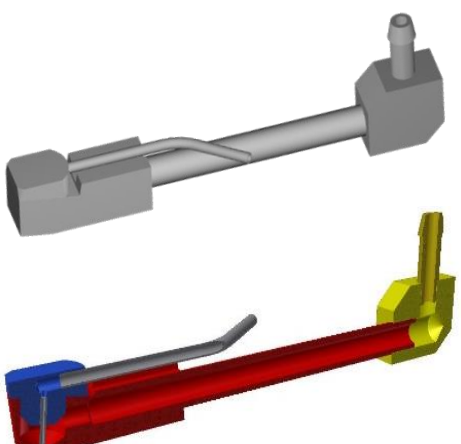
- Twisted fiber guide for modular system
- Complex channel ducts with very good surface quality & geometry tolerances
- Inner channel diameter 500 µm
- Min. 200 µm wall thickness



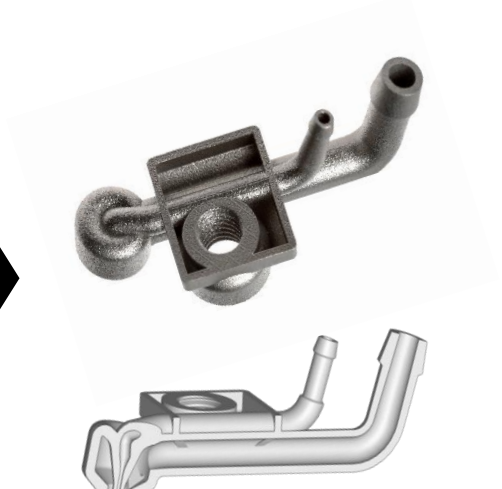
Application „Print-as-one“ – TSL-Dicing Nozzle

→ **Complex assembly** of several bodies is fused into **a single** printable 3D printed component

originale design



print-as-one design for MLS

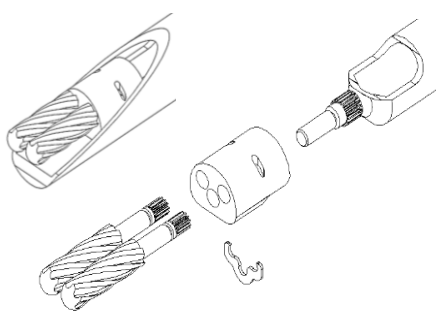


- **1 component** instead of 7 parts
- **Made entirely** of stainless steel
- **60% reduction** in production costs
- **Reduce** lead time

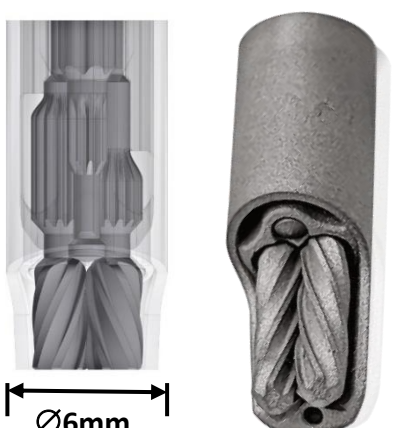
Application „Print-as-one“ – Twin-tipped Arthroscopic Shaver

→ **Complex mechanism** consisting of several bodies printed as **one component**

Design concept



Print-as-one design for MLS

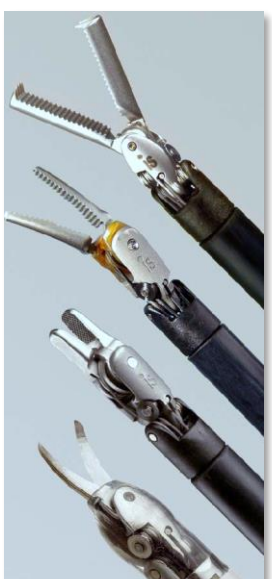


- **1 component** instead of 6 parts
- Improved **functionality**
- **Reduced** wear
- **Shortened** prototype phase
- **Reduced** overall manufacturing **costs**

Applikation „Print-as-one“ - Medical / Biopsy Grippers

→ **Complex mechanism** consisting of several bodies printed as **one component**

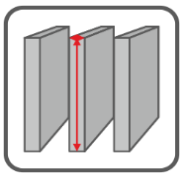
Conventional design



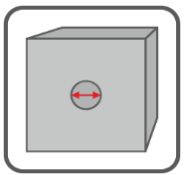
Print-as-one design for MLS

- **1 component** instead of 5-7 parts
- Extended **features**
- **Reduced** production time & total cost

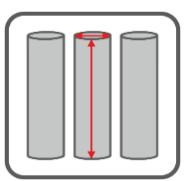
Design rules



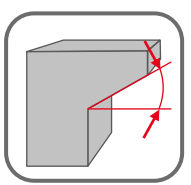
Wall thickness:
Rule of thumb: 100 µm
Min. so far: 30 µm
Avoid: > 2.000 µm



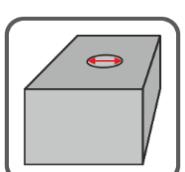
Horizontal holes:
Rule of thumb:> 300 µm
Min: 120 µm
Shape like gothic arch or drop



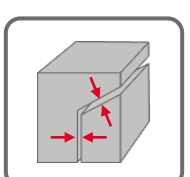
Pin diameter:
Rule of thumb: 150 µm
Min. so far: 50 µm
Avoid: > 2.000 µm



Overhang angle:
Min. 30 degrees,
Below must be supported



Vertical holes diameter:
Rule of thumb:> 130 µm
Min: 30 µm



Gap size:
Vertical walls: 15 µm
45° walls: 50 µm

- Details or sub structures have to arise from an existing structure.
- Structures must be sufficiently open to allow loose powder residues to be removed.
- Lightweight, hollow or lattice structures should be used instead of solid & high walls.
- Feature size limits also depend also on the actual part design & the material used.

Thank you for your attention!

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