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Technologies & Materials

Part 2: 3D Printed Metal

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Design & Engineering Departement

Metal vs. Polymer 3D Printing

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	Bed based	Selective deposition
Liquid	STEREOLITHOGRAPHY	POLYJET
Solid	Selective Laser Melting LASER SINTERING	FUSED DEPOSITION MODELING (FDM)

Metal vs. Polymer 3D Printing

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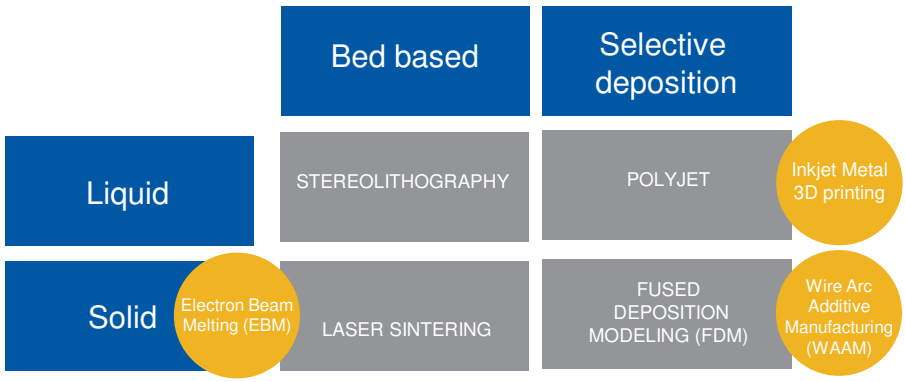
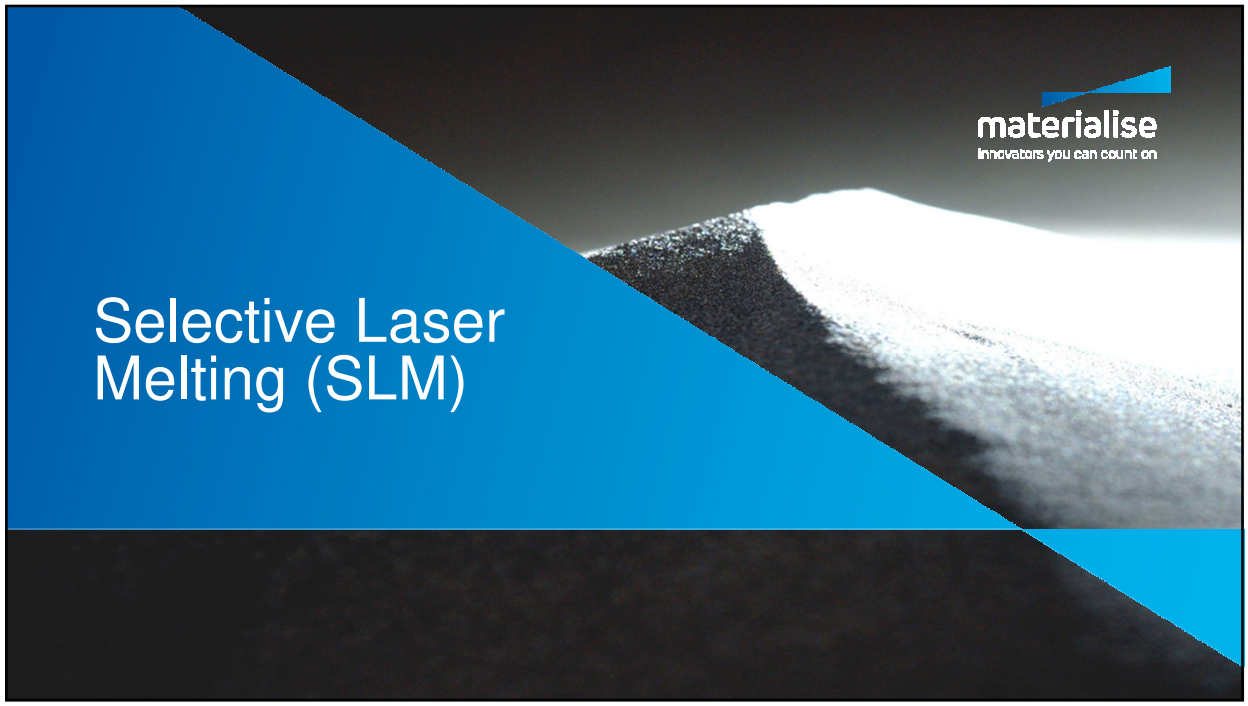
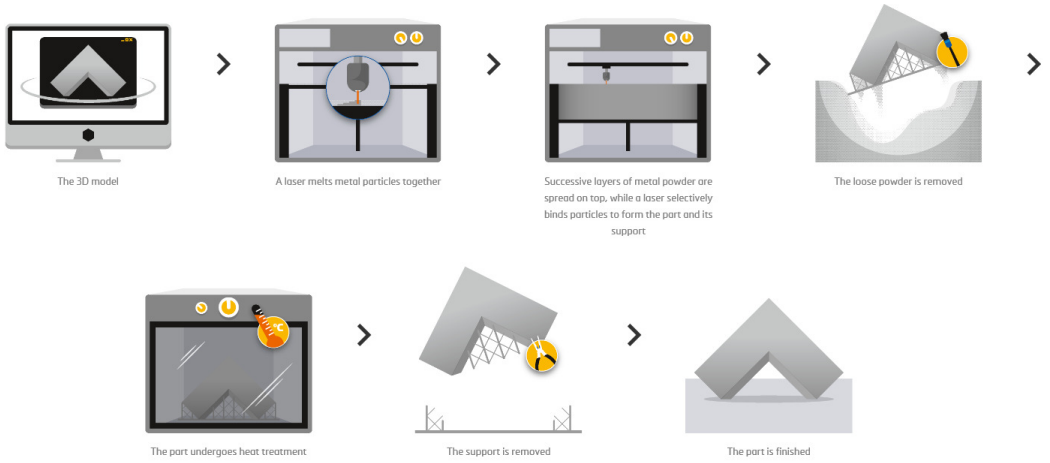




Metal 3D Printing Process



Metal Alloys for 3D Printing

Steel	Aluminum	Titanium	Others
1.4540 (15-SPH)	AlSi12	TiAl6V4	Inconel 718
1.4404 (316L)	AlSi10Mg	TiAl6Nb7	Copper
1.2344 (H13)	AlSi7Mg	Titanium	Cobalt
1.2709			

Yellow marked alloys are available today

Technical Specifications
TiAl6V4, AlSi10Mg, Inconel 718 & 316L

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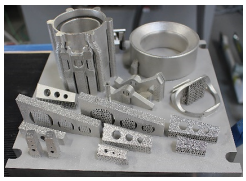
TiAl6V4

AlSi10Mg

316L



Inconel 718

- **Standard lead time**
  Minimum of 6, 10 or 30 working days
  (depending on part size, number of components and required finishing)
- **Standard accuracy**
  +/- 0.2% (0.2 mm lower boundary)
- **Minimum wall thickness**
  0.5 mm – 1 mm
- **Layer thickness**
  30 – 60 µm (TiAl6V4)
  30 – 100 µm (AlSi10Mg, 316L, Inconel 718)
- **Maximum part dimensions**
  Maximum build area: 245 x 245 x 250 mm (TiAl6V4)
  500 x 280 x 365 mm (AlSi10Mg)
  250 x 250 x 280 mm (316L / Inconel 718)

Mechanical Properties TiAl6V4

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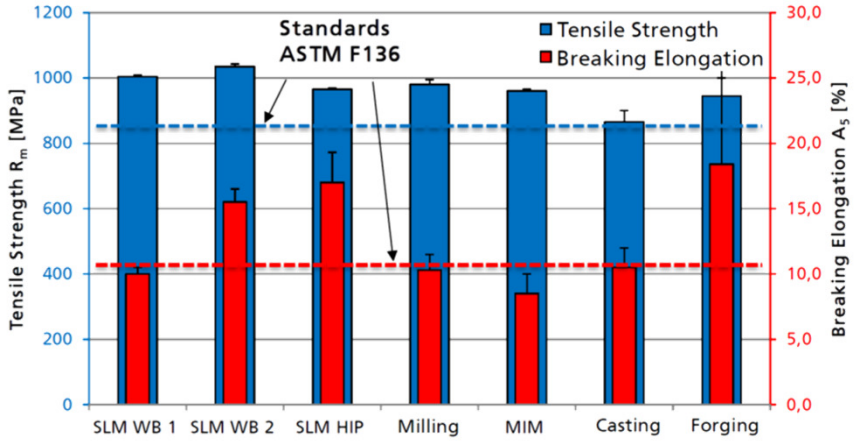
TiAl6V4 Properties	Unit	After heat treatment
Tensile strength	Mpa	min. 930
Yield strength (Rp 0.2%)	Mpa	min. 860
Elongation at break	%	14 ± 1
Young's modulus	GPa	114 ± 10
Impact strength	J	11 ± 4
Hardness	HV5	320 ± 12
Relative density	%	> 99.5
Density	g/cm^3	4.41

Source: EOS & Materialise

Properties of TiAl6V4 vs…



ASTM F136Standard Specification for Wrought Titanium-6Aluminum-4Vanadium ELI (Extra Low Interstitial) Alloy for Surgical Implant Applications (UNS R56401)

Source: Fraunhofer ILT

SLM: Technology effects Material performance and Design Freedom

Need for **support structures**

Support Removal in M3DP (e-Stage)

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SLM: Technology effects Material performance and Design Freedom

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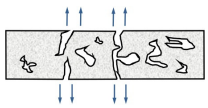
Need for **support structures**

0.1-0.01%


Porosity → Low risk of porosity due to flow characteristics
can be even improved by HIPing

INCONEL 718

Alloy properties: no load, static & dynamic

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AlSi10Mg	units	no loads	static loads	dynamic loads
Density	g/cm³	>2,60	>2,65	>2,67
Tensile Strenght	MPa	250 -330	300 -350	335 - 380
Yield Strength	MPa	180 - 220	190 -240	200 - 240
Elongation at Break	%	1,0 - 4,0	2,0 -5,0	2,5 - 6,0

higher performance →

SLM: Technology effects Material performance and Design Freedom

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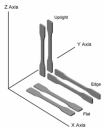
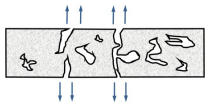
Need for **support structures**

No anisotropy

Layerwise →
No anisotropy due to low porosity and better flow of material in melt bath

0.1-0.01%

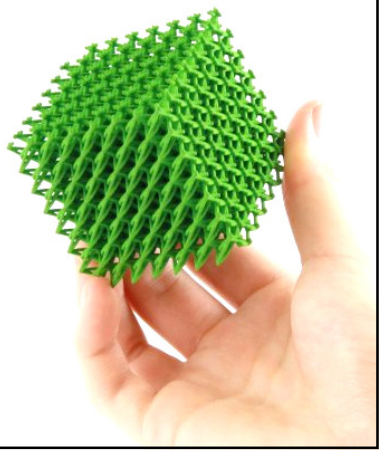




Porosity → Low risk of porosity due to flow characteristics can be even improved by HIPing

SLM:
Multicolor not possible

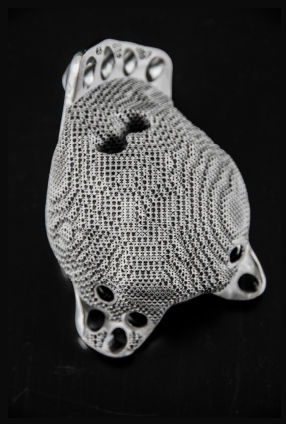
Cost drivers for SLM

- Part size and height
- Melt Volume
- Material selection and post processes
- Part Orientation



When choose SLM?

- High Part Complexity
- Low / moderate lot size
- Product individuality
- Possible advantages due to design freedom
- Conventionally hardly producible parts

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Thanks for your attention!