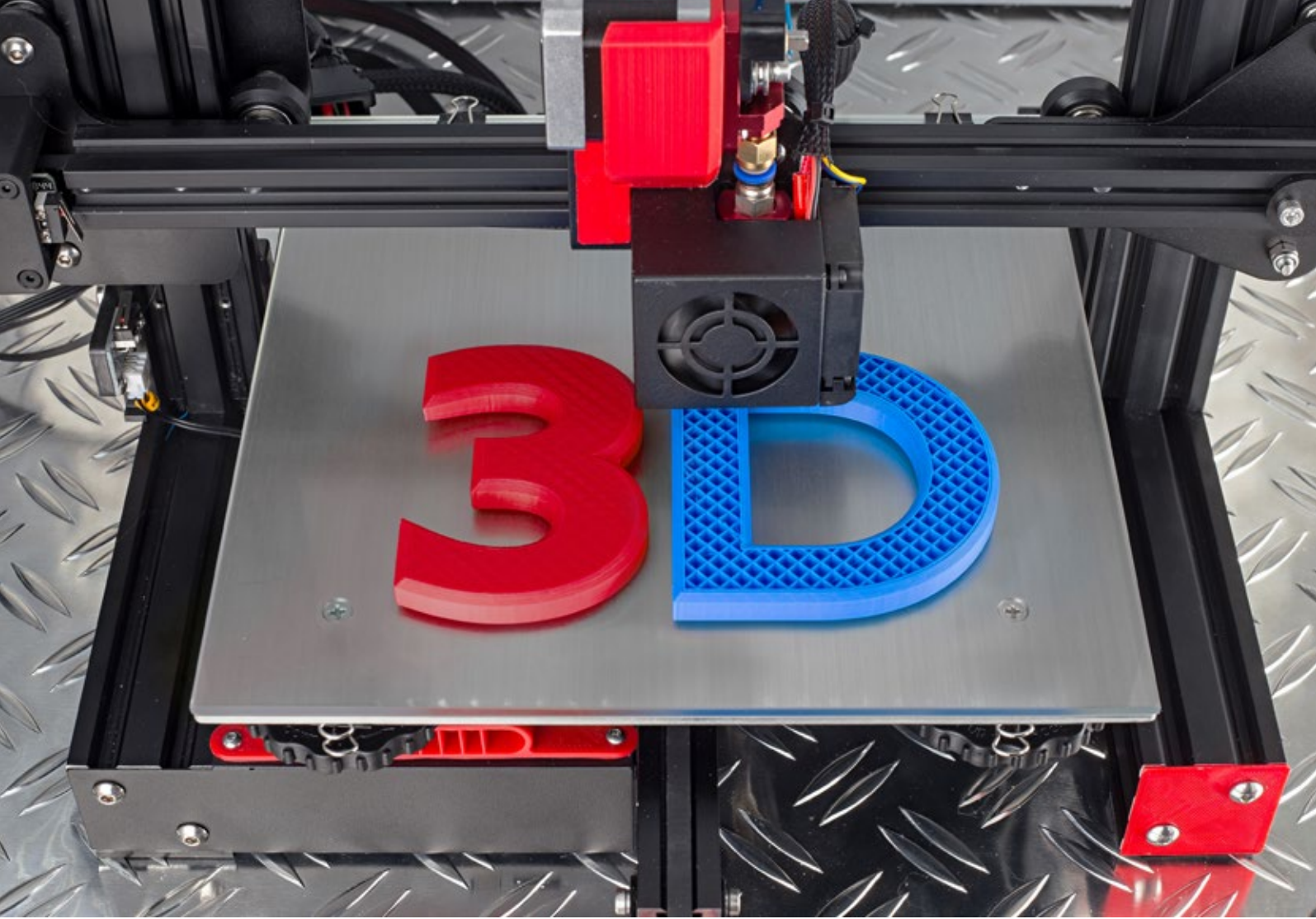


3 D P R I N T I N G

Advanced Ceramic Solutions
in New Dimension

**Additive
Manufacturing with
SiSiC and Al₂O₃**



Additive manufacturing with SiSiC and Al₂O₃

Advanced ceramics from batch size 1 – individually designed additive manufacturing

Additive manufacturing solutions from CeramTec – your benefits

- + Maximum design freedom
- + Flexibility: single-batch customization possible
- + Short delivery times
- + Competent service team
- + Maximum homogeneity, stability and product reliability
- + Simultaneous production of several components on one 3D printer

CeramTec combines the unique product properties of advanced ceramics with the unbeatable process advantages of 3D printing. This is how high-quality, additively manufactured components made of silicon carbide (SiSiC) and aluminium oxide (Al₂O₃) are created: in a large design variety and in the shortest possible production time.

Additive manufacturing without compromise – Silicon Carbide

SiSiC – outstanding material properties

- + Temperature resistance up to 1,350 °C
- + High hardness, stiffness and flexural strength
- + Lower density than metal
- + Very abrasion-resistant
- + Thermal expansion near zero
- + High thermal conductivity
- + Resistant to oxidation
- + Erodible



CeramTec SiSiC 3D Printing Process

System Specifications	
Build area (w/d)	1 job box, 500 x 400 x 300 mm / 19.7 x 15.7 x 11.8 in
Layer thickness	150 microns
Building speed	Approx. 10 mm height per hour
Material	SiC

Part Quality	
Accuracy	± 0,4% (min. ± 0.3 mm)
Minimum feature size	2 mm
Surface roughness	N11 / Ra25

AM SiSiC vs. conventional SiSiC – material properties

Material Properties	AM SiSiC	Conventional SiSiC
Density	2.95 g/cm ³	3.07 g/cm ³
Si content	25 - 30 Vol% SiC%	10 - 20 Vol% SiC%
Hardness HV 0.2	>1200 / 2700 (Si/SiC)	>1200 / 2700 (Si/SiC)
Flex. Strength	220 MPa	350 MPa
E-Modulus	340 GPa	395 GPa
Fracture Toughness	2.0 MPa·m ^{1/2}	2.5 - 3 MPa·m ^{1/2}
Thermal Conductivity	160 W/mK (20 - 100°C)	160 W/mK (20 - 100°C)
Resistivity at RT	1.14*10 ⁻⁴ Ωm	-
Resistivity at 800°C	1.6*10 ⁻⁴ Ωm	5.5*10 ⁻⁴ Ωm

Additive manufacturing without compromise – Aluminium Oxide

Al₂O₃ – outstanding material properties

- + Very good electrical insulation
- + high mechanical & compressive strength
- + High hardness (>1600 HV)
- + Moderate thermal conductivity
- + High corrosion and wear resistance
- + Good gliding properties
- + Low density
- + Operating temperature without mechanical load above 1,000°C



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CeramTec Al₂O₃ 3D Printing Process

System Specifications	
Build area (w/d) on removable build tray	2 trays, 500 x 140 mm / 19.7 x 5.5 in, each
Layer thickness	10 microns
Building speed	Up to 1 mm height per hour
Material	Alumina Soluble support ceramics

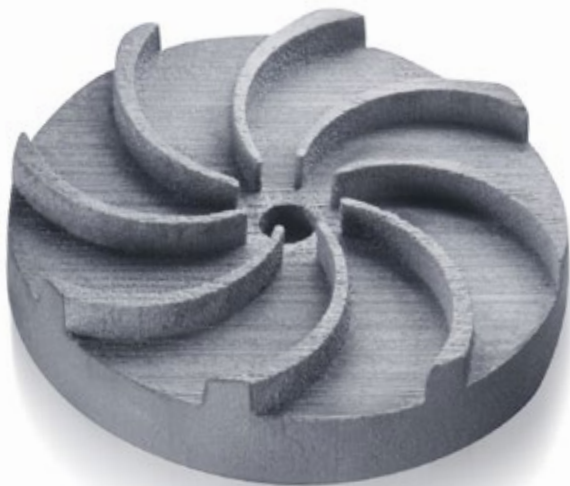
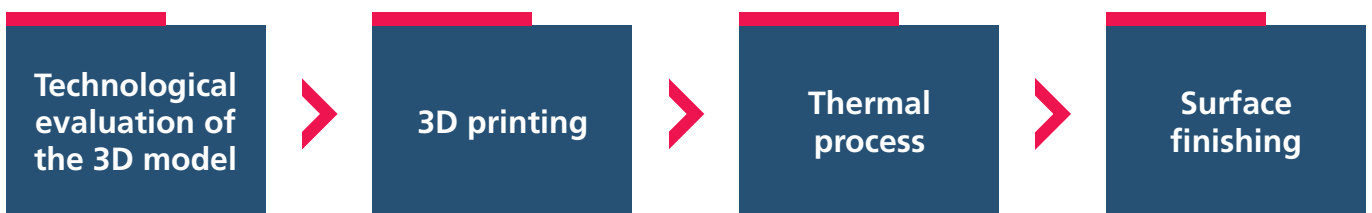
Part Quality	
Accuracy	± 50 micron on dimensions up to 5 mm 1% of larger dimensions up to ± 100 micron
Minimum feature size	200 microns
Surface roughness	N7 - N9 / Ra1,6 - 6,3

AM Al₂O₃ vs. conventional Al₂O₃ – material properties

Material Properties	AM Al ₂ O ₃	Conventional Al ₂ O ₃
Density	> 99.4% > 3.93 g/cm ³	> 3.95 g/cm ³
Purity	99.99 %	99.2 %
Hardness	>1600 HV	>1730 HV
Flex. Strength	400 - 450 MPa	470 MPa
E-Modulus	387 GPa	390 GPa
Fracture Toughness	3.4 MPa· m ^{1/2}	3.2 MPa· m ^{1/2}
Thermal Conductivity	32 W/mK (20 - 100°C)	30 W/mK (20 - 100°C)

Benefit from a streamlined process for your success

- + Print directly from CAD data
- + No tools required
- + Cavities and undercuts possible
- + Short production lead and tooling
- + Maximum flexibility: make design changes with a mouse click
- + Digitalization of existing components possible
- + Competent service team



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