

Inconel[®] 718

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Material

Inconel® 718 is a precipitation-hardenable nickel-based superalloy known for superb tensile strength even under extreme pressure and heat. It has rupture strength at temperatures up to 1290°F (700°C), is ideal for high temperature applications such as gas turbine and power/process industry parts. It is used for critical applications in the aerospace, defense, and petrochemical industries.

Process Capabilities

Velo3D lets you build the parts you need without compromising on design intent or quality. Flow, our print preparation software, now features user-selectable core parameter sets and different layer thicknesses that provide enhanced control over builds. This lets you optimize material properties and print speeds without sacrificing part performance. In addition, Flow provides a complete print file transferable to any Sapphire printer worldwide, enabling engineers to achieve identical geometric accuracy and material properties regardless of which printers you use.

- \bullet Available Layer Thicknesses: 50 $\mu m,$ 100 μm
- Available Core Powers: 240 W, 1000 W



Surface Finish versus Angle



Density, g/cc (lbs/cubic in)	8.19 (0.296)				
Relative Density, percent	99.9+				
Curfe en Finish] C. une (uin)	50 µm <15 (590)				
Suriace Finish", S _a , µm (µin)	100 μm <20 (786)				

Mechanical Properties after Post Processing²

Performance @ 21°C, 70°F			Ultimate Tensile Strength, MPa (ksi)		Yield (0.2% Offset), MPa (ksi)		Elongation		Modulus	
Process Recipe	TBR (cc/h) ³	Orientation	Sample Size	Mean, MPa (ksi)	Mean -3σ ⁴ , MPa (ksi)	Mean, MPa (ksi)	Mean -3σ⁴, MPa (ksi)	Mean, percent	Mean -3σ⁴, percent	Range
240W/50 µm	15	Horizontal	30	1350 (196)	1330 (193)	1093 (159)	1076 (156)	21.3	16.6	26.5-29 MSI 183-200 GPa
		Vertical	30	1343 (195)	1323 (192)	1103 (160)	1081 (157)	20.6	16.2	
1kW/50 µm	53	Horizontal	24	1343 (192)	1308 (187)	1109 (159)	1070 (153)	17.8	15.3	
		Vertical	274	1273 (183)	1220 (177)	1037 (150)	960 (139)	22.9	12.0	
1kW/100 µm	60	Vertical	24	1237 (179)	1191 (173)	989 (143)	930 (135)	22.1	11.3	158-179 GPa
Performance @	649°C, 1200°F									
240W/50 µm	15	Horizontal	7	1068 (155)	1047 (152)	902 (131)	806 (117)	24.2	12.0	
	15	Vertical	9	1077 (156)	1056 (153)	904 (131)	883 (128)	22.5	12.0	
1kW/50 µm	50	Horizontal	9	1055 (153)	988 (143)	885 (128)	840 (122)	20.0	10.0	
	33	Vertical	9	1036 (150)	1008 (146)	889 (129)	836 (121)	19.1	10.0	

1. 50 µm thickness, for angles >25° from horizontal; 100 µm thickness, for angles >45°; depends on orientation and process selected. 2. Stress Relief at 1950°F ±25°F (1065 ±14°C) for 90 +5/-15 minutes, Hot Isostatic Pressing per ASTM F3055 CL-D at 14750 ±250 psi (100 ±2MPa) at 2125 ±25°F (1163 ±14°C) for 180-225 minutes, Solution & Age per AMS 2774 S1750DP. 3. TBR: Theoretical Build Rate (TBR) is a per-laser build rate calculated from the process conditions of bulk core as *scan speed x hatch spacing x layer thickness*. This value represents a single laser only and is reported for comparison purposes across different materials and recipes, but does not correspond to true build rate, which is dependent on geometry and system characteristics (i.e. number of lasers, recoat times, etc.) 4. Data from sample sizes ≤30 for information only.

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Microstructure Details

All photographs at 100X magnification. 50 μm layer samples were etched with HCl and $\rm H_2O_2.$ 100 μm layer samples were etched Kalling's 2 Reagent

 $50\,\mu\text{m}$ Layers - Micrograph showing the typical microstructure in the horizontal plane



240W core

1000W core

50 µm Layers - Micrograph showing the typical microstructure in the vertical plane



240W core

1000W core

 $100\,\mu\text{m}$ Layers - Micrograph showing the typical microstructure in both planes at 1000W



1000W core, horizontal plane

1000W core, vertical plane