

Inconel 718

Parameter set options

Layer thickness	Optimised for	Page
30 µm	Single laser per part	3
60 µm	Single laser per part	4
60 µm	Multiple lasers per part	5

To download the latest material files, visit www.renishaw.com/softwarelicensing.

Material description

Inconel 718 alloy comprises of primarily nickel with a mass fraction up to 55% alloyed with iron up to 21% and chromium up to 21%, along with other minor elements. Properties include high strength, excellent corrosion resistance and a working temperature range between -250 °C and 650 °C (-418 °F to $1\ 200\text{ °F}$). It is also age-hardenable.

Inconel 718 has a wide range of applications within industry and is particularly suitable for applications where good tensile, creep, and rupture strength is required. Like Inconel 625, it is suitable for applications where corrosion and oxidation resistance at high temperatures is required. Its excellent welding characteristics and resistance to cracking makes it an ideal material for additive manufacturing.

Material properties

- Retains strength up to 650 °C
- High creep resistance
- High corrosion resistance
- Solidification properties suit additive manufacturing

Applications

- Aerospace and defence
- Gas turbine blades
- Exhaust manifolds
- Rocket motors
- Heat exchangers
- Nuclear

Generic material data

Typical wrought material properties

Material property	Wrought material value
Density	8.2 g/cm ³
Thermal conductivity	6 W/mK to 12 W/mK
Melting temperature	1 290 °C to 1 336 °C
Coefficient of thermal expansion ¹	12×10 ⁻⁶ K ⁻¹ to 16×10 ⁻⁶ K ⁻¹

¹ In the range of 25 °C to 760 °C.

Recommended composition of powder

Element	Mass (%)
Iron	Balance
Nickel	50.00 to 55.00
Chromium	17.00 to 21.00
Niobium + Tantalum	4.75 to 5.50
Molybdenum	2.80 to 3.30
Titanium	0.65 to 1.15
Cobalt	≤ 1.00
Aluminium	0.20 to 0.80
Silicon	≤ 0.35
Manganese	≤ 0.35
Copper	≤ 0.10
Carbon	≤ 0.08
Phosphorus	≤ 0.02
Sulphur	≤ 0.02
Boron	≤ 0.01

Recommended powder size distribution: 15 µm to 45 µm.

The values shown in this table are for ASTM standard composition powder. Renishaw powders are supplied to a tighter specification to minimise batch-to-batch variations. Results quoted in this data sheet are from samples produced using Renishaw's tighter-specification powder. To purchase powder from Renishaw, visit the online store at www.renishaw.com/shop.

Please contact Renishaw for further information about specifications or if you require support in qualifying non-Renishaw powders.

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate	
30 µm	Single laser per part	Modulated	190 m ³ /h	One laser: 8.5 cm ³ /h	Four lasers: 34 cm ³ /h

Material files: In718_500QS_A30_M_##_# (meander scan strategy)
In718_500QS_A30_S_##_# (stripe scan strategy)

Properties of additively manufactured components

NOTE: This parameter set is optimised for bulk density. The material properties in this table are indicative only. Further modification of the material file may be required to suit your application.

	Solution treated and aged ¹	
	Mean	Standard deviation
Bulk density ²	≥ 99.8%	-
Ultimate tensile strength ³		
Vertical direction (Z)	1 414 MPa	7 MPa
Yield strength ³		
Vertical direction (Z)	1 163 MPa	11 MPa
Elongation after fracture ³		
Vertical direction (Z)	27%	3%
Modulus of elasticity ³		
Vertical direction (Z)	130 GPa	3 GPa
Hardness (Vickers) ⁴		
Horizontal direction (XY)	466 HV0.5	8 HV0.5
Vertical direction (Z)	484 HV0.5	5 HV0.5

Mechanical test samples were created using four lasers, one laser per sample and with no downstream processing. Meander scan strategy was used for vertical samples and stripe scan strategy for horizontal samples. The mechanical property data were obtained from tests performed in Renishaw's laboratories and they indicate the mechanical properties that can be achieved. The data is not intended as a guaranteed minimum specification.

- ¹ Solution treatment and aging method used for testing: Under vacuum, heat at 13 °C/min to 980 °C ±10 °C, then hold temperature for 1 hour. Gas quench with argon at 1 bar to room temperature. Heat at 13 °C/min to 720 °C ±10 °C, then hold temperature for 8 hours. Furnace cool to 620 °C ±10 °C, then hold temperature for 8 hours. Gas quench with argon at 1 bar to room temperature.
- ² Measured optically on a 10 mm × 10 mm × 10 mm sample at 75× magnification.
- ³ Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 16 samples.
- ⁴ Tested to ASTM E384-11 after polishing.

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate	
60 µm	Single laser per part	Continuous wave	190 m ³ /h	One laser: 29.2 cm ³ /h	Four lasers: 116.8 cm ³ /h

Material files: In718_500QS_B60_M_##_# (meander scan strategy)
In718_500QS_B60_S_##_# (stripe scan strategy)

Properties of additively manufactured components

	As built		Solution treated and aged ¹	
	Mean	Standard deviation	Mean	Standard deviation
Bulk density ²	≥ 99.8%	-	-	-
Ultimate tensile strength ³				
Horizontal direction (XY)	1 054 MPa	10 MPa	1 491 MPa	12 MPa
Vertical direction (Z)	1 002 MPa	3 MPa	1 440 MPa	4 MPa
Yield strength ³				
Horizontal direction (XY)	743 MPa	7 MPa	1 257 MPa	13 MPa
Vertical direction (Z)	632 MPa	3 MPa	1 201 MPa	12 MPa
Elongation after fracture ³				
Horizontal direction (XY)	29%	1%	15%	1%
Vertical direction (Z)	4%	1%	18%	1%
Modulus of elasticity ³				
Horizontal direction (XY)	190 GPa	6 GPa	196 GPa	6 GPa
Vertical direction (Z)	187 GPa	5 GPa	198 GPa	4 GPa
Hardness (Vickers) ⁴				
Horizontal direction (XY)	252 HV0.5	8 HV0.5	-	-
Vertical direction (Z)	275 HV0.5	9 HV0.5	-	-
Surface roughness (Ra) ⁵				
Vertical direction (Z)	10 Ra	2 Ra	-	-

Mechanical test samples were created using four lasers, one laser per sample and with no downstream processing. Meander scan strategy was used for vertical samples and stripe scan strategy for horizontal samples. The mechanical property data were obtained from tests performed in Renishaw's laboratories and they indicate the mechanical properties that can be achieved. The data is not intended as a guaranteed minimum specification.

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- ³ Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 16 samples.
- ⁴ Tested to ASTM E384-11 after polishing.
- ⁵ Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601-2001 (ISO 97).

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate
60 µm	Multiple lasers per part	Continuous wave	190 m ³ /h	Four lasers: 116.8 cm ³ /h

Material files: In718_500QS_C60_S_##_# (stripe scan strategy)

Properties of additively manufactured components

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	Mean	Standard deviation	Mean	Standard deviation
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Vertical direction (Z)	187 GPa	5 GPa	198 GPa	4 GPa
Hardness (Vickers) ⁴				
Horizontal direction (XY)	252 HV0.5	8 HV0.5	-	-
Vertical direction (Z)	275 HV0.5	9 HV0.5	-	-
Surface roughness (Ra) ⁵				
Vertical direction (Z)	10 Ra	2 Ra	-	-

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