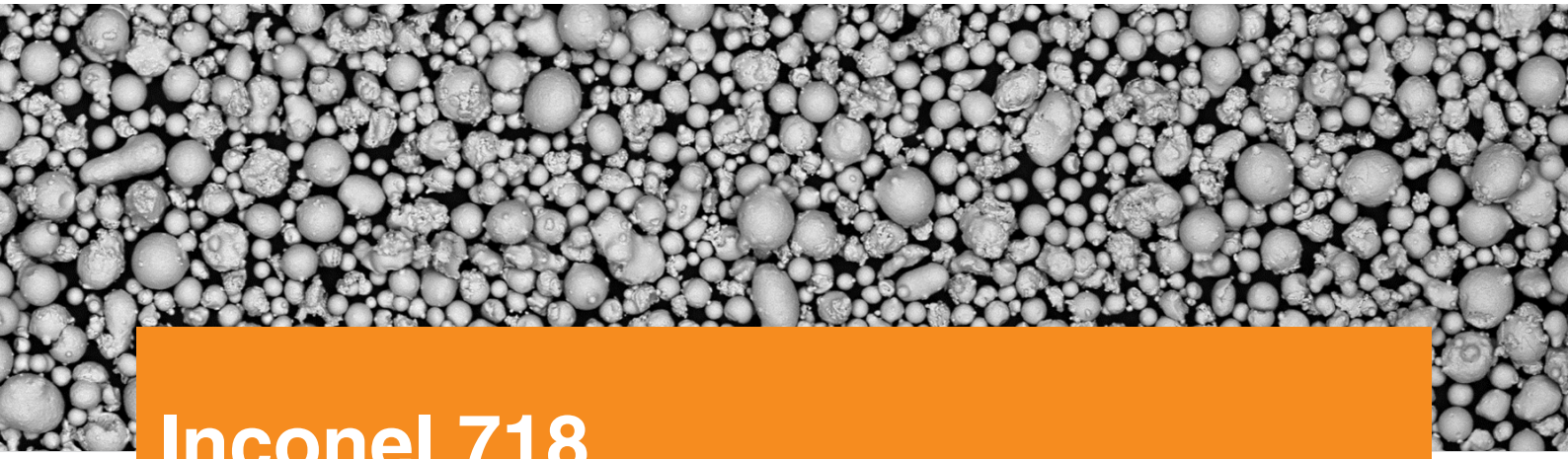
RENISHAW
apply innovation™



Inconel 718

Parameter set options

Layer thickness	Optimised for	Laser mode	Page
30 µm	Single laser per part	Modulated	4
30 µm	Single laser per part	Continuous wave	5
60 µm	Single laser per part	Continuous wave	6
60 µm	Multiple lasers per part	Continuous wave	7
90 µm	Single laser per part	Continuous wave	8
120 µm	Single laser per part	Continuous wave	9

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

Material description

Inconel 718 is an age-hardenable alloy comprised of primarily nickel with a mass fraction up to 55% alloyed with iron up to 23% and chromium up to 21%, along with other minor elements. It's properties include high strength, excellent corrosion resistance and a working temperature range between –250 °C and 650 °C (–418 °F to 1 200 °F).

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

Disclaimer

The mechanical property data featured in this document 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.

Glossary of terms

Term	Definition
Scan strategy	Determines the path the laser will take to melt the cross-sectional area of the parts featured in each layer of the build process.
Meander	A scan strategy that takes the form of a straight-line vector path that bounces back and forth from each side of the part border. Meander strategy is quick and ideal for parts with a small XY cross section.
Stripe	A scan strategy where the area within the part border is split into strips and a meander technique is used within each strip. Stripe is ideal for parts with a large XY cross section.

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 1 330 °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_01_B (meander scan strategy)
In718_500QS_A30_S_01_B (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]
Bulk density [2]		≥ 99.8%
Ultimate tensile strength [3]	Vertical (Z)	1 414 MPa ±7 MPa
Yield strength [3]	Vertical (Z)	1 163 MPa ±11 MPa
Elongation after fracture [3]	Vertical (Z)	27% ±3%
Hardness (Vickers) [4]	Horizontal (XY)	466 HV0.5 ±8 HV0.5
	Vertical (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.

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 10 mm × 10 mm × 10 mm samples 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	
30 µm	Single laser per part	Continuous wave	190 m^3/h	One laser: 14.3 cm^3/h	Four lasers: 57 cm^3/h

Material files: In718_500QS_B30_M_01_A (meander scan strategy)
In718_500QS_B30_S_01_A (stripe scan strategy)

Properties of additively manufactured components

		Solution treated and aged [1]
Bulk density [2]		≥ 99.8%
Ultimate tensile strength [3]	Horizontal (XY)	1 539 MPa ±7 MPa
	Vertical (Z)	1 448 MPa ±9 MPa
Yield strength [3]	Horizontal (XY)	1 350 MPa ±11 MPa
	Vertical (Z)	1 256 MPa ±25 MPa
Elongation after fracture [3]	Horizontal (XY)	17% ±3%
	Vertical (Z)	24% ±1%
Modulus of elasticity [3]	Horizontal (XY)	207 GPa ±9 GPa
	Vertical (Z)	190 GPa ±5 GPa
Hardness (Vickers) [4]	Horizontal (XY)	486 HV0.5 ±9 HV0.5
	Vertical (Z)	480 HV0.5 ±10 HV0.5
Surface roughness [5]	Vertical (Z) (Median Ra)	7 µm ±1 µm
	Vertical (Z) (Median Rz)	50 µm ±8 µm

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. Stripe scan strategy was used for horizontal samples.

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 10 mm × 10 mm × 10 mm samples 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_02_A (meander scan strategy)
In718_500QS_B60_S_02_A (stripe scan strategy)

Properties of additively manufactured components

		As built	Solution treated and aged [1]	High temperature solution and aged [2]
Bulk density [3]		≥ 99.8%	≥ 99.8%	≥ 99.8%
Ultimate tensile strength [4]	Horizontal (XY)	1 051 MPa ±7 MPa	1 480 MPa ±10 MPa	-
	Vertical (Z) – Meander	1 002 MPa ±3 MPa	1 440 MPa ±4 MPa	1 369 MPa ±6 MPa
	Vertical (Z) – Stripe	-	1 389 MPa ±7 MPa	-
Yield strength [4]	Horizontal (XY)	735 MPa ±6 MPa	1 275 MPa ±17 MPa	-
	Vertical (Z) – Meander	632 MPa ±3 MPa	1 201 MPa ±12 MPa	1 102 MPa ±17 MPa
	Vertical (Z) – Stripe	-	1 226 MPa ±19 MPa	-
Elongation after fracture [4]	Horizontal (XY)	33% ±1%	18% ±3%	-
	Vertical (Z) – Meander	36% ±1%	18% ±1%	28% ±3%
	Vertical (Z) – Stripe	-	23% ±3%	-
Modulus of elasticity [4]	Horizontal (XY)	184 GPa ±8 GPa	195 GPa ±10 GPa	-
	Vertical (Z) – Meander	187 GPa ±5 GPa	198 GPa ±4 GPa	201 GPa ±7 GPa
	Vertical (Z) – Stripe	-	177 GPa ±10 GPa	-
Hardness (Vickers) [5]	Horizontal (XY)	266 HV0.5 ±6 HV0.5	476 HV0.5 ±11 HV0.5	465 HV0.5 ±14 HV0.5
	Vertical (Z)	281 HV0.5 ±6 HV0.5	483 HV0.5 ±12 HV0.5	465 HV0.5 ±7 HV0.5
Surface roughness [6]	Vertical (Z) (Median Ra)	8 µm ±1 µm	-	-
	Vertical (Z) (Median Rz)	53 µm ±8 µm	-	-
Plastometrex yield strength [7]	Horizontal (XY)	-	1 223 MPa ± 65 MPa	-
Plastometrex ultimate tensile strength [7]	Horizontal (XY)	-	1 515 MPa ± 24 MPa	-

Mechanical test samples were created using four lasers, one laser per sample and with no downstream processing. The scan strategy used for vertical samples is indicated in the table above. Stripe scan strategy was used for horizontal samples.

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 High temperature solution treatment and aging method used for testing: Under vacuum, heat at 13 °C/min to 1 155 °C ±10 °C, then hold temperature for 4 hours. Gas quench with argon at 1 bar to room temperature. Heat at 13 °C/min to 950 °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 745°C ±10 °C, then hold temperature for 4 hours. Furnace cool to 645°C ±10 °C, then hold temperature for 4 hours. Gas quench with argon at 1 bar to room temperature.

3 Measured optically on 10 mm × 10 mm × 10 mm samples at 75× magnification.

4 Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 16 samples.

5 Tested to ASTM E384-11 after polishing.

6 Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601 2001 (ISO 4287:1997).

7 Plastometrex's standard indentation procedure was used to generate the data. Indents were carried out on 10 mm × 10 mm × 10 mm samples. Values are based on 5 indents from 3 samples.

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_01_A (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.

		As built	Solution treated and aged [1]
Bulk density [2]		≥ 99.8%	≥ 99.8%
Ultimate tensile strength [3]	Horizontal (XY)	1 048 MPa ±3 MPa	1 484 MPa ±5 MPa
	Vertical (Z)	951 MPa ±6 MPa	1 399 MPa ±6 MPa
Yield strength [3]	Horizontal (XY)	731 MPa ±3 MPa	1 280 MPa ±15 MPa
	Vertical (Z)	588 MPa ±5 MPa	1 196 MPa ±8 MPa
Elongation after fracture [3]	Horizontal (XY)	34% ±2%	16% ±1%
	Vertical (Z)	40% ±3%	25% ±1%
Modulus of elasticity [3]	Horizontal (XY)	191 GPa ±9 GPa	193 GPa ±8 GPa
	Vertical (Z)	171 GPa ±5 GPa	188 GPa ±8 GPa
Hardness (Vickers) [4]	Horizontal (XY)	268 HV0.5 ±9 HV0.5	474 HV0.5 ±11 HV0.5
	Vertical (Z)	280 HV0.5 ±12 HV0.5	480 HV0.5 ±12 HV0.5
Surface roughness [5]	Vertical (Z) (Median Ra)	9 µm ±1 µm	-
	Vertical (Z) (Median Rz)	73 µm ±14 µm	-

Mechanical test samples were created using four lasers, multiple lasers per sample and with no downstream processing. Stripe scan strategy was used for all samples.

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 10 mm × 10 mm × 10 mm samples 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.

5 Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601 2001 (ISO 4287:1997).

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate	
90 µm	Single laser per part	Continuous wave	190 m^3/h	One laser: 42.12 cm^3/h	Four lasers: 168.48 cm^3/h

Material files: In718_500QS_B90_M_01_A (meander scan strategy)
In718_500QS_B90_S_01_A (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]
Bulk density [2]		≥ 99.8%
Ultimate tensile strength [3]	Vertical (Z)	1 461 MPa ±8 MPa
Yield strength [3]	Vertical (Z)	1 221 MPa ±26 MPa
Elongation after fracture [3]	Vertical (Z)	19% ±3%
Modulus of elasticity [3]	Vertical (Z)	213 GPa ±8 GPa
Hardness (Vickers) [4]	Horizontal (XY)	478 HV0.5 ±8 HV0.5
	Vertical (Z)	479 HV0.5 ±9 HV0.5
Surface roughness [5]	Vertical (Z) (Median Ra)	10 µm ±2 µm
	Vertical (Z) (Median Rz)	73 µm ±13 µm

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. Stripe scan strategy was used for horizontal samples.

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.

5 Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601 2001 (ISO 4287:1997).

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate	
120 µm	Single laser per part	Continuous wave	190 m^3/h	One laser: 44.9 cm^3/h	Four lasers: 179.7 cm^3/h

Material files: In718_500QS_B120_M_01_A (meander scan strategy)
In718_500QS_B120_S_01_A (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]
Bulk density [2]		≥ 99.8%
Ultimate tensile strength [3]	Vertical (Z)	1 461 MPa ±9 MPa
Yield strength [3]	Vertical (Z)	1 264 MPa ±19 MPa
Elongation after fracture [3]	Vertical (Z)	22% ±4%
Modulus of elasticity [3]	Vertical (Z)	207 GPa ±9 GPa
Hardness (Vickers) [4]	Horizontal (XY)	484 HV0.5 ±10 HV0.5
	Vertical (Z)	482 HV0.5 ±8 HV0.5
Surface roughness [5]	Vertical (Z) (Median Ra)	12 µm ±2 µm
	Vertical (Z) (Median Rz)	84 µm ±13 µm

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.

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.

5 Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601-2001 (ISO 4287:1997).

RENISHAW
apply innovation™

www.renishaw.com/additivemanufacturing

#renishaw

+44 (0) 1453 524524 uk@renishaw.com

Part no.: H-5800-6794-03-A
Issued: 08.2024