

Stainless steel 316L (1.4404)

Parameter set options

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

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

Material description

Stainless steel 316L alloy is an austenitic stainless steel which comprises of iron alloyed with chromium of mass fraction up to 18%, nickel up to 14% and molybdenum up to 3%, along with other minor elements.

Due to its low carbon content, stainless steel 316L is resistant to sensitisation (carbide precipitation at grain boundaries) and displays good welding characteristics. It also has high stress to rupture and tensile strength at high temperatures.

Material properties

- High hardness and toughness
- High corrosion resistance
- High machinability
- Can be highly polished

Applications

- Plastic injection, pressure die-casting moulds and extrusion dies
- Surgical tools
- Cutlery and kitchenware
- Maritime components
- Spindles and screws
- General engineering

Generic material data

Typical wrought material properties

Material property	Wrought material value
Density	8.0 g/cm ³
Thermal conductivity	16 W/mK
Melting temperature	1 371 °C to 1 399 °C
Coefficient of thermal expansion ¹	16×10 ⁻⁶ K ⁻¹

¹ In the range of 0 °C to 100 °C.

Recommended composition of powder

Element	Mass (%)
Iron	Balance
Chromium	16.00 to 18.00
Nickel	10.00 to 14.00
Molybdenum	2.00 to 3.00
Manganese	≤ 2.00
Silicon	≤ 1.00
Nitrogen	≤ 0.10
Oxygen	≤ 0.10
Phosphorus	≤ 0.05
Carbon	≤ 0.03
Sulphur	≤ 0.03

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	
60 µm	Single laser per part	Continuous wave	190 m ³ /h	One laser: 23.8 cm ³ /h	Four lasers: 95.2 cm ³ /h

Material files: SS316L_500QS_B60_M_##_# (meander scan strategy)
SS316L_500QS_B60_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.

	As built	
	Mean	Standard deviation
Bulk density ¹	≥ 99.8%	-
Ultimate tensile strength ²		
Horizontal direction (XY)	699 MPa	6 MPa
Vertical direction (Z)	631 MPa	3 MPa
Yield strength ²		
Horizontal direction (XY)	564 MPa	6 MPa
Vertical direction (Z)	495 MPa	3 MPa
Elongation after fracture ²		
Horizontal direction (XY)	40%	2%
Vertical direction (Z)	47%	1%
Modulus of elasticity ²		
Horizontal direction (XY)	198 GPa	8 GPa
Vertical direction (Z)	208 GPa	19 GPa
Hardness (Vickers) ³		
Horizontal direction (XY)	206 HV0.5	7 HV0.5
Vertical direction (Z)	222 HV0.5	7 HV0.5
Surface roughness (Ra) ⁴		
Vertical direction (Z)	11 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.

¹ Measured optically on a 10 mm × 10 mm × 10 mm sample at 75× magnification.

² Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 16 samples for vertical, 12 for horizontal.

³ Tested to ASTM E384-11 after polishing

⁴ Tested to JIS B 0601-2001 (ISO 97) after bead blasting.

Parameter set summary

Layer thickness	Optimised for	Laser mode	Gas flow rate	Build rate
60 µm	Multiple laser per part	Continuous wave	190 m ³ /h	Four lasers: 95.2 cm ³ /h

Material files: SS316L_500QS_C60_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.

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Part no.: H-5800-6796-02-A

Issued: 03.2023