

# Stainless steel 17-4PH (1.4542)

## Parameter set options

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

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## Material description

Stainless steel 17-4PH is a martensitic, precipitation-hardening stainless steel that comprises of iron alloyed with chromium of mass fraction up to 17.5%, nickel up to 5%, copper up to 5%, and other minor elements.

The excellent specific strength and good corrosion-resistant properties of 17-4PH have resulted in its use across a wide range of industries and applications, such as engine components, petrochemical equipment, and food processing.

### Material properties

- High toughness
- High corrosion resistance
- Excellent specific strength
- Good machinability

### Applications

- Surgical tools
- Aerospace
- Chemical processing
- Nuclear
- General engineering

# Generic material data

## Typical wrought material properties

Material property	Wrought material value
Density	7.8 g/cm <sup>3</sup>
Thermal conductivity	18 W/mK to 23 W/mK
Melting temperature	1 404 °C to 1 440 °C
Coefficient of thermal expansion <sup>1</sup>	11×10 <sup>-6</sup> K <sup>-1</sup>

<sup>1</sup> In the range of 21 °C to 427 °C.

## Recommended composition of powder

Element	Mass (%)
Iron	Balance
Chromium	15.00 to 17.50
Nickel	3.00 to 5.00
Copper	3.00 to 5.00
Silicon	≤ 1.00
Manganese	≤ 1.00
Nitrogen	≤ 0.25
Oxygen	≤ 0.20
Carbon	≤ 0.07
Phosphorus	≤ 0.04
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](http://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 <sup>3</sup> /h	One laser: 19.3 cm <sup>3</sup> /h	Four lasers: 77.1 cm <sup>3</sup> /h

**Material files:** SS17-4PH\_500QS\_B60\_M\_##\_# (meander scan strategy)  
SS17-4PH\_500QS\_B60\_S\_##\_# (stripe scan strategy)

## Properties of additively manufactured components

	Solution treated and precipitation hardened <sup>1</sup>	
	Mean	Standard deviation
<b>Bulk density</b> <sup>2</sup>	≥ 99.9%	-
<b>Ultimate tensile strength</b> <sup>3</sup>		
Horizontal direction (XY)	1 119 MPa	4 MPa
Vertical direction (Z)	1 299 MPa	9 MPa
<b>Yield strength</b> <sup>3</sup>		
Horizontal direction (XY)	893 MPa	18 MPa
Vertical direction (Z)	1 046 MPa	14 MPa
<b>Elongation after fracture</b> <sup>3</sup>		
Horizontal direction (XY)	17%	1%
Vertical direction (Z)	17%	1%
<b>Modulus of elasticity</b> <sup>3</sup>		
Horizontal direction (XY)	164 GPa	12 GPa
Vertical direction (Z)	180 GPa	8 GPa
<b>Hardness (Vickers)</b> <sup>4</sup>		
Vertical direction (Z)	440 HV0.5	11 HV0.5
<b>Surface roughness (Ra)</b> <sup>5</sup>		
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.

- <sup>1</sup> Solution treatment and precipitation hardening method used for testing: Under vacuum, heat at 13 °C/min to 1 040 °C ±10 °C, then hold temperature for 30 min. Gas quench with argon at 1 bar to room temperature. Under vacuum, heat at 13 °C/min to 480 °C ±10 °C, then hold temperature for 1 hour. Gas quench with argon at 1 bar to room temperature.
- <sup>2</sup> Measured optically on a 10 mm × 10 mm × 10 mm sample at 75× magnification.
- <sup>3</sup> Tested at ambient temperature to ASTM E8. Machined prior to testing. Values based on 32 samples for vertical scenario and 16 for horizontal.
- <sup>4</sup> Tested to ASTM E384-11 after polishing.
- <sup>5</sup> Tested on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601-2001 (ISO 97).

[www.renishaw.com/additivemanufacturing](http://www.renishaw.com/additivemanufacturing)



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