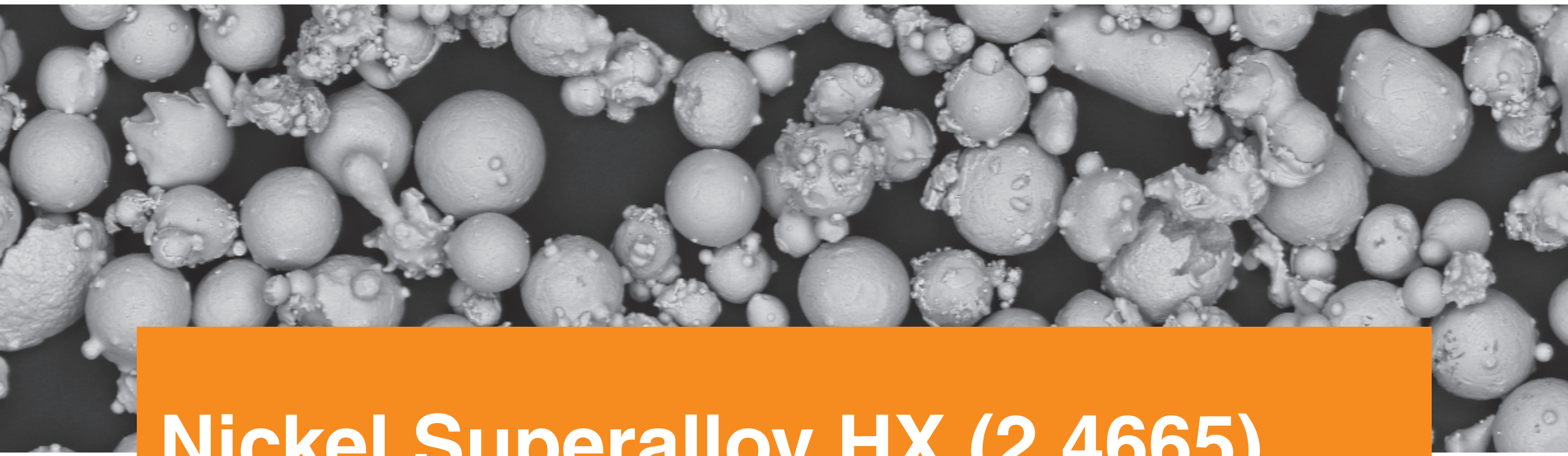

Nickel Superalloy HX (2.4665)

Parameter set options

Layer thickness	Optimised for	Laser mode	Page
60 µm	Single laser per part	Continuous wave	4

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Material description

HX (DIN/W Nr. 2.4665) is a superalloy comprising of primarily nickel alloyed with chromium, iron, molybdenum and other minor elements.

It has excellent high temperature strength along with very high resistance to oxidation, reducing, carburisation and nitriding. These material properties make HX an ideal material for gas turbines, furnace applications and petrochemical process equipment.

Material properties

- Excellent high temperature strength
- Excellent oxidation resistance
- High carburisation resistance
- High nitriding resistance

Applications

- Aerospace
- Oil and gas
- Chemical processing

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	8.22 g/cm^3
Thermal conductivity	9 W/mK
Melting temperature	1 355 °C
Coefficient of thermal expansion [1]	14×10^{-6} K^{-1}

[1] In the range of 20 °C to 100 °C.

Recommended composition of powder

Element	Mass (%)
Nickel	Balance
Chromium	20.5 to 23.0
Iron	17.0 to 20.0
Molybdenum	8.0 to 10.0
Cobalt	1.0 to 2.5
Tungsten	0.2 to 1.0
Aluminium	0.50
Copper	0.50
Manganese	0.50
Silicon	0.20
Titanium	0.15
Oxygen	0.10
Carbon	0.10
Phosphorus	0.04
Nitrogen	0.03
Sulphur	0.03
Boron	0.01
Hydrogen	0.005

Recommended powder size distribution: 15 µm to 53 µm.

The values shown in this table are representative of a general composition powder. Contact your powder supplier for more detailed information about specific powders.

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: 19.4 cm^3/h	Four lasers: 77.6 cm^3/h

Material files: HastX_500QS_B60_M_01_A (meander scan strategy)
HastX_500QS_B60_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.

		Annealed [1]
Bulk density [2]		≥99.8%
Ultimate tensile strength [3]	Horizontal (XY)	763 MPa ±2 MPa
	Vertical (Z)	704 MPa ±13 MPa
Yield strength [3]	Horizontal (XY)	456 MPa ±2 MPa
	Vertical (Z)	438 MPa ±13 MPa
Elongation after fracture [3]	Horizontal (XY)	38% ±1%
	Vertical (Z)	47% ±3%
Modulus of elasticity [3]	Horizontal (XY)	195 GPa ±6 GPa
	Vertical (Z)	187 GPa ±9 GPa
Surface roughness [4]	Vertical (Z) (Median Ra)	8 µm ±3 µm

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

1 Annealing method used for testing: Under vacuum, heat at 10°C/min to 1020 °C ± 10 °C, then hold temperature for 30 minutes. Air cool 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 on as-built vertical surfaces using laser interferometry. Tested to JIS B 0601 2001 (ISO 4287:1997).

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