Data sheet

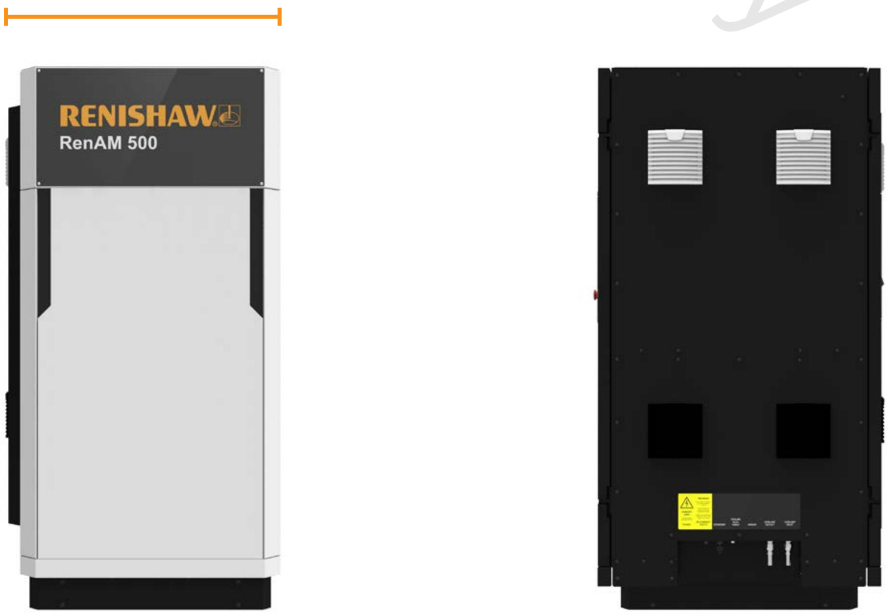
RenAM 500Q/S
additive manufacturing systems

System description

RenAM 500Q/S are Renishaw's multi-laser AM systems. The RenAM 500 series can be configured with one (S) or four (Q) high power 500 W lasers, each able to access the whole powder bed surface simultaneously. With its four lasers, RenAM 500Q achieves build rates up to four times faster than single laser systems. Its compact galvanometer assembly has been designed and additively manufactured in-house, using aluminium for high thermal conductivity, and includes conformal cooling fluid channels resulting in excellent thermal stability of the optical system.

The system features automated powder and waste handling systems that enable consistent process quality, reduce operator intervention time and ensure high standards of system safety. RenAM 500Q/S features a digital control system and is fully compatible with Renishaw's InfiniAM process planning and monitoring tools.

RenAM 500Q front view



RenAM 500Q side views

System specification

Dimensions without accessories (L × W × H)	1 236 mm × 2 165 mm × 2 130 mm (49 in × 86 in × 84 in)
Clearance under RenAM 500 series with no plinth	146 mm (5.75 in)
Size of build volume (X × Y × Z)	250 mm × 250 mm × 350 mm (9.84 in × 9.84 in × 13.78 in)
Typical maximum build envelope (X × Y × Z) (using standard 15 mm (3/5 in) substrate)	245 mm × 245 mm × 335 mm (9.64 in × 9.64 in × 13.19 in)
Build rate* (including recoater time)	Up to 150 cm^3/hr (9.15 in^3/hr)
Powder layer thickness	In the range of 20 µm to 100 µm (1 µin to 4 µin)
Weight (net)	Q (quad) 2 040 kg (4 498 lb) S (single) 1 950 kg (4 300 lb)
Minimum pressure in chambers (vacuum)	-950 mbar-gauge or 5 kPa-abs (-13.8 psi-gauge)
Working pressure (above atmosphere)	10 mbar-gauge (0.15 psi-gauge)
Power supply	380 V to 480 V AC, 50 A, 50 Hz to 60 Hz, 3-phase
Data connections	Standard network connection RJ45
Chilled water connection	From HRSH090-AF-40 chiller
Argon gas supply connection	3/8 in BSP male cone fitting
Running argon consumption (after initial fill)	< 50 L/hr (1.8 ft^3/hr)
Maximum argon consumption (during fill)	400 L/min (14.12 ft^3/min)
System fill/purge consumption	< 1 200 L (43 ft^3)
Build atmosphere preparation time	< 20 minutes to 1000 ppm using vacuum
Argon quality (greatest permissible impurities)	20 ppm or better (99.998% pure)
Continuous noise level	≤ 70 dB
Maximum noise level (temporary)	≤ 71 dB
Number of lasers, laser power and type of laser	Q (quad) 4 × 500 W – ytterbium fibre lasers S (single) 1 × 500 W – ytterbium fibre laser
Laser focus diameter	80 µm (3 µin)
Laser focusing	Dynamic
Maximum scanning and positioning speed **	10 m/s (32.8 ft/s)
Typical processing speed **	2 m/s (6.6 ft/s)
Beam wavelength	PRISM laser 1 080 nm
Laser modulation frequency	15 kHz
Dynamic focus diameter	Up to 500 µm (20 µin)
Optical module sealing	IP6X
Time to prepare build chamber atmosphere to 1 000 ppm oxygen	15 minutes

* Build rate is dependent upon parameters, part geometry and material.

** Typical processing speed is dependent upon parameters and material.

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Refer to the RenAM 500Q/S brochure H-5800-4031 for further information

For worldwide contact details, visit www.renishaw.com/contact

Issued: 10.2019

H-5800-4030-03-A

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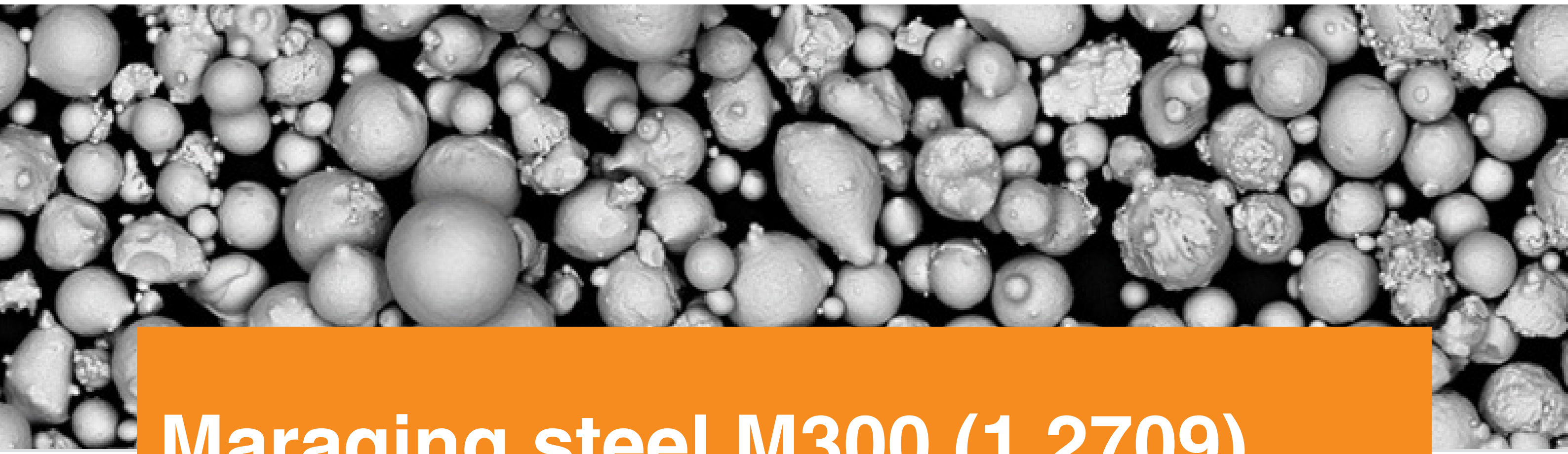

Maraging steel M300 (1.2709)

Parameter set options

Layer thickness	Optimised for	Page number
50 µm	Single laser per part	3

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

Material description

Maraging steels form a class of iron alloys. This group of materials has a martensitic crystal structure and is strengthened via aging at approximately 500 °C (900 °F), hence the name 'maraging'. These ultra-low carbon alloys have very high strength and hardness properties derived from precipitation of intermetallic compounds rather than carbon content. Nickel is the main alloying element, with cobalt, molybdenum, and titanium as secondary intermetallic alloying metals.

Material properties

- High strength
- High hardness
- High fatigue strength
- Good machinability

Applications

- Tooling inserts
- Moulds and dies
- High strength components

Generic material data

Typical wrought material properties

Material property	Wrought material value
Density	8.1 g/cm³
Thermal conductivity	14 W/mK at 20 °C, 21 W/mK at 600 °C, 29 W/mK at 1 300 °C
Melting temperature	1 413 °C
Coefficient of thermal expansion	10×10^{-6} K^{-1}

Recommended composition of powder

Element	Mass (%)
Iron	Balance
Nickel	17.00 to 19.00
Cobalt	8.00 to 10.00
Molybdenum	4.50 to 5.20
Titanium	0.60 to 0.80
Chomium	≤ 0.50
Aluminium	≤ 0.15
Manganese	≤ 0.10
Silicon	≤ 0.10
Niobium	≤ 0.05
Tanatalum	≤ 0.05
Vanadium	≤ 0.05
Tungsten	≤ 0.05
Carbon	≤ 0.03
Oxygen	≤ 0.03
Nitrogen	≤ 0.02
Boron	≤ 0.01
Phosporus	≤ 0.01
Sulfur	≤ 0.01
Residual elements	≤ 0.10 total

Recommended powder size distribution: 15 µm to 45 µm.

The values shown in this table are representative of a general 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	
50 µm	Single laser per part	Modulated	190 m^3/h	One laser: 13.5 cm^3/h	Four lasers: 54 cm^3/h

Material files: MarStM300_500QS_A50_M_##_# (meander scan strategy)
MarStM300_500QS_A50_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		Age hardened [1]	
	Mean	Standard deviation	Mean	Standard deviation
Bulk density [2]	≥ 99.8%	-	-	-
Ultimate tensile strength [3]				
Vertical direction (Z)	979 MPa	7 MPa	1 916 MPa	16 MPa
Yield strength [3]				
Vertical direction (Z)	822 MPa	7 MPa	1 854 MPa	16 MPa
Elongation after fracture [3]				
Vertical direction (Z)	14%	1%	8%	1%
Modulus of elasticity [3]				
Vertical direction (Z)	140 GPa	8 GPa	171 GPa	6 GPa

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 Age hardening method used for testing: Under argon at 15 L/min flow rate, heat at 3 °C/min to 490 °C ±10 °C, then hold temperature for 6 hours. Air cool 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.

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Part no.: H-5800-6795-02-A
Issued: 03.2023