Material data sheet

EOS MaragingSteel MS1

EOS MaragingSteel MS1 is a steel powder which has been optimized especially for processing on EOSINT M systems.

This document provides information and data for parts built using EOS MaragingSteel MS1 powder (EOS art.-no. 9011-0016) on the following system specifications:

- EOSINT M 280 400W
  with PSW 3.6 and EOS Original Parameter Set MS1_Performance 1.0 or MS1_Speed 1.0
- EOS M290 400W
  with EOSPRINT 1.0 and Parameter Set MS1_Performance 1.0 or MS1_Speed 1.0

Description

Parts built in EOS MaragingSteel MS1 have a chemical composition corresponding to US classification 18% Ni Maraging 300, European 1.2709 and German X3NiCoMoTi 18-9-5. This kind of steel is characterized by having very good mechanical properties, and being easily heat-treatable using a simple thermal age-hardening process to obtain excellent hardness and strength.

Parts built from EOS MaragingSteel MS1 are easily machinable after the building process and can be easily post-hardened to more then 50 HRC by age-hardening at 490 °C (914 °F) for 6 hours. In both as-built and age-hardened states the parts can be machined, spark-eroded, welded, micro shot-peened, polished and coated if required. Due to the layerwise building method, the parts have a certain anisotropy, which can be reduced or removed by appropriate heat treatment - see Technical Data for examples.

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Technical data

General process data

Typical achievable part accuracy [1], [8]	
- small parts (< 80 x 80 mm)	approx. ± 20 µm approx. ± 0.8 x 10^{-3} inch
- large parts	approx. ± 50 µm approx. ± 0.002 inch
Age hardening shrinkage [2], [8]	approx. 0.08 %
Min. wall thickness [3], [8]	approx. 0.3 - 0.4 mm approx. 0.012 - 0.016 inch
Surface roughness (approx.) [4]	
- as manufactured	
MS1 Performance (40 µm)	R_a 5 µm; Rz 28 µm R_a 0.19 x 10^{-3} inch, R_z 1.10 x 10^{-3} inch
MS1 Speed (50 µm)	R_a 9 µm; Rz 50 µm R_a 0.47 x 10^{-3} inch, R_z 2.36 x 10^{-3} inch
- after shot-peening	R_a 4 - 6.5 µm; R_z 20 - 50 µm R_a 0.16 – 0.26 x 10^{-3} inch R_z 0.78 – 1.97 x 10^{-3} inch
- after polishing	R_z up to < 0.5 µm R_z up to < 0.02 x 10^{-3} inch (can be very finely polished)
Volume rate [5]	
- Parameter set MS1_Performance (40 µm)	4.2 mm³/s (15.1 cm³/h) 0.92 in³/h
- Parameter set MS1_Speed 1.0 (50 µm)	5.5 mm³/s (19.8 cm³/h) 1.21 in³/h

[1] Based on users' experience of dimensional accuracy for typical geometries, as built. Part accuracy is subject to appropriate data preparation and post-processing, in accordance with EOS training.

[2] Ageing temperature 490 °C (914 °F), 6 hours, air cooling

[3] Mechanical stability is dependent on geometry (wall height etc.) and application

[4] Due to the layerwise building, the surface structure depends strongly on the orientation of the surface, for example sloping and curved surfaces exhibit a stair-step effect. The values also depend on the measurement method used. The values quoted here given an indication of what can be expected for horizontal (up-facing) or vertical surfaces.

[5] Volume rate is a measure of build speed during laser exposure of hatched areas. The total build speed depends on the average volume rate, the recoating time (related to the number of layers) and other geometry- and machine setting-related factors.

Physical and chemical properties of parts*

Material composition	Fe (balance) Ni (17 - 19 wt-%) Co (8.5 - 9.5 wt-%) Mo (4.5 - 5.2 wt-%) Ti (0.6 - 0.8 wt-%) Al (0.05 - 0.15 wt-%) Cr, Cu (each ≤ 0.5 wt-%) C (≤ 0.03 wt-%) Mn, Si (each ≤ 0.1 wt-%) P, S (each ≤ 0.01 wt-%)
Relative density	approx. 100 %
Density	8.0 - 8.1 g/cm³ 0.289 - 0.293 lb/in³

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Mechanical properties of parts at 20 °C (68°F)* [8]

	As built
Tensile strength [6]	
- in horizontal direction (XY)	typ. 1200 ± 100 MPa typ. 160 ± 15 ksi
- in vertical direction (Z)	typ. 1100± 150 MPa typ. 160 ± 22 ksi
Yield strength (Rp 0.2 %) [6]	
- in horizontal direction (XY)	typ. 1100 ± 100 MPa typ. 1xx ± 22 ksi
- in vertical direction (Z)	typ. 930 ± 150 MPa typ. 145 ± 22 ksi
Elongation at break [6]	
- in horizontal direction (XY)	typ. (12 ± 4) %
- in vertical direction (Z)	x
Modulus of elasticity [6]	
- in horizontal direction (XY)	typ. 150 ± 25 GPa typ. 22 ± 4 Msi
- in vertical direction (Z)	typ. 140 ± 25 GPa typ. 20 ± 4 Msi
Hardness [7]	typ. 33 - 37 HRC

[6] Tensile testing according to ISO 6892-1:2009 (B) Annex D, proportional test pieces, diameter of the neck area 5mm (0.2 inch), original gauge length 25mm (1 inch).

[7] Rockwell C (HRC) hardness measurement according to EN ISO 6508-1 on polished surface. Note that measured hardness can vary significantly depending on how the specimen has been prepared.

[8] Hint: these properties were determined on an EOSINT M 280-400W. Test parts from machine type EOS M 290-400W correspond with these data.

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Thermal properties of parts*

	As built	After age hardening [2]
Thermal conductivity	typ. 15 ± 0.8 W/m°C typ. 104 ± 6 Btu in/(h ft^2 °F)	typ. 20 ± 1 W/m°C typ. 139 ± 7 Btu in/(h ft^2 °F)
Specific heat capacity	typ. 450 ± 20 J/kg°C typ. 0.108 ± 0.005 Btu/(lb °F)	typ. 450 ± 20 J/kg°C typ. 0.108 ± 0.005 Btu/(lb °F)
Maximum operating temperature		approx. 400 °C approx. 750 °F

Abbreviations

typ.	typical
min.	minimum
approx.	approximately
wt	weight

*Part properties are provided for information purposes only and EOS makes no representation or warranty, and disclaims any liability, with respect to actual part properties achieved. Part properties are dependent on a variety of influencing factors and therefore, actual part properties achieved by the user may deviate from the information stated herein. This document does not on its own represent a sufficient basis for any part design, neither does it provide any agreement or guarantee about the specific properties of a material or part or the suitability of a material or a part for a specific application.

This powder has not been developed, tested or certified as a medical device according to Directive 93/42/EEC (MDD) or Regulation (EU) 2017/745 (MDR) and is not intended to be used as a medical device, in particular for the purposes specified in Art. 2 No. 1 MDR. Insofar as you intend to use the powder as raw material for the manufacture of pharmaceutical products or medical devices (e.g. as raw material which as a material must meet the requirements of Annex 1, Chapter II MDR), the responsibility and liability for all analyses, tests, evaluations, procedures, risk assessments, conformity assessments, approval and certification procedures as well as for all other official and regulatory measures required for this purpose shall lie solely with you both with regard to the pharmaceutical product and/or medical device manufactured by you and with regard to the properties, suitability, testing, evaluation, risk assessment, other requirements for use of the powder as raw material.
This also applies to applications with food contact. In this respect, the limitations of liability pursuant to our General Terms and Conditions and the system sales or material contracts shall apply.

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