Material data sheet

EOS MaragingSteel MS1 for EOSINT M 270 Systems

A number of different materials are available for use with EOSINT M systems, offering a broad range of e-Manufacturing applications. EOS MaragingSteel MS1 is a steel powder which has been optimized especially for processing on EOSINT M 270 systems. Other materials are also available for EOSINT M systems, and further materials are continuously being developed - please refer to the relevant material data sheets for details.

This document provides a brief description of the principle applications, and a table of technical data. For details of the system requirements please refer to the relevant information quote.

Description, application

EOS MaragingSteel MS1 is a pre-alloyed ultra high strength steel in fine powder form. Its composition corresponds 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.

This material is ideal for many tooling applications (DirectTool) such as tools for injection moulding, die casting of light metal alloys, punching, extrusion etc., and also for highperformance industrial and engineering parts, for example in aerospace and motor racing applications.

Standard processing parameters use full melting of the entire geometry, typically with 40 µm layer thickness, but it is also possible to use Skin & Core building style to increase the build speed. Using standard parameters, the mechanical properties are fairly uniform in all directions. 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 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. Unexposed powder can be reused.

Typical applications:

- heavy duty injection moulds and inserts for moulding all standard thermoplastics using standard injection parameters, with achievable tool life of up to millions of parts - die casting moulds for up to several thousand parts in light alloys

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- direct manufacture of parts for engineering applications including functional prototypes, small series products, individualised products or spare parts.
- parts requiring particularly high strength and hardness.

Technical data

General process data

Minimum recommended layer thickness	40 µm 1.6 mil (20 µm / 0.8 mil under development)
Typical achievable part accuracy [1]	
- small parts [1]	± 40 – 60 µm 16 - 24 mil
- large parts	± 0.2 %
Age hardening shrinkage	
- ageing temperature 490 °C (914°F), 6 hours, air cooling	0.08%
Min. wall thickness [2]	0.3 - 0.4 mm 8 - 20 mil
Surface roughness	
- after shot-peening	R_a 4 - 6.5 µm; R_y 20 - 50 µm R_a 0.16 – 0.25; R_z 0.78 – 1.95 mil
- after polishing	R_z up to < 0.5 µm R_z up to < 0.02 mil (can be very finely polished)
Volume rate [3]	
- standard parameters (full density)	3 - 3.6 mm³/s 0.66 – 0.79 in³/h

[1] Based on users' experience of dimensional accuracy for typical geometries, e.g. ± 40 µm when parameters can be optimized for a certain class of parts or ± 60 µm when building a new kind of geometry for the first time.

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

[3] Volume rate is a measure of build speed during laser exposure. The total build speed depends on the average volume rate, the recoating time (related to the number of layers) and other factors such as DMLS-Start settings.

Physical and chemical properties of parts

Material composition	Fe (bal) 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 (≤ 0.5 wt-%) C (≤ 0.03 wt-%) Mn, Si (each ≤ 0.1 wt-%) P, S (each ≤ 0.01 wt-%)
Relative density with standard parameters	approx. 100 %
Density with standard parameters	8.0 - 8.1 g/cm³ 0.289 - 0.293 lb/in³

Mechanical properties of parts

Ultimate tensile strength (MPIF 10)	
- as built	1100 MPa ± 100 MPa 160 ksi ± 15 ksi
- after age hardening	1950MPa ± 100 MPa 280 ksi ± 15 ksi
Yield strength (Rp 0.2 %)	
- as built	1000 MPa ± 100 MPa 145 ksi ± 15 ksi
- after age hardening	1900MPa ± 100 MPa 275 ksi ± 15 ksi
Elongation at break	
- as built	8% ± 3 %
- after age hardening	2% ± 1 %
Young's modulus	180 GPa ± 20 GPa 26.5 msi ± 3 msi

Hardness [4]	
- as built	33-37 HRC
- after age hardening	50-54 HRC
Ductility (Notched Charpy impact test)	
- as built	45 J ± 10 J
- after age hardening	11 J ± 4 J

[4] Rockwell C (HRC) hardness measurement according to DIN EN ISO 6508-1.

Thermal properties of parts

Thermal conductivity	
- as built	15 ± 0.8 W/m °C 105 Btu/(h ft² °F/in)
- after age hardening	20 ± 1 W/m °C 139 Btu/(h ft² °F/in)
Specific heat capacity	
- as built	450 ± 20 J/kg °C 0.108 ± 0.005 Btu/(lb °F)
- after age hardening	450 ± 20 J/kg °C 0.108 ± 0.005 Btu/(lb °F)
Maximum operating temperature	400 °C 750 °F

The quoted values refer to the use of these materials with EOSINT M 270 systems according to current specifications (including the latest released process software PSW and any hardware specified for the relevant material) and operating instructions. All values are approximate. Unless otherwise stated, the quoted mechanical and physical properties refer to standard building parameters and test samples built in horizontal orientation. They depend on the building parameters and strategies used, which can be varied by the user according to the application. The data are based on our latest knowledge and are subject to changes without notice. They are provided as an indication and not as a guarantee of suitability for any specific application.