Material
Data Sheet

EOS Maraging-Steel MS1

Ultra high strength tooling grade maraging steel

EOS MaragingSteel MS1

EOS MaragingSteel MS1 is an ultra high strength tooling grade maraging steel. Its excellent properties are enabled by forming intermetallic phases and precipitates in heat treatment. It's nickel, cobalt, molybdenum and titanium alloying results in an excellent material for additive manufacturing and provide low distortion and balanced properties. The properties enable successful use in diverse applications including injection molding and cold and hot working.

Main Characteristics:

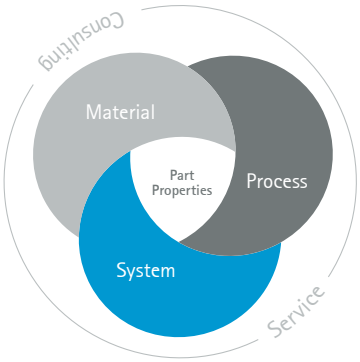
- Ultra high strength and hardness
- Properties adjustable with different heat treatment
- Low distortions
- Good machinability

Typical Applications:

- Plastic injection molding
- Extrusion tools
- Hot pressing tools

The EOS Quality Triangle

EOS uses an approach that is unique in the AM industry, taking each of the three central technical elements of the production process into account: the system, the material and the process – together simply described as the Quality Triangle. EOS focuses on delivering reproducible part properties for the customer.



All of the data stated in this material data sheet is produced according to EOS Quality Management System and international standards.

Powder Properties

The chemicalal composition of EOS MaragingSteel MS1 corresponds to AMS6514 18Ni300 maraging steel standard.

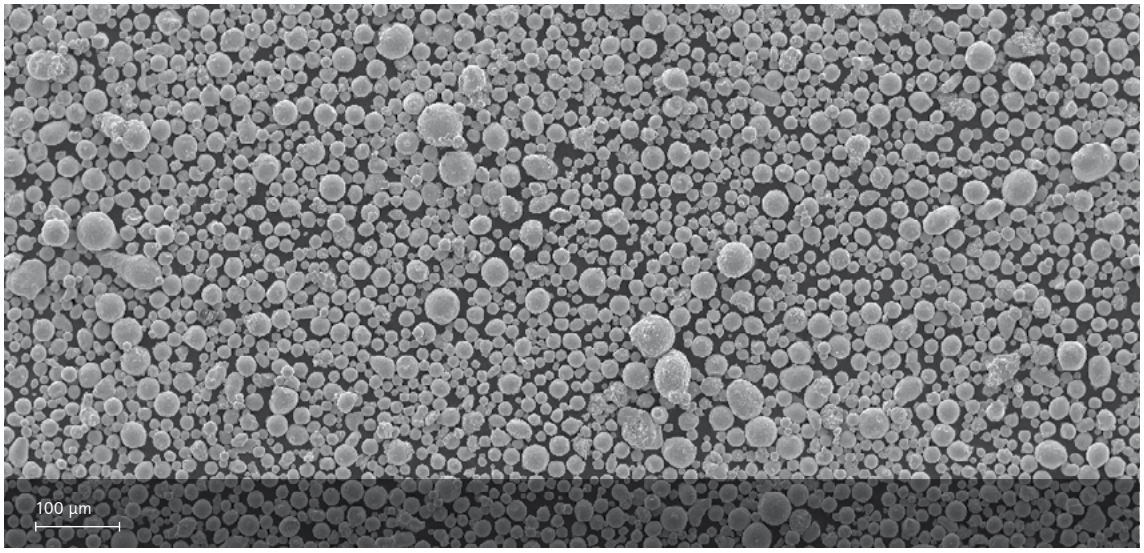
Powder chemical composition (wt.-%)

Element	Min.	Max.
Fe	Balance	
Ni	17.00	19.00
Co	8.50	9.50
Mo	4.50	5.20
Ti	0.60	0.80
Al	0.05	0.15

Powder particle size

Generic particle size distribution	15 – 65 µm

SEM picture of EOS MaragingSteel MS1 powder.

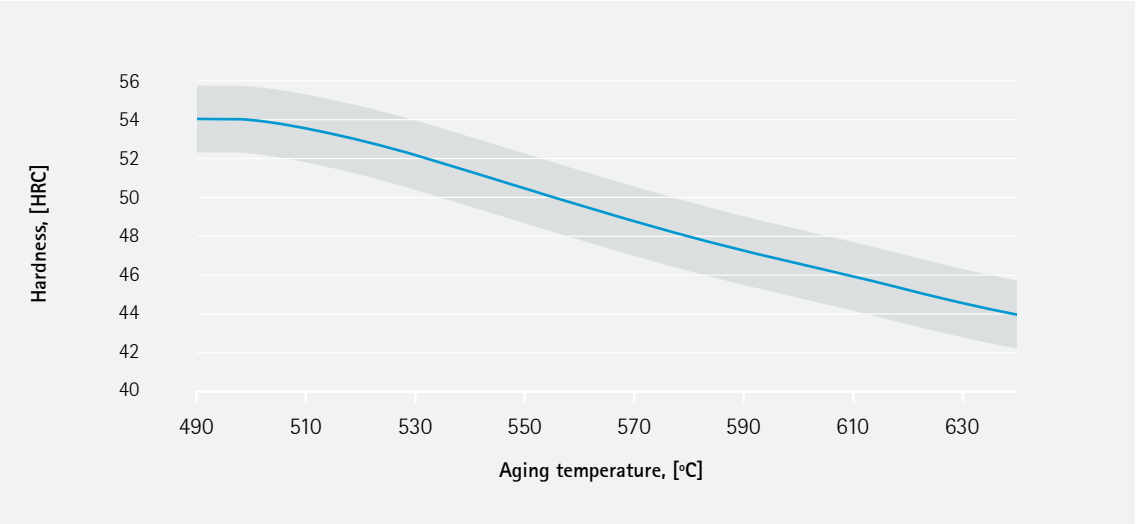


Heat Treatment

EOS MaragingSteel can be heat treated to match various needs of different applications. The two step heat treatment can be performed under vacuum or inert gas atmosphere. First step is solution annealing to minimize amount of austenite in the martensitic matrix.The needed hardness and strength is achieved through aging treatment where hardening takes place through forming of intermetallic phases and precipitates.

Solution annealing: 2 h at 940 °C (±10 °C) measured from the part followed by rapid air cooling to room temperature (below 32 °C). Cooling rate 5-60 °C/min. Reaching room temperature before starting aging treatment is required to achieve desired microstructure.

Aging: For peak hardness of 54 HRC age 6 h at 490 °C (±10 °C) measured from the part followed by air cooling. Mechanical properties presented in this document achieved through this aging procedure. For lower hardness and strength choose aging temperature according to the graph below



Rockwell C hardness according to ISO 6508

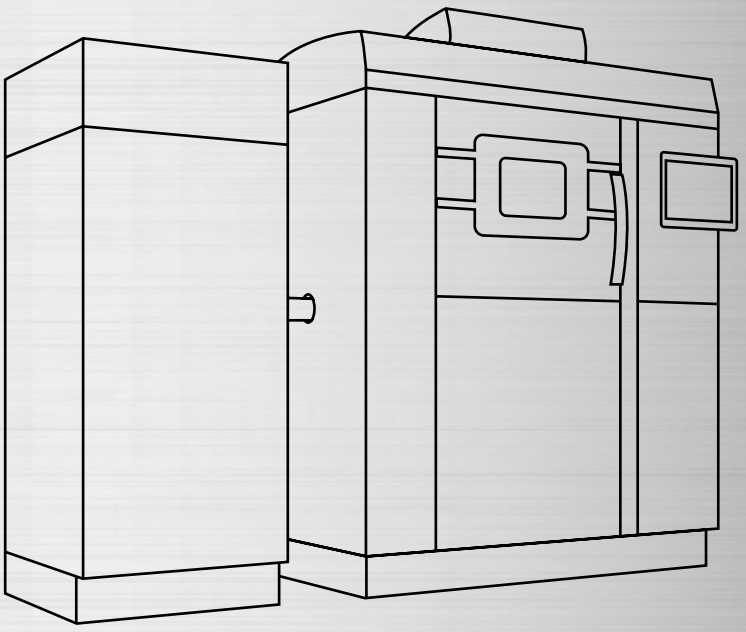
Coefficient of Thermal Expansion ASTM E228

Temperature	25-100 °C	25-200 °C	25-300 °C	25-400 °C
CTE	10.6 *10^{-6}/K	10.9*10^{-6}/K	11.2*10^{-6}/K	11.5*10^{-6}/K

Modulus of Elasticity ASTM E 132-04

State	Heat treated
Modulus of elasticity [GPa]	190

TRL 8
Premium



EOS MaragingSteel MS1
for EOS M 290 | 40 µm

Process Information
Chemical and Physical Part Properties
Mechanical Properties
Additional Data

EOS MaragingSteel MS1 for EOS M 290 | 40 µm

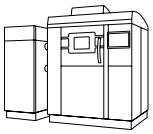
Process Information

This process product is optimized for building high quality parts with EOS M 290 system using EOS MaragingSteel MS1.

System set-up	EOS M 290
EOSPAR name	MS1_040_PerformanceM291
Also compatible with	EOS M290-2 400W
Powder part no.	9011-0016
Recoater blade	Ceramic blade
Nozzle	Grid nozzle
Inert gas	Nitrogen
Sieve	63 µm

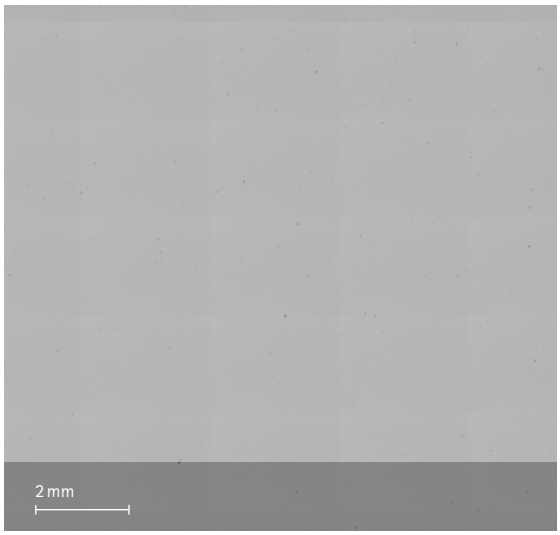
Additional information	
Layer thickness	40 µm
Typical dimensional change after HT	+0.1 %
Volume rate	4.2 mm^3/s

Chemical and Physical Properties of Parts[1]



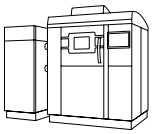
Chemical composition of printed parts matches the chemistry of EOS MaragingSteel MS1 powder.

Micrograph of polished surface



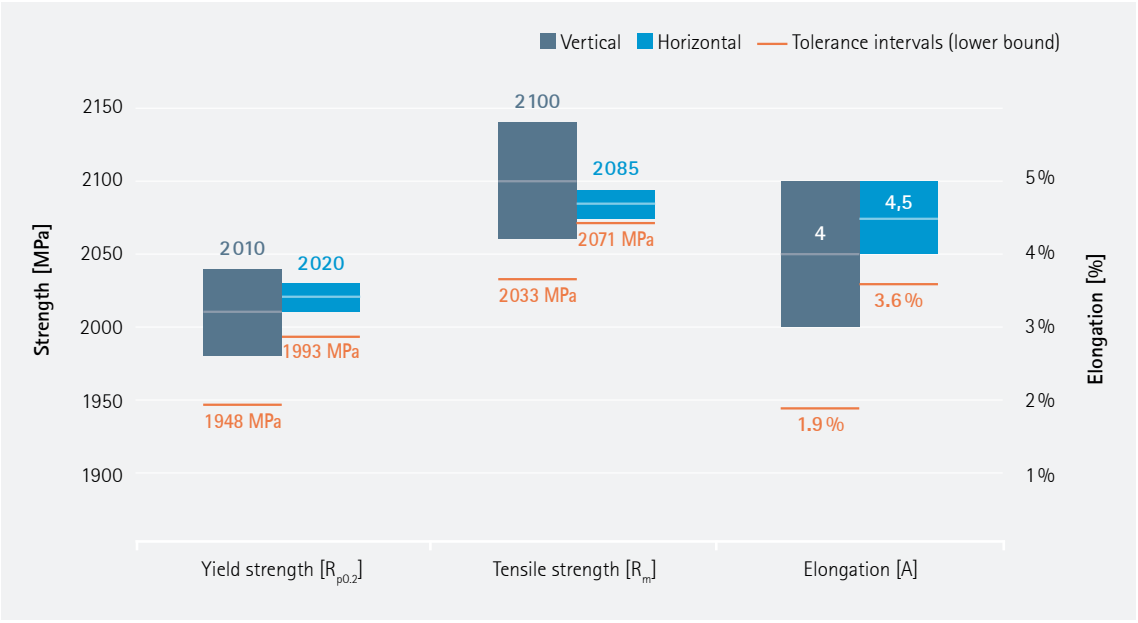
Defects	Result	Number of samples
Average defect percentage	0.04 %	10

Mechanical Properties[1]



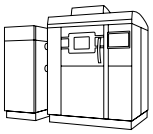
Mechanical properties ISO6892-1

Heat Treated	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]
Vertical	2010	2100	4
Horizontal	2020	2085	4.5

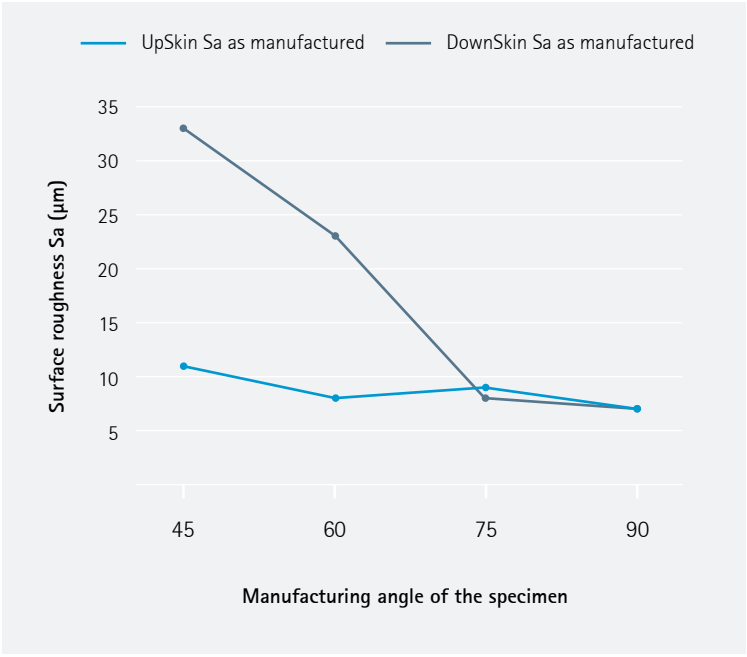


T95: Tolerance intervals provide lower bounds where 95 % of the population falls with 95 % confidence.
Tolerance intervals are based on validation data / QA statistics and are not directly transferable to other systems.

Additional Data[1]



Surface Roughness

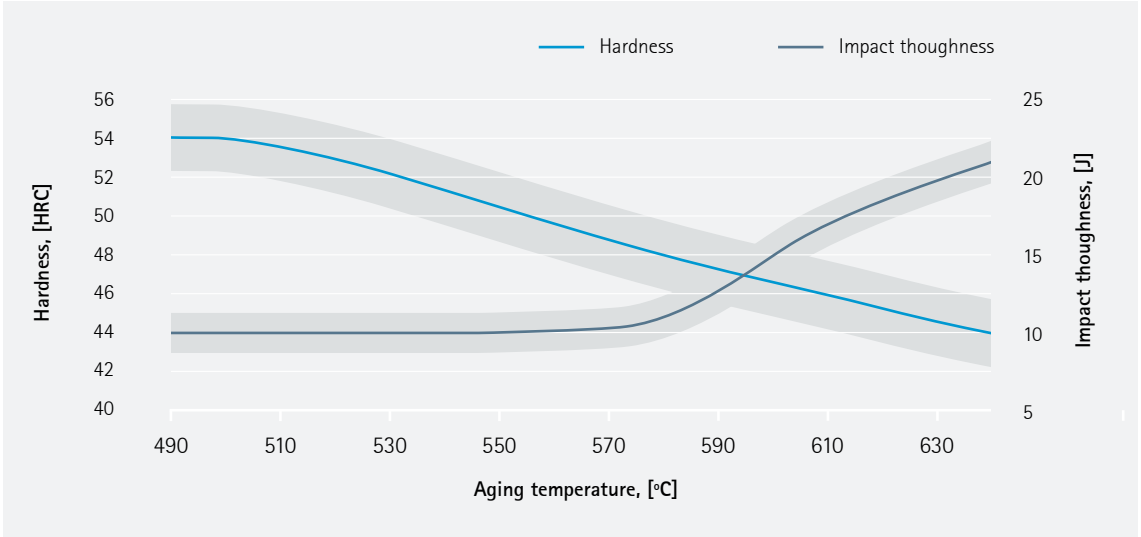


Fatigue Strength

State	Heat treated
Fatigue Strength [MPa]	650

Fatigue strength determines a stress level where specimen fails at a defined number of stress cycles. Fatigue strength was estimated statistically according to ISO 12107. Testing was performed according to ASTM E466. Fatigue results typically show large deviations due to the nature of the fatigue process.

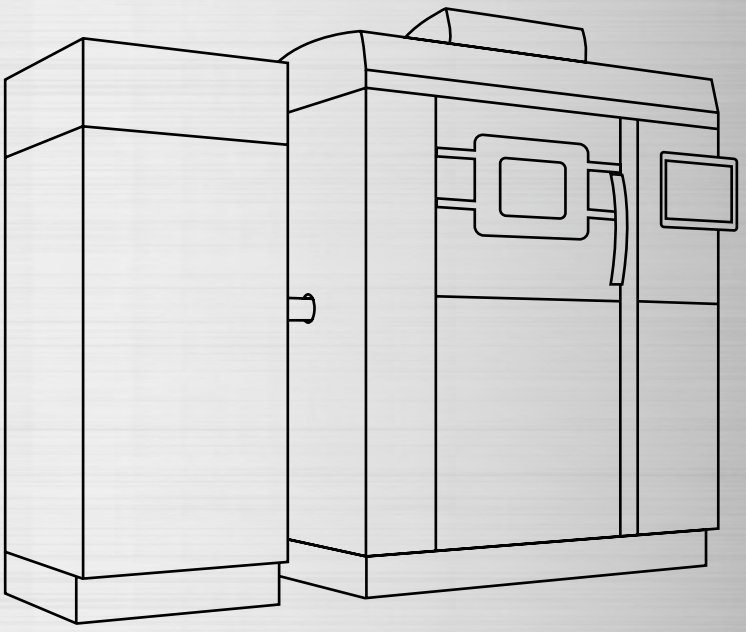
Impact Thoughness



Charpy-V impact thoughness in relation to hardness and aging temperature according to ISO 148.

TRL 3

Core



EOS MaragingSteel MS1
for EOS M 290 | 50 µm

Process Information

Chemical and Physical Part Properties

Mechanical Properties

Additional Data

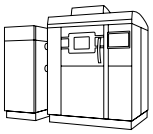
EOS MaragingSteel MS1 for EOS M 290 | 50 µm
Process Information

This process product is optimized for fast production of MS1 parts with EOS M 290.

System set-up	EOS M 290
EOSPAR name	MS1_050_SpeedM291
Also compatible with	EOS M290-2 400W
Powder part no.	9011-0016
Recoater blade	Ceramic blade
Nozzle	Grid nozzle
Inert gas	Nitrogen
Sieve	63 µm

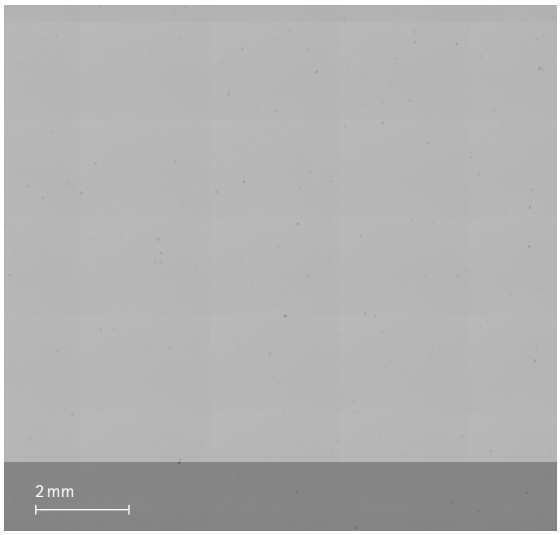
Additional information	
Layer thickness	50 µm
Typical dimensional change after HT	+0.1 %
Volume rate	5.5 mm^3/s

Chemical and Physical Properties of Parts[1]



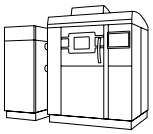
Chemical composition of printed parts matches the chemistry of EOS MaragingSteel MS1 powder.

Micrograph of polished surface



Defects	Result
Average defect percentage	< 0.1 %

Mechanical Properties[1]

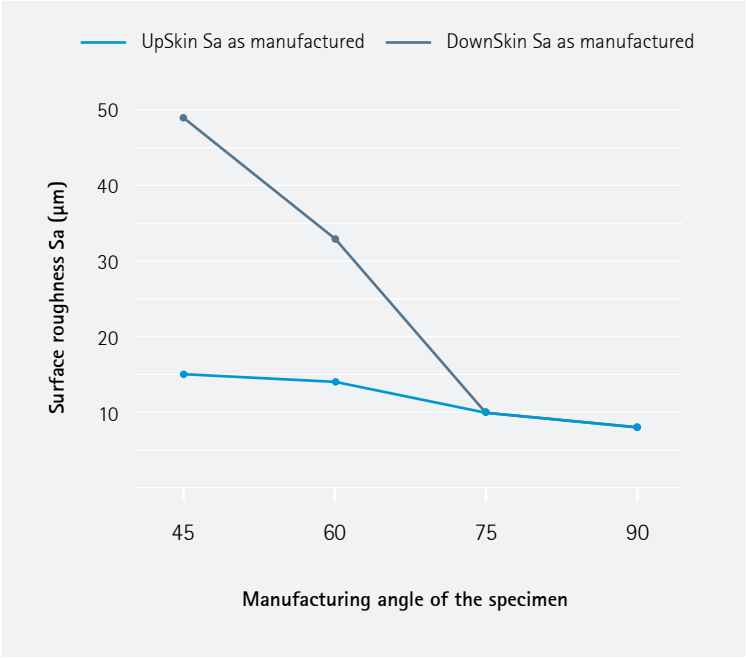


Mechanical properties ISO6892-1

Heat Treated	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]
Vertical	2000	2100	2
Horizontal	2030	2100	3

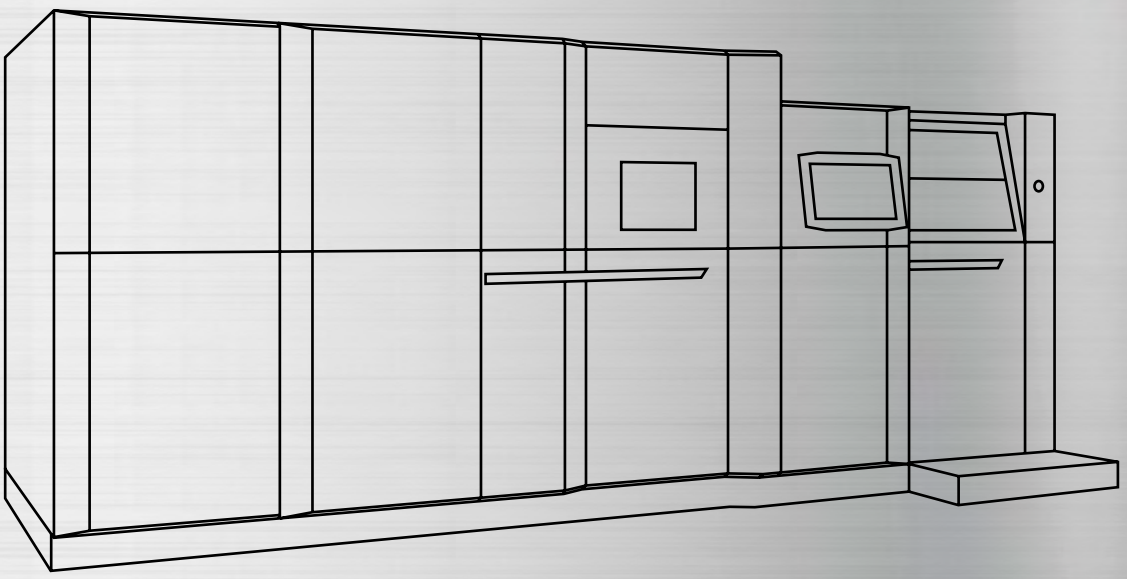
Additional Data[1]

Surface Roughness



TRL 3

Core



EOS MaragingSteel MS1
for EOS M 300-4 | 50 µm

Process Information

Chemical and Physical Part Properties

Mechanical Properties

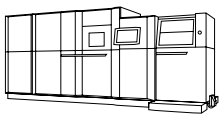
EOS MaragingSteel MS1 for EOS 300-4 | 50 µm
Process Information

This process product is optimized for fast production of MS1 parts with EOS M 300-4.

System set-up	EOS M 300-4
EOSPAR name	MS1_050_CoreM304
Software requirements	EOSPRINT 2.8 or newer EOSYSTEM 2.11 or newer
Powder part no.	9011-0016
Recoater blade	Ceramic blade
Inert gas	Nitrogen
Sieve	63 µm

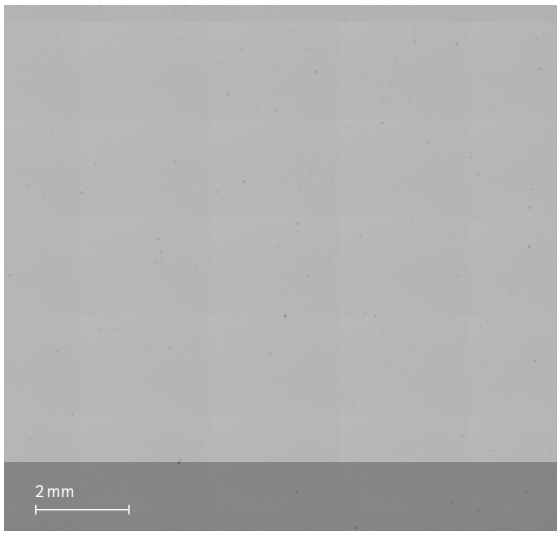
Additional information	
Layer thickness	50 µm
Typical dimensional change after HT	+0.1 %
Volume rate	up to 4 x 5.5 mm^3/s

Chemical and Physical Properties of Parts[1]



Chemical composition of printed parts matches the chemistry of EOS MaragingSteel MS1 powder.

Micrograph of polished surface



Defects	Result
Average defect percentage	< 0.1 %

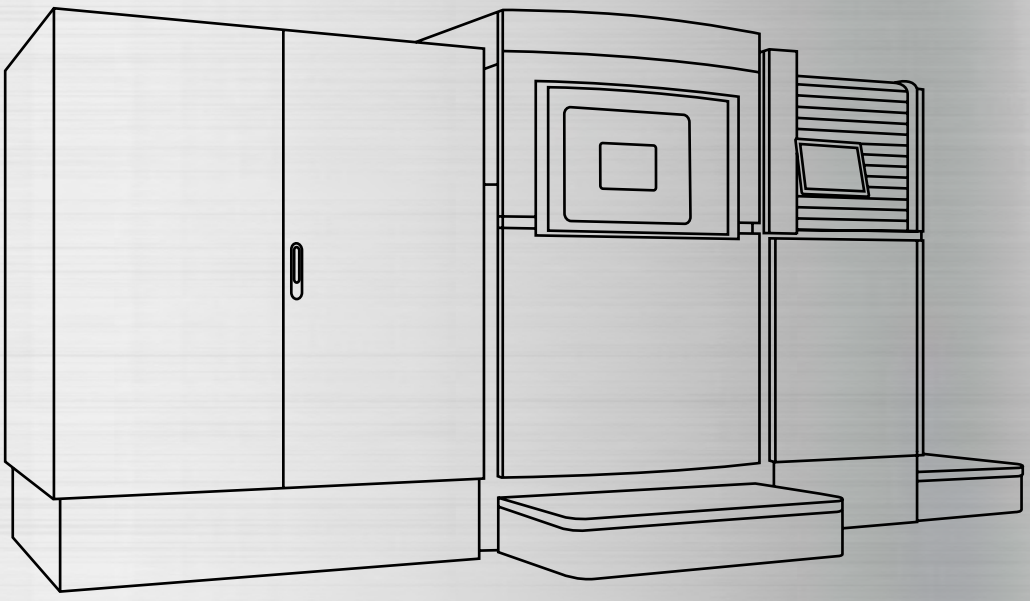
Mechanical Properties[1]

Mechanical properties ISO6892-1

Heat Treated	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]
Vertical	1990	2110	3
Horizontal	2040	2120	4

TRL 7

Premium



EOS MaragingSteel MS1
for EOS M 400-4 | 40 µm

Process Information

Chemical and Physical Part Properties

Mechanical Properties

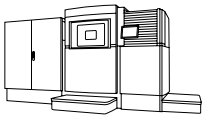
EOS MaragingSteel MS1 for EOS M 400-4 | 40 µm
Process Information

This process product is optimized for building high quality parts with EOS M 400-4 system using EOS MaragingSteel MS1.

System set-up	EOS M 400-4
EOSPAR name	MS1_040_FlexM404
Powder part no.	9011-0016
Recoater blade	Ceramic blade
Nozzle	Standard
Inert gas	Nitrogen
Sieve	63 µm

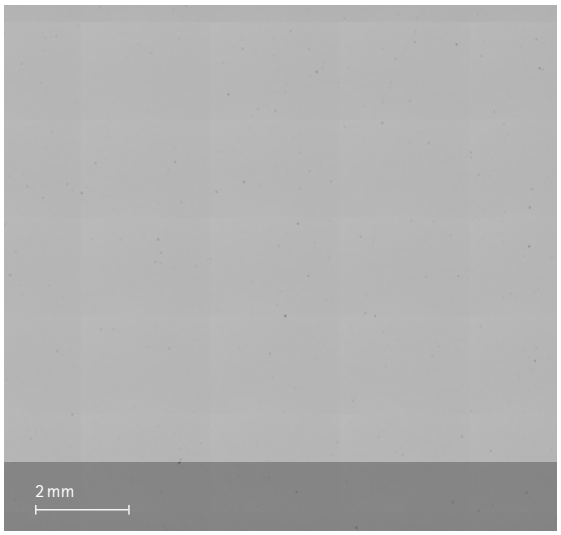
Additional information	
Layer thickness	40 µm
Typical dimensional change after HT	+0.1 %
Volume rate	up to 4 x 4.2 mm^3/s

Chemical and Physical Properties of Parts[1]



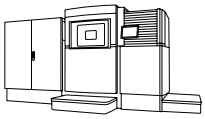
Chemical composition of built parts is compliant to EOS MaragingSteel MS1 powder chemical composition.

Micrograph of polished surface



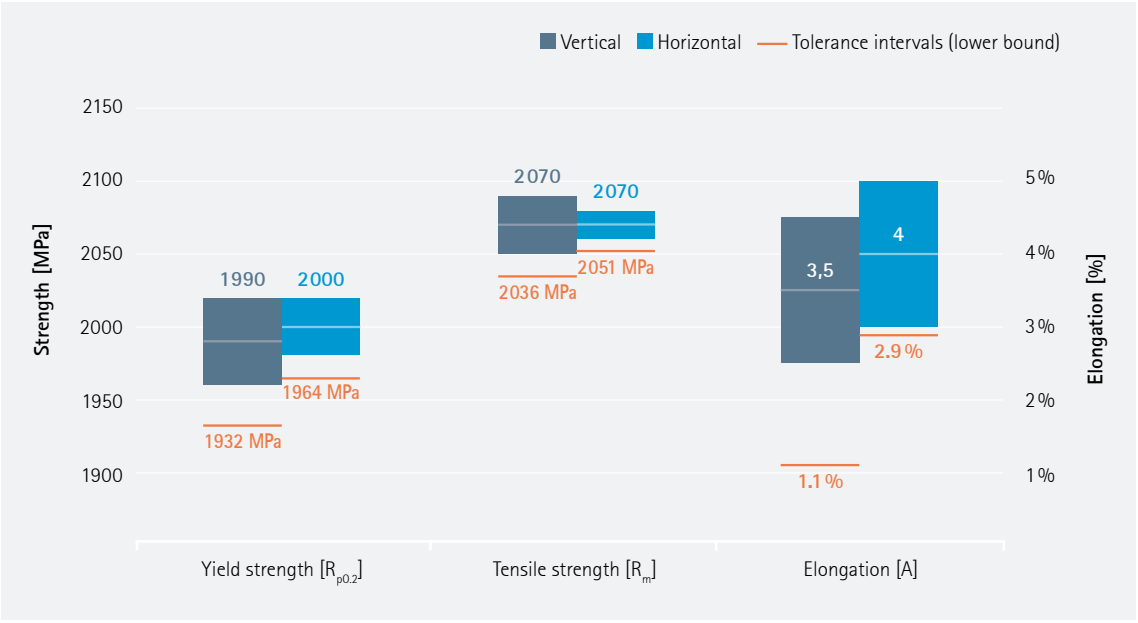
Defects	Result
Average defect percentage	< 0.1 %

Mechanical Properties[1]



Mechanical properties ISO6892-1

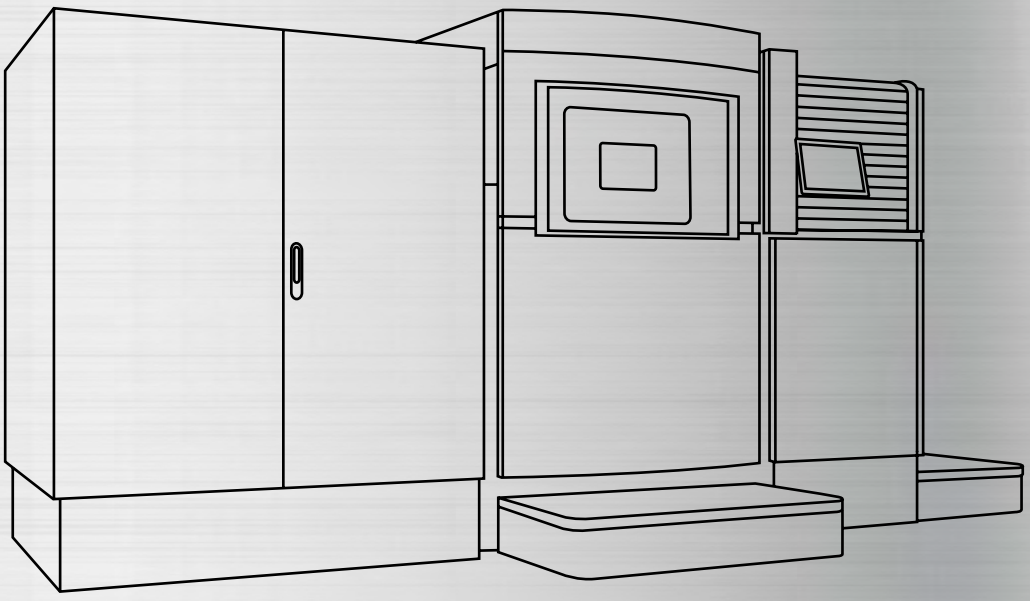
Heat Treated	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]
Vertical	1990	2070	3.5
Horizontal	2000	2070	4



T90: Tolerance intervals provide lower bounds where 90 % of the population falls with 95 % confidence.
Tolerance intervals are based on validation data / QA statistics and are not directly transferable to other systems.

TRL 3

Core



EOS MaragingSteel MS1
for EOS M 400-4 | 80 µm

Process Information

Chemical and Physical Part Properties

Mechanical Properties

Additional Data

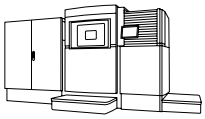
EOS MaragingSteel MS1 for EOS M 400-4 | 80 µm
Process Information

This process product is optimized for fast production of MS1 parts with EOS M 400-4.

System set-up	EOS M 400-4
EOSPAR name	MS1_080_CoreM404
Software requirements	EOSPRINT 2.16 or newer EOSYSTEM 2.20 or newer
Powder part no.	9011-0016
Recoater blade	Ceramic blade
Nozzle	Aerospike
Inert gas	Nitrogen
Sieve	63 µm

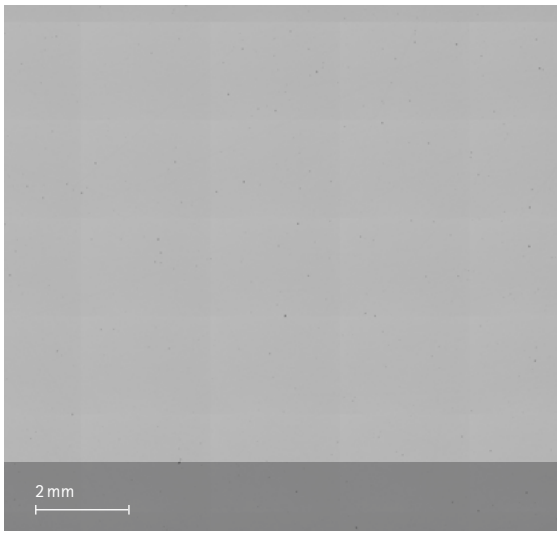
Additional information	
Layer thickness	80 µm
Volume rate	up to 4 x 7.68 mm^3/s

Chemical and Physical Properties of Parts[1]



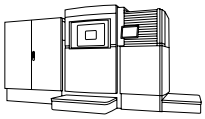
Chemical composition of built parts is compliant to EOS MaragingSteel MS1 powder chemical composition.

Micrograph of polished surface



Defects	Result
Average defect percentage	< 0.1 %

Mechanical Properties[1]

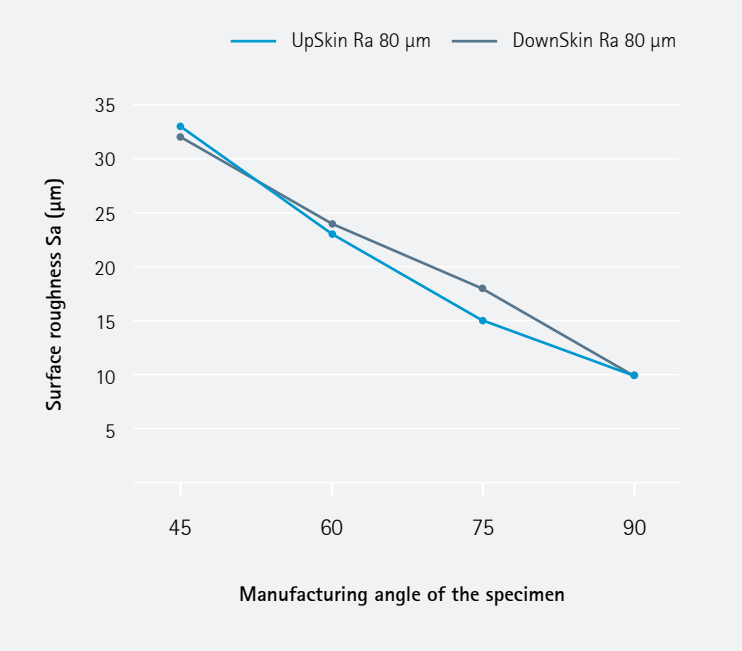


Typical properties ISO6892-1

Heat Treated	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]
Vertical	1980	2050	4
Horizontal	1990	2055	4

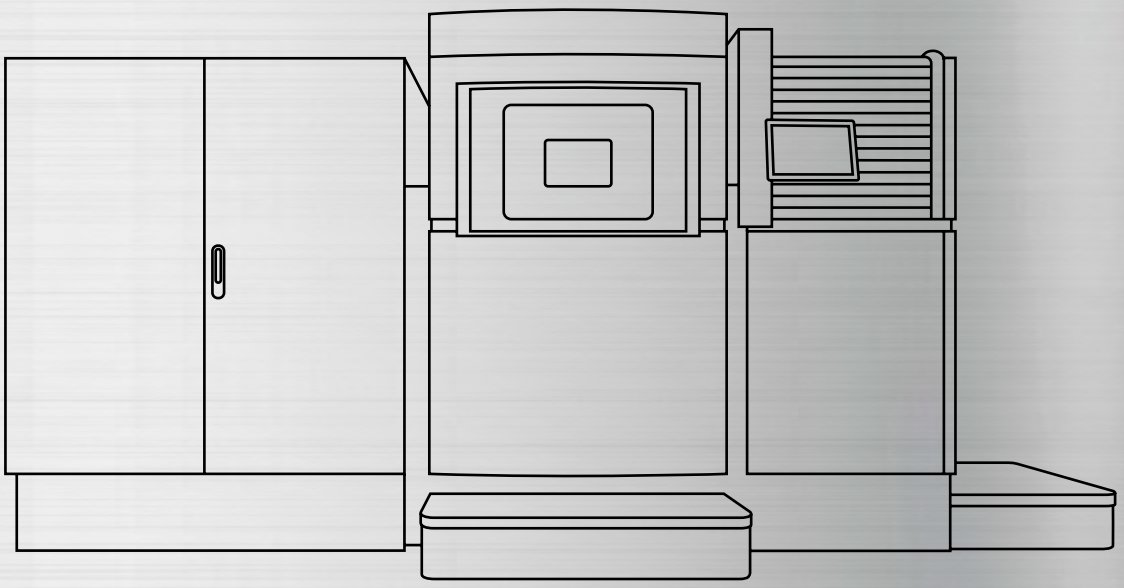
Additional Data[1]

Surface Roughness



TRL 3

Core



EOS MaragingSteel MS1
for EOS M 400-1 | 50 µm

Process Information

Chemical and Physical Part Properties

Mechanical Properties

Additional Data

EOS MaragingSteel MS1 for EOS M 400-1 | 50 µm

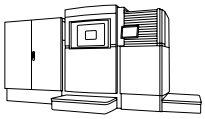
Process Information

This process product is optimized for fast production of MS1 parts with EOS M 400-1.

System set-up	EOS M 400-1
EOSPAR name	MS1_050_FlexM400
Powder part no.	9011-0016
Recoater blade	Ceramic blade
Inert gas	Nitrogen
Sieve	63 µm

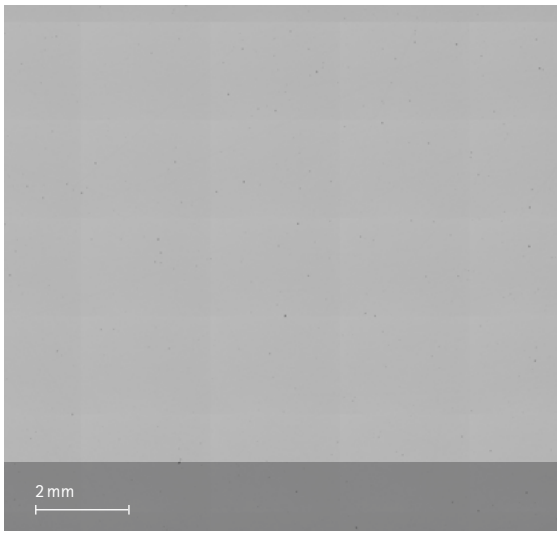
Additional information	
Layer thickness	50 µm
Typical dimensional change after HT	+0.1 %
Volume rate	5.5 mm^3/s

Chemical and Physical Properties of Parts[1]



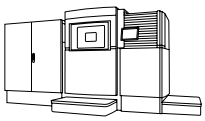
Chemical composition of built parts is compliant to EOS MaragingSteel MS1 powder chemical composition.

Micrograph of polished surface



Defects	Result
Average defect percentage	< 0.1 %

Mechanical Properties[1]



Typical properties ISO6892-1

Heat Treated	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Elongation at break A [%]
Vertical	2000	2100	2
Horizontal	2030	2100	2

Additional Data[1]

Surface Roughness

Vertical	Ra 9 µm

[1] 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.

Status 06/2024

Cover: This image shows a possible application.

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