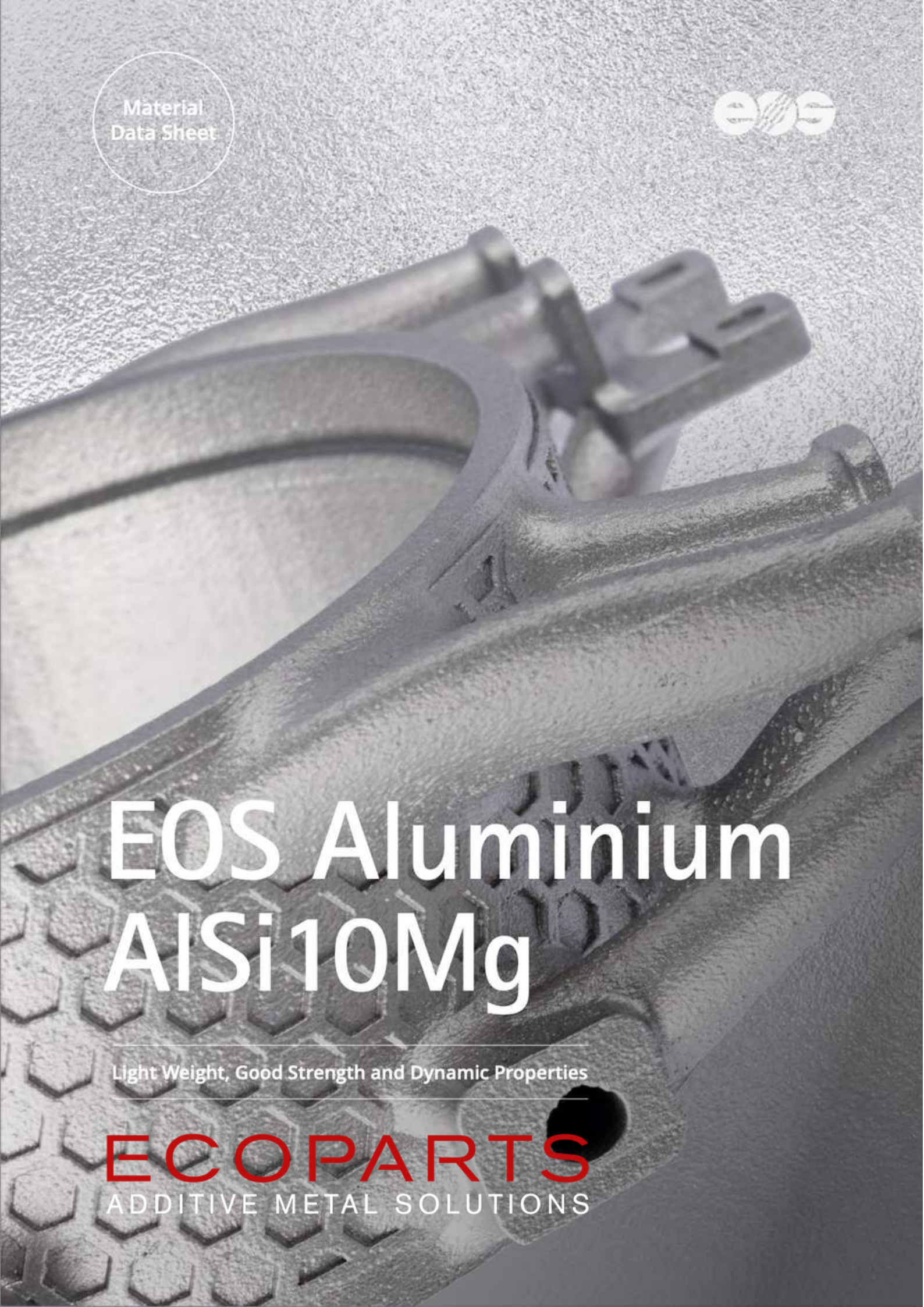
Material
Data Sheet



EOS Aluminium AlSi10Mg

Light Weight, Good Strength and Dynamic Properties

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ADDITIVE METAL SOLUTIONS

EOS Aluminium AlSi10Mg

Good Strength & Dynamic Load Bearing Capacity

EOS Aluminium AlSi10Mg is a widely used alloy that combines light weight and good mechanical properties. Different heat treatments can be applied to modify properties for example to increase ductility and conductivity. The material has good thermal and electrical conductivity especially after heat treatment. In addition, gas tight parts can be manufactured with EOS Aluminium AlSi10Mg.

Main Characteristics:

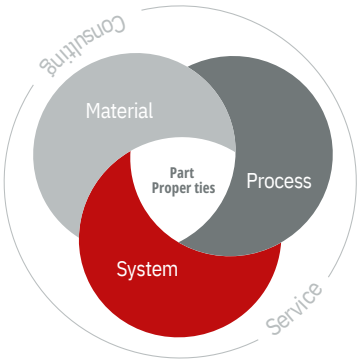
- Good strength, hardness and dynamic properties
- High corrosion resistance
- Good thermal and electrical conductivity
- Properties can be modified with heat treatments

Typical Applications:

- General engineering components and parts subject to high loads
- Lightweight designs
- Aerospace and automotive components
- Substitution of cast AlSi10Mg parts

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. The data resulting from each combination is assigned a Technology Readiness Level (TRL) which makes the expected performance and production capability of the solution transparent.



EOS incorporates these TRLs into the following two categories:

- Premium products (TRL 7-9): offer highly validated data, proven capability and reproducible part properties.
- Core products (TRL 3 and 5): enable early customer access to newest technology still under development and are therefore less mature with less data.

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

Powder Properties

The chemical composition of the powder is in compliance with standard DIN EN 1706 (EN AC—43000) and ASTM F3318-18.

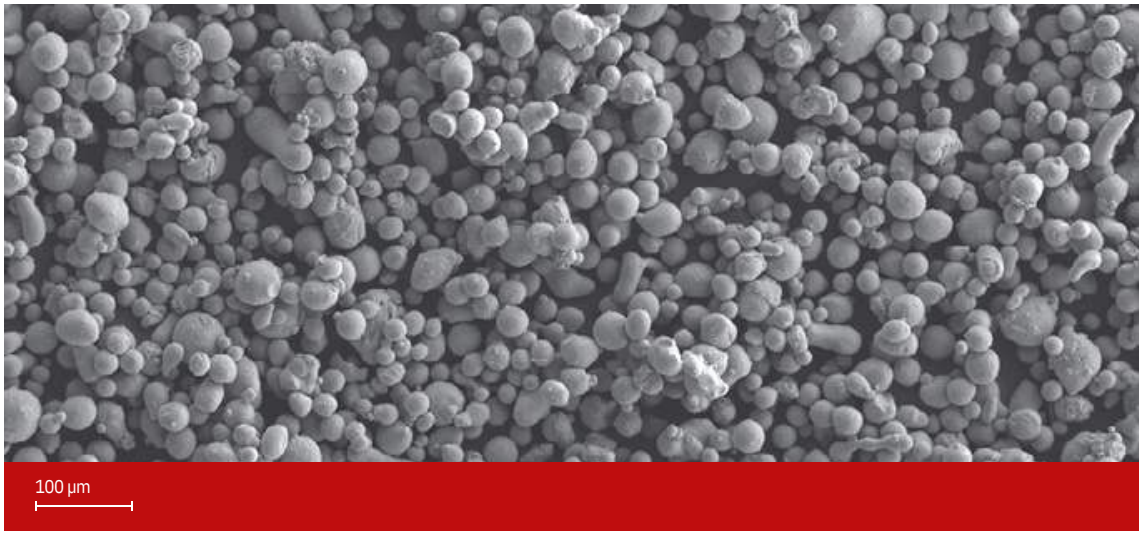
Powder chemical composition (wt.-%)

Element	Min.	Max.
Al	Balance	
Si	9.0	11.0
Fe	-	0.55
Cu	-	0.05
Mn	-	0.45
Mg	0.20	0.45
Ni	-	0.05
Zn	-	0.10
Pb	-	0.03
Sn	-	0.05
Ti	-	0.15

Powder particle size

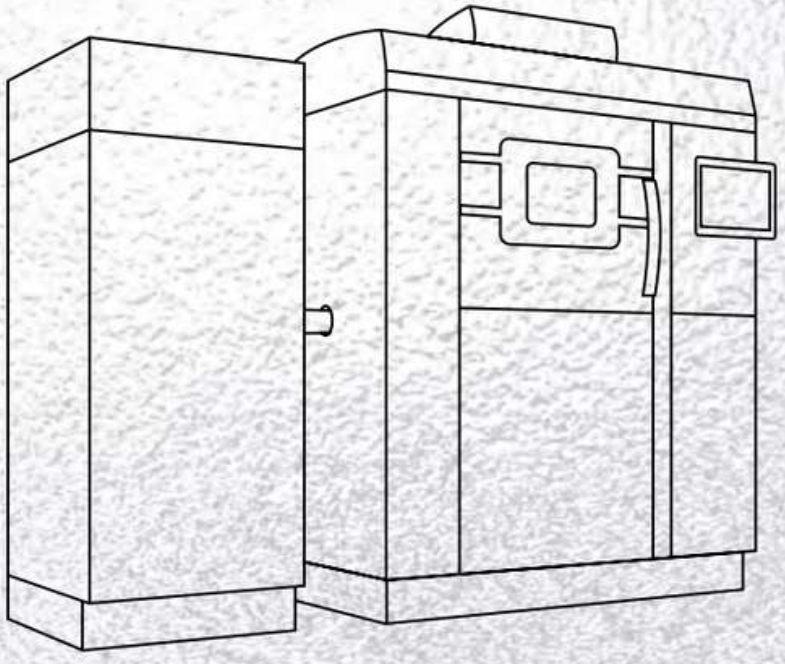
Generic particle size distribution	25 - 70 µm

SEM image of EOS Aluminium AlSi10Mg powder.



TRL 9

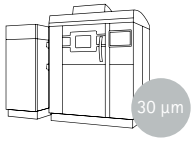
EOS Premium



EOS Aluminium AlSi10Mg
for EOS M 290 | 30 µm

Process Information
Heat Treatment
Physical Part Properties
Mechanical Properties
Additional Data

EOS Aluminium AlSi10Mg for EOS M 290 | 30 µm
Process Information



High performance process with smooth and shiny surfaces. Process is developed to have high density with smooth vertical surfaces. T6 heat treatment enables excellent elongation with moderate strength and reduced anisotropy.

Main Characteristics:

- → Good mechanical properties and low amount of defects.
- → Shiny and smooth surfaces on vertical areas.
- → Mechanical properties can be modified with heat treatment.

System set-up	EOS M 290
EOS MaterialSet	AlSi10Mg_FlexM291 2.02
Software requirements	EOSPRINT 1.6 or newer EOSYSTEM 04.19 or newer
Powder part no.	9 011- 0 0 24
Recoater blade	EOS HSS blade
Build platform temperature	35 °C
Nozzle	EOS standard nozzle
Inert gas	Argon
Sieve	90 µm

Additional information	
Layer thickness	30 µm
Volume rate	5.1 mm³/s
Minimum wall thickness	0.4 mm

Increasing build platform temperature can improve buildability but build platform temperatures >100 °C together with high energy input from laser may lead to aging / overaging of parts and thus a change in mechanical properties. This risk is relevant in builds with long duration and when heat conductivity from parts is reduced due to light support structures.

Heat Treatment

EOS T6 Heat Treatment:

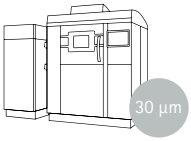
EOS has developed an AM optimized heat treatment procedure that is 40 % shorter than conventional T6 heat treatment procedures. Solution annealing 30 min @ 530 °C, water quench. Artificial aging 6 h @ 165 °C, cooling in air. Parts to preheated oven. Maximum overheating 5 °C. Delay between SA and quenching maximum 30 s. Oven type & configuration may have impact on the mechanical properties. For complex and massive parts uniform heating and cooling needs to be arranged.
EOS T6 treatment is recommended to obtain controlled mechanical properties and lower variation in mechanical values (for example in long build jobs if heat transfer from parts is limited by low amount of support and after stress relief heat treatment).
An increase in porosity due to heat treatment is possible. A more detailed description of heat treatment is available upon request.

Solution Annealing:

30 minutes in 530 °C followed by immediate quenching to water.

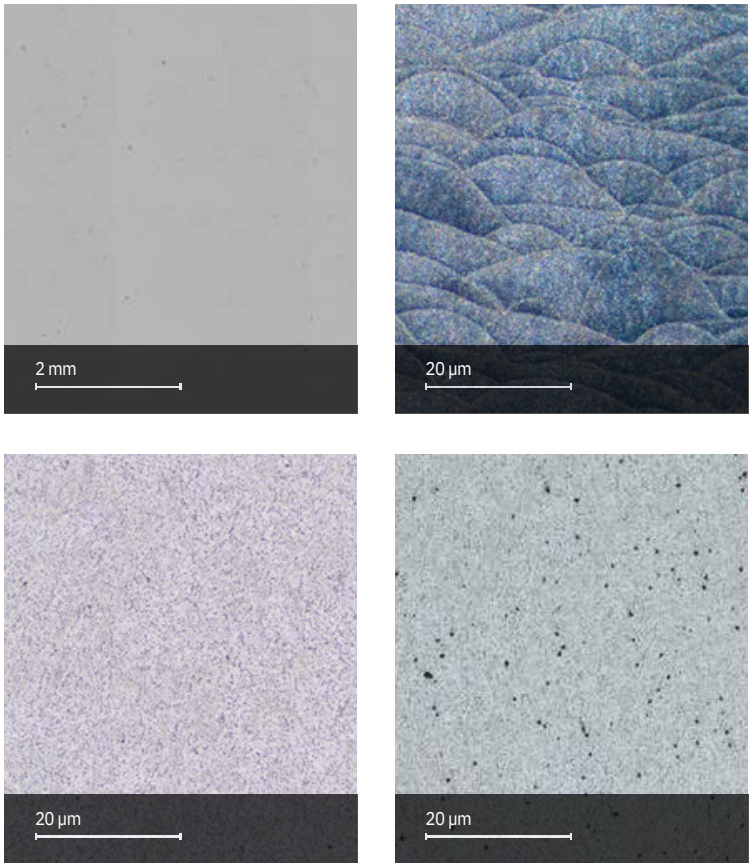
Aging:

Artificial aging of 6 hours in 165 °C followed by cooling in air.



Physical Part Properties

The chemical composition of the EOS Aluminium AlSi10Mg parts is in compliance with DIN EN 1706 (EN AC—43000) and ASTM F3318-18 standards.



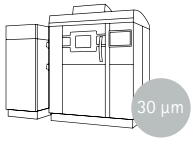
Microstructure images in the top row are as manufactured and as manufactured plus etched. Those in the bottom row are heat treated and heat treated plus etched. Etched according to internal procedure using Groesbeck reagent.

Microstructure of the produced parts

Defects	Result	Number of samples
Average defect percentage as manufactured	0.04 %	45
Average defect percentage after EOS T6 HT	0.1 - 0.2 %	-

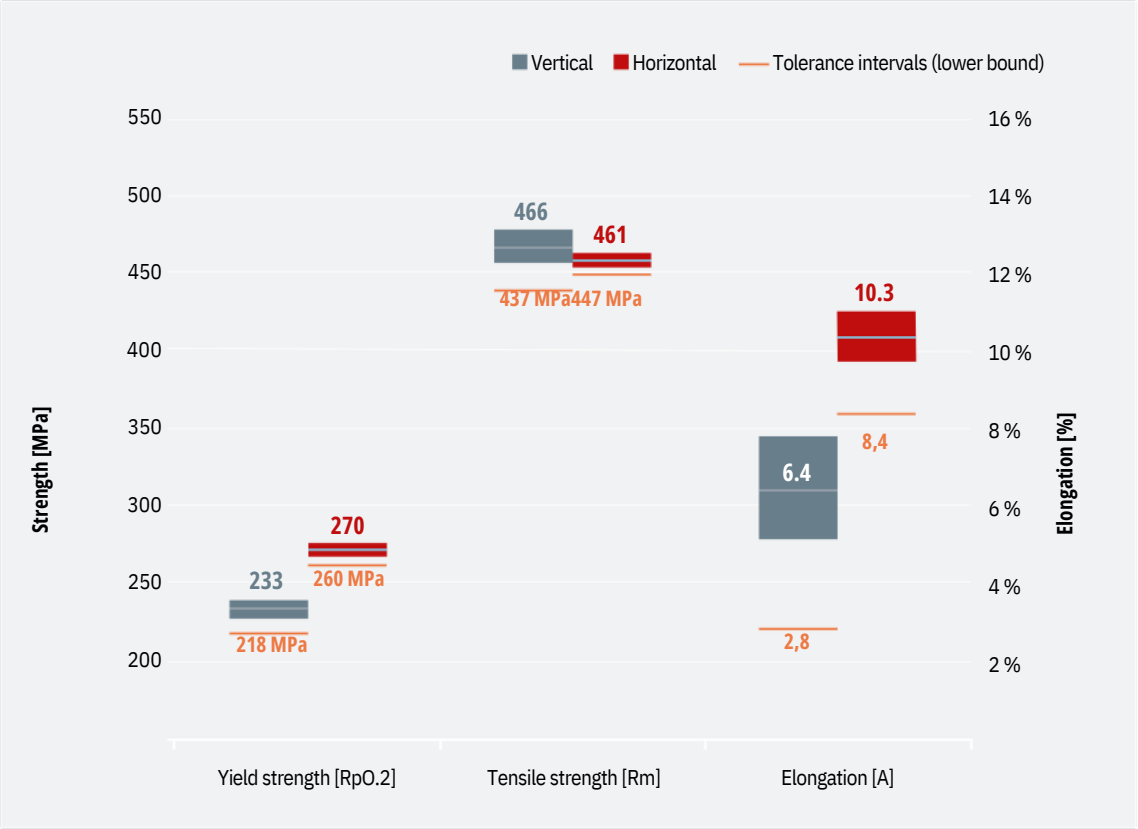
Density ISO 3369	Result	Number of samples
Average density	≥ 2.67 g/cm3	34

Mechanical Properties



Mechanical properties (as manufactured state)

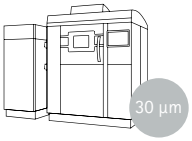
	Yield strength Rp0.2 [MPa]	Tensile strength Rm [MPa]	Elongation at break A [%]	Number of samples
Vertical	230	460	6.3	261
Horizontal	270	450	10.2	108



The testing was done according to ISO 6892-1, B10. Machined (turned) samples were used. T99: One-sided (lower bound) Tolerance Interval provides limit above which 99% of the population falls with 95% level of confidence. Tolerance intervals are based on e.g validation data / QA statistics.

Typical hardness EN ISO 6506-1

As manufactured	114 HBW 2.5/62.5



Typical mechanical properties (heat treated state, EOS T6)

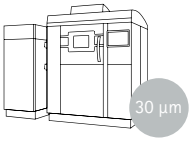
	Yield strength Rp0.2 [MPa]	**Tensile strength** Rm [MPa]	**Elongation at break** A [%]	**Number of samples**
Vertical	250	310	11	42
Horizontal	260	320	11	36

In case higher build platform temperature is used it is strongly advised to perform EOS T6 heat treatment in order to obtain mechanical properties similar to those stated in the MDS.

In case stress relieving of parts is needed prior to removal from build platform, EOS recommends SR HT: 90 minutes @ 270 °C.
Typical properties obtained after SR: YS 200 MPa; TS 310 MPa; elongation 9 %.

EOS T6 treatment is recommended to obtain controlled mechanical properties and lower variation in mechanical values (for example in long build jobs if heat transfer from parts is limited by low amount of support and after stress relieve heat treatment).

Additional Data



Thermal conductivity

Thermal conductivity (ISO 22007-2:2015)

Typical values	as manufactured [W/m·K]	EOS T6 [W/m·K]	stress-relieved [W/m·K]
Vertical	100	16	16
Horizontal	110	5	0
		15	16
		5	5

Electrical conductivity

Electrical conductivity (ASTM E1004)

Typical values	as manufactured [% IACS]	EOS T6 [% IACS]	stress-relieved [% IACS]
Horizontal	25	44	44

Fatigue strength

Typical lower limit of fatigue strength

[MPa] as manufactured	110

Method:
HCF, ASTM E466-15, 20 million cycles, turned, fully reversed

High cycle fatigue testing performed on machined vertical and horizontal samples. No heat treatment.

Aluminum alloys do not have fatigue limit. Actual fatigue values depend on sample geometry and specially surface finish.

Coefficient of thermal expansion

Coefficient of thermal expansion

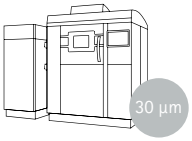
St an d ard			ASTM E228
Temperature	25-100 °C	25-200 °C	25-300 °C
CTE	20*10-6/K	22*10-6/K	27*10-6/K

Gas tightness

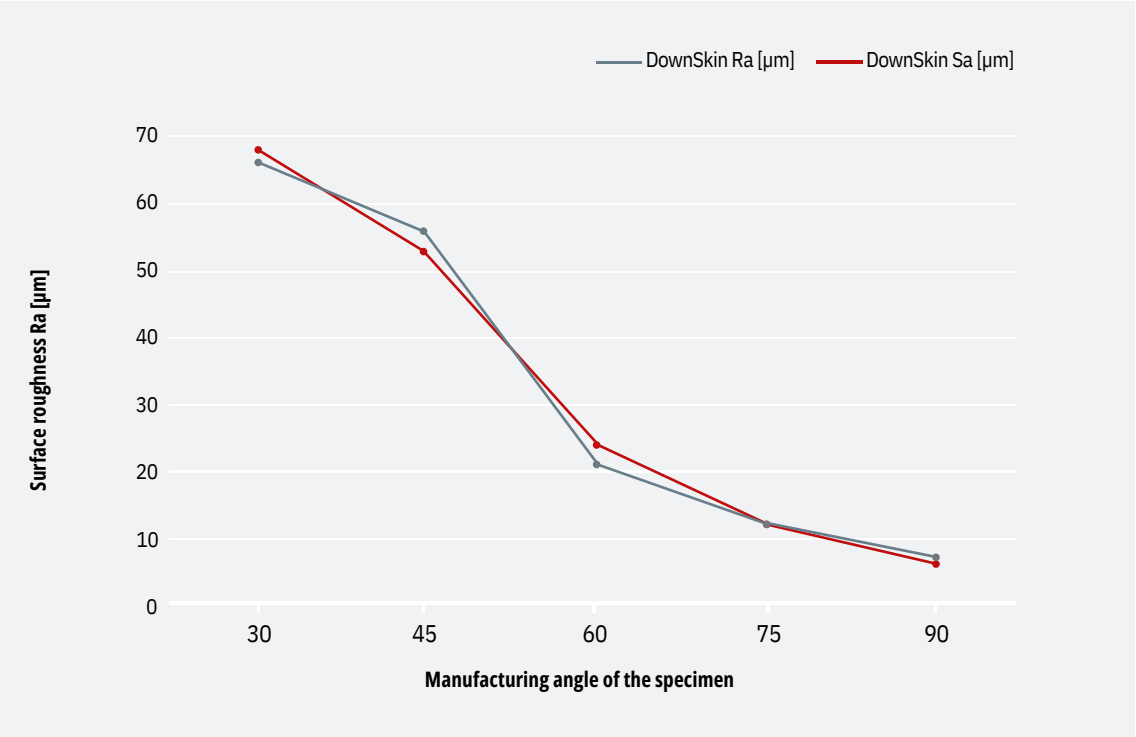
Typical gas tightness with helium leak test (2 mm wall thickness)

Standard	EN 13185:2001
Typical leak level	10-6 mbar I/s

Additional Data

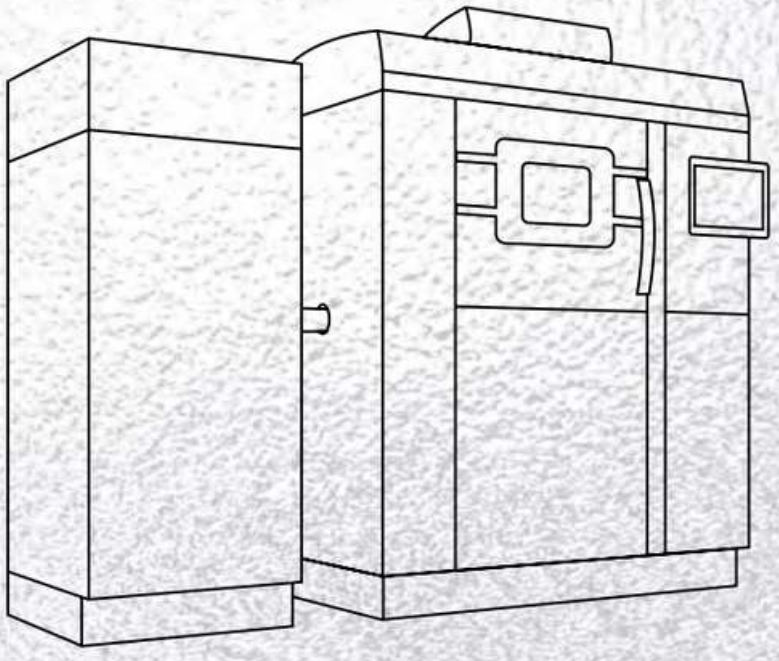


Surface roughness as manufactured



TRL 3

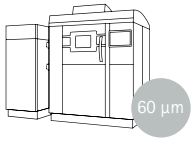
EOS Core



EOS Aluminium AlSi10Mg
for EOS M 290 | 60 µm

Process Information
Heat Treatment
Physical Part Properties
Mechanical Properties
Additional Data

EOS Aluminium AlSi10Mg for EOS M 290 | 60 µm
Process Information



Higher productivity process can be used where mechanical requirements are less demanding but where cost-efficiency is needed. The 60 µm EOS M 290 process has high resolution of fine features and buildabilty of thin walls.

Heat treatment can be used to affect mechanical properties.

Main Characteristics:

- → Increased productivity of aluminum parts with EOS M 290
- → Good mechanical properties
- → Good buildability of challenging geometries

System set-up	EOS M 290
EOS MaterialSet	AlSi10Mg_060_CoreM291 1.01
Software requirements	EOSPRINT 2.6 or newer EOSYSTEM 04.19 or newer
Powder part no.	9 011- 0 0 24
Recoater blade	EOS HSS blade
Build platform temperature	100 °C
Nozzle	EOS grid nozzle
Inert gas	Argon
Sieve	90 µm

Additional information	
Layer thickness	60 µm
Volume rate	10.5 mm³/s

Heat Treatment

EOS T6 Heat Treatment:

EOS has developed an AM optimized heat treatment procedure that is 40 % shorter than conventional T6 heat treatment procedures. Solution annealing 30 min @ 530 °C, water quench. Artificial aging 6 h @ 165 °C, cooling in air. Parts to preheated oven. Maximum overheating 5 °C. Delay between SA and quenching maximum 30 s. Oven type & configuration may have impact on the mechanical properties. For complex and massive parts uniform heating and cooling needs to be arranged.
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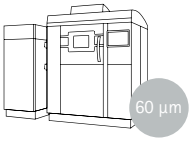

Physical Part Properties

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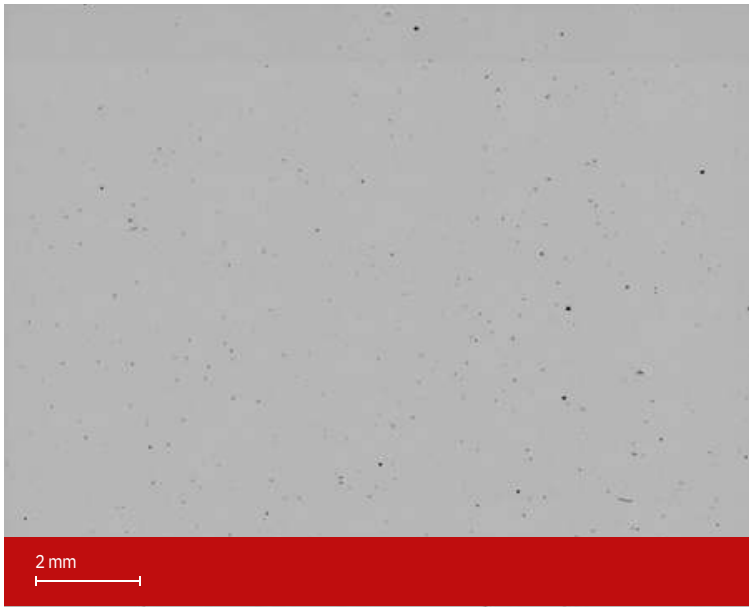


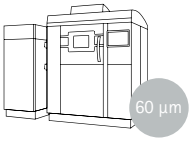
Microstructure as manufactured.

Microstructure of the produced parts (as manufactured state)

Defects	Result
Average defect percentage	0.2 %

Density ISO 3369	Result
Average density	≥ 2.66 g/cm3

Mechanical Properties



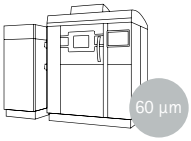
Typical properties (as manufactured state)

	Yield strength	Tensile strength	Elongation at break
	Rp0.2 [MPa]	Rm [MPa]	A [%]
Vertical	240	440	4
Horizontal	250	440	7

The testing was done according to ISO 6892-1, B10. Machined (turned) samples were used.

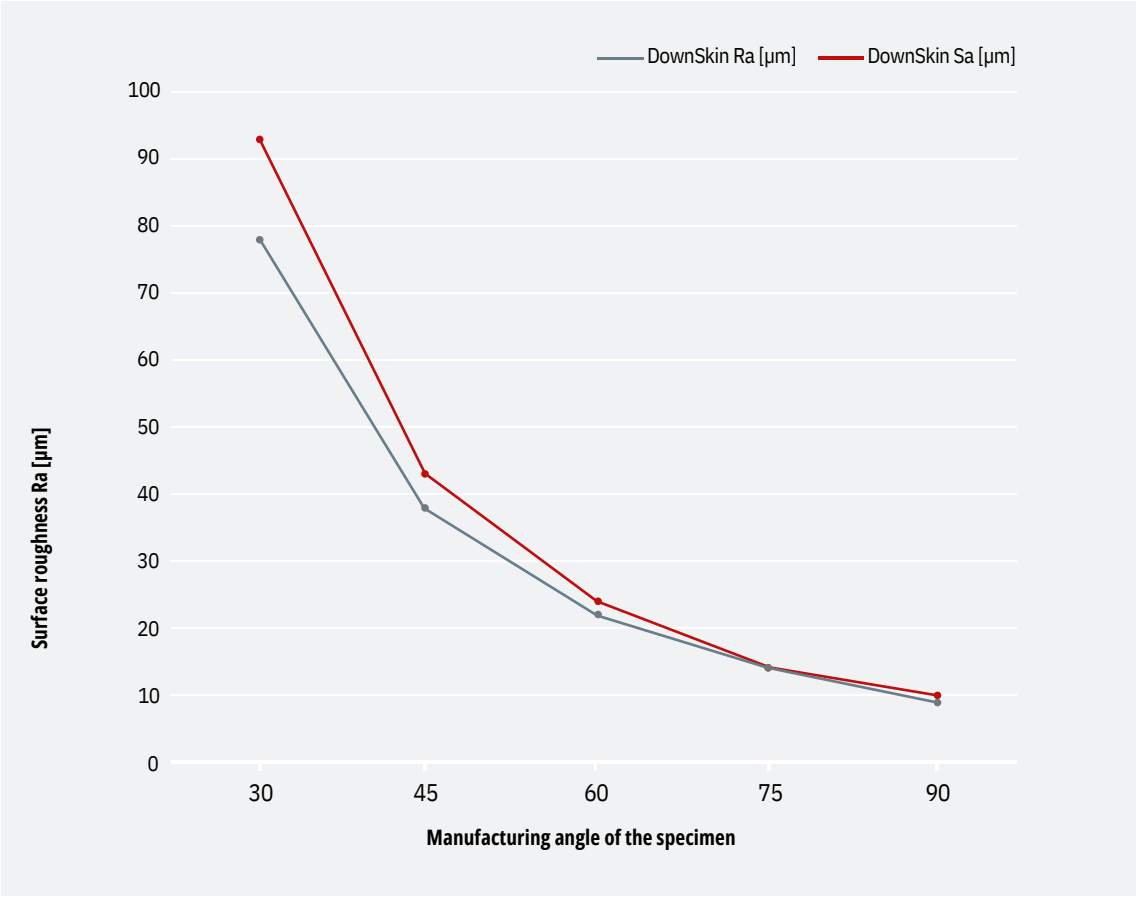
Typical mechanical properties (heat treated state, EOS T6)

	Yield strength	Tensile strength	Elongation at break
	Rp0.2 [MPa]	Rm [MPa]	A [%]
Vertical	250	320	8
Horizontal	260	320	9



Additional Data

Surface roughness as manufactured



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