

A white circular logo containing the text "Material Data Sheet".

Material  
Data Sheet

A close-up, high-angle photograph of a stainless steel watch case. The case is highly reflective, showing clear highlights and shadows. The bezel is visible, and the crown and pushers are partially seen on the right side. The background is a soft, out-of-focus grey.

# EOS Stainless- Steel 316L

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High performance marine-grade stainless steel

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# EOS StainlessSteel 316L

EOS StainlessSteel 316L is a high performance marine-grade austenitic stainless steel that is molybdenum alloyed for enhanced corrosion resistance in chloride environments. 316L is a standard material for numerous applications in process, energy, paper, transportation and other industries. EOS StainlessSteel 316L is a stainless steel powder intended for manufacturing parts on EOS metal systems with EOS DMLS processes.

## Main Characteristics:

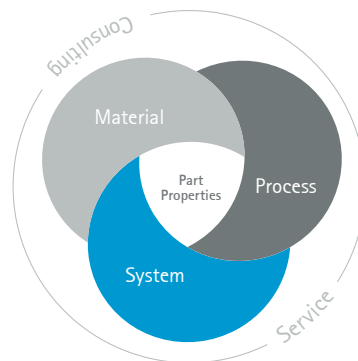
- High ductility and toughness
- High strength
- High corrosion resistance

## Typical Applications:

- Chemical industry
- Food processing
- Medical devices

## 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 chemical composition of EOS StainlessSteel 316L corresponds to ASTM F138 material standard for Surgical Implants (UNS S31673).

### Powder chemical composition (wt.-%)

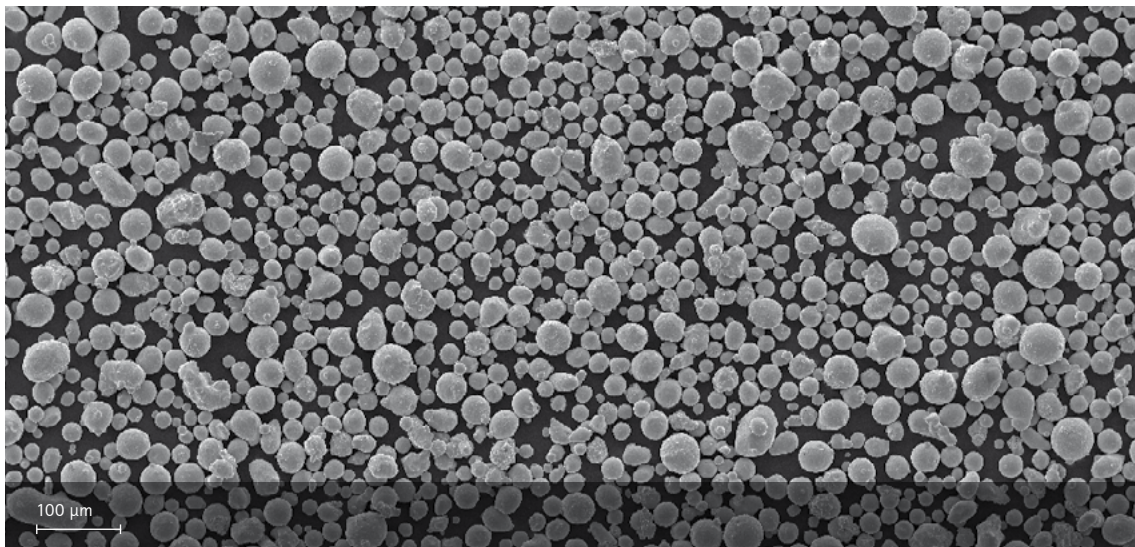
Element	Min.	Max.
Fe	Balance	
Cr	17.00	19.00
Ni	13.00	15.00
Mo	2.25	3.00
C	-	0.03
N	-	0.10

### Powder particle size

Generic particle size distribution

20 – 65  $\mu\text{m}$

*SEM picture of EOS StainlessSteel 316L powder.*





## Heat Treatment

**Stress relieve:** Hold temperature 900 C, hold time minimum 2 h when thoroughly heated, water quenching or high speed gas quenching. Cooling rate to be high enough to prevent chromium carbide precipitation.

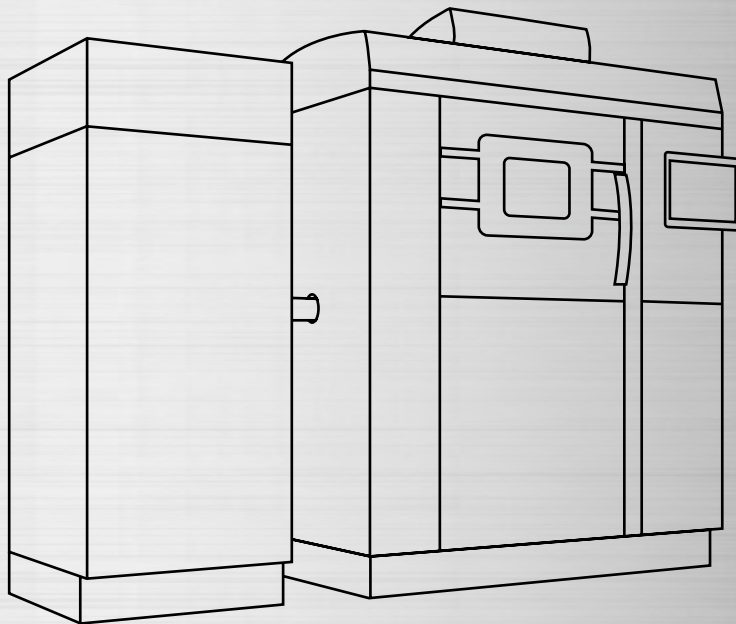
**Solution annealing:** Hold temperature 1150 C, hold time minimum 1,5 h when thoroughly heated, water quenching or high speed gas quenching. Cooling rate to be high enough to prevent chromium carbide precipitation.

**Microstructure solution annealed**  
Etched with etchant Kallings 2



### Coefficient of Thermal Expansion ASTM E228

Temperature	25-100 °C	25-200 °C	25-300 °C	25-400 °C
CTE	15.72 *10 <sup>-6</sup> /K	16.75 *10 <sup>-6</sup> /K	17.27 *10 <sup>-6</sup> /K	17.70 *10 <sup>-6</sup> /K



## EOS StainlessSteel 316L for EOS M 290 | 20 $\mu\text{m}$

Process Information  
Chemical and Physical Part Properties  
Heat Treatment  
Mechanical Properties  
Additional Data

## EOS StainlessSteel 316L for EOS M 290 | 20 µm

### Process Information

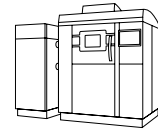
This process product is optimized for robustly building parts with EOS M290 system using EOS StainlessSteel 316L. The mechanical properties have been validated to TRL9 level.

System set-up	EOS M 290
EOSPAR name	316L_Surface
Software requirements	EOSPRINT 2.7 or newer EOSYSTEM 2.11 or newer
Powder part no.	9011-0032
Recoater blade	EOS HSS blade
Nozzle	Standard nozzle
Inert gas	Argon
Sieve	63 µm

#### Additional information

Layer thickness	20 µm
Min. wall thickness	0.3 - 0.4 mm
Typical dimensional change after HT	+0.02 %
Volume rate	2.0 mm <sup>3</sup> /s

## Chemical and Physical Properties of Parts<sup>1</sup>



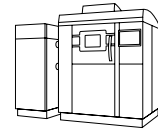
Chemical composition of built parts is compliant to EOS StainlessSteel 316L powder chemical composition.

### Micrograph of polished surface



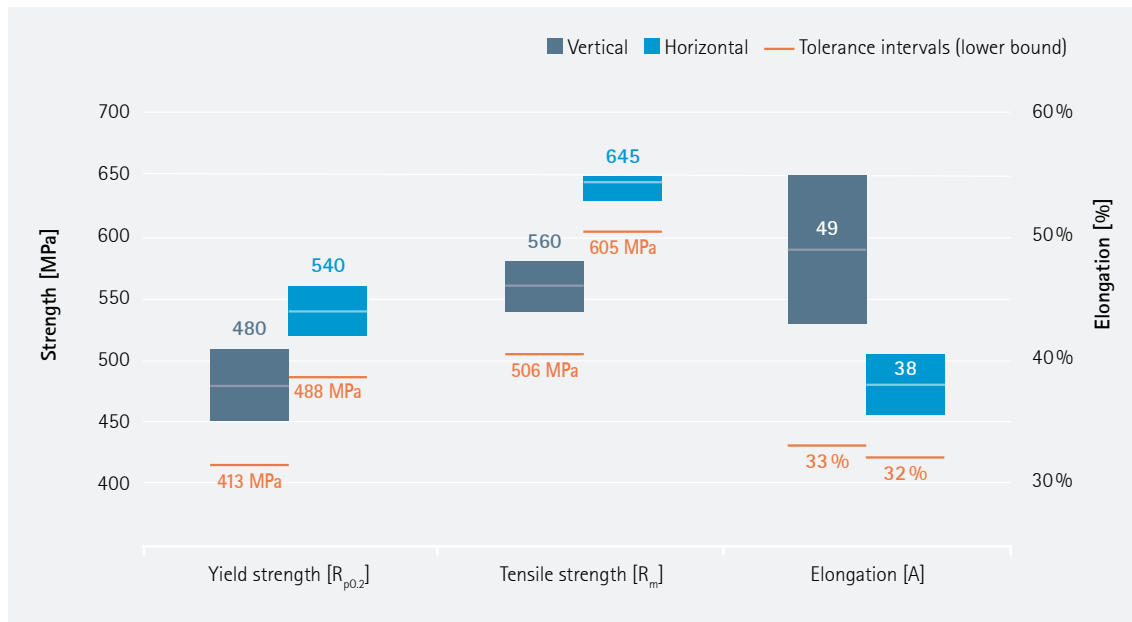
Defects	Result	Number of samples
Average defect percentage	0.018 %	45
Density, ISO3369	Result	Number of samples
Average density	$\geq 7.97 \text{ g/cm}^3$	45

# Mechanical Properties as Manufactured<sup>1</sup>



Mechanical properties ISO6892-1

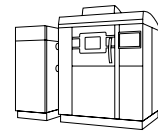
	Yield strength $R_{p0.2}$ [MPa]	Tensile strength $R_m$ [MPa]	Elongation at break A [%]	Number of samples
Vertical	480	560	49	363
Horizontal	540	645	38	246



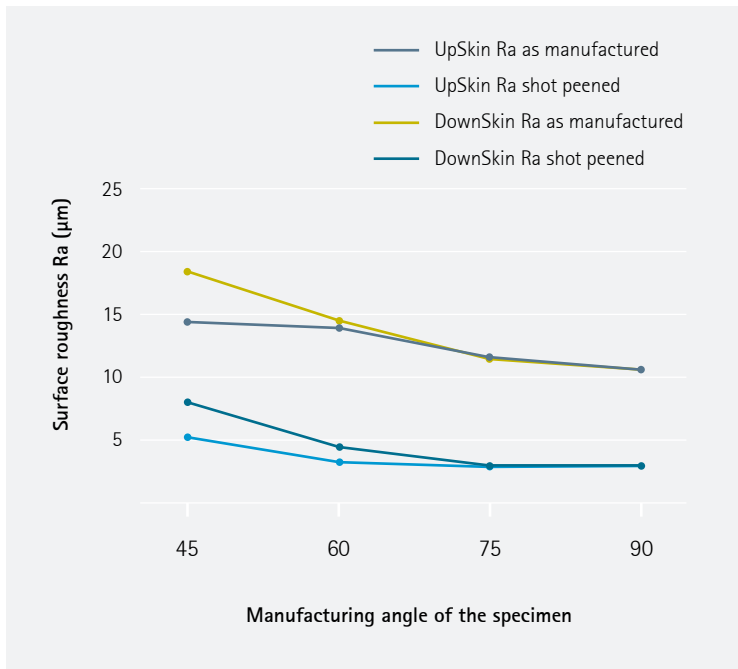
T99: Tolerance intervals provide lower bounds where 99 % of the population falls with 95 % confidence. Tolerance intervals are based on validation data / QA statistics and are not directly transferable to other systems.

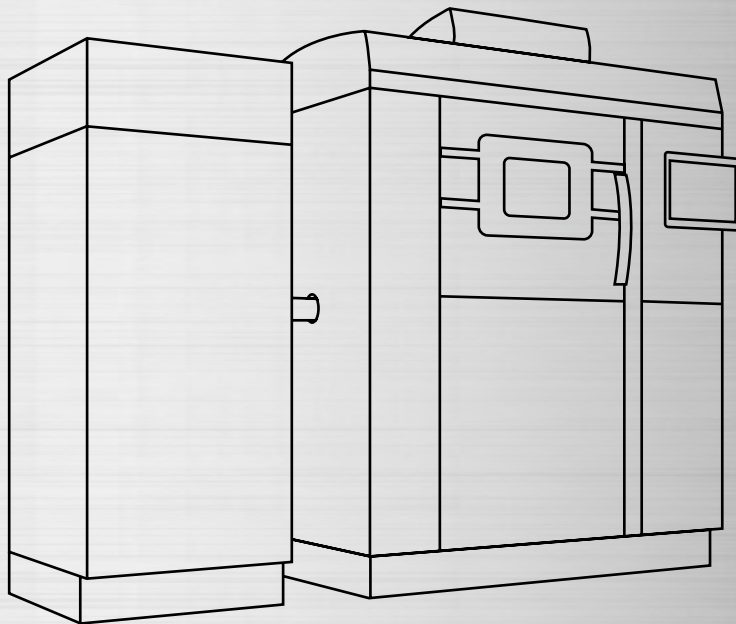


# Additional Data<sup>1</sup>



## Surface Roughness





## EOS StainlessSteel 316L for EOS M 290 | 40 $\mu\text{m}$

Process Information  
Chemical and Physical Part Properties  
Heat Treatment  
Mechanical Properties  
Additional Data

## EOS StainlessSteel 316L for EOS M 290 | 40 µm

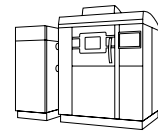
### Process Information

This process product is optimized for building high quality parts with EOS M 290 system reliably using EOS StainlessSteel 316L. Mechanical properties have been validated to TRL7 level.

System set-up	EOS M 290
EOSPAR name	316L_040_FlexM291
Software requirements	EOSPRINT 2.7 or newer EOSYSTEM 2.11 or newer
Powder part no.	9011-0032
Recoater blade	EOS HSS blade
Nozzle	EOS grid nozzle
Inert gas	Argon
Sieve	63 µm

#### Additional information

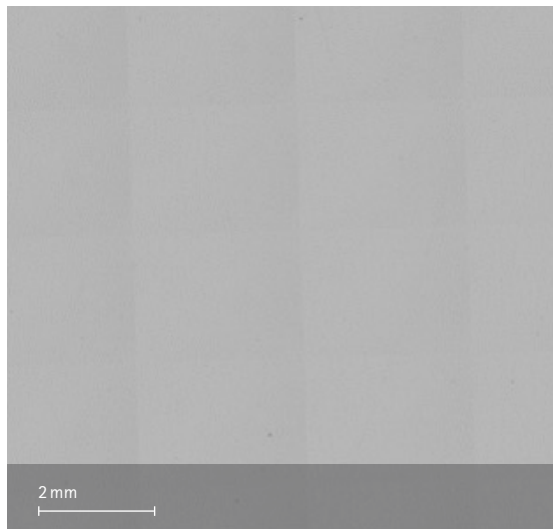
Layer thickness	40 µm
Min. wall thickness	0.1 mm
Typical dimensional change after HT	+0.2 %
Volume rate	3.7 mm <sup>3</sup> /s



## Chemical and Physical Properties of Parts<sup>1</sup>

Chemical composition of built parts is compliant to EOS StainlessSteel 316L powder chemical composition.

### Micrograph of polished surface

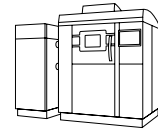


Defects	Result	Number of samples
Average defect percentage	0.015 %	20

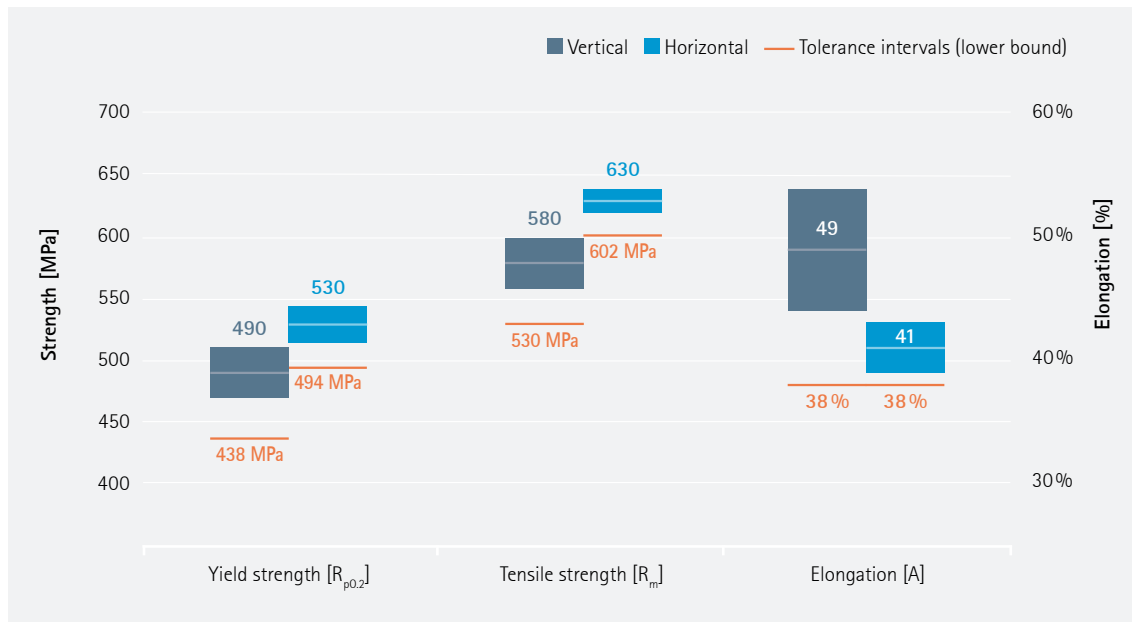
Density, ISO3369	Result	Number of samples
Average density	$\geq 7.97 \text{ g/cm}^3$	20

# Mechanical Properties as Manufactured<sup>1</sup>



Mechanical properties ISO6892-1

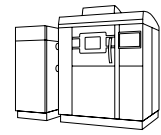
	Yield strength $R_{p0.2}$ [MPa]	Tensile strength $R_m$ [MPa]	Elongation at break A [%]	Number of samples
Vertical	490	580	49	162
Horizontal	530	630	41	72



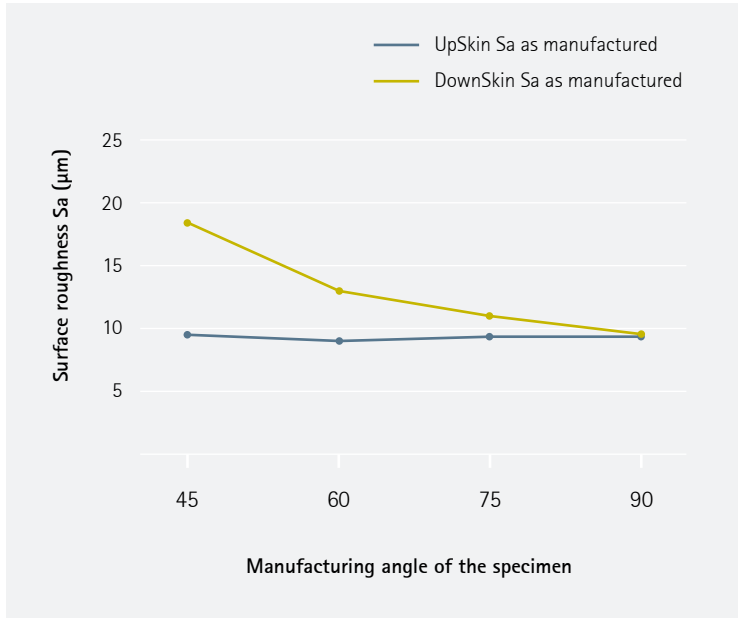
T95: Tolerance intervals provide lower bounds where 95 % of the population falls with 95 % confidence. Tolerance intervals are based on validation data / QA statistics and are not directly transferable to other systems.

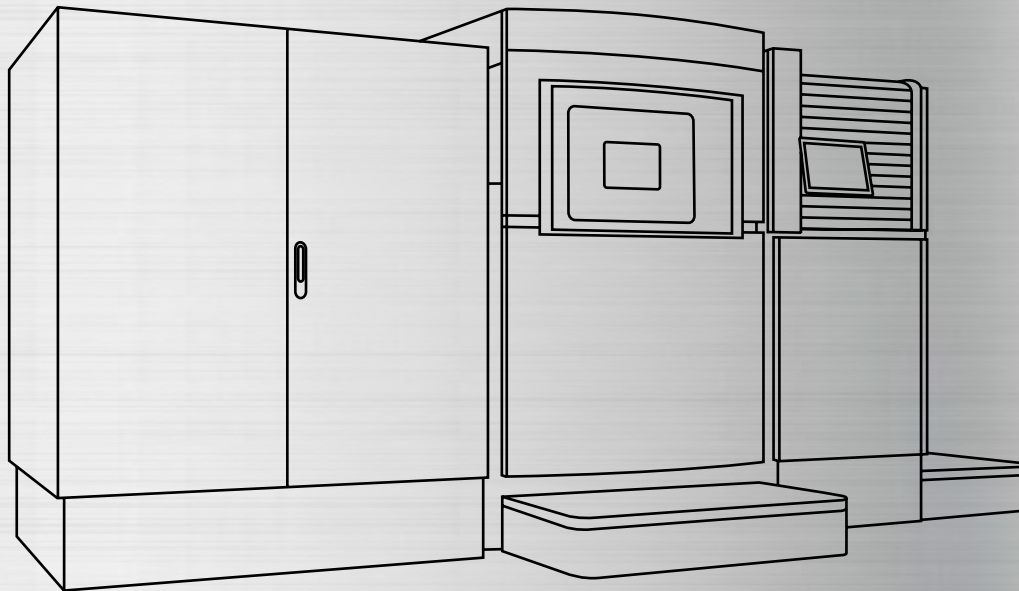


## Additional Data<sup>1</sup>



### Surface Roughness





## EOS StainlessSteel 316L for EOS M 400-4 | 40 $\mu\text{m}$

Process Information  
Chemical and Physical Part Properties  
Heat Treatment  
Mechanical Properties  
Additional Data

## EOS StainlessSteel 316L for EOS M 400-4 | 40 µm

### Process Information

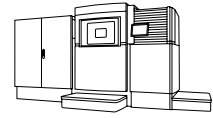
This process product is optimized for building high quality parts with EOS M 400-4 system using EOS StainlessSteel 316L.

System set-up	EOS M 400-4
EOSPAR name	316L_040_FlexM404
Software requirements	EOSPRINT 2.7 or newer EOSYSTEM 2.11 or newer
Powder part no.	9011-0032
Recoater blade	EOS HSS blade
Inert gas	Argon
Sieve	63 µm

#### Additional information

Layer thickness	40 µm
Volume rate	14.8 mm <sup>3</sup> /s

## Chemical and Physical Properties of Parts<sup>1</sup>



Chemical composition of built parts is compliant to EOS StainlessSteel 316L powder chemical composition.

### Micrograph of polished surface

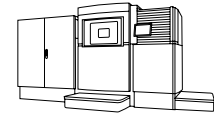


Defects	Result	Number of samples
Average defect percentage	0.015 %	40

Density, ISO3369	Result	Number of samples
Average density	$\geq 7.9 \text{ g/cm}^3$	40

# Mechanical Properties as Manufactured<sup>1</sup>



## Mechanical properties ISO6892-1

	Yield strength $R_{p0.2}$ [MPa]	Tensile strength $R_m$ [MPa]	Elongation at break A [%]	Number of samples
Vertical	490	590	45	120
Horizontal	550	650	40	96

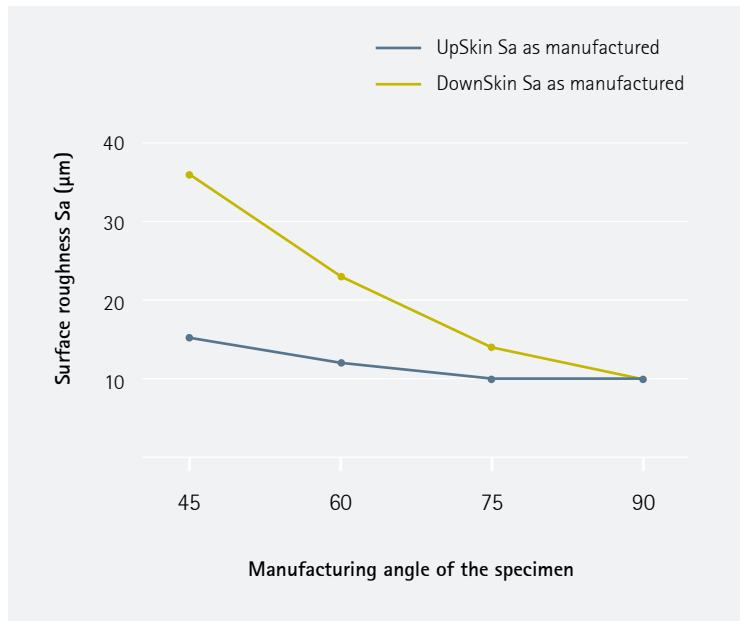


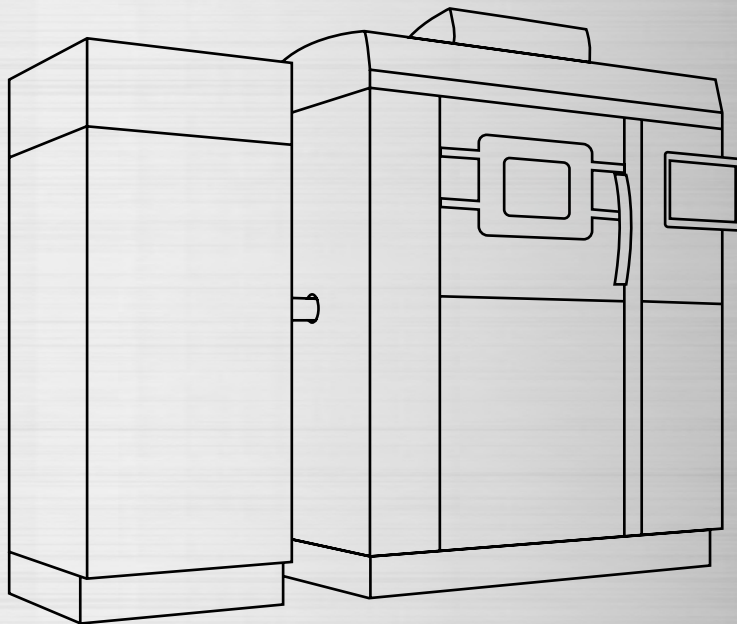
T90: Tolerance intervals provide lower bounds where 90 % of the population falls with 95 % confidence. Tolerance intervals are based on validation data / QA statistics and are not directly transferable to other systems.



## Additional Data<sup>1</sup>

### Surface Roughness





## EOS StainlessSteel 316L for EOS M 290 | 40/80 $\mu\text{m}$

Process Information

Chemical and Physical Part Properties

Heat Treatment

Mechanical Properties

Additional Data

## EOS StainlessSteel 316L for EOS M 290 | 40/80 µm Process Information

This process product is optimized for flexible and fast production of EOS StainlessSteel 316L parts with the EOS M 290 system. The parameter set has three different layer thickness options that can all be utilized within the same build: 40 µm, 80 µm and 40/80 µm Skin.

The 40 µm parameter set is ideal for parts needing great detail resolution and more dense structure. The 80 µm parameter set offers a build rate that is more than double that of the long established 40 µm parameter set.

With the 40/80 µm Skin parameter set, the total build time can be reduced with the same surface quality. The parameter sets are assigned to different sections in the same build job depending on the requirements.

### Main characteristics:

- Parameter set for fast and cost efficient production of EOS StainlessSteel 316L parts in small series or serial production
- With 80 µm parameter 100 % increase in productivity compared to the 40 µm FlexLine parameter set
- Faster production without compromising the part quality

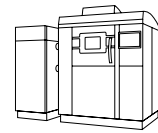
System set-up	EOS M 290
EOSPAR name	316L_040_080_Core M291
Software requirements	EOSPRINT 2.7 or newer EOSYSTEM 2.11 or newer
Powder part no.	9011-0032
Recoater blade	EOS HSS blade
Nozzle	EOS grid nozzle
Inert gas	Argon
Sieve	63 µm

### Additional information

Layer thickness	40 µm, 80 µm Et 40/80 µm Skin
Volume rate*	3.7 mm <sup>3</sup> /s (40 µm), 8.4 mm <sup>3</sup> /s (80 µm), 3.7 - 8.4 (40/80 µm Skin)

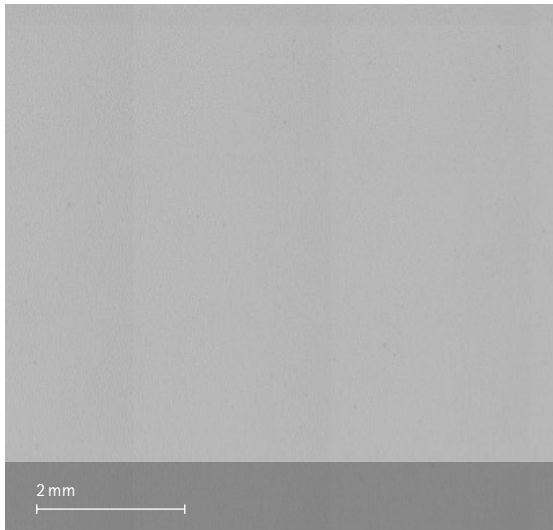
\* Volume rate depends on the part dimensions and skin thickness.

# Chemical and Physical Properties of Parts<sup>1</sup>

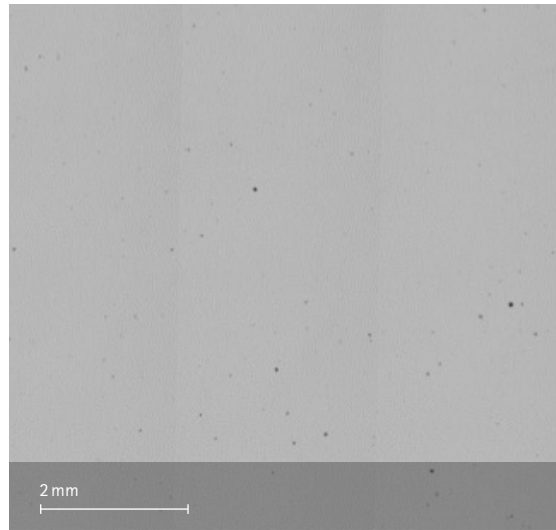


Chemical composition of built parts is compliant to EOS StainlessSteel 316L powder chemical composition.

Micrograph of polished surface (40 μm)

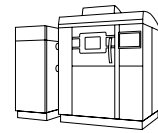


Micrograph of polished surface (80 μm)



Defects	Result
Average defect percentage	0.1 %* (40 μm), < 0.2 %* (80 μm)

\*Defect % varies with platform position.



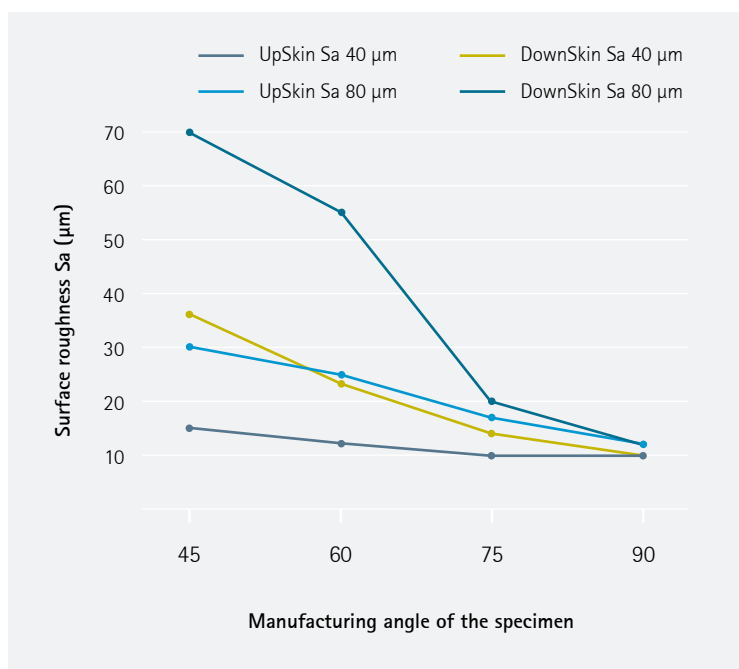
## Mechanical Properties as Manufactured<sup>1</sup>

Typical properties as manufactured ISO 6892-1

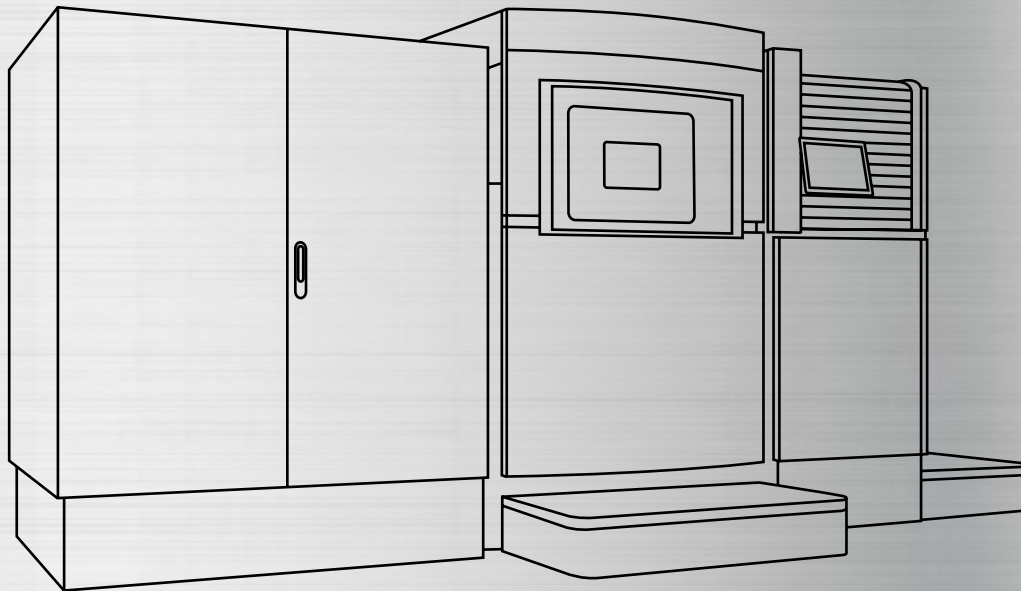
	Yield strength $R_{p0.2}$ [MPa]	Tensile strength $R_m$ [MPa]	Elongation at break A [%]
40 $\mu\text{m}$ horizontal	500	600	35
40 $\mu\text{m}$ vertical	450	550	50
80 $\mu\text{m}$ horizontal	500	600	35
80 $\mu\text{m}$ vertical	450	550	45

## Additional Data<sup>1</sup>

### Surface Roughness







## EOS StainlessSteel 316L for EOS M 400-4 | 40/80 $\mu\text{m}$

Process Information

Chemical and Physical Part Properties

Heat Treatment

Mechanical Properties

Additional Data

## EOS StainlessSteel 316L for EOS M 400-4 | 40/80 µm Process Information

This process product is optimized for flexible and fast production of EOS StainlessSteel 316L parts with the EOS M 400-4 system. The parameter set has three different layer thickness options that can all be utilized within the same build: 40 µm, 80 µm and 40/80 µm Skin.

The 40 µm parameter set is ideal for parts needing great detail resolution and more dense structure. The 80 µm parameter set offers a build rate that is more than double that of the long established 40 µm parameter set.

With the 40/80 µm Skin parameter set, the total build time can be reduced with the same surface quality. The parameter sets are assigned to different sections in the same build job depending on the requirements.

### Main Characteristics:

- Parameter set for fast and cost efficient production of EOS StainlessSteel 316L parts in small series or serial production
- With 80 µm parameter 100 % increase in productivity compared to the 40 µm FlexLine parameter set
- Faster production without compromising the part quality

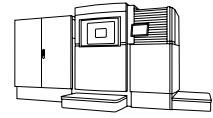
System set-up	EOS M 400-4
EOSPAR name	316L_040_080_Core M404
Software requirements	EOSPRINT 2.7 or newer EOSYSTEM 2.11 or newer
Powder part no.	9011-0032
Recoater blade	EOS HSS blade
Inert gas	Argon
Sieve	63 µm

### Additional information

Layer thickness	40 µm, 80 µm Et 40/80 µm Skin
Volume rate*	40µm: up to 4 x 3.7mm <sup>3</sup> /s 80µm: up to 4 x 8.4 mm <sup>3</sup> /s 40/80µm Skin: between 4 x 3.7 - 4 x 8.4 mm <sup>3</sup> /s

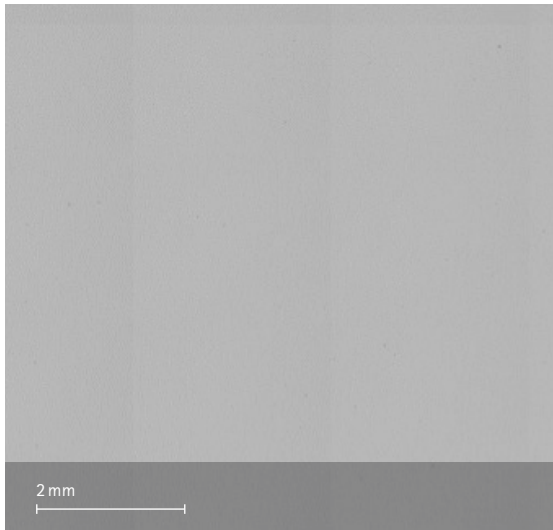
\*Volume rate depends on the part dimensions and skin thickness.

# Chemical and Physical Properties of Parts<sup>1</sup>

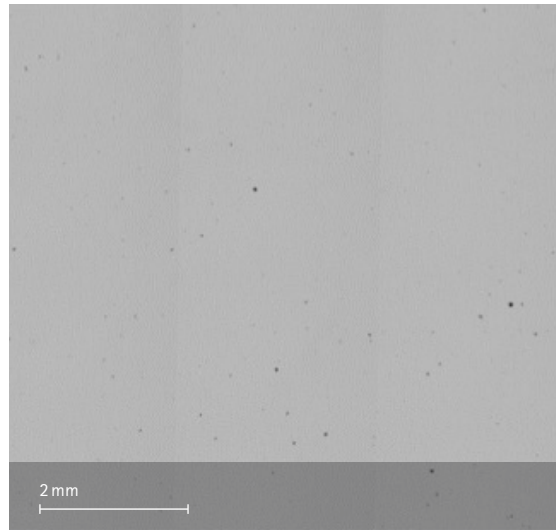


Chemical composition of built parts is compliant to EOS StainlessSteel 316L powder chemical composition.

Micrograph of polished surface (40 μm)

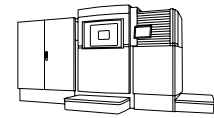


Micrograph of polished surface (80 μm)



Defects	Result
Average defect percentage	0.1 %* (40 μm), < 0.2 %* (80 μm)

\*Defect % varies with platform position.



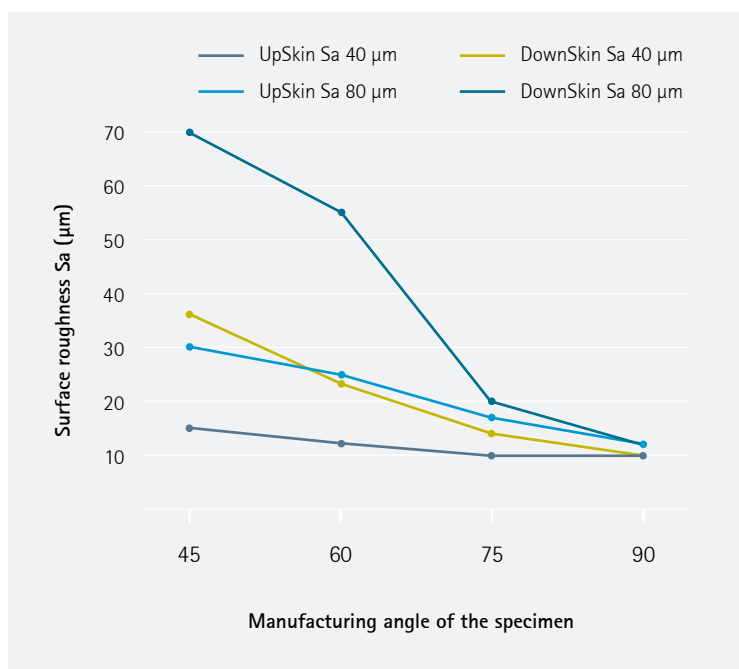
## Mechanical Properties as Manufactured<sup>1</sup>

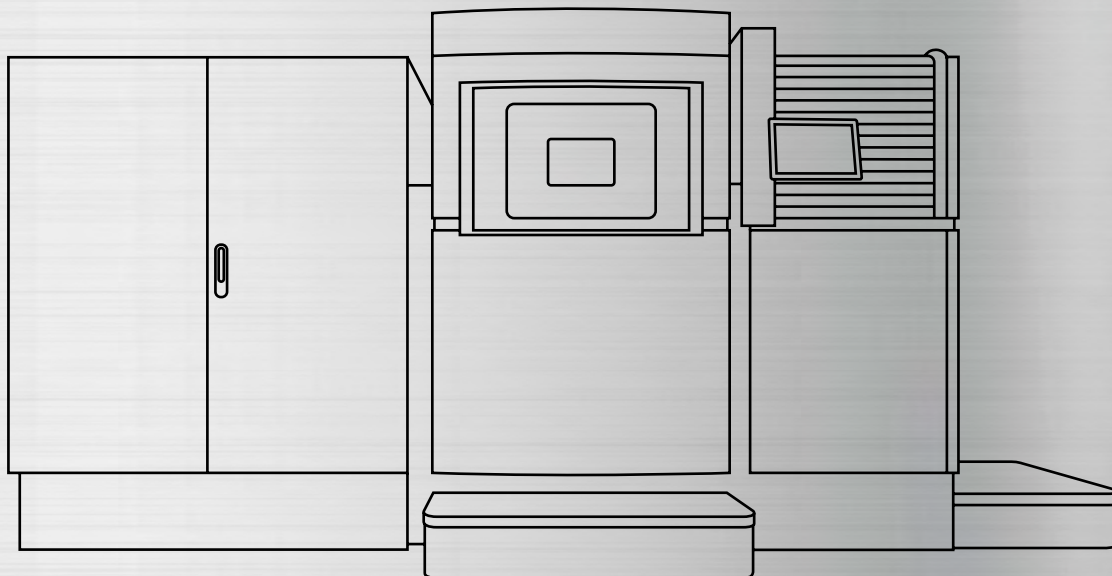
Typical properties as manufactured ISO 6892-1

	Yield strength $R_{p0.2}$ [MPa]	Tensile strength $R_m$ [MPa]	Elongation at break A [%]
40 $\mu\text{m}$ horizontal	500	600	35
40 $\mu\text{m}$ vertical	450	550	50
80 $\mu\text{m}$ horizontal	500	600	35
80 $\mu\text{m}$ vertical	450	550	45

## Additional Data<sup>1</sup>

### Surface Roughness





## EOS StainlessSteel 316L for EOS M 400-1 | 80 $\mu\text{m}$

Process Information

Chemical and Physical Part Properties

Heat Treatment

Mechanical Properties

Additional Data

## EOS StainlessSteel 316L for EOS M 400-4 | 40/80 µm Process Information

This process product is optimized for flexible and fast production of 316L parts with EOS M 400-1 system. The parameter set has three different layer thickness options that can all be utilized within the same build: 40µm, 80 µm and 40/80 µm Skin. For high productivity needs a 80 µm parameter set is included with a build rate more than double the long established 40 µm parameter set. Both can be used separately for different parts or combined by using 40/80 µm Skin with faster 80 µm for the core of the part and higher quality 40 µm building for the surface of the part with defined thickness. Sectionioning parts in vertical direction for different parameters is also possible.

### Main Characteristics:

- Parameter set for fast and cost efficient production of EOS StainlessSteel 316L parts in small series or serial production
- Fast production achieved with only a minor decrease in quality

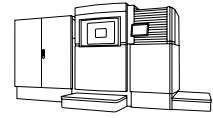
System set-up	EOS M 400-1
EOSPAR name	316L_040_080_Core M401
Powder part no.	9011-0032
Recoater blade	EOS HSS blade
Inert gas	Argon
Sieve	63 µm

### Additional information

Layer thickness	40 µm, 80 µm Et 40/80 µm Skin
Volume rate*	40µm: 3.7mm <sup>3</sup> /s 80µm: 8.4 mm <sup>3</sup> /s 40/80µm Skin: 3.7 - 8.4 mm <sup>3</sup> /s
Typical dimensional change after HT	+0.02 %

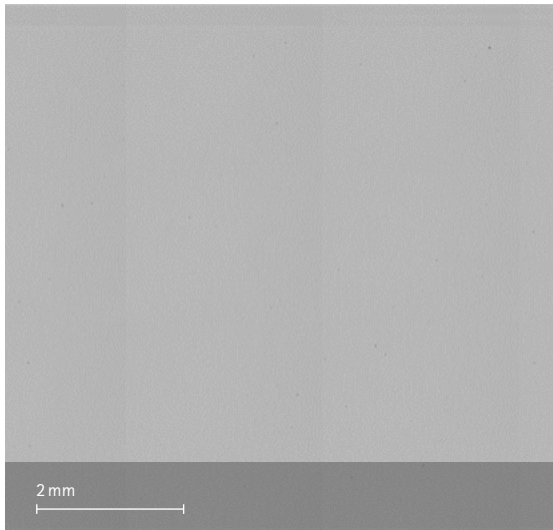
\* Volume rate depends on the part dimensions and skin thickness.

## Chemical and Physical Properties of Parts<sup>1</sup>

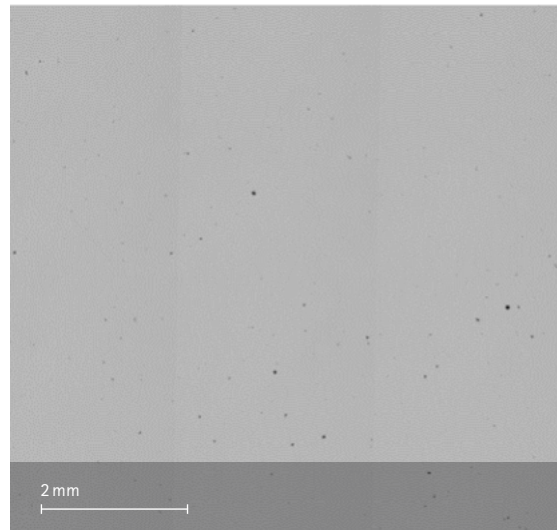


Chemical composition of built parts is compliant to EOS StainlessSteel 316L powder chemical composition.

Micrograph of polished surface  
(40  $\mu\text{m}$ )

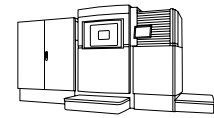


Micrograph of polished surface  
(80  $\mu\text{m}$ )



Defects	Result
Average defect percentage	0.1 %* (40 $\mu\text{m}$ ), < 0.2 %* (80 $\mu\text{m}$ )

\*Defect % varies with platform position.



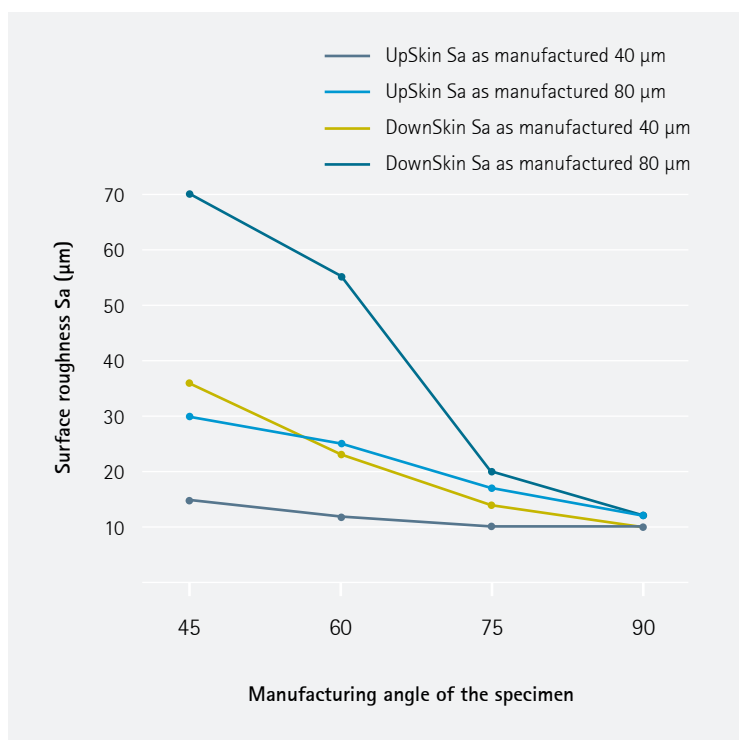
## Mechanical Properties as Manufactured<sup>1</sup>

Typical properties as manufactured ISO 6892-1

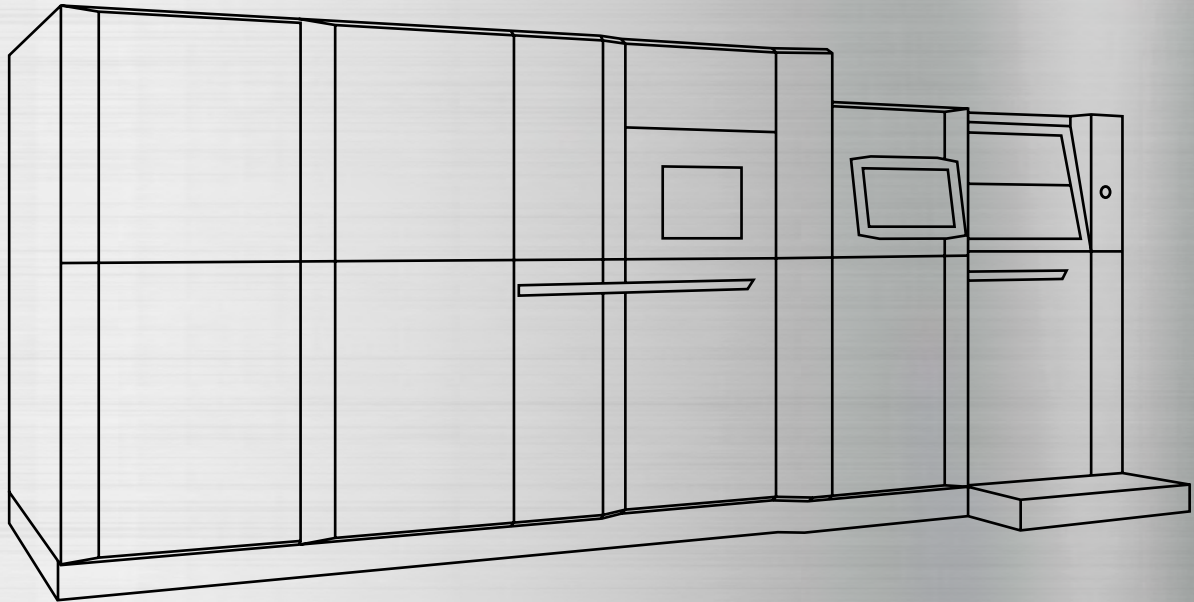
	Yield strength $R_{p0.2}$ [MPa]	Tensile strength $R_m$ [MPa]	Elongation at break A [%]
40 $\mu\text{m}$ horizontal	570	670	35
40 $\mu\text{m}$ vertical	500	600	45
80 $\mu\text{m}$ horizontal	550	650	35
80 $\mu\text{m}$ vertical	500	620	40

## Additional Data<sup>1</sup>

### Surface Roughness







## EOS StainlessSteel 316L for EOS M 300-4 | 40/80 $\mu\text{m}$

Process Information

Chemical and Physical Part Properties

Mechanical Properties

## EOS StainlessSteel 316L for EOS M 300-4 | 40/80 µm Process Information

This process product is optimized for flexible and fast production of EOS StainlessSteel 316L parts with the EOS M 300-4 system. The parameter set has three different layer thickness options that can all be utilized within the same build: 40µm, 80 µm and 40/80 µm SkinCore.

For high productivity needs a 80 µm parameter set is included with a build rate more than double the 40 µm parameter set. Both can be used separately for different parts or combined by using 40/80 µm SkinCore with faster 80 µm for the core of the part and higher quality 40 µm building for the surface of the part with defined thickness. Sectioning parts in the vertical direction for different parameters is also possible.

### Main Characteristics:

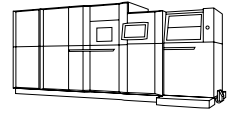
- Parameter set for fast and cost efficient production of EOS StainlessSteel 316L parts in small series or serial production
- 100% increase in productivity with 80 µm parameter compared to 316L 40 µm FlexLine parameter with only minor decrease in quality
- High part quality – mechanical properties and surface – with 40µm parameter

System set-up	EOS M 300-4
EOSPAR name	316L_040_080_Core M304
Software requirements	EOSPRINT 2.11 or newer EOSYSTEM 2.15 or newer
Powder part no.	9011-0032
Recoater blade	EOS HSS blade
Inert gas	Argon
Sieve	63 µm

### Additional information

Layer thickness	40 µm, 80 µm & 40/80 µm SkinCore
Volume rate*	40µm: 4 x 3.7mm <sup>3</sup> /s 80µm: 4 x 8.4 mm <sup>3</sup> /s 40/80µm Skin: between 4 x 3.7 - 8.4 mm <sup>3</sup> /s

\* Volume rate depends on the part dimensions and skin thickness.



## Chemical and Physical Properties of Parts<sup>1</sup>

Defects	Result
Average defect percentage	40µm <0.06 % & 80µm <0.1 %

## Mechanical Properties as Manufactured<sup>1</sup>

Typical properties as manufactured ISO 6892-1

	Yield strength $R_{p0.2}$ [MPa]	Tensile strength $R_m$ [MPa]	Elongation at break A [%]
40 µm horizontal	580	670	35
40 µm vertical	510	610	40
80 µm horizontal	550	660	35
80 µm vertical	490	620	40

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<sup>1</sup> 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.

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Cover: This image shows a possible application.

