Premium

TRL 8

Material Data Sheet
StainlessSteel CX
Tool Steel

EOS StainlessSteel **CX**

EOS StainlessSteel CX is a tooling grade steel characterized having a good corrosion resistance combined with high strength and hardness. Parts built from EOS StainlessSteel CX can be machined, shot-peened and polished in as manufactured or heat treated state.

Main characteristics:

- Stainless steel with excellent corrosion resistance combined with high strength and hardness
- The parts are easily machinable and offer excellent polishability
- The parts offer excellent wear and fatigue resistance

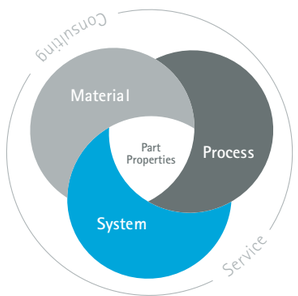
This material is typically used for:

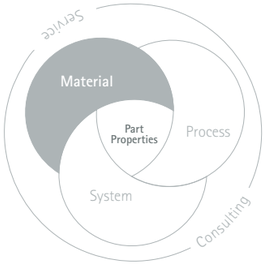
- Plastic injection moulding tools and tool parts for demanding applications
- Rubber moulding tools and tool parts
- Moulding tools and tool parts for corrosive plastics
- Other industrial applications where high strength and hardness are required

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 DataSheet is produced according to the Quality Management System and standards .





CX Technical Data
Powder Properties

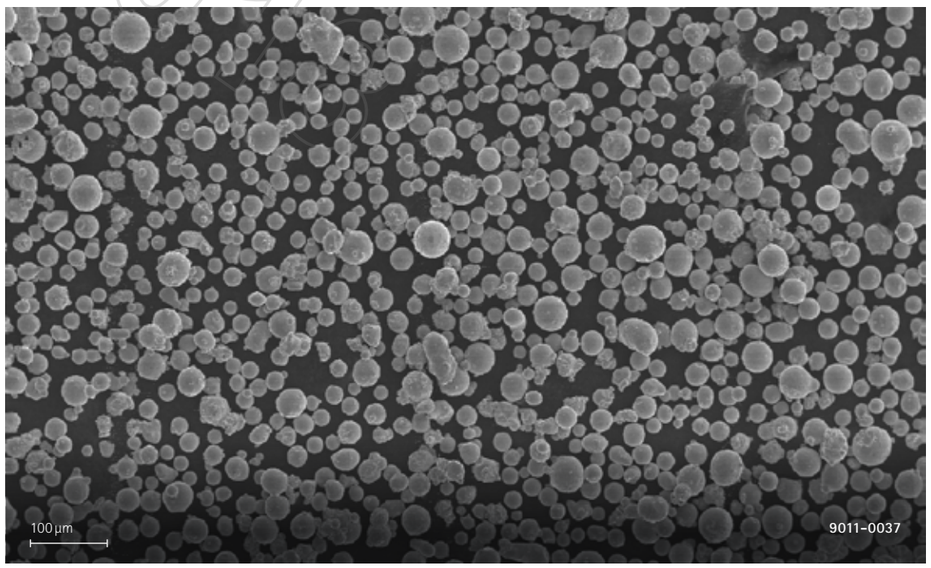
Powder chemical composition (wt.-%)

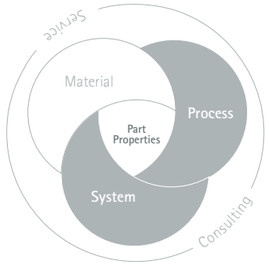
Element	Min.	Max.
Fe	Balance	
Cr	11.00	13.00
Ni	8.40	10.00
Mo	1.10	1.70
Al	1.20	2.00
Mn	–	0.40
Si	–	0.40
C	–	0.05

Powder particle size

Generic particle size distribution	20 – 65 µm

SEM image of EOS StainlessSteel CX powder.

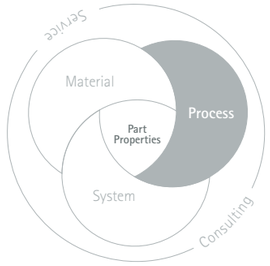




EOS StainlessSteel CX Technical Data
Process and Heat Treatment Information

EOS M System	M 290
EOS ParameterSet	M 290 CX 030 V1
EOSPAR name	CX_030_HiPerM291_100
Software/System Requirements	HCS 2.8 or newer
Volume rate	3.2 mm^3/s
Compatible powder	9011-0037
Recoater Blade	EOS Ceramic Blade
Nozzle	EOS Grid Nozzle
Inert Gas	Argon
Sieve	63 µm

Additional information	
Min. wall thickness	Approx. 0.4 mm
Typical dimensional change after HT (for parts ø 50 mm)	0.1 %



Heat treatment of EOS StainlessSteel CX

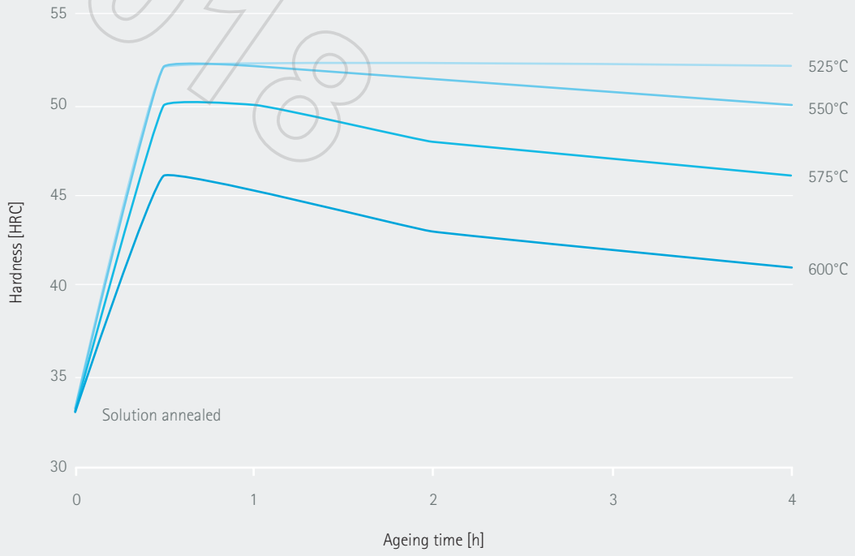
EOS StainlessSteel CX can be heat treated to match various needs of different applications. The two step heat treatment can be performed under vacuum or inert gas atmosphere. First step is solution annealing to minimize amount of austenite in the martensitic matrix . The needed hardness and strength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

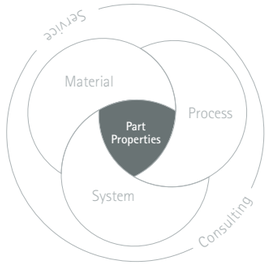
→ **Solution annealing:**
30 minutes at 850 °C (±10 °C) measured from the part followed by rapid air cooling to room temperature (below 32 °C). Cooling rate 20-60 °C/min. Reaching room temperature before starting ageing treatment is required to achieve desired microstructure.

→ **Ageing:**
For peak hardness and strength 2 h at 525 °C (±10 °C) measured from the part followed by air cooling. Mechanical properties presented in this document achieved through this ageing procedure.

If lower hardness and improved toughness is required ageing temperature can be increased according to figure below.

Hardness after heat treatment

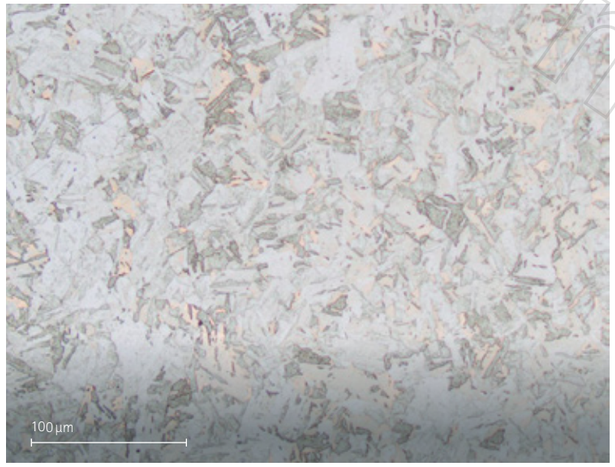




EOS StainlessSteel CX Technical Data

Physical and Chemical Properties of Parts

Chemical composition of built parts is compliant to EOS StainlessSteel CX powder chemical composition

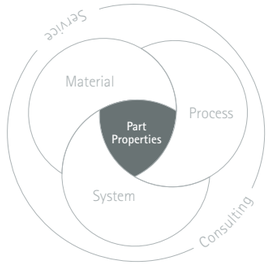


Heat treated microstructure. Etching; ASTM E407-94

Defects	Result	Number of samples
Average defect percentage	0.03%	65

Density, ISO3369	Result	Number of samples
Average density	7.69 g/cm³	65

The areal defect percentage was determined from cross-cuts of the built parts using optical microscope fitted with a camera and analysis software. The analysis was carried out for sample area of 15 x 15 mm. The defects were detected and analyzed with an image capture/analysis software with an automatic histogram based filtering procedure on monochrome images. The density of the built specimen was measured according to ISO3369.



EOS StainlessSteel CX Technical Data

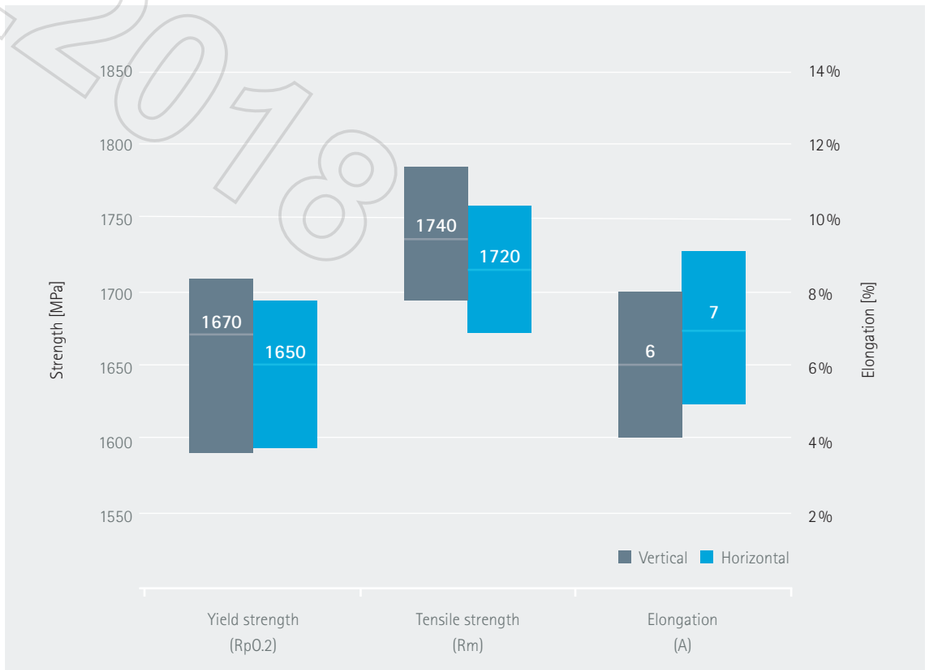
Mechanical Properties in Heat Treated State

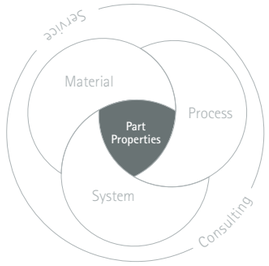
Mechanical properties ISO6892-1

	Yield strength Rp0.2 [MPa]	Tensile strength Rm [MPa]	Elongation at break A [%]	Number of samples
Vertical	1670	1740	6	189
Horizontal	1650	1720	7	162

Hardness in heat treated state ISO6508

Hardness, HRC	50
Number of samples	45





EOS StainlessSteel CX Technical Data
Additional Technical Data

Estimation of fatigue strength at 1 x 10^7 cycles in heat treated status

Fatigue strength determines a stress level where specimen fails at a defined number of stress cycles [ISO 12107]. Fatigue strength was estimated statistically according to ISO 12107.

Testing was done according to ASTM E466. Fatigue results typically show large deviations due to the nature of the fatigue process [ISO 12107].

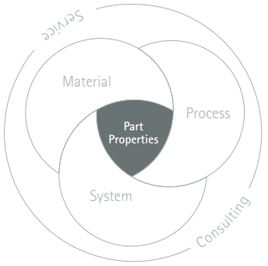
Fatigue strength in heat treated state ASTM E466

Fatigue strength, MPa	695

Comparison of tooling and precipitation hardening steels

EOS Grade	Hardness [HRC]	Corrosion resistance
MS1	55	–
CX	50	●●●●
PH 1	43	●●●●
17-4 PH	42	●●●●●

Corrosion Resistance
Corrosion resistance comparison between EOS tooling and precipitation hardening steels based on potentiodynamic measurement data.

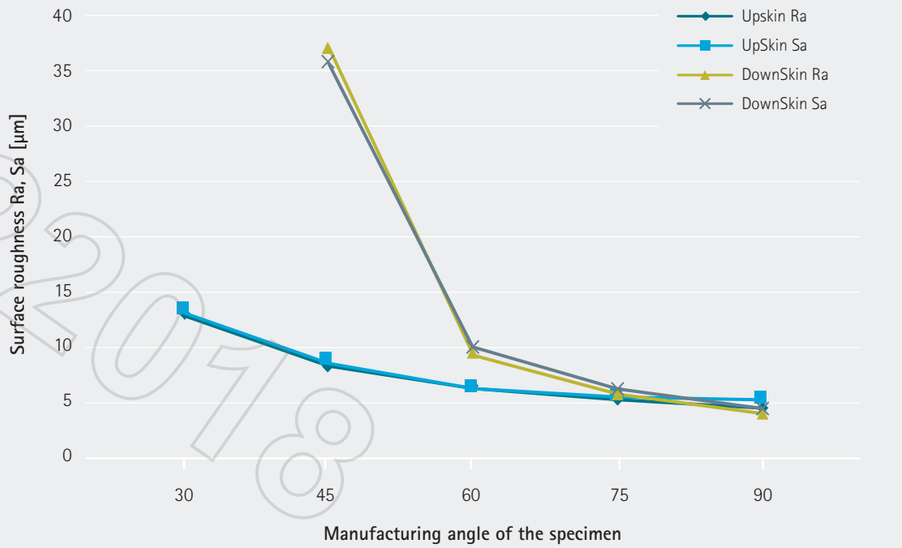


EOS StainlessSteel CX Technical Data
Additional Data

Surface roughness

Horizontal surface	Ra 7.5 µm, Sa 9.0 µm
Vertical and angled surfaces according to figure	

Surface roughness as manufactured
EOS StainlessSteel CX



The surface quality was characterized by an optical measurement method according to an internal procedure.

Coefficient of thermal expansion ASTM E228

	25 – 100 °C	25 – 200 °C	25 – 300 °C	25 – 400 °C
CTE	11.1 *10^{-6}/K	11.6 *10^{-6}/K	11.9 *10^{-6}/K	12.0 *10^{-6}/K

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Cover: This image shows a possible application.