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ECOPARTS
ADDITIVE METAL SOLUTIONS

EOS StainlessSteel CX
Material Data Sheet

EOS StainlessSteel CX

Combines Corrosion Resistance with High Strength and Hardness

EOS StainlessSteel CX is a tooling grade steel characterized by 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:

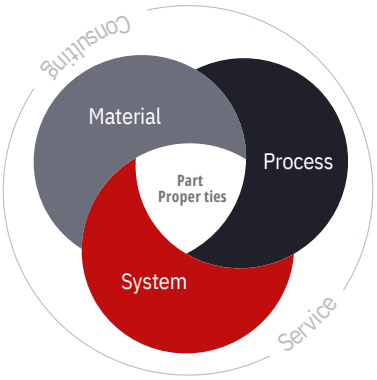
- Stainless steel with excellent corrosion resistance combined with high strength and hardness
- The parts are easily machinable and offer excellent polishability
- The parts offer excellent wear and fatigue resistance

Typical Applications:

- Plastic injection molding tools and tool parts for demanding applications
- Rubber molding tools and tool parts
- Molding 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.



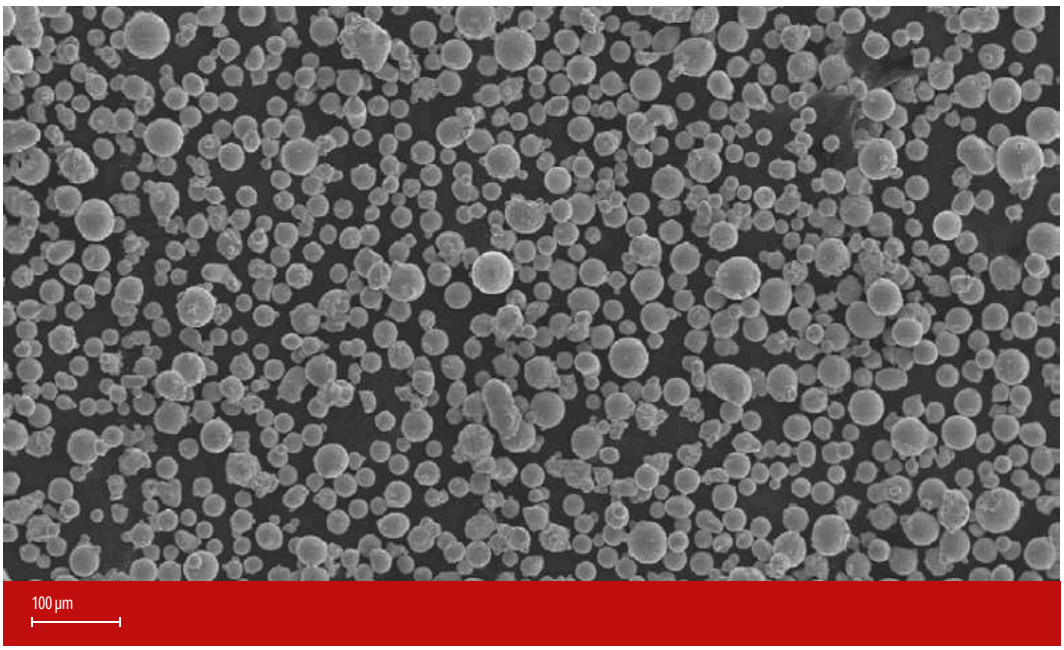
All of the data stated in this material data sheet is produced according to EOS Quality Management System and international standards.

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.



Process Information

System set-up	EOS M 290
EOS ParameterSet	M 290 CX 030 V1 C X _ 0 30 _
EOSPAR name	HiPerM291_10 0
Software requirements	EOSPRINT 2.3 or newer EOSYSTEM 2.8 or newer
Powder part no.	9 011- 0 0 37
Recoater blade	EOS ceramic blade
Nozzle	EOS grid nozzle
Inert gas	Argon
Sieve	63 µm

Additional information

Layer thickness	30 µm
Volume rate	3.2 mm^3/s
Min. wall thickness	Approx. 0.4 mm
Typical dimensional change after HT (for parts ø 50 mm)	0.1 %

Heat Treatment

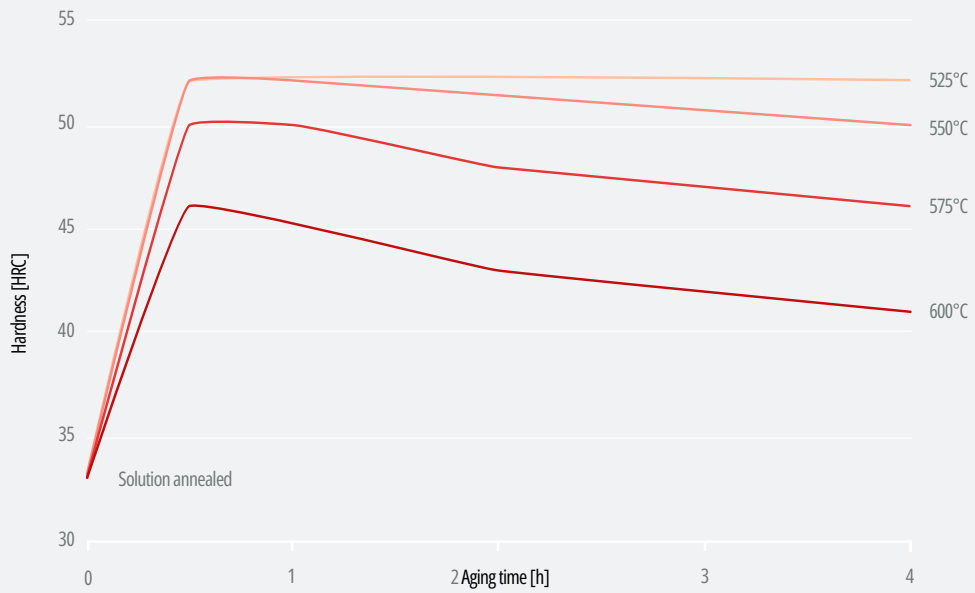
EOS StainlessSteel CX can be heat treated to match various needs of different applications. The two step heat treatment can be performed under vacuum or inert gas atmos- phere. First step is solution annealing to minimize amount of austenite in the martensitic matrix. The needed hardness and strength is achieved through aging treatment where preci- pitation 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 aging treat- ment is required to achieve desired microstructure.

Aging:
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 aging procedure.

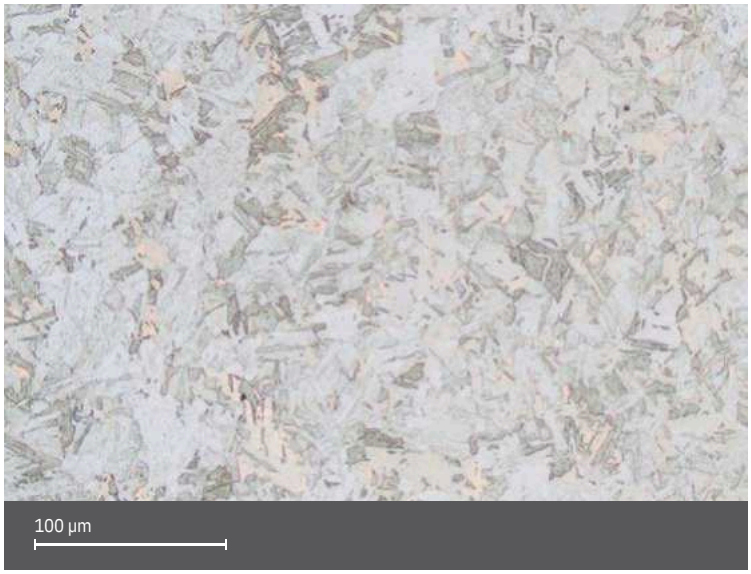
If lower hardness and improved toughness is required aging tem- perature can be increased according to figure below.

Hardness after heat treatment



Chemical and Physical 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 an 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.

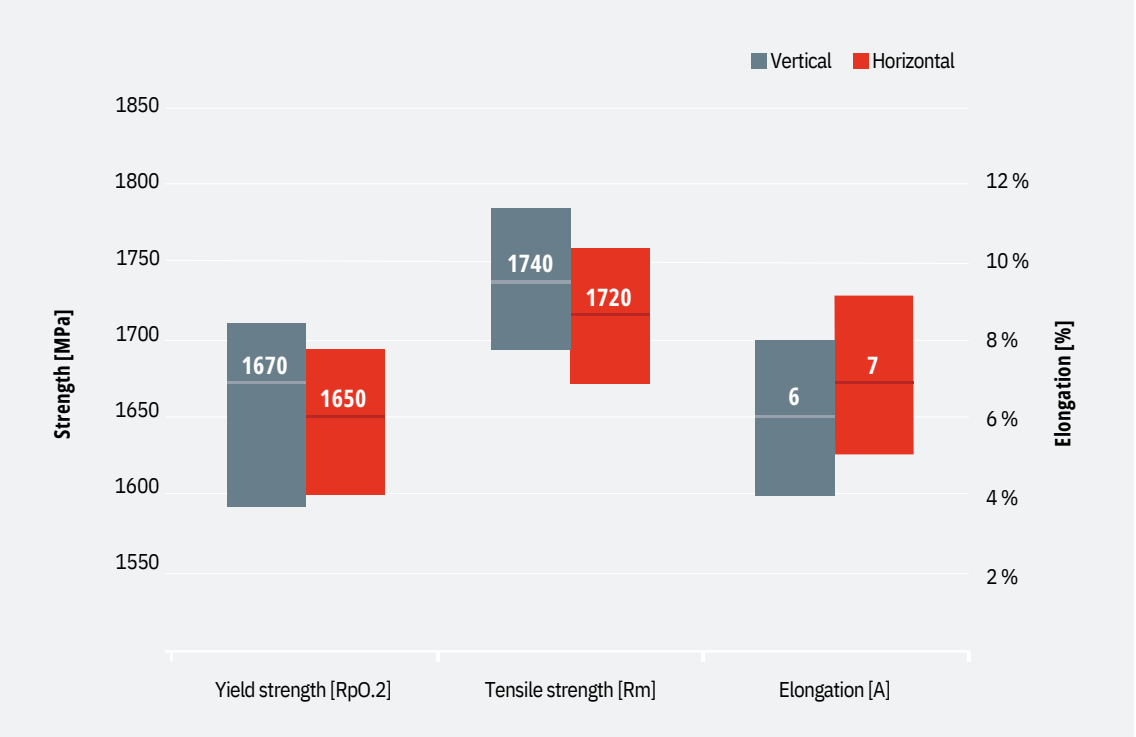
Mechanical Properties in Heat Treated State

Mechanical properties ISO6892-1

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

Hardness in heat treated state ISO6508

Hardness, HRC	50
Number of samples	45



Additional Data

Fatigue Strength

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 at 1 x 107 cycles in heat treated state ASTM E466	
Fatigue strength, MPa	695

Corrosion Resistance Comparison of Tooling and Precipitation Hardening Steels

EOS Material	Hardness [HRC]	Corrosion resistance
EOS MaragingSteel MS1	55	–
EOS StainlessSteel CX	50	●●●●
EOS StainlessSteel PH1	43	●●●●
EOS StainlessSteel 17-4PH	42	●●●●●

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

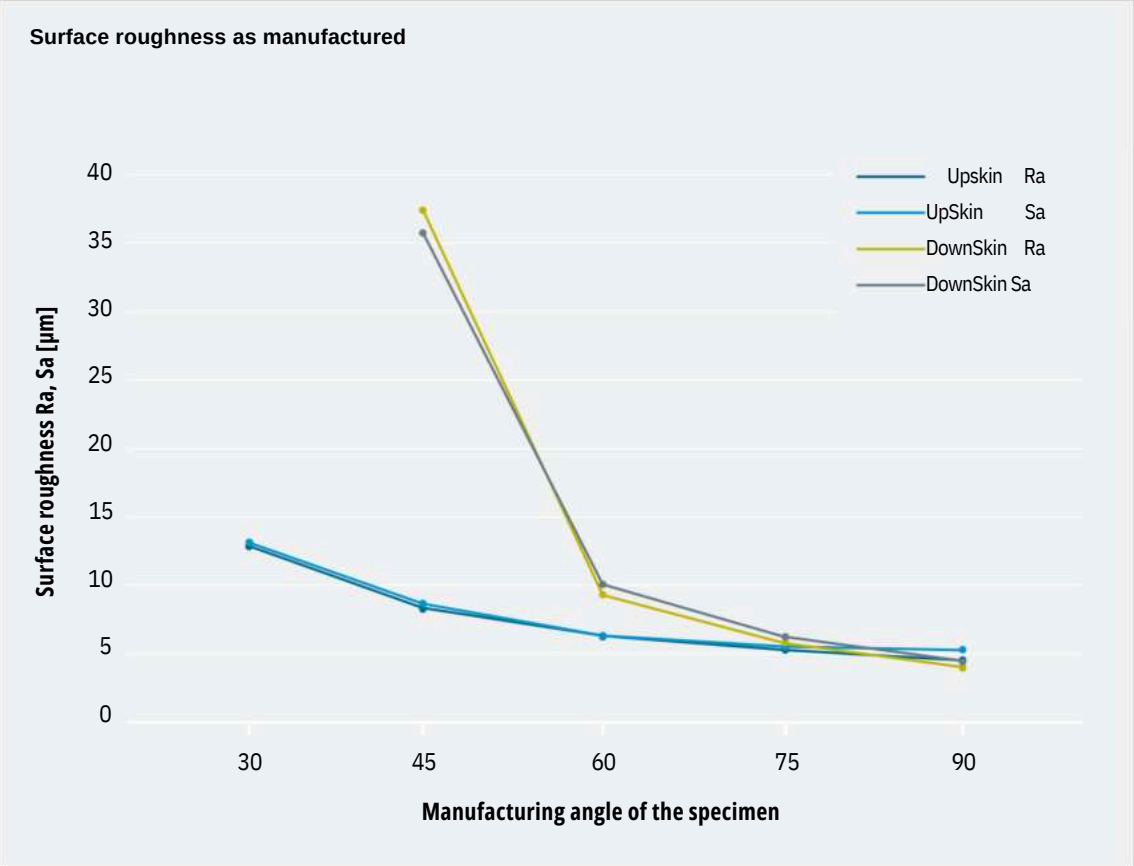
Coefficient of Thermal Expansion ASTM E228

Temperature	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

Additional Data

Surface Roughness

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



The surface quality was characterized by optical measurement method according to internal procedure. The 90 degree angle corresponds to vertical surface.

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