EOS StainlessSteel 17-4 for EOSINT M 270

A number of different materials are available for use with EOSINT M systems, offering a broad range of e-Manufacturing applications. EOS Stainless Steel 17-4 is a stainless steel powder which has been optimized especially for EOSINT M 270 systems. Other materials are also available for EOSINT M systems, and further materials are continuously being developed - please refer to the relevant material data sheets for details.

This document provides a brief description of the principle applications, and a table of technical data. For details of the system requirements please refer to the relevant information quote.

Description, application

MS / 05-07

EOS Stainless Steel 17-4 is a pre-alloyed stainless steel in fine powder form. Its composition corresponds to US classification 17-4 and European 1.4542 and fulfils the requirements of AMS 5643 for Mn, Mo, Ni, Si, C, Cr and Cu. This kind of steel is characterized by having very good corrosion resistance and mechanical properties, especially excellent ductility in laser processed state, and is widely used in a variety of engineering applications.

This material is ideal for many part-building applications (Direct Part) such as functional metal prototypes, small series products, individualized products or spare parts. Standard processing parameters use full melting of the entire geometry with 20 µm layer thickness, but it is also possible to use Skin & Core building style to increase the build speed. Using standard parameters the mechanical properties are fairly uniform in all directions. Parts made from EOS Stainless Steel 17-4 can be machined, spark-eroded, welded, micro shot-peened, polished and coated if required. Unexposed powder can be reused.

Typical applications:

- engineering applications including functional prototypes, small series products, individualized products or spare parts.
- parts requiring high corrosion resistance, sterilisability, etc.
- parts requiring particularly high toughness and ductility.

Technical data

General process and geometric data

Minimum recommended layer thickness	20 µm 0.8 mil
Typical achievable part accuracy [1]	
- small parts ± 20 – 50 µm	0.8 – 2.0 mil
- large parts [2]	± 0.2 %
Min. wall thickness [3]	0.3 - 0.4 mm 0.012 - 0.016 in
Surface roughness	

- after shot-peening	R_a 2.5 - 4.5 µm, R_y 15 - 40 µm R_a 0.1 - 0.2 mil, R_y 0.6 - 1.6 µm
- after polishing R_z up to < 0.5 µm	(can be very finely polished)
Volume rate [4]	
- standard parameters (20 µm layers, full density)	2 mm³/s 0.44 in³/h
- Inner core parameters (Skin & Core style, full density)	4 mm³/s 0.88 - 1.1 in³/h

[1] Based on users' experience of dimensional accuracy for typical geometries, e.g. ± 20 µm when parameters can be optimized for a certain class of parts or ± 50 µm when building a new kind of geometry for the first time.

[2] For larger parts the accuracy can be improved by post-process stress-relieving at 650 ºC for 1 hour.

[3] Mechanical stability is dependent on geometry (wall height etc.) and application

[4] Volume rate is a measure of build speed during laser exposure. The total build speed depends on the average volume rate, the recoating time (related to the number of layers) and other factors such as DMLS-Start settings.

Physical and chemical properties of parts

Material composition	steel including alloying elements Cr (15 – 17.5 wt-%) Ni (3 - 5 wt-%) Cu (3 - 5 wt-%) Mn (max. 1 wt-%) Si (max. 1 wt-%) Mo (max. 0.5 wt-%) Nb (0.15 - 0.45 wt-%) C (max. 0.07 wt-%)
Relative density with standard parameters	approx. 100 %
Density with standard parameters	7.8 g/cm³ 0.28 lb/in³

Mechanical properties of parts

Ultimate tensile strength		
- in horizontal direction (MPIF 10)	1050 ± 50 MPa	152 ± 7 ksi
- in vertical direction (modified MPIF 10)	980 ±50 MPa	142 ±7 ksi
- after stress relieving at 650 °C (1170 °F) for 1 hour	approx. 1200 MPa	approx. 174 ksi
Yield strength (Rp 0.2 %) (MPIF 10)		
- in horizontal direction (MPIF 10)	540 ±50 MPa	78 ±7 ksi
- in vertical direction (modified MPIF 10)	500 ±50 MPa	73 ± 7 ksi
Elongation at break (MPIF 10)		25 ± 5 %
Young's modulus (MPIF 10)	170 ± 20 GPa	25 ± 3 msi
- after stress relieving at 650 °C (1170 °F) for 1 hour	approx. 195 GPa	approx. 29 msi
Hardness [5]		
- as built	approx. 230 ± 20 HV1	
- ground & polished [6]		approx. 250 - 400 HV1

[5] Vickers hardness measurement (HV) according to DIN EN ISO 6507-1. Note that depending on the measurement method used, the measured hardness value can be dependent on the surface roughness and can be lower than the real hardness. To avoid inaccurate results, hardness should be measured on a polished surface.
[6] Due to work-hardening effect

Thermal properties of parts

Coefficient of thermal expansion		
- over 20 - 600 °C (68 - 1080 °F)	14 x 10^{-6} m/m °C	7.8 x 10^{-6} in/in °F

Thermal conductivity		
- at 20 °C (68 °F)	13 W/m °C	90 Btu/(h ft² °F/in)
- at 100 °C (212 °F)	14 W/m °C	97 Btu/(h ft² °F/in)
- at 200 °C (392 °F)	15 W/m °C	104 Btu/(h ft² °F/in)
- at 300 °C (572 °F)		16 W/m °C 111 Btu/(h ft² °F/in)
Maximum operating temperature		550 °C 1022 °F

The quoted values refer to the use of these materials with EOSINT M 270 systems according to current specifications (including the latest released process software PSW and any hardware specified for the relevant material) and operating instructions. All values are approximate. Unless otherwise stated, the quoted mechanical and physical properties refer to standard building parameters and test samples built in horizontal orientation. They depend on the building parameters and strategies used, which can be varied by the user according to the application. Measurements of the same properties using different test methods (e.g. specimen geometries) can give different results. The data are based on our latest knowledge and are subject to changes without notice. They are provided as an indication and not as a guarantee of suitability for any specific application.