Material data sheet

EOS StainlessSteel PH1 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 StainlessSteel PH1 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

EOS StainlessSteel PH1 is a pre-alloyed stainless steel in fine powder form. The chemistry of EOS StainlessSteel PH1 conforms to the compositions of DIN 1.4540 and UNS S15500.

This kind of steel is characterized by having good corrosion resistance and excellent mechanical properties, especially in the precipitation hardened state. This type of steel is widely used in variety of medical, aerospace and other engineering applications requiring high hardness, strength and corrosion resistance.

This material is ideal for many part-building applications (DirectPart) such as functional metal prototypes, small series products, individualised 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 40µm layer thickness to increase the build speed. Using standard parameters the mechanical properties are fairly uniform in all directions. Parts made from EOS StainlessSteel PH1 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, individualised products or spare parts.
- parts requiring high corrosion resistance, sterilisability, etc.
- parts requiring particularly high hardness and strength.

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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	± 0.2 %
Min. wall thickness [2]	0.3 - 0.4 mm 0.012 - 0.016 in
Surface roughness	
- after shot-peening	Ra 2.5 - 4.5 µm, Ry 15 - 40 µm Ra 0.1 - 0.2 mil, Ry 0.6 - 1.6 µm
- after polishing	Rz up to < 0.5 µm (can be very finely polished)
Volume rate [3]	
- standard parameters (20µm layers, full density)	1.8 mm³/s 0.40 in³/h
- 40µm layer parameters (full density)	3.2 mm³/s 0.70 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] Mechanical stability is dependent on geometry (wall height etc.) and application

[3] 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.

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Physical and chemical properties of parts

Material composition	steel including alloying elements Fe (balance) Cr (14 – 15.5 wt-%) Ni (3.5 – 5.5 wt-%) Cu (2.5 – 4.5 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

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Mechanical properties of parts [4]

	As manufactured	Hardened [6] (mod H900 heat treatment)
Ultimate tensile strength		
- in horizontal direction (XY)	1150 ± 50 MPa	min 1310 MPa (typical 1450 ± 100 MPa)
- in vertical direction (Z)	1050 ± 50 MPa	min 1310 MPa (typical 1450 ± 100 MPa)
Yield strength (Rp 0.2 %)		
- in horizontal direction (XY)	1050 ± 50 MPa	min 1170 MPa (typical 1300 ± 100 MPa)
- in vertical direction (Z)	1000 ± 50 MPa	min 1170 MPa (typical 1300 ± 100 MPa)
Elongation at break		
- in horizontal direction (XY)	16 % ± 4 %	min 10 % (typical 12 % ± 2 %)
- in vertical direction (Z)	17 % ± 4 %	min 10 % (typical 12 % ± 2 %)
Hardness [5]		
- as built	30 - 35 HRC	min 40 HRC

[4] Mechanical testing according to ISO 6892:1998(E) Annex C, proportional test pieces, Diameter of the neck area 5mm, original gauge length 25mm, test pieces built in 20µm layer-thickness.

[5] Rockwell C (HRC) hardness measurement according to DIN EN ISO 6508-1. 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] Mechanical properties are expressed as minimum values to indicate that mechanical properties exceed the min requirements of material specification standards such as ASTM A564-04 (XM12), ASTM A693-06 (XM12). Hardening of EOS StainlessSteel PH1 done using modified H900 heat treatment (soaking time at precipitation hardening temperature 482°C elongated from 1 hour to 4 hours)

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Thermal properties of parts (Room temperature)

	As manufactured	Hardened [6] (mod H900 heat treatment)
Thermal conductivity		
- in horizontal direction (XY)	13.8 ± 0.8 W/m°C	15.7 ± 0.8 W/m°C
- in vertical direction (Z)	13.7 ± 0.8 W/m°C	15.8 ± 0.8 W/m°C
Specific heat capacity	460 ± 20 J/kg °C	470 ± 20 J/kg °C

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.

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