Material data sheet

EOS StainlessSteel PH1

EOS StainlessSteel PH1 is a metal alloy powder which has been optimized for processing on EOS M systems.

This document provides information and data for parts built using EOS StainlessSteel PH1 powder (EOS art.-no. 9011-0019) on the following specifications:

- DMLS system: M290
  - Ceramic blade (2200-3013), carbon fibre (2200-4366) compatible
  - IPCM sieving module with 63µm mesh size (9044-0032) recommended
  - Nitrogen atmosphere
  - Internal 80µm mesh sieve (1212-0312) possible
- Software: EOSYSTEM 2.4 or newer
- Parameter set: PH1_020_Surface_M291_200

Description

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 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. 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.

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

Powder properties

Material composition

Element	Min [wt.-%]	Max [wt.-%]
Cr	14.0	15.5
Ni	3.5	5.5
Cu	2.5	4.5
Mn		1.00
Si		1.00
C		0.07
Mo		0.5
Nb	0.15	0.45

Max. particle size

Particles ≥ 63µm [1]	0.5 wt.-%

[1] Sieve analysis according to DIN ISO 4497 or ASTM B214.

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General process data

Layer thickness	20 µm 0.8 mil.
Typical achievable part accuracy [2]	
- small parts	± 20 – 50 µm 0.8 – 2.0 mil
- large parts	± 0.2 %
Volume rate [3]	~2.0 mm³/s (~7.0cm³/h) ~0.40 in³/h
Min. wall thickness [4]	~ 0.4 mm ~ 0.016 in

[2] 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.

[3] The volume rate is a measure of build speed during laser exposure of the skin area. The total build speed depends on this volume rate and many other factors such as exposure parameters of contours, supports, up and downskin, recoating time, Home-In or LPM settings.

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

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Physical and chemical properties of parts*

Part density [5]	~7.7 g/cm³ ~0.27 lb/in³
Relative density with standard parameters	approx. 100 %
Surface roughness after shot peening [6]	
- after shot-peening	Ra ~ 5.0 µm, Rz ~ 25.0 µm Ra ~ 0.2 mil, Rz ~ 1.0 mil
- after polishing	Rz up to < 0.5 µm (can be very finely polished)

[5] Weighing in air and water according to ISO 3369.

[6] Measurement according to ISO 4287. The numbers were measured at the horizontal (up-facing) and all vertical surfaces of test cubes. Due to the layerwise building the roughness strongly depends on the orientation of the surface, for example sloping and curved surfaces exhibit a stair-step effect.

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Tensile data at room temperature* [7]

	As built	Heat treated [9] (mod H900 heat treatment)
Ultimate tensile strength		
- in horizontal direction (XY)	1200 ± 50 MPa	min. 1350 MPa (typical 1450 ± 100 MPa)
- in vertical direction (Z)	1200 ± 50 MPa	min. 1340 MPa (typical 1440 ± 100 MPa)
Yield strength (Rp 0.2 %)		
- in horizontal direction (XY)	1025 ± 85 MPa	min. 1250 MPa (typical 1350 ± 100 MPa)
- in vertical direction (Z)	930 ± 75 MPa	min. 1200 MPa (typical 1300 ± 100 MPa)
Elongation at break		
- in horizontal direction (XY)	17 % ± 4 %	min 10 % (typical 15 % ± 3 %)
- in vertical direction (Z)	14 % ± 4 %	min 10 % (typical 13 % ± 3 %)
Hardness [8]		
- as built	-	min 40 HRC (typical 43 HRC)

[7] 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.

[8] 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.

[9] 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 525°C elongated for 4 hours).

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Abbreviations

min. minimum

max. maximum

wt. weight

*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. This document does not on its own represent a sufficient basis for any part design, neither does it provide any agreement or guarantee about the specific properties of a material or part or the suitability of a material or a part for a specific application.

This powder has not been developed, tested or certified as a medical device according to Directive 93/42/EEC (MDD) or Regulation (EU) 2017/745 (MDR) and is not intended to be used as a medical device, in particular for the purposes specified in Art. 2 No. 1 MDR. Insofar as you intend to use the powder as raw material for the manufacture of pharmaceutical products or medical devices (e.g. as raw material which as a material must meet the requirements of Annex 1, Chapter II MDR), the responsibility and liability for all analyses, tests, evaluations, procedures, risk assessments, conformity assessments, approval and certification procedures as well as for all other official and regulatory measures required for this purpose shall lie solely with you both with regard to the pharmaceutical product and/or medical device manufactured by you and with regard to the properties, suitability, testing, evaluation, risk assessment, other requirements for use of the powder as raw material. This also applies to applications with food contact. In this respect, the limitations of liability pursuant to our General Terms and Conditions and the system sales or material contracts shall apply.

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